

Report of the CPM on technical, operational and regulatory/procedural matters to be considered by the World Radiocommunication Conference 2019

Radiocommunication Bureau



I n t e r n a t i o n a l T e l e c o m m u n i c a t i o n U n i o n

2nd Session of the Conference Preparatory Meeting for WRC-19

CPM Report on technical,
operational and regulatory/
procedural matters to be
considered by the
World Radiocommunication
Conference 2019

Radiocommunication Sector



Preface

This CPM Report to the World Radiocommunication Conference 2019 (WRC-19) was prepared in response to Resolution 1380 (Modified 2017) of the ITU Council to assist those who will be involved in the preparations for and deliberations at WRC-19. The Report was prepared and approved by the Conference Preparatory Meeting (CPM) at its Second Session held in Geneva from 18 to 28 February 2019. The Report is structured to follow the topics of the WRC-19 Agenda and its content follows the outline approved by the First Session of the CPM, which was held during the week following WRC-15. A cross-reference list is provided to facilitate finding specific topics within the framework of the WRC-19 Agenda. This Report comprises six Chapters and one Annex.

The Report represents the most up-to-date information on technical, operational and regulatory/procedural issues relevant to the WRC-19 Agenda available at the time of its preparation and should provide a good basis for the discussions at the Conference.

Mario Maniewicz
Director, Radiocommunication Bureau

Cross-reference between the WRC-19 agenda items and the chapters of the draft CPM Report

| WRC-19 agenda item | | Chapter of the draft CPM Report to WRC-19 |
|--------------------|---|---|
| 1 | on the basis of proposals from administrations, taking account of the results of WRC-15 and the Report of the Conference Preparatory Meeting, and with due regard to the requirements of existing and future services in the frequency bands under consideration, to consider and take appropriate action in respect of the following items: | – |
| 1.1 | to consider an allocation of the frequency band 50-54 MHz to the amateur service in Region 1, in accordance with Resolution 658 (WRC-15) ; | 5 |
| 1.2 | to consider in-band power limits for earth stations operating in the mobile-satellite service, meteorological-satellite service and Earth exploration-satellite service in the frequency bands 401-403 MHz and 399.9-400.05 MHz, in accordance with Resolution 765 (WRC-15) ; | 4 |
| 1.3 | to consider possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a possible primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz, in accordance with Resolution 766 (WRC-15) ; | 4 |
| 1.4 | to consider the results of studies in accordance with Resolution 557 (WRC-15) , and review, and revise if necessary, the limitations mentioned in Annex 7 to Appendix 30 (Rev.WRC-15) , while ensuring the protection of, and without imposing additional constraints on, assignments in the Plan and the List and the future development of the broadcasting-satellite service within the Plan, and existing and planned fixed-satellite service networks; | 3 |
| 1.5 | to consider the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service and take appropriate action, in accordance with Resolution 158 (WRC-15) ; | 3 |
| 1.6 | to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), in accordance with Resolution 159 (WRC-15) ; | 3 |
| 1.7 | to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution 659 (WRC-15) ; | 4 |
| 1.8 | to consider possible regulatory actions to support Global Maritime Distress Safety Systems (GMDSS) modernization and to support the introduction of additional satellite systems into the GMDSS, in accordance with Resolution 359 (Rev.WRC-15) ; | 5 |

| WRC-19 agenda item | | Chapter of the draft CPM Report to WRC-19 |
|--------------------|---|---|
| 1.9 | to consider, based on the results of ITU-R studies: | — |
| 1.9.1 | regulatory actions within the frequency band 156-162.05 MHz for autonomous maritime radio devices to protect the GMDSS and automatic identifications system (AIS), in accordance with Resolution 362 (WRC-15) ; | 5 |
| 1.9.2 | modifications of the Radio Regulations, including new spectrum allocations to the maritime mobile-satellite service (Earth-to-space and space-to-Earth), preferably within the frequency bands 156.0125-157.4375 MHz and 160.6125-162.0375 MHz of Appendix 18 , to enable a new VHF data exchange system (VDES) satellite component, while ensuring that this component will not degrade the current terrestrial VDES components, applications specific messages (ASM) and AIS operations and not impose any additional constraints on existing services in these and adjacent frequency bands as stated in <i>recognizing d) and e)</i> of Resolution 360 (Rev.WRC-15) ; | 5 |
| 1.10 | to consider spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System (GADSS), in accordance with Resolution 426 (WRC-15) ; | 5 |
| 1.11 | to take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands to support railway radiocommunication systems between train and trackside within existing mobile service allocations, in accordance with Resolution 236 (WRC-15) ; | 1 |
| 1.12 | to consider possible global or regional harmonized frequency bands, to the maximum extent possible, for the implementation of evolving Intelligent Transport Systems (ITS) under existing mobile-service allocations, in accordance with Resolution 237 (WRC-15) ; | 1 |
| 1.13 | to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 238 (WRC-15) ; | 2 |
| 1.14 | to consider, on the basis of ITU-R studies in accordance with Resolution 160 (WRC-15) , appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations; | 1 |
| 1.15 | to consider identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz, in accordance with Resolution 767 (WRC-15) ; | 1 |
| 1.16 | to consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution 239 (WRC-15) ; | 2 |
| 2 | to examine the revised ITU-R Recommendations incorporated by reference in the Radio Regulations communicated by the Radiocommunication Assembly, in accordance with Resolution 28 (Rev.WRC-15) , and to decide whether or not to update the corresponding references in the Radio Regulations, in accordance with the principles contained in Annex 1 to Resolution 27 (Rev.WRC-12) ; | 6 |
| 3 | to consider such consequential changes and amendments to the Radio Regulations as may be necessitated by the decisions of the conference; | Not in scope of CPM |
| 4 | in accordance with Resolution 95 (Rev.WRC-07) , to review the resolutions and recommendations of previous conferences with a view to their possible revision, replacement or abrogation; | 6 |
| 5 | to review, and take appropriate action on, the Report from the Radiocommunication Assembly submitted in accordance with Nos. 135 and 136 of the Convention; | Not in scope of CPM |
| 6 | to identify those items requiring urgent action by the radiocommunication study groups in preparation for the next world radiocommunication conference; | Not in scope of CPM |

| WRC-19 agenda item | | Chapter of the draft CPM Report to WRC-19 |
|--------------------|--|---|
| 7 | to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution 86 (Rev.WRC-07) , in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit; | 3 |
| 8 | to consider and take appropriate action on requests from administrations to delete their country footnotes or to have their country name deleted from footnotes, if no longer required, taking into account Resolution 26 (Rev.WRC-07) ; | Not in scope of CPM |
| 9 | to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention: | – |
| 9.1 | on the activities of the Radiocommunication Sector since WRC-15; | – |
| | 9.1.1a) Res. 212 (Rev.WRC-15) – <i>Implementation of International Mobile Telecommunications in the frequency bands 1 885-2 025 MHz and 2 110-2 200 MHz</i> | 2 |
| | 9.1.2a) Res. 761 (-15) – <i>Compatibility of International Mobile Telecommunications and broadcasting-satellite service (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3</i> | 3 |
| | 9.1.3a) Res. 157 (WRC-15) – <i>Study of technical and operational issues and regulatory provisions for new non-geostationary-satellite orbit systems in the 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz and 6 725-7 025 MHz frequency bands allocated to the fixed-satellite service</i> | 3 |
| | 9.1.4a) Res. 763 (WRC-15) – <i>Stations on board sub-orbital vehicles</i> | 5 |
| | 9.1.5a) Res. 764 (WRC-15) – <i>Consideration of the technical and regulatory impacts of referencing Recommendations ITU-R M.1638 1 and ITU R M.1849 1 in Nos. 5.447F and 5.450A of the Radio Regulations</i> | 2 |
| | 9.1.6a) Issue 1) in the Annex to Resolution 958 (WRC-15) – <i>Urgent studies required in preparation for the 2019 World Radiocommunication Conference</i> 1) <i>Studies concerning Wireless Power Transmission (WPT) for electric vehicles:</i> a) <i>to assess the impact of WPT for electric vehicles on radiocommunication services;</i> b) <i>to study suitable harmonized frequency ranges which would minimize the impact on radiocommunication services from WPT for electrical vehicles.</i> <i>These studies should take into account that the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO) and the Society of Automotive Engineers (SAE) are in the process of approving standards intended for global and regional harmonization of WPT technologies for electric vehicles.</i> | 6 |
| | 9.1.7a) Issue 2) in the Annex to Resolution 958 (WRC-15) – <i>Urgent studies required in preparation for the 2019 World Radiocommunication Conference</i> 2) <i>Studies to examine:</i> a) <i>whether there is a need for possible additional measures in order to limit uplink transmissions of terminals to those authorized terminals in accordance with No. 18.1;</i> b) <i>the possible methods that will assist administrations in managing the unauthorized operation of earth station terminals deployed within its territory, as a tool to guide their national spectrum management programme, in accordance with Resolution ITU-R 64 (RA 15).</i> | 6 |

a) Issue identified by CPM19-1 under WRC-19 agenda item 9.1 (see Administrative Circular [CA/226](#) of 23 December 2015).

| WRC-19 agenda item | | Chapter of the draft CPM Report to WRC-19 |
|--------------------|--|---|
| 9.2 | 9.1.8a) Issue 3) in the Annex to Resolution 958 (WRC-15) – <i>Urgent studies required in preparation for the 2019 World Radiocommunication Conference</i> 3) <i>Studies on the technical and operational aspects of radio networks and systems, as well as spectrum needed, including possible harmonized use of spectrum to support the implementation of narrowband and broadband machine-type communication infrastructures, in order to develop Recommendations, Reports and/or Handbooks, as appropriate, and to take appropriate actions within the ITU Radiocommunication Sector (ITU-R) scope of work.</i> | 2 |
| | 9.1.9a) Res. 162 (WRC-15) – <i>Studies relating to spectrum needs and possible allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space)</i> | 3 |
| | on any difficulties or inconsistencies encountered in the application of the Radio Regulations [*] ; and | — |
| | 9.3 on action in response to Resolution 80 (Rev.WRC-07) ; | — |
| 10 | to recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, in accordance with Article 7 of the Convention, | 6 |

^{*} This agenda item is strictly limited to the Report of the Director on any difficulties or inconsistencies encountered in the application of the Radio Regulations and the comments from administrations.

CPM Report to WRC-19

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I Introduction to the CPM Report to WRC-19

This CPM Report to WRC-19 is provided to assist the ITU Member States and the Radiocommunication Sector Members who will be involved in preparation for the World Radiocommunication Conference 2019. It represents the most updated information on the technical, operational and regulatory/procedural issues relevant to the WRC-19 agenda items and issues available at the time of its preparation.

I.1 Origin and purpose of CPM-19

The World Radiocommunication Conference (WRC-19) will be held in Sharm el-Sheikh (Egypt) from 28 October to 22 November 2019, immediately following the Radiocommunication Assembly (RA-19) (see Council Resolution 1380 (modified 2017)).

The conditions for invitation and admission to the World Radiocommunication Conference are specified in Article 24 of the Convention and in accordance with the relevant Plenipotentiary Conference resolutions.

The agenda for WRC-19 is contained in Council Resolution 1380 (modified 2017) (see Annex I-1), on the basis of Resolution 809 (WRC-15).

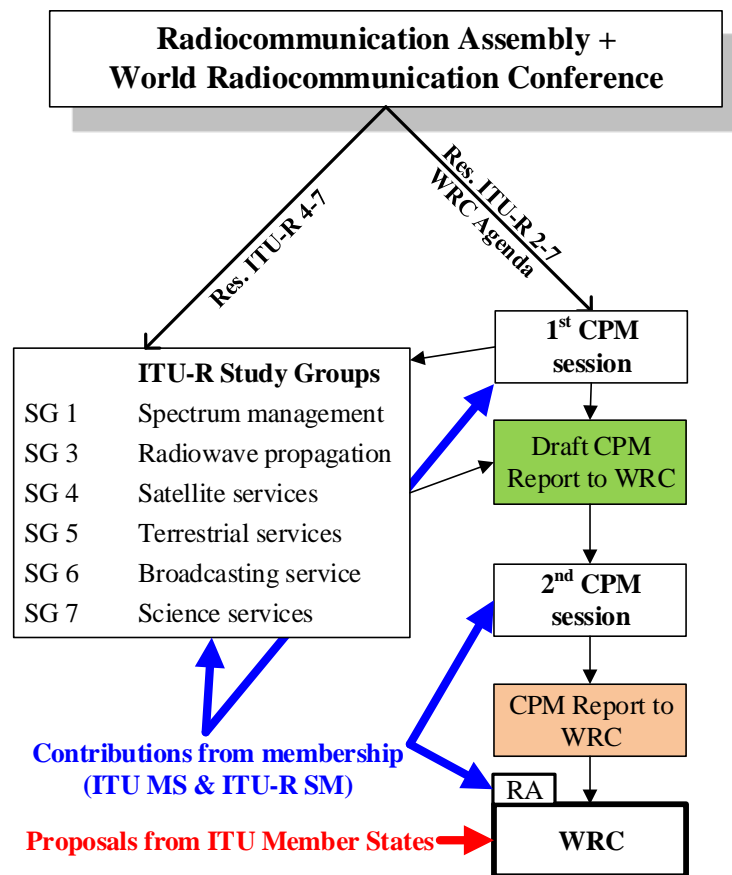
The 2015 Radiocommunication Assembly, by its Resolution ITU-R 2-7, reconfirmed that preparatory studies for the WRC are to be carried out by a Conference Preparatory Meeting (CPM) and appointed Mr Khalid Al-Awadi (United Arab Emirates) as the Chairman of CPM-19 and Mr Mohammed Al Badi (Oman), Ms Chantal Beaumier (Canada), Mr Xiaoyang Gao (China), Mr Viresh Goel (India), Mr Alexander Kuehn (Germany), Dr Hyangsuk Seong (Korea (Rep. of)), Mr Taghi Shafiee (Iran (Islamic Republic of)) and Mr Alexandre V. Vassiliev (Russian Federation) as the Vice-Chairmen.

All administrations of the ITU Member States and the Radiocommunication Sector Members were invited to participate in the preparation of the CPM Report to WRC-19.

I.2 Organization of the ITU-R preparation for the conference

The organization of the conference preparatory work is shown in Figure I-1.

FIGURE I-1

Organization of the ITU-R conference preparatory work

On the basis of contributions from the membership of the ITU and inputs from the Radiocommunication Study Groups, concerning the technical, operational, regulatory and procedural matters to be considered by world radiocommunication conferences, the CPM prepares a consolidated report for such conferences (see Resolution ITU-R 2-7).

The first session of the 2019 Conference Preparatory Meeting (CPM19-1) was held in Geneva on 30 November and 1 December 2015 and organized the preparatory studies for WRC-19. It also identified studies in preparation for the following WRC. A structure for the CPM Report to WRC-19 was agreed together with a preparatory process, working procedures and a chapter structure. The meeting appointed a Rapporteur for each chapter to assist the Chairman in managing the development and flow of draft report contributions. The results of CPM19-1 were published in Administrative Circular [CA/226](#) of the Radiocommunication Bureau, dated 23 December 2015.

The ITU-R preparations for WRC-19 were concentrated in the following responsible groups (listed in the order of the Study Groups):

Study Group 1 chaired by Mr S. Pastukh (Russian Federation), **WP 1A** chaired by Mr R. Garcia de Souza (Brazil) and **WP 1B** chaired by Mr R. Chang (China) who was replaced by Mr L. Kibet Boruett (Kenya), WP 1B Vice-Chairman, acting Chairman on the last WP 1B meeting);

Study Group 3 chaired by Ms C. Wilson (Australia);

Study Group 4 chaired by Mr C. Hofer (United States of America), **WP 4A** chaired by Mr J. Wengryniuk (United States of America) and **WP 4C** chaired by Mr N. Kawai (Japan);

Study Group 5 chaired by Mr M. Fenton (United Kingdom), **WP 5A** chaired by Mr J. Costa (Canada), **WP 5B** chaired by Mr J. Mettrop (United Kingdom), **WP 5C** chaired by Mr P. Nava (China), **WP 5D** chaired by Mr S. Blust (United States of America) and **TG 5/1** chaired by Ms C. Cook (Canada);

Study Group 6 chaired by Dr Y. Nishida (Japan);

Study Group 7 chaired by Mr J.E. Zuzek (United States of America), **WP 7B** chaired by Mr B. Kaufman (United States of America) and **WP 7C** chaired by Mr M. Dreis (Germany).

I.3 Preparation of the CPM Report to WRC-19

Texts for the draft CPM Report have been prepared by the responsible groups identified by CPM19-1 and provided by the Chairmen of these groups to the CPM-19 Chapter Rapporteurs.

The work was coordinated by the Chairman of CPM-19, in consultation with the CPM-19 Management Team, as defined in Sections 5 and 6 of Annex 1 to Resolution ITU-R 2-7.

In accordance with Section 6 of Annex 1 to Resolution ITU-R 2-7, the CPM-19 Management Team meeting was held in Geneva on 5 and 6 September 2018. It consolidated the draft CPM Report which was distributed to all Member States and Radiocommunication Sector Members as Document CPM19-2/1.

The Radiocommunication Bureau provided the required assistance in the above-mentioned meetings.

The second session of CPM-19 (CPM19-2) met in Geneva from 18 to 28 February 2019 under the chairmanship of Mr Khalid Al-Awadi (United Arab Emirates) to consider the draft CPM Report, contributions from the ITU membership and additional material submitted by the Radiocommunication Bureau.

About 1 294 participants, representing 106 Member States and 83 Radiocommunication Sector Members, including international organizations, attended the CPM.

CPM19-2 considered 198 input contributions including the draft CPM Report and the documents from the Director of the Radiocommunication Bureau.

At CPM19-2, the contributions were assigned for preparation of the final CPM Report to WRC-19 according to the following adopted structure:

| | |
|--|--|
| Chairman, CPM-19 | Mr K. Al-Awadi (UAE) |
| Vice-Chairman, CPM-19 | Mr M. Al Badi (OMA) |
| Vice-Chairman, CPM-19 | Ms C. Beaumier (CAN) |
| Vice-Chairman, CPM-19 | Mr X. Gao (CHN) |
| Vice-Chairman, CPM-19 | Mr V. Goel (IND) |
| Vice-Chairman, CPM-19 | Mr A. Kuehn (D) |
| Vice-Chairman, CPM-19 | Dr H. Seong (KOR) |
| Vice-Chairman, CPM-19 | Mr T. Shafiee (IRN) |
| Vice-Chairman, CPM-19 | Mr A.V. Vassiliev (RUS) |
| Rapporteur of the Plenary | Ms S.-R. Haskins (USA) |
| Chairman of the Drafting Group of the Plenary | Mr S. Pastukh (RUS) |
| Secretary of the Plenary | Mr Ph. Aubineau (ITU BR, Counsellor for the CPM) |

| CPM19-2 Groups | Topic | Chairman | ITU BR (Co-) Secretary |
|-----------------------|--|--------------------------|-------------------------------|
| Working Group 1 | Chapter 1: land mobile and fixed services; AI 1.11, 1.12, 1.14, 1.15 | Ms K. Zhu (CHN) | Mr S. Buonomo |
| Working Group 2 | Chapter 2: broadband applications in the mobile service; AI: 1.13, 1.16, 9.1 (issues 9.1.1, 9.1.5, 9.1.8) | Mr J. Arias Franco (MEX) | Mr D. Botha |
| Working Group 3 | Chapter 3: satellite services; AI 1.4, 1.5, 1.6, 7, 9.1 (issues 9.1.2, 9.1.3, 9.1.9) | Mr N. VARLAMOV (RUS) | Mr N. Malaguti |
| Working Group 4 | Chapter 4: science services; AI 1.2, 1.3, 1.7 | Mr V. Meens (F) | Mr V. Nozdrin |
| Working Group 5 | Chapter 5: maritime, aeronautical and amateur services; AI 1.1, 1.8, 1.9 (1.9.1, 1.9.2), 1.10, 9.1 (issue 9.1.4) | Mr W. SAYED (EGY) | Mr K. Bogens |
| Working Group 6 | Chapter 6: General issues; AI 2, 4, 9.1 (issues 9.1.6, 9.1.7), 10 | Mr P.N. Ngige (KEN) | Mr R. Chang |

The meeting was successful in approving the CPM Report to WRC-19.

I.4 Presentation and structure of the Report

The Report is structured to follow the topics of the WRC-19 agenda, taking into account the outline developed and approved by the first session of CPM-19.

The Report comprises six Chapters, defined in accordance with the adopted structure described in section I.3 above.

A cross-reference list between the Chapters of this Report and the WRC-19 agenda items and issues is provided at the beginning of this Report to facilitate the identification of specific topics within the framework of the WRC-19 agenda. A list of abbreviations is also provided at the beginning of this Report. Squared brackets (i.e. '[' and ']') have been used in the Report around values (e.g. frequencies, limits, etc.) or around names (e.g. future number of draft new WRC Resolutions or draft new ITU-R Recommendations or Reports, future list of country names, etc.), to indicate the provisional nature of this information.

The Report also contains in its Annex a list of the ITU-R Recommendations including certain draft new and revised Recommendations which are referred to in the text of the Report. The final version of this list reflecting the decisions of the 2019 Radiocommunication Assembly will be made available to the World Radiocommunication Conference 2019.

ANNEX I-1

RESOLUTION 1380 (MODIFIED 2017)

(adopted at the eighth Plenary Meeting)

Place, dates and agenda of the World Radiocommunication Conference (WRC-19)

The Council,

noting

that Resolution 809 of the World Radiocommunication Conference (Geneva, 2015):

- a)* resolved to recommend to the Council that a world radiocommunication conference be held in 2019 for a maximum period of four weeks;
- b)* recommended its agenda, and invited the Council to finalize the agenda and arrange for the convening of WRC-19 and to initiate as soon as possible the necessary consultation with Member States,

noting further

that the Government of the Arab Republic of Egypt has invited the International Telecommunication Union to hold the World Radiocommunication Conference 2019 in the city of Sharm el-Sheikh (Egypt),

resolves

to convene a World Radiocommunication Conference (WRC-19) in Sharm el-Sheikh (Egypt) from 28 October to 22 November 2019, preceded by the Radiocommunication Assembly from 21 to 25 October 2019, with the following agenda:

- 1 on the basis of proposals from administrations, taking account of the results of WRC-15 and the Report of the Conference Preparatory Meeting, and with due regard to the requirements of existing and future services in the frequency bands under consideration, to consider and take appropriate action in respect of the following items:
 - 1.1 to consider an allocation of the frequency band 50-54 MHz to the amateur service in Region 1, in accordance with Resolution **658 (WRC-15)**;
 - 1.2 to consider in-band power limits for earth stations operating in the mobile-satellite service, meteorological-satellite service and Earth exploration-satellite service in the frequency bands 401-403 MHz and 399.9-400.05 MHz, in accordance with Resolution **765 (WRC-15)**;
 - 1.3 to consider possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a possible primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz, in accordance with Resolution **766 (WRC-15)**;
 - 1.4 to consider the results of studies in accordance with Resolution **557 (WRC-15)**, and review, and revise if necessary, the limitations mentioned in Annex 7 to Appendix **30 (Rev.WRC-15)**, while ensuring the protection of, and without imposing additional constraints on, assignments in the Plan and the List and the future development of the broadcasting-satellite service within the Plan, and existing and planned fixed-satellite service networks;

- 1.5 to consider the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service and take appropriate action, in accordance with Resolution **158 (WRC-15)**;
- 1.6 to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), in accordance with Resolution **159 (WRC-15)**;
- 1.7 to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution **659 (WRC-15)**;
- 1.8 to consider possible regulatory actions to support Global Maritime Distress Safety Systems (GMDSS) modernization and to support the introduction of additional satellite systems into the GMDSS, in accordance with Resolution **359 (Rev.WRC-15)**;
- 1.9 to consider, based on the results of ITU-R studies:
- 1.9.1 regulatory actions within the frequency band 156-162.05 MHz for autonomous maritime radio devices to protect the GMDSS and automatic identifications system (AIS), in accordance with Resolution **362 (WRC-15)**;
- 1.9.2 modifications of the Radio Regulations, including new spectrum allocations to the maritime mobile-satellite service (Earth-to-space and space-to-Earth), preferably within the frequency bands 156.0125-157.4375 MHz and 160.6125-162.0375 MHz of Appendix **18**, to enable a new VHF data exchange system (VDES) satellite component, while ensuring that this component will not degrade the current terrestrial VDES components, applications specific messages (ASM) and AIS operations and not impose any additional constraints on existing services in these and adjacent frequency bands as stated in *recognizing d) and e)* of Resolution **360 (Rev.WRC-15)**;
- 1.10 to consider spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System (GADSS), in accordance with Resolution **426 (WRC-15)**;
- 1.11 to take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands to support railway radiocommunication systems between train and trackside within existing mobile service allocations, in accordance with Resolution **236 (WRC-15)**;
- 1.12 to consider possible global or regional harmonized frequency bands, to the maximum extent possible, for the implementation of evolving Intelligent Transport Systems (ITS) under existing mobile-service allocations, in accordance with Resolution **237 (WRC-15)**;
- 1.13 to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution **238 (WRC-15)**;
- 1.14 to consider, on the basis of ITU-R studies in accordance with Resolution **160 (WRC-15)**, appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations;
- 1.15 to consider identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz, in accordance with Resolution **767 (WRC-15)**;

1.16 to consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution **239 (WRC-15)**;

2 to examine the revised ITU-R Recommendations incorporated by reference in the Radio Regulations communicated by the Radiocommunication Assembly, in accordance with Resolution **28 (Rev.WRC-15)**, and to decide whether or not to update the corresponding references in the Radio Regulations, in accordance with the principles contained in Annex 1 to Resolution **27 (Rev.WRC-12)**;

3 to consider such consequential changes and amendments to the Radio Regulations as may be necessitated by the decisions of the conference;

4 in accordance with Resolution **95 (Rev.WRC-07)**, to review the resolutions and recommendations of previous conferences with a view to their possible revision, replacement or abrogation;

5 to review, and take appropriate action on, the Report from the Radiocommunication Assembly submitted in accordance with Nos. 135 and 136 of the Convention;

6 to identify those items requiring urgent action by the radiocommunication study groups in preparation for the next world radiocommunication conference;

7 to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution **86 (Rev.WRC-07)**, in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit;

8 to consider and take appropriate action on requests from administrations to delete their country footnotes or to have their country name deleted from footnotes, if no longer required, taking into account Resolution **26 (Rev.WRC-07)**;

9 to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:

9.1 on the activities of the Radiocommunication Sector since WRC-15;

9.2 on any difficulties or inconsistencies encountered in the application of the Radio Regulations^{*}; and

9.3 on action in response to Resolution **80 (Rev.WRC-07)**;

10 to recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, in accordance with Article 7 of the Convention,

instructs the Director of the Radiocommunication Bureau

to make the necessary arrangements to convene meetings of the Conference Preparatory Meeting and to prepare a report to WRC-19,

* This agenda item is strictly limited to the Report of the Director on any difficulties or inconsistencies encountered in the application of the Radio Regulations and the comments from administrations.

instructs the Secretary-General

- 1 to consult the Member States on the precise place and exact dates of the 2019 World Radiocommunication Conference and Radiocommunication Assembly, as well as on the agenda of the World Radiocommunication Conference 2019;
- 2 to make all the necessary arrangements, in agreement with the Director of the Radiocommunication Bureau, for the convening of the Conference;
- 3 to communicate this Resolution to international and regional organizations concerned.

CHAPTER 1

Land mobile and fixed services

(Agenda items 1.11, 1.12, 1.14, 1.15)

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Agenda item 1.11

1.11 to take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands to support railway radiocommunication systems between train and trackside within existing mobile service allocations, in accordance with Resolution 236 (WRC-15);

Resolution **236 (WRC-15)** – *Railway radiocommunication systems between train and trackside*

1/1.11/1 Executive summary

Resolution **236 (WRC-15)** invites WRC-19, based on the results of ITU-R studies, to take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands, to the extent possible, for the implementation of railway radiocommunication systems between train and trackside (RSTT), within existing mobile service allocations.

To address this agenda item, ITU-R has undertaken studies towards the development of two ITU-R Reports and one Recommendation (see section 1/1.11/3).

Three methods have been proposed to satisfy this agenda item:

- Method A: No change to the RR except suppression of Resolution **236 (WRC-15)**;
- Method B: Add a new Resolution [**A111-METHOD B**] (**WRC-19**) specifying frequency ranges for RSTT and referencing the most recent version of Recommendation ITU-R M.[RSTT_FRQ] and consequently suppress the Resolution **236 (WRC-15)**;
- Method C: Add a new Resolution [**B111-METHOD C**] (**WRC-19**) without specifying frequency ranges for RSTT, while referencing the most recent version of Recommendation ITU-R M.[RSTT_FRQ] and consequently suppress the Resolution **236 (WRC-15)**.

1/1.11/2 Background

The evolving radiocommunication technologies facilitate the railway transportation, which contributes to global economic and social development, especially for developing countries. As one of the core infrastructures, RSTT are vital to provide improved railway traffic control, passenger safety and improved security for train operations.

The implementation of RSTT varies in different countries, leading to high operational costs for international railway transportation. International standards and harmonized spectrum will improve interoperability of RSTT, reducing the railway infrastructure investment and providing for economies of scale.

1/1.11/3 Summary and analysis of the results of ITU-R studies

ITU-R studied the generic architecture, main applications, current technologies, generic operating scenarios of RSTT and developed Report [ITU-R M.2418](#). ITU-R circulated a questionnaire (see Circular Letter [5/LCCE/60](#)) to administrations of Member States, gathering information on the usage of RSTT. Responses from 37 administrations and one regional organization were received and are included in Report [ITU-R M.2442](#) which also includes the detailed characteristics, implementations of current and planned RSTT and the spectrum needs of RSTT. ITU-R commenced development of Recommendation ITU-R M.[RSTT_FRQ], which provides possible harmonization of frequency ranges for RSTT on global or regional basis, as well as some frequency bands used by individual administrations. These study results provide useful elements to facilitate global or regional harmonization of frequency bands to support RSTT within existing mobile service allocations.

Some of these frequency bands are reported to be harmonized in a number of countries within Region 1, especially for RSTT train radio applications.

1/1.11/3.1 Summary and analysis on spectrum needs of RSTT

One case study on spectrum needs of RSTT in Report ITU-R M.2442 shows that the total spectrum needs of train radio applications of RSTT in a typical scenario would be 11.9 MHz to 14.04 MHz (for uplink), and 4.7 MHz to 8.37 MHz (for downlink).

1/1.11/3.2 Summary and analysis on technical and operational characteristics and implementation of RSTT

Report ITU-R M.2418 addresses the architecture, applications, technologies and operational scenarios of RSTT. Four main categories of RSTT applications were identified, which are:

- train radio (for voice dispatching, signalling and traffic management with the aim to safe train operation),
- train positioning information (gathering train positioning information relevant to train operations),
- train remote (data communication between locomotive and ground to control the engine), and
- train surveillance (capture and transmission of video of the public and trackside areas etc.).

Report ITU-R M.2418 also contains five generic operating scenarios of RSTT which are railway line, railway station, shunting yard, maintenance base and railway hub.

Recommendation ITU-R P.1411-9 contains the propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz, and includes, *inter alia*, a section dealing with RSTT scenarios.

1/1.11/3.3 Summary and analysis on spectrum usage of RSTT

Based on the input provided in the development of Report ITU-R M.2442, it is recognized that spectrum currently used for RSTT varies among administrations. Analysis of the available data led to the following general conclusions regarding spectrum used by the responding administrations for the four main categories of RSTT:

- radiocommunication systems for train radio and train remote applications of RSTT are mostly deployed in the frequency bands below 1 GHz;
- radiocommunication systems for train positioning information applications mainly use frequency bands: below 1 MHz for axle counter, around 4 MHz (uplink) and 27 MHz (downlink) for balise and millimetric bands for radar;
- radiocommunication systems for train surveillance applications are currently realized by different technical approaches, using frequency bands above 5 GHz.

Radiocommunication systems for train radio and train remote applications are within existing mobile service allocations.

However, some radiocommunication systems for the application of train positioning and train surveillance are not within the existing mobile service allocations. For instance, some are within the radiolocation service.

1/1.11/4 Methods to satisfy the agenda item

Regulatory procedures associated with some of the methods as described below are provided by those proponents of the methods in question, reflect the view of the proponents, and were presented and discussed by ITU-R.

In various parts of the draft CPM text, reference is made to the prevailing situation in certain countries or regions in regard to the use of certain frequency bands for RSTT which reflects the situation in those countries or regions and thus should not be generalized to give the impression that these conditions would be applicable to other countries or regions.

1/1.11/4.1 Method A: No change to the RR except suppression of Resolution 236 (WRC-15)

Reasons: Harmonization of frequencies for RSTT can be achieved through the course of ITU-R study group work by applicable ITU-R Recommendations and/or Reports (e.g. Recommendation ITU-R M.[RSTT_FRQ]).

1/1.11/4.2 Method B: Add a new Resolution [A111-METHOD B] (WRC-19) specifying frequency ranges for RSTT and referencing the most recent version of Recommendation ITU-R M.[RSTT_FRQ] and consequently suppress Resolution 236 (WRC-15)

A new WRC Resolution specifying frequency ranges for RSTT can provide a regulatory framework to guide the harmonization process. At the same time, an ITU-R Recommendation can recommend possible global and/or regional harmonization of frequency ranges for RSTT and can provide flexibility.

1/1.11/4.3 Method C: Add a new Resolution [B111-METHOD C] (WRC-19) without specifying frequency ranges for RSTT, while referencing the most recent version of Recommendation ITU-R M.[RSTT_FRQ] and consequently suppress the Resolution 236 (WRC-15).

A new WRC Resolution can provide a regulatory framework to guide the harmonization process through reference to the most recent version of Recommendation ITU-R M.[RSTT_FRQ] which recommends possible global and/or regional harmonization of frequency ranges for RSTT. In the *resolves* part of the new Resolution, no specific frequency band is mentioned.

1/1.11/5 Regulatory and procedural considerations

1/1.11/5.1 For Method A

NOC

ARTICLES

NOC

APPENDICES

SUP

RESOLUTION 236 (WRC-15)

Railway radiocommunication systems between train and trackside

1/1.11/5.2 For Method B

ADD

DRAFT NEW RESOLUTION [A111-METHOD B] (WRC-19)

Harmonization of frequency bands for railway radiocommunication systems between train and trackside (RSTT)

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that railway transportation contributes to global economic and social development, especially for developing countries;
- b)* that the term “railway radiocommunication systems between train and trackside (RSTT)” refers to radiocommunication systems providing improved railway traffic control, passenger safety and improved security for train operations;
- c)* that the main categories of applications of RSTT are train radio, train positioning information, train remote and train surveillance;
- d)* that the devices used in train positioning information applications may be based on short-range devices (SRDs) using frequency bands contained in the most recent version of Recommendation ITU-R SM.1896;
- e)* that spectrum harmonization of train radio application of RSTT may have priority among the four categories of RSTT applications, because train radio applications provide for train dispatching, train control and other important railway services which is used to ensure the safety for train operations and passenger, and require high reliability and high quality of services;
- f)* that there may be a need to integrate different technologies across multiple bands in order to facilitate various functions, for instance dispatching commands, operating control and data transmission, into railway train and trackside systems to also meet the needs of a high-speed railway environment;
- g)* that the technologies for RSTT are evolving and international or regional organizations such as 3GPP, UIC, ETSI, ERA etc. are developing specifications for technologies and new functions to evolve RSTT;
- h)* that the implementation of future RSTT needs to take account of the development of the railway industry;

- i) that the evolving safety-related applications of railway transportation may require more spectrum;
- j) that the harmonization of frequency bands for RSTT does not preclude the use of these bands by any applications of the primary services to which they are allocated;
- k) that many administrations wish to facilitate RSTT interoperability in particular for cross-border operations, for effectively using spectrum resources and for minimizing the risk of interference;
- l) that deployment of RSTT requires significant long-term investment and a stable radio regulatory environment;
- m) that international standards and global/regional harmonized spectrum facilitate deployment of RSTT based on readily available cost-effective technologies that would help to provide economies-of-scale for the railway industry,

recognizing

- a) that Report ITU-R M.2418 provides the generic architecture, main applications, current technologies and generic operating scenarios of RSTT;
- b) that Report ITU-R M.2442 provides detailed characteristics of RSTT and also provides spectrum usage of current and planned RSTT by some administrations;
- c) that the most recent version of Recommendation ITU-R M.[RSTT_FRQ] contains harmonized RSTT frequency ranges as well as frequency bands of individual administrations;
- d) that RSTT are composed of categories of applications and systems which operate in various frequency bands not limited to mobile service allocations;
- e) that radiocommunication systems for train radio and train remote applications are widely deployed in the frequency bands below 1 GHz, and higher frequency bands such as millimetric bands are used for train radio and train surveillance applications of RSTT in some countries,

noting

- a) that among various technologies, two global standardized technologies, namely GSM-R and TETRA, are currently widely used for RSTT train radio applications, and that LTE-based RSTT is being deployed for train radio and train remote applications in some countries;
- b) that Report ITU-R M.2442 indicates that several particular frequency bands are in common use for train radio applications of RSTT by many administrations and this may form the basis for global or regional spectrum harmonization for the train radio applications;
- c) that some administrations in Region 1 have already implemented several harmonized frequency bands for some applications of RSTT;
- d) that lower frequency bands are generally preferred for those RSTT applications requiring large coverage areas, while higher frequency bands could provide *inter alia* higher capacity for high data volume applications of RSTT,

emphasizing

that flexibility must be afforded to administrations to determine:

- how much spectrum to make available at national level for RSTT from the ranges in the *resolves* part of this Resolution in order to meet their particular national requirements;

- the need and timing of availability as well as the conditions of usage of the bands used for RSTT, including those covered in this Resolution and in Recommendation ITU-R M.[RSTT_FRQ], in meeting specific regional or national situations; and
- whether existing RSTT systems using other bands will continue in operation and require ongoing support,

resolves

1 to encourage administrations to use harmonized frequency bands for RSTT to the extent possible;

2 to encourage administrations to consider the following frequency ranges¹, or parts thereof, for achieving the global frequency harmonization for RSTT, in particular for train radio applications, within existing mobile service allocations: 138-174 MHz, 335.4-470 MHz, 873-915 MHz, 918-960 MHz (see Note 1 and Note 3);

Note 1: These frequency ranges 138-174 MHz, 335.4-470 MHz, 873-915 MHz, 918-960 MHz for possible global harmonization were not agreed upon, and may be further considered by WRC-19.

3 to encourage administrations to consider the following frequency ranges, or parts thereof, for achieving regional frequency harmonization for RSTT, in particular for train radio applications, within existing mobile service allocations:

a) in Region 1:

- view 1: TBD (see Note 2);

Note 2: The frequency ranges for possible regional harmonization in Region 1, 138-174 MHz, 340-470 MHz, 873-925 MHz, were submitted to CPM19-2. However, there was no indication about their feasibility of harmonization throughout Region 1. Therefore, frequency ranges for harmonization for RSTT are to be defined and need further consideration before and at WRC-19.

- view 2: 138-174 MHz, 340-470 MHz, 873-925 MHz;

b) in Region 2: TBD (see Note 3);

Note 3: It should not be construed that the preceding frequency bands should imply the need for any requirements for globally or regionally harmonized RSTT frequency bands in Region 2. However, the proponents of this method would invite countries to give due consideration to the benefits of harmonization for RSTT applications above.

c) in Region 3: 138-174 MHz, 335.4-470 MHz, 703-748 MHz, 758-803 MHz, 873-915 MHz, 918-960 MHz, 1 770-1 880 MHz, 43.5-45.5 GHz, 92-109.5 GHz (see Note 4);

Note 4: APT Members are of the view that frequency bands (or parts thereof) within the frequency ranges above, within the existing mobile service allocations, could be considered as potentially harmonized frequency bands for Region 3 for RSTT, in particular for train radio applications. And APT Members will further consider the approach to satisfy this harmonization.

View: Concerns were expressed by some administrations and ITU-R members with respect to the use of frequency ranges in *resolves* 2 and 3, in particular when these proposed frequency ranges cover bands that are not allocated to the mobile service or are allocated to the mobile service on a secondary basis, rendering these bands unsuitable for achieving harmonization for RSTT.

¹ In the context of this Resolution, the term “frequency range” means a range of frequencies over which radio equipment is envisaged to be capable of operating but limited to specific frequency band(s) according to national conditions and requirements.

4 to encourage administrations to consider frequency bands within the frequency ranges specified in *resolves* 2 and *resolves* 3, and other possible future harmonized frequency ranges as well as countries' specific frequency bands for RSTT, with the view for including them in the most recent version of Recommendation ITU-R M.[RSTT_FRQ],

invites ITU-R

1 to continue technical studies and to make recommendations concerning technical and operational implementation of RSTT, taking into account the spectrum needs and the evolution of RSTT, to facilitate the implementation of this Resolution in a timely manner;

2 to review and update Recommendation ITU-R M.[RSTT_FRQ] and other relevant ITU-R Recommendations and ITU-R Reports, as appropriate,

invites administrations

to encourage railway agencies and organizations to utilize relevant ITU-R publications in implementing technologies and systems supporting RSTT,

invites Member States, Sector Members, Associates and Academia

to participate actively in the study by submitting contributions to ITU-R,

instructs the Secretary-General

to bring this Resolution to the attention of the International Union of Railways (UIC) and other relevant international and regional organizations.

SUP

RESOLUTION 236 (WRC-15)

Railway radiocommunication systems between train and trackside

1/1.11/5.3 For Method C

ADD

DRAFT NEW RESOLUTION [B111-METHOD C] (WRC-19)

Harmonization of frequency bands for railway radiocommunication systems between train and trackside (RSTT)

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

a) that railway transportation contributes to global economic and social development, especially for developing countries;

- b) that the term “railway radiocommunication systems between train and trackside (RSTT)” refers to radiocommunication systems providing improved railway traffic control, passenger safety and improved security for train operations;
- c) that the main categories of applications of RSTT are train radio, train positioning information, train remote and train surveillance;
- d) that the devices used in train positioning information applications may be based on short-range devices (SRDs) using frequency bands contained in the most recent version of Recommendation ITU-R SM.1896;
- e) that spectrum harmonization of train radio applications of RSTT may have priority among the four categories of RSTT applications, because train radio applications provide for train dispatching, train control and other important railway services which is used to ensure the safety for train operations and passenger, and require high reliability and high quality of services;
- f) that there may be a need to integrate different technologies across multiple bands in order to facilitate various functions, for instance dispatching commands, operating control and data transmission, into railway train and trackside systems to also meet the needs of a high-speed railway environment;
- g) that the technologies for RSTT are evolving and international or regional organizations such as 3GPP, UIC, ETSI, ERA etc. are developing specifications for technologies and new functions to evolve RSTT;
- h) that the implementation of future RSTT needs to take account of the development of the railway industry;
- i) that the evolving safety-related applications of railway transportation may require more spectrum;
- j) that the harmonization of frequency bands for RSTT does not preclude the use of these bands by any applications of the primary services to which they are allocated;
- k) that many administrations wish to facilitate RSTT interoperability in particular for cross-border operations, for effectively using spectrum resources and for minimizing the risk of interference;
- l) that deployment of RSTT requires significant long-term investment and a stable radio regulatory environment;
- m) that international standards and global/regional harmonized spectrum facilitate deployment of RSTT based on readily available cost-effective technologies that would help to provide economies-of-scale for the railway industry,

recognizing

- a) that Report ITU-R M.2418 provides the generic architecture, main applications, current technologies and generic operating scenarios of RSTT;
- b) that Report ITU-R M.2442 provides detailed characteristics of RSTT and also provides spectrum usage of current and planned RSTT by some administrations;
- c) that the most recent version of Recommendation ITU-R M.[RSTT_FRQ] contains harmonized RSTT frequency ranges as well as frequency bands of individual administrations;
- d) that RSTT are composed of categories of applications and systems which operate in various frequency bands not limited to mobile service allocations;

e) that radiocommunication systems for train radio and train remote applications are widely deployed in the frequency bands below 1 GHz, and higher frequency bands such as millimetric bands are used for train radio and train surveillance applications of RSTT in some countries,

noting

a) that among various technologies, two global standardized technologies, namely GSM-R and TETRA, are currently widely used for RSTT train radio applications, and that LTE-based RSTT is being deployed for train radio and train remote applications in some countries;

b) that Report ITU-R M.2442 indicates that several particular frequency bands are in common use for train radio applications of RSTT by many administrations and this may form the basis for global or regional spectrum harmonization for the train radio applications;

c) that some administrations in Region 1 have already implemented several harmonized frequency bands for some applications of RSTT;

d) that lower frequency bands are generally preferred for those RSTT applications requiring large coverage areas, while higher frequency bands could provide *inter alia* higher capacity for high data volume applications of RSTT,

emphasizing

that flexibility must be afforded to administrations to determine:

- how much spectrum to make available at national level for RSTT from the ranges in the *resolves* part of this Resolution in order to meet their particular national requirements;
- the need and timing of availability as well as the conditions of usage of the bands used for RSTT, including those covered in this Resolution and in Recommendation ITU-R M.[RSTT_FRQ], in meeting specific regional or national situations; and
- whether existing RSTT systems using other bands will continue in operation and require ongoing support,

resolves

to encourage administrations to use harmonized frequency bands for RSTT to the extent possible, by considering the frequency bands within the frequency ranges¹ or parts thereof, which are listed in the most recent version of Recommendation ITU-R M.[RSTT_FRQ], for achieving the global and/or regional frequency harmonization for RSTT, in particular for train radio applications, within existing mobile service allocations,

invites ITU-R

1 to continue technical studies and to make recommendations concerning technical and operational implementation of RSTT, taking into account the spectrum needs and the evolution of RSTT, to facilitate the implementation of this Resolution in a timely manner;

2 to review and update Recommendation ITU-R M.[RSTT_FRQ] and other relevant ITU-R Recommendations and ITU-R Reports, as appropriate,

¹ In the context of this Resolution, the term “frequency range” means a range of frequencies over which radio equipment is envisaged to be capable of operating but limited to specific frequency band(s) according to national conditions and requirements.

invites administrations

to encourage railway agencies and organizations to utilize relevant ITU-R publications in implementing technologies and systems supporting RSTT,

invites Member States, Sector Members, Associates and Academia

to participate actively in the study by submitting contributions to ITU-R,

instructs the Secretary-General

to bring this Resolution to the attention of the International Union of Railways (UIC) and other relevant international and regional organizations.

SUP

RESOLUTION 236 (WRC-15)

Railway radiocommunication systems between train and trackside

Agenda item 1.12

1.12 to consider possible global or regional harmonized frequency bands, to the maximum extent possible, for the implementation of evolving Intelligent Transport Systems (ITS) under existing mobile-service allocations, in accordance with Resolution 237 (WRC-15);

Resolution 237 (WRC-15) – *Intelligent Transport Systems applications*

1/1.12/1 Executive summary

There is a need to consider harmonization of frequency bands for the implementation of evolving Intelligent Transport Systems (ITS).

Evolving ITS are being deployed to assist safe driving and to support transportation system efficiency and environmental sustainability. It is recognized that the frequency bands within existing mobile service allocations being used by evolving ITS may also be utilized by other applications and services.

Several ITU-R Reports and Recommendations have been developed in support of this agenda item, as listed in section 1/1.12/3.

ITU-R studies indicated that some administrations in each of the three Regions have designated the frequency band of 5 850-5 925 MHz, or parts thereof, for the deployment of evolving ITS.

Recommendation ITU-R M.2121 recommends that several frequency bands within each Region, in whole or in part, be used for current and future ITS applications.

Three methods have been proposed to satisfy this agenda item:

- Method A: No change to the Radio Regulations because ITS continue to operate within existing mobile service allocations and the required harmonization of frequencies for ITS can be achieved through ITU-R Recommendations and Reports.
- Method B: No change to the Table of Frequency Allocations in the Radio Regulations, and add a new WRC Resolution to encourage administrations to use 5 850-5 925 MHz, or parts thereof, as global harmonized evolving ITS frequency bands. Other harmonized frequency band(s) for evolving ITS applications refer to the most recent version of Recommendation ITU-R M.2121.
- Method C: No change to the Table of Frequency Allocations in the Radio Regulations, and add a new WRC Resolution to encourage administrations to use globally and regionally harmonized frequency bands for evolving ITS applications by referring to the most recent version of Recommendation ITU-R M.2121.

For all Methods, Resolution 237 (WRC-15) should be suppressed.

1/1.12/2 Background

Since 1995, research and development activities have been conducted in infocommunication systems as core technologies of ITS. ITS, including legacy ITS, have been deployed in some countries. Evolving ITS, including vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-network (V2N) and vehicle-to-pedestrian (V2P) communications have been deployed in some countries to assist with safer driving. Communicating with moving vehicles is one of the typical use cases for radiocommunications, and a variety of ITS applications rely on radiocommunication technologies including the next generation of ITS applications.

Evolving ITS also become important in helping to reduce road traffic problems such as congestion and accidents. To address road safety and efficiency-related matters, the ITS with vehicle-to-

everything communication (e.g. WAVE, ETSI ITS-G5, LTE based V2X, ITS Connect) are studied in ITU-R.

Recognizing that harmonized spectrum and international standards would facilitate deployment of ITS radiocommunications, WRC-19 agenda item 1.12 was approved by WRC-15 and Resolution **237 (WRC-15)** requested to consider possible global or regional harmonized frequency bands for the implementation of evolving ITS under existing mobile service allocations. The mobile service bands being used by the evolving ITS may also be utilized by other applications and services and some of the frequency bands are also being considered under other agenda items.

1/1.12/3 Summary and analysis of the results of ITU-R studies

Technical and operational studies performed by ITU-R in relation to WRC-19 agenda item 1.12 have indicated that the frequency band 5 850-5 925 MHz, or parts thereof, have been designated for the implementation of evolving ITS by some administrations in each of Regions 1, 2 and 3. Consequently, the ITU-R has developed new Recommendation ITU-R M.2121, “Harmonization of frequency bands for Intelligent Transport Systems in the mobile service” and new Report ITU-R.2445, “Intelligent transport systems (ITS) usage”.

View #1: It was indicated that there is potential harmful interference from FSS earth station uplinks into evolving ITS receivers. Consequently, some administrations in Region 1 have concluded that evolving ITS stations cannot claim protection from FSS earth station uplinks in the 5 850-5 925 MHz frequency band. In these cases, any coexistence issues between evolving ITS stations and FSS earth station uplinks, may be mitigated by evolving ITS equipment design which would take into account the potential harmful interference from FSS earth stations.

View #2: Other views were also expressed that the frequency band 5 850-5 925 MHz is shared between the MS and FSS on a co-primary basis and any coexistence issues in this band should be a national matter.

View #3: In regard with coordination between various services on a national basis, it is to emphasize that national issues are not dealt with by ITU-R due to the fact that national policy of a given administration on how to manage the use of radiocommunication services associated with spectrum is a national matter and shall not be discussed internationally.

View #4: Some views were expressed that the probability of interference from evolving ITS stations to FSS space receivers may be negligible.

1/1.12/3.1 ITU-R Recommendations and Reports

In ITU-R, several documents have been published, as follows: Recommendations [ITU-R M.1452-2](#), [ITU-R M.1453-2](#), [ITU-R M.1890\[-1\]](#), [ITU-R M.2084\[-1\]](#), and [ITU-R M.2121](#), and Reports [ITU-R M.2228-1](#) and [ITU-R M.2445](#).

1/1.12/4 Methods to satisfy the agenda item

1/1.12/4.1 Method A – No change to the Radio Regulations and suppress Resolution 237 (WRC-15)

No change to the Radio Regulations other than to suppress Resolution **237 (WRC-15)**.

Reasons: ITS operate within existing mobile service allocations. Harmonization of frequencies for ITS pertaining to the exchange of information to improve traffic management and to assist driving safety can be achieved through the course of ITU-R Study Group work by applicable ITU-R Recommendations and/or Reports (e.g., Recommendation ITU-R M.2121).

1.12/4.2 Method B – Add a new WRC Resolution and non-mandatory reference to ITU-R Recommendation

No change to the Table of Frequency Allocations in the Radio Regulations, and add a new WRC Resolution to encourage administrations to use 5 850-5 925 MHz, or parts thereof, as global harmonized evolving ITS frequency bands. Other harmonized frequency band(s) for evolving ITS applications refer to the most recent version of Recommendation ITU-R M.2121.

This method provides a regulatory framework for worldwide or regional harmonization for ITS applications through a new WRC Resolution, the current global harmonized frequency bands for evolving ITS indicated by the new WRC Resolution, the other harmonized frequency can be non-mandatory referenced to the most recent version of Recommendation ITU-R M.2121.

1/1.12/4.3 Method C – Add a new WRC Resolution and non-mandatory reference to ITU-R Recommendation

No change to the RR Table of Frequency Allocations and to add a new WRC Resolution to encourage administrations to use globally and regionally harmonized frequency bands for ITS applications through reference to ITU-R Recommendation(s). Suppress Resolution **237 (WRC-15)**.

This method provides a regulatory framework for worldwide or regional harmonization for ITS applications through a new WRC Resolution and the most recent version of Recommendation ITU-R M.2121.

1/1.12/5 Regulatory and procedural considerations

1/1.12/5.1 For Method A

NOC

ARTICLES

NOC

APPENDICES

SUP

RESOLUTION 237 (WRC-15)

Intelligent Transport Systems applications

1/1.12/5.2 For Methods B and C

ADD

DRAFT NEW RESOLUTION [A112] (WRC-19)

Harmonization of frequency bands for evolving Intelligent Transport Systems applications under mobile service allocations

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that information and communication technologies are integrated in a vehicle system to provide evolving Intelligent Transport Systems (ITS) communication applications for the purpose of improving traffic management and assisting safer driving;
- b)* that there is a need for consideration of spectrum harmonization for evolving ITS applications, which are being used globally or regionally;
- c)* that there is a need to integrate various technologies, including radiocommunications, into land transportation systems;
- d)* that many new connected vehicles use intelligent technologies in the vehicles' combined advanced traffic management, advanced traveller information, advanced public transportation management systems and/or advanced fleet management systems to improve traffic management;
- e)* that future vehicular radiocommunication technologies and ITS broadcast systems are emerging;
- f)* that some administrations have harmonized frequency bands for ITS radiocommunication applications;
- g)* that under certain circumstances, FSS earth station uplinks may create potential interference to ITS stations which may have operational issues while in close proximity;
- h)* that the compatibility between ITS stations and FSS space stations is achievable for certain ITS stations as an interferer,

recognizing

- a)* that harmonized spectrum and international standards would facilitate worldwide deployment of evolving ITS radiocommunications and provide for economies of scale in bringing evolving ITS equipment and services to the public;
- b)* that the designation of those harmonized frequency bands, or parts thereof, for evolving ITS does not preclude the use of these bands/frequencies by any other application of the services to which they are allocated and does not establish priority in applying and using the Radio Regulations;
- c)* that in those harmonized frequency bands or parts thereof for ITS, there are existing services whose protection needs to be ensured;
- d)* that a certain country in Region 3 operates an ITS system around 5.8 GHz as described in Recommendation ITU-R M.1453;

e) that evolving ITS also becomes important in helping to reduce road traffic problems such as congestion and accidents;

f) that ITU-R studies on evolving ITS technologies (e.g. WAVE, ETSI ITS-G5, LTE-based V2X, ITS Connect) are meant to address road safety and efficiency-related matters,

noting

a) that the guidelines for radio interface requirements of ITS are described in Recommendation ITU-R M.1890;

b) that outlines of technologies and characteristics for dedicated short-range communications at 5.8 GHz are described in Recommendation ITU-R M.1453;

c) that some administrations in each of the three Regions have deployed radiocommunication local area networks in the frequency band 5 725-5 850 MHz and some administrations are considering allowing radiocommunication local area networks in the frequency band 5 850-5 925 MHz;

d) that studies, feasibility tests, and actual operation of advanced evolving ITS radiocommunications have been actively conducted towards the realization of traffic safety and a reduction of environmental impact as described in Report ITU-R M.2228;

e) that radio interface standards of vehicle-to-vehicle and vehicle-to-infrastructure communications for evolving ITS applications are described in Recommendation ITU-R M.2084;

f) that ITS usage in ITU Member States is described in Report ITU-R M.2445;

g) that some administrations have considered that ITS devices cannot claim protection from FSS earth station uplinks in 5 850-5 925 MHz in order to facilitate coexistence, in which case ITS devices deployed need to cope with the interference created by FSS earth station uplinks;

h) that some administrations in Region 1, in the spirit of Article 6, have applied a coordinated approach by which when they deploy ITS stations, protection cannot be claimed from FSS earth station uplinks in 5 850-5 925 MHz;

i) that the latest version of Recommendation ITU-R M.2121 provides frequency bands for evolving ITS systems,

emphasizing

a) that the provisions of Nos. **1.59** and **4.10** do not apply to evolving ITS applications under mobile-service allocations,

resolves

For Method B

to encourage administrations to consider using the frequency band 5 850-5 925 MHz, or parts thereof, when planning and deploying evolving ITS applications, for achieving frequency harmonization taking into account *recognizing b)* while considering *recognizing d)* above;

other harmonized frequency bands, which are listed in the most recent version of Recommendation ITU-R M.2121, can be considered as harmonized frequency bands for evolving ITS,

For Method C

to encourage administrations to consider globally or regionally harmonized frequency bands or parts thereof, which are listed in the most recent version of Recommendation ITU-R M.2121, when planning and deploying evolving ITS applications, taking into account *recognizing b)* above,

For both Methods B and C

invites Member States and Sector Members

to take into account, as necessary, possible coexistence issues between ITS stations and FSS earth stations operating in the 5 850-5 925 MHz frequency band,

invites Member States, Sector Members, Associates and Academia

to actively contribute to the ITU-R studies on ITS,

instructs the Secretary-General

to bring this Resolution to the attention of relevant international and regional organizations dealing with ITS.

[Note: Upon the selection of Methods B or C, only the relevant parts should be kept in the draft new Resolution above.]

SUP

RESOLUTION 237 (WRC-15)

Intelligent Transport Systems applications

Agenda item 1.14

1.14 to consider, on the basis of ITU-R studies in accordance with Resolution 160 (WRC-15), appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations;

Resolution 160 (WRC-15) – Facilitating access to broadband applications delivered by high-altitude platform stations

1/1.14/1 Executive summary

WRC-19 agenda item 1.14 considers additional spectrum needs for gateway and fixed terminal links for HAPS to provide broadband connectivity in the fixed-service (FS) pursuant to Resolution 160 (WRC-15).

The results of studies estimate the total spectrum needs for HAPS systems to be:

- in the range of 396 (for lower user density setting) to 2 969 MHz (for higher user density setting) for the ground-to-HAPS links;
- in the range of 324 (for lower user density setting) to 1 505 MHz (for higher user density setting) for the HAPS to ground links.

The sharing studies conducted by ITU-R consider the following frequency ranges:

- 6 440-6 520 MHz;
- 21.4-22 GHz (Region 2 only);
- 24.25-27.5 GHz (Region 2 only);
- 27.9-28.2 GHz and 31-31.3 GHz;
- 38-39.5 GHz;
- 47.2-47.5 GHz and 47.9-48.2 GHz.

Section 1/1.14/4 includes the following generic methods to satisfy the agenda item, and describes the way the methods are applied to the above-mentioned frequency bands, as appropriate:

- Method A – No change.
- Method B – Identification of bands for HAPS, in accordance with Resolution 160 (WRC-15) with options:
 - Method B1 – Revision of the regulatory provisions for HAPS in the fixed service (FS) with a primary status in bands already identified for HAPS.
 - Method B2 – Add new identification(s) for HAPS in bands already allocated to the FS with a primary status.
 - Method B3 – Add a primary allocation to the FS and a new identification for HAPS in the band 24.25-25.25 GHz (Region 2) not already allocated to the FS.
- Method C – Suppress the existing HAPS identification, pursuant to *resolves* 3 of Resolution 160 (WRC-15).

1/1.14/2 Background

The technological innovations and the growing urgency to expand the availability of broadband led to a review of the current regulatory environment for delivery platforms such as HAPS. Stations operating in the stratosphere are high enough to provide broadband service to a large area. Recent test deployments of stations delivering broadband from above 20 km above ground have

demonstrated their potential to provide connectivity to underserved communities with minimal ground-level infrastructure. The HAPS platform are also of particular interest of disaster management.

More options for broadband delivery are needed, especially for countries with less-developed infrastructures. HAPS may facilitate broadband rollout by providing an additional platform which provides service that could augment the capacity of other providers using innovative and easily-deployable platforms positioned in the upper atmosphere. In recognition of this opportunity, WRC-15 adopted Resolution **160** to study how to facilitate access to global broadband applications delivered by HAPS in the FS.

Broadband HAPS applications in the FS are expected to serve several use cases, providing Internet access to users on a medium (days to weeks) to long-term basis. It can be a link to an access point, or a backhaul connection for remote networks. Capacity may vary for connectivity and specific use cases (e.g. for disaster relief missions, commercial use, etc.). Regardless, HAPS will provide FS connections between a HAPS airborne platform and temporary or permanent FS ground stations.

1/1.14/3 Summary and analysis of the results of ITU-R studies

1/1.14/3.1 Relevant ITU-R Recommendations and Reports

The relevant ITU Recommendations are:

ITU-R [F.699-8](#), ITU-R [F.758-6](#), ITU-R [F.1500-0](#), ITU-R [F.1501-0](#), ITU-R [F.1569-0](#), ITU-R [F.1570-2](#), ITU-R [F.1607-0](#), ITU-R [F.1608-0](#), ITU-R [F.1609-1](#), ITU-R [F.1612-0](#), ITU-R [F.1764-1](#), ITU-R [F.1819-0](#), ITU-R [F.1891-0](#), ITU-R [F.2011-0](#), ITU-R [F.1820-0](#), ITU-R [P.1409-1](#), ITU-R [SF.1601-2](#), ITU-R [SF.1843-0](#), ITU-R [RS.1813-0](#), ITU-R [RS.1861-0](#), ITU-R [RS.2017-0](#), ITU-R [RS.1858-0](#), ITU-R [SM.1541-6](#), ITU-R [SA.1396-0](#), ITU-R [SA.1811-0](#), ITU-R [SA.509-3](#), ITU-R [SA.609-2](#), ITU-R [SA.1014-3](#), ITU-R [SA.1155-2](#), ITU-R [SA.1276-5](#), ITU-R [SA.1414-2](#), ITU-R [M.2101-0](#), ITU-R [M.2114-0](#), ITU-R [P.525-3](#), ITU-R [M.2120-0](#), ITU-R [RA.769-1](#).

To perform the studies under Resolution **160 (WRC-15)**, ITU-R developed the following Reports:

Report [ITU-R F.2438](#), *Spectrum needs of high altitude platform stations (HAPS) broadband links operating in the fixed service.*

Report [ITU-R F.2439](#), *Deployment and technical characteristics of broadband high altitude platform stations in the fixed service in the frequency bands 6 440-6 520 MHz, 21.4-22.0 GHz, 24.25-27.5 GHz, 27.9-28.2 GHz, 31.0-31.3 GHz, 38.0-39.5 GHz, 47.2-47.5 GHz and 47.9-48.2 GHz used in sharing and compatibility studies.*

The documents that are providing the results of the sharing studies conducted under this agenda item are:

- Report ITU-R F.2437, *Sharing and compatibility studies of HAPS systems in the fixed service for the frequency band 6 400-6 520 MHz;*
- PDN Report ITU-R F.[HAPS-21 GHz] on sharing and compatibility studies for HAPS broadband systems in the 21.4-22 GHz frequency range ([Annex 16](#) to Document [5C/617](#));
- PDN Report ITU-R F.[HAPS-25 GHz] on sharing and compatibility studies for HAPS broadband systems in the 24.25-27.5 GHz frequency range ([Annex 17](#) to Document [5C/617](#));
- PDN Report ITU-R F.[HAPS-31 GHz] on sharing and compatibility studies for HAPS broadband systems in the 27.9-28.2 and 31-31.3 GHz frequency ranges ([Annex 18](#) to Document [5C/617](#));

- PDN Report ITU-R F.[HAPS-39 GHz] on sharing and compatibility studies for HAPS broadband systems in the 38-39.5 GHz frequency range ([Annex 19](#) to Document [5C/617](#));
- PDN Report ITU-R F.[HAPS-47 GHz] on sharing and compatibility studies for HAPS broadband systems in the 47.2-47.5 GHz and 47.9-48.2 GHz frequency range ([Annex 20](#) to Document [5C/617](#)).

1/1.14/3.2 HAPS deployment and technical characteristics, and spectrum needs for broadband applications

1/1.14/3.2.1 Deployment and technical characteristics of HAPS systems

The technical and operational characteristics of HAPS for delivering broadband applications for the purpose of sharing and compatibility studies were determined and provided in Report ITU-R F.2439. These characteristics were provided for deploying HAPS for broadband applications in the existing identifications listed in *recognizing c*) of Resolution **160 (WRC-15)** and the additional potential HAPS identifications in the FS bands at 38-39.5 GHz (worldwide) and 21.4-22 GHz and 24.25-27.5 GHz (Region 2 only).

1/1.14/3.2.2 Broadband HAPS implementations

Broadband HAPS applications will serve several use cases, providing broadband Internet access to users on a medium to long-term basis (from just a few days up to several weeks). Capacity may vary for connectivity and specific use cases (e.g., for disaster relief missions, commercial use, etc.). Regardless, HAPS provides fixed service connections to temporary or permanent FS ground stations. During the development of ITU-R studies under WRC-19 agenda item 1.14, several different HAPS implementations for commercial use cases were presented.

1/1.14/3.2.3 HAPS and ground station descriptions

The different platform implementations for HAPS are assumed to be in accordance with the HAPS definition in RR No. **1.66A**. Consequently HAPS operates at a nominal fixed position.

View 1: some administrations are of the view that, HAPS should operate at a nominal fixed position. The HAPS systems considered in Report ITU-R F.2439 have a northerly/southerly latitudinal and easterly/westerly longitudinal tolerance (platform station keeping), which overall ranges up to 1 to 5 km. Tolerances need to be provided by the notifying administrations to the BR in fulfilling the information required in RR Appendix 4 (see Appendix 4, Annex 1 at Table 2, which includes mandatory elements for northerly and southerly latitudinal tolerances, easterly and westerly longitudinal tolerances, and altitudinal tolerance). Such set of data do not include information associated to the HAPS flight radius around a nominal position. Consequently, the impact of deviations from the notified elements through tolerances on the interference environment have not been studied, and the possible tolerance limits, and of radius of platform movement, when applicable, for the nominally fixed position have not been identified.

View 2: some administrations are of the view that the positional tolerances of HAPS do not impact the conclusions of the studies, including sharing and compatibility studies, conducted under agenda item 1.14. Furthermore, the specific provisions to ensure the protection of other services provided in the example resolutions are not impacted by the HAPS tolerances.

The gateway (GW) link connects HAPS with terrestrial based networks for voice, data and video communications and to connect HAPS with public switched telephone network (PSTN), cellular-phone providers, worldwide providers of broadband communications, and television and sound broadcasters.

The customer premises equipment (CPE) for HAPS applications is understood to be equipment (fixed terminals) for ground-based fixed links which communicate with the HAPS and redistribute their connectivity to end users by other wired or wireless means (e.g., international mobile telecommunications (IMT), wireless access systems (WAS) including radio local area networks (WAS/RLAN), etc.). CPE can be direct to home access or it can be a link to an access point.

The following table provides the terminology used in the CPM text:

| | |
|----------------------|---|
| HAPS | High Altitude Platform Station |
| HAPS System | HAPS Ground Stations + HAPS |
| HAPS GW | HAPS Gateway Station only |
| HAPS CPE | HAPS Customer Premises Equipment Station only |
| HAPS Ground Stations | HAPS GW + HAPS CPE |

1/1.14/3.2.4 HAPS spectrum needs summary

1/1.14/3.2.4.1 Existing HAPS identifications in FS bands

The existing HAPS identifications have not been fully utilized in the past partly due to particular physical and technical and regulatory conditions.

TABLE 1/1.14/1

Existing HAPS identifications in FS bands

| Frequency band | Use | Direction | Bandwidth | Identification |
|--|---------|-----------|-----------|--------------------|
| 6 440-6 520 MHz | GW | ↓ | 80 MHz | 5 Admins (R1, R3) |
| 6 560-6 640 MHz | GW | ↑ | 80 MHz | 5 Admins (R1, R3) |
| 27.9-28.2 GHz | GW, CPE | ↓ | 300 MHz | 23 Admins (R1, R3) |
| 31-31.3 GHz | GW, CPE | ↑ | 300 MHz | 23 Admins (R1, R3) |
| 47.2-47.5 GHz | GW, CPE | ↑↓ | 300 MHz | Worldwide |
| 47.9-48.2 GHz | GW, CPE | ↑↓ | 300 MHz | Worldwide |
| GW: Gateway CPE: fixed terminal customer premises equipment | | | | |

Further modifications to the footnotes of existing identifications could be considered to revise technical conditions to facilitate the use of the existing identifications for services at worldwide level. As noted in Resolution **160 (WRC-15)**, common worldwide identifications for HAPS are desirable in order to improve and harmonize their utilization of the radiofrequency spectrum. The studies that have been carried out on spectrum needs to satisfy HAPS capacity demand demonstrate that spectrum needs for broadband HAPS applications may not be fully accommodated within current HAPS identifications, even if modified to make them global and co-primary, with technically favourable conditions. However, existing HAPS identifications may be enough spectrum for some number of broadband HAPS system use cases. Whereas the majority of broadband HAPS systems could not be satisfied using the existing spectrum identifications. Please see the Table below for the existing identifications, and Report ITU-R F.2438 for more detailed information on these identifications.

1/1.14/3.2.4.2 Spectrum needs for HAPS for broadband applications

Given the existing identifications for HAPS and the interest in facilitating access to broadband applications delivered by HAPS, spectrum needs were studied for the delivery of broadband via HAPS links in the FS.

The spectrum needs for HAPS operating in the FS to provide broadband connectivity presented in this document are taken into account in the studies called for in the *resolves to invite ITU-R 2, 3 and 4 of Resolution 160 (WRC-15)*.

The spectrum needs are summarized in Table 1/1.14/2 below based on the system characteristics and descriptions for a variety of HAPS systems for broadband applications used in sharing and compatibility studies in support of WRC-19 agenda item 1.14. The spectrum needs cover specific applications (e.g. disaster relief missions) and connectivity applications (e.g. commercial broadband).

TABLE 1/1.14/2
Summary of spectrum needs

| Capacity for | | Forward | | Return | |
|----------------------------|-----|------------------------------|-------------------------------|-------------------------------|------------------------------|
| | | GW to HAPS Ground-to-HAPS | HAPS to CPE HAPS-to-ground | CPE to HAPS Ground-to-HAPS | HAPS to GW HAPS-to-ground |
| Specific applications | MHz | 110 | 15 | 15 | 110 |
| Connectivity applications* | MHz | 247-2 727 | 164-938 | 24-240 | 35-480 |

* The ranges are covering several possible use cases with different targeted markets.

Additional details of the analysis conducted on the spectrum needs for HAPS are available in Report ITU-R F.2438, *Spectrum needs of high altitude platform stations (HAPS) broadband links operating in the fixed service*.

TABLE 1/1.14/3
Spectrum needs for a variety of system characteristics

| Type of HAPS system | | GW to HAPS Ground-to-HAPS | HAPS to CPE HAPS-to-ground | CPE to HAPS Ground-to-HAPS | HAPS to GW HAPS-to-ground | Total uplink | Total downlink |
|---------------------|-----|------------------------------|-------------------------------|-------------------------------|------------------------------|--------------|----------------|
| Connectivity 1 | MHz | 1 800 | 900 | 240 | 480 | 2 040 | 1 380 |
| Connectivity 2 | MHz | 2 727 | 938 | 117 | 341 | 2 844 | 1 279 |
| Connectivity 3 | MHz | 1 114 | 576 | 213 | 371 | 1 327 | 947 |
| Connectivity 4 | MHz | 1 424 | 200 | 59 | 310 | 1 483 | 510 |
| Connectivity 5 | MHz | 247 | 164 | 24 | 35 | 271 | 199 |
| Minimum | MHz | | | | | 271 | 199 |
| Maximum | MHz | | | | | 2 844 | 1 380 |
| Specific | MHz | 110 | 15 | 15 | 110 | 125 | 125 |

| Type of HAPS system | | GW to HAPS Ground-to-HAPS | HAPS to CPE HAPS-to-ground | CPE to HAPS Ground-to-HAPS | HAPS to GW HAPS-to-ground | Total uplink | Total downlink |
|--|-----|------------------------------|-------------------------------|-------------------------------|------------------------------|--------------|----------------|
| Minimum (including specific applications) | MHz | | | | | 396 | 324 |
| Maximum (including specific applications) | MHz | | | | | 2 969 | 1 505 |

Noting the variety of HAPS systems characteristics and targeted services, there is also a variation in the spectrum needs. The results of studies that estimate the total spectrum needs for HAPS systems to be:

- in the range of 396 MHz (for lower capacity) to 2 969 MHz (for higher capacity) for the ground to HAPS platform links;
- in the range of 324 MHz (for lower capacity) to 1 505 MHz (for higher capacity) for the HAPS platform to ground links.

The above spectrum needs are based on assumed HAPS throughputs, user densities and the operation of a single HAPS over a given coverage area. Different assumptions would result in spectrum needs that would differ from those provided.

Given the regulatory provisions in the existing identifications and the current demand for multi-gigabit broadband, the existing identifications associated with current HAPS regulatory provisions are not sufficient to accommodate the largest case requirements of all HAPS systems in their more demanding spectrum scenarios. Consequently, sharing and compatibility studies on possible new HAPS identifications were conducted per Resolution **160 (WRC-15)**.

1/1.14/3.3 Summary and analysis of sharing studies between broadband HAPS and other services (in-band/adjacent bands)

1/1.14/3.3.1 Sharing and compatibility studies of HAPS systems in the 6 440-6 520 MHz and 6 560-6 640 MHz frequency ranges

Studies were performed for the HAPS-to-ground direction in the 6 440-6 520 MHz.

No studies were performed for the 6 440-6 520 MHz in the ground-to-HAPS direction.

No studies were performed for the 6 560-6 640 MHz in either direction as no systems were proposed.

Accordingly, Report ITU-R F.2437 addresses the impact of HAPS systems operating in the HAPS-to-ground direction in 6 440-6 520 MHz.

1/1.14/3.3.1.1 Sharing and compatibility of FS and HAPS systems (HAPS-to-ground) operating in the 6 440-6 520 MHz frequency range

Impact from transmitting HAPS into receiving FS stations

Results of studies have shown that the following pfd mask per HAPS, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the fixed service by meeting its long-term protection criteria:

| | | | |
|---|------------------------------|-----|---------------|
| -160 | dB(W/(m ² · MHz)) | for | 0° ≤ θ < 6° |
| 3.75 θ - 182.5 | dB(W/(m ² · MHz)) | for | 6° ≤ θ < 10° |
| -152.5 + 25.5 log ₁₀ (θ - 8) | dB(W/(m ² · MHz)) | for | 10° ≤ θ < 56° |
| -109.63 | dB(W/(m ² · MHz)) | for | 56° ≤ θ ≤ 90° |

where θ is the angles of arrival of the incident wave above the horizontal plane, in degrees.

Note that the pfd level shown above is derived from a maximum interference level of -149.5 dB(W/MHz) (i.e. $I/N = -10$ dB not to be exceeded for more than 20% of the time) for the FS long-term protection criteria. The FS parameters and operational characteristics are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. Gaseous atmospheric attenuation is not considered for this frequency range.

This study shows that the one HAPS system considered can meet such a pfd limit. To verify that the pfd produced by HAPS does not exceed the proposed pfd mask, the following equation was used:

$$pfd(\theta) = e.i.r.p. \cdot dB\left(\frac{W}{MHz}\right)(\theta) + 10 * \log_{10}\left(\frac{1}{4\pi d^2(\theta)}\right)$$

where:

e.i.r.p.: maximum HAPS e.i.r.p. density level in dB(W/MHz) (dependent to the elevation angle θ);

d: distance between the HAPS and the ground (elevation angle dependent).

Impact from transmitting FS stations into receiving HAPS ground stations

The study showed that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. This study suggests that protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

1/1.14/3.3.1.2 Sharing and compatibility of FSS (Earth-to-space) and HAPS systems (HAPS-to-ground) operating in the 6 440-6 520 MHz frequency range

Impact from transmitting HAPS into receiving FSS space station

ITU-R study shows that, in order to protect FSS space station receivers, the e.i.r.p. density per HAPS transmitter should be limited to -16.1 dB(W/MHz) towards the GSO arc. The study also shows that it is possible to design a HAPS system compliant with the above proposed e.i.r.p. density limit and protect FSS satellite with large margin.

Impact from transmitting FSS earth station into receiving HAPS ground stations

ITU-R study considered the potential emissions from FSS earth stations received by the HAPS ground stations receivers. This analysis also compared the level of emissions at the HAPS receivers to those that would be received by a fixed service receiver.

The analysis performed shows that the required separation distance of HAPS ground stations receivers and FSS earth stations is less than the required separation distance between an FSS earth station and FS terminal. The study was based on a statistical single-entry analysis and did not take into account deployment densities. It should be noted that the coexistence feasibility could also be dependent on the expected deployment of FSS earth stations and HAPS ground stations.

1/1.14/3.3.1.3 Sharing and compatibility of MS and HAPS systems operating in the 6 440-6 520 MHz frequency range

Impact from transmitting HAPS into receiving MS stations

The study has shown that the following pfd mask per HAPS, would ensure the protection of the MS receivers:

$$\begin{array}{llll} 0.35 \theta - 120 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 0^\circ \leq \theta < 40^\circ \\ -106 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 40^\circ \leq \theta \leq 90^\circ \end{array}$$

where θ is the angles of arrival of the incident wave above the horizontal plane, in degrees.

Note that gaseous atmospheric loss was not considered for this frequency range as it is negligible.

The study showed that a HAPS system can meet such a pfd limit. To verify that the pfd produced by HAPS does not exceed the proposed pfd mask, the following equation was used:

$$pfd(\theta) = e.i.r.p. \cdot dB\left(\frac{W}{MHz}\right)(\theta) + 10 \cdot \log_{10}\left(\frac{1}{4\pi d^2(\theta)}\right)$$

where:

e.i.r.p.: maximum HAPS e.i.r.p. density level in dB(W/MHz) (dependent to the elevation angle);

d: distance between the HAPS and the ground (elevation angle dependent);

θ : angles of arrival of the incident wave above the horizontal plane, in degrees.

HAPS ground stations transmitting towards the HAPS

No systems characteristics with HAPS uplink in this frequency range were presented in Report ITU-R F.2439, so the HAPS uplink was not studied.

Impact from transmitting MS station into receiving HAPS ground stations

The study performed two different percentages of time, i.e., 20% and 0.01%, using propagation model Recommendation ITU-R P.452-16. The statistical single-entry showed that the range of separation distances between MS station and HAPS ground station receiver is between approximately 0 km and 10 km, depending on the probability.

Similar analysis showed that the range of separation distances between the MS and conventional FS station is between approximately 0 km and 43 km for the same probabilities. Therefore the study suggested that the protection between HAPS ground stations and MS stations can be managed on a case-by-case basis by coordination amongst administrations at national level.

Impact from transmitting MS station transmitting towards HAPS

No systems characteristics with HAPS uplink in this frequency range were presented in Report ITU-R F.2439, so the HAPS uplink was not studied in this frequency range.

1/1.14/3.3.1.4 Compatibility of EESS (passive) and HAPS systems operating in the 6 440-6 520 MHz frequency range

HAPS-to-ground

Two studies provide consistent results, showing that in order to protect EESS (passive) the e.i.r.p. density of HAPS would have to be limited to -34.9 dB(W/200 MHz) above 35° elevation (off-nadir angle higher than 125°).

Such e.i.r.p. density limit can be met when considering the actual parabolic antenna pattern as well as the additional attenuation provided by the HAPS structure and should only apply to operation of HAPS over the oceans or over the land at a distance less than 29 km from the ocean coast line (distance between the HAPS nadir point and the ocean coast line).

1/1.14/3.3.1.5 Compatibility of RAS stations performing observations in the 6 650-6 675.2 MHz frequency range and HAPS systems operating in the 6 440-6 520 MHz frequency ranges

HAPS-to-ground

A study has addressed HAPS to HAPS ground station links in the band 6 440-6 520 MHz with regard to RAS in the band 6 650-6 675.2 MHz. The band 6 650-6 675.2 MHz is not allocated to the RAS but is included in RR No. **5.149** which urges administrations to take all practicable steps to protect RAS.

The RAS station performing observations in the band 6 650-6 675.2 MHz can be protected from HAPS downlink transmissions in the band 6 440-6 520 MHz provided that such HAPS meet unwanted emission pfd values of -210 dB(W/($m^2 \cdot 50$ kHz)) for continuum observations in the 6 650-6 675.2 MHz band at the RAS station location. This takes into account an allowable percentage of data loss of 2%. In order to avoid data loss to RAS systems, when pointing towards HAPS, RAS stations may need to implement angular cones of avoidance around HAPS by up to 1.3 degrees. These pfd values can be met by the HAPS system through a combination of unwanted emission attenuation, separation distance, or limitation of the ground station locations. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model.

1/1.14/3.3.2 Sharing and compatibility studies of HAPS systems in the 21.4-22 GHz frequency range

1/1.14/3.3.2.1 Sharing and compatibility of FS and HAPS systems operating in the 21.4-22 GHz frequency range

There were no sharing studies performed between HAPS uplink and FS in the 21.4-22 GHz frequency range.

Impact from transmitting HAPS into receiving FS stations

Several studies have shown that the following pfd mask to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the fixed service by meeting its long-term protection criteria:

| | | | |
|---------------------|--------------------------|-----|--------------------------------------|
| $0.7 \theta - 135$ | dB(W/($m^2 \cdot$ MHz)) | for | $0^\circ \leq \theta < 10^\circ$ |
| $2.4 \theta - 152$ | dB(W/($m^2 \cdot$ MHz)) | for | $10^\circ \leq \theta < 20^\circ$ |
| $0.45 \theta - 113$ | dB(W/($m^2 \cdot$ MHz)) | for | $20^\circ \leq \theta < 60^\circ$ |
| -86 | dB(W/($m^2 \cdot$ MHz)) | for | $60^\circ \leq \theta \leq 90^\circ$ |

where θ is the angles of arrival of the incident wave above the horizontal plane, in degrees.

Note that the pfd level shown above is derived from a maximum interference level of -143 dB(W/MHz) (i.e., $I/N = -10 \text{ dB}$ not to be exceeded more than 20% of the time) for the FS long-term protection criteria. The FS parameters and operational characteristics are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. Gaseous atmospheric attenuation is considered (Recommendation ITU-R SF.1395-0).

Option 1: This study made the assumption that to compensate for additional propagation impairments in the boresight of any beam of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e. suffering the rain fade) by a value only equivalent to the level of rain fading and limited to a maximum of 20 dB. This level is the difference between long-term protection criteria of $I/N = -10 \text{ dB}$ that can be exceeded for no more than 20% of the time (i.e., clear sky) and assumed short-term protection criteria of $I/N = +10 \text{ dB}$ that is never exceeded.

Option 2: Automatic transmit power control may be used to increase the e.i.r.p. density to compensate for rain attenuation to the extent that the power flux-density at the FS/MS station does not exceed the value resulting from use by HAPS station of an e.i.r.p. density meeting the above limits in the clear sky conditions.

The study showed that a HAPS system can meet such a pfd limit. To verify that the pfd in $\text{dB(W/(m}^2 \cdot \text{MHz))}$ produced by these systems HAPS do not exceed the proposed pfd mask the following equation was used:

$$pfd(\theta) = e.i.r.p. \left(\frac{dBW}{MHz} \right) (\theta) + 10 * \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

e.i.r.p.: is the nominal HAPS e.i.r.p. density level in dB(W/MHz) (dependent to the elevation angle θ);

d: is the distance between the HAPS and the ground (elevation angle dependent).

The impact of the gaseous attenuation is not included in this verification formula since it is already taken into account in this proposed pfd mask.

Impact from transmitting FS stations into receiving HAPS ground stations

Several studies show that the antennas used for both HAPS ground stations and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

1/1.14/3.3.2.2 Sharing and compatibility of MS and HAPS systems operating in the 21.4-22 GHz frequency range

For this frequency range, two aeronautical mobile service (AMS) studies were presented. No characteristics were received for other types of mobile service operation.

Impact from transmitting HAPS into receiving AMS stations

One study shows that AMS station can be protected from emission of HAPS in case the HAPS maximum aggregate e.i.r.p. per HAPS is limited to $17.5 \text{ dB(W/100 MHz)}$ in the band 21.4-21.5 GHz. However, the risk potential of interference only arises when the AMS station is located in the beam of the HAPS. Given that HAPS coverage will not extend beyond the border of the operating country, the

above interference scenario will be limited to in-country cases and protection between HAPS and AMS stations can be managed on a case-by-case basis at national level.

Another study shows HAPS systems exceeds AMS protection criterion while shifting the centre frequency of the closest channel of HAPS up to 100 MHz. With the exception of the GW component of system 2, in the band 21.4-21.5 GHz, the risk of potential interference still arises when the AMS station is located in the beam of the HAPS. The study showed that the exceedance will drop off quickly above 21.5 GHz, and therefore HAPS transmissions occupying bandwidth above 21.5 GHz should not present harmful interference into AMS.

Impact from transmitting HAPS ground stations into receiving AMS stations

One study show that that sharing is not feasible between HAPS uplink and AMS in the band 21.4-21.5 GHz.

HAPS as a system exceeds AMS protection criterion while shifting the centre frequency of the closest channel of HAPS up to 100 MHz. It is expected that the exceedance will drop off quickly above 21.5 GHz, and therefore HAPS transmissions occupying bandwidth above 21.5 GHz should not present harmful interference into AMS.

Impact from transmitting AMS stations into receiving HAPS ground stations

No studies were presented for this scenario.

Impact from transmitting AMS stations into receiving HAPS

No studies were presented for this scenario.

1/1.14/3.3.2.3 Compatibility of EESS (passive) in the adjacent band 21.2-21.4 GHz and HAPS systems operating in the 21.4-22 GHz frequency range

Impact from transmitting HAPS into EESS (passive)

Three independent studies show that compatibility between EESS (passive) sensors and HAPS downlinks is feasible provided that the unwanted emission e.i.r.p. density in dB(W/100 MHz) from the HAPS in the band 21.2-21.4 GHz is below the following values:

$$\begin{array}{lll} -0.76 \theta - 9.5 & \text{dB(W/100 MHz)} & \text{for } -4.53^\circ \leq \theta < 35.5^\circ \\ -36.5 & \text{dB(W/100 MHz)} & \text{for } 35.5^\circ \leq \theta \leq 90^\circ \end{array}$$

where:

θ is the elevation angle ($^\circ$) at the platform height.

This e.i.r.p. density mask would cover all the transmissions from the HAPS (i.e. towards CPE and/or gateways) that could also have emissions in the direction of the EESS satellite. No apportionment of the EESS (passive) protection criterion was considered.

The study shows that a HAPS system can meet such an e.i.r.p. density limit.

Impact from transmitting HAPS ground stations into EESS (passive)

One study that considered interference only from HAPS CPEs shows that the EESS (passive) sensors would be protected from HAPS CPE uplinks if the unwanted emission input power of the CPE in the band 21.2-21.4 GHz is limited to -68.5 dB(W/100 MHz) (equivalent to an e.i.r.p. density limit of -28.3 dB(W/100 MHz) into the 21.2-21.4 GHz band). Another study that examined only HAPS GW uplinks indicated that the EESS (passive) would be protected if the unwanted emission input power of the GW in the band 21.2-21.4 GHz is limited to -53 dB(W/100 MHz). If HAPS CPE and GW use the same spectrum, and are located within the service area, further

suppression of the out-of-band emissions of both CPE and GW would be necessary due to aggregation.

1/1.14/3.3.2.4 Compatibility of EESS (passive) in the band 22.21-22.5 GHz and HAPS systems operating in the 21.4-22 GHz frequency range

Impact from transmitting HAPS into EESS (passive)

Three independent studies show that compatibility between EESS (passive) sensors and HAPS downlinks is feasible provided that the unwanted emission e.i.r.p. density in dB(W/100 MHz) from the HAPS in the band 22.21-22.5 GHz is below the following values:

$$\begin{array}{llll} -0.76 \theta - 9.5 & \text{dB(W/100 MHz)} & \text{for} & -4.53^\circ \leq \theta < 35.5^\circ \\ -36.5 & \text{dB(W/100 MHz)} & \text{for} & 35.5^\circ \leq \theta \leq 90^\circ \end{array}$$

where θ is the elevation angle ($^\circ$) at the HAPS height.

This e.i.r.p. mask would cover all the transmissions from the HAPS (i.e. towards CPE and/or gateways) that could also have emissions in the direction of the EESS satellite. No apportionment of the EESS (passive) protection criterion was considered.

The study shows that a HAPS system can meet such an e.i.r.p. density limit.

Impact from transmitting HAPS ground stations into EESS (passive)

One study indicates that, in order to protect EESS (passive), the unwanted emission e.i.r.p. density of HAPS CPE should be below -33.4 dB(W/100 MHz), and the unwanted emission e.i.r.p. density of HAPS gateways should be below -29.6 dB(W/100 MHz). This is assuming 5 dB apportionment to account for interference from other services and 3 dB to account for interference from the CPE and GW to the EESS (passive) protection criterion.

1/1.14/3.3.2.5 Compatibility of RAS in the 22.21-22.5 GHz frequency range and HAPS systems operating in the 21.4-22 GHz frequency range

Impact from transmitting HAPS ground stations into RAS

RAS stations performing observations in the band 22.21-22.5 GHz can be protected from HAPS CPE and GW uplink transmissions in the band 21.4-22 GHz provided that those stations meet an unwanted emission pfd value of -146 dB(W/(m² · 290 MHz)) for continuum observations and -162 dB(W/(m² · 250 kHz)) for spectral line observations in the 22.21-22.5 GHz band at the RAS station location at a height of 50 m. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model. These pfd values can be met by the HAPS system through a combination of unwanted emission attenuation, separation distance or limitation to the uplink beam pointing direction. The possibilities for placement of HAPS ground stations may be affected by their situation with respect to the RAS station and HAPS.

Impact from transmitting HAPS into RAS

Studies have shown that the RAS station performing observations in the band 22.21-22.5 GHz can be protected from HAPS downlink transmissions in the band 21.4-22 GHz provided that such HAPS meet unwanted emission pfd values of -176 dB(W/(m² · 290 MHz)) for continuum observations and -192 dB(W/(m² · 250 kHz)) for spectral line observations in the 22.21-22.5 GHz band at the RAS station location. This takes into account an allowable percentage of data loss of 2%. In order to avoid data loss to RAS systems, when pointing towards HAPS, RAS stations may need to implement angular cones of avoidance around HAPS by up to 1.3 degrees. These pfd values can be met by the HAPS system through a combination of unwanted emission attenuation,

separation distance, or limitation of the ground station locations. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model.

The following verification formula was used:

$$pfd = e.i.r.p.\text{-nominal clear sky}(Az, \theta) + Att_{618p=2\%} + 10 \cdot \log_{10} \left(\frac{1}{4\pi d^2} \right) - GasAtt(\theta)$$

where:

e.i.r.p.-nominal clear sky is the nominal unwanted emission e.i.r.p. density towards the RAS station at which the HAPS station operates under clear sky condition in dB(W/290 MHz) for continuum observations or dB(W/250 kHz) for spectral line observations in the RAS band;

Az: is the azimuth from the HAPS toward the RAS station;

θ: is the elevation angle at the HAPS towards the RAS station;

Att_{618p=2%}: is the attenuation from Recommendation ITU-R P.618 corresponding to *p* = 2% of the time at the radio astronomy location. It is being added in the equation above to take into account the increased unwanted emission e.i.r.p. density using automatic transmit power control with an amount equivalent to the level of rain attenuation for 2% of the time;

d: is the separation distance in m between the HAPS platform;

GasAtt(θ): is gaseous attenuation for elevation *θ* (Rec. ITU-R SF.1395).

1/1.14/3.3.3 Sharing and compatibility studies of HAPS systems in the 24.25-27.5 GHz frequency range

1/1.14/3.3.3.1 Sharing and compatibility study of FS and HAPS systems operating in the 25.25-27.5 GHz frequency range

Impact from transmitting HAPS into receiving FS stations

In the bands 24.25-27.5 GHz, Report ITU-R F.2439 only provides characteristics for systems involving HAPS to HAPS CPE stations and does not include characteristics from HAPS to HAPS gateway station. However, the pfd mask given below is only derived from the FS protection criteria and parameters and other additional losses.

Two studies have shown that the following pfd mask to be applied under clear-sky conditions at the surface of the Earth for a single HAPS, ensures the protection of the FS by meeting its long-term protection criteria:

| | | | |
|-----------------|------------------------------|-----|---------------|
| 0.39 θ – 132.12 | dB(W/(m ² · MHz)) | for | 0° ≤ θ < 13° |
| 2.715 θ – 162.3 | dB(W/(m ² · MHz)) | for | 13° ≤ θ < 20° |
| 0.45 θ – 117 | dB(W/(m ² · MHz)) | for | 20° ≤ θ < 60° |
| –90 | dB(W/(m ² · MHz)) | for | 60° ≤ θ ≤ 90° |

where *θ* is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the pfd level shown above is derived from a maximum interference level of –146 dB(W/MHz) (i.e. *I/N* = –10 dB not to be exceeded more than 20% of the time) for the FS long-term protection criteria. The FS parameters and operational characteristics are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. Gaseous atmospheric attenuation is considered (Recommendation ITU-R SF.1395-0).

Option 1: This study made the assumption that to compensate for additional propagation impairments in the boresight of any beam of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e. suffering the rain fade) by a value only equivalent to the level of rain fading and limited to a maximum of 20 dB. This level is the difference between long-term protection criteria of $I/N = -10$ dB that can be exceeded for no more than 20% of the time (i.e. clear sky) and assumed short-term protection criteria of $I/N = +10$ dB that is never exceeded.

Option 2: Automatic transmit power control may be used to increase the e.i.r.p. density to compensate for rain attenuation to the extent that the power flux-density at the FS/MS station does not exceed the value resulting from use by HAPS station of an e.i.r.p. density meeting the above limits in the clear sky conditions.

The study showed that a HAPS system can meet such a pfd limit. To verify that the pfd in $\text{dB(W/(m}^2 \cdot \text{MHz))}$ produced by HAPS does not exceed the proposed pfd mask, the following equation was used:

$$pfd(\theta) = e.i.r.p.(\theta) + 10 * \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

e.i.r.p.: is the nominal HAPS e.i.r.p. density level in dB(W/MHz) (dependent to the elevation angle θ);

d: is the distance between the HAPS and the ground (elevation angle dependent).

The impact of the gas attenuation is not included in this verification formula since it is already taken into account in this proposed pfd mask.

Impact from transmitting HAPS ground station into receiving FS stations

The study performed two different percentages of time, i.e., 20% and 0.01%, using propagation model Recommendation ITU-R P.452-16. The statistical single-entry study showed that the range of separation distances between FS station and HAPS ground station receiver is between approximately 0 and 20 km as well as 0 and 5 km respectively, depending on the probability.

Similar analysis showed that the range of separation distances between two FS stations are between approximately 0 and 32 km as well as 0 and 40 km for the same probabilities. Therefore, the study suggested that the protection between HAPS ground stations and FS stations can be managed on a case-by-case basis by coordination amongst administrations.

Impact from transmitting FS stations into receiving HAPS ground stations

Several studies show that the antennas used for both HAPS ground stations and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

Impact from transmitting FS stations into receiving HAPS

No studies were presented for this scenario.

1/1.14/3.3.3.2 Sharing and compatibility study of MS and HAPS systems operating in the 24.25-27.5 GHz frequency range

Impact from transmitting HAPS into receiving MS stations

In the bands 24.25-27.5 GHz, report ITU-R F.2439 only provides characteristics for systems involving HAPS to HAPS CPE stations and does not include characteristics from HAPS to HAPS gateway station. However, the pfd mask given below is only derived from the MS protection criteria and parameters and other additional losses.

Several studies have shown that the following pfd mask to be applied at the surface of the Earth, ensures the protection of the MS receivers:

for MS base station receiver:

$$\begin{array}{llll} 0.95 \theta - 114 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 0^\circ \leq \theta < 20^\circ \\ -95 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 20^\circ \leq \theta \leq 90^\circ \end{array}$$

for MS user equipment receiver:

$$\begin{array}{llll} 0.6 \theta - 112 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 0^\circ \leq \theta < 20^\circ \\ -100 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 20^\circ \leq \theta \leq 90^\circ \end{array}$$

for MS user equipment and base station (combination of the two above pfd masks):

$$\begin{array}{llll} 0.95 \theta - 114 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 0^\circ \leq \theta < 5.7^\circ \\ 0.6 \theta - 112 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 5.7^\circ \leq \theta \leq 20^\circ \\ -100 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 20^\circ \leq \theta \leq 90^\circ \end{array}$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that for the pfd level used in the study above, polarization and gaseous atmospheric (Recommendation ITU-R SF.1395-0) losses are considered. In addition, body loss is considered for the user equipment pfd level calculation.

Option 1: To compensate for additional propagation impairments in the boresight of any beam of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e. suffering the rain fade) by a value only equivalent to the level of rain fading.

Option 2: Automatic transmit power control may be used to increase the e.i.r.p. density to compensate for rain attenuation to the extent that the power flux density at the FS/MS station does not exceed the value resulting from use by HAPS station of an e.i.r.p. density meeting the above limits in the clear sky conditions. The study showed that a HAPS system can meet such a pfd limit. To verify that the pfd in dB(W/(m² · MHz)) produced by a HAPS of these two systems does not exceed the proposed pfd mask, the following equation was used:

$$pfd(\theta) = e.i.r.p. \frac{dBW}{MHz}(\theta) + 10 \cdot \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

e.i.r.p.: is the nominal HAPS e.i.r.p. density level in dB(W/MHz) (dependent to the elevation angle);

d: is the distance between the HAPS and the ground (elevation angle dependent).

The impact of the gas attenuation, body loss (for user equipment), and polarization loss are not included in the verification formula above since it is already taken into account in the pfd mask.

One study has shown that the following pfd mask to be applied at the surface of the Earth, should be feasible to protect the IMT-2020 from HAPS systems. In the case that IMT-2020 system is coexisted with HAPS and FS in the same geographical area, 3 dB apportionments should be considered additionally to the pfd mask below to ensure this protection.

$$\begin{array}{lll} 0.6 \theta - 114 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 0^\circ \leq \theta < 12^\circ \\ -107 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 12^\circ \leq \theta \leq 90^\circ \end{array}$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the attenuations are not considered in the pfd mask above, but in the verification formula.

In this study, the verification formula for aggregated interference, from multiple beams of single HAPS, with the proposed pfd mask, the following equations were used:

$$\begin{aligned} pfd_b(\theta) &= P^H(b) + G_{tx}^H(\varphi(b)) - 10 \log \left(4\pi d_{(\theta)}^2 \right) - L_{pol} - L_{body} - AL(\theta) \\ pfd(\theta) &= 10 \log \left(\sum_{b=1}^{b_n} 10^{pfd_b(\theta)/10} \right) \end{aligned}$$

where:

Option 1: $P^H(b)$: transmit power of beam b generated by the HAPS dB(W/MHz). Transmit power of the HAPS downlink under clear sky condition is nominal e.i.r.p. density, transmit power of the HAPS downlink under raining condition is maximum e.i.r.p. density;

Option 2: $P^H(b)$: Transmit power of beam b generated by the HAPS dB(W/MHz). Transmit power of the HAPS downlink under clear sky condition is nominal e.i.r.p.;

$\varphi(b)$: discrimination angle (degrees) at the HAPS between the pointing direction of a HAPS spot beam b and the MS receiver;

$G_{tx}^H(\theta(b))$: transmitter antenna pattern gain (dBi) of the HAPS for off-axis angle $\varphi(b)$;

$d(\theta)$: distance (m) between the MS receiver and the HAPS;

$AL(\theta)$: atmospheric loss (dB) between the MS receiver and the HAPS, based on Recommendation ITU-R P.619-3;

L_{pol} : polarization discrimination in dB (3 dB);

L_{body} : body loss in dB (4 dB), only applied when $\theta \geq 12^\circ$;

b_n : number of co-frequency beams.

In addition, assuming a worst-case scenario of main-beam coupling between the two systems, this study proposed that in order to meet the protection of IMT-2020 stations in the HAPS-to-ground link, HAPS e.i.r.p. should be reduced by 4.8 dB or a protection distance between HAPS nadir and IMT-2020 stations of 36.4 km should be applied. When considering 3 dB interference apportionment, the transmitter e.i.r.p. should be reduced by 7.8 dB, or a protection distance between HAPS nadir and IMT-2020 stations of 50.7 km should be applied. Another study shows that for the HAPS \rightarrow CPE (downlink) case, the following pfd level applies:

for MS base station receiver:

$$-100.4 \text{ dB(W/(m}^2 \cdot \text{MHz))}$$

for MS user equipment receiver:

$$-104.1 \text{ dB(W/(m}^2 \cdot \text{MHz))}$$

considering the total aggregated interference that is generated by a single 4-beam HAPS into the stations of an IMT network that is deployed within the HAPS coverage area. Simulation results from this study indicate that pfd limits of the IMT stations is met for the modelled network with a margin of at least 5.0 dB for one HAPS considered: only suburban deployments were considered for this scenario.

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

In addition, based on the information liaised for the required pfd level at the receiver antenna port to protect the MS, expressed in dBm/m² in 1 Hz, the following calculation formula was used to compute the appropriate pfd limit to protect the mobile service:

$$pfd_{MS} \text{ (in dBm/m}^2 \text{ in 1 Hz)} = -6 \text{ dB (protection criteria for MS)} + 10 \log(4\pi/\lambda^2) - G(\theta, \phi) - 174 \text{ dBm/Hz} + F$$

in which:

λ = wavelength, m;

$G(\theta, \phi)$ = MS receive antenna gain, dBi;

F = MS receiver noise figure, dB.

Based on applying the formula above and calculated according to receiver antenna gain pattern and noise figure provided, the following limits are necessary to protect the mobile service:

$$\begin{aligned} -113.3 & \text{ dB(W/(m}^2 \cdot \text{MHz)) for } 0^\circ \leq \theta \leq 4^\circ \\ -113.3 + 1.2 (\theta - 4) & \text{ dB(W/(m}^2 \cdot \text{MHz)) for } 4^\circ < \theta \leq 9^\circ \\ -107.3 & \text{ dB(W/(m}^2 \cdot \text{MHz)) for } 9^\circ < \theta \leq 90^\circ \end{aligned}$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

Impact from transmitting HAPS ground stations into receiving MS stations

The study performed two different percentages of time, i.e. 20% and 0.01%, using propagation model Recommendation ITU-R P.452-16. The statistical single-entry study showed that the range of separation distances between MS station and HAPS ground station receiver is between approximately 0 and 5 km as well as 0 and 5 km respectively, depending on the probability.

Similar analysis showed that the range of separation distances between MS and FS stations are between approximately 0 and 22 km as well as 0 and 40 km for the same probabilities. Therefore, the study suggested that the protection between HAPS ground stations and MS stations can be managed on a case-by-case basis by coordination amongst administrations.

One study has shown that the following pfd mask to be applied under clear-sky conditions, at the surface of the Earth, ensures the protection of the MS receivers from a single HAPS ground station emission:

for the MS base station receiver:

$$\begin{aligned} 1.14 \theta - 111 & \text{ dB(W/(m}^2 \cdot \text{MHz)) for } 0^\circ \leq \theta < 12^\circ \\ -97.3 & \text{ dB(W/(m}^2 \cdot \text{MHz)) for } 12^\circ \leq \theta < 40^\circ \end{aligned}$$

for the MS user equipment receiver:

$$-103.9 \text{ dB(W/(m}^2 \cdot \text{MHz)) for } 0^\circ < \theta < 60^\circ$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

The impact of the gas attenuation, body loss (for user equipment), and polarization loss are not included in the pfd mask since it is already taken into account in the verification formula.

Note that such pfd mask could be used for coordination between administrations.

The study showed that a HAPS ground station can meet such a pfd limit. To verify that the pfd in $\text{dB(W/(m}^2 \cdot \text{MHz))}$ produced by HAPS ground station does not exceed the proposed pfd mask, the following equation was used:

$$pfd(\theta) = e.i.r.p.(\theta) - 10 \cdot \log_{10} \left(\frac{\lambda^2}{4\pi} \right) - P(d)_{452} - L_{pol} - B_{loss} - C_{loss}$$

where:

$e.i.r.p.$: is the nominal HAPS e.i.r.p. density level in dB(W/MHz) (dependent to the elevation angle θ);

d : is the distance between the HAPS and the ground (elevation angle dependent);

L_{pol} : is the polarization discrimination in dB;

C_{loss} : is the clutter loss (Recommendation ITU-R P.2108-0) in dB;

$P(d)_{452}$: is the propagation loss based on Recommendation ITU-R P.452-16 in dB. The percentage of time to be used when applying this recommendation is 0.1%;

B_{loss} : is the body loss (dB), only applicable to the user equipment.

Another study shows that the case CPE \rightarrow HAPS (uplink) indicates that the pfd of $(-128.2 \text{ dB(W/(m}^2 \cdot \text{MHz))})$ can be met for 99.99% IMT base stations with a margin of at least 18.2 dB from the pfd mask $(-110.0 \text{ dB(W/(m}^2 \cdot \text{MHz))})$ proposed by the study. For the case GW \rightarrow HAPS (uplink) indicate that the pfd of $(-149.4 \text{ dB(W/(m}^2 \cdot \text{MHz))})$ can be met for 99.99% IMT user equipment with a margin of at least 39.4 dB from the pfd mask $(-110.0 \text{ dB(W/(m}^2 \cdot \text{MHz))})$ proposed in the study for one of the six HAPS systems. This study considers ubiquitous deployment of IMT networks and HAPS gateways for suburban deployments for the one HAPS system considered.

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

In addition, based on the information liaised for the required pfd level at the receiver antenna port to protect the MS, expressed in dBm/m^2 in 1 Hz, the following calculation formula was used to compute the appropriate pfd limit to protect the mobile service:

$$pfd_{MS} \text{ (in dBm/m}^2 \text{ in 1 Hz)} = -6 \text{ dB (protection criteria for MS)} + 10 \log(4\pi/\lambda^2) - G(\theta, \phi) - 174 \text{ dBm/Hz} + F$$

in which:

λ = wavelength, m;

$G(\theta, \phi)$ = MS receive antenna gain, dBi;

F = MS receiver noise figure, dB.

Based on applying the formula above and calculated according to receiver antenna gain pattern and noise figure provided, the following limits are necessary to protect the mobile service:

$$-113.3 \quad \text{dB(W/(m}^2 \cdot \text{MHz))} \quad \text{for } 0^\circ \leq \theta \leq 4^\circ$$

$$-113.3 + 1.2(\theta - 4) \quad \text{dB(W/(m}^2 \cdot \text{MHz))} \quad \text{for } 4^\circ < \theta \leq 9^\circ$$

$$-107.3 \quad \text{dB(W/(m}^2 \cdot \text{MHz)) for } 9^\circ < \theta \leq 90^\circ$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

Impact from transmitting MS stations into receiving HAPS ground stations

No studies were presented for this scenario.

Impact from transmitting MS stations into receiving HAPS

No studies were presented for this scenario.

1/1.14/3.3.3.3 Sharing and compatibility study of RNS and HAPS systems operating in the 24.25-24.65 GHz frequency range

No RNS systems have been identified using this band nor RNS technical characteristics have been made available. Therefore, no sharing and compatibility studies have been performed.

1/1.14/3.3.3.4 Sharing and compatibility study of RLSS and HAPS systems operating in the 24.65-24.75 GHz frequency range

No RLSS systems have been identified using this band nor RLSS technical characteristics have been made available. Therefore, no sharing and compatibility studies have been performed.

1/1.14/3.3.3.5 Sharing and compatibility study of ISS and HAPS systems operating in the 24.45-24.75 and 25.25-27.5 GHz

Impact from transmitting HAPS ground stations into receiving ISS space station (25.25-27 GHz)

One study was performed on sharing between HAPS ground stations and ISS in the 25.25-27.0 GHz band. This study examined interference HAPS uplinks into data relay satellite (DRS) inter-orbit return links. Calculations were performed to determine the compliance of HAPS ground stations with the Recommendation ITU-R SA.1155 protection criteria which defines a maximum e.i.r.p. density limit toward the ISS satellite of 13.5 dB(W/MHz). The study has showed that HAPS system can meet such a pfd limit.

Another study shows that when each HAPS ground station's maximum e.i.r.p. density is arbitrarily fixed to 0 dB(W/MHz), the maximum I_{agg}/N for 0.1% is -25.3 dB which is 15.3 dB lower than the protection criteria. Therefore, when considering an apportionment factor of 3 dB, the e.i.r.p. density per HAPS ground station should be limited to 12.3 dB(W/MHz) under clear-sky conditions. During periods of rain, the e.i.r.p. density limits for clear sky conditions can be exceeded to the level needed to compensate for rain fade, up to 20 dB.

Another study examined interference from HAPS uplinks into data relay satellite (DRS) inter-orbit return links based on information in Recommendation ITU-R SA.1414-2. Limits for off-axis e.i.r.p. density of HAPS emissions in the DRS direction were calculated (0.5 dB(W/MHz) for most sensitive DRS) which would meet DRS interference criterion, provided in Recommendation ITU-R SA.1155-2. It should be noted that this limit is to protect GSO ISS satellites assuming single-entry interference from one ground station. Real DRS satellite position (assuming possible orbit inclination between -5 degrees and $+5$ degrees) should be considered when referring to DRS direction. To further ensure compatibility by avoiding interference, these limits should apply to extended GSO arc with width of 10 degrees. It should be noted that this value is to protect GSO ISS satellites assuming single entry interference from one ground station and e.i.r.p. density limit should be adjusted accordingly when considering aggregate interference from a number of HAPS ground stations and other sources of interference (i.e. possible usage of 25.25-27.5 GHz band by IMT-2020 systems which will lead to introduction of some apportionment value.)

Impact from transmitting HAPS into receiving ISS non-GSO space station (24.45-24.75 GHz)

An aggregate study was performed on sharing between HAPS and non-GSO ISS in the 24.45-24.75 GHz frequency band. This study concludes that the e.i.r.p. density from a single HAPS should be limited to -19.9 dB(W/MHz) above 85.5-degree HAPS off-nadir pointing in order to protect the ISS non-GSO systems. The study has showed that HAPS system can meet such a pfd limit.

Impact from transmitting HAPS ground station into receiving ISS space station (24.45-24.75 GHz)

A study shows that the e.i.r.p. density from a HAPS ground station should be limited in the band 24.45-24.75 GHz to protect ISS non-GSO. In first approximation the limit could be set at 10.2 dB(W/MHz) under clear-sky conditions (7.2 dB(W/MHz) per polarization). During periods of rain, the e.i.r.p. density limits for clear-sky conditions can be exceeded to the level needed to compensate for rain fade, up to 20 dB.

Impact from transmitting HAPS into receiving ISS GSO space station (24.25-27.5 GHz)

Several aggregate studies were performed on sharing between HAPS and GSO ISS operating over the 24.25-27.5 GHz frequency range. These studies conclude that the e.i.r.p. density from a single HAPS should be limited to -70.7 dB(W/Hz) above 85.5-degree HAPS off-nadir pointing in order to protect the ISS systems.

1/1.14/3.3.3.6 Sharing and compatibility study of FSS (Earth-to-space) and HAPS systems (HAPS-to-ground) operating in the 24.75-25.25 and 27-27.5 GHz frequency range

Only the HAPS-to-ground direction in the 24.75-25.25 GHz and 27-27.5 GHz frequency bands was considered so as to be in the opposite direction of transmission to FSS (Earth-to-space).

Impact from transmitting HAPS into receiving FSS space station

Two studies considered the potential emissions into the FSS space station receiver. The studies included assessment for satellite receiver I/N values of -10.5 dB. No assumption on the percentage of time associated to that interference level was needed.

The analyses performed show that HAPS system downlink emissions will not impact the FSS receivers if the e.i.r.p. density per HAPS transmitter is limited to -9.1 dB(W/MHz) for off-nadir angle higher than 85.5° .

One study undertakes aggregated interference simulations from HAPS ground station and HAPS towards FSS GSO space station in the 24.25-27.5 GHz frequency band.

The results of this study show that for the HAPS system, the aggregate I/N level will always meet the assumed FSS satellite receiver I/N values of -10 dB (20% of time) and -6 dB (0.6% of time), and 0 dB (0.02% of time), based on the assumptions and input parameters used in the study.

Impact from transmitting FSS earth station into receiving HAPS ground station

Two studies considered the potential emissions from FSS earth stations received by the HAPS CPE receiver. These analyses also compared the level of emissions at the HAPS CPE receiver to those that would be received by an FS receiver.

It was shown that the required separation distance between HAPS ground terminal and FSS earth station is much less compared to FSS earth station and FS terminal. This single-entry analysis was presented only to show that HAPS can coexist with FSS.

This study did not include consideration of potential deployment density of either FSS earth stations or HAPS gateway or CPE receivers. The study was based on a statistical single-entry analysis and did not take into account deployment densities. It should be noted that the coexistence feasibility could also be dependent on the expected deployment of FSS earth stations and HAPS ground stations.

One study focused on the sharing and compatibility of FSS earth stations interference into HAPS GW in the frequency band 24.25-27.5 GHz. The study assumed two cases of interference protection criteria of I/N of -10 dB and $+10$ dB not be exceeded more than 20% and 0.01% of time, respectively. The results for worst case antenna pointing scenarios and specific terrain assumptions indicate that HAPS GW requires separation distances, from transmitting FSS earth stations which vary from 1.2 km to 59.9 km assuming a HAPS I/N of -10 dB for 20% time and from 0.71 km to 27 km assuming a HAPS I/N of $+10$ dB for 0.01% time for the band 24.25-27.5 GHz. The study assumed a worst-case scenario where the FSS earth station and HAPS GW are always pointing towards each other (no azimuth discrimination).

The study was based on a statistical single-entry analysis and did not take into account deployment densities. It should be noted that the coexistence feasibility could also be dependent on the expected deployment of FSS earth stations and HAPS ground stations.

1/1.14/3.3.3.7 Sharing and compatibility study of EESS/SRS and HAPS systems operating in the 25.5-27 GHz frequency range

Impact from transmitting HAPS and/or HAPS ground stations into receiving EESS/SRS stations

Studies have shown that in order to ensure the protection of in-band SRS/EESS from the HAPS or from the HAPS ground station in the band 25.5-27.0 GHz, the pfd of a HAPS should not exceed the sets of values provided below. The pfd limits applied to HAPS are established to be met under clear-sky conditions 100% of the time, at the location of the SRS/EESS earth station. For the case of the HAPS ground station towards an SRS/EESS earth station path case there will be a need to consider HAPS and SRS/EESS antenna heights in order to apply attenuation using Recommendation ITU-R P.452-16, using the following percentages: 1) SRS: 0.001%; 2) EESS non-GSO: 0.005%; 3) EESS GSO: 20%.

The SRS interference protection criteria are derived from Recommendation ITU-R SA.609-2. The EESS non-GSO interference protection criteria are derived from the Recommendation ITU-R SA.1027-5 short-term criterion. The EESS GSO interference protection criteria are derived from the Recommendation ITU-R SA.1161-2 long-term criterion. The EESS and SRS pfd values calculated are shown below, which should be considered and acted upon, as appropriate.

| | | |
|---------------------------------------|------------------------------|---|
| – SRS: | | |
| $-138.8 + 25 * \log_{10}(5 - \theta)$ | dB(W/(m ² · MHz)) | for $0^\circ \leq \theta < 4.925^\circ$ |
| -166.9 | dB(W/(m ² · MHz)) | for $4.925^\circ \leq \theta < 5^\circ$ |
| -183.9 | dB(W/(m ² · MHz)) | for $5^\circ \leq \theta < 90^\circ$ |

Where these equations are based on the SRS antenna gain towards the HAPS or the HAPS ground station following the Recommendation ITU-R SA.509-3 antenna pattern for an angle of arrival θ of the interfering signal above the local horizontal plane at the SRS antenna.

| | | |
|---------------------------------------|------------------------------|---|
| – EESS – non-GSO: | | |
| $-108.8 + 25 * \log_{10}(3 - \theta)$ | dB(W/(m ² · MHz)) | for $0^\circ \leq \theta < 2.808^\circ$ |
| -126.7 | dB(W/(m ² · MHz)) | for $2.808^\circ \leq \theta < 3^\circ$ |

$$-143.4 \quad \text{dB(W/(m}^2 \cdot \text{MHz))} \quad \text{for} \quad 3^\circ \leq \theta < 90^\circ$$

Where these equations are based on the EESS antenna gain towards the HAPS or the HAPS ground station following RR Appendix 8, Annex 3 antenna pattern for an angle of arrival θ of the interfering signal above the local horizontal plane at the EESS antenna.

– **EESS – GSO:**

$$-140.5 + 25 * \log_{10}(3 - \theta) \text{ dB(W/(m}^2 \cdot \text{MHz))} \quad \text{for} \quad 0^\circ \leq \theta < 2.808^\circ$$

$$-158.4 \quad \text{dB(W/(m}^2 \cdot \text{MHz))} \quad \text{for} \quad 2.808^\circ \leq \theta < 3^\circ$$

$$-178.5 \quad \text{dB(W/(m}^2 \cdot \text{MHz))} \quad \text{for} \quad 3^\circ \leq \theta < 90^\circ$$

Where these equations are based on the EESS antenna gain towards the HAPS or the HAPS ground station following RR Appendix 8, Annex 3 antenna pattern for an angle of arrival θ of the interfering signal above the local horizontal plane at the EESS antenna.

1/1.14/3.3.3.8 Compatibility study of RAS in the 23.6-24 GHz band and HAPS systems operating in the 24.25-27.5 GHz frequency range

Impact from transmitting HAPS ground station into RAS

Studies have shown that the RAS station performing observations in the band 23.6-24 GHz can be protected from HAPS ground station uplink transmissions in the band 24.25-27.5 GHz provided that those stations meet an unwanted emission pfd value of $-147 \text{ dB(W/(m}^2 \cdot 400 \text{ MHz))}$ for continuum observations and $-161 \text{ dB(W/(m}^2 \cdot 250 \text{ kHz))}$ for spectral line observations in the 23.6-24 GHz band at the RAS station location at a height of 50 m.

These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model. These pfd values can be met by the HAPS system through a combination of unwanted emission attenuation, separation distance or limitation to the uplink beam pointing direction. The possibilities for placement of HAPS ground stations may be affected by their situation with respect to the RAS station and HAPS.

Impact from transmitting HAPS into RAS

Studies have shown that the RAS station performing observations in the band 23.6-24 GHz can be protected from HAPS downlink transmissions in the band 24.25-27.5 provided that such HAPS meet unwanted emission pfd values of $-177 \text{ dB(W/(m}^2 \cdot 400 \text{ MHz))}$ for continuum observations and $-191 \text{ dB(W/(m}^2 \cdot 250 \text{ kHz))}$ for spectral line observations in the 23.6-24 GHz band at the RAS station location. This takes into account an allowable percentage of data loss of 2%. In order to avoid data loss to RAS systems, when pointing towards HAPS, RAS stations may need to implement angular cones of avoidance around HAPS by up to 1.3 degrees. These pfd values can be met by the HAPS system through a combination of unwanted emission attenuation, separation distance, or limitation of the ground station locations. These pfd density values shall be verified considering a percentage of time of 2% in the relevant propagation model.

To verify the compliance, the following formula was used:

$$pfd = e.i.r.p.\text{-nominal clear sky}(Az, \theta) + Att_{618_{p=2\%}} + 10 * \log_{10} \left(\frac{1}{4\pi d^2} \right) - GasAtt(\theta)$$

where:

e.i.r.p.-nominal clear sky is the nominal unwanted emission e.i.r.p. density towards the RAS station at which the HAPS station operates under clear-sky condition in dB(W/400 MHz) for continuum observations or dB(W/250 kHz) for spectral line observations in the RAS band;

- Az : is the azimuth from the HAPS toward the RAS station;
- θ : is the elevation angle at the HAPS towards the RAS station;
- $Att_{618p=2\%}$: is the attenuation from Recommendation ITU-R P.618 corresponding to $P = 2\%$ of the time at the radio astronomy location. It is being added in the equation above to take into account the increased unwanted emission e.i.r.p. density using automatic transmit power control with an amount equivalent to the level of rain attenuation for 2% of the time;
- d : is the separation distance in m between the HAPS and the RAS stations;
- $GasAtt(\theta)$: is gaseous attenuation for elevation θ (Rec. ITU-R SF.1395).

1/1.14/3.3.3.9 Compatibility study of EESS (passive) service in the 23.6-24 GHz band and HAPS systems operating in the 24.25-27.5 GHz frequency range

Impact from transmitting HAPS into EESS (passive)

Three independent studies show that compatibility between EESS (passive) and HAPS downlinks is feasible provided that the unwanted emission e.i.r.p. density in dB(W/200 MHz) from the HAPS in the band 23.6-24 GHz is below the following values:

$$\begin{array}{ll} -0.7714 \theta - 16.5 & \text{dB(W/200 MHz)} \quad \text{for } -4.53^\circ \leq \theta < 35^\circ \\ -43.5 & \text{dB(W/200 MHz)} \quad \text{for } 35^\circ \leq \theta \leq 90^\circ \end{array}$$

where θ is the elevation angle ($^\circ$) at the HAPS height.

This e.i.r.p. mask would cover all the transmissions from the HAPS (i.e. towards CPE and/or gateways) that could also have emissions in the direction of the EESS satellite. An apportionment of 5 dB of the EESS (passive) protection criterion was considered.

The study shows that a HAPS system can meet such an e.i.r.p. density limit.

Impact from transmitting HAPS ground stations into EESS (passive)

One study indicates that, in order to protect EESS (passive), the unwanted emission e.i.r.p. density of HAPS CPE should be below -46 dB(W/200 MHz), and the unwanted emission e.i.r.p. density of HAPS GW should be below -39.9 dB(W/200 MHz). This is assuming 5 dB apportionment to account for interference from other services and 3 dB to account for interference from the CPE and GW to the EESS (passive) protection criterion.

Another study considered only CPE uplinks and shows that an unwanted emission e.i.r.p. density limit of -36 dB(W/200 MHz) would be required in order to protect EESS (passive) in the band 23.6-24 GHz. This is assuming 5 dB apportionment of the EESS (passive) protection criterion. This study considered all types of EESS sensors for this frequency band.

An additional study considered only GW uplinks and shows that an unwanted emission e.i.r.p. density limit of -25 dB(W/200 MHz) would be required in order to protect EESS (passive) in the band 23.6-24 GHz. This is assuming 5 dB apportionment of the EESS (passive) protection criterion. This study considered all types of EESS sensors for this frequency band.

For the two last studies, it may be necessary to consider an additional apportionment factor of 3 dB for systems that plan to operate both GW and CPE in the same frequency range, since the EESS (passive) sensors would potentially face the aggregate interference of both types of stations.

It should be noted that HAPS in the band 24.25-25.25 GHz being limited to the HAPS-to-ground direction would be in the opposite direction of transmission to EESS (passive) service operating in the 23.6-24 GHz band.

1/1.14/3.3.4 Sharing and compatibility studies of HAPS systems in the 27.9-28.2 GHz and 31-31.3 GHz frequency ranges

1/1.14/3.3.4.1 Sharing and compatibility of FS and HAPS systems operating in the 27.9-28.2 GHz and 31-31.3 GHz frequency ranges

1/1.14/3.3.4.1.1 Sharing and compatibility of FS and HAPS systems operating in the 27.9-28.2 GHz frequency range

Impact from transmitting HAPS into receiving FS stations

Two studies have shown that the following pfd mask, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the FS from a single HAPS by meeting its long-term protection criteria:

| | | | |
|----------------------|------------------------------|-----|--------------------------------------|
| $3\theta - 140$ | dB(W/(m ² · MHz)) | for | $0^\circ \leq \theta < 10^\circ$ |
| $0.57\theta - 115.7$ | dB(W/(m ² · MHz)) | for | $10^\circ \leq \theta < 45^\circ$ |
| -90 | dB(W/(m ² · MHz)) | for | $45^\circ \leq \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the pfd level shown above is derived from a maximum interference level of -146 dB(W/MHz) (i.e. $I/N = -10$ dB not to be exceeded more than 20% of the time) for the FS long-term protection criteria. The FS parameters and operational characteristics are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. Gaseous atmospheric attenuation is considered (Recommendation ITU-R SF.1395-0).

Option 1:

This study made the assumption that to compensate for additional propagation impairments in the boresight of any beam of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e. suffering the rain fade) by a value only equivalent to the level of rain fading and limited to a maximum of 20 dB. This level is the difference between long-term protection criteria of $I/N = -10$ dB that can be exceeded for no more than 20% of the time (i.e. clear sky) and assumed short-term protection criteria of $I/N = +10$ dB that is never exceeded.

Option 2:

Automatic transmit power control may be used to increase the e.i.r.p. density to compensate for rain attenuation to the extent that the power flux-density at the FS/MS station does not exceed the value resulting from use by HAPS station of an e.i.r.p. density meeting the above limits in the clear sky conditions.

The study showed that a HAPS system can meet such a pfd limit.

To verify that the pfd in dB(W/(m² · MHz)) produced by HAPS does not exceed the proposed pfd mask, the following equation was used:

$$pfd(\theta) = e.i.r.p. \frac{dBW}{MHz}(El) + 10 * \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

e.i.r.p.: is the nominal HAPS e.i.r.p. density level in dB(W/MHz) (dependent to the elevation angle);

d : is the distance between the HAPS and the ground (dependent to the elevation angle).

The impact of the gas attenuation is not included in the verification formula since it is already taken into account in the pfd mask in these studies.

Impact from transmitting HAPS ground stations into receiving FS stations

No system characteristics with HAPS uplink in the 27.9-28.2 GHz frequency band were presented so HAPS uplink was not studied in this range.

Impact from transmitting FS stations into receiving HAPS ground stations

Several studies show that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

Impact from transmitting FS stations into receiving HAPS

No system characteristics with HAPS uplink in the 27.9-28.2 GHz frequency band were presented, so HAPS uplink was not studied in this range.

1/1.14/3.3.4.1.2 Sharing and compatibility of FS and HAPS systems operating in the 31-31.3 GHz frequency range

Impact from transmitting HAPS into receiving FS stations

Two studies have shown that the following pfd mask to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the FS from a single HAPS by meeting its long-term protection criteria:

| | | | |
|------------------------|------------------------------|-----|--------------------------------------|
| $0.875 \theta - 143$ | dB(W/(m ² · MHz)) | for | $0^\circ \leq \theta < 8^\circ$ |
| $2.58 \theta - 156.6$ | dB(W/(m ² · MHz)) | for | $8^\circ \leq \theta < 20^\circ$ |
| $0.375 \theta - 112.5$ | dB(W/(m ² · MHz)) | for | $20^\circ \leq \theta < 60^\circ$ |
| -90 | dB(W/(m ² · MHz)) | for | $60^\circ \leq \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the pfd level shown above is derived from a maximum interference level of -148 dB(W/MHz) (i.e. $I/N = -10$ dB not to be exceeded more than 20% of the time) for the FS long-term protection criteria. The FS parameters and operational characteristics are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. Gaseous atmospheric attenuation is considered (Recommendation ITU-R SF.1395-0).

Option 1:

This study made the assumption that to compensate for additional propagation impairments in the boresight of any beam of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e., suffering the rain fade) by a value only equivalent to the level of rain fading and limited to a maximum of 20 dB. This level is the difference between long-term protection criteria of $I/N = -10$ dB that can be exceeded for no more than 20% of the time (i.e. clear sky) and assumed short-term protection criteria of $I/N = +10$ dB that is never exceeded.

Option 2:

Automatic transmit power control may be used to increase the e.i.r.p. density to compensate for rain attenuation to the extent that the power flux-density at the FS/MS station does not exceed the value resulting from use by HAPS station of an e.i.r.p. density meeting the above limits in the clear-sky conditions.

The study showed that a HAPS system can meet such a pfd limit. To verify that the pfd in dB(W/(m² · MHz)) produced by a single HAPS does not exceed the proposed pfd mask in the studies, the following equation was used:

$$pfd(\theta) = e.i.r.p. \frac{dBW}{MHz}(\theta) + 10 * \log_{10} \left(\frac{1}{4\pi d^2} \right)$$

where:

e.i.r.p.: is the nominal HAPS e.i.r.p. density level in dB(W/MHz) (dependent to the elevation angle);

d: is the distance between the HAPS and the ground (dependent to the elevation angle).

The impact of the gas attenuation is not included in this verification formula since it is already taken into account in the pfd mask in these studies.

Impact from transmitting HAPS ground stations into receiving FS stations

No studies were presented for this scenario.

Impact from transmitting FS stations into receiving HAPS ground stations

Several studies show that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

Impact from transmitting FS stations into receiving HAPS

The HAPS gateway beam station short-term protection criteria is never exceeded. The long term is exceeded for less than 1 over 10 deployments scenarios in the case of HAPS gateway beam and less than 1 over 20 deployments scenarios in case of HAPS CPE beam. It should be noted that HAPS should operate in areas where the density of FS station is much less than the one used in the study.

1/1.14/3.3.4.2 Sharing and compatibility of FSS (Earth-to-space) and HAPS systems (HAPS-to-ground) operating in the 27.9-28.2 GHz

Impact from transmitting HAPS into receiving FSS space station

Two studies considered the potential emissions into the FSS GSO and non-GSO space station receivers. The studies included assessment for satellite receiver *I/N* values of –10.5 dB. No assumption on the percentage of time associated to that interference level was needed.

The analysis performed shows that HAPS system downlink emissions will not impact the FSS space receivers if the e.i.r.p. density per HAPS platform transmitter is limited to –8 dB(W/MHz) for off-nadir angle higher than 85.5°.

Impact from transmitting FSS earth station into receiving HAPS ground station

One study considered the potential emissions from FSS earth stations received by the HAPS CPE receiver. This analysis also compared the level of emissions at the HAPS CPE receiver to those that would be received by an FS receiver.

It was shown that the required separation distance between HAPS ground terminal and FSS E/S is less compared to FSS E/S and FS terminal.

The study was based on a statistical single-entry analysis and did not take into account deployment densities. It should be noted that the coexistence feasibility could also be dependent on the expected deployment of FSS earth stations and HAPS ground stations.

One study considered the potential emissions from FSS earth stations received by the HAPS ground station receiver. This analysis also compared the level of emissions at the HAPS receivers to those that would be received by a FS receiver.

The analysis performed shows that the required separation distance of HAPS ground stations receivers and FSS earth stations is less than the required separation distance between an FSS earth station and FS terminal.

One study focused on the sharing and compatibility of FSS earth station interference into HAPS GW in the frequency band 27.9-28.2 GHz. The study assumed two cases of interference protection criteria of I/N -10 dB and $+10$ dB not be exceeded more than 20% and 0.01% of time. The results for worst-case (no azimuth discrimination) antenna pointing scenarios and specific terrain assumptions indicate that HAPS GW requires separation distances from transmitting FSS earth stations which vary from 1.2 km to 59.9 km assuming a HAPS I/N of -10 dB for 20% time and from 0.71 km to 27 km assuming a HAPS I/N of $+10$ dB for 0.01% time for the band 27.9-28.2 GHz. The study assumed a worst-case scenario where the FSS earth station and HAPS GW are always pointing towards each other (no azimuth discrimination). One study, using an I/N value of 10 dB (0.01%) and -10 dB (20%) for the HAPS ground stations' receivers shows the following:

For GSO FSS earth station to HAPS receivers, the worst-case separation distance is at least 200 m, considering 20 dB shielding at the HAPS GW receiver and 204 m for CPE receivers (without shielding).

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

Additional information was reported to the CPM for this same scenario. Updated information shows that for GSO FSS earth station to HAPS ground stations' receivers, the worst-case separation distance is at least 0.18 km, 0.43 km (considering 20 dB shielding, for 10 dB (0.01%) and -10 dB (20%), respectively) at the HAPS GW receiver and 0.42 km, 4.54 km (for 10 dB (0.01%) and -10 dB (20%), respectively) for CPE receivers (without shielding).

For non-GSO FSS earth station to HAPS receivers, the worst-case separation distance is at least 4.1 km, considering 20 dB shielding at the HAPS GW receiver and 2.58 km for CPE receivers (without shielding).

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

Additional information was reported to the CPM for this same scenario. Updated information shows that for non-GSO FSS earth station to HAPS ground stations' receivers, the worst-case separation distance is at least 0.44 km, 4.67 km (considering 20 dB shielding, for 10 dB (0.01%) and -10 dB (20%), respectively) at the HAPS GW receiver and 6.17 km, 25.67 km (for 10 dB (0.01%) and -10 dB (20%), respectively) for CPE receivers (without shielding).

The above results demonstrate that these separation distances will be required between FSS earth stations and HAPS ground terminals. Further, mitigation techniques such as, RF shielding around the HAPS GW and polarization isolation could reduce the separation distances even further, depending on the elevation and azimuth angle of the respective links.

The study was based on a single-entry analysis and did not take into account deployment densities. It should be noted that the coexistence feasibility depends on the expected deployment of FSS earth stations and HAPS ground stations (noting the different complexity of implementing the mitigation techniques if required for gateways or CPEs).

1/1.14/3.3.4.3 Sharing and compatibility of MS and HAPS systems operating in the 27.9-28.2 GHz and 31-31.3 GHz frequency ranges

1/1.14/3.3.4.3.1 Sharing and compatibility of MS and HAPS systems operating in the 27.9-28.2 GHz frequency range

Impact from transmitting HAPS into receiving mobile stations

One study shows that the following pfd mask, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the MS receivers from a single HAPS emission:

| | | | |
|-----------------------|---------------------------------------|-----|--------------------------------------|
| $\theta - 120$ | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $0^\circ \leq \theta < 13^\circ$ |
| -143 | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $13^\circ \leq \theta < 65^\circ$ |
| $0.68 \theta - 151.2$ | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $65^\circ \leq \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that for the pfd level above, polarization and gaseous atmospheric (ITU-R SF.1395-0) losses are considered. In addition, body loss is considered for the user equipment pfd level calculation.

Option 1: This study made the assumption that to compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading.

Option 2: Automatic transmit power control may be used to increase the e.i.r.p. density to compensate for rain attenuation to the extent that the power flux density at the FS/MS station does not exceed the value resulting from use by HAPS station of an e.i.r.p. density meeting the above limits in the clear sky conditions.

The study showed that a HAPS system can meet such a pfd limit. To verify that the pfd produced by HAPS does not exceed the proposed pfd mask, the following equation was used:

$$pfd(\theta) = e.i.r.p. \frac{dBW}{MHz}(\theta) + 10 * \log_{10} \left(\frac{1}{4\pi d^2} \right)$$

where:

e.i.r.p.: is the nominal HAPS e.i.r.p. density level in dB(W/MHz) (dependent to the elevation angle);

d: is the distance between the HAPS and the ground (dependent to the elevation angle).

The impact of the gas attenuation, body loss (for user equipment), and polarization loss are not included in the verification formula since it is already taken into account in the pfd mask proposed in this study.

Another study shows that the following pfd mask, to be applied at the surface of the Earth, should be feasible to protect the MS from HAPS systems. And in case that MS is coexisted with HAPS and FS in the same geographical area, 3 dB apportionments should be considered additionally to the pfd mask below to ensure this protection.

$$\begin{array}{lll} -121.3 + 1.5 \theta & \text{dB(W/(m}^2 \cdot \text{MHz))} & \theta \leq 5^\circ \\ -113.7 & \text{dB(W/(m}^2 \cdot \text{MHz))} & 5^\circ < \theta \leq 90^\circ \end{array}$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the attenuations are not considered in the pfd mask above, but in the verification formula stage.

In this study, to verify the aggregated interference, from multiple beams of single HAPS, with the proposed pfd mask, the following equations are used:

$$pfd_b(\theta) = P^H(b) + G_{tx}^H(\theta(b)) - FSL(\theta) - L_{pol} - L_{body} - AL$$

$$pfd(\theta) = 10 \log \left(\sum_{b=1}^{b_n} 10^{pfd_b(\theta)/10} \right)$$

where:

Option 1: $P^H(b)$: transmit power of beam b generated by the HAPS dB(W/MHz). Transmit power of the HAPS downlink under clear sky condition is nominal e.i.r.p., transmit power of the HAPS downlink under raining condition is maximum e.i.r.p.;

Option 2: $P^H(b)$: transmit power of beam b generated by the HAPS dB(W/MHz). Transmit power of the HAPS downlink under clear sky condition is nominal e.i.r.p.;

$\varphi(b)$: discrimination angle (degrees) at the HAPS between the pointing direction of a HAPS spot beam b and the MS receiver;

$G_{tx}^H(\theta(b))$: transmitter antenna pattern gain (dBi) of the HAPS for off-axis angle $\varphi(b)$;

d : distance (m) between the MS receiver and the HAPS;

AL : atmospheric loss (dB) between the MS receiver and the HAPS, based on Recommendation ITU-R P.619-3;

pol : polarization discrimination in dB (3 dB);

L_{body} : body loss in dB (4 dB), only applied when $\theta \geq 5^\circ$;

b_n : number of co-frequency beams.

In addition, assuming a worst-case scenario of main-beam coupling between the two systems, this study proposed that in order to meet the protection of mobile stations in the HAPS-to-ground link, HAPS e.i.r.p. should be reduced by 13.2 dB or a protection distance between HAPS nadir and mobile stations of 59.3 km should be applied. When considering 3 dB interference apportionment, the transmitter e.i.r.p. reduction required is 16.2 dB, or a protection distance between HAPS nadir and mobile stations of 63.5 km should be applied.

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

The following pfd mask in dB(W/(m² · MHz)), to protect MS from HAPS systems.

$$\begin{array}{lll} -116 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 0^\circ \leq \theta < 5^\circ \end{array}$$

$$\begin{array}{lll} -116 + 0.15 (\theta - 5) & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 5^\circ \leq \theta < 20^\circ \\ -113.7 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 20^\circ \leq \theta \leq 90^\circ \end{array}$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

The following equation is used in proposed pfd mask above:

$$pfd_{\max}(\theta) = I/N + 10\log_{10}(KTB) + NF + 10\log_{10}(4\pi/\lambda^2) - G_{MS}(\theta_m, \theta_e, \theta_\delta) + L_{pol} + L_{body} + Att_{\text{gaz}}(\theta)$$

where:

θ : elevation angle in degrees (angle of arrival above the horizontal plane) ($^\circ$)

I/N : ratio of the interference power to the receiver thermal noise (-6 dB)

K : Boltzmann's constant = 1.38×10^{-23} (J/K);

T : system noise temperature of HAPS (K);

B : noise bandwidth = 1 MHz;

NF : noise figure;

θ_m : mechanical tilt of mobile service (10°);

θ_e : electronic tilt of mobile service ($^\circ$);

θ_δ : elevation angle toward the HAPS ($^\circ$);

$G_{MS}(\theta_m, \theta_e, \theta_\delta)$: MS station (BS,UE) antenna gain toward the HAPS taking into account all possible θ_e (dBi);

L_{pol} : polarization loss;

L_{body} : body loss in dB;

$Att_{\text{gaz}}(\theta)$: is the atmospheric attenuation for the link (Recommendation ITU-R SF.1395) which is dependent to the elevation angle θ (dB).

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

The protection of the mobile service should be calculated using the following formula for the required pfd level at the receiver antenna port:

$$pfd_{MS} \text{ (in dBm/m}^2 \text{ in 1 Hz)} = -6 \text{ dB (protection criteria for MS)} + 10\log(4\pi/\lambda^2) - G(\theta, \phi) - 174 \text{ dBm/Hz} + F$$

in which:

λ = wavelength, m;

$G(\theta, \phi)$ = MS receive antenna gain, dBi;

F = MS receiver noise figure, dB.

$$\begin{array}{lll} -122.7 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 0^\circ \leq \theta < 5^\circ \\ -122.7 + 2 (\theta - 2) & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 2^\circ \leq \theta < 2.3^\circ \\ -122.6 + 1.5 (\theta - 2) & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 2.3^\circ \leq \theta \leq 7.9^\circ \\ -113.9 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 7.9^\circ \leq \theta < 90^\circ \end{array}$$

Another study shows that the aggregate interference levels obtained by UE exceed the maximum acceptable interference levels specified for the mobile service systems. The amount of excess ranges from 9.06 to 17.6 dB for the specific HAPS system considered in the study.

Impact from transmitting HAPS ground stations into receiving mobile stations

No system characteristics with HAPS uplink in the 27.9-28.2 GHz frequency range were presented so HAPS uplink was not studied for this range.

Impact from transmitting mobile stations into receiving HAPS ground stations

No studies were presented.

Impact from transmitting mobile stations into receiving HAPS

No system characteristics with HAPS uplink in the 27.9-28.2 GHz frequency range were presented so HAPS uplink was not studied for this range.

1/1.14/3.3.4.3.2 Sharing and compatibility of MS and HAPS systems operating in the 31-31.3 GHz frequency range

No MS system characteristics in the 31-31.3 GHz frequency range were provided to WP 5C.

1/1.14/3.3.4.4 Compatibility study of EESS (passive) in the adjacent band 31.3-31.8 GHz and HAPS systems operating in the 31-31.3 GHz frequency range

Impact from transmitting HAPS into EESS (passive)

Three independent studies show that compatibility between EESS (passive) and HAPS downlinks is feasible provided that unwanted emission e.i.r.p. density in dB(W/200 MHz) from the HAPS in the band 31.3-31.8 GHz is below the following values:

| | | | |
|------------------|---------------|-----|--------------------------------------|
| $-\theta - 13.1$ | dB(W/200 MHz) | for | $-4.53^\circ \leq \theta < 22^\circ$ |
| -35.1 | dB(W/200 MHz) | for | $22^\circ \leq \theta \leq 90^\circ$ |

where θ is the elevation angle ($^\circ$) at the HAPS height.

This e.i.r.p. mask would cover all the transmissions from the HAPS (i.e. towards CPE and/or gateways) that could also have emissions in the direction of the EESS satellite. An apportionment of 5 dB of the EESS (passive) protection criterion was considered.

The study shows that a HAPS system can meet such an e.i.r.p. density limit.

Impact from transmitting HAPS ground stations into EESS (passive)

The two studies addressing uplinks propose to either keep the unwanted emission input power limit of -106 dB(W/MHz) currently in RR No. **5.543A**, or convert it using a 200 MHz bandwidth, i.e. -83 dB(W/200 MHz). This limit would apply to both HAPS CPE and gateways, considering clear-sky conditions.

1/1.14/3.3.4.5 Compatibility of RAS in the adjacent band 31.3-31.8 GHz and HAPS systems operating in the 31-31.3 GHz frequency range

Impact from transmitting HAPS ground stations into RAS

Studies have shown that the RAS station performing observations in the band 31.3-31.8 GHz can be protected from HAPS CPE and gateways uplink transmissions in the band 31-31.3 GHz provided that those stations meet an unwanted emission pfd value of -141 dB(W/(m² · 500 MHz)) in the 31.3-31.8 GHz band at the RAS station location at a height of 50 m. This pfd value shall be verified considering a percentage of time of 2% in the relevant propagation model. These pfd values can be met by the HAPS system through a combination of unwanted emission attenuation, separation distance or limitation to the uplink beam pointing direction. The possibilities for placement of HAPS ground stations may be affected by their situation with respect to the RAS station and HAPS.

Impact from transmitting HAPS into RAS

Studies have shown that the RAS station performing observations in the band 31.3-31.8 GHz can be protected from HAPS downlink transmissions in the band 31-31.3 GHz provided that such HAPS meet unwanted emission pfd values of $-171 \text{ dB(W/(m}^2 \cdot 500 \text{ MHz))}$ in the 31.3-31.8 GHz band at the RAS station location. This takes into account an allowable percentage of data loss of 2%. In order to avoid data loss to RAS systems, when pointing towards HAPS, RAS stations may need to implement angular cones of avoidance around HAPS by up to 1.3 degrees. These pfd values can be met by the HAPS system through a combination of unwanted emission attenuation, separation distance, or limitation of the ground station locations. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model.

To verify the compliance, the following formula was used:

$$pfd = e.i.r.p \cdot p_{\text{nominal clear sky}}(Az, \theta) + Att_{618p=2\%} + 10 \cdot \log_{10} \left(\frac{1}{4\pi d^2} \right) - GasAtt(\theta)$$

where:

$e.i.r.p \cdot p_{\text{nominal clear sky}}$ is the nominal unwanted emission e.i.r.p. density towards the RAS station at which the HAPS station operates under clear sky condition in dB(W/500 MHz) for continuum observations or dB(W/250 kHz) for spectral line observations in the RAS band;

Az : is the azimuth from the HAPS toward the RAS station;

θ : is the elevation angle at the HAPS towards the RAS station;

$Att_{618p=2\%}$: is the attenuation from Recommendation ITU-R P.618-13 corresponding to $p=2\%$ of the time at the radio astronomy location. It is being added in the equation above to take into account the increased unwanted emission e.i.r.p. density using automatic transmit power control with an amount equivalent to the level of rain attenuation for 2% of the time;

d : is the separation distance in m between the HAPS and the RAS station;

$GasAtt(\theta)$: is the gaseous attenuation for elevation angle of θ (Rec. ITU-R SF.1395-0).

1/1.14/3.3.5 Sharing and compatibility studies of HAPS systems in the 38-39.5 GHz frequency range

1/1.14/3.3.5.1 Sharing and compatibility study of FS and HAPS systems operating in the 38-39.5 GHz frequency range

Impact from transmitting HAPS into receiving FS stations

One study has shown that the following pfd mask to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the FS from a single HAPS by meeting its long-term protection criteria:

| | | | |
|------------------------------|------------------------------|-----|--------------------------------------|
| -137 | dB(W/(m ² · MHz)) | for | $0^\circ \leq \theta < 13^\circ$ |
| $-137 + 3.125 (\theta - 13)$ | dB(W/(m ² · MHz)) | for | $13^\circ \leq \theta < 25^\circ$ |
| $-99.5 + 0.5 (\theta - 25)$ | dB(W/(m ² · MHz)) | for | $25^\circ \leq \theta < 50^\circ$ |
| -87 | dB(W/(m ² · MHz)) | for | $50^\circ \leq \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane).

Note that the pfd level shown above is derived from on a maximum interference level of -147 dB(W/MHz) (i.e. $I/N = -10 \text{ dB}$ not to be exceeded more than 20% of the time) for the FS

long-term protection criteria. The FS parameters and operational characteristics are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. Gaseous atmospheric attenuation was taken into account (Recommendation ITU-R SF.1395-0).

Option 1: This study made the assumption that to compensate for additional propagation impairments in the boresight of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e., suffering the rain fade) by a value only equivalent to the level of rain fading and limited to a maximum of 20 dB. This level is the difference between long-term protection criteria of $I/N = -10$ dB that can be exceeded for no more than 20% of the time (i.e. clear sky) and assumed short-term protection criteria of $I/N = +10$ dB that is never exceeded.

Option 2: Automatic transmit power control may be used to increase the e.i.r.p. density to compensate for rain attenuation to the extent that the power flux density at the FS/MS station does not exceed the value resulting from use by HAPS station of an e.i.r.p. meeting the above limits in the clear sky conditions.

The study showed that a HAPS system can meet such a pfd limit. To verify that the pfd produced by the HAPS does not exceed the proposed pfd mask, the following equation was used:

$$pfd(\theta) = e.i.r.p. \cdot \frac{dBW}{MHz} (El) + 10 * \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

d : distance between the HAPS and the FS station (m) as a function of the elevation angle θ ;

$e.i.r.p.$: HAPS nominal e.i.r.p. spectral density at a specific elevation angle (dB(W/MHz));

The impact of the gas attenuation is not included in this verification formula since it is already taken into account in the proposed pfd mask.

Impact from transmitting HAPS ground stations into receiving FS stations

Several studies show that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. This study suggests that protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

Impact from transmitting FS stations into receiving HAPS ground stations

One study shows that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

Impact from transmitting FS stations into receiving HAPS

One study shows that the HAPS gateway station short-term protection criteria ($I/N = +10$ dB) is never exceeded. The long-term ($I/N = -10$ dB) is exceeded for less than 1 over 900 deployment scenarios in the case of HAPS gateway beam and less than 1 over 2 000 deployment scenarios in

case of HAPS CPE beam. The density of the FS assumed in this study is set to 10 000 links per HAPS visibility area.

1/1.14/3.3.5.2 Sharing and compatibility study of MS and HAPS systems operating in the 38-39.5 GHz frequency range

Impact from transmitting HAPS into MS receivers

One study shows that the following pfd mask to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the MS receivers from a single HAPS emission:

$$\begin{array}{llll} -102 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 0^\circ \leq \theta < 5^\circ \\ -102 + 0.25 (\theta - 5) & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 5^\circ \leq \theta < 25^\circ \\ -97 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 25^\circ \leq \theta \leq 90^\circ \end{array}$$

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane).

Note that for the pfd level above, polarization and gaseous atmospheric (Recommendation ITU-R SF.1395-0) losses are considered. In addition, body loss is considered for the user equipment pfd level calculation.

Option 1: This study made the assumption that to compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading.

Option 2: Automatic transmit power control may be used to increase the e.i.r.p. density to compensate for rain attenuation to the extent that the power flux-density at the FS/MS station does not exceed the value resulting from use by HAPS station of an e.i.r.p. meeting the above limits in the clear-sky conditions.

The study showed that a HAPS system can meet such a pfd limit. To verify that the pfd produced by HAPS does not exceed the proposed pfd mask, the following equation was used:

$$pfd(\theta) = e.i.r.p. \frac{dBW}{MHz}(\theta) + 10 * \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

e.i.r.p.: is the nominal HAPS e.i.r.p. density level in dB(W/MHz) (dependent to the elevation angle);

d: is the distance between the HAPS and the ground (dependent to the elevation angle).

The impact of the gas attenuation, body loss (for user equipment), and polarization loss are not included in this verification formula since it is already taken into account in this proposed pfd mask.

Another study shows that the following pfd mask to be applied at the surface of the Earth, should be feasible to protect the IMT-2020 from HAPS systems. And in case that IMT-2020 system is coexisted with HAPS and FS in the same geographical area, 3 dB apportionments should be considered additionally to the pfd mask below to ensure this protection.

$$\begin{array}{llll} -109 + 0.72 \theta & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 0^\circ \leq \theta < 10^\circ \\ -101.8 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 10^\circ \leq \theta \leq 90^\circ \end{array}$$

θ is the elevation angle in degrees (angles of arrival above the horizontal plane). Note that the attenuations are not considered in the pfd mask above, but in the verification formula stage. In this

study, the verification of the aggregated interference, from multiple beams of single HAPS, with the proposed pfd mask, the following equations are used:

$$pfd_b(\theta) = P^H(b) + G_{tx}^H(\theta(b)) - 10 \log(4\pi d^2) - L_{pol} - L_{body} - AL$$

$$pfd(\theta) = 10 \log \left(\sum_{b=1}^{b_n} 10^{pfd_b(\theta)/10} \right)$$

where:

- Option 1: $P^H(b)$: transmit power of beam b generated by the HAPS dB(W/MHz). Transmit power of the HAPS downlink under clear-sky conditions is nominal e.i.r.p., transmit power of the HAPS downlink under raining conditions is maximum e.i.r.p.;
- Option 2: $P^H(b)$: transmit power of beam b generated by the HAPS dB(W/MHz). Transmit power of the HAPS downlink under clear-sky conditions is nominal e.i.r.p.;
- $\varphi(b)$ discrimination angle (degrees) at the HAPS between the pointing direction of a HAPS spot beam b and the MS receiver;
- $G_{tx}^H(\theta(b))$: transmitter antenna pattern gain (dBi) of the HAPS for off-axis angle $\varphi(b)$;
- d : distance (m) between the MS receiver and the HAPS;
- AL : atmospheric loss (dB) between the MS receiver and the HAPS, based on Recommendation ITU-R P.619-3;
- L_{pol} : polarization discrimination in dB (3 dB);
- L_{body} : body loss in dB (4 dB), only applied when $\theta \geq 10^\circ$;
- b_n : number of co-frequency beams.

In addition, assuming a worst-case scenario of main-beam coupling between the two systems, this study proposed that in order to meet the protection of IMT-2020 stations in the HAPS-to-ground link, HAPS e.i.r.p. should be reduced by 11.7 dB, or a protection distance between HAPS nadir and IMT-2020 stations of 49.5 km should be applied. And when considering 3 dB interference apportionment, the transmitter HAPS e.i.r.p. should be reduced by 14.7 dB, or a protection distance between HAPS nadir and IMT-2020 stations of 52.1 km should be applied. Note that the separation distances from this specific study do not take into account the latest HAPS characteristics presented in Report ITU-R F.2439. Any updates to the results of these studies will be finalized by the Radiocommunication Assembly or ITU-R Study Group 5.

Another study proposes that a maximum worst-case separation distance, considering a specific HAPS system used in the study and an $I/N = -6$ never exceeded for the IMT-2020 protection criteria, of 60 km (to HAPS nadir) might be required to protect the communications of these two systems in some rare cases (when both systems are pointing towards each other in azimuth). For the other cases, the separation distance will be lower. The results are based on the maximum transmit power that will be transmitted during a very small percentage of time (during worst case raining conditions).

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

The protection of the mobile service should be calculated using the following formula for the required pfd level at the receiver antenna port:

$$pfd_{MS} \text{ (in dBm/m}^2 \text{ in 1 Hz)} = -6 \text{ dB (protection criteria for MS)} + 10\log(4\pi/\lambda^2) - G(\theta, \phi) - 174 \text{ dBm/Hz} + F$$

in which:

λ = wavelength, m;

$G(\theta, \phi)$ = MS receive antenna gain, dBi;

F = MS receiver noise figure, dB.

$$\begin{array}{llll} -110.8 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 0^\circ \leq \theta < 4^\circ \\ -110.8 + 1.5 (\theta - 5) & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 4^\circ \leq \theta < 11.5^\circ \\ -101.8 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 11.5^\circ \leq \theta \leq 90^\circ \end{array}$$

Impact from transmitting HAPS ground stations into receiving MS stations

One study concluded that HAPS ground stations (CPE/GW) can share with MS stations (base station and UE) as the maximum required separation distance for a probability of 1 case over 100 000 is less than 160 m for $p = 20\%$ (clear-sky conditions) and 4 km for $p = 0.01\%$ (raining conditions). For the majority of cases, the separation distance is much lower.

Another study shows that the worst-case separation distance of 0.42 km might be required in rare cases to guarantee the coexistence of these two systems when the HAPS ground stations and IMT-2020 transmitter are pointing to each other in azimuth and with the worst case elevation angles (MCL analysis). For the majority of cases, the separation distance is much shorter. Another study showed that the GW \rightarrow HAPS (uplink) case indicates that the pfd of $(-107.7 \text{ dB(W/(m}^2 \cdot \text{MHz))})$ can be met for 99.99% of IMT base stations with a margin of at least 36.3 dB for the pdf mask $(-144.0 \text{ dB(W/(m}^2 \cdot \text{MHz))})$. This case represents a scenario that considers ubiquitous deployment of IMT networks and 1 HAPS gateway on the same suburban deployment area: the urban deployment characteristics proposed for some of the HAPS systems were not considered. The case of CPE \rightarrow HAPS (uplink) indicates that the pfd proposed in the study $(-107.9 \text{ dB(W/(m}^2 \cdot \text{MHz))})$ can be met for 99.99% of IMT base stations with a margin of at least 31.8 dB for the pdf mask $(-139.7 \text{ dB(W/(m}^2 \cdot \text{MHz))})$. This study also represents a scenario that considers ubiquitous deployment of IMT networks and HAPS CPE's in the same suburban deployment area.

Impact from transmitting MS stations into receiving HAPS ground stations

The study performed two different percentages of time, i.e. 20% and 0.01%, using propagation model Recommendation ITU-R P.452-16. The statistical single-entry study showed that the range of separation distances between MS station and HAPS ground station receiver is between approximately 0 and 16 km as well as 0 and 4 km respectively, depending on the probability.

Similar analysis showed that the range of separation distances between MS and FS stations are between approximately 0 and 30 km as well as 0 and 76 km for the same probabilities. Therefore, the study suggested that the protection between HAPS ground stations and MS stations can be managed on a case-by-case basis by coordination amongst administrations. Another study shows that the worst case separation distance of 0.93 km might be required in rare cases to guarantee the coexistence of these two systems when the HAPS ground stations and IMT-2020 transmitter are pointing to each other in azimuth and with the worst-case elevation angles (MCL analysis). For the majority of cases, the separation distance is much shorter.

Impact from transmitting MS stations into receiving HAPS

One study shows that the worst-case separation distance of 62 km might be required in rare cases to guarantee the coexistence of the two systems when IMT-2020 is co frequency with HAPS gateway links and when the HAPS Gateway and IMT-2020 transmitter are pointing to each other in azimuth and with the worst case elevation angles (MCL analysis). For the other cases, the required

separation distances will be lower. With regard to the impact of BS into HAPS CPE link receiver and UE into HAPS no separation distance is required.

1/1.14/3.3.5.3 Sharing and compatibility study of FSS and HAPS systems operating in the 38-39.5 GHz frequency range

Impact from transmitting HAPS ground station into receiving FSS earth station

One study presented a deterministic approach to analyse the interference from HAPS uplink to FSS earth station receivers. For the long-term protection of FSS earth station receiver, a required I/N value was assumed as -15.2 dB (-12.2 dB with a 3 dB apportionment). The separation distances between HAPS ground terminals and FSS earth stations were calculated using a free-space model. To comply with the required long-term I/N value, HAPS GW station would need to be located at a distance of 4.7 km from FSS earth stations, and HAPS CPEs would need to be located at a distance of 15 km, noting that these distances are based on a worst case main beam coupling scenario and that, for other scenarios, distances may be lower. This study considered the interference from an individual HAPS ground station towards an individual FSS ES. The case of aggregate interference from all co-frequency HAPS ground stations was not addressed in this study.

One study presented two analyses. The first analysis provides pfd limits to ensure protection of FSS GSO and non-GSO earth station receivers. A range of pfd limits are provided for satellite receiver I/N criteria as presented in the following table:

pfd limits in dB(W/(m² · MHz)) at the FSS earth station receivers

| FSS I/N values | Time percentage | pfd limit at GSO earth station | pfd limit at non-GSO earth station |
|------------------|-----------------|--|--|
| $I/N = -6$ dB | 1% | -104.4 dB(W/(m ² · MHz)) | -106.6 dB(W/(m ² · MHz)) |
| $I/N = -10.5$ dB | 20% | -108.9 dB(W/(m ² · MHz)) | -111.1 dB(W/(m ² · MHz)) |
| $I/N = +8$ dB | 0.02% | -90.4 dB(W/(m ² · MHz)) | -92.6 dB(W/(m ² · MHz)) |

Taking the worst-case assumption of an I/N value of -10.5 dB, a pfd level of -111.1 dB(W/(m² · MHz)) should not be exceeded to protect the FSS earth station receivers. A separation distance of 320 metres to 3.9 km between HAPS ground stations and satellite earth stations receivers may be applied when using I/N criteria listed in the above table.

The second analysis uses a statistical methodology to determine a separation distance between HAPS ground stations and satellite receivers. This second analysis shows that the separation distance between an FS terminal and an FSS earth station is greater compared to the separation between a HAPS ground station and an FSS earth station. The study was based on a statistical single-entry analysis, and did not take into account deployment densities. It should be noted that the coexistence feasibility could also be dependent on the expected deployment of FSS earth stations and HAPS ground stations.

One study provides an assessment of potential interference from HAPS system ground stations using the same process that would be used in assessing interference from an FS station. The study shows that the impact of HAPS ground-station emissions is less than the impact of an FS emitting station into FSS receiving earth station. Protection by HAPS ground stations of FSS earth stations can be managed on a case-by-case basis by coordination or usual link/planning method and procedures used at national level for conventional FS stations.

One study considers the effects of aggregated interference from HAPS ground stations towards FSS GSO earth station. The study uses I/N values for satellite receivers of -6 dB and -10 dB. The results show that the aggregate I/N value will always meet the FSS protection criteria (with and without an allowance for apportionment of 3 dB).

One study shows that 3 km is a sufficient separation distance between a HAPS GW station uplink and a FSS earth station receiver. For the HAPS CPE uplinks, the studies show 6.6 km separation distance is sufficient between a CPE and a FSS earth station. These results are based on the use of satellite earth station receiver I/N value of -12.2 dB.

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

Additional information was reported to the CPM for this same scenario. Updated information shows that 0.554 km, 1.31 km, 2.6 km are sufficient separation distances between a HAPS GW uplink and a FSS earth station receiver. For the HAPS CPE uplinks, the information shows 2.41 km, 3.66 km, 4.9 km separation distances are sufficient between a CPE and a FSS earth station. These results are based on the use of satellite earth station receiver I/N values of 8 dB (0.02%), -6 dB (1.0%), and -10.5 dB (20%), respectively.

Impact from transmitting HAPS into receiving FSS earth station

One study provides pfd limits facilitate coexistence between FSS GSO and non-GSO earth station receivers in the 38-39.5 GHz band.

Under this study and for the purpose of protecting GSO FSS earth station from co-channel interference, coordination of a transmitting HAPS station would be required when the power flux-density over any point of an administration's border exceeds the following values:

| | | | |
|---------------------------|------------------------------|-----|---|
| $-169.9 + 1954 \alpha^2$ | dB(W/(m ² · MHz)) | for | $0 \leq \alpha < 0.136^\circ$ |
| -133.9 | dB(W/(m ² · MHz)) | for | $0.136^\circ \leq \alpha < 1^\circ$ |
| $-133.9 + 25 \log \alpha$ | dB(W/(m ² · MHz)) | for | $1^\circ \leq \alpha < 47.9^\circ$ |
| -91.9 | dB(W/(m ² · MHz)) | for | $47.9^\circ \leq \alpha \leq 180^\circ$ |

where α is the minimum angle at the border between the line to the HAPS platform and the lines to the GSO arc in degrees.

For the verification formula of the proposed pfd mask the following equation should be used:

$$pfd = e.i.r.p. - 10\log_{10}(4\pi d^2) - Att_{gaz}$$

where:

- d : distance between the HAPS and the GSO FSS earth station (m);
- Att_{gaz} : attenuation to atmospheric gazes on the HAPS to GSO FSS earth station path (dB);
- pfd : required pfd at the GSO FSS earth station location to meet the FSS protection criteria (dB(W/(m² · MHz)));
- $e.i.r.p.$: maximum e.i.r.p. spectral density in the direction of the GSO FSS earth station (dB(W/MHz)).

The pfd necessary to protect GSO FSS earth station use within the territory of an administration deploying the HAPS is not specified. While conditions for the coexistence between HAPS and GSO FSS earth stations within the territory of an administration can be based on the same HAPS pfd levels, further specific conditions would need to be addressed at a national level to avoid undue constraints to existing fixed-satellite services.

HAPS technology can also coexist with non-GSO FSS in the 38-39.5 GHz band when taking into account the statistics of the non-GSO FSS earth station pointing directions relative to the HAPS, and on the tracking strategy of the satellites by the non-GSO FSS earth stations.

For the purpose of protecting non-GSO FSS earth stations from co-channel interference, coordination of a transmitting HAPS should be undertaken when the distance between the HAPS nadir and any point of an administration's border is less than 100 km.

One deterministic study provides a minimum coupling loss analysis based on a single HAPS and FSS GSO/non-GSO earth station pair. The analysis assumes that the HAPS transmitter is pointing directly towards the FSS earth station receiver in azimuth. Note, the FSS earth station receive antenna (both GSO and non-GSO) is pointing with maximum gain towards the HAPS platform. The required separation distance between HAPS nadir and FSS earth station receiver (GSO and non-GSO) was calculated based on the FSS threshold I/N values of -6 dB, -10 dB, and -12.2 dB).

For the gateway downlinks from the HAPS, the studies show that for a satellite earth station receiver with an I/N value of -12.2 dB, the required separation distance from the HAPS nadir is 119 km for both GSO and non-GSO satellite earth station receivers.

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

Additional information was reported to the CPM for this same scenario. Updated information shows that for the GW downlinks from the HAPS, the information show that for a satellite earth station receiver with I/N values of 8 dB (0.02%), -6 dB (1.0%), and -10.5 dB (20%), respectively, the required separation distance from the HAPS nadir are 113 km, 118 km, and 118 km for the worst case including GSO and non-GSO satellite earth station receivers.

For the CPE downlinks from the HAPS platform, the studies show that for a satellite earth station receiver with an I/N value of -12.2 dB, the required separation distance from the HAPS nadir is 150 km for both GSO and non-GSO satellite earth station receivers.

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

Additional information was reported to the CPM for this same scenario. Updated information shows that for the CPE downlinks from the HAPS, the studies show that for a satellite earth station receiver with I/N values of 8 dB (0.02%), -6 dB (1.0%), and -10.5 dB (20%) respectively, the required separation distances from the HAPS nadir are 120 km, 134 km and 147 km for the worst case including GSO and non-GSO satellite earth station receivers.

Impact from transmitting FSS space station into receiving HAPS

One study provides an analysis to determine whether the I/N value at the HAPS receiver is exceeded by emissions from FSS (GSO and non-GSO) satellites. The calculated I/N value at the HAPS receiver does not exceed -25.39 dB.

The analysis shows that the I/N value is below the HAPS protection criteria of $I/N = -6$ dB for worst-case analysis.

One study shows that HAPS platform receivers will not be impacted and can accept interference from FSS downlink that are compliant with Table 21-4 of RR Article 21.

Impact from transmitting FSS space station into receiving HAPS ground station

One study shows that HAPS receiving ground stations can coexist with FSS space stations emissions in the 38-39.5 GHz band given the percentage of HAPS service area where there could be potentially a problem and given mitigation techniques that could be implemented by HAPS.

One study, using an I/N value of -12.2 dB for the HAPS receiver shows the following:

For the FSS GSO and non-GSO satellite transmitting to HAPS GW and CPE, at worst case:

- The I/N threshold is exceeded for any elevation higher than 85.5 degrees.
- An off-axis angular separation of 2.4 degrees between the satellite beam and the HAPS beam is required in order to satisfy the threshold at the HAPS receiver.

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

Additional information was reported to the CPM for this same scenario. Updated information shows that using I/N values of 10 dB (0.01%) and -10 dB (20%) for the HAPS receiver shows the following:

For the FSS GSO and non-GSO satellite transmitting to HAPS ground stations, at worst case:

- The I/N threshold is exceeded for any elevation angle higher than 87.9 and 85.7 degrees respectively.
- An off-axis angular separation of 2.2 and 3.7 degrees between the satellite beam and the HAPS beam is required in order to satisfy the threshold at the HAPS receiver.

This analysis assumes there is no azimuth off-axis for the HAPS link and the FSS link.

By employing appropriate mitigation, HAPS GW or CPE receivers can coexist with FSS transmissions that are at the RR Article 21 pfd levels.

1/1.14/3.3.5.4 Compatibility study of SRS in the adjacent band 37-38 GHz frequency range and HAPS systems operating in 38-39.5 GHz frequency range

Protection of receiving SRS earth stations

SRS (space-to-Earth) earth stations operating in the band 37-38 GHz are protected from harmful interference by unwanted emissions of HAPS or HAPS ground stations in the fixed service 38-39.5 GHz when the protection level of -217 dB(W/Hz) at the input of the SRS receiver with 0.001% exceedance due to atmospheric and precipitation effects as referred to in the relevant ITU-R Recommendations is fulfilled.

The studies show that the protection of sensitive receiving earth stations operating in the SRS in the band 37-38 GHz may be achieved through a combination of separation distance and attenuation of unwanted emissions for HAPS stations operating in the band 38-39.5 GHz.

An unwanted emission pfd mask to be applied at the SRS earth station location at the relevant earth station antenna height has also been proposed to address the protection of SRS in the adjacent band:

$$\begin{array}{lll} -198 + 21 \log_{10}(5 - \theta) & \text{dB(W/(m}^2 \cdot \text{Hz))} & \text{for } 0^\circ \leq \theta < 5 - \theta_1^\circ \\ -250 & \text{dB(W/(m}^2 \cdot \text{Hz))} & \text{for } 5 - \theta_1^\circ \leq \theta \leq 90^\circ \end{array}$$

where the corner angle $\theta_1 = 10^{-52/21} \approx 0.003^\circ$ and θ is the elevation angle in degrees (angle of arrival above the horizontal plane). The interference pfd should be calculated using propagation losses for $p = 0.001\%$.

1/1.14/3.3.6 Sharing and compatibility studies of HAPS systems in the 47.2-47.5 GHz and 47.9-48.2 GHz frequency ranges

Studies between HAPS systems, FSS and MS in the 47.2-47.5 GHz and 47.9-48.2 GHz frequency ranges have been performed.

1/1.14/3.3.6.1 Sharing and compatibility study of MS and HAPS systems operating in the 47.2-47.5 GHz and 47.9-48.2 GHz frequency ranges

HAPS ground stations into MS receiver

One single-entry statistical analysis shows that for the specific HAPS system considered in the study in a suburban deployment area, with $p = 0.01$ for path loss and 1% for clutter loss, the separation distance between:

- a HAPS gateway and IMT-2020 UE is 0 km for less than 1 out of 10 cases to 1 km for 1 out of 100 000 cases, and
- the separation distance between a HAPS gateway and IMT-2020 base station is 0 km for less than 1 out of 10 cases to 3 km for 1 out of 100 000 cases.

Another sharing study indicates that sharing is feasible under the assumptions and parameters that are described in this study. A summary of the most stringent margins is provided below.

The GW → HAPS (uplink) case indicates that the proposed pfd protection values of ($-105.9 \text{ dB(W/(m}^2 \cdot \text{MHz))}$) that can be met for 99.99% of IMT base stations with a margin of at least 10.9 dB. This case represents a scenario that considers ubiquitous deployment of IMT networks and 1 HAPS gateway of one HAPS system in the same suburban area: this study does not consider other HAPS systems and deployment scenarios (e.g. urban).

NOTE: The following information was submitted for consideration to the CPM19-2 meeting. No study was presented nor discussed during the meeting.

The protection of the mobile service should be calculated using the following formula for the required pfd level at the receiver antenna port:

$$pfd_{MS} \text{ (in dBm/m}^2 \text{ in 1 Hz)} = -6 \text{ dB (protection criteria for MS)} + 10\log(4\pi/\lambda^2) - G(\theta, \phi) - 174 \text{ dBm/Hz} + F$$

in which:

λ = wavelength, m;

$G(\theta, \phi)$ = MS receive antenna gain, dBi;

F = MS receiver noise figure, dB.

| | | | |
|---------------------------|------------------------------|-----|--|
| -109 | dB(W/(m ² · MHz)) | for | $0^\circ \leq \theta < 4^\circ$ |
| $-109 + 1.2 (\theta - 4)$ | dB(W/(m ² · MHz)) | for | $4^\circ \leq \theta < 11.5^\circ$ |
| -100 | dB(W/(m ² · MHz)) | for | $11.5^\circ \leq \theta \leq 90^\circ$ |

1/1.14/3.3.6.2 Sharing and compatibility study of FSS and HAPS systems operating in the 47.2-47.5 GHz and 47.9-48.2 GHz frequency ranges

Impact from transmitting HAPS ground station into receiving FSS earth station

One study shows that with regard to the medium-term protection criteria ($I/N = -6 \text{ dB}$ 0.6% of cases) and the short-term protection criteria ($I/N = 8 \text{ dB}$ 0.02% of cases), the impact of HAPS ground stations into FSS receivers are equal for the following two scenarios:

- All HAPS ground stations visible from the FSS satellite emitting at nominal e.i.r.p. density and no clouds between the HAPS ground stations.
- 5% of HAPS ground stations with clouds between the HAPS ground stations and the HAPS are emitting at e.i.r.p. density nominal plus 20 dB. 95% of HAPS ground stations with no clouds between the stations and the HAPS are emitting at e.i.r.p. density nominal.

Therefore, this study shows that during periods of rain, the e.i.r.p. density limits for clear sky conditions can be exceeded to the level needed to compensate for rain fade, up to 20 dB.

Impact from transmitting HAPS into receiving FSS satellite

No studies were performed between the HAPS towards FSS space station receivers, thus proposed HAPS shall operate under provisions contained in current RR, and no modification of the current RR were proposed based on study.

1/1.14/3.4 Use of ATPC for HAPS systems and impact on sharing with FS

NOTE: The following information was submitted for consideration the CPM 19-2 meeting. This particular study, including its methodology and assumptions, has not been fully considered by the expert group in the ITU-R for the fixed services.

One study was presented at the CPM to suggest that Automated Transmit Power Control (ATPC) mechanism can be used to compensate the attenuation due to the rain without significant degradation of the FS link availability. This statistical study assumes that rain attenuation in the HAPS-to-HAPS ground station link is compensated by using ATPC mechanism equivalent to the rain fading and limited to 20 dB. Considering rain statistics on the HAPS-to-HAPS ground stations link and FS-to-FS receivers link, the worst-case assumption is no rain on HAPS-to-FS receivers link. Based on the scenarios and assumptions taken in this study, results show that the worst FS unavailability maximum increase is 5.95% without ATPC and 6.09% with ATPC (from 0.01% without interference to 0.010609% with HAPS interference), depending on stations locations.

1/1.14/4 Methods to satisfy the agenda item

With respect to methods to satisfy the agenda item, as a first step generic methods are briefly described and as a second step, when considering the band-by-band approach, the relevant methods that could be considered as applicable to a given frequency band are indicated.

The following methods are considered under this agenda item and may be applied to potential candidate frequency bands. In the options below, changes to existing identifications to HAPS are proposed on a global basis and do not prejudice the consideration of these options on a regional basis (according to the definition of Regions in the Radio Regulations) or country footnotes, where applicable. In addition, proposals for candidate bands could include both partial or full band identifications for HAPS, as well as limitations on, or additional options for, directionality in order to ensure compatibility with existing services. These methods are:

Method A – No change

The existing provisions in the Radio Regulations remain unchanged in the corresponding frequency band.

Method B – Identification of bands, or parts thereof in accordance with Resolution 160 (WRC-15) with options

Method B1 – Revision of the regulatory provisions for HAPS in the FS with a primary status in bands already identified for HAPS

This may include, e.g. global or regional identification for HAPS, limitations regarding link directions, and inclusion of the technical conditions of operation of HAPS systems for the protection of other services. This could be achieved by new or revised footnotes to the Table of Frequency Allocations, and new or revised associated Resolutions.

Method B2 – Add new identification(s) for HAPS in bands already allocated to the FS with a primary status

This may include, e.g. global or regional identification for HAPS, limitations regarding link directions, and inclusion of the technical conditions of operation of HAPS systems for the protection of other services. This could be achieved by new or revised footnotes to the Table of Frequency Allocations, and new or revised associated Resolutions.

Method B3 – Add a primary allocation to the FS and a new identification for HAPS in the band 24.25-25.25 GHz (Region 2) not already allocated to the FS

This may include, primary allocation for FS in Region 2 and identification for HAPS in that Region, together with conditions e.g. limitations regarding link directions, and inclusion of the technical conditions of operation of HAPS systems for the protection of other services. This could be achieved by new or revised footnotes to the Table of Frequency Allocations, and new or revised associated Resolutions.

Method C – Suppress the existing HAPS identification, pursuant to *resolves* 3 of Resolution **160 (WRC-15)**

View 1: Some administrations are of the view that method B3 is out-of-scope of Resolution 160. Resolution 160 permits HAPS identifications only in bands allocated to the fixed service on a primary basis. In Region 2, the band 24.25-25.25 GHz is not allocated to the fixed service. In addition, no studies have been performed between the fixed service and other incumbent services except for HAPS fixed links and primary and adjacent existing services.

View 2: Some administrations are of the view that method B3 is in the scope of Resolution 160. Resolution 160 permits a HAPS identification in the band 24.25-27.5 GHz in Region 2. In Region 2, the 24.25-25.25 GHz portion of this range is not allocated to the fixed service, but Resolution 160 inconsistently states that the entire 24.25-27.5 GHz range is allocated to the fixed service. Therefore, this sub-band could be allocated to the fixed service under agenda item 1.14, but limited to HAPS application only, since no studies have been performed between conventional fixed service systems and other incumbent services.

An overview of methods and relevant options currently considered in this CPM text under the agenda item is provided in the table below:

TABLE 1/1.14/4

Summary of methods to satisfy the agenda item and associated frequency bands

| Section 1/1.14/ | Bands | Methods and options | | |
|--------------------|-------------------------------|---------------------|--------------|----------|
| | | Method A | Method B | Method C |
| 4.1/5.1 | 6 440-6 520 MHz | √ | B1 | √ |
| 4.2/5.2 | 6 560-6 640 MHz | √ | Not proposed | √ |
| 4.3/5.3 | 21.4-22 GHz (R2 only) | √ | B2 | N/A |
| 4.4/5.4 | 24.25-25.25 GHz (R2 only) | √ | B3 | N/A |
| 4.5/5.5 | 25.25-27.5 GHz (R2 only) | √ | B2 | N/A |
| 4.6/5.6 | 27.9-28.2 GHz | √ | B1 | √ |
| 4.7/5.7 | 31-31.3 GHz | √ | B1 | √ |
| 4.8/5.8 | 38-39.5 GHz | √ | B2 | N/A |
| 4.9/5.9 | 47.2-47.5 GHz / 47.9-48.2 GHz | √ | B1 | √ |

1/1.14/4.1 Frequency bands 6 440–6 520 MHz

Methods A, B1 and C are applicable (see Methods 1A, 1B1 and 1C in section 1/1.14/5.1).

In case Method A is applied

There would be no change to the HAPS identification in the 6 440-6 520 MHz band.

In case Method B1 is applied

Option 1: Identify the band 6 440-6 520 MHz worldwide for use by HAPS and limited to HAPS-to-ground direction via a new footnote RR No. **5.A114[-6400B1-O1]** together with a new Resolution **[A114-6400B1-O1] (WRC-19)** that will incorporate all necessary provisions to protect the existing services and taking into account RR No. **5.458**. To this effect the existing footnote RR No. **5.457** and existing Resolution **150 (WRC-12)** need to be amended accordingly.

Option 2: Identify the band 6 440-6 520 MHz worldwide for use by HAPS stations and limited to HAPS-to-ground direction, subject to the provisions of draft new Resolution **[A114-6400B1-O2] (WRC-19)**, to protect existing primary services and taking into account RR No. **5.458**; including that HAPS shall not cause harmful interference to, nor claim protection from existing primary services.

In case Method C is applied

The current identification in RR No. **5.457** and Resolution **150 (WRC-12)** would be suppressed, since the identification may not be technically feasible for HAPS on the condition that those affected countries agree, where applicable.

1/1.14/4.2 Frequency band 6 560-6 640 MHz

Methods A and C are applicable (see Methods 2A and 2C in section 1/1.14/5.2 below).

In case Method A is applied

The band 6 560-6 640 MHz is not under consideration for HAPS; therefore, no modifications are required. The existing HAPS identification will remain unchanged, limited to the ground-to-HAPs direction, in accordance with Resolution **150 (WRC-12)**.

In case Method C is applied

The current identification to HAPS in the band 6 560-6 640 MHz in RR No. **5.457** and Resolution **150 (WRC-12)** would be suppressed.

1/1.14/4.3 Frequency band 21.4-22 GHz for Region 2 only

Methods A and B2 are applicable (see Methods 3A and 3B2 in section 1/1.14/5.3).

In case Method A is applied

There would be no change to the frequency band 21.4-22 GHz.

In case Method B2 is applied

Option 1a: Identify in a new footnote RR No. **5.B114[-21B2-O1a]** the band 21.4-22 GHz in Region 2 for use by HAPS stations in the HAPS-to-ground direction. Such use is proposed to be subject to the provisions of a new Resolution **[B114-21B2-O1] (WRC-19)** that will incorporate all necessary provisions to protect existing services.

Option 1b: Same as option 1a but with reference to a new footnote **5.B114[-21B2-O1b]**.

Option 2: Identify in a new footnote RR No. **5.A114[-21B2-O2]** the band 21.5-22 GHz in Region 2 for use by HAPS stations in the HAPS-to-ground direction, subject to the provisions of draft new Resolution **[B114-21B2-O2] (WRC-19)**, containing necessary provisions to protect existing primary services; including that HAPS shall not cause harmful interference to, nor claim protection from existing primary services.

1/1.14/4.4 Frequency band 24.25-25.25 GHz for Region 2 only

Method A and B3 are applicable (see Methods 4A and 4B3 in section 1/1.14/5.4 below).

In case Method A is applied

There would be no change to the frequency band 24.25-25.25 GHz.

In case Method B3 is applied

Option 1: Allocate in Region 2 the band 24.25-25.25 GHz to the fixed service for the operation of HAPS systems. Identify the bands 24.25-25.25 GHz in Region 2 for use by HAPS in the HAPS-to-ground direction in a new footnote RR No. **5.C114[-24B3-O1]**. Such use is proposed to be subject to the provisions of a new Resolution **[C114-24B3-O1] (WRC-19)** that will incorporate all necessary provisions to protect existing services.

Option 2: Same as option 1 but with a reference to Resolution **[C114-24B3-O2] (WRC-19)**.

1/1.14/4.5 Frequency band 25.25-27.5 GHz for Region 2 only

Method A and B2 are applicable (see Methods 5A and 5B2 in section 1/1.14/5.5 below).

In case Method A is applied

There would be no change to the frequency band 25.25-27.5 GHz.

In case Method B2 is applied

Option 1: Identify the bands 25.25-25.5 GHz in Region 2 for use by HAPS in the ground-to-HAPS direction and 27-27.5 GHz in Region 2 for use by HAPS in the HAPS-to-ground direction in a new footnote RR No. **5.D114[-26B2-O1]**. Such use is proposed to be subject to the provisions of a new Resolution **[C114-24B3-O1] (WRC-19)** that will incorporate all necessary provisions to protect existing services.

Option 2: Identify the bands 25.25-27 GHz in Region 2 for use by HAPS in the ground-to-HAPS direction and 27-27.5 GHz in Region 2 for use by HAPS in the HAPS-to-ground direction. Furthermore, limit the use of the band 25.5 to 27 GHz to gateway links. The identifications are to be shown in a new footnote RR No. **5.D114[-26B2-O2]**. Such use is proposed to be subject to the provisions of a new Resolution [**C114-24B3-O2**] (**WRC-19**) that will incorporate all necessary provisions to protect existing services.

Option 3: Identify the band 25.25-27.5 GHz in Region 2 for use by HAPS stations, subject to the provisions of new Resolution [**D114-26B2-O3**] (**WRC-19**), containing necessary provisions to protect existing services. Such use of the fixed service allocation by HAPS is limited to operation in the ground-to-HAPS direction in the frequency range 25.25-27 GHz, and HAPS-to-ground direction in the frequency range 27.0-27.5 GHz. HAPS shall not cause harmful interference to, nor claim protection from existing services.

View 1: Some administrations are of the view that, with regard to option 2 and 3, the protection of EESS and SRS receiving earth stations operating in the band 25.5-27 GHz would require the deactivation of RR **5.536A** for HAPS applications operating under the fixed service, since this footnote states that EESS and SRS cannot claim protection from FS in this band.

View 2: Some administrations are of the view that, any modifications to RR footnote **5.536A** are considered outside the scope of agenda item 1.14. Footnote **5.536A** refers specifically to the status of Earth stations in the EESS and SRS with respect to the fixed and mobile services. Agenda item 1.14 deals with an application in the fixed service and does not address the status of other services. Therefore, any proposed changes to RR No. **5.536A** would change the status of both the EESS and SRS services and in the context of agenda item 1.14 is considered out of scope. Regarding the protection of the EESS and SRS earth stations at 26 GHz from HAPS operating within the fixed service, it is considered sufficient to place technical conditions on HAPS without the need to introduce Article 9 coordination which would also be inconsistent with RR No. **5.536A**.

1/1.14/4.6 Frequency band 27.9-28.2 GHz

Methods A, B1 and C are applicable (see Methods 6A, 6B1 and 6C in section 1/1.14/5.6 below).

In case Method A is applied

The current identification would remain for fixed HAPS links as provided in RR No. **5.537A**.

In case Method B1 is applied

Option 1: Identify the band 27.9-28.2 GHz worldwide for use by HAPS and limited to HAPS-to-ground direction through a new footnote RR No. **5.E114[-28B1-O1]**. A new Resolution [**E114-28+31B1-O1**] (**WRC-19**) will incorporate all necessary provisions to protect the existing services. Suppress RR No. **5.537A** and modify Resolution **145 (Rev.WRC-12)** accordingly.

Option 2: Identify the band 27.9-28.2 GHz worldwide for use by HAPS and limited to HAPS-to-ground direction through a new footnote RR No. **5.E114[-28B1-O2]**. Develop a new Resolution [**E114-28+31B1-O2**] (**WRC-19**) that will incorporate all necessary provisions to protect the existing services, maintaining that HAPS shall not cause harmful interference to, nor claim protection from existing services. Suppress RR No. **5.537A** and Resolution **145 (Rev.WRC-12)** accordingly.

In case Method C is applied

The current identification in RR No. **5.537A** and Resolution **145 (Rev.WRC-12)** would be suppressed.

1/1.14/4.7 Frequency band 31-31.3 GHz

Methods A, B1 and C are applicable (see Methods 7A, 7B1 and 7C in section 1/1.14/5.7 below).

In case Method A is applied

There would be no change to the HAPS identification in the 31-31.3 GHz band. The current identification would remain for fixed HAPS links as provided in RR No. **5.543A**.

In case Method B1 is applied

Option 1a: Identify worldwide the band 31-31.3 GHz for use by HAPS in the HAPS-to ground direction through an new footnote RR No. **5.F114[-31B1-O1A]**. Such use is proposed to be subject to the provisions of a new Resolution **[E114-28+31B1-O1] (WRC-19)** and/or Resolution **145 (Rev.WRC-12)** that will be amended to incorporate all necessary provisions to protect the existing services.

Option 1b: Identify worldwide the band 31–31.3 GHz for use by HAPS in the ground-to-HAPS direction through an new footnote RR No. **5.F114[-31B1-O1B]**. Such use is proposed to be subject to the provisions of a new Resolution **[E114-28+31B1-O1] (WRC-19)** and/or Resolution **145 (Rev.WRC-12)** that will be amended to incorporate all necessary provisions to protect the existing services.

Option 2: Identify the band 31-31.3 GHz worldwide through a new footnote RR No. **5.F114[-31B1-O2]** for use by HAPS in the HAPS-to-ground direction. This identification will be subject to the provisions of draft new Resolution **[E114-28+31B1-O2] (WRC-19)** to incorporate all necessary provisions to protect existing primary services; maintaining that HAPS shall not cause harmful interference to, nor claim protection from existing services.

In case Method C is applied

The current identification in RR No. **5.543A** and Resolution **145 (Rev.WRC-12)** would be suppressed.

1/1.14/4.8 Frequency band 38-39.5 GHz

Method A and B2 are applicable (see Methods 8A and 8B2 in section 1/1.14/5.8 below).

In case Method A is applied

There would be no change to the 38-39.5 GHz frequency band.

In case Method B2 is applied

Option 1a: Identify the band 38-39.5 GHz through a new footnote RR No. **5.G114[-38B2-O1A]** for use by HAPS in the HAPS-to-ground direction on a worldwide basis. Such use is proposed to be subject to the provisions of a new Resolution **[G114-38B2-O1A+B] (WRC-19)** that will incorporate all necessary provisions to protect other services.

Option 1b: Identify the band 38-39.5 GHz through a new footnote RR No. **5.G114[-38B2-O1B]** for use by HAPS in the ground-to-HAPS direction on a worldwide basis. Such use is proposed to be subject to the provisions of a new Resolution **[G114-38B2-O1A+B] (WRC-19)** that will incorporate all necessary provisions to protect other services.

Option 1c: Identify the band 38-39.5 GHz through a new footnote RR No. **5.G114[-38B2-O1C]** for use by HAPS in the ground-to-HAPS direction on a worldwide basis with all relevant provisions included in a new footnote RR No. **5.G114-38B2-O1C]**.

Option 2: Identify the band 38-39.5 GHz through a new footnote RR No **5.G114[-38B2-O2]** for use by HAPS stations in the ground-to-HAPS direction on a worldwide basis. This identification would be subject to the provisions of draft new Resolution **[G114-38B2-O2] (WRC-19)** containing necessary provisions to protect co-primary services. HAPS shall not cause harmful interference to, nor claim protection from existing services.

1/1.14/4.9 Frequency band 47.2-47.5 GHz and 47.9-48.2 GHz

Methods A, B1 and C are applicable (see Methods 9A, 9B1 and 9C in section 1/1.14/5.9 below).

In case Method A is applied

There would be no change to the HAPS identifications in the 47.2-47.5 GHz and 47.9-48.2 GHz bands.

In case Method B1 is applied

The use of the bands by HAPS is proposed to be subject to the provisions of Resolution **122 (WRC-07)** amended to review the protection of existing services.

In case Method C is applied

The current identification in RR No. **5.552A** would be suppressed together with Resolution **122 (WRC-07)**.

1/1.14/5 Regulatory and procedural considerations

NOTE: The *resolves* below provides a possible example of a mechanism to address the protection of FS with high elevation angles. This provision requires further clarification and may be included in relevant resolution.

with regard to the protection of fixed service stations with pointing elevation beyond 25°, an administration believing that unacceptable interference may still be caused shall, within four months of the date of publication of the relevant BR IFIC, provide its comments with technical justification to the notifying administration.

1/1.14/5.1 Frequency band 6 440-6 520 MHz

1/1.14/5.1.1 For Method 1A

NOC

ARTICLE 5

Frequency allocations

NOC

RESOLUTION 150 (WRC-12)

Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links for high-altitude platform stations in the fixed service

1/1.14/5.1.2 For Method 1B

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

5 570-6 700 MHz

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 5 925-6 700 | FIXED MOD 5.457 ADD 5.A114 FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B MOBILE 5.457C 5.149 5.440 5.458 | |

1/1.14/5.1.2.1 For Method 1B1, Option 1

ADD

5.A114[-6400B1-O1] The allocation to the fixed service in the band 6 440-6 520 MHz is identified for worldwide use by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the operation of gateway links in the HAPS-to-ground direction and shall be in accordance with the provisions of Resolution **[A114-6400B1-O1] (WRC-19)**. (WRC-19)

MOD

5.457 In Australia, Burkina Faso, Cote d'Ivoire, Mali and Nigeria, the allocation to the fixed service in the bands ~~6 440-6 520 MHz (HAPS to ground direction)~~ and 6 560-6 640 MHz (ground-to-HAPS direction) may also be used by gateway links for high-altitude platform stations (HAPS) within the territory of these countries. Such use is limited to operation in HAPS gateway links and shall not cause harmful interference to, and shall not claim protection from, existing services, and shall be in compliance with Resolution **150 (Rev. WRC-1219)**. Existing services shall not be constrained in future development by HAPS gateway links. The use of HAPS gateway links in these

bands requires explicit agreement with other administrations whose territories are located within 1 000 kilometres from the border of an administration intending to use the HAPS gateway links. (WRC-19)

1/1.14/5.1.2.2 For Method 1B1, Option 2

ADD

5.A114[-6400B1-O2] The allocation to the fixed service in the 6 440-6 520 MHz band is identified for worldwide use by administrations wishing to implement high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction and shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS subject to the provisions of Resolution [A114-6400B1-O2] (WRC-19). (WRC-19)

1/1.14/5.1.2.3 Example Resolution for Method 1B1 – Option 1

ADD

DRAFT NEW RESOLUTION [A114-6400B1-O1] (WRC-19)

Use of the bands 6 440-6 520 MHz by high-altitude platform stations in the fixed service

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

Note: No text has been developed, it may be proposed in contributions to WRC-19.

recognizing

- a) that in the band 6 440-6 520 MHz with respect to earth stations in the fixed-satellite service (Earth-to-space) and HAPS ground station receivers which operate in the fixed service, No. 9.17 applies,
- b) that ITU-R has studied technical and operational characteristics of HAPS gateway links in the fixed service in the range 6 440-6 520 MHz resulting in Report ITU-R F.2439;
- c) that Report ITU-R F.2437 contains the results of interference analyses between HAPS gateway links in the fixed service and other systems/services in the range 6 440-6 520 MHz;
- d) that the World Summit on the Information Society has encouraged the development and application of emerging technologies to facilitate infrastructure and network development worldwide with special focus on under-served regions and areas,

resolves

- 1 that for the purpose of protecting the fixed service systems in territory of other administrations in the band 6 440-6 520 MHz, the power flux-density level per HAPS at the surface

of the Earth in territory of other administrations shall not exceed the following limits unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|---|------------------------------|-----|---------------|
| -160 | dB(W/(m ² · MHz)) | for | 0° ≤ θ < 6° |
| 3.75 θ - 182.5 | dB(W/(m ² · MHz)) | for | 6° ≤ θ < 10° |
| -152.5 + 25.5 log ₁₀ (θ - 8) | dB(W/(m ² · MHz)) | for | 10° ≤ θ < 56° |
| -109.63 | dB(W/(m ² · MHz)) | for | 56° ≤ θ ≤ 90° |

where θ is the angles of arrival of the incident wave above the horizontal plane, in degrees.

Option 1: To verify that the pfd produced by a HAPS does not exceed the above pfd mask, the following equation shall be used:

$$pfd(\theta) = e.i.r.p(\theta) + 10 \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

e.i.r.p.: maximum HAPS e.i.r.p. density level in dB(W/MHz) (dependent on the elevation angle θ);

d: distance in metres between the HAPS and the ground (elevation angle dependent);

pfd(θ): power flux-density at the Earth's surface per HAPS in dB(W/(m² · MHz));

Option 2: These limits relate to the power flux-density which would be obtained under assumed free-space propagation conditions.

2 that for the purpose of protecting the mobile service systems in territory of other administrations in the band 6 440-6 520 MHz, the power flux-density level at the surface of the Earth in territory of other administrations per HAPS shall not exceed the following limits unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|--------------|------------------------------|-----|---------------|
| 0.35 θ - 120 | dB(W/(m ² · MHz)) | for | 0° ≤ θ < 40° |
| -106 | dB(W/(m ² · MHz)) | for | 40° ≤ θ ≤ 90° |

where θ is the angles of arrival of the incident wave above the horizontal plane, in degrees.

Option 1: To verify that the pfd produced by a HAPS does not exceed the above pfd mask, the following equation shall be used:

$$pfd(\theta) = e.i.r.p(\theta) + 10 \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

e.i.r.p.: maximum HAPS e.i.r.p. density level in dB(W/MHz) (dependent on the elevation angle θ);

d: distance in metres between the HAPS and the ground (elevation angle dependent);

pfd(θ): power flux-density at the Earth's surface per HAPS in dB(W/(m² · MHz)).

Option 2: These limits relate to the power flux-density which would be obtained under assumed free-space propagation conditions.

3 that for the purpose of protecting fixed-satellite service space station receivers in the band 6 440-6 520 MHz, the e.i.r.p. density per HAPS platform transmitter shall be limited to -16.1 dB(W/MHz) for off-nadir angles higher than 95°;

4 that for the purpose of protecting EESS (passive) operations over oceans, the e.i.r.p. density of HAPS operating over the oceans or over the land at a distance lower than 29 km from a coast line (distance between the HAPS nadir point and the coast line) shall be limited to -34.9 dB(W/200 MHz) for off-nadir angles higher than 125°;

5 that administrations planning to implement a HAPS system in the 6 440-6 520 MHz band shall notify the frequency assignments by submitting all mandatory elements of Appendix 4 to the Bureau for the examination of compliance with respect to the Radio Regulations with a view to their registration in the Master International Frequency Register,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

MOD

RESOLUTION 150 (~~REV.WRC-12~~19)

Use of the bands ~~6 440-6 520 MHz~~ and 6 560-6 640 MHz by gateway links for high-altitude platform stations in the fixed service

The World Radiocommunication Conference (~~Geneva, 2012~~Sharm el-Sheikh, 2019),

considering

a) that ITU has among its purposes “to promote the extension of the benefit of the new telecommunication technologies to all the world’s inhabitants” (No. 6 of the Constitution);

b) that systems based on new technologies using high-altitude platform stations (HAPS) can potentially be used for various applications such as the provision of high-capacity services to urban and rural areas;

c) that provision has been made in the Radio Regulations for the deployment of HAPS in specific bands, including as base stations to serve IMT networks;

d) that at WRC-07, a need for provision for gateway links to serve HAPS operations was expressed;

e) that WRC-07 invited ITU-R to conduct sharing studies, with a view to identifying two channels of 80 MHz each for gateway links for HAPS in the range from 5 850 to 7 075 MHz, in bands already allocated to the fixed service, while ensuring the protection of existing services;

f) that for the purpose of protecting the operations of the Earth exploration-satellite service (EESS) (passive) in the band 6 425-7 075 MHz, No. **5.458** applies;

g) that for the purpose of protecting the radio astronomy service in the band 6 650-6 675.2 MHz, No. **5.149** applies;

h) that the range 5 850-7 075 MHz is already heavily used or planned to be used by a number of different services and a number of other types of applications in the fixed service;

- i) that in order to accommodate the need stated in *considering d)*, WRC-12 adopted No. **5.457** to permit the use of HAPS gateway links in the fixed service in the bands 6 440-6 520 MHz and 6 560-6 640 MHz in the limited number of countries listed in the footnote;
- j) that compatibility between HAPS and affected services will largely depend on the number of administrations deploying HAPS and the total number of such systems;
- k) that while the deployment of HAPS gateway links in the bands ~~6 440-6 520 MHz and~~ 6 560-6 640 MHz is taken on a national basis, such deployment would affect other administrations;
- l) that Appendix 4 does not contain all the necessary data elements pertaining to HAPS gateway links,

recognizing

- a) that ITU-R has studied technical and operational characteristics of HAPS gateway links in the fixed service in the range 5 850-7 075 MHz resulting in Recommendation ITU-R F.1891;
- b) that Recommendation ITU-R F.2011 contains a methodology to evaluate interference from HAPS gateway downlinks in the fixed service to conventional fixed wireless systems in the range 5 850-7 075 MHz;
- c) that Report ITU-R F.2240 contains the results of interference analyses between HAPS gateway links in the fixed service and other systems/services in the range 5 850-7 075 MHz;
- d) that the World Summit on the Information Society has encouraged the development and application of emerging technologies to facilitate infrastructure and network development worldwide with special focus on under-served regions and areas,

resolves

- 1 that the antenna pattern for ~~both the HAPS platform and~~ the HAPS gateway station in the bands ~~6 440-6 520 MHz and~~ 6 560-6 640 MHz shall meet the following antenna beam patterns:

$$\begin{aligned}
 G(\psi) &= G_m - 3(\psi/\psi_b)^2 & \text{dBi} & \quad \text{for} & \quad 0^\circ \leq \psi \leq \psi_1 \\
 G(\psi) &= G_m + L_N & \text{dBi} & \quad \text{for} & \quad \psi_1 < \psi \leq \psi_2 \\
 G(\psi) &= X - 60 \log(\psi) & \text{dBi} & \quad \text{for} & \quad \psi_2 < \psi \leq \psi_3 \\
 G(\psi) &= L_F & \text{dBi} & \quad \text{for} & \quad \psi_3 < \psi \leq 90^\circ
 \end{aligned}$$

where:

$G(\psi)$: gain at the angle ψ from the main beam direction (dBi);

G_m : maximum gain in the main lobe (dBi);

ψ_b : one-half of the 3 dB beamwidth in the plane considered (3 dB below G_m) (degrees);

L_N : near side-lobe level (dB) relative to the peak gain required by the system design, and has a maximum value of -25 dB;

L_F : far side-lobe level, $G_m - 73$ dBi.

$$\psi_1 = \psi_b \sqrt{L_N/3} \quad \text{degrees}$$

$$\psi_2 = 3.745 \psi_b \quad \text{degrees}$$

$$X = G_m + L_N + 60 \log(\psi_2) \quad \text{dBi}$$

$$\psi_3 = 10^{(X-L_F)/60} \quad \text{degrees}$$

$$\Psi_b = \sqrt{7\,442 / (10^{0.1G_m})} \quad \text{degrees;}$$

2 that the maximum angle of deviation of the HAPS airborne antenna from the nadir for gateway links shall be limited to 60 degrees corresponding to the urban area coverage of the HAPS; and the maximum number of gateway stations operating with a single platform shall not exceed 5;

3 that the minimum antenna elevation angle of HAPS gateway stations on the ground shall be 30 degrees;

4 that for the purpose of protecting the fixed satellite service (Earth-to-space), the aggregate ~~power flux-density~~ of HAPS uplinks shall be limited to a maximum of $-183.9 \text{ dB(W/(m}^2 \text{ in } 4 \text{ kHz))}$ at any point in the geostationary arc. To meet this aggregate ~~power flux-density~~ criterion, the maximum e.i.r.p. ~~density~~ value of a single HAPS gateway link towards the geostationary arc shall not exceed $-59.9 \text{ dB(W/4 kHz)}$ in any direction within ± 5 degrees of the geostationary arc;

~~5 that for the purpose of protecting the fixed wireless systems in other administrations in the band 6 440-6 520 MHz, the e.i.r.p. of the HAPS downlink shall be limited to a maximum of -0.5 dBW/10 MHz for all off-axis angles from the nadir to 60 degrees from the nadir;~~

~~6~~5 that for the purpose of protecting EESS passive operations over oceans, HAPS gateway stations shall maintain a minimum distance of 100 kilometres for a single HAPS gateway station and 150 kilometres for several HAPS gateway stations from coast lines;

~~7~~6 that administrations planning to implement HAPS gateway links in the notification to the Bureau of the frequency assignment(s) shall submit all mandatory parameters for the examination by the Bureau for compliance with respect to *resolves* 1 to ~~6~~5 above, and also the explicit agreement obtained pursuant to No. **5.457**,

invites

administrations to consult with the Director of the Radiocommunication Bureau to determine the data elements of HAPS gateway stations necessary for notification and examination of frequency assignments in accordance with the provisions of Article **11** and Appendix **4**,

instructs the Director of the Radiocommunication Bureau

to implement this Resolution.

1/1.14/5.1.3 For Method 1C

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. **2.1**)

MOD**5 570-6 700 MHz**

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 5 925-6 700 | FIXED- 5.457 FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B MOBILE 5.457C 5.149 5.440 5.458 | |

SUP**5.457****SUP****RESOLUTION 150 (WRC-12)**

**Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links
for high-altitude platform stations in the fixed service**

NOTE: If one of the two bands in RR No. 5.457 and Resolution 150 (WRC-12) is suppressed and the other is maintained, there would need to be consequential modifications to both the footnote and the resolution in implementation of Method C.

1/1.14/5.2 Frequency band 6 560–6 640 MHz**1/1.14/5.2.1 For Method 2A****NOC****ARTICLE 5****Frequency allocations****NOC****RESOLUTION 150 (WRC-12)**

**Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links
for high-altitude platform stations in the fixed service**

1/1.14/5.2.2 For Method 2C

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

5 570-6 700 MHz

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 5 925-6 700 | FIXED 5.457 FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B MOBILE 5.457C 5.149 5.440 5.458 | |

SUP

5.457

SUP

RESOLUTION 150 (WRC-12)

Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links for high-altitude platform stations in the fixed service

NOTE: If one of the two bands in No. 5.457 and Resolution 150 (WRC-12) is suppressed and the other is maintained, there would need to be consequential modifications to both the footnote and the resolution in implementation of Method C.

1/1.14/5.3 Frequency band 21.4-22 GHz for Region 2 only

1/1.14/5.3.1 For Method 3A

NOC

ARTICLE 5

Frequency allocations

1/1.14/5.3.2 For Method 3B2

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

18.4-22 GHz

| Allocation to services | | |
|---|---|---|
| Region 1 | Region 2 | Region 3 |
| 21.4-22 FIXED MOBILE BROADCASTING-SATELLITE 5.208B 5.530A 5.530B 5.530D | 21.4-22 FIXED <u>ADD 5.B114</u> MOBILE 5.530A | 21.4-22 FIXED MOBILE BROADCASTING-SATELLITE 5.208B 5.530A 5.530B 5.530D 5.531 |

1/1.14/5.3.2.1 For Method 3B2, Option 1

ADD

5.B114[-21B2-O1a] The allocation to the fixed service in the band 21.4-22 GHz is identified for use in Region 2 by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction and shall be in accordance with the provisions of Resolution [B114-21B2-O1] (WRC-19).

ADD

5.B114[-21B2-O1b] The allocation to the fixed service in the band 21.4-22 GHz is identified for use in Region 2 by high-altitude platform stations (HAPS). This identification does not preclude the use of this frequency band by any application of the services to which it is allocated on a co-primary

basis and does not establish priority in the Radio Regulations. Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction and shall be in accordance with the provisions of Resolution **[B114-21B2-O1] (WRC-19)**. (WRC-19)

1/1.14/5.3.2.2 For Method 3Bs2, Option 2

ADD

5.B114[-21B2-O2] In Region 2, the allocation to the fixed service in the band 21.5-22 GHz may also be used by administrations wishing to implement high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction and shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. See Resolution **[B114-21B2-O2] (WRC-19)**. (WRC-19)

1/1.14/5.3.2.3 Example Resolution for Method 3B2 – Option 1

ADD

DRAFT NEW RESOLUTION [B114-21B2-O1] (WRC-19)

Use of the bands 21.4-22 GHz by high-altitude platform stations in the fixed service for Region 2

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;
- b)* that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 21.4-22 GHz in Region 2, recognizing that the existing HAPS identifications were established without reference to today's broadband capabilities;
- c)* that HAPS can provide broadband connectivity with minimal ground network infrastructure;
- d)* that ITU-R has conducted studies dealing with compatibility between systems using HAPS and existing services in the band 21.4-22 GHz in Region 2 leading to Report ITU-R F.[HAPS-21],

recognizing

Note: No text has been developed, it may be proposed in contributions to WRC-19.

resolves

- 1* that for the purpose of protecting fixed service systems in territory of other administrations in the band 21.4-22 GHz, the power flux-density level per HAPS at the surface of

the Earth in territory of other administrations shall not exceed the following limits, under clear-sky conditions, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|---------------------|---------------------------------------|-----|--------------------------------------|
| $0.7 \theta - 135$ | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $0^\circ \leq \theta < 10^\circ$ |
| $2.4 \theta - 152$ | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $10^\circ \leq \theta < 20^\circ$ |
| $0.45 \theta - 113$ | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $20^\circ \leq \theta < 60^\circ$ |
| -86 | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $60^\circ \leq \theta \leq 90^\circ$ |

where θ is the angles of arrival of the incident wave above the horizontal plane, in degrees;

Option 1: In order to compensate for additional propagation impairments in the boresight of any beam of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e. suffering the rain fade) by a value only equivalent to the level of rain fading and limited to a maximum of 20 dB.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(\theta) = e.i.r.p.(\theta) + 10 \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

- d : distance in metres between the HAPS and the ground (elevation angle dependent);
- $e.i.r.p.$: HAPS nominal e.i.r.p. density in dB(W/MHz) (dependent to the elevation angle θ);
- $pfd(\theta)$: is the power flux-density at the Earth's surface per HAPS in $\text{dB(W/(m}^2 \cdot \text{MHz))}$.

Option 2: These limits relate to the power flux-density which would be obtained under clear-sky conditions with assumed free-space propagation. These limits were derived by taking into account the impact of gaseous attenuation and polarization loss.

2 that in order to ensure the protection of EESS (passive), the e.i.r.p. density in the bands 21.2-21.4 GHz and 22.21-22.5 GHz, per HAPS operating in the band 21.4-22 GHz, shall not exceed:

| | | | |
|----------------------|------------------------|-----|--|
| $-0.76 \theta - 9.5$ | dB(W/100 MHz) | for | $-4.53^\circ \leq \theta < 35.5^\circ$ |
| -36.5 | dB(W/100 MHz) | for | $35.5^\circ \leq \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane);

3 that in order to ensure the protection of the radio astronomy service, the unwanted emission power flux density produced by HAPS downlink transmissions shall not exceed $-176 \text{ dB(W/(m}^2 \cdot 290 \text{ MHz))}$ for continuum observations, and $-192 \text{ dB(W/(m}^2 \cdot 250 \text{ kHz))}$ for spectral line observations in the band 22.21-22.5 GHz at an RAS station location at a height of 50 m. This limit relates to the power flux-density which would be obtained using a time percentage of 2% in the relevant propagation model;

Option 1:

To verify the compliance, the following formula shall be used:

$$pfd = e.i.r.p.\text{nominal clear sky} (Az, \theta) + Att_{618_{p=2\%}} + 10 * \log_{10} \left(\frac{1}{4\pi d^2} \right) - GasAtt(\theta)$$

where:

e.i.r.p.nominal clear sky: is the nominal unwanted emission e.i.r.p. density towards the RAS station at which the HAPS operates under clear-sky conditions in dB(W/290 MHz) for continuum observations and in dB(W/250 kHz) for spectral line observations in the band 22.21-22.5 GHz;

Az: is the azimuth from the HAPS toward the RAS station;

θ: is the elevation angle at the HAPS towards the RAS station;

Att_{618p=2%}: is the attenuation from Recommendation ITU-R P.618 corresponding to *P* = 2% of the time at the radio astronomy location;

d: is the separation distance in m between the HAPS platform;

GasAtt(θ): is gaseous attenuation for elevation *θ* (Rec. ITU-R SF.1395).

Option 2:

NOTE: No formula necessary.

4 that *resolves* 3 shall apply at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020, or at any radio astronomy station that was notified before the date of receipt of the complete Appendix 4 information for notification for the HAPS system to which *resolves* 3 applies. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS;

5 that administrations planning to implement a HAPS system in the 21.4-22 GHz shall notify the frequency assignments by submitting all mandatory elements of Appendix 4 to the Bureau for the examination of compliance with respect to the Radio Regulations with a view to their registration in the Master International Frequency Register,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

1/1.14/5.3.2.4 Example Resolution for Method 3B2 – Option 2

ADD

DRAFT NEW RESOLUTION [B114-21B2-O2] (WRC-19)

Use of the bands 21.5-22 GHz by high-altitude platform stations in the fixed service for Region 2

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

a) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 21.4-22 GHz in Region 2;

- b) that HAPS can provide broadband connectivity with minimal ground network infrastructure;
- c) that compatibility with existing services allocated on a primary basis in the frequency range 21.4-22 GHz must be ensured when introducing any new HAPS designations;
- d) that Recommendation ITU-R P.618, "Propagation data and prediction methods required for the design of Earth-space telecommunication systems", should be used to determine rain attenuation from HAPS platforms,

recognizing

- a) that existing services and their applications shall be protected from HAPS applications, and no undue constraints shall be imposed on the future development of existing services by HAPS;
- b) that No. **5.532** requires that the use of the band 22.21-22.5 GHz by the Earth exploration-satellite (passive) and space research (passive) services shall not impose constraints upon the fixed and mobile, except aeronautical mobile, services;
- c) that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**,

resolves

1 that for the purpose of protecting fixed service systems in territory of other administrations in the band 21.4-22 GHz, the power flux-density level per HAPS produced at the surface of the Earth in territory of other administrations shall not exceed the following limits, under clear-sky conditions, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|--------------------|------------------------------|-----|--------------------------------------|
| $0.7 \theta - 135$ | dB(W/(m ² · MHz)) | for | $0^\circ \leq \theta < 10^\circ$ |
| $2.4 \theta - 152$ | dB(W/(m ² · MHz)) | for | $10^\circ \leq \theta < 20^\circ$ |
| $0.45 - 113$ | dB(W/(m ² · MHz)) | for | $20^\circ \leq \theta < 60^\circ$ |
| -86 | dB(W/(m ² · MHz)) | for | $60^\circ \leq \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

These limits relate to the power flux-density which would be obtained under clear-sky conditions with assumed free-space propagation and already include the impact of gaseous attenuation;

2 that in order to ensure the protection of EESS (passive), the e.i.r.p. density of each HAPS in the bands 21.2-21.4 GHz and 22.21-22.5 GHz, per HAPS operating in the band 21.5-22 GHz, shall not exceed:

| | | | |
|----------------------|---------------|-----|--|
| $-0.76 \theta - 9.5$ | dB(W/100 MHz) | for | $-4.53^\circ \leq \theta < 35.5^\circ$ |
| -36.5 | dB(W/100 MHz) | for | $35.5^\circ \leq \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane);

3 that in order to ensure the protection of the radio astronomy service, the unwanted emission pfd produced by HAPS downlink transmissions shall not exceed -176 dB(W/(m² · 290 MHz)) for continuum observations, and -192 dB(W/(m² · 250 kHz)) for spectral line observations in the band 22.21-22.5 GHz at an RAS station location at a height of 50 m, and that these pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model;

4 that *resolves* 3 shall apply at any radio astronomy station that was in operation prior to 22 November 2019 and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020 or at any radio astronomy station that was notified before the date of receipt of the complete Appendix 4 information for notification, for the HAPS system to which *resolves* 3 applies. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

1/1.14/5.4 Frequency band 24.25-25.25 GHz for Region 2 only

1/1.14/5.4.1 For Method 4A

NOC

ARTICLE 5

Frequency allocations

1/1.14/5.4.2 For Method 4B3

A new allocation to the fixed service in Region 2 is required as shown in the MOD table entry below:

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

22-24.75 GHz

| Allocation to services | | |
|-------------------------------|--|--|
| Region 1 | Region 2 | Region 3 |
| 24.25-24.45 FIXED | 24.25-24.45 <u>FIXED ADD 5.C114</u> RADIONAVIGATION | 24.25-24.45 RADIONAVIGATION FIXED MOBILE |

| | | |
|--|---|---|
| 24.45-24.65 FIXED INTER-SATELLITE | 24.45-24.65 <u>FIXED ADD 5.C114</u> INTER-SATELLITE RADIONAVIGATION 5.533 | 24.45-24.65 FIXED INTER-SATELLITE MOBILE RADIONAVIGATION 5.533 |
| 24.65-24.75 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE | 24.65-24.75 <u>FIXED ADD 5.C114</u> INTER-SATELLITE RADIOLOCATION- SATELLITE (Earth-to-space) | 24.65-24.75 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE MOBILE 5.533 |

MOD**24.75-29.9 GHz**

| Allocation to services | | |
|---|---|--|
| Region 1 | Region 2 | Region 3 |
| 24.75-25.25 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B | 24.75-25.25 <u>FIXED ADD 5.C114</u> FIXED-SATELLITE (Earth-to-space) 5.535 | 24.75-25.25 FIXED FIXED-SATELLITE (Earth-to-space) 5.535 MOBILE |

1/1.14/5.4.2.1 Method 4B3, Option 1**ADD**

5.C114[-24B3-O1] The allocation to the fixed service in the band 24.25-25.25 GHz is identified for and limited to use in Region 2 by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction, and shall be in accordance with the provisions of Resolution [C114-24B3-O1] (WRC-19). (WRC-19)

1/1.14/5.4.2.2 Method 4B3, Option 2**ADD**

5.C114[-24B3-O2] The allocation to the fixed service in the band 24.25-25.25 GHz is identified for and limited to use in Region 2 by high-altitude platform stations (HAPS), without any priority with respect to the other co-primary services allocated in this band. Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction, and shall be in accordance with the provisions of Resolution [C114-24B3-O2] (WRC-19). (WRC-19)

1/1.14/5.4.2.3 Example Resolution for Method 4B3 – Option 1 and Method 5B2 – Option 1

ADD

DRAFT NEW RESOLUTION [C114-24B3-O1] (WRC-19)

Use of the bands 24.25-25.5 GHz and 27-27.5 GHz by high-altitude platform stations in the fixed service in Region 2

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that WRC-15 considered that there is a need for greater broadband connectivity in under-served communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;
- b)* that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including the band 24.25-27.5 GHz in Region 2, recognizing that the existing HAPS identifications were established without reference to today's broadband capabilities;
- c)* that HAPS can provide broadband connectivity with minimal ground network infrastructure;
- d)* that ITU-R has conducted studies dealing with compatibility between HAPS systems and systems in existing services in the 24.25-27.5 GHz band and in adjacent band in Region 2 leading to Report ITU-R F.[HAPS-25 GHz],

recognizing

- a)* that in the bands 24.75-25.25 GHz and 27.0-27.5 GHz with respect to earth stations in the fixed-satellite service (Earth-to-space) and HAPS ground station receivers which operate in the fixed service, No. **9.17** applies;
- b)* that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**,

resolves

1 that for the purpose of protecting the fixed service systems in territory of other administrations in the bands 27-27.5 GHz, the power flux-density limit per HAPS at the surface of the Earth in territory of other administrations shall not exceed the following limits, under clear-sky conditions, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|------------------------|------------------------------|-----|--------------------------------------|
| 0.39 θ – 132.12 | dB(W/(m ² · MHz)) | for | $0^\circ \leq \theta < 13^\circ$ |
| 2.715 θ – 162.3 | dB(W/(m ² · MHz)) | for | $13^\circ \leq \theta < 20^\circ$ |
| 0.45 θ – 117 | dB(W/(m ² · MHz)) | for | $20^\circ \leq \theta < 60^\circ$ |
| –90 | dB(W/(m ² · MHz)) | for | $60^\circ \leq \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

In order to compensate for additional propagation impairments in the boresight of any beam of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e. suffering the rain fade) by a value only equivalent to the level of rain fading and limited to a maximum of 20 dB.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(\theta) = e.i.r.p.(\theta) + 10 \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

e.i.r.p.: is the nominal HAPS e.i.r.p. density level in dB(W/MHz) (dependent to the elevation angle θ);

d: is the distance in metres between the HAPS and the ground (elevation angle dependent);

pfd(θ): power flux-density at the Earth's surface per HAPS in dB(W/(m² · MHz));

2 that for the purpose of protecting the mobile service systems in territory of other administrations in the bands 24.25-25.25 GHz and 27-27.5 GHz, the power flux-density limit per HAPS at the surface of the Earth in territory of other administrations shall not exceed the following limits, under clear-sky conditions, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|---------------------|------------------------------|-----|---------------------------------------|
| 0.95 $\theta - 114$ | dB(W/(m ² · MHz)) | for | $0^\circ \leq \theta < 5.7^\circ$ |
| 0.6 $\theta - 112$ | dB(W/(m ² · MHz)) | for | $5.7^\circ \leq \theta \leq 20^\circ$ |
| -100 | dB(W/(m ² · MHz)) | for | $20^\circ \leq \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane).

In order to compensate for additional propagation Impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of fading.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(\theta) = e.i.r.p.(\theta) + 10 \cdot \log_{10} \left(\frac{1}{4\pi d^2} \right)$$

where:

d: distance in metres between the HAPS and the ground (elevation angle dependent);

e.i.r.p.: HAPS nominal e.i.r.p. spectral density in dB(W/MHz) at a specific elevation angle;

pfd(θ): power flux-density at the Earth's surface per HAPS station in dB(W/(m² · MHz));

3 that for the purpose of protecting the inter-satellite service, the e.i.r.p. density per HAPS in the bands 27-27.5 GHz, shall not exceed -70.7 dB(W/Hz) for off-nadir angle higher than 85.5°;

4 that for the purpose of protecting the inter-satellite service, the e.i.r.p. density per HAPS in the bands 24.45-24.75 GHz, shall not exceed -19.9 dB(W/MHz) for off-nadir angle higher than 85.5°;

Option 1:

5 that for the purpose of protection the inter-satellite service, the e.i.r.p. density per HAPS ground station in the band 25.25-25.5 GHz, shall not exceed 12.3 dB(W/MHz) under clear-sky conditions.

During periods of rain, the e.i.r.p. density limits for clear-sky conditions can be exceeded to the level needed to compensate for rain fade, up to 20 dB;

Option 2:

5 that for the purpose of protection the inter-satellite service maximum e.i.r.p. density in the band 25.25-25.5 GHz density of HAPS ground stations should not exceed 0.5 dB(W/MHz) in clear-sky conditions in the direction of inter-satellite service space stations on geostationary orbit.

Specific GSO positions which need to be protected are contained in latest version of Recommendation ITU-R SA.1276, it is also needed to take into account possible orbit inclination of space stations between -5° and 5° .

Automatic power control may be used to increase the e.i.r.p. density to compensate for rain attenuation, to the extent that interference into space station of inter-satellite service does not exceed the value resulting from use by HAPS ground stations of an e.i.r.p. density, meeting the above limits in clear-sky conditions;

6 that for the purpose of protecting the fixed-satellite service, the e.i.r.p. density per HAPS, in the bands 24.75-25.25 and 27-27.5 GHz, shall not exceed -9.1 dB(W/MHz) for off-nadir angles higher than 85.5° ;

7 that for the purpose of protecting the Earth exploration-satellite (passive) service, the e.i.r.p. density in the band 23.6-24 GHz per HAPS operating in the band 24.25-25.25 GHz, shall not exceed:

$$\begin{array}{lll} -0.7714 \theta - 16.5 & \text{dB(W/200 MHz)} & \text{for } -4.53^\circ \leq \theta < 35^\circ \\ -43.5 & \text{dB(W/200 MHz)} & \text{for } 35^\circ \leq \theta \leq 90^\circ \end{array}$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane);

8 that in order to ensure the protection of the radio astronomy service, the power flux-density produced by unwanted emissions from HAPS downlink transmissions operating in the band 24.25-25.25 GHz shall not exceed -177 dB(W/($\text{m}^2 \cdot 400$ MHz)) for continuum observations and -191 dB(W/($\text{m}^2 \cdot 250$ kHz)) for spectral line observations in the band 23.6-24 GHz at an RAS station location at the height of 50 m. This limit relates to the power flux-density which would be obtained using a time percentage of 2% in the relevant propagation model;

Option 1:

To verify the compliance the following formula shall be used:

$$pfd = e.i.r.p. \cdot nominal \ clear \ sky (Az, \theta) + Att_{618_{p=2\%}} + 10 \cdot \log_{10} \left(\frac{1}{4\pi d^2} \right) - GasAtt(\theta)$$

where:

e.i.r.p. nominal clear sky: is the nominal unwanted emission e.i.r.p. density towards the RAS station at which the HAPS operates under clear-sky conditions in dB(W/400 MHz) for continuum observations and in dB(W/250 kHz) for spectral line observations in the band 23.6-24 GHz;

Az: is the azimuth in degrees from the HAPS toward the RAS station;

- θ : is the elevation angle in degrees at the HAPS towards the RAS station;
- $Att_{618p=2\%}$: is the attenuation in dB from Recommendation ITU-R P.618 corresponding to $p = 2\%$ of the time at the radio astronomy location;
- d : is the separation distance in metres between the HAPS and the RAS station;
- pdf : power flux-density at the Earth's surface per HAPS in dB(W/(m² · 400 MHz)) for continuum observations and in dB(W/(m² · 250 kHz)) for spectral line observations in the band 23.6-24 GHz;
- $GasAtt(\theta)$: is gaseous attenuation for elevation θ (Rec. ITU-R SF.1395);

Option 2:

NOTE: No formula necessary.

9 that *resolves* 8 shall apply at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 23.6-24 GHz before 22 May 2020, or at any radio astronomy station that was notified before the date of receipt of the complete Appendix 4 information for notification, for the HAPS system to which *resolves* 8 applies. Radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS;

10 that administrations planning to implement a HAPS system in the bands 24.25-25.5 GHz and 27-27.5 GHz shall notify the frequency assignments by submitting all mandatory elements of Appendix 4 to the Bureau for the examination of compliance with respect to the Radio Regulations with a view to their registration in the Master International Frequency Register,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

1/1.14/5.4.2.4 Example Resolution for Method 4B3 – Option 2 and Method 5B2 – Option 2

ADD

DRAFT NEW RESOLUTION [C114-24B3-O2] (WRC-19)

Use of the bands 24.25-27.5 GHz by fixed links for high-altitude platform stations in the fixed service in Region 2

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in under-served communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including the band 24.25-27.5 GHz in Region 2, recognizing that

the existing HAPS identifications were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity with minimal ground network infrastructure;

d) that ITU-R has conducted studies dealing with compatibility between HAPS systems and systems in existing services in the 24.25-27.5 GHz band and in adjacent band in Region 2 leading to Report ITU-R F.[HAPS-25 GHz],

recognizing

a) that in the bands 24.75-25.25 GHz and 27.0-27.5 GHz with respect to earth stations in the fixed-satellite service (Earth-to-space) and HAPS ground station receivers which operate in the fixed service, No. **9.17** applies;

b) that HAPS is defined in No. **1.66A** of the Radio Regulations as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and is subject to No. **4.23**,

resolves

1 that for the purpose of protecting the fixed service systems in territory of other administrations in the bands 27-27.5 GHz, the power flux-density level per HAPS at the surface of the Earth in territory of other administrations shall not exceed the following limits unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|------------------------|------------------------------|-----|----------------------|
| 0.39 θ – 132.12 | dB(W/(m ² · MHz)) | for | 0° ≤ θ < 13° |
| 2.715 θ – 162.3 | dB(W/(m ² · MHz)) | for | 13° ≤ θ < 20° |
| 0.45 θ – 117 | dB(W/(m ² · MHz)) | for | 20° ≤ θ < 60° |
| –90 | dB(W/(m ² · MHz)) | for | 60° ≤ θ ≤ 90° |

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane).

These limits relate to the power flux-density which would be obtained under clear-sky conditions with assumed free-space propagation. These limits were derived by taking into account the impact of gaseous attenuation and polarization loss;

2 that for the purpose of protecting the mobile service systems in territory of other administrations in the band 24.25-25.25 GHz and 27-27.5 GHz, the power flux-density level per HAPS at the surface of the Earth in territory of other administrations shall not exceed the following limits, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|---------------------|------------------------------|-----|-----------------------|
| 0.95 θ – 114 | dB(W/(m ² · MHz)) | for | 0° ≤ θ < 5.7° |
| 0.6 θ – 112 | dB(W/(m ² · MHz)) | for | 5.7° ≤ θ < 20° |
| –100 | dB(W/(m ² · MHz)) | for | 20° ≤ θ ≤ 90° |

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane).

These limits relate to the power flux-density which would be obtained under clear-sky conditions with assumed free-space propagation. These limits were derived by taking into account the impacts of polarization, gaseous attenuation and body loss for user equipment;

Note: 24.25-27.5 GHz is possible a frequency range to be identified for IMT-2020 under agenda item 1.13 (WRC-19). *Resolves* 2 may need to be revised subject to the outcome of WRC-19.

3 that for the purpose of protecting the inter-satellite service, the e.i.r.p. density per HAPS in the bands 27-27.5 GHz, shall not exceed -70.7 dB(W/Hz) for off-nadir angle higher than 85.5° ;

4 that for the purpose of protecting the inter-satellite service, the e.i.r.p. density per HAPS in the bands 24.45-24.75 GHz, shall not exceed -19.9 dB(W/MHz) for off-nadir angle higher than 85.5° ;

Option 1:

5 that for the purpose of protection the inter-satellite service, the e.i.r.p. density per HAPS ground station in the band 25.25-27 GHz, shall not exceed 12.3 dB(W/MHz) under clear-sky conditions.

During periods of rain, the e.i.r.p. density limits for clear-sky conditions can be exceeded to the level needed to compensate for rain fade, up to 20 dB;

Option 2:

5 that for the purpose of protection the inter-satellite service maximum e.i.r.p. density in the band 25.25-27 GHz density of HAPS ground stations should not exceed 0.5 dB(W/MHz) in clear-sky conditions in the direction of inter-satellite service space stations on geostationary orbit.

Specific GSO positions which need to be protected are contained in latest version of Recommendation ITU-R SA.1276, it is also needed to take into account possible orbit inclination of space stations between -5° and 5° .

Automatic power control may be used to increase the e.i.r.p. density to compensate for rain attenuation, to the extent that interference into space station of inter-satellite service does not exceed the value resulting from use by HAPS ground stations of an e.i.r.p. density, meeting the above limits in clear-sky conditions;

6 that for the purpose of protecting the fixed-satellite service, the e.i.r.p. density per HAPS platform, in the bands 24.75-25.25 and 27-27.5 GHz, shall not exceed -9.1 dB(W/MHz) for off-nadir angles higher than 85.5° ;

7 that for the purpose of protecting the Earth exploration-satellite passive service in the band 23.6-24 GHz, the e.i.r.p. density per HAPS operating in the band 24.25-25.25 GHz, shall not exceed:

$$\begin{array}{lll} -0.7714 \theta - 16.5 & \text{dB(W/200 MHz)} & \text{for } -4.53^\circ \leq \theta < 35^\circ \\ -43.5 & \text{dB(W/200 MHz)} & \text{for } 35^\circ \leq \theta \leq 90^\circ \end{array}$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane);

Example 1:

8 that with respect to HAPS ground stations using the frequency band 25.5-27 GHz, the provisions of No. **5.536A** shall not apply;

9 that, in order to ensure the protection of in-band SRS/EESS satellite services from the HAPS gateway in the band 25.5-27 GHz, the power flux-density shall not exceed the threshold values below at the SRS/EESS earth stations. If the power flux-density threshold values below are exceeded, then HAPS shall coordinate in accordance with No. **9.18**, taking into account the parameters of the relevant systems. These limits relate to the power flux-density which would be obtained under assumed propagation conditions predicted by Recommendation ITU-R P.452 using the following time percentages: 0.001% for SRS, 0.005% for EESS non-GSO, and 20% for EESS GSO:

NOTE: The case of protection of typical EESS and SRS Earth stations may require further clarification.

SRS

$$pfd, dB \left(\frac{W}{m^2 * MHz} \right) = -121.33$$

EESS non-GSO

$$pfd, dB \left(\frac{W}{m^2 * MHz} \right) = -96.87$$

EESS GSO

$$pfd, dB \left(\frac{W}{m^2 * MHz} \right) = -128.57$$

Example 2:

8 (not used);

9 that, in order to ensure the protection of in-band SRS/EESS satellite services in the territory of other administrations from the HAPS gateway in the band 25.5-27 GHz, the power flux-density shall not exceed the values below at the SRS/EESS earth stations. These pfd values may be exceeded with the agreement between the concerned administrations. These limits relate to the power flux-density which would be obtained under assumed propagation conditions predicted by Recommendation ITU-R P.452 using the following time percentages: 0.001% for SRS, 0.005% for EESS non-GSO, and 20% for EESS GSO:

Note: The case of protection of typical EESS and SRS earth stations may require further clarification.

SRS

$$pfd, dB \left(\frac{W}{m^2 * MHz} \right) = -121.33$$

EESS non-GSO

$$pfd, dB \left(\frac{W}{m^2 * MHz} \right) = -96.87$$

EESS GSO

$$pfd, dB \left(\frac{W}{m^2 * MHz} \right) = -128.57$$

10 that in order to ensure the protection of the radio astronomy service, the power flux-density produced by unwanted emissions from HAPS downlink transmissions operating in the band 24.25-25.25 GHz, shall not exceed $-177 \text{ dB}(W/(m^2 \cdot 400 \text{ MHz}))$ for continuum observations and $-191 \text{ dB}(W/(m^2 \cdot 250 \text{ kHz}))$ for spectral line observations in the band 23.6-24 GHz at an RAS station location at the height of 50 m. This limit relates to the power flux-density which would be obtained using a time percentage of 2% in the relevant propagation model;

Option 1:

To verify the compliance the following formula shall be used:

$$pfd = e.i.r.p.\text{nominal clear sky}(Az, \theta) + Att_{618p=2\%} + 10 \cdot \log_{10} \left(\frac{1}{4\pi d^2} \right) - GasAtt(\theta)$$

where:

- e.i.r.p.nominal clear sky*: is the nominal e.i.r.p. density towards the RAS station at which the HAPS platform station operates under clear-sky conditions in dB(W/400 MHz) for continuum observations and in dB(W/250 kHz) for spectral line observations in the band 23.6-24 GHz;
- Az*: is the azimuth in degrees from the HAPS platform toward the RAS station;
- θ*: is the elevation angle in degrees at the HAPS platform towards the RAS station;
- Att_{618p=2%}*: is the attenuation in dB from Recommendation ITU-R P.618 corresponding to *p* = 2% of the time at the radio astronomy location;
- d*: is the separation distance in metres between the HAPS platform and the RAS station;
- pfd*: power flux-density at the Earth's surface per HAPS platform station in dB(W/(m² · 400 MHz)) for continuum observations and in dB(W/(m² · 250 kHz)) for spectral line observations in the band 23.6-24 GHz;

Option 2:

NOTE: No formula necessary.

11 that *resolves* 10 shall apply at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 23.6-24 GHz before 22 May 2020, or at any radio astronomy station that was notified before the date of receipt of the complete Appendix 4 information for notification, for the HAPS system to which *resolves* 10 applies. Radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS;

12 that administrations planning to implement a HAPS system in the bands 24.25-27.5 GHz shall notify the frequency assignments by submitting all mandatory elements of Appendix 4 to the Bureau for the examination of compliance with respect to the Radio Regulations with a view to their registration in the Master International Frequency Register,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

1/1.14/5.5 Frequency band 25.25-27.5 GHz for Region 2 only**1/1.14/5.5.1 For Method 5A****NOC****ARTICLE 5****Frequency allocations****1/1.14/5.5.2 For Method 5B2****ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**
(See No. 2.1)**MOD****24.75-29.9 GHz**

| Allocation to services | | |
|--|---|-----------------|
| Region 1 | Region 2 | Region 3 |
| 25.25-25.5 | FIXED <u>ADD 5.D114</u> INTER-SATELLITE 5.536 MOBILE Standard frequency and time signal-satellite (Earth-to-space) | |
| 25.5-27 | EARTH EXPLORATION-SATELLITE (space-to-Earth) 5.536B FIXED <u>ADD 5.D114</u> INTER-SATELLITE 5.536 MOBILE SPACE RESEARCH (space-to-Earth) 5.536C Standard frequency and time signal-satellite (Earth-to-space) 5.536A | |
| 27-27.5 FIXED INTER-SATELLITE 5.536 MOBILE | 27-27.5 FIXED <u>ADD 5.D114</u> FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE 5.536 5.537 MOBILE | |

1/1.14/5.5.2.1 For Method 5B2, Option 1

ADD

5.D114[-26B2-O1] The allocation to the fixed service in the bands 25.25-25.5 GHz and 27-27.5 GHz is identified for use in Region 2 by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the ground-to-HAPS direction in the band 25.25-25.5 GHz, to the HAPS-to-ground direction in the band 27-27.5 GHz, and is subject to the provisions of Resolution **[C114-24B3-O1] (WRC-19)**. (WRC-19)

1/1.14/5.5.2.2 For Method 5B2, Option 2

ADD

5.D114[-26B2-O2] The allocation to the fixed service in the band 25.25-27.5 GHz is identified for use in Region 2 by high-altitude platform stations (HAPS) in accordance with the provisions of Resolution **[C114-24B3-O2] (WRC-19)**. Such use of the fixed-service allocation by HAPS shall be limited to the ground-to-HAPS direction in the frequency band 25.25-25.5 GHz, to gateway links and to ground-to-HAPS direction in the frequency band 25.5-27 GHz and to the HAPS-to-ground direction in the frequency band 27-27.5 GHz. This identification does not preclude the use of this frequency band by any application of the services to which it is allocated on a co-primary basis and does not establish priority in the Radio Regulations. (WRC-19)

1/1.14/5.5.2.3 For Method 5B2, Option 3

ADD

5.D114[-26B2-O3] In Region 2, the allocation to the fixed service in the bands 25.25-25.5 GHz, 25.5-27.0 GHz and 27.0-27.5 GHz may also be used high-altitude platform stations (HAPS). Such use of the fixed service allocation by HAPS is limited to operation in the ground-to-HAPS in the frequency range 25.25-27 GHz, and HAPS-to-ground in the band 27.0-27.5 GHz; and shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS. The emissions of HAPS shall satisfy the provisions of Resolution **[D114-26B2-O3] (WRC-19)** for the protection of the services to which the band is allocated. (WRC-19)

1/1.14/5.5.2.4 Example Resolution for Method 5B2 – Option 1

The example Resolution in section 1/1.14/5.4.2.3 above includes the 27-27.5 GHz band for Method 4B2, Option 1.

1/1.14/5.5.2.5 Example Resolution for Method 5B2 – Option 2

The example Resolution in section 1/1.14/5.4.2.4 above includes the 25.25-27.5 GHz band for Method 4B2, Option 2.

1/1.14/5.5.2.6 Example Resolution for Method 5B2 – Option 3

ADD

DRAFT NEW RESOLUTION [D114-26B2-O3] (WRC-19)

Use of the frequency range 25.25-27.5 GHz by fixed links for high-altitude platform stations in the fixed service in Region 2

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 24.25-27.5 GHz in Region 2;
- b) that HAPS can provide broadband connectivity with minimal ground network infrastructure,

resolves

- 1 that in order to ensure the protection of the fixed-satellite service in the band 27-27.5 GHz from the HAPS platform, the e.i.r.p. density per HAPS platform shall not exceed -9.1 dB(W/MHz) for off-nadir angle higher than 85.5° ;
- 2 that in order to ensure the protection of in-band SRS/EESS satellite services from a HAPS ground station in the band 25.5-27.0 GHz, the pfd shall not exceed the threshold values below at the SRS/EESS earth stations. If the EESS threshold values below are exceeded then HAPS shall coordinate in accordance with No. 9.18 taking into account the parameters of the relevant systems.

NOTE: The case of protection of typical EESS and SRS earth stations may require further clarification.

SRS

$$\begin{array}{lll}
 -138.8 + 25 * \log_{10}(5 - \theta) \text{ dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 0^\circ \leq \theta < 4.925^\circ \\
 -166.9 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} \quad 4.925^\circ \leq \theta < 5^\circ \\
 -183.9 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} \quad 5^\circ \leq \theta < 90^\circ
 \end{array}$$

where (θ) is the angle of arrival (φ) of the interfering signal above the local horizontal plane at the SRS antenna.

EESS non-GSO

$$\begin{array}{lll}
 -108.8 + 25 * \log_{10}(3 - \theta) \text{ dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 0^\circ \leq \theta < 2.808^\circ \\
 -126.7 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} \quad 2.808^\circ \leq \theta < 3^\circ \\
 -143.4 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} \quad 3^\circ \leq \theta < 90^\circ
 \end{array}$$

where (θ) is the angle of arrival (φ) of the interfering signal above the local horizontal plane at the EESS antenna.

EESS GSO

$$\begin{array}{lll}
 -140.5 + 25 * \log_{10}(3 - \theta) \text{ dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 0^\circ \leq \theta < 2.808^\circ \\
 -158.4 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} \quad 2.808^\circ \leq \theta < 3^\circ
 \end{array}$$

$$-178.5 \quad \text{dB(W/(m}^2 \cdot \text{MHz))} \quad \text{for} \quad 3^\circ \leq \theta < 90^\circ$$

where (θ) is the angle of arrival (φ) of the interfering signal above the local horizontal plane at the EESS antenna.

For the HAPS ground station towards an SRS/EESS earth station, attenuation using the relevant ITU-R propagation Recommendations shall be applied using the following percentages:

1) SRS: .001%; 2) EESS non-GSO: .005%; 3) EESS GSO: 20%, and the HAPS and SRS/EESS antenna heights shall be used in this calculation;

3 that in order to ensure the protection of the inter-satellite service (ISS) the e.i.r.p. density per HAPS in the bands 27-27.5 GHz, shall not exceed -70.7 dB(W/Hz) for off-nadir angle higher than 85° ;

Option 1:

4 that in order to ensure the protection of the inter-satellite service (ISS) the e.i.r.p. density per HAPS ground station in the band 25.25-27 GHz, shall not exceed 12.3 dB(W/MHz) towards the ISS GSO receiver under clear-sky conditions;

Option 2:

4 that for the purpose of protection the inter-satellite service maximum e.i.r.p. density in the band 25.25-27 GHz density of HAPS ground stations should not exceed 0.5 dB(W/MHz) in clear-sky conditions in the direction of inter-satellite service space stations on geostationary orbit.

Specific GSO positions which need to be protected are contained in latest version of Recommendation ITU-R SA.1276, it is also needed to take into account possible orbit inclination of space stations between -5° and 5° .

Automatic power control may be used to increase the e.i.r.p. density to compensate for rain attenuation, to the extent that interference into space station of inter-satellite service does not exceed the value resulting from use by HAPS ground stations of an e.i.r.p. density, meeting the above limits in clear-sky conditions;

5 that for the purpose of protecting fixed service systems in territory of other administrations in the band 25.25-27.5 GHz, the power flux-density level per HAPS produced at the surface of the Earth in the territory of other administrations shall not exceed the following limits, under clear-sky conditions, unless the explicit agreement from the affected administration is provided at the time of notification of HAPS:

$$\begin{array}{lll} 0.39 \theta - 132.12 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} \quad 0^\circ \leq \theta < 13^\circ \\ 2.715 \theta - 162.3 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} \quad 13^\circ \leq \theta < 20^\circ \\ 0.45 \theta - 117 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} \quad 20^\circ \leq \theta < 60^\circ \\ -90 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} \quad 60^\circ \leq \theta \leq 90^\circ \end{array}$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane). This pfd mask already takes into account the impact of attenuation due to atmospheric gases;

6 that for the purpose of protecting mobile service systems in territory of other administrations in the band 25.25-27.5 GHz, the power flux-density level per HAPS or a single HAPS ground station at the surface of the Earth, applied at the border of affected neighbouring administrations shall not exceed the following limits unless the explicit agreement from the affected administration is provided at the time of notification of HAPS:

$$-113.3 \quad \text{dB(W/(m}^2 \cdot \text{MHz))} \quad \text{for} \quad 0^\circ \leq \theta < 4^\circ$$

$$\begin{array}{llll}
 -113.3 + 1.2 (\theta - 4) & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 4^\circ \leq \theta < 9^\circ \\
 -107.3 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for} & 9^\circ \leq \theta \leq 90^\circ
 \end{array}$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane),

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

1/1.14/5.6 Frequency band 27.9-28.2 GHz

1/1.14/5.6.1 For Method 6A

NOC

ARTICLE 5

Frequency allocations

NOC

RESOLUTION 145 (REV.WRC-12)

Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high altitude platform stations in the fixed service

1/1.14/5.6.2 For Method 6B1

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD**24.75-29.9 GHz**

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 27.5-28.5 | FIXED 5.537A ADD 5.E114 FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 MOBILE 5.538 5.540 | |

*NOTE: Under this method, if the band 27.9-28.2 GHz is modified, there would need to be consequential modifications to Resolution **145 (Rev.WRC-12)** in implementation of Method B1.*

1/1.14/5.6.2.1 For Method 6B1, Option 1**ADD**

5.E114[-28B1-O1] The allocation to the fixed service in the band 27.9-28.2 GHz is identified for worldwide use by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to operation in the HAPS-to-ground direction and shall be in accordance with the provisions of Resolution **[E114-28+31B1-O1] (WRC-19)**. (WRC-19)

SUP**5.537A****1/1.14/5.6.2.2 For Method 6B1, Option 2****ADD**

5.E114[-28B1-O2] The allocation to the fixed service in the 27.9-28.2 GHz band is identified for worldwide use by administrations wishing to implement high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS. The use of the fixed service allocation by HAPS is limited to operation in the HAPS-to-ground direction and is subject to the provisions of Resolution **[E114-28+31B1-O2] (WRC-19)**. (WRC-19)

SUP**5.537A**

1/1.14/5.6.2.3 Example Resolution for Method 6B1 – Option 1 and Method 7B1 – Option 1

ADD

DRAFT NEW RESOLUTION [E114-28+31B1-O1] (WRC-19)

Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high-altitude platform stations in the fixed service

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that No. **4.23** specifies that transmissions to or from HAPS shall be limited to the bands specifically identified in Article **5**;
- b)* that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;
- c)* that HAPS deployment in the band 27.9-28.2 GHz is intended to provide connectivity from the HAPS to a limited number of HAPS ground stations per beam;
- d)* that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity on a global basis, including within the bands 27.9-28.2 GHz and 31-31.3 GHz, recognizing that the existing HAPS identifications were established without reference to today's broadband capabilities;
- e)* that ITU-R has conducted studies dealing with sharing between systems using HAPS in the fixed service and other types of systems in the fixed service in the bands 27.9-28.2 GHz and 31-31.3 GHz leading to Report ITU-R F.[HAPS-31 GHz];
- f)* that ITU-R has conducted studies dealing with compatibility between systems using HAPS and the passive services in the 31.3-31.8 GHz band leading to Report ITU-R F.[HAPS-31 GHz];
- g)* that Report ITU-R F.2438 contains worldwide spectrum needs of HAPS systems;
- h)* that Report ITU-R F.2439 has updated deployment and technical characteristics of broadband HAPS systems to complete feasibility, sharing and compatibility studies between HAPs and other affected services,

recognizing

that in the band 27.9-28.2 GHz with respect to transmitting earth stations in the fixed-satellite service (Earth-to-space) and HAPS ground station receivers which operate in the fixed service, No. **9.17** applies,

resolves

- 1** that for the purpose of protecting the fixed wireless systems in territory of other administrations in the band 27.9-28.2 GHz, the power flux-density level per HAPS at the surface of the Earth in territory of other administrations shall not exceed the following limits under clear-sky

conditions, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|----------------------|------------------------------|-----|-----------------------------------|
| $3\theta - 140$ | dB(W/(m ² · MHz)) | for | $0^\circ \leq \theta < 10^\circ$ |
| $0.57\theta - 115.7$ | dB(W/(m ² · MHz)) | for | $10^\circ \leq \theta < 45^\circ$ |
| -90 | dB(W/(m ² · MHz)) | for | $45^\circ \leq \theta < 90^\circ$ |

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane);

Option 1:

In order to compensate for additional propagation impairments in the boresight of any beam of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e. suffering the rain fade) by a value only equivalent to the level of rain fading and limited to a maximum of 20 dB.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(\theta) = e.i.r.p.(\theta) + 10 \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

d : is the distance in metres between the HAPS and the ground (dependent to the elevation angle);

$e.i.r.p.$: HAPS nominal e.i.r.p. spectral density in dB(W/MHz) at a specific elevation angle;

$pfd(\theta)$: power flux-density at the Earth's surface per HAPS in dB(W/(m² · MHz));

Option 2:

These limits relate to the power flux-density which would be obtained under clear-sky conditions with assumed free-space propagation. These limits were derived by taking into account the impact of gaseous attenuation and polarization loss;

2 that for the purpose of protecting the mobile service systems in territory of other administrations in the band 27.9-28.2 GHz, the power flux-density level per HAPS at the surface of the Earth in territory of other administrations shall not exceed the following limits, under clear-sky conditions, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|----------------------|------------------------------|-----|-----------------------------------|
| $\theta - 120$ | dB(W/(m ² · MHz)) | for | $0^\circ < \theta \leq 13^\circ$ |
| -107 | dB(W/(m ² · MHz)) | for | $13^\circ < \theta \leq 65^\circ$ |
| $0.68\theta - 151.2$ | dB(W/(m ² · MHz)) | for | $65^\circ < \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane);

Option 1:

In order to compensate for additional propagation impairments in the boresight of any beam of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e. suffering the rain fade) by a value only equivalent to the level of rain fading.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(\theta) = e.i.r.p.(\theta) + 10 \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

- d*: distance in metres between the HAPS and the ground (dependent to the elevation angle θ);
- e.i.r.p.*: HAPS nominal e.i.r.p. spectral density in dB(W/MHz) at a specific elevation angle;
- pfd*(θ): power flux-density at the Earth's surface per HAPS in dB(W/(m² · MHz));

Option 2:

These limits relate to the power flux-density which would be obtained under clear-sky conditions with assumed free-space propagation. These limits were derived by taking into account the impacts of polarization, gaseous attenuation and body loss for user equipment;

3 that for the purpose of protecting the fixed-satellite service (Earth-to-space) in the 27.9-28.2 GHz, the maximum e.i.r.p. density per HAPS downlink shall be less than -9.7 dB(W/MHz) in any direction for off-nadir angle higher than 85.5°;

4 that for the purpose of protecting the fixed-service systems in territory of other administrations in the band 31-31.3 GHz, the power flux-density level per HAPS at the surface of the Earth in other administrations shall not exceed the following limits, under clear-sky conditions, unless the explicit agreement of the affected administration is provided at the time of notification of the HAPS:

| | | | |
|------------------------|------------------------------|-----|----------------------|
| 0.875 θ – 143 | dB(W/(m ² · MHz)) | for | 0° ≤ θ < 8° |
| 2.58 θ – 156.6 | dB(W/(m ² · MHz)) | for | 8° ≤ θ < 20° |
| 0.375 θ – 112.5 | dB(W/(m ² · MHz)) | for | 20° ≤ θ < 60° |
| -90 | dB(W/(m ² · MHz)) | for | 60° ≤ θ ≤ 90° |

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane);

Option 1:

In order to compensate for additional propagation impairments in the boresight of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e. suffering the rain fade) by a value only equivalent to the level of rain fading and limited to a maximum of 20 dB.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(\theta) = e.i.r.p.(\theta) + 10 \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

- d*: distance in metres between the HAPS and the ground (dependent to the elevation angle);
- e.i.r.p.*: HAPS nominal e.i.r.p. spectral density in dB(W/MHz) at a specific elevation angle;
- pfd*(θ): power flux-density at the Earth's surface per HAPS in dB(W/(m² · MHz));

Option 2:

These limits relate to the power flux-density which would be obtained under clear-sky conditions with assumed free-space propagation. These limits were derived by taking into account the impact of gaseous attenuation and polarization loss;

5 that in order to ensure the protection of EESS (passive), the level of unwanted power density in the band 31.3-31.8 GHz into the antenna of a HAPS ground station operating in the band 31-31.3 GHz, shall be limited to $-83 \text{ dB(W/200 MHz)}$ under clear-sky conditions and may be increased under rainy conditions to mitigate fading due to rain, provided that the effective impact on the passive satellite does not exceed the impact under clear-sky conditions;

6 that in order to ensure the protection of EESS (passive) services the e.i.r.p. density in the band 31.3-31.8 GHz per HAPS, operating in the band 31-31.3 GHz, shall not exceed:

| | | |
|------------------|------------------------|--------------------------------------|
| $-\theta - 13.1$ | dB(W/200 MHz) | $-4.53^\circ \leq \theta < 22^\circ$ |
| -35.1 | dB(W/200 MHz) | $22^\circ \leq \theta < 90^\circ$ |

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane);

7 that in order to ensure the protection of the radio astronomy service, the power flux-density level produced by any HAPS ground station at the RAS stations locations at a height of 50 m, shall not exceed $-141 \text{ dB(W/(m}^2 \cdot 500 \text{ MHz))}$ in the band 31.3-31.8 GHz. This limit relates to the power flux-density which would be obtained under assumed propagation conditions predicted by Recommendation ITU-R P.452 using a time percentage of 2%;

8 that in order to ensure the protection of the radio astronomy service the power flux-density produced by unwanted emissions from HAPS downlink transmissions shall not exceed $-171 \text{ dB(W/(m}^2 \cdot 500 \text{ MHz))}$ for continuum observations in the band 31.3-31.8 GHz at an RAS station location at a height of 50 m. This limit relates to the power flux-density which would be obtained using a time percentage of 2% in the relevant propagation model;

Option 1:

to verify the compliance the following formula shall be used:

$$pfd = e.i.r.p.\text{-nominal clear sky} (Az, \theta) + Att_{618p=2\%} + 10 * \log_{10} \left(\frac{1}{4\pi d^2} \right) - GasAtt(\theta)$$

where:

e.i.r.p.nominal clear sky: nominal unwanted emission e.i.r.p. density towards the RAS station at which the HAPS station operates under clear-sky conditions in dB(W/500 MHz) in the RAS band;

Az: azimuth from the HAPS toward the RAS station;

θ : elevation angle at the HAPS towards the RAS station;

Att_{618p=2%}: attenuation from Recommendation ITU-R P.618 corresponding to $p = 2\%$ of the time at the radio astronomy location;

d: separation distance in m between the HAPS and the RAS station;

pfd(θ): power flux-density at the Earth's surface per HAPS station in $\text{dB(W/m}^2 \cdot 500 \text{ MHz)}$;

GasAtt(θ): gaseous attenuation for elevation angle of θ (Rec. ITU-R SF.1395-0);

Option 2:

NOTE: No formula necessary.

9 that that *resolves* 7 and 8 apply at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 31.3-31.8 GHz before 22 May 2020, or at any radio astronomy station that was notified before the date of receipt of the complete Appendix 4 information for notification, for the HAPS system to which *resolves* 7 and 8 apply. Radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS;

10 that administrations planning to implement a HAPS system in the in the bands 27.9-28.2 GHz and 31-31.3 GHz shall notify the frequency assignments by submitting all mandatory elements of Appendix 4 to the Bureau for the examination of compliance with respect to the Radio Regulations with a view to their registration in the Master International Frequency Register,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

1/1.14/5.6.2.4 Example Resolution for Method 6B1 – Option 2 and Method 7B1 – Option 2

ADD

DRAFT NEW RESOLUTION [E114-28+31B1-O2] (WRC-19)

Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high-altitude platform stations in the fixed service

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

a) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity;

b) that HAPS can provide broadband connectivity with minimal ground network infrastructure,

resolves

Option 1 (Protection of mobile service):

1 that for the purpose of protecting mobile service systems in territory of other administrations in the band 27.9-28.2 GHz, the power flux-density level per HAPS produced at the surface of the Earth in territory of other administrations shall not exceed the following pfd limits, unless the explicit agreement of the affected administrations is provided at the time of notification of HAPS:

| | | | |
|----------------------|------------------------------|-----|-----------------|
| -122.7 | dB(W/(m ² · MHz)) | for | 0° ≤ θ < 2° |
| -122.7 + 2 (θ - 2) | dB(W/(m ² · MHz)) | for | 2° ≤ θ < 2.3° |
| -122.6 + 1.5 (θ - 2) | dB(W/(m ² · MHz)) | for | 2.3° ≤ θ < 7.9° |

$$-113.9 \quad \text{dB(W/(m}^2 \cdot \text{MHz))} \quad \text{for } 7.9^\circ \leq \theta \leq 90^\circ$$

where θ is the elevation angle in degrees (angles of arrival above the horizontal plane);

Option 2 (Protection of mobile service):

1 that for the purpose of protecting the mobile service systems in the band 27.9-28.2 GHz, 63.5 km a protection distance between HAPS nadir and MS stations is required;

2 that for the purpose of protecting the fixed-satellite service (Earth-to-space) in the band 27.9-28.2 GHz, the maximum e.i.r.p. density per HAPS downlink shall be less than -8 dB(W/MHz) in any direction for off-nadir angle higher than 85° ;

3 that for the purpose of protecting fixed-service systems in territory of other administrations in the band 27.9-28.2 GHz, the power flux-density level per HAPS produced at the surface of the Earth in territory of other administrations shall not exceed the following limits, under clear-sky conditions, unless the explicit agreement from the affected administration is provided at the time of notification of HAPS:

$$\begin{array}{lll} 2\theta - 135 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 0^\circ \leq \theta < 10^\circ \\ 0.66\theta - 119.6 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 10^\circ \leq \theta < 45^\circ \\ -90 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 45^\circ \leq \theta < 90^\circ \end{array}$$

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane). This pfd mask already takes into account the impact of attenuation due to atmospheric gases;

4 that for the purpose of protecting fixed service systems in territory of other administrations in the band 31-31.3 GHz, the power flux-density level per HAPS produced at the surface of the Earth in territory of other administrations shall not exceed the following limits, under clear-sky conditions, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

$$\begin{array}{lll} 0.3\theta - 140 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 0^\circ \leq \theta < 10^\circ \\ 3.1\theta - 167 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 10^\circ \leq \theta < 20^\circ \\ 0.375\theta - 112.5 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 20^\circ \leq \theta < 60^\circ \\ -90 & \text{dB(W/(m}^2 \cdot \text{MHz))} & \text{for } 60^\circ \leq \theta \leq 90^\circ \end{array}$$

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane). This pfd mask already takes into account the impact of attenuation due to atmospheric gases;

5 that in order to ensure the protection of the Earth exploration-satellite service (passive), the level of unwanted emission e.i.r.p. density per HAPS transmitter operating in the 31-31.3 GHz band shall be limited into the 31.3-31.8 GHz band to:

$$\begin{array}{lll} -\theta - 13.1 & \text{dB(W/200 MHz)} & -4.53^\circ \leq \theta < 22^\circ \\ -35.1 & \text{dB(W/200 MHz)} & 22^\circ \leq \theta < 90^\circ \end{array}$$

where El is the elevation angle in degrees (angles of arrival above the horizontal plane);

6 that in order to ensure the protection of the radio astronomy service the pfd produced by unwanted emissions from HAPS downlink transmissions shall not exceed $-171 \text{ dB(W/(m}^2 \cdot 500 \text{ MHz))}$ for continuum observations in the band 31.3-31.8 GHz at an RAS station location at a height of 50 m; and that this pfd value shall be verified considering a percentage of time of 2% in the relevant propagation model;

7 that *resolves* 6 shall apply at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 31.3-31.8 GHz before

22 May 2020, or at any radio astronomy station that was notified before the date of receipt of the complete Appendix 4 information for notification for the HAPS system to which *resolves* 8 applies. Radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

1/1.14/5.6.3 For Method 6C

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

24.75-29.9 GHz

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 27.5-28.5 | FIXED 5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 MOBILE 5.538 5.540 | |

SUP

5.537A

SUP

RESOLUTION 145 (REV.WRC-12)

Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high altitude platform stations in the fixed service

NOTE: If RR No. 5.537A is suppressed and RR No. 5.543A is retained, there would need to be consequential modifications to Resolution 145 (Rev.WRC-12) in implementation of Method 6C.

1/1.14/5.7 Frequency band 31-31.3 GHz**1/1.14/5.7.1 For Method 7A****NOC****ARTICLE 5****Frequency allocations****NOC****RESOLUTION 145 (REV.WRC-12)****Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by
high altitude platform stations in the fixed service****1/1.14/5.7.2 For Method 7B1****ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**
(See No. 2.1)**MOD****29.9-34.2 GHz**

| Allocation to services | | |
|-------------------------------|---|-----------------|
| Region 1 | Region 2 | Region 3 |
| 31-31.3 | FIXED 5.338A– 5.543A <u>ADD 5.F114</u> MOBILE Standard frequency and time signal-satellite (space-to-Earth) Space research 5.544 5.545 5.149 | |

NOTE: Under this method, if the band 31-31.3 GHz is modified, there would need to be consequential modifications to Resolution 145 (Rev.WRC-12) in implementation of Method B1.

1/1.14/5.7.2.1 For Method 7B1, Option 1**1/1.14/5.7.2.1.1 For Method 7B1, Option 1A****ADD**

5.F114[-31B1-O1A] The allocation to the fixed service in the band 31-31.3 GHz is identified for worldwide use by high-altitude platform stations (HAPS) in the HAPS-to-ground direction. Such use of the fixed-service allocation by HAPS shall be in accordance with the provisions of Resolution **[E114-28+31B1-O1] (WRC-19)**. (WRC-19)

SUP**5.543A****1/1.14/5.7.2.1.2 For Method 7B1, Option 1B****ADD**

5.F114[-31B1-O1B] The allocation to the fixed service in the band 31-31.3 GHz is identified for worldwide use by high-altitude platform stations (HAPS) in the ground-to-HAPS direction. Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[E114-28+31B1-O1] (WRC-19)**. (WRC-19)

SUP**5.543A****1/1.14/5.7.2.2 For Method 7B1, Option 2****ADD**

5.F114[-31B1-O2] The allocation to the fixed service in the 31-31.3 GHz band is identified for worldwide use by administrations wishing to implement high-altitude platform stations (HAPS) in the HAPS-to-ground direction. Such use of the fixed-service allocation by HAPS shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS. Use of the band is subject to the provisions of Resolution **[E114-28+31B1-O2] (WRC-19)**. (WRC-19)

SUP**5.543A****1/1.14/5.7.2.3 Example Resolution for Method 7B1 – Option 1**

The example Resolution in section 1/1.14/5.6.2.3 above includes the 31-31.3 GHz band for Method 6B1, Option 1.

1/1.14/5.7.2.4 Example Resolution for Method 7B1 – Option 2

The example Resolution in section 1/1.14/5.6.2.4 above includes the 31-31.3 GHz band for Method 6B1, Option 2.

1/1.14/5.7.3 For Method 7C

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

(See No. 2.1)

MOD

29.9-34.2 GHz

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 31-31.3 | FIXED 5.338A– 5.543A MOBILE Standard frequency and time signal-satellite (space-to-Earth) Space research 5.544 5.545 5.149 | |

SUP

5.543A

SUP

RESOLUTION 145 (REV.WRC-12)

Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high altitude platform stations in the fixed service

NOTE: If No. 5.543A is suppressed and No. 5.537A is retained, there would need to be consequential modifications to Resolution 145 in implementation of Method C.

1/1.14/5.8 Frequency band 38-39.5 GHz**1/1.14/5.8.1 For Method 8A****NOC****ARTICLE 5****Frequency allocations****1/1.14/5.8.2 For Method 8B2****ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**
(See No. 2.1)**MOD****34.2-40 GHz**

| Allocation to services | | |
|-------------------------------|--|-----------------|
| Region 1 | Region 2 | Region 3 |
| 38-39.5 | FIXED <u>ADD 5.G114</u> FIXED-SATELLITE (space-to-Earth) MOBILE Earth exploration-satellite (space-to-Earth) 5.547 | |

1/1.14/5.8.2.1 For Method 8B2, Option 1**1/1.14/5.8.2.1.1 For Method 8B2, Option 1A****ADD**

5.G114[-38B2-O1A] The allocation to the fixed service in the band 38-39.5 GHz is identified for worldwide use by high-altitude platform stations (HAPS) in the HAPS-to-ground direction. Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[G114-38B2-O1A+B] (WRC-19)**. (WRC-19)

1/1.14/5.8.2.1.2 For Method 8B2, Option 1B

ADD

5.G114[-38B2-O1B] The allocation to the fixed service in the band 38-39.5 GHz is identified for worldwide use by high-altitude platform stations (HAPS) in the ground-to-HAPS direction. Such use of the fixed-service allocation by HAPS shall be in accordance with the provisions of Resolution **[G114-38B2-O1A+B] (WRC-19)**. (WRC-19)

1/1.14/5.8.2.1.3 For Method 8B2, Option 1C

ADD

5.G114[-38B2-O1C] The allocation to the fixed service in the band 38-39.5 GHz is identified for worldwide use by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the ground-to-HAPS direction. This identification does not preclude the use of this frequency band by any application of the services to which it is allocated on a co-primary basis and does not establish priority in the Radio Regulations. Administrations planning to implement a HAPS system in the 38-39.5 GHz band shall notify the frequency assignments by submitting all mandatory elements of Appendix 4 to the Bureau for the examination of compliance with respect to the Radio Regulations with a view to their registration in the Master International Frequency Register. (WRC-19)

1/1.14/5.8.2.2 For Method 8B2, Option 2

ADD

5.G114[-38B2-O2] The allocation to the fixed service in the band 38-39.5 GHz may also be used by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the ground-to-HAPS direction and shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS. See Resolution **[G114-38B2-O2] (WRC-19)**. (WRC-19)

1/1.14/5.8.2.3 Example Resolution for Method 8B2 – Options 1A and 1B

ADD

DRAFT NEW RESOLUTION [G114-38B2-O1A+B] (WRC-19)

Use of the bands 38-39.5 GHz by high-altitude platform stations in the fixed service

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

a) that WRC-15 considered that there is a need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to

deliver broadband applications by high-altitude platform stations (HAPS), which can provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity on a global basis, including within the band 38-39.5 GHz, recognizing that the existing HAPS identifications were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity with minimal ground network infrastructure;

d) that ITU-R has conducted studies dealing with compatibility between systems using HAPS and existing services in the 38-39.5 GHz band leading to Report ITU-R F.[HAPS-39 GHz],

recognizing

a) that in the band 38-39.5 GHz with respect to earth stations in the fixed-satellite service (space-to-Earth) and HAPS ground station transmitters and receivers which operate in the fixed service, Nos. **9.17** and **9.18** apply,

resolves

1 that for the purpose of protecting the fixed-service systems in territory of other administrations in the band 38-39.5 GHz, the power flux-density limit per HAPS at the surface of the Earth in territory of other administrations shall not exceed the following limits, under clear-sky conditions, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|------------------------------|------------------------------|-----|-----------------------------------|
| -137 | dB(W/(m ² · MHz)) | for | $\theta \leq 13^\circ$ |
| $-137 + 3.125 (\theta - 13)$ | dB(W/(m ² · MHz)) | for | $13^\circ < \theta \leq 25^\circ$ |
| $-99.5 + 0.5 (\theta - 25)$ | dB(W/(m ² · MHz)) | for | $25^\circ < \theta \leq 50^\circ$ |
| -87 | dB(W/(m ² · MHz)) | for | $50^\circ < \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane);

Option 1:

In order to compensate for additional propagation impairments in the boresight of any beam of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e. suffering the rain fade) by a value only equivalent to the level of rain fading and limited to a maximum of 20 dB.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(\theta) = e.i.r.p.(\theta) + 10 \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

d: distance in metres between the HAPS and the ground (dependent to the elevation angle);

e.i.r.p.: HAPS nominal e.i.r.p. spectral density in dB(W/MHz) at a specific elevation angle;

pfd(θ): power flux-density at the Earth's surface per HAPS in dB(W/(m² · MHz));

Option 2:

These limits relate to the power flux-density which would be obtained under clear-sky conditions with assumed free-space propagation. These limits were derived by taking into account the impact of gaseous attenuation and polarization loss;

2 that for the purpose of protecting the mobile service systems in territory of other administrations in the band 38-39.5 GHz, the power flux-density limit per HAPS at the surface of the Earth in territory of other administrations shall not exceed the following limits in dB(W/(m² · MHz)), under clear-sky conditions, unless the explicit agreement of the affected administration is provided at the time of notification of HAPS:

| | | | |
|----------------------------|------------------------------|-----|-----------------------------------|
| -102 | dB(W/(m ² · MHz)) | for | $\theta \leq 5^\circ$ |
| $-102 + 0.25 (\theta - 5)$ | dB(W/(m ² · MHz)) | for | $5^\circ < \theta \leq 25^\circ$ |
| -97 | dB(W/(m ² · MHz)) | for | $25^\circ < \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane);

Option 1:

In order to compensate for additional propagation impairments in the boresight of any beam of the HAPS due to rain, the HAPS can be operated so that the pfd mask can be increased in any corresponding beam (i.e. suffering the rain fade) by a value only equivalent to the level of rain fading.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(\theta) = e.i.r.p.(\theta) + 10 \log_{10} \left(\frac{1}{4\pi d^2(\theta)} \right)$$

where:

d : distance in metres between the HAPS and the ground (dependent to the elevation angle);

$e.i.r.p.$: HAPS nominal e.i.r.p. spectral density in dB(W/MHz) at a specific elevation angle;

$pfd(\theta)$: power flux-density at the Earth's surface per HAPS in dB(W/(m² · MHz));

Option 2:

These limits relate to the power flux-density which would be obtained under clear-sky conditions with assumed free-space propagation. These limits were derived by taking into account the impact of gaseous attenuation and polarization loss;

3 that for the purpose of protecting FSS GSO earth station in the fixed-satellite service (space-to-Earth) in the territory of other administrations, coordination of a transmitting HAPS is required when the power flux-density over any point of an administration's border exceeds the following values:

| | | |
|-----------------------------|------------------------------|---|
| $-169.9 + 1\,954\,\alpha^2$ | dB(W/(m ² · MHz)) | $0 \leq \alpha < 0.136^\circ$ |
| -133.9 | dB(W/(m ² · MHz)) | $0.136^\circ \leq \alpha < 1^\circ$ |
| $-133.9 + 25 \log \alpha$ | dB(W/(m ² · MHz)) | $1^\circ \leq \alpha < 47.9^\circ$ |
| -91.9 | dB(W/(m ² · MHz)) | $47.9^\circ \leq \alpha \leq 180^\circ$ |

where α is the minimum angle at the border between the line to the HAPS platform and the lines to the GSO arc in degrees.

To calculate the pfd produced by a HAPS platform, the following equation shall be used:

$$pfd = e.i.r.p. - 10\log_{10}(4\pi d^2) - Att_{gaz}$$

where:

- d : distance between the HAPS and the GSO FSS earth station (m);
- Att_{gaz} : attenuation due to atmospheric gases on the HAPS to GSO FSS earth station path in dB;
- pfd : required pfd at the GSO FSS earth station location to meet the FSS protection criteria in dB(W/(m² · MHz));
- $e.i.r.p.$: maximum HAPS e.i.r.p. spectral density in the direction of the GSO FSS earth station in dB(W/MHz);

4 that for the purpose of protecting FSS non-GSO systems in the fixed-satellite service (space-to-Earth) in the territory of other administrations from co-channel interference, coordination of a transmitting HAPS station is required when the distance between the sub-HAPS point and any point of an administration's border is less than 100 km;

5 that in making assignments to HAPS in the fixed service 38-39.5 GHz, administrations shall protect the space research service (space-to-Earth) in the band 37-38 GHz from harmful interference by unwanted emissions, taking into account the space research service (space-to-Earth) protection level of -217 dB(W/Hz) at the input of the SRS receiver with 0.001% exceedance due to atmospheric and precipitation effects as referred to in the relevant ITU-R Recommendations;

6 that administrations planning to implement a HAPS system in the 38-39.5 GHz band shall notify the frequency assignments by submitting all mandatory elements of Appendix 4 to the Bureau for the examination of compliance with respect to the Radio Regulations with a view to their registration in the Master International Frequency Register,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

1/1.14/5.8.2.4 Example Resolution for Method 8B2 – Option 2

ADD

DRAFT NEW RESOLUTION [G114-38B2-O2] (WRC-19)

Use of the bands 38-39.5 GHz by high-altitude platform stations in the fixed service

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

a) that WRC-15 decided to conduct studies to address the need for greater broadband connectivity in underserved communities and in rural and remote areas, that current technologies can be used to deliver broadband applications by high-altitude platform stations (HAPS), which can

provide broadband connectivity and disaster recovery communications with minimal ground network infrastructure;

b) that WRC-15 decided to study additional spectrum needs for fixed HAPS links to provide broadband connectivity, including within the band 38-39.5 GHz, recognizing that the existing HAPS designations were established without reference to today's broadband capabilities;

c) that HAPS can provide broadband connectivity with minimal ground network infrastructure,

resolves

1 that in making assignments to HAPS ground stations in the fixed service in the bands 38-39.5 GHz, administrations shall protect the space research service (space-to-Earth) in the bands 37-38 GHz from harmful interference by unwanted emissions, taking into account the space research service (space-to-Earth) protection level of -217 dB(W/Hz) at the input terminals of the SRS receiver with 0.001% exceedance due to atmospheric and precipitation effects;

2 that for the purpose of protecting fixed-service systems in territory of other administrations in the band 38-39.5 GHz, the power flux-density limit per HAPS produced at the surface of the Earth in territory of other administrations shall not exceed the following limits, under clear-sky conditions, without the explicit agreement of the affected administration:

| | | | |
|------------------------------|---------------------------------------|-----|-----------------------------------|
| -137 | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $\theta \leq 13^\circ$ |
| $-137 + 3.125 (\theta - 13)$ | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $13^\circ < \theta \leq 25^\circ$ |
| $-99.5 + 0.5 (\theta - 25)$ | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $25^\circ < \theta \leq 50^\circ$ |
| -87 | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $50^\circ < \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane). This pfd mask already takes into account the impact of attenuation due to atmospheric gases;

3 that for the purpose of protecting mobile-service systems in territory of other administrations in the band 38-39.5 GHz, the power flux-density level per HAPS ground station produced at the surface of the Earth, applied at the border of affected neighbouring administrations shall not exceed the following limits, under clear-sky conditions, without the explicit agreement of the affected administration:

| | | | |
|-----------------------------|---------------------------------------|-----|-------------------------------------|
| -110.8 | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $\theta \leq 4^\circ$ |
| $-110.8 + 1.5 (\theta - 4)$ | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $4^\circ < \theta \leq 11.5^\circ$ |
| -101.8 | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for | $11.5^\circ < \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane);

4 that for the purpose of protecting FSS GSO and non-GSO earth station systems in the fixed satellite service (space-to-Earth) in the territory of other administrations, coordination of a transmitting HAPS ground station is required when the power-flux density in $\text{dB(W/(m}^2 \cdot \text{MHz))}$ at the border of the territory of other administration exceeds pfd limit of $-111.1 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for non-GSO operations and $-108.9 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for GSO operations and the pfd values shall be verified considering a percentage of time of 20% in the relevant propagation model,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

1/1.14/5.9 Frequency band 47.2-47.5 GHz and 47.9-48.2 GHz**1/1.14/5.9.1 For Method 9A****NOC****ARTICLE 5****Frequency allocations****NOC****RESOLUTION 122 (REV.WRC-07)****Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz by high altitude platform stations in the fixed service and by other services****1/1.14/5.9.2 For Method 9B1****ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**
(See No. 2.1)**MOD****40-47.5 GHz**

| Allocation to services | | |
|-------------------------------|--|-----------------|
| Region 1 | Region 2 | Region 3 |
| 47.2-47.5 | FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE <u>MOD</u> 5.552A | |

MOD**47.5-51.4 GHz**

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 47.9-48.2 | FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE <u>MOD</u> 5.552A | |

1/1.14/5.9.2.1 Method 9B1**Method 9B1 – Example 1:****MOD**

5.552A The allocation to the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz is ~~designated~~ identified for use by high altitude platform stations (HAPS). ~~The~~ Such use of the fixed-service allocation in the bands 47.2-47.5 GHz and 47.9-48.2 GHz by HAPS shall be in accordance with ~~is subject to~~ the provisions of Resolution **122 (Rev.WRC-~~07~~19)**. (WRC-~~07~~19)

Method 9B1 – Example 2:**MOD**

5.552A The allocation to the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz is ~~designated~~ identified for use by high altitude platform stations (HAPS). This identification does not preclude the use of this frequency band by any application of the services to which it is allocated on a co-primary basis and does not establish priority in the Radio Regulations. ~~The~~ Such use of the fixed-service allocation in the bands 47.2-47.5 GHz and 47.9-48.2 GHz by HAPS shall be in accordance with ~~is subject to~~ the provisions of Resolution **122 (Rev.WRC-~~07~~19)**. (WRC-~~07~~19)

1/1.14/5.9.2.2 Example modification of Resolution 122 for Method 9B1**1/1.14/5.9.2.2.1 Example 1 for Method 9B1****MOD****RESOLUTION 122 (REV.WRC-~~07~~19)**

Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz by high altitude platform stations in the fixed service and by other services

The World Radiocommunication Conference (Geneva, 2007Sharm el-Sheikh, 2019),

considering

- a) that the band 47.2-50.2 GHz is allocated to the fixed, mobile and fixed-satellite services on a co-primary basis;

- b) that WRC-97 made provision for operation of high altitude platform stations (HAPS), also known as stratospheric repeaters, within the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;
- c) that establishing a stable technical and regulatory environment will promote the use of all co-primary services in the band 47.2-47.5 GHz and 47.9-48.2 GHz;
- ~~d) that systems using HAPS are in an advanced stage of development and some countries have notified such systems to ITU in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;~~
- ~~e~~d) that Recommendation ITU-R F.1500 contains the characteristics of systems in the fixed service using HAPS in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;
- ~~f~~e) that while the decision to deploy HAPS can be taken on a national basis, such deployment may affect ~~neighbouring the territory of other~~ administrations and operators of co-primary services;
- ~~g~~f) that ITU-R has completed studies dealing with sharing between systems using HAPS in the fixed service and other types of systems in the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;
- ~~h~~g) that ITU-R has completed studies on compatibility between HAPS systems in the 47.2-47.5 GHz and 47.9-48.2 GHz bands and the radio astronomy service in the 48.94-49.04 GHz band;
- ~~i~~h) that No. **5.552** urges administrations to take all practicable steps to reserve fixed-satellite service (FSS) use of the band 47.2-49.2 GHz for feeder links for the broadcasting-satellite service (BSS) operating in the band 40.5-42.5 GHz, and that ITU-R studies indicate that HAPS in the fixed service may share with such feeder links;
- ~~j~~i) that the technical characteristics of expected BSS feeder links and FSS gateway-type stations are similar;
- ~~k~~j) that ITU-R has completed studies dealing with sharing between systems using HAPS in the fixed service and the fixed-satellite service,
- recognizing*
- a) that, in the long term, the bands 47.2-47.5 GHz and 47.9-48.2 GHz are expected to be required for HAPS operations ~~for both gateway and ubiquitous terminal applications, for which several administrations have already notified systems to the Radiocommunication Bureau;~~
- ~~b) that identification of common sub-bands for ubiquitous ground terminal applications in the use of the fixed service could facilitate HAPS deployment and sharing with other primary services in the 47.2-47.5 GHz and 47.9-48.2 GHz bands;~~
- ~~e~~b) that ~~Recommendation ITU-R SF.1481-1 and~~ Recommendation ITU-R SF.1843 provides information on the feasibility of HAPS systems in the fixed service sharing with the FSS;
- ~~c~~c) that ITU-R studies on HAPS operation in the bands 47.2-47.5 GHz and 47.9-48.2 GHz allocated to the fixed service have concluded that, in order to share with FSS (Earth-to-space), the maximum uplink transmit e.i.r.p. density of HAPS ground terminals in the bands should, in clear-sky conditions, be 6.4 dB(W/MHz) for Urban Area Coverage (UAC), 22.57 dB(W/MHz) for Suburban Area Coverage (SAC) and 28 dB(W/MHz) for Rural Area Coverage (RAC), and that these values can be increased by up to ~~5~~20 dB during periods of rain;
- ~~e~~d) that ITU-R studies have established specific power flux-density values to be met at international borders to facilitate ~~bilateral agreement on~~ sharing conditions for HAPS with other types of fixed service systems within a neighbouring concerned country;

fe) that FSS satellite networks and systems with earth station antenna diameters of 2.5 metres or larger operating as a gateway-type station are capable of sharing with ubiquitous HAPS terminals,

resolves

1 that to facilitate sharing with the FSS (Earth-to-space), the maximum transmit e.i.r.p. density of a ubiquitous HAPS ground terminal shall not exceed the following levels under clear-sky conditions:

| | | | |
|-------|-----------|---------|-----------------|
| 6.4 | dB(W/MHz) | for UAC | (30° < θ ≤ 90°) |
| 22.57 | dB(W/MHz) | for SAC | (15° < θ ≤ 30°) |
| 28 | dB(W/MHz) | for RAC | (5° < θ ≤ 15°) |

where θ is the ground terminal elevation angle in degrees;

2 that the values in resolves 1 can be increased, up to 20 dB, to compensate for rain fade provided that the pfd at the space station does not exceed the value that would result when transmitting with the levels in resolves 1 in clear-sky conditions;
~~that the maximum transmit e.i.r.p. density levels specified in resolves 1 may be increased, using fading compensation techniques, by up to 5 dB during periods of rain;~~

3 that the ground terminal antenna patterns of HAPS operating in the bands 47.2-47.5 GHz and 47.9-48.2 GHz shall meet the following antenna beam patterns:

$$G(\varphi) = G_{max} - 2.5 \times 10^{-3} \left(\frac{D}{\lambda} \varphi \right)^2 \quad \text{for} \quad 0^\circ < \varphi < \varphi_m$$

$$G(\varphi) = 39 - 5 \log(D/\lambda) - 25 \log \varphi \quad \text{for} \quad \varphi_m \leq \varphi < 48^\circ$$

$$G(\varphi) = -3 - 5 \log(D/\lambda) \quad \text{for} \quad 48^\circ \leq \varphi \leq 180^\circ$$

where:

G_{max} : maximum antenna gain (dBi)

$G(\varphi)$: gain (dBi) relative to an isotropic antenna

φ : off-axis angle (degrees)

D : antenna diameter }
 λ : wavelength } expressed in the same units

$$\varphi_m = \frac{20 \lambda}{D} \sqrt{G_{max} - G_1} \quad \text{degrees}$$

G_1 : gain of the first side lobe

$$= 2 + 15 \log(D/\lambda) \text{ (dBi);}$$

4 that for the purpose of protecting fixed wireless systems in the territory of other neighbouring administrations from co-channel interference, a HAPS system operating in the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz
the power flux-density the level produced at the Earth's surface per HAPS in any part of the bands 47.2-47.5 GHz and 47.9-48.2 GHz shall not exceed the following power flux density limits values at the Earth's surface at an administration's border, under clear-sky conditions unless explicit agreement of the affected administration is provided at the time of the notification of HAPS:

$$-141 \quad \text{dB(W/(m}^2 \cdot \text{MHz))} \quad \text{for} \quad \theta \leq 3^\circ$$

| | | |
|------------------------|---------------------------------------|---|
| $-141 + 2(\theta - 3)$ | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for $3^\circ < \theta \leq 13^\circ$ |
| -121 | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for $13^\circ < \theta \leq 90^\circ$ |
| -141 | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for $0^\circ \leq \delta < 3^\circ$ |
| $-141 + 2(\delta - 3)$ | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for $3^\circ \leq \delta \leq 13^\circ$ |
| -121 | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for $13^\circ < \delta \leq 90^\circ$ |

where θ is the angle of the arrival above the horizontal plane in degrees;

~~5~~ that, to protect radio astronomy stations operating in the band 48.94-49.04 GHz from unwanted emissions of HAPS operating in the 47.2-47.5 GHz and 47.9-48.2 GHz bands, the separation distance between the radio astronomy station and the nadir of a HAPS platform shall exceed 50 km;

~~6~~5 that administrations planning to implement a HAPS system in the 47.2-47.5 GHz and 47.9-48.2 GHz bands shall notify the frequency assignments by submitting all mandatory elements of Appendix 4 to the Bureau for the examination of compliance with respect to *resolves* 1, 2, 3, ~~and~~ 4 and 5 above with a view to their registration in the Master International Frequency Register;

~~7~~6 that administrations shall notify the new data elements for the notices referred to in *instructs the Director of the Radiocommunication Bureau* 1 in order to enable the Bureau to perform the examinations;

7 that for the purpose of protecting systems in the mobile service in territory of other administrations, a HAPS system operating in the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz shall not exceed the following power flux-density limits at the Earth's surface applied at the border of the territory of other administrations without the explicit agreement of the affected administrations:

| | | |
|--------------------------|---------------------------------------|---|
| -109 | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for $\theta \leq 4^\circ$ |
| $-109 + 1.2(\theta - 4)$ | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for $4^\circ < \theta \leq 11.5^\circ$ |
| -100 | $\text{dB(W/(m}^2 \cdot \text{MHz))}$ | for $11.5^\circ < \theta \leq 90^\circ$ |

where θ is the elevation angle in degrees (angle of arrival above the horizontal plane for HAPS space station and below the horizon for the HAPS ground station),

invites administrations

that intend to deploy HAPS systems in the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz to consider specifying the use of the bands 47.2-47.35 GHz and 47.9-48.05 GHz for ubiquitous HAPS terminals,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

~~1~~ to maintain and process notices concerning HAPS that were received by the Bureau prior to 20 October 2007 and provisionally recorded in the Master International Frequency Register, only until 1 January 2012, unless the notifying administration informs the Bureau before that date that a particular assignment has been brought into use and provides the complete set of data elements of Appendix 4;

~~2~~ to examine all assignments to HAPS in the fixed service notified prior to 20 October 2007 and apply the provisions of *resolves* 1, 2, 3, 4 and 5 and the respective calculation methodologies included in Recommendation ITU-R F.1820 and Recommendation ITU-R SF.1843.

1/1.14/5.9.2.2.2 Example 2 for Method 9B1

MOD

RESOLUTION 122 (REV.WRC-~~07~~19)

Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz by high altitude platform stations in the fixed service and by other services

The World Radiocommunication Conference (~~Geneva, 2007~~[Sharm el-Sheikh, 2019](#)),

considering

- a) that the band 47.2-50.2 GHz is allocated to the fixed, mobile and fixed-satellite services on a co-primary basis;
- b) that WRC-97 made provision for operation of high altitude platform stations (HAPS), also known as stratospheric repeaters, within the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;
- c) that establishing a stable technical and regulatory environment will promote the use of all co-primary services in the band 47.2-47.5 GHz and 47.9-48.2 GHz;
- ~~d) that systems using HAPS are in an advanced stage of development and some countries have notified such systems to ITU in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;~~
- ~~e)~~ that Recommendation ITU-R F.1500 contains the characteristics of systems in the fixed service using HAPS in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;
- ~~f)~~ that while the decision to deploy HAPS can be taken on a national basis, such deployment may affect the territory of other~~neighbouring~~ administrations and operators of co-primary services;
- ~~g)~~ that ITU-R has completed studies dealing with sharing between systems using HAPS in the fixed service and other types of systems in the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz;
- ~~h) that ITU-R has completed studies on compatibility between HAPS systems in the 47.2-47.5 GHz and 47.9-48.2 GHz bands and the radio astronomy service in the 48.94-49.04 GHz band;~~
- ~~ig)~~ that No. **5.552** urges administrations to take all practicable steps to reserve fixed-satellite service (FSS) use of the band 47.2-49.2 GHz for feeder links for the broadcasting-satellite service (BSS) operating in the band 40.5-42.5 GHz, and that ITU-R studies indicate that HAPS in the fixed service may share with such feeder links;
- ~~jh)~~ that the technical characteristics of expected BSS feeder links and FSS gateway-type stations are similar;
- ~~ki)~~ that ITU-R has completed studies dealing with sharing between systems using HAPS in the fixed service and the fixed-satellite service,

recognizing

- a) that, in the long term, the bands 47.2-47.5 GHz and 47.9-48.2 GHz are expected to be required for HAPS operations ~~for both gateway and ubiquitous terminal applications, for which several administrations have already notified systems to the Radiocommunication Bureau;~~

~~b) — that identification of common sub-bands for ubiquitous ground terminal applications in the use of the fixed service could facilitate HAPS deployment and sharing with other primary services in the 47.2-47.5 GHz and 47.9-48.2 GHz bands;~~

~~e)~~ that ~~Recommendation ITU-R SF.1481-1 and~~ Recommendation ITU-R SF.1843 provides information on the feasibility of HAPS systems in the fixed service sharing with the FSS;

~~d)~~ that ITU-R studies on HAPS operation in the bands 47.2-47.5 GHz and 47.9-48.2 GHz allocated to the fixed service have concluded that, in order to share with FSS (Earth-to-space), the maximum uplink transmit e.i.r.p. density of HAPS ground terminals in the bands should, in clear-sky conditions, be 6.4 dB(W/MHz) for Urban Area Coverage (UAC), 22.57 dB(W/MHz) for Suburban Area Coverage (SAC) and 28 dB(W/MHz) for Rural Area Coverage (RAC), and that these values can be increased by up to ~~520~~ dB during periods of rain;

~~d)~~ that ITU-R studies have established specific power flux-density values to be met at international borders to facilitate sharing conditions for HAPS with other types of fixed service systems within a concerned country;

~~e)~~ that ITU-R studies have established specific power flux-density values to be met at international borders to facilitate bilateral agreement on sharing conditions for HAPS with other types of fixed service systems in a neighbouring country;

~~f)~~ that FSS satellite networks and systems with earth station antenna diameters of 2.5 metres or larger operating as a gateway-type station are capable of sharing with ubiquitous HAPS terminals,

resolves

1 that to facilitate sharing with the FSS (Earth-to-space), the maximum transmit e.i.r.p. density of a ubiquitous HAPS ground terminal shall not exceed the following levels under clear-sky conditions:

| | | | |
|-------|-----------|---------|-----------------|
| 6.4 | dB(W/MHz) | for UAC | (30° < θ ≤ 90°) |
| 22.57 | dB(W/MHz) | for SAC | (15° < θ ≤ 30°) |
| 28 | dB(W/MHz) | for RAC | (5° < θ ≤ 15°) |

where θ is the ground terminal elevation angle in degrees;

2 that the maximum transmit e.i.r.p. density levels specified in *resolves* 1 may be increased, using fading compensation techniques, by up to ~~520~~ dB during periods of rain only to compensate the rain fade;

3 that the ground terminal antenna patterns of HAPS operating in the bands 47.2-47.5 GHz and 47.9-48.2 GHz shall meet the following antenna beam patterns:

$$\begin{aligned}
 G(\varphi) &= G_{max} - 2.5 \times 10^{-3} \left(\frac{D}{\lambda} \varphi \right)^2 & \text{for } 0^\circ < \varphi < \varphi_m \\
 G(\varphi) &= 39 - 5 \log(D/\lambda) - 25 \log \varphi & \text{for } \varphi_m \leq \varphi < 48^\circ \\
 G(\varphi) &= -3 - 5 \log(D/\lambda) & \text{for } 48^\circ \leq \varphi \leq 180^\circ
 \end{aligned}$$

where:

G_{max} : maximum antenna gain (dBi)

$G(\varphi)$: gain (dBi) relative to an isotropic antenna

φ : off-axis angle (degrees)

D : antenna diameter }
 λ : wavelength } expressed in the same units

$$\varphi_m = \frac{20 \lambda}{D} \sqrt{G_{max} - G_1} \quad \text{degrees}$$

G_1 : gain of the first side lobe
 $= 2 + 15 \log (D/\lambda)$ (dBi);

4 that for the purpose of protecting fixed wireless systems in the territory of otherneighbouring administrations from co-channel interference, the power flux-density level per HAPS produced at the surface of the Earth in territory of other administrations shall not exceed the following limits without explicit agreement from the affected administrations:~~a HAPS system operating in the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz shall not exceed the following power flux-density values at the Earth's surface at an administration's border, unless explicit agreement of the affected administration is provided at the time of the notification of HAPS:~~

| | | | |
|------------------------|------------------------------|-----|-------------------------------------|
| -141 | dB(W/(m ² · MHz)) | for | $\theta \leq 3^\circ$ |
| $-141 + 2(\theta - 3)$ | dB(W/(m ² · MHz)) | for | $3^\circ < \theta \leq 13^\circ$ |
| -121 | dB(W/(m ² · MHz)) | for | $13^\circ < \theta \leq 90^\circ$ |
| -141 | dB(W/(m ² · MHz)) | for | $0^\circ \leq \delta < 3^\circ$ |
| $-141 + 2(\delta - 3)$ | dB(W/(m ² · MHz)) | for | $3^\circ \leq \delta \leq 13^\circ$ |
| -121 | dB(W/(m ² · MHz)) | for | $13^\circ < \delta \leq 90^\circ$ |

where θ is the angle of the arrival above the horizontal plane in degrees. These limits relate to the power flux-density which would be obtained under clear-sky conditions;

5 that, to protect radio astronomy stations operating in the band 48.94-49.04 GHz from unwanted emissions of HAPS operating in the 47.2-47.5 GHz and 47.9-48.2 GHz bands, the separation distance between the radio astronomy station and the nadir of a HAPS platform shall exceed 50 km;

6 that administrations planning to implement a HAPS system in the 47.2-47.5 GHz and 47.9-48.2 GHz bands shall notify the frequency assignments by submitting all mandatory elements of Appendix 4 to the Bureau for the examination of compliance with respect to *resolves* 1, 2, 3, 4 and 5 above with a view to their registration in the Master International Frequency Register;

7 that administrations shall notify the new data elements for the notices referred to in *instructs the Director of the Radiocommunication Bureau* 1 in order to enable the Bureau to perform the examinations,

invites administrations

that intend to deploy HAPS systems in the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz to consider specifying the use of the bands 47.2-47.35 GHz and 47.9-48.05 GHz for ubiquitous HAPS terminals,

instructs the Director of the Radiocommunication Bureau

to take all necessary measures to implement this Resolution.

~~1 to maintain and process notices concerning HAPS that were received by the Bureau prior to 20 October 2007 and provisionally recorded in the Master International Frequency Register, only until 1 January 2012, unless the notifying administration informs the Bureau before that date~~

~~that a particular assignment has been brought into use and provides the complete set of data elements of Appendix 4;~~

~~2 ——— to examine all assignments to HAPS in the fixed service notified prior to 20 October 2007 and apply the provisions of *resolves* 1, 2, 3, 4 and 5 and the respective calculation methodologies included in Recommendation ITU-R F.1820 and Recommendation ITU-R SF.1843.~~

1/1.14/5.9.3 For Method 9C

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

(See No. 2.1)

MOD

40-47.5 GHz

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 47.2-47.5 | FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE 5.552A | |

MOD

47.5-51.4 GHz

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 47.9-48.2 | FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE 5.552A | |

SUP

5.552A

SUP**RESOLUTION 122 (REV.WRC-07)****Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz by high altitude platform stations in the fixed service and by other services**

1/1.14/5.10 For Methods 1B1-Option 1, 3B2-Option 1, 4B3-Option 1, 5B2-Option 1, 6B1-Option 1, 7B1-Option 1, 8B2-Option 1 and 9C

ARTICLE 11**Notification and recording of frequency assignments^{1, 2, 3, 4, 5, 6, 7, 8} (WRC-15)****MOD**

11.26 Notices relating to assignments for high-altitude platform stations in the fixed service in the bands identified in Nos. ~~5.457, 5.537A, 5.543A, 5.A114[-6400B1-O1], 5.B114[-21B2-O1], 5.C114[-24B3-O1], 5.D114[-26B2-O1], 5.E114[-28B1-O1], 5.F114[-31B1-O1A], 5.F114[-31B1-O1B], 5.G114[-38B2-O1A], 5.G114[-38B2-O1B]~~ and **5.552A** shall reach the Bureau not earlier than five years before the assignments are brought into use. (WRC-~~12~~**19**)

1/1.14/5.11 For Methods 1B1-Option 1, 3B2-Option 1, 4B3-Option 1, 5B2-Option 1, 6B1-Option 1, 7B1-Option 1, 8B2-Option 1 and 9C

The necessary updates to Appendix 4 of the Radio Regulations also need to be made to reflect the updated frequency bands identified for HAPS and the appropriate set of data elements which need to be submitted to the Bureau. An example below is given for Methods 1B1-Option 1, 3B2-Option 1, 4B3-Option 1, 5B2-Option 1, 6B1-Option 1, 7B1-Option 1, 8B2-Option 1 and 9C.

MOD**APPENDIX 4 (REV.WRC-~~15~~**19**)****Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III**

1 The substance of this Appendix is separated into two parts: one concerning data and their use for terrestrial radiocommunication services and another concerning data and their use for space radiocommunication services or the radio astronomy service. (WRC-12)

2 Both parts contain a list of characteristics and a table indicating the use of each of the characteristics in specific circumstances.

Annex 1: Characteristics of stations in the terrestrial services

Annex 2: Characteristics of satellite networks, earth stations or radio astronomy stations.

ANNEX 1

Characteristics of stations in the terrestrial services¹

MOD

TABLE 2

Characteristics for high altitude platform stations (HAPS) frequency assignments
in the terrestrial services

| Item identifier | | Transmitting station in the bands listed in No. 5.388A for the application of No. 11.2 | Receiving station in the bands listed in No. 5.388A for the application of No. 11.9 | Transmitting station in the bands listed in Nos. 5.537A <u>5.A114[-6400B1-O1]</u> , <u>5.B114[-21B2-O1]</u> , <u>5.C114[-24B3-O1]</u> , <u>5.D114[-26B2-O1]</u> , <u>5.E114[-28B1-O1]</u> , <u>5.F114[-31B1-O1A]</u> , <u>5.G114[-38B2-O1A]</u> and 5.552A for the application of No. 11.2 | Receiving station in the bands listed in Nos. 5.543A <u>5.457</u> , <u>5.F114[-31B1-O1B]</u> , <u>5.G114[-38B2-O1B]</u> and 5.552A for the application of No. 11.9 | Item identifier |
|-----------------|--|--|---|---|---|-----------------|
| | 1 - GENERAL CHARACTERISTICS OF THE HAPS | | | | | |
| | GENERAL INFORMATION | | | | | |
| 1.B | the symbol of the notifying administration (see the Preface) | X | X | X | X | 1.B |
| 1.D | the provision code of the Radio Regulations under which the notice has been submitted | X | X | X | X | 1.D |
| 1.ID1 | the unique identifier given by the administration to the station | X | X | X | X | 1.ID1 |
| | LOCATION OF THE STATION | | | | | |
| 1.4.a | the name by which the station is known | X | X | X | X | 1.4.a |
| 1.4.b | the code of the geographical area, above which the station is located (see the Preface) | X | X | X | X | 1.4.b |
| 1.4.c | the nominal geographical coordinates of the station Latitude and longitude are provided in degrees, minutes and seconds | X | X | X | X | 1.4.c |
| 1.4.h | the nominal altitude of the station above mean sea level, in metres | X | X | X | X | 1.4.h |
| 1.4.t | Station location tolerances: | | | | | 1.4.t |
| 1.4.t.1.a | the planned latitudinal tolerance northerly limit, using d.m.s units | X | X | X | X | 1.4.t.1.a |
| 1.4.t.1.b | the planned latitudinal tolerance southerly limit, using d.m.s units | X | X | X | X | 1.4.t.1.b |
| 1.4.t.2.a | the planned longitudinal tolerance easterly limit, using d.m.s units | X | X | X | X | 1.4.t.2.a |

| Item identifier | | Transmitting station in the bands listed in No. 5.388A for the application of No. 11.2 | Receiving station in the bands listed in No. 5.388A for the application of No. 11.9 | Transmitting station in the bands listed in Nos. 5.537A-5.4114-6400B1-O1 , 5.B114f-21B2-O1 , 5.C114f-24B3-O1 , 5.D114f-26B2-O1 , 5.E114f-28B1-O1 , 5.F114f-31B1-O1A , 5.G114f-38B2-O1A and 5.552A for the application of No. 11.2 | Receiving station in the bands listed in Nos. 5.543A-5.457 , 5.F114f-31B1-O1B , 5.G114f-38B2-O1B and 5.552A for the application of No. 11.9 | Item identifier |
|-----------------|--|--|---|--|--|-----------------|
| | 1 - GENERAL CHARACTERISTICS OF THE HAPS | | | | | |
| 1.4.t.2.b | the planned longitudinal tolerance westerly limit, using d.m.s units | X | X | X | X | 1.4.t.2.b |
| 1.4.t.3 | the planned altitudinal tolerance, in metres | X | X | X | X | 1.4.t.3 |
| | COMPLIANCE WITH TECHNICAL OR OPERATIONAL LIMITS | | | | | |
| 1.14.b | a commitment that the HAPS does not exceed an out-of-band pfd of $-165 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz))}$ at the Earth's surface in the bands 2 160-2 200 MHz in Region 2 and 2 170-2 200 MHz in Regions 1 and 3 (see Resolution 221 (Rev.WRC-07)) | X | | | | 1.14.b |
| 1.14.c | a commitment that the HAPS does not exceed the out-of-band pfd limits of $-165 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for angles of arrival (θ) less than 5° above the horizontal plane, $-165 + 1.75 (\theta - 5) \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for angles of arrival between 5° and 25° and $-130 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for angles of arrival between 25° and 90° (see Resolution 221 (Rev.WRC-07)) | X | | | | 1.14.c |
| 1.14.d | a commitment that the unwanted power density into the HAPS ground station antenna in the band 31.3-31.8 GHz shall e.i.r.p. density per HAPS does not exceed -106.1 dB(W/MHz) under clear sky conditions and -100 dB(W/MHz) under rainy conditions <u>for off-nadir angles higher than 95°</u> (see <u>draft new</u> Resolution 122 [A114-6400B1-O1] (Rev.WRC-0719)) Required in the band 31-31.3 GHz <u>6 440-6 520 MHz</u> | | | | + | 1.14.d |
| 1.14.e | a commitment that the maximum power density into an ubiquitous HAPS ground station antenna in the Urban Area Coverage (UAC) shall e.i.r.p. density per HAPS operating over the oceans or over the land at a distance lower than 29 km from a coast line (distance between the sub-HAPS point and the coast line) does not exceed $6.4-34.9 \text{ dB(W/200 MHz)}$ for elevation angles of ground station antenna greater than 30° and less than or equal to 90° <u>off-nadir angles higher than 125°</u> (see <u>draft new</u> Resolution 122 [A114-6400B1-O1] (Rev.WRC-0719)) Required in the bands 47.2-47.5 GHz and 47.9-48.2 GHz <u>6 440-6 520 MHz</u> | | | | + | 1.14.e |

| Item identifier | 1 – GENERAL CHARACTERISTICS OF THE HAPS | Transmitting station in the bands listed in No. 5.388A for the application of No. 11.2 | Receiving station in the bands listed in No. 5.388A for the application of No. 11.9 | Transmitting station in the bands listed in Nos. 5.537A-5.5114[-6400B1-O1], 5.B114[-21B2-O1], 5.C114[-24B3-O1], 5.D114[-26B2-O1], 5.E114[-28B1-O1], 5.F114[-31B1-O1A], 5.G114[-38B2-O1A] and 5.552A for the application of No. 11.2 | Receiving station in the bands listed in Nos. 5.543A-5.457, 5.F114[-31B1-O1B], 5.G114[-38B2-O1B] and 5.552A for the application of No. 11.9 | Item identifier |
|-----------------|---|--|---|--|--|-----------------|
| 1.14.f | <p>a commitment that the maximum power density into an ubiquitous HAPS ground station antenna in the Suburban Area Coverage (SAC) shall <u>e.i.r.p. density per HAPS in the bands 21.2-21.4 GHz and 22.21-22.5 GHz</u> does not exceed 22.57-0.76 <u>0 – 9.5</u> dB(W/100 MHz) for elevation angles of ground station antenna greater than 15° and less than or equal to 30° <u>arrival between –4.53° and 35.5°</u> and –36.5 dB(W/100 MHz) for angles of arrival between 35.5° and 90° (see <u>draft new</u> Resolution 122 <u>[B114-21B2-O1]</u> (Rev. WRC-0719))</p> <p>Required in the bands 47.2-47.5 GHz and 47.9-48.2 GHz <u>21.4-22 GHz</u></p> | | | | + | 1.14.f |
| 1.14.g | <p>a commitment that the maximum power density into an ubiquitous HAPS ground station antenna in the Rural Area Coverage (RAC) shall <u>unwanted emission power-flux density produced by HAPS</u> does not exceed 28-176 dB(W/(m² · 290 MHz)) for elevation angles of ground station antenna greater than 5° and less than or equal to 15° <u>continuum observations, and</u> –192 dB(W/(m² · 250 kHz)) for spectral line observations in the band 22.21-22.5 GHz at an RAS station location at a height of 50 m (see <u>draft new</u> Resolution 122 <u>[B114-21B2-O1]</u> (Rev. WRC-0719))</p> <p>Required in the bands 47.2-47.5 GHz and 47.9-48.2 GHz <u>21.4-22 GHz</u></p> | | | | + | 1.14.g |
| 1.14.h | <p>a commitment that the separation distance between the nadir of the HAPS and a radio astronomy station operating in the band 48.94-49.04 GHz within the territory of another administration shall exceed 50 km <u>e.i.r.p. density per HAPS</u> does not exceed –70.7 dB(W/Hz) for off-nadir angles higher than 85° (see <u>draft new</u> Resolution 122 <u>[C114-24B3-O1]</u> (Rev. WRC-0719))</p> <p>Required in the bands 47.2-47.5 GHz and 47.9-48.2 GHz <u>27-27.5 GHz</u></p> | | | + | | 1.14.h |
| 1.14.i | <p>a commitment that the <u>e.i.r.p. density per HAPS</u> does not exceed –19.9 dB(W/MHz) for off-nadir angles higher than 85° (see <u>draft new</u> Resolution <u>[C114-24B3-O1]</u> (<u>WRC-19</u>))</p> <p>Required in the bands <u>24.45-24.75 GHz</u></p> | | | + | | 1.14.i |

| Item identifier | 1 – GENERAL CHARACTERISTICS OF THE HAPS | Transmitting station in the bands listed in No. 5.388A for the application of No. 11.2 | Receiving station in the bands listed in No. 5.388A for the application of No. 11.9 | Transmitting station in the bands listed in Nos. 5.537A 5.A114[-6400B1-O1], 5.B114[-21B2-O1], 5.C114[-24B3-O1], 5.D114[-26B2-O1], 5.E114[-28B1-O1], 5.F114[-31B1-O1A], 5.G114[-38B2-O1A] and 5.552A for the application of No. 11.2 | Receiving station in the bands listed in Nos. 5.543A 5.457, 5.F114[-31B1-O1B], 5.G114[-38B2-O1B] and 5.552A for the application of No. 11.9 | Item identifier |
|------------------------|--|--|---|--|--|------------------------|
| 1.14.j | a commitment that the e.i.r.p. density per HAPS ground station does not exceed 12.3 dB(W/MHz) under clear-sky conditions, the e.i.r.p. limit can be increased by 20 dB only to compensate for rain fade (see draft new Resolution [C114-24B3-O1] (WRC-19)) Required in the bands 25.25-25 GHz | | | I+ | | 1.14.j |
| 1.14.k | a commitment that the e.i.r.p. density per HAPS does not exceed -9.1 dB(W/MHz) for off-nadir angles higher than 85.5° (see draft new Resolution [C114-24B3-O1] (WRC-19)) Required in the bands 24.25-25.25 and 27-27.5 GHz | | | I+ | | 1.14.k |
| 1.14.l | a commitment that the e.i.r.p. density per HAPS in the band 23.6-24.2 GHz does not exceed -0.7714 θ – 16.5 dB(W/200 MHz) for angles of arrival between -4.53° and 35° and -43.5 dB(W/100 MHz) for angles of arrival between 35° and 90° (see draft new Resolution [C114-24B3-O1] (WRC-19)) Required in the bands 24.25-25.25 GHz | | | I+ | | 1.14.l |
| 1.14.m | a commitment that the power flux-density produced by unwanted emissions from HAPS does not exceed -177 dB(W/(m ² · 400 MHz)) for continuum observations and -191 dB(W/(m ² · 250 kHz)) for spectral line observations in the band 23.6-24 GHz at an RAS station location at the height of 50 m (see draft new Resolution [C114-24B3-O1] (WRC-19)) Required in the bands 24.25-25.25 GHz | | | I+ | | 1.14.m |
| 1.14.n | a commitment that the maximum e.i.r.p. density per HAPS does not exceed -8 dB(W/MHz) for off-nadir angles higher than 95° (see draft new Resolution [E114-28+31B1-O1] (WRC-19)) Required in the band 27.9-28.2 GHz | | | I+ | | 1.14.n |
| 1.14.o | a commitment that the level of unwanted power density into the HAPS ground station antenna in the band 31.3-31.8 GHz does not exceed -83 dB(W/200 MHz) under clear-sky conditions and may be increased under rainy conditions to mitigate fading due to rain, provided that the effective impact on the passive satellite does not exceed the impact under clear sky conditions (see draft new Resolution [E114-28+31B1-O1] (WRC-19)) Required in the band 31-31.3 GHz | | | I+ | | 1.14.o |

| Item identifier | 1 – GENERAL CHARACTERISTICS OF THE HAPS | Transmitting station in the bands listed in No. 5.388A for the application of No. 11.2 | Receiving station in the bands listed in No. 5.388A for the application of No. 11.9 | Transmitting station in the bands listed in Nos. 5.537A 5.A114[-6400B1-O1], 5.B114[-21B2-O1], 5.C114[-24B3-O1], 5.D114[-26B2-O1], 5.E114[-28B1-O1], 5.F114[-31B1-O1A], 5.G114[-38B2-O1A] and 5.552A for the application of No. 11.2 | Receiving station in the bands listed in Nos. 5.543A 5.457, 5.F114[-31B1-O1B], 5.G114[-38B2-O1B] and 5.552A for the application of No. 11.9 | Item identifier |
|------------------------|---|--|---|--|--|------------------------|
| 1.14.p | a commitment that the e.i.r.p. density per HAPS in the band 31.3-31.8 GHz does not exceed $-0 - 13.1$ dB(W/200 MHz) for angles of arrival between -4.53° and 22° and -35.1 dB(W/200 MHz) for angles of arrival between 22° and 90° [E114-28+31B1-O1] (WRC-19)) Required in the band 31-31.3 GHz | | | + | | 1.14.p |
| 1.14.q | a commitment that the power flux-density produced by unwanted emissions from HAPS ground station does not exceed -141 dB(W/(m ² · 500 MHz)) in the band 31.3-31.8 GHz at an RAS station location at the height of 50 m (see Resolution [E114-28+31B1-O1] (WRC-19)) Required in the band 31-31.3 GHz | | | + | | 1.14.q |
| 1.14.r | a commitment that the power flux-density produced by unwanted emissions from HAPS does not exceed -171 dB(W/(m ² · 500 MHz)) in the band 31.3-31.8 GHz at an RAS station location at the height of 50 m (see Resolution [E114-28+31B1-O1] (WRC-19)) Required in the band 31-31.3 GHz | | | + | | 1.14.r |
| 1.14.s | a commitment that space research service (space-to-Earth) protection level of -217 dB(W/Hz) at the input of SRS receiver with 0.001% exceedance due to atmospheric and precipitation effects as referred to in the relevant ITU-R Recommendations is not exceeded (see Resolution [G114-38B2-O1A+B] (WRC-19)) Required in the band 38-39.5 GHz | | | + | + | 1.14.s |
| 1.14.t | a commitment that the maximum power density into an ubiquitous HAPS ground station antenna in the Urban Area Coverage (UAC) shall not exceed 6.4 dB(W/MHz) for elevation angles of ground station antenna greater than 30° and less than or equal to 90° (see Resolution 122 (Rev.WRC-07)) Required in the bands 47.2-47.5 GHz and 47.9-48.2 GHz | | | | + | 1.14.t |
| 1.14.u | a commitment that the maximum power density into an ubiquitous HAPS ground station antenna in the Suburban Area Coverage (SAC) shall not exceed 22.57 dB(W/MHz) for elevation angles of ground station antenna greater than 15° and less than or equal to 30° (see Resolution 122 (Rev.WRC-07)) Required in the bands 47.2-47.5 GHz and 47.9-48.2 GHz | | | | + | 1.14.u |

| Item identifier | 1 - GENERAL CHARACTERISTICS OF THE HAPS | Transmitting station in the bands listed in No. 5.388A for the application of No. 11.2 | Receiving station in the bands listed in No. 5.388A for the application of No. 11.9 | Transmitting station in the bands listed in Nos. 5.537A 5.114[-6400B1-O1], 5.B114[-21B2-O1], 5.C114[-24B3-O1], 5.D114[-26B2-O1], 5.E114[-28B1-O1], 5.F114[-31B1-O1A], 5.G114[-38B2-O1A] and 5.552A for the application of No. 11.2 | Receiving station in the bands listed in Nos. 5.543A 5.457, 5.F114[-31B1-O1B], 5.G114[-38B2-O1B] and 5.552A for the application of No. 11.9 | Item identifier |
|-----------------|---|--|---|---|--|-----------------|
| 1.14.v | <u>a commitment that the maximum power density into an ubiquitous HAPS ground station antenna in the Rural Area Coverage (RAC) shall not exceed 28 dB(W/MHz) for elevation angles of ground station antenna greater than 5° and less than or equal to 15° (see Resolution 122 (Rev.WRC-07))</u> <u>Required in the bands 47.2-47.5 GHz and 47.9-48.2 GHz</u> | | | | + | 1.14.v |
| 1.14.w | <u>a commitment that the separation distance between the nadir of the HAPS and a radio astronomy station operating in the band 48.94-49.04 GHz within the territory of another administration shall exceed 50 km (see Resolution 122 (Rev.WRC-07))</u> <u>Required in the bands 47.2-47.5 GHz and 47.9-48.2 GHz</u> | | | + | | 1.14.w |
| | COORDINATION AND AGREEMENT | | | | | |
| 1.11.a | the symbol of each administration with which coordination has been successfully effected, including where the agreement is to exceed the limits prescribed in the Radio Regulations Required if coordination is necessary and has been obtained pursuant to the relevant provisions of the Radio Regulations | + | + | + | + | 1.11.a |
| | OPERATING ADMINISTRATION OR AGENCY | | | | | |
| 1.12.a | the symbol for the operating agency | O | O | O | O | 1.12.a |
| 1.12.b | the symbol for the address of the administration responsible for the station and to which communication should be sent on urgent matters regarding interference, quality of emissions and questions referring to the technical operation of the circuit (see Article 15) | X | X | X | X | 1.12.b |
| | REMARKS | | | | | |
| 1.13.c | Remarks for assisting the Bureau in processing the notice | O | O | O | O | 1.13.c |

| Item identifier | 2 – CHARACTERISTICS TO BE PROVIDED FOR EACH INDIVIDUAL OR COMPOSITE HAPS ANTENNA BEAM | Transmitting station in the bands listed in No. 5.388A for the application of No. 11.2 | Receiving station in the bands listed in No. 5.388A for the application of No. 11.9 | Transmitting station in the bands listed in Nos. 5.537A-5.4114F-6400B1-O1I , 5.B114F-21B2-O1I , 5.C114F-24B3-O1I , 5.D114F-26B2-O1I , 5.E114F-28B1-O1I , 5.F114F-31B1-O1A , 5.G114F-38B2-O1A and 5.52A for the application of No. 11.2 | Receiving station in the bands listed in Nos. 5.543A-5.457 , 5.F114F-31B1-O1B , 5.G114F-38B2-O1B and 5.52A for the application of No. 11.9 | Item identifier |
|-----------------|--|--|---|---|---|-----------------|
| | IDENTIFICATION AND DIRECTION OF THE HAPS ANTENNA BEAM | | | | | |
| 2.1.a | the designation-identification of the HAPS antenna beam | X | X | X | X | 2.1.a |
| 2.1.b | an indicator showing whether the antenna beam, under 2.1.a, is fixed or whether it is steerable and/or reconfigurable | X | X | X | X | 2.1.b |
| 2.1.c | an indicator showing whether the HAPS antenna tracks the service area | X | | X | | 2.1.c |
| 2.1.d | an indicator showing whether the antenna beam is individual or composite beam | X | X | X | X | 2.1.d |
| | ANTENNA CHARACTERISTICS | | | | | |
| 2.9.g | the maximum co-polar isotropic gain | X | X | X | X | 2.9.g |
| 2.9.j | the measured radiation pattern of the antenna, the reference radiation pattern or the symbols in standard references to be used for coordination | X | X | | | 2.9.j |
| 2.9.gp | the co-polar antenna gain contours plotted on a map of the Earth's surface, preferably in a radial projection from the HAPS onto a plane perpendicular to the axis from the centre of the Earth to the HAPS The HAPS antenna gain contours shall be drawn as isolines of the isotropic gain, relative to the maximum antenna gain, when any of these contours is located either totally or partially outside the territory of the notifying administration The antenna gain contours shall include the effects of the planned longitudinal and latitudinal tolerance, planned altitudinal tolerance and the pointing accuracy of the antenna, taking into consideration the movement of the HAPS antenna boresight around the effective boresight area | X | X | X | X | 2.9.gp |

| Item identifier | 3 – CHARACTERISTICS TO BE PROVIDED FOR EACH FREQUENCY ASSIGNMENT FOR EACH INDIVIDUAL OR COMPOSITE HAPS ANTENNA BEAM | Transmitting station in the bands listed in No. 5.388A for the application of No. 11.2 | Receiving station in the bands listed in No. 5.388A for the application of No. 11.9 | Transmitting station in the bands listed in Nos. 5.537A-5.4114I-6400B1-O1I , 5.B114I-21B2-O1I , 5.C114I-24B3-O1I , 5.D114I-26B2-O1I , 5.E114I-28B1-O1I , 5.F114I-31B1-O1A1 , 5.G114I-38B2-O1A1 and 5.52A for the | Receiving station in the bands listed in Nos. 5.543A-5.457 , 5.F114I-31B1-O1B1 , 5.G114I-38B2-O1B1 and 5.552A for the application of No. 11.9 | Item identifier |
|-----------------|---|--|---|---|--|-----------------|
| | ASSIGNED FREQUENCY | | | | | |
| 3.1.a | the assigned frequency, as defined in No. 1.148 | X | X | X | X | 3.1.a |
| 3.1.b | the reference frequency, as defined in Article 1 Required if the modulation envelope is asymmetric | + | + | + | + | 3.1.b |
| | DATE OF OPERATION | | | | | |
| 3.2.c | the date (actual or foreseen, as appropriate) of bringing the frequency assignment (new or modified) into use | X | X | X | X | 3.2.c |
| | LOCATION OF THE ASSOCIATED ANTENNA(S) | | | | | |
| | For an area in which associated transmitting/receiving ground station(s) operate: | | | | | |
| 3.5.c.a | the geographical coordinates of a given zone A minimum of six geographical coordinates are required, in degrees, minutes and seconds <i>Note</i> – For the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz the geographical coordinates are provided for each of the UAC, SAC and if applicable RAC (see the most recent version of Recommendation ITU-R F.1500) Required if neither a circular area (3.5.e and 3.5.f) nor a geographical area (3.5.d) are provided | + | + | (X?) | (X?) | 3.5.c.a |
| 3.5.d | the code of the geographical area (see the Preface) <i>Note</i> – For the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz separate geographical areas are provided for each of the UAC, SAC and if applicable RAC (see the most recent version of Recommendation ITU-R F.1500) Required if neither a circular area (3.5.e and 3.5.f) nor the geographical coordinates of a given zone (3.5.c.a) are provided | + | + | (X?) | (X?) | 3.5.d |
| 3.5.e | the geographical coordinates of the centre of the circular area in which the associated ground station(s) are operating The latitude and longitude are provided in degrees, minutes and seconds <i>Note</i> – For the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz different centres of the circular area may be provided for the UAC, SAC and if applicable RAC (see the most recent version of Recommendation ITU-R F.1500) | + | + | (X?) | (X?) | 3.5.e |

| Item identifier | 3 – CHARACTERISTICS TO BE PROVIDED FOR EACH FREQUENCY ASSIGNMENT FOR EACH INDIVIDUAL OR COMPOSITE HAPS ANTENNA BEAM | Transmitting station in the bands listed in No. 5.388A for the application of No. 11.2 | Receiving station in the bands listed in No. 5.388A for the application of No. 11.9 | Transmitting station in the bands listed in Nos. 5.537A 5.A114f-6400B1-O1f, 5.B114f-21B2-O1f, 5.C114f-24B3-O1f, 5.D114f-26B2-O1f, 5.E114f-28B1-O1f, 5.F114f-31B1-O1A1, 5.G114f-38B2-O1A1 and 5.552A for the application of No. 11.9 | Receiving station in the bands listed in Nos. 5.543A 5.457, 5.F114f-31B1-O1B1, 5.G114f-38B2-O1B1 and 5.552A for the application of No. 11.9 | Item identifier |
|-----------------|---|--|---|--|--|-----------------|
| | Required if neither a geographical area (3.5.d) or geographical coordinates of a given zone (3.5.c.a) are provided | | | | | |
| 3.5.f | the radius, in km, of the circular area <i>Note</i> – For the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz, a separate radius is provided for each of the UAC, SAC and if applicable RAC (see the most recent version of Recommendation ITU-R F.1500) Required if neither a geographical area (3.5.d) nor geographical coordinates of a given zone (3.5.c.a) are provided | + | + | + | + | 3.5.f |
| | CLASS OF STATION AND NATURE OF SERVICE | | | | | |
| 3.6.a | the class of station, using the symbols from the Preface | X | X | X | X | 3.6.a |
| 3.6.b | the nature of service, using the symbols from the Preface | X | X | X | X | 3.6.b |
| | CLASS OF EMISSION AND NECESSARY BANDWIDTH (in accordance with Article 2 and Appendix 1) | | | | | |
| 3.7.a | the class of emission | X | X | X | X | 3.7.a |
| 3.7.b | the necessary bandwidth | X | X | X | X | 3.7.b |
| | POWER CHARACTERISTICS OF THE TRANSMISSION | | | | | |
| 3.8 | the symbol (X, Y or Z, as appropriate) describing the type of power (see Article 1) corresponding to the class of emission | X | X | X | X | 3.8. |
| 3.8.aa | the nominal power delivered to the antenna, in dBW, including excluding the level of power control in 3.8.BA <i>Note</i> – For a receiving HAPS, the nominal power delivered to the antenna refers to the associated transmitting ground station(s) | X | | X | X | 3.8.aa |
| 3.8.AB | the maximum nominal power density ¹ averaged over the worst 1 MHz band delivered to the antenna | X | | X | | 3.8.AB |
| 3.8.BA | the range of power control, in dB <i>Note</i> – For a receiving HAPS, the power control refers to its use by the associated transmitting ground station(s) <u>In the case of a transmitting HAPS, required in the bands 21.4-22 GHz, 24.25-25.25 GHz, 27-27.5 GHz, 27.9-28.2 GHz, 31-31.3 GHz, 38-39.5 GHz, 47.2-47.5 GHz and 47.9-48.2 GHz</u> In the case of a receiving HAPS, required in the bands 47.2-47.5 GHz and 47.9-48.2 GHz | X | | | X | 3.8.BA |

| Item identifier | 3 – CHARACTERISTICS TO BE PROVIDED FOR EACH FREQUENCY ASSIGNMENT FOR EACH INDIVIDUAL OR COMPOSITE HAPS ANTENNA BEAM | Transmitting station in the bands listed in No. 5.388A for the application of No. 11.2 | Receiving station in the bands listed in No. 5.388A for the application of No. 11.9 | Transmitting station in the bands listed in Nos. 5.537A-5.4114F-6400B1-O1L , 5.B114F-21B2-O1L , 5.C114F-24B3-O1L , 5.D114F-26B2-O1L , 5.E114F-28B1-O1L , 5.F114F-31B1-O1A1 , 5.G114F-38B2-O1A1 and 5.52A for the | Receiving station in the bands listed in Nos. 5.543A-5.457L , 5.F114F-31B1-O1B1 , 5.G114F-38B2-O1B1 and 5.552A for the application of No. 11.9 | Item identifier |
|-----------------|--|--|---|---|---|-----------------|
| | POLARIZATION AND RECEIVING SYSTEM NOISE TEMPERATURE | | | | | |
| 3.9.d | the code indicating the type of polarization (see the Preface) | X | X | X | X | 3.9.d |
| 3.9.j | the reference radiation pattern of the associated ground station(s) Required in the bands 47.2-47.5 GHz and 47.9-48.2 GHz | | | + | + | 3.9.j |
| 3.9.k | the lowest total receiving system noise temperature, in kelvins, referred to the output of the receiving antenna | | X | | X | 3.9.k |
| | HOURS OF OPERATION | | | | | |
| 3.10.b | the regular hours of operation (in hours and minutes from ... to ...) of the frequency assignment, in UTC | X | X | X | X | 3.10.b |

1/1.14/5.12 For Methods 1B1-Option 1, 3B2-Option 1, 4B3-Option 1, 5B2-Option 1, 6B1-Option 1, 7B1-Option 1, 8B2-Option 1 and 9C

APPENDIX 7 (REV.WRC-15)

Methods for the determination of the coordination area around an earth station in frequency bands between 100 MHz and 105 GHz

ANNEX 7

System parameters and predetermined coordination distances for determination of the coordination area around an earth station

3 Horizon antenna gain for a receiving earth station with respect to a transmitting earth station

MOD

TABLE 7b (Rev.WRC-1519)

Parameters required for the determination of coordination distance for a transmitting earth station

| Transmitting space radiocommunication service designation | | Fixed-satellite, mobile-satellite | Aero-nautical mobile-satellite (R) service | Aero-nautical mobile-satellite (R) service | Fixed-satellite | Fixed-satellite | Fixed-satellite | Fixed-satellite | Fixed-satellite | Earth exploration-satellite, space operation, space research | Fixed-satellite, mobile-satellite, meteorological-satellite | Fixed-satellite | Fixed-satellite | Fixed-satellite | Fixed-satellite | Fixed-satellite ³ | Fixed-satellite | Fixed-satellite ³ |
|---|--------------------------|-----------------------------------|--|--|-------------------------------|-------------------------|-----------------|---|-----------------------------|--|---|-----------------|-----------------|---|------------------------------|------------------------------|-----------------|------------------------------|
| Frequency bands (GHz) | | 2.655-2.690 | 5.030-5.091 | 5.030-5.091 | 5.091-5.150 | 5.091-5.150 | 5.725-5.850 | 5.725-7.075 | 6 440-6 520 | 7.100-7.250 ⁵ | 7.900-8.400 | 10.7-11.7 | 12.5-14.8 | 13.75-14.3 | 15.43-15.65 | 17.7-18.4 | 19.3-19.7 | |
| Receiving terrestrial service designations | | Fixed, mobile | Aeronautical radio-navigation | Aeronautical mobile (R) | Aeronautical radio-navigation | Aeronautical mobile (R) | Radiolocation | Fixed (except HAPS ground stations), mobile | Fixed (HAPS ground station) | Fixed, mobile | Fixed, mobile | Fixed, mobile | Fixed, mobile | Radiolocation radionavigation (land only) | Aeronautical radionavigation | Fixed, mobile | Fixed, mobile | |
| Method to be used | | § 2.1 | § 2.1, § 2.2 | § 2.1, § 2.2 | | | § 2.1 | § 2.1 | § 2.1 | § 2.1, § 2.2 | § 2.1 | § 2.1 | § 2.1, § 2.2 | § 2.1 | | § 2.1, § 2.2 | § 2.2 | |
| Modulation at terrestrial station ¹ | | A | | | | | A | N | N | A | N | A | N | A | N | – | N | N |
| Terrestrial station interference parameters and criteria | P_0 (%) | 0.01 | | | | | 0.01 | 0.005 | 0.01 | 0.01 | 0.005 | 0.01 | 0.005 | 0.01 | 0.005 | 0.01 | 0.005 | 0.005 |
| | n | 2 | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 |
| | p (%) | 0.005 | | | | | 0.005 | 0.0025 | 0.005 | 0.005 | 0.0025 | 0.005 | 0.0025 | 0.005 | 0.0025 | 0.01 | 0.0025 | 0.0025 |
| | N_L (dB) | 0 | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | M_S (dB) | 26 ² | | | | | 33 | 37 | 33 | 33 | 37 | 33 | 40 | 33 | 40 | 1 | 25 | 25 |
| | W (dB) | 0 | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Terrestrial station parameters | G_x (dBi) ⁴ | 49 ² | 6 | 10 | 6 | 6 | 46 | 46 | 2 ⁶ | 46 | 46 | 46 | 46 | 50 | 50 | 52 | 52 | 48 |
| | T_e (K) | 500 ² | | | | | 750 | 750 | 500 | 750 | 750 | 750 | 750 | 1 500 | 1 100 | 1 500 | 1 100 | 1 100 |
| Reference bandwidth | | B (Hz) | 4×10^3 | 150×10^3 | 37.5×10^3 | 150×10^3 | 10^6 | 4×10^3 | 10^6 | 4×10^3 | 10^6 | 4×10^3 | 10^6 | 4×10^3 | 10^6 | 10^7 | 10^6 | 10^6 |
| Permissible interference power | | $P_{f,p}$ (dBW) in B | –140 | –160 | –157 | –160 | –143 | –131 | –103 | –131 | –103 | –131 | –103 | –128 | –98 | –128 | –98 | –113 |

¹ A: analogue modulation; N: digital modulation.² The parameters for the terrestrial station associated with transhorizon systems have been used. Line-of-sight radio-relay parameters associated with the frequency band 5 725-7 075 MHz may also be used to determine a supplementary contour with the exception that $G_x = 37$ dBi.³ Feeder links of non-geostationary satellite systems in the mobile-satellite service.⁴ Feeder losses are not included.⁵ Actual frequency bands are 7 190-7 250 MHz for the Earth exploration-satellite service, 7 100-7 155 MHz and 7 190-7 235 MHz for the space operation service and 7 145-7 235 MHz for the space research service.⁶ Maximum HAPS ground station antenna gain toward the horizon.

MOD

TABLE 7c (Rev.WRC-12.19)

Parameters required for the determination of coordination distance for a transmitting earth station

| Transmitting space radiocommunication service designation | | Fixed-satellite | <u>Fixed-satellite</u> | Fixed-satellite ² | Fixed-satellite ³ | Space research | Earth exploration-satellite, space research | Fixed-satellite, mobile-satellite, radionavigation-satellite | Fixed-satellite ² |
|---|--------------------------|--------------------------------------|--|------------------------------|------------------------------|------------------------------|---|--|------------------------------|
| Frequency bands (GHz) | | 24.65-25.25 27.0-29.5 | <u>24.65-25.25</u> <u>27-27.5</u> <u>27.9-28.2</u> | 28.6-29.1 | 29.1-29.5 | 34.2-34.7 | 40.0-40.5 | 42.5-47 47.2-50.2 50.4-51.4 | 47.2-50.2 |
| Receiving terrestrial service designations | | Fixed (<u>except HAPS</u>), mobile | <u>Fixed (HAPS ground station)</u> | Fixed, mobile | Fixed, mobile | Fixed, mobile, radiolocation | Fixed, mobile | Fixed, mobile, radionavigation | Fixed, mobile |
| Method to be used | | § 2.1 | <u>§ 2.1</u> | § 2.2 | § 2.2 | | § 2.1, § 2.2 | § 2.1, § 2.2 | § 2.2 |
| Modulation at terrestrial station ¹ | | N | <u>N</u> | N | N | | N | N | N |
| Terrestrial station interference parameters and criteria | p_0 (%) | 0.005 | <u>0.01</u> | 0.005 | 0.005 | | 0.005 | 0.005 | 0.001 |
| | n | 1 | <u>1</u> | 2 | 1 | | 1 | 1 | 1 |
| | p (%) | 0.005 | <u>0.005</u> | 0.0025 | 0.005 | | 0.005 | 0.005 | 0.001 |
| | N_L (dB) | 0 | <u>0</u> | 0 | 0 | | 0 | 0 | 0 |
| | M_s (dB) | 25 | <u>10</u> | 25 | 25 | | 25 | 25 | 25 |
| | W (dB) | 0 | <u>0</u> | 0 | 0 | | 0 | 0 | 0 |
| Terrestrial station parameters | G_x (dBi) ⁴ | 50 | <u>0</u> ⁵ | 50 | 50 | | 42 | 42 | 46 |
| | T_e (K) | 2 000 | <u>350</u> | 2 000 | 2 000 | | 2 600 | 2 600 | 2 000 |
| Reference bandwidth | B (Hz) | 10^6 | <u>10^6</u> | 10^6 | 10^6 | | 10^6 | 10^6 | 10^6 |
| Permissible interference power | $P_r(p)$ (dBW) in B | -111 | <u>-134</u> | -111 | -111 | | -110 | -110 | -111 |

¹ A: analogue modulation; N: digital modulation.² Non-geostationary satellites in the fixed-satellite service.³ Feeder links to non-geostationary-satellite systems in the mobile-satellite service.⁴ Feeder losses are not included.⁵ Maximum HAPS ground station antenna gain toward the horizon.

1/1.14/5.13 For all Methods

SUP

RESOLUTION 160 (WRC-15)

**Facilitating access to broadband applications delivered by high-altitude
platform stations**

Agenda item 1.15

1.15 to consider identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz, in accordance with Resolution 767 (WRC-15);

Resolution 767 (WRC-15) – *Studies towards an identification for use by administrations for land-mobile and fixed services applications operating in the frequency range 275-450 GHz*

1/1.15/1 Executive summary

This agenda item seeks to identify spectrum for land mobile service (LMS) and fixed service (FS) applications in the 275-450 GHz frequency range while maintaining protection of the existing Earth exploration-satellite service (EESS) (passive) and radio astronomy service (RAS) applications identified in RR No. **5.565**. A PDN Report ITU-R SM.[275-450GHz SHARING] has been developed. This Report contains the results of compatibility studies, based on the technical information available on LMS and FS characteristics in Reports [ITU-R M.2417-0](#) and [ITU-R F.2416-0](#), for the purpose of identifying spectrum that can be used by LMS/FS applications without the need for regulatory restrictions to protect passive service applications (RAS and EESS (passive)).

Compatibility studies concluded that atmospheric attenuation independent of free-space losses at 275-450 GHz is not sufficient to provide compatibility between FS and RAS operations in the absence of other considerations. Separation distances and/or avoidance angles between RAS stations and FS stations should be considered depending on the deployment environment of FS stations. It was assumed that for the RAS studies, FS also covered the case for LMS.

In order to maintain the protection of the passive services and satisfy the spectrum needs of the LMS/FS applications, seven methods have been identified and are described in section 4 below.

1/1.15/2 Background

RR No. **5.565** was revised in accordance with Resolution **950 (Rev.WRC-07)**, and the specific frequency bands were identified for measurements by passive services, such as the RAS, EESS (passive), and SRS (passive). In the specific identification of the frequencies in the range of 275-1 000 GHz, the use by the passive services does not preclude use of this range by active services. The bands of interest to EESS/SRS (passive) from 275 to 3 000 GHz have been addressed in Report [ITU-R RS.2194-0](#) and the sharing studies between the RAS and active services in the frequency range 275-3 000 GHz have been conducted in Report [ITU-R RA.2189-1](#).

High data rate wireless communication systems above 100 Gbit/s have been discussed within international standardization organizations, and technology development in this area is growing. Several applications such as wireless links for data centres, close proximity wireless connections, intra-device communications and fronthaul/backhaul links which are expected to be operated in the band above 275 GHz are summarized in Report [ITU-R SM.2352-0](#). The LMS and FS applications have been studied by the relevant working parties based on Questions ITU-R 256/5 and 257/5, respectively. Reports [ITU-R F.2416-0](#) and [ITU-R M.2417-0](#) summarize the technical and operational parameters as well as the spectrum needs for each of the applications.

1/1.15/3 Summary and analysis of the results of ITU-R studies

1/1.15/3.1 Technical and operational characteristics and spectrum needs

1/1.15/3.1.1 Land mobile service applications

Report [ITU-R M.2417-0](#) provides the technical and operational characteristics and spectrum needs of LMS applications operating in the frequency band 275-450 GHz. The spectrum needs for the LMS applications identified to date, such as close proximity mobile system (CPMS) applications, intra-device applications, and wireless links for data centres, are 50 GHz of total spectrum bandwidth. One of the technical characteristics of LMS applications indicates that channel bandwidths of up to 103.68 GHz may be considered in the future. The LMS applications typically operate over short distances mostly in indoors environment and/or with shielded conditions as well as device blocking operations.

1/1.15/3.1.2 Fixed service applications

Report [ITU-R F.2416-0](#) provides the technical and operational characteristics and spectrum needs of FS applications operating in the frequency band 275-450 GHz. The Report states that a bandwidth of around 25 GHz may satisfy the initial typical deployment scenarios while a bandwidth of about 50 GHz will sufficiently support the evolution of IMT traffic of fronthaul and backhaul. The Report also indicates that the possible candidate frequency bands for fronthaul and backhaul applications are 275-325 GHz and 380-445 GHz, and that the frequency band 330-370 GHz may also be considered in the future, if and when parameters are available for that range.

1/1.15/3.1.3 Passive service applications

Several frequency bands in the 275-450 GHz range are identified for use by passive services for scientific investigation and environmental sensing and monitoring by both the EESS and the RAS, as provided in RR No. **5.565**. In this frequency range there are currently nine current or planned EESS (passive) sensors, which perform global measurements. Additionally, there are at least thirteen distinct RAS sites using these frequencies throughout the world at present, although a few more may be planned in the future. Details on the EESS (passive) systems and RAS sites can be found in PDN Report ITU-R SM.[275-450GHz SHARING].

1/1.15/3.1.3.1 Earth exploration-satellite service

Report [ITU-R RS.2431-0](#) provides technical and operational characteristics of EESS (passive) systems in the frequency range 275-450 GHz. In this frequency range, there are several different systems using various portions of this band for scientific measurements, and additional systems are planned.

Systems in the EESS use sensitive instrumentation to detect naturally occurring electromagnetic energy absorbed and emitted by constituents of the Earth's atmosphere, land and sea. EESS (passive) measurements are used for climate studies, weather predictions and warnings and water monitoring, prediction and warnings; as well as for supporting disaster-relief operations and for planning preventive measures for adapting to and mitigating the negative effects of climate change.

In the 275-450 GHz frequency range, there are several different systems using various portions of this band for scientific measurements, and additional systems are planned. Report [ITU-R RS.2431-0](#) provides technical and operational characteristics of EESS (passive) systems in the frequency range 275-450 GHz.

1/1.15/3.1.3.2 Radio astronomy service

Information about threshold levels of interference to radio astronomy systems are contained in Report [ITU-R RA.2189](#) and summarized in Tables 9 and 10 of PDN Report ITU-R SM.[275-450GHz SHARING].

Radio astronomy systems in this frequency range include single dish telescopes, interferometers, and balloon-borne platforms. Most RAS observatories are geographically located at high altitudes where water vapour presents far less attenuation in the bands listed in RR No. **5.565** than at sea level. The remoteness of these locations may facilitate sharing; however, in some cases additional protections may be necessary as the propagation characteristics at these sites results in significantly lower attenuation and may result in less signal loss from potentially interfering transmitters. Many nations have contributed considerable time, resources, and expertise in the design and construction of these facilities, which represent shared global resources for scientific investigation.

The information about threshold levels of detrimental effects to radio astronomy systems are contained in Tables 9 and 10 of PDN Report ITU-R SM.[275-450GHz SHARING].

1/1.15/3.2 Sharing and compatibility studies in the frequency range 275-450 GHz

The characteristics used for sharing and compatibility studies are based on the information on fixed and land mobile service parameters that were provided in ITU-R Reports as described above. These parameters were used in conjunction with characteristics of radio astronomy and EESS (passive) systems that are used in these bands, to assess whether the interference thresholds for RAS and EESS (passive) are exceeded for the fixed and mobile operational parameters and deployments given in the reports.

Studies done in PDN Report ITU-R SM.[275-450GHz SHARING] did not seek to develop regulatory provisions (such as power limits, shielding requirements and/or elevation angle restrictions, etc.) that could facilitate sharing with EESS and focused on identifying spectrum for LMS/FS applications, where such restrictions would not be necessary to protect the passive services.

1/1.15/3.2.1 Sharing and compatibility studies for EESS (passive)

Several studies were performed to assess frequency sharing between passive services (EESS and RAS) and the fixed (FS) and land-mobile services (LMS) in the 275-450 GHz range. These studies are contained in PDN Report ITU-R SM.[275-450GHz SHARING].¹

Study 2 focused on an aggregate analysis performed for FS elevation angle distributions ± 20 and ± 12 degrees, and a static analysis of FS stations and EESS (passive) sensor for three different pointing scenarios across the 275-450 GHz frequency range. This study found compatibility in the frequency bands 275-286 GHz, 318-334 GHz, 350-356 GHz, 361-365 GHz, 369-392 GHz, 397-399 GHz, 409-411 GHz, 416-434 GHz and 439-450 GHz possible.

Study 3 concluded that the following bands in the 275-450 GHz frequency range can be identified for FS and LMS applications: 275-296 GHz, 306-313 GHz, 320-330 GHz and 356-450 GHz. Study 3 also noted that in the band 275-286 GHz, FS and LMS applications could be problematic for both conical and nadir scanning sensors; however, conical and nadir scanning sensors are not presently deployed in this band. If these types of sensors are to be deployed in this band in the future, further studies may be necessary to determine if there are sharing and compatibility issues.

¹ Study 1 is a preliminary study prepared before all characteristics were finalized.

Study 4 performed an analysis of the 275-325 GHz band and did not consider the entire 275-450 GHz range. This study concluded that the band 275-325 GHz can be made available to LMS applications, which include both indoor and outdoor use, in accordance with the deployment scenarios provided by Report [ITU-R M.2417](#). This result was based on the assumption that there would be a minimum building entry loss of 56 dB for indoor usage, and 20 dB shielding loss for outdoor usage. Study 4 also concluded that the bands 275-296 GHz, 306-313 GHz and 319-325 GHz are available for use of FS applications without any conditions.

Study 5 concluded that the following bands in the 275-450 GHz frequency range can be identified for FS and LMS applications: 275-296 GHz, 306-313 GHz, 320-330 GHz and 356-450 GHz. These results are based on the evaluation of interference into bands identified for EESS (passive) usage in RR No. **5.565**. If the actual bandwidth of the systems currently operating is taken into account instead of the entire identified bands, then the band 318-333 GHz can be considered instead of 320-330 GHz, noting that this expanded range does not take into account future EESS (passive) use.

A contribution was brought to CPM19-2 that reflected an updated study conducted on the entire 275-450 GHz frequency range. This study concluded that the band 275-450 GHz could be made available to LMS applications, for both indoor and outdoor use, in accordance with the deployment scenarios provided by Report [ITU-R M.2417](#). The study incorporated additional losses in building attenuation of 17 dB for indoor usage, and blocking loss of 18.5 dB for nadir mode for both indoor and outdoor usage.

Another contribution document on the compatibility study between EESS (passive) and FS applications was submitted to CPM 19-2 meeting, which showed that the frequency bands 330-355.6 GHz and 361.2-365 GHz are not feasible to be identified for FS.

The updated studies presented to CPM19-2 are pending review by the relevant ITU-R groups.

1/1.15/3.2.2 Sharing and compatibility studies for RAS

Compatibility studies, contained in Report [ITU-R RA.2189-1](#) and summarized in SM.[275-450GHz SHARING], between the RAS and FS applications concluded that atmospheric attenuation alone, independent of free-space losses, at 275-450 GHz is not sufficient to provide compatibility in the absence of other considerations. In the relevant bands identified for RAS in RR No. **5.565** (275-323 GHz, 327-371 GHz, 388-424 GHz and 426-442 GHz), separation distances and or avoidance angles between RAS stations and FS stations should be considered depending on the deployment environment of FS stations.

1/1.15/4 Methods to satisfy the agenda item

Seven methods A-G are proposed to satisfy this agenda item. Methods B-G identify bands that are more than sufficient to meet the spectrum needs summarized in the ITU-R studies.

Method B proposes to modify RR No. **5.565** to identify frequency bands for use by FS/LMS applications within the frequency range 275-450 GHz without requiring specific constraints to protect EESS (passive). Methods C through G propose to accomplish this identification by adding a new footnote. There is a great deal of commonality between methods for this agenda item identifying bands as shown in the table below.

| Method | Action | Application service | Proposed bands for FS/LMS (where no specific conditions to protect EESS are necessary) | | | |
|--------|-----------------|---------------------|---|-----------------|-----------------|-----------------|
| | | | Band 1 (GHz) | Band 2 (GHz) | Band 3 (GHz) | Band 4 (GHz) |
| B | Modify FN 5.565 | FS & LMS | 275-296 | 306-313 | 318-333 | 356-450 |
| C | Add footnote | FS & LMS | 275-296 | 306-313 | 320-330 | 356-450 |
| D | Add footnote | FS & LMS | 275-296 | 306-313 | 320-330 | 356-450 |
| E | Add footnote | FS & LMS | 275-296 | 306-313 | 318-333 | 356-450 |
| F | Add footnote | FS | 275-296 | 306-313 | 318-336 | 348-450 |
| | | LMS | 275-296 | 306-313 | 319-332 | 356-450 |
| G | Add footnote | FS & LMS | 275-296 | 306-313 | 320-330 | 400-420 |

For the other frequency bands not in the table, some methods provide regulatory solutions to protect passive services.

It should be noted that in the relevant bands identified for RAS in RR No. **5.565** that overlap bands identified for FS/LMS applications, some specific conditions (e.g. minimum separation distances and/or avoidance angles) should be considered to ensure protection of radio astronomy sites from fixed service and/or land mobile applications, on a case-by-case basis.

1/1.15/4.1 Method A

No change to the Radio Regulations.

1/1.15/4.2 Method B

Modifying the existing footnote RR No. **5.565** is proposed for FS/LMS applications in portions of the 275-450 GHz frequency range.

1/1.15/4.3 Method C

This method suggests adding a new footnote to identify the 275-450 GHz frequency range for use by FS/LMS applications, while protecting EESS (passive) and RAS using the evolving guidance of ITU-R Recommendations and Reports, taking into account that there are no service allocations above 275 GHz.

1/1.15/4.4 Method D

Adding a new footnote RR No. **5.D115** is proposed for land mobile and fixed service applications: 275-296 GHz, 306-313 GHz, 320-330 GHz and 356-450 GHz.

1/1.15/4.5 Method E

Adding a new footnote RR No. **5.E115** and modifying the existing footnote RR No. **5.565** are proposed for FS/LMS applications in portions of the 275-450 GHz band.

1/1.15/4.6 Method F

Adding a new footnote RR No. **5.F115** is proposed for FS applications in portions of the 275-450 GHz band and for LMS applications in the entire 275-450 GHz frequency band.

1/1.15/4.7 Method G

Adding a new footnote RR No. **5.G115** is proposed for FS/LMS applications in portions of the 275-450 GHz band.

1/1.15/5 Regulatory and procedural considerations

The regulatory and procedural considerations to satisfy the agenda item are considered below for each of the proposed methods defined in section 1/1.15/4.

1/1.15/5.1 For Method A**ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**

(See No. 2.1)

NOC

248-3 000 GHz

Reasons: Although footnote **5.565** already provides the possibility of using the frequency range 275-450 GHz for active services, urging administrations to take all practicable steps to protect the passive services from harmful interference, it however does not take into account the result of compatibility studies and does not provide the relevant guidance in identifying frequency bands for developing LMS/FS applications as requested by this agenda item.

1/1.15/5.2 For Method B**ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**

(See No. 2.1)

MOD

248-3 000 GHz

| Allocation to services | | |
|------------------------|----------------------------------|----------|
| Region 1 | Region 2 | Region 3 |
| 275-3 000 | (Not allocated) MOD 5.565 | |

MOD

5.565 The following frequency bands in the range 275-1 000 GHz are identified for use by administrations for passive service applications:

- radio astronomy service: 275-323 GHz, 327-371 GHz, 388-424 GHz, 426-442 GHz, 453-510 GHz, 623-711 GHz, 795-909 GHz and 926-945 GHz;
- Earth exploration-satellite service (passive) and space research service (passive): 275-286 GHz, 296-306 GHz, 313-356 GHz, 361-365 GHz, 369-392 GHz, 397-399 GHz, 409-411 GHz, 416-434 GHz, 439-467 GHz, 477-502 GHz, 523-527 GHz, 538-581 GHz, 611-630 GHz, 634-654 GHz, 657-692 GHz, 713-718 GHz, 729-733 GHz, 750-754 GHz, 771-776 GHz, 823-846 GHz, 850-854 GHz, 857-862 GHz, 866-882 GHz, 905-928 GHz, 951-956 GHz, 968-973 GHz and 985-990 GHz.

Moreover, the following frequency bands within the range of 275-450 GHz are also identified for use by administrations for implementing active service applications as mentioned below:

- land mobile service applications: 275-296 GHz, 306-313 GHz, 318-333 GHz and 356-450 GHz;
- fixed service applications: 275-296 GHz, 306-313 GHz, 318-333 GHz and 356-450 GHz.

The use of the range 275-1 000 GHz by the passive services does not preclude use of this range by active services. Administrations wishing to make frequencies in the 275-1 000 GHz range available for active service applications in particular for land mobile service and fixed service are urged to take all practicable steps to protect these passive services from harmful interference until the date when the Table of Frequency Allocations is established in the above-mentioned 275-1 000 GHz frequency range.

All frequencies in the range 1 000-3 000 GHz may be used by both active and passive services. (WRC-12¹⁹)

Reasons: Studies that evaluated the entire 275-450 GHz frequency range show sharing is feasible between FS/LMS applications and the EESS (passive)/RAS in the particular bands. For frequencies in the range 275-450 GHz not identified for use under Method B, current studies have shown that sharing between FS/LMS applications and EESS (passive)/RAS applications is not feasible. Method B identifies frequency bands for use by LMS and FS applications that meet the spectrum needs summarized in ITU-R studies as contained in section 1/1.15/3 above.

1/1.15/5.3 For Method C**MOD****248-3 000 GHz**

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 275-3 000 | (Not allocated) 5.565 <u>ADD 5.A115</u> | |

ADD

5.A115 The frequency band 275-450 GHz is identified for use by administrations for fixed and land mobile service applications:

In the frequency bands 275-296 GHz, 306-313 GHz, 320-330 GHz and 356-450 GHz, no specific conditions are necessary by fixed and/or land mobile service applications to protect Earth exploration-satellite service (passive) applications.

In the frequency bands 275-323 GHz, 327-371 GHz, 388-424 GHz and 426-442 GHz, some specific conditions (e.g. minimum separation distances and/or avoidance angles) may be necessary to ensure protection of radio astronomy sites from fixed and/or land mobile service applications, on a case-by-case basis.

In the frequency bands 296-306 GHz, 313-320 GHz, 330-356 GHz, specific conditions are necessary (such as adequate shielding) in order to ensure the protection of Earth exploration-satellite service (passive) applications.

When applying this provision, administrations should take into account the latest relevant ITU-R Recommendations and may consider the latest relevant ITU-R Reports. (WRC-19)

NOC**5.565**

Reasons: Studies have shown that sharing is feasible between applications of the LMS/FS and EESS (passive)/RAS without conditions in parts of the 275-450 GHz range.

Studies also show that LMS/FS and RAS applications can coexist in other parts of the range with conditions.

For the frequency ranges where EESS operates, sharing can be achieved by ensuring that transmissions from LMS/FS applications do not impact the sensitive EESS receivers through appropriate mitigation measures.

Considering that the 275-450 GHz range is already available for use by all active services on a best effort basis the proposed additional footnote will provide stronger protection to passive services while keeping the balance between all active and passive service applications that can use this frequency range where there are no service allocations.

Beyond the measures that can be taken at this time to achieve sharing, technology evolution and deployment conditions may further facilitate sharing. Such conditions can continue to be studied in ITU-R to provide additional guidance.

1/1.15/5.4 For Method D**MOD****248-3 000 GHz**

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 275-3 000 | (Not allocated) 5.565 ADD 5.B115 | |

ADD

5.B115 The following frequency bands are identified for use by administrations for land mobile and fixed service applications:

- 275-296 GHz, 306-313 GHz, 320-330 GHz and 356-450 GHz. (WRC-19)

NOC**5.565**

Reasons: Modifications to RR No. **5.565** are not necessary as the addition of fixed and land mobile services to the 275-450 GHz frequency range can be accomplished through the addition of a new footnote that identifies the specific frequency ranges in which sharing between fixed service/land mobile service applications and the EESS (passive)/RAS is feasible, based on studies.

1/1.15/5.5 For Method E**MOD****248-3 000 GHz**

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 275-3 000 | (Not allocated) MOD 5.565 ADD 5.C115 | |

ADD

5.C115 The frequency bands 275-296 GHz, 306-313 GHz, 318-333 GHz and 356-450 GHz are identified for use by administrations for the implementation of the land mobile and fixed service.

Administrations wishing to make these above-mentioned frequency bands available for land mobile and/or fixed service applications are urged to take all practicable steps to protect passive services operating according to No. **5.565** until the date when the Table of Frequency Allocations is established in the 275-1 000 GHz frequency range. Considering the protection of the Earth exploration-satellite service (passive), the bands 296-306 GHz, 313-318 GHz and 333-356 GHz are not suitable for land mobile and fixed services.

In the frequency bands 275-296 GHz, 306-313 GHz, 318-323 GHz, 327-333 GHz, 356-371 GHz, 388-424 GHz and 426-442 GHz, some specific conditions (e.g. minimum separation distances and/or avoidance angles) may be necessary to ensure protection of radio astronomy sites from land mobile and/or fixed service applications, on a case-by-case basis. (WRC-19)

Reasons: Studies that evaluated the entire 275-450 GHz range show sharing is feasible between fixed service/land mobile service applications and the EESS (passive)/RAS in the particular bands proposed to be identified in RR No. **5.E115**. For the other frequency bands current studies have shown that sharing between FS/LMS applications and EESS (passive)/RAS applications is not feasible. The amount of spectrum (in total 137 GHz) identified in Method E for use by land mobile and fixed services' applications overachieve the current spectrum needs of 50 GHz for each service (with possibility of overlap). Method E provides guidance to administrations in which bands land mobile and fixed services should operate.

MOD

5.565 The following frequency bands in the range 275-1 000 GHz are identified for use by administrations for passive service applications:

- radio astronomy service: 275-323 GHz, 327-371 GHz, 388-424 GHz, 426-442 GHz, 453-510 GHz, 623-711 GHz, 795-909 GHz and 926-945 GHz;
- Earth exploration-satellite service (passive) and space research service (passive): 275-286 GHz, 296-306 GHz, 313-356 GHz, 361-365 GHz, 369-392 GHz, 397-399 GHz, 409-411 GHz, 416-434 GHz, 439-467 GHz, 477-502 GHz, 523-527 GHz, 538-581 GHz, 611-630 GHz, 634-654 GHz, 657-692 GHz, 713-718 GHz, 729-733 GHz, 750-754 GHz, 771-776 GHz, 823-846 GHz, 850-854 GHz, 857-862 GHz, 866-882 GHz, 905-928 GHz, 951-956 GHz, 968-973 GHz and 985-990 GHz.

The use of the **frequency** range 275-1 000 GHz by the passive services does not preclude use of this range by active services. Administrations wishing to make frequencies in the 275-1 000 GHz range available for active service applications are urged to take all practicable steps to protect these passive services from harmful interference until the date when the Table of Frequency Allocations is established in the above-mentioned 275-1 000 GHz frequency range.

The use of the range 275-450 GHz by land mobile and fixed services is subject to No. 5.C115.

All frequencies in the range 1 000-3 000 GHz may be used by both active and passive services. (WRC-12¹⁹)

Reasons: Consequential to the addition of RR No. 5.C115.

1/1.15/5.6 For Method F**MOD****248-3 000 GHz**

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 275-3 000 | (Not allocated) 5.565 <u>ADD 5.D115</u> | |

ADD

5.D115 The following frequency bands are identified for use by administrations for the implementation of the following active service applications:

- land mobile service applications: 275-450 GHz;
- fixed service applications: 275-296 GHz, 306-313 GHz, 318-336 GHz and 348-450 GHz.

Administrations wishing to make these above-mentioned frequency bands available for land mobile and/or fixed service applications are urged to take all practicable steps to protect passive services operating according to No. 5.565 until the date when the Table of Frequency Allocations is established in the 275-1 000 GHz frequency range.

In the frequency bands 296-306 GHz, 313-319 GHz and 332-356 GHz, specific conditions are necessary (such as indoor use) to ensure the protection of Earth exploration-satellite service (passive) from land mobile service applications.

In the frequency bands 275-450 GHz, some specific conditions (e.g. minimum separation distances and/or avoidance angles) may be necessary to ensure protection of radio astronomy sites from land mobile and/or fixed service applications, on a case-by-case basis. (WRC-19)

NOC

5.565

Reasons: Modifications to RR No. **5.565** are not necessary as the addition of fixed and land mobile services to the 275-450 GHz frequency range can be accomplished through the addition of a new footnote, which identifies frequency bands for use by LMS/FS applications that exceed spectrum needs summarized in ITU-R studies as contained in section 1/1.15/3 above.

1/1.15/5.7 For Method G

MOD

248-3 000 GHz

| Allocation to services | | |
|------------------------|-----------------------|-------------------|
| Region 1 | Region 2 | Region 3 |
| 275-3 000 | (Not allocated) 5.565 | <u>ADD 5.E115</u> |

ADD

5.E115 The following frequency bands are identified for use by administrations for the implementation of the following active service applications:

- land mobile service applications: 275-296 GHz, 306-313 GHz, 320-330 GHz, and 400-420 GHz;
- fixed service applications: 275-296 GHz, 306-313 GHz, 320-330 GHz, and 400-420 GHz.

Administrations wishing to make these above-mentioned frequency bands available for land mobile and/or fixed service applications are urged to take all practicable steps to protect passive services operating according to No. **5.565** until the date when the Table of Frequency Allocations is established in the 275-1 000 GHz frequency range. Considering the protection of the Earth exploration-satellite service (passive) identified in No. **5.565**, the bands 296-306 GHz, 313-320 GHz, 330-356 GHz and 361-365 GHz are not suitable for land mobile and fixed services.

In the frequency bands 275-296 GHz, 306-313 GHz, 318-323 GHz, 327-333 GHz, and 388-424 GHz, some specific conditions (e.g. minimum separation distances and/or avoidance angles) should be considered to ensure protection of radio astronomy sites from land mobile and/or fixed service applications, on a case-by-case basis. (WRC-19)

NOC

5.565

Reasons: Compatibility studies show 296-306 GHz, 313-320 GHz, 330-356 GHz and 361-365 GHz bands are not feasible for identification for applications of FS/LMS. Existing

Recommendations show that spectrum needs of FS/LMS application within 275-450 GHz are around 50 GHz, and attenuation by atmospheric gases in 400-420 GHz has relatively flat characteristics. The identification for LMS/FS applications operating in this frequency range can be accomplished by adding a new footnote.

1/1.15/5.8 For all Methods A, B, C, D, E, F and G

SUP

RESOLUTION 767 (WRC-15)

Studies towards an identification for use by administrations for land-mobile and fixed services applications operating in the frequency range 275-450 GHz

CHAPTER 2

Broadband applications in the mobile service

(Agenda items 1.13, 1.16, 9.1 (issues 9.1.1, 9.1.5, 9.1.8))

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Agenda item 1.13

1.13 to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 238 (WRC-15);

Resolution 238 (WRC-15) – *Studies on frequency-related matters for International Mobile Telecommunications identification including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency range between 24.25 and 86 GHz for the future development of International Mobile Telecommunications for 2020 and beyond*

2/1.13/1 Executive summary

IMT-2020 supports several new applications. Resolution **238 (WRC-15)** invites ITU-R to carry out studies to determine the spectrum needs for IMT, as well as to conduct sharing and compatibility studies in the frequency range between 24.25 GHz and 86 GHz.

Under the text for agenda item 1.13 is considered the following:

- a description of the estimated spectrum needs for the terrestrial component of IMT in the frequency range between 24.25 GHz and 86 GHz;
- the sharing and compatibility studies carried out by ITU-R for each frequency band under study;
- the methods to satisfy agenda item 1.13;
- regulatory and procedural considerations for each frequency band under study.

It is to be noted that the methods to satisfy the agenda item are included in Section 2/1.13/4 and have been organized by frequency bands, as follows: Item A (24.25-27.5 GHz), Item B (31.8-33.4 GHz), Item C (37-40.5 GHz), Item D (40.5-42.5 GHz), Item E (42.5-43.5 GHz), Item F (45.5-47 GHz), Item G (47-47.2 GHz), Item H (47.2-50.2 GHz), Item I (50.4-52.6 GHz), Item J (66-71 GHz), Item K (71-76 GHz), and Item L (81-86 GHz). It should be noted that regulatory solutions could be proposed that utilize only portions of a band associated with an item or that combine several of the items into a single proposal.

It was decided to include for each of the frequency bands a no-change method to the Radio Regulations (RR). Some other methods are accompanied by a series of alternatives for allocation and/or identification for IMT as appropriate. Furthermore, conditions for protection measures of different services are also included, as appropriate. This is detailed in Section 2/1.13/4.

Finally, the regulatory and procedural considerations are available in Section 2/1.13/5.

2/1.13/2 Background

IMT systems are now being evolved to provide diverse usage scenarios and applications such as enhanced mobile broadband (eMBB), massive machine-type communications (mMTC) and ultra-reliable and low-latency communications (URLLC) requiring larger contiguous blocks of spectrum than currently available as described in Recommendation ITU-R M.2083.

It is important to note that the properties of higher frequency bands, such as shorter wavelength, would better enable the use of advanced antenna systems, including multiple-input and multiple-output (MIMO) and beam-forming techniques in supporting eMBB.

Resolution **238 (WRC-15)** calls for studies to determine the spectrum needs for the terrestrial component of IMT in the frequency range between 24.25 GHz and 86 GHz, as well as sharing and

compatibility studies, taking into account the protection of services to which the frequency band is allocated on a primary basis, for the frequency bands:

- 24.25-27.5 GHz², 37-40.5 GHz, 42.5-43.5 GHz, 45.5-47 GHz, 47.2-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz and 81-86 GHz, which have allocations to the mobile service on a primary basis; and
- 31.8-33.4 GHz, 40.5-42.5 GHz and 47-47.2 GHz, which may require additional allocations to the mobile service on a primary basis.

2/1.13/3 Summary and analysis of the results of ITU-R studies

2/1.13/3.1 Spectrum needs

Studies for WRC-19 agenda item 1.13 estimated the spectrum needs for the terrestrial component of IMT in the frequency range between 24.25 GHz and 86 GHz, in accordance with Resolution **238 (WRC-15)** and [CA/226](#).

Terrestrial IMT-2020 systems will incorporate the use of new technologies that benefit from the physical characteristics of the frequencies in the frequency range from 24.25 to 86 GHz and the large bandwidths potentially available, which will provide higher data rates and lower latencies. A number of approaches were considered and the results obtained using the application-based and the technical performance-based approaches are summarized in Table 2/1.13/3-1. The estimated spectrum needs would be different based on the approaches used together with the assumptions thereof.

Furthermore, some administrations provided information on spectrum needs in their countries based on their national considerations, which is also summarized in Table 2/1.13/3-1.

TABLE 2/1.13/3-1

Spectrum needs for frequency ranges between 24.25 and 86 GHz (see Note)

| | Examples | Associated conditions for different examples | Spectrum needs in total (GHz) ³ | Spectrum needs (GHz) per range |
|----------------------------|----------|--|--|---|
| Application-based approach | 1 | Overcrowded, dense urban and urban areas | 18.7 | 3.3 (24.25-33.4 GHz range) 6.1 (37-52.6 GHz range) 9.3 (66-86 GHz range) |
| | | Dense urban and urban areas | 11.4 | 2.0 (24.25-33.4 GHz range) 3.7 (37-52.6 GHz range) 5.7 (66-86 GHz range) |
| | 2 | Highly crowded area | 3.7 | 0.67 (24.25-33.4 GHz range) 1.2 (37-52.6 GHz range) 1.9 (66-86 GHz range) |

² When conducting studies in the frequency band 24.5-27.5 GHz, to take into account the need to ensure the protection of existing earth stations and the deployment of future receiving earth stations under the EESS (space-to-Earth) and SRS (space-to-Earth) allocation in the frequency band 25.5-27 GHz.

³ The spectrum needs estimates of the different approaches and examples should be considered separately.

| | Examples | Associated conditions for different examples | Spectrum needs in total (GHz) ³ | Spectrum needs (GHz) per range |
|--|----------|---|---|---|
| | | Crowded area | 1.8 | 0.33 (24.25-33.4 GHz range) 0.61 (37-52.6 GHz range) 0.93 (66-86 GHz range) |
| Technical performance-based approach (Type 1 ⁴) | 1 | User experienced data rate of 1 Gbit/s with N simultaneously served users/devices at the cell-edge, e.g. indoor | 3.33 ($N=1$), 6.67 ($N=2$), 13.33 ($N=4$) | Not available |
| | | User experienced data rate of 100 Mbits/s with N simultaneously served users/devices at the cell-edge, for wide area coverage | 0.67 ($N=1$), 1.32 ($N=2$), 2.64 ($N=4$) | Not available |
| | 2 | eMBB dense urban | 0.83-4.17 | Not available |
| | | eMBB indoor hot spot | 3-15 | Not available |
| | 3 | With a file transfer of 10 Mbits by a single user at cell-edge in 1 msec | 33.33 GHz (one direction) | Not available |
| | | With a file transfer of 1 Mbit by a single user at cell-edge in 1 msec | 3.33 GHz (one direction) | |
| | | With a file transfer of 0.1 Mbits by a single user at cell-edge in 1 msec | 333 MHz (one direction) | |
| Technical performance-based approach (Type 2 ⁵) | — | Dense urban micro | 14.8-19.7 | 5.8-7.7 (24.25-43.5 GHz range) |
| | | Indoor hot spot | | 9-12 (24.25-43.5 GHz and 45.5-86 GHz range) |
| Information from some countries based on their national considerations | — | — | 7-16 | 2-6 (24.25-43.5 GHz range) 5-10 (43.5-86 GHz range) |

Note: The spectrum needs in the table above are for the frequency ranges between 24.25 GHz and 86 GHz as called for in *resolves to invite ITU-R 1 of Resolution 238 (WRC-15)*. The frequency bands studied and addressed in Sections 2/1.13/3, 2/1.13/4 and 2/1.13/5 are the specific frequency bands as called for in *resolves to invite ITU-R 2 of Resolution 238 (WRC-15)*.

In the above table, the application-based approach calculates the spectrum needs for IMT systems to support certain applications, which are characterized by various factors, such as connection density,

⁴ For Type 1, the spectrum needs are calculated taking into account a single technical performance requirement, i.e. user experienced data rate.

⁵ For Type 2, the spectrum needs are calculated taking into account different technical performance requirements, i.e. user experienced data rate, peak data rate and area traffic capacity.

application data rate, application usage pattern, deployment considerations, etc. Meanwhile, the technical performance-based approach calculates the spectrum needs to support certain technical performance requirements of IMT systems, such as peak data rate, user experienced data rate, area traffic capacity, etc.

As indicated in these approaches, for the spectrum needs of IMT-2020 in the range of 24.25 and 86 GHz, different channel propagation characteristics and available channel bandwidth should be taken into account. With a view to accommodate the wide range of usage and deployment scenarios for IMT-2020, it is important to consider a number of frequency bands within the ranges identified under Resolution **238 (WRC-15)**.

2/1.13/3.2 Sharing and compatibility studies

The following subsections present results for the sharing and compatibility studies for each frequency band. The characteristics and propagation models provided to Task Group (TG) 5/1 for use in the studies are referenced in Annex 1 to the TG 5/1 Chairman's Report (see Document [5-1/478](#)). No sharing and compatibility studies between IMT within the LMS and other systems of the MS were received in any of the bands, although characteristics were received for some of them.

2/1.13/3.2.1 Frequency range 24.25-27.5 GHz

The frequency range 24.25-27.5 GHz, or parts thereof, is allocated to the EESS, FS, FSS, ISS, MS, RLSS, RNS and SRS. The frequency bands adjacent to this frequency range are allocated to the EESS (passive), RAS, RLS and SRS (passive). The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the EESS, EESS (passive), FS, FSS, ISS, RAS and SRS and are summarized in the subsections below. Characteristics were not received for the RLS, RLSS and RNS and therefore, studies were not carried out for these services. Studies are not needed for the SRS (passive), as this service is dealing with sensors around other planets and no interference issue is expected.

2/1.13/3.2.1.1 EESS/SRS (space-to-Earth) in 25.5-27 GHz and IMT

2/1.13/3.2.1.1.1 EESS

Some studies performed a non-site-specific aggregate analysis with Monte Carlo simulations. The simulations took time and deployment dependent parameters into account, and the probability distribution of IMT network aggregate interference was compared to the earth station protection criterion level. Some did the simulations in which time and deployment dependent parameters were mixed to illustrate a random deployment scenario and the average of the interference level from all the snapshots was compared to the protection criterion level at the specified time exceedance level. The separation distance was found to be in the range of 0.2-1.0 km in urban and suburban (including suburban open-space) scenarios.

Some studies performed a non-site-specific single-entry worst-case analysis, which evaluated the interference caused by a single base station (BS) in front of the earth station with Monte Carlo simulations. The separation distance was shown to be less than 0.8 km. Another study performed a single cluster worst-case analysis, where the interference from one cluster of 31 BSs and user equipment (UEs) in front of the earth station was analysed with Monte Carlo simulations. The separation distance was up to 1 km.

Two other single-entry studies used a deterministic analysis method. These studies led to a separation distance in the range 0.2-1.7 km. These studies assumed scenarios where the IMT BS antenna main beam pointed towards the EESS earth stations.

The results of non-site-specific studies considered flat terrain, as well as clutter loss according to Recommendation ITU-R P.2108, which addressed the urban and suburban environments.

Three studies addressed the separation distances that would be required around a number of specific EESS earth stations located in the USA, Europe and China, considering either one single BS whose antenna panel was oriented towards the victim earth station, or a cluster of up to 31 BSs with random antenna panel orientations. These studies led to the following separation distances for 8×8 antenna BSs:

- 3.9-6.0 km for EESS earth stations tracking non-geostationary-satellite orbit (non-GSO) satellites;
- 3.0-7.0 km for EESS earth stations tracking geostationary-satellite orbit (GSO) satellites.

These distances are only valid for the specific earth stations considered in these studies. The actual separation distances vary from one earth station to another and need to be determined on a case-by-case basis.

An additional aggregate study was performed for some of these specific earth stations using a full IMT network deployment in suburban and urban environments, showing that when the separation distance determined for the single-entry case was respected, then the EESS protection criterion was met.

All site-specific studies took into account the terrain elevation around the earth station as well as no clutter or local clutter values, which were lower than the clutter values considered in non-site-specific studies.

2/1.13/3.2.1.1.2 SRS

Some studies performed a non-site-specific aggregate analysis with Monte Carlo simulations. The simulations took time and deployment dependent parameters into account, and the probability distribution of IMT network aggregate interference was compared to the earth station protection criterion level. Some did simulations in which time and deployment dependent parameters were mixed to illustrate a random deployment scenario and the average of the interference level from all the snapshots was compared to the protection criterion level at the specified time exceedance level. The separation distance was found to be in the range of 0.8-2.0 km in urban, suburban (including suburban open-space) scenarios.

The results of non-site-specific studies considered flat terrain, as well as clutter loss according to Recommendation ITU-R P.2108, which addressed the urban and suburban environment.

Two studies addressed the separation distances that would be required around a number of specific SRS earth stations, considering either one single BS whose antenna panel was oriented towards the victim earth station, or a cluster of up to 31 BSs with random antenna panel orientations. The separation distance would be in the range of 23.8-92.0 km for SRS earth stations, based on the assumptions used in the studies. These distances are only valid for the specific earth stations considered in these studies. The actual separation distances vary from one earth station to another and need to be determined on a case-by-case basis.

All site-specific studies took into account the terrain elevation around the earth station, as well as no clutter or local clutter values, which were lower than the clutter values considered in non-site-specific studies.

2/1.13/3.2.1.2 Passive services in adjacent bands and IMT

2/1.13/3.2.1.2.1 EESS (passive)

Ten studies were performed in relation to compatibility between IMT-2020 in the 24.25-27.5 GHz band and the EESS (passive) in the band 23.6-24.0 GHz. The results in the tables below are expressed as:

- interference exceedance relative to the EESS (passive) protection criteria (–166 dB(W/200 MHz)) based on the IMT-2020 parameters provided; and
- corresponding unwanted emission levels to protect the EESS (passive).

While some of the studies were performed on all sensors in Recommendation ITU-R RS.1861 operating in the 23.6-24.0 GHz frequency band, the results below are based on the most restrictive Sensor F3. Results obtained for the other sensors are similar (F2 and F8) or less restrictive.

Single element antenna pattern

Some studies considered the IMT single element antenna pattern from Recommendation ITU-R M.2101:

Five studies led to the following results for Sensor F3 (applying the apportionment value of 3 dB of the EESS (passive) protection criteria):

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|---|--|------------|
| | | UE | BS |
| A | 22.5 | –42 | –46 |
| B | 24.5 | –44 | –48 |
| I | 21.9 to 24.4 (variation due to not normalized/normalized) | –42 to –44 (total UE and BS) | |
| L | 18.5 to 25.2 (variation due to normalized/not normalized and percentage of distribution 50% to 99%) | –38.5 to –45 | –42 to –49 |
| M | 17.7 to 23 dB, (variation due to normalized/not normalized and percentage of distribution 50% to 99%) | –38 to –43 | –42 to –47 |

Three studies led to the following results for Sensor F3 (assuming no apportionment of the EESS (passive) protection criteria):

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|--|--|-----|
| | | UE | BS |
| F | 15.6 (considering a split of the interference of 90% for BS and 10% for UE) | –30 | –40 |
| H | 16.4 | –36 | –40 |

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|---|--|----------------|
| | | UE | BS |
| J | 19.4 to 20.4 (variation due to different percentile of unwanted emission level; 90 th to 99 th) | −35.4 to −36.4 | −39.1 to −40.1 |

In addition, Studies A and B performed a sensitivity analysis considering a population-based redistribution of the IMT-2020 BSs (capped to a maximum of 10 BS/km²) and led to the following results for Sensor F3 (applying the apportionment value of 3 dB of the EESS (passive) protection criteria):

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|------------------------------|--|-----|
| | | UE | BS |
| A | 31 | −51 | −55 |
| B | 30.4 | −50 | −54 |

Moreover, Studies A and B considered a 2 dB “multi-operator interference factor” to cover the interference falling into the EESS (passive) band 23.6-24.0 GHz from multiple IMT-2020 operators’ channels using the entire 24.25-27.5 GHz frequency band for outdoor deployments and including the possible impact of outdoor UEs connected to indoor BS.

Beamforming antenna model

Some studies performed a sensitivity analysis using a beamforming antenna model in the unwanted emission domain. In the absence of IMT-2020 antenna measurement data it was agreed in ITU-R that:

- the antenna pattern may remain beamformed to some extent in the adjacent frequency band;
- the Recommendation ITU-R M.2101 model applicable to beamforming gain may in that case underestimate the side-lobe levels (e.g. some simulations have shown that, for an 8×8 array simplified active antenna system (AAS) antenna design model with one slant dipole elements, the Recommendation ITU-R M.2101 model appears to be a reasonable match for the side lobes closest to the main beam, but side lobes further from the main beam would be underestimated by this model);
- the “variance” of the interference distribution is much wider compared to the use of a single element pattern and hence a conclusion on average interference would not be appropriate.

Five studies led to the following results for Sensor F3 (applying the apportionment value of 3 dB of the EESS (passive) protection criteria):

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|---------|---|--|------------|
| | | UE | BS |
| A and J | 18 (these studies also considered a multi-operator interference factor) | −38 | −42 |
| I | 21.1 to 22.6 (variation due to not normalized/normalized) | −41 to −42 for BS and UE (total) | |
| L | 11 to 15.7 dB (variation due to normalized/not normalized and percentage of distribution 50% to 99%) | −31 to −36 | −35 to −39 |
| M | 13.5 to 18 dB (variation due to normalized/not normalized and percentage of distribution 50% to 99%) | −33 to −39 | −37 to −42 |

Four studies considered an IMT-2020 beamforming antenna pattern, assuming no apportionment, and led to the following results for Sensor F3:

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|---|--|----------------|
| | | UE | BS |
| F | 9.2 dB (Considering a split of the interference of 90% for BS and 10% for UE) | −32 | −33 |
| G | 9 to 14 dB (for an interference probability from 1% to 10%) | −29 to −34 | −32 to −35 |
| H | 10.9 dB (Considering a split of the interference of 80% of BS and 20% of UE) | −30.9 | −34.7 |
| J | 10.1 to 13.8 dB (variation due to with and without normalization at different percentiles of unwanted emission levels, 90% to 99%) | −30.1 to −33.8 | −33.8 to −37.5 |

One study led to the following results on the permissible interference criteria levels over the measurement area as prescribed in Recommendation ITU-R RS.2017 for Sensor F3:

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|--|--|------------|
| | | UE | BS |
| G | 9 to 14 dB (for an interference probability from 1% to 10%) | −29 to −34 | −32 to −35 |

Study L considered an IMT unwanted emission distribution (mean value $-30/-26.3$ dB(W/200 MHz) per BS/UE, a standard deviation of 2 dB instead of the baseline fixed value for Sensor F3 (including apportionment) and led to the following results:

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|------------------------------|--|--------------------|
| | | UE | BS |
| L | 6.4 to 9.7 | -26.4 to -29.7 | -30.1 to -33.4 |

Study B also considered the possible impact of the second harmonic of the IMT-2020 stations operating in the 24.25-27.5 GHz frequency band falling in the 50.2-50.4 GHz and 52.6-54.25 GHz EESS (passive) frequency bands, in particular from IMT-2020 BSs.

View 1:

The following table provides a comparison between the above 8 studies carried out by ITU-R using agreed baseline assumptions and the non-baseline assumption of the beamforming antenna model. Results are also presented by aligning the following assumptions: percentage of distribution, antenna normalization, 3 dB apportionment and 2 dB multi-operator factor

Summary of results of studies

| Study | A | F | G | H | I | J | L | M |
|---|----------|----------|--------|----------|----------|------------|----------|--------|
| Results extracted from the studies (without change) | | | | | | | | |
| Antenna normalization | X | | | | X | X | X | X |
| Results with a CDF | X | X | X | X | X | X | X | X |
| Percentage of distribution | 99% | Aver. | N.A | Aver. | Max. | 99% | 99% | 99% |
| Interference (dB(W/200 MHz)) | -151.6 | -156.8 | N.A | -155.1 | -147.6 | -152.2 | -153.3 | -151 |
| Apportionment (dB) | 3 | 0 | 0 | 0 | 0 | 3 | 3 | 3 |
| Multi-op. factor (2 dB) | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 (?) |
| Necessary attenuation (dB) in conclusion | 18 | 9.2 | 14 | 10.9 | 22.6 | Approx. 18 | 15.7 | 18 |
| Limit for BS (dB(W/200 MHz)) | -42 | -33 | -35 | -34.7 | -42 | -42 | -39 | -42 |
| Limit for UE (dB(W/200 MHz)) | -38 | -32 | -34 | -30.9 | -42 | -38 | -36 | -38 |
| Modified (rounded) Results with aligned assumptions (antenna normalization, 3 dB apportionment, 2 dB multi-operator factor). NB: These assumptions are those of administrations supporting this view | | | | | | | | |
| Interference at 99% (Approximation) (dB(W/200 MHz)) | -151 | -153 | -151 | -153 | -147 | -152 | -153 | -151 |
| Result of interference (dB(W/200 MHz)) | 18 | 18 | 20 | 17 | 24 | 18 | 17 | 18 |
| Limit for BS (dB(W/200 MHz)) | -42 | -42 | -44 | -41 | -48 | -42 | -41 | -42 |

| | | | | | | | | |
|---------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Limit for UE (dB(W/200 MHz)) | –38 | –38 | –40 | –37 | –44 | –38 | –37 | –38 |
|---------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|

In conclusion, studies made by ITU provide similar results when using the same assumptions. The differences in the results are linked primarily to a few parameters such as:

- *The EESS protection criteria apportionment requested by Working Party 7C.*
- *The normalization factor that ensures a physical behaviour of the antenna model.*
- *The aggregated channel factor in order to take into account the power summation from different channels of IMT-2020 equipment in the passive band.*
- *The values of percentage used in the interference distribution.*

View 2:

Within ITU-R Task Group 5/1 (TG 5/1), administrations and sector members performed ten different sharing studies between IMT in 24.25-27.5 GHz and EESS/SRS in 23.6-24 GHz. TG 5/1 deliberated the technical merits of these studies over the course of two and a half years and submitting parties refined the studies over multiple TG 5/1 meetings. TG 5/1 concluded this work by developing a balanced summary of studies, which was agreed to by all concerned parties.

The additional comparison table provided in View 1 disregards the work of TG 5/1 and mischaracterizes and incorrectly summarizes the results of studies other administrations and sector members submitted. The TG 5/1 studies highlighted nearly 20 pages of details regarding parameters utilized in each of the studies. However, the new comparison table unilaterally selects several “additional factors” above and beyond those provided by concerned groups. Further, other valid alternative studies and their associated results are not presented in the new table. The new table also adds factors to other members’ studies, which those members did not believe were relevant to include. The administrations submitting this view believe it is inappropriate to modify the parameters selected and results of studies submitted by other administrations and sector members without the explicit consent of the submitting parties.

The new comparison table in View 1 adjusts the output of studies on a dB-for-dB basis to account for differences in the input assumptions. However, this approach does not account for implementation-related details and, therefore, is not valid. As one example, the method of distributing user equipment (UEs) in a given area per snapshot could change the results of a study by several dB. Any such adjustment of input assumptions would require validation, which was not performed under View 1. While comparing studies by adjusting the output on a dB-for-dB basis to account for differing input assumptions is possible for deterministic studies and similar studies using averaging of values, the approach does not provide meaningful results for a Monte-Carlo simulation using the methodology in Recommendation ITU-R M.2101.

Resolution ITU-R 2-7 states that the CPM Report should be based on “the inclusion, to the extent possible, of reconciled differences in approaches as contained in the source material, or, in the case where the approaches cannot be reconciled, the inclusion of the differing views and their justification”. View 1 goes far beyond providing a concise summary of a justified technical or regulatory concern. Rather, View 1 sets a new precedent in which a single member provides an input directly to CPM which revises other members’ work in order to justify a desired political outcome.

View 3:

Along the study period no doubt was raised on the need to ensure the protection of EESS (passive) from IMT-2020 on a global basis and with a long-term perspective taking into account existing, planned and future sensors.

All studies conclude on the necessity to limit IMT-2020 unwanted emission in 23.6-24 GHz frequency band to ensure the operations and the availability of this frequency band for EESS (passive).

EESS (passive) sensors are radiometers that measure all emissions sources (noise-like) within a band and as such, are in most cases not able to discriminate between natural and man-made radiations. Report ITU-R RS.2165 characterizes these levels of Radio Frequency Interference (RFI) as “Low levels of RFI that cannot be discriminated from natural radiations and hence represent very serious problem since degraded or incorrect data would be accepted as valid.”

Therefore, being impossible to rely on interference detection and mitigation, the EESS (passive) community can only rely on compatibility studies performed with the highest level of confidence (i.e. with assumptions based on evidences) to ensure protection of EESS (passive) sensors.

Difference in the study results are mainly due to differences in assumptions for some of the parameters such as the IMT-2020 antenna pattern, the number of IMT-2020 base stations, the apportionment of EESS (passive) protection criteria..., which could lead to strongly increase the level of interference in the 23.6-24 GHz EESS (passive) frequency band.

When using baseline assumptions agreed in ITU-R (i.e. single element pattern, baseline BS distribution, apportionment of EESS (passive) protection criteria)), studies depict very similar results, leading to the following range of necessary IMT-2020 stations unwanted emissions levels:

- *For BS: from –49 to –42 dB(W/200 MHz)*
- *For UE: from –45 to –38 dB(W/200 MHz)*

Studies leading to higher values have been using different assumptions than the agreed baseline, in particular related to the IMT-2020 antenna pattern, considering beamforming effect in the adjacent band, in contradiction with Recommendation ITU-R M.2101.

Despite repeated request, no compelling elements justifying the use of this beamforming antenna pattern (e.g. antenna pattern measurements and/or relevant IMT-2020 antenna model) have been provided to date, justifying caveat agreed in ITU-R on the use of this antenna pattern/model in the adjacent band. Also, a number of elements described in Annex 1 to Study B lead to seriously question the relevance to maintain any sensitivity analysis based on a beamforming pattern.

It should however be highlighted that, compared to these scenarios using beamformed antenna, a number of assumptions could lead to a large increase of the interference to EESS (passive), hence possibly justifying lower necessary IMT-2020 unwanted emissions:

- *Uncertainties on the IMT-2020 antenna pattern in the adjacent bands, in particular for side lobes (see in particular impact in Annex 2 of Study B) could lead to an underestimation of the interference to EESS (passive) by more than 10 dB.*
- *Number of IMT-2020 base stations that could be relatively higher when considering a real deployment in suburban and urban areas (i.e. population based redistribution) and lead to an increase of the interference to EESS (passive) by more than 5/6 dB (according to Study B).*

It can be highlighted that baseline BS distribution figures agreed in ITU-R are also now put in doubt by recent IMT 5G licensing process results (with much higher numbers imposed to bidders (a factor of about 8), hence higher potential interference to EESS (passive) by about 9 dB).

Finally, more recently the IMT industry has found a new parameter called “manufacturing factor” to artificially decrease by at least 6 dB the potential impact of IMT-2020 on EESS (passive). Here also, no compelling elements has been given to justify such factor and it is doubtful that it is used in any IMT reference document such as standardization.

View 4:

View 1 does not correctly report the results of Study G:

The reference interference level used in Study G is different to that used in Study A and therefore the comparison table in View 1 arrives at incorrect comparison results. Study G uses a very different methodology than that of Study A, making a one to one comparison very difficult.

Furthermore, Study G contains a range of results which reflect the time/geographical area element of the protection criteria in Recommendation ITU-R RS.2017. This range of results addresses how many very large cities there may be within the protection criteria measurement area of 2 million km²; this is not reflected in the comparison table provided in View 1, as this important protection criteria element was not included in Study A.

Because of the variability in national allocation/utilization of the frequencies either side of the EESS passive band and how an administration may decide to allocate spectrum to IMT in 24.25-27.5 GHz, Study G is also not including any speculative values pertaining to any particular national situation on spectrum use nor extreme IMT deployment densities.

View 5:

View 5 does not support modifying the results of TG 5/1 studies. View 1 modified the results of the eight studies conducted in TG 5/1 to derive a desired set of results.

Therefore, View 5 provides an example of how the results in View 1 could be further modified using different assumptions to derive alternate results.

The following table provides a comparison among 8 studies, which used the baseline parameters of ITU-R studies and applied assumptions which includes a 16x16 antenna array (the most recent technology development) and incorporates a manufacturing production margin.

| Study | A | F | G | H | I | J | L | M |
|---|--------|--------|--------|--------|--------|------------|--------|--------|
| Results extracted from the studies (without change) | | | | | | | | |
| Antenna normalization | X | | | | X | X | X | X |
| Results with a CDF | X | X | X | N.A | X | X | X | X |
| Percentage of distribution | 99% | Aver. | N.A | Aver. | Max. | 99% | 99% | 99% |
| Interference (dB(W/200 MHz)) | -151.6 | -156.8 | N.A | -155.1 | -147.6 | -152.2 | -153.3 | -151 |
| Apportionment (dB) | 3 | 0 | 0 | 0 | 0 | 3 | 3 | 3 |
| Multi-op. factor (2 dB) | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| Necessary attenuation (dB) in conclusion | 18 | 9.2 | 14 | 10.9 | 22.6 | Approx. 18 | 15.7 | 18 |
| Limit for BS (dB(W/200 MHz)) | -42 | -33 | -35 | -34.7 | -42 | -42 | -39 | -42 |
| Limit for UE (dB(W/200 MHz)) | -38 | -32 | -34 | -30.9 | -42 | -38 | -36 | -38 |
| An analysis with the baseline parameters, not including “other assumptions” (normalization, apportionment, multi-operator factor) in View 1. Also includes percent of distribution (average:70%), 16x16 array antenna for IMT BS | | | | | | | | |
| Interference at 99% (Approximation) (dB(W/200 MHz)) | -156.5 | -156.5 | -154.0 | NA | -149.9 | -156.5 | -156.8 | -152.5 |
| Result of interference (dB(W/200 MHz)) | 9.5 | 9.5 | 12.0 | NA | 16.1 | 9.5 | 9.2 | 13.5 |

| | | | | | | | | |
|---|--------|-------|-------|----|-------|-------|-------|-------|
| Percent of distribution (Average: 70%) | 3.5 dB | | | | | | | |
| 16x16 array antenna for IMT BS | 6 dB | | | | | | | |
| Limit for BS (dB(W/200 MHz)) | -23.7 | -23.7 | -26.2 | NA | -30.3 | -23.7 | -23.4 | -25.7 |
| Limit for UE (dB(W/200 MHz)) | -20.0 | -20.0 | -22.5 | NA | -26.6 | -20.0 | -19.7 | -22.0 |
| When manufacturing margin of minimum of 6 dB is applied, the following values are derived. | | | | | | | | |
| Limit for BS (dB(W/200 MHz)) | -17.7 | -17.7 | -20.2 | NA | -24.3 | -17.7 | -17.4 | -19.7 |
| Limit for UE (dB(W/200 MHz)) | -14.0 | -14.0 | -16.5 | NA | -20.6 | -14.0 | -13.7 | -16.0 |

Based on these different views no further conclusions were reached regarding the comparison of the different studies.

2/1.13/3.2.1.2.2 RAS

Four compatibility studies between the RAS in the frequency band 23.6-24 GHz and IMT systems in the frequency band 24.25-27.5 GHz were provided to ITU-R.

In the case of a single-entry analysis, one non-site specific study using a flat-Earth terrain profile derived a separation distance around a RAS station of 27 km for IMT user equipment and 48-52 km for IMT BSs for out-of-band IMT emission levels of -13 dB(m/MHz) (i.e. -43 dB(W/MHz)) and 5 km for user equipment and 17-18 km for BSs for -30 dB(m/MHz) (i.e. -60 dB(W/MHz)). Another study assumed out-of-band IMT emission levels of -65 dB(W/MHz) for BSs and -61 dB(W/MHz) for user equipment and derived a separation distance of up to 5 km for user equipment and up to 9 km for BSs. Another study using real terrain profiles derived separation distances for BSs and user equipment, which do not exceed 70 km for most of the radio telescopes considered.

Statistical results showed that if the combined aggregate interference of both BSs and user equipment were considered, separation distances were 17-22.5 km for a suburban environment and they ranged from 30 to 52 km for mixed or urban environments. This range was mainly due to the differences in assumed polarization loss (3 or 0 dB) and antenna gain normalization. Unless mentioned otherwise, the above separation distances were derived assuming a -13 dB(m/MHz) i.e. -43 dB(W/MHz) level of out-of-band emission levels for both IMT mobile and BSs. If the unwanted emission level is decreased (as has been proposed to protect the EESS (passive), these separation distances also decrease, accordingly.

No detailed terrain profiles were used in most of these studies. Taking into account detailed terrain profiles around RAS stations would lead to different separation distances for RAS stations on a case-by-case basis. Given the expected dimensions of the coordination zones around RAS stations, the protection of RAS stations could be established on a national level.

2/1.13/3.2.1.3 FSS and IMT

Sharing and compatibility studies between IMT and the FSS in the Earth-to-space direction have been provided to ITU-R for the frequency bands 24.65-25.25 GHz and 27-27.5 GHz.

Aggregate interference from IMT stations into FSS space stations

Interference into FSS space stations – Baseline cases

The FSS protection criteria (without apportionment) in this band are, for the long term, -10.5 dB I/N (exceeded up to 20% or I/N average) and, for the short term, -6 dB I/N exceeded 0.6% and 0 dB I/N exceeded 0.02% of time, location or probability, for example, for Monte Carlo simulations, the percentage of probability can be expressed in terms of a number of snapshots.

In the case of aggregate long-term interference from IMT stations into FSS space stations in a geostationary orbit, results showed that the calculated I/N ranged from -40.62 dB to -19 dB for the baseline case.

When considering short-term interference, seven of the studies provided results that showed maximum I/N values ranging from -28.3 dB to -15.8 dB for the baseline case, which satisfy the short-term protection criteria. The other studies do not address short-term interference.

The studies have been carried out with various methodologies, some statistical, some static/part statistical and some deterministic. The differences in the methodologies and assumptions that have been identified as influencing the results are the FSS boresight elevation angle of the satellite, the density of BSs, the normalization factor of the IMT antenna, the polarization discrimination and the use of clutter loss. The combination of these assumptions can cause a large variation in the results.

A comparison has been made between the studies in terms of long-term I/N results. In all the following cases, the most sensitive satellite carrier had an antenna gain of 46.6 dBi and a noise temperature of 400 K. The comparison below is based on this satellite carrier and on the cumulative distribution function (CDF) percentages listed above (i.e. 50%, 20% or I/N average, depending on the study).

Eight of the studies found long-term I/N values in the range -30.3 dB to -24.3 dB corresponding to FSS boresight elevation angles in the range of 10° to 30° . Some of the variation in results between these studies is due to the inclusion of an IMT antenna normalization factor, which may worsen the I/N by up to 2 dB. These studies all assumed 3 dB of polarization discrimination.

One study gave results close to other studies with a mean I/N up to -19.2 dB for a 10° elevation and -27.7 dB I/N for a 45° elevation with a normalization factor and with a 1.5 dB polarization discrimination.

Study N used census data to assess the IMT deployment density in built-up urban and suburban areas, rather than assuming a constant density, resulting in a mean I/N of -27 dB for a 10° FSS boresight elevation, not taking into account polarization discrimination or clutter loss. Study E found an I/N mean of -32.8 dB (with normalization factor), which may be explained by the higher FSS boresight elevation angle (48.2°). In this case the BS distribution, adjusted to match the distribution of large cities across different latitudes, makes it difficult to have a more precise comparison.

Different apportionment values for the FSS protection criteria, from 0 dB to 4.7 dB have been assumed in the various studies above.

Interference into FSS space stations – Non-baseline cases

Several studies on the interference to FSS GSO satellites from IMT conducted a sensitivity analysis, i.e. up to 5 dB higher antenna element conducted power than that specified in the baseline or 16×16 antenna array as provided for in the clarifications and guidance developed by the ITU-R on how to use the parameters provided in sharing and compatibility studies. These studies concluded that the interference would be increased up to 5 dB or up to 3 dB respectively.

Some studies evaluated the level of interference resulting from assumed deviations on the IMT characteristics other than those provided for in the clarifications and guidance developed by the ITU-R on how to use the parameters provided in sharing and compatibility studies. The additional assumptions included one or more of the following; denser IMT deployments, higher network loading, higher IMT BS conducted power or e.i.r.p., higher FSS boresight elevation angles or higher UE height.

- Study H showed that if a 5 dB higher antenna element conducted power is applied, together with 16×16 antenna arrays the average I/N would be as high as –15 dB.
- Study N showed that if uniform distribution of UE⁶ in the BS service area is applied the average I/N would be as high as –12.9 dB, not including clutter loss or polarization discrimination.
- Study M showed that if a 5 dB higher antenna element conducted power is applied, together with increase of network loading factor and 16×16 antenna arrays, the I/N not exceeded more than 20% of the time would be –7.6 dB.

Study P implemented a Monte Carlo simulation examining the average long-term interference from IMT stations to a non-GSO space station. The study found an $I/N = -28.3$ dB for the nadir case using baseline IMT parameters and ignoring clutter loss, polarization discrimination and atmospheric attenuation for low elevation angles. If the IMT parameters are varied from baseline, the I/N would be –21.7 dB (for an increase of electronic up tilt of each IMT BS by 10 degrees) or –20.5 dB (for an increase of IMT BS and UE deployment density of five times).

Note: Study P used non-GSO parameters not provided by the involved groups in ITU-R (non-GSO parameters based on filings to the ITU). The results of Study P were not verified by other studies.

Conclusions on aggregate interference from IMT stations into FSS space stations

All studies show that sharing is feasible when using the baseline parameters.

Some administrations were of the view that, based on the results of studies using IMT characteristics other than those provided by the involved groups and in the clarifications and guidance developed by ITU-R on how to use the parameters provided in sharing and compatibility studies, mitigation techniques are required to address potential cases of interference and achieve compatibility between IMT stations and FSS space stations.

FSS earth station interference into IMT

For the case of a FSS earth station interfering into IMT, the results of studies showed separation distances of less than 100 m up to about 10 km between the FSS earth station and IMT stations.

In the case of deployment of FSS earth stations at specified locations, when the required separation distance can be maintained between a location of a FSS earth station with known position and a deployment area of IMT stations, sharing between IMT and the FSS is feasible.

In case of deployment of small FSS earth stations at unspecified locations and IMT stations in the same geographical area, the separation distance between FSS and IMT stations cannot be ensured. Therefore, sharing may or may not be feasible and could be dealt with on a case-by-case basis.

2/1.13/3.2.1.4 ISS and IMT

Six sharing and compatibility studies were provided that assessed the aggregate interference from IMT-2020 stations into data relay satellite (DRS) systems in the 25.25-27.5 GHz frequency range.

⁶ Noting that ITU-R recommended the use of a Rayleigh distribution of UE.

The results of four studies showed a positive interference margin of 12.2 to 25 dB using the following assumptions: no apportionment, 3 dB polarization loss, three different DRS systems (Chinese Data Tracking and Relay System (CTDRS), European Data Relay System (EDRS) and Tracking and Data Relay Satellite (TDRS)), as well as different orbital locations and DRS beam pointing elevation angles. Two of these studies assessed aggregate interference levels within the visibility area of a DRS satellite (based on 99.9% I/N value or I/N value from a single snapshot or mean I/N value) and performed a sensitivity analysis on the antenna array (16×16 antenna array or 5 dB higher per antenna element power) and found an interference margin of 9.5 to 18.4 dB. One of these studies also considered a sensitivity analysis on a population redistribution, which found a margin of 8.2 to 10.2 dB for BS with 8×8 array and minimal elevation angle of 20 degrees towards the DRS satellite for IMT-2020 deployments.

A fifth study considered a statistical calculation based on BS antenna panel random positioning with antenna normalization and assuming an apportionment of 7 dB and a 1.5 dB polarization loss, and derived an interference margin of 10.2 dB for EDRS.

The results of a sixth study showed interference margins of –1.5 and 0.7 dB for two different DRS systems (EDRS and TDRS) using the following assumptions: apportionment of 7 dB, 1.5 dB polarization loss, normalization of IMT-2020 antenna gain patterns and a DRS beam pointing elevation angle of 10 degrees. This study also contained a set of sensitivity analysis, e.g. a 16×16 antenna array and a 5 dB higher per antenna element power, which is similar to the other five studies. The study also considered IMT characteristics other than those provided by the involved ITU-R groups and in the clarifications and guidance developed by ITU-R on how to use the parameters in the studies as follows: A network loading factor of 50% resulted in a 3.5 dB increase in interference; the use of three sectors per BS resulted in a 4.1 dB increase; the application of all of the above-mentioned factors together resulted in an increase of interference up to 15.6 dB. Furthermore, 10% of outdoor users with a height from 10 m to 30 m resulted in an increase of interference by 3.5 and 8 dB for 8×8 and 16×16 antenna arrays, respectively. In order to compensate for the negative margins, this study proposed an e.i.r.p. mask as a mitigation technique to ensure the compatibility of IMT-2020 with ISS space stations.

2/1.13/3.2.1.5 FS and IMT

Several sharing and compatibility studies between the FS and IMT in the frequency band 24.25-27.5 GHz were performed in ITU-R as detailed below.

The results of deterministic studies for the point-to-point FS, using the parameters and assumptions provided, found separation distances ranging from 2.6 km up to 70 km for co-channel cases, while immediately adjacent band cases range from 0.9 to 12 km. The larger separation distances (20 to 70 km) are only found in specific co-channel examples, with a limited probability of occurrence, in which BSs were placed directly in the main beam of high gain FS antennas.

Studies that applied a statistical approach (Monte Carlo simulation) using the parameters and assumptions as provided resulted in separation distances ranging from 1 km to 10 km. The separation distances depend on the scenarios analysed and the ways to account for clutter losses for co-frequency coexistence case.

The single-entry studies summarized above for both the deterministic approach (minimum coupling loss calculation) and the statistical approach (Monte Carlo simulation) showed that the separation distance primarily depends on the coexistence scenarios, frequency separation, relative positions of IMT-2020 BS and FS receiver antennas, and ways to account for clutter losses.

One study that used a statistical approach (Monte Carlo simulation) for multiple entry, using the provided parameters and assumptions, resulted in a separation distance of 4.2 km for the co-frequency coexistence case.

Point-to-multipoint studies investigated the effect of different parameters on a possible coexistence scenario between IMT-2020 and the FS in the 26 GHz band.

Studies that used a statistical approach (Monte Carlo simulation) using parameters and assumptions provided, found that for the co-channel case, the required separation distance ranged approximately from 0.5 up to 34 km. For the adjacent frequency case, the required separation distance ranged from 0 to less than 13 km, while the separation distance further reduced to less than 3 km with the use of a guardband. The separation distances mainly depended on the frequency separation, interference scenario and deployment environments.

The point-to-multipoint studies summarized above showed that coexistence between IMT-2020 and the fixed service is possible using frequency and/or spatial separation.

For both point-to-point and point-to-multipoint, coexistence between IMT-2020 and FS receivers can be achieved taking into account local specifics, frequency separation and deployment scenarios.

2/1.13/3.2.2 Frequency range 31.8-33.4 GHz

The frequency range 31.8-33.4 GHz, or parts thereof, is allocated to the FS, ISS, RNS and SRS. The frequency bands adjacent to this frequency range are allocated to the EESS (passive), RAS and SRS (passive). The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the RNS, SRS, EESS (passive) and RAS and are summarized in the subsections below. Characteristics were not received for the ISS and, therefore, studies were not carried out for the ISS. Studies are not needed for the SRS (passive), as this service is dealing with sensors around other planets and no interference issue is expected. Studies were not carried out for the FS.

2/1.13/3.2.2.1 RNS and IMT

Several studies have dealt with single-entry and aggregated interference from IMT into the RNS. All these studies have demonstrated difficulties for co-channel sharing.

In particular, for the case of compatibility of IMT-2020 and aircraft radars, the sharing studies (single-entry/aggregated, dynamic/static) have shown that IMT-2020 systems can cause interference to the airborne radars operating in the RNS:

- the percentages of time of exceedance of the protection criterion ($I/N = -6$ dB) range from 20% up to 43% depending on the type of radar;
- separation distances of about 100 km are necessary to avoid interference exceeding the protection criterion, therefore coordination would be difficult to carry out for airborne radars.

Based on these results, it can be concluded that sharing between IMT-2020 systems and the RNS within 31.8-33.4 GHz is not feasible.

2/1.13/3.2.2.2 SRS (deep space) (space-to-Earth) and IMT

Sharing and compatibility studies between the SRS (deep space) (space-to-Earth) in the 31.8-32.3 GHz frequency band and IMT systems in the 31.8-33.4 GHz frequency band were conducted.

These studies have shown that the separation distances around several SRS earth station locations would be in the order of 24 to 83 km depending on the earth stations considered. These distances

were calculated for a single BS and for multiple-entry aggregate interference with a power per antenna element of 10 dB (m/200 MHz), i.e. -20 dB(W/200 MHz), and an 8×8 elements antenna.

The study results indicate that the separation distances needed to protect these particular facilities are relatively small; consequently, the protection of these stations could be considered on a national or bilateral/multilateral level.

2/1.13/3.2.2.3 EESS (passive) in adjacent band and IMT

Three compatibility studies between the EESS (passive) sensors in the frequency band 31.3-31.8 GHz and IMT systems in the frequency band 31.8-33.4 GHz were provided to ITU-R. In this section, these studies are referred to as Studies 1 to 3. Among the sensors given in Recommendation ITU-R RS.1861, these studies showed that Sensor G3 is the most sensitive to aggregated interference from IMT systems.

When the IMT antenna pattern in the adjacent band is modelled by a single element, the levels of interference exceedance compared to the protection criterion of Sensor G3 were 23.7 dB in Study 1 and 16.1 dB in Study 3. The different exceedance levels were due to different assumptions employed in these studies, such as the apportionment of EESS (passive) protection criteria (Study 1: 3 dB, Study 3: 0 dB) and application of the normalization factor for the IMT single-element antenna pattern (BS: 4.8 dB, UE: 2.4 dB) (Study 1: applied, Study 3: not applied). Furthermore, Study 1 considered a 2 dB “multi-operator interference factor” to cover the interference falling into the EESS passive band 31.3-31.8 GHz from multiple IMT-2020 operators’ channels using the entire 31.8-33.4 GHz frequency band for outdoor deployments and including the possible impact of outdoor UEs connected to indoor BS.

As a sensitivity analysis for Sensor G3, Study 1 derived that, if the deployment density of IMT BSs in an urban area is increased using a population based redistribution, the exceedance level is increased to 28.4 dB. Study 1 also demonstrated that, when considering the new type of EESS (passive) sensor (MWI sensor), which presents different parameters than those described in Recommendation ITU-R RS.1861, the level of interference exceedance became 30.7 dB under the same conditions.

Studies 2 and 3 performed a sensitivity analysis using a beamforming antenna model in the unwanted emission domain. In the absence of IMT-2020 antenna measurement data, it was agreed in ITU-R that:

- the antenna pattern may remain beamformed to some extent in the adjacent frequency band;
- the Recommendation ITU-R M.2101 model applicable to beamforming gain may in that case underestimate the side-lobe levels (e.g. some simulations have shown that, for an 8×8 array simplified AAS antenna design model with one slant dipole elements, the Recommendation ITU-R M.2101 model appears to be a reasonable match for the side lobes closest to the main beam, but side lobes further from the main beam would be underestimated by this model);
- the “variance” of the interference distribution is much wider compared to the use of a single element pattern and hence a conclusion on average interference would not be appropriate.

In Study 3, the exceedance level compared to the protection criterion of the Sensor G3 is calculated as 5.6 dB under the same conditions described above for the IMT single-element antenna pattern (based on no apportionment assumed).

Based on the levels of interference exceedance derived above for Sensor G3, the following unwanted emission limits in the 31.3-31.8 GHz frequency band are suggested in some studies:

- in Study 1: -50.3 dB(W/200 MHz) for BS and -48.4 dB(W/200 MHz) for UE.
- in Study 3: -26.7 dB(W/200 MHz) for BS and -24.1 dB(W/200 MHz) for UE.

2/1.13/3.2.2.4 RAS in adjacent band and IMT

A sharing and compatibility study between the RAS in the frequency band 31.3-31.8 GHz and IMT systems in the frequency band 31.8-33.4 GHz was conducted.

In the study, a -13 dB(m/MHz), i.e. -43 dB(W/MHz), level of unwanted emission was assumed for both IMT UEs and BSs. This study showed that for IMT UEs, the separation distances around RAS stations are 19 km for a single interferer scenario and 35 km for the aggregate interference scenario assuming a constant density of UEs around the RAS stations. For IMT BSs, the study showed that the separation distances are 48 km for a single interferer and 49 km for the aggregate interference scenario assuming a constant density of BSs around the RAS stations. If the combined aggregated emissions of both UEs and BSs are considered, the study derived a separation distance of 49 km.

2/1.13/3.2.3 Frequency bands 37-40.5 GHz and 40.5-42.5 GHz

The frequency range 37-42.5 GHz, or parts thereof, is allocated to the broadcasting service, BSS, EESS, FS, FSS, MS, MSS, and SRS. The frequency bands adjacent to this frequency range are allocated to the EESS (passive), RAS and SRS (passive) among other services. The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the EESS/SRS (passive) in 36-37 GHz, SRS, FSS, MSS, BSS, RAS and FS which are summarized in the subsections below. Characteristics were not received for the broadcasting service (40.5-42.5 GHz)⁷ or the EESS/SRS (40.0-40.5 GHz)⁸ and, therefore, studies were not carried out for these services. Studies are not needed for the SRS (Earth-to-space in 40.0-40.5 GHz), as the receivers in this service are on and around other planets and no interference issue is expected.

2/1.13/3.2.3.1 FSS/BSS/MSS (space-to-Earth) and IMT

Several sharing and compatibility studies between IMT-2020 and FSS/BSS/MSS in the space-to-Earth direction were provided to ITU-R in the frequency bands 37.5-42.5 GHz, as well as in the frequency bands 47.5-47.9 GHz, 48.2-48.54 GHz and 49.44-50.2 GHz in Region 1. These studies employed statistical analyses using the same or similar parameter values and assessed aggregate interference from IMT-2020 stations into an earth station. With respect to the interference criteria of an earth station, different values were assumed according to the respective studies, together with different time percentages to model the long-term and short-term interference criteria. The results of these studies showed that, when a separation distance between 210 and 2 000 metres is kept between a location of a FSS earth station and a deployment area of IMT-2020 stations, the aggregate interference from IMT-2020 stations met the interference criteria assumed in the respective studies and sharing between IMT-2020 and the FSS in the space-to-Earth direction is feasible. One study conducted a sensitivity analysis of the IMT parameters and the results for the separation distance were consistent with the results given above.

In the case of deployment of FSS earth stations at specified locations, when the required separation distance can be maintained between a location of a FSS earth station with a known position and a deployment area of IMT stations, sharing between IMT and FSS is feasible.

⁷ There are no entries in the MIFR for the broadcasting service in this band.

⁸ EESS/SRS in the band is an active service operating in the Earth-to-space direction. No impact is expected from IMT.

In case of deployment of small FSS earth stations at unspecified locations and IMT stations in the same geographical area the separation distance between FSS and IMT stations cannot be ensured. Therefore, sharing may or may not be feasible and could be dealt with on a case-by-case basis.

2/1.13/3.2.3.2 SRS and IMT

Studies have shown that the separation distances around several SRS (space-to-Earth in 37-38 GHz) earth station locations would be in the order of 24 to 100 km depending on the earth stations considered and the surrounding terrain. Another study, considering data transfer from space-very long baseline interferometry (VLBI) missions, clutter losses, and smooth Earth propagation predicted that the separation distance needed would be of the order of a few kilometres. The results depend on the earth station considered and the actual distance should be determined on a case-by-case basis.

The study results also indicated that the protection of these stations could be considered on a national or bilateral/multilateral level.

2/1.13/3.2.3.3 EESS/SRS (passive) and IMT

According to Resolution **752 (WRC-07)**, in order to facilitate sharing between active and passive services in the frequency band 36-37 GHz, stations in the MS brought into use after the date of entry into force of the Final Acts of WRC-07 shall comply with the sharing criterion that the maximum transmitter power at the antenna port is -10 dBW. In this case, the unwanted emission level of -13 dB(m/MHz), i.e. -43 dB(W/MHz), for an IMT station, which is equivalent to -13 dBW in the frequency band 36-37 GHz, satisfies the conditions described in Resolution **752 (WRC-07)** (-10 dBW). It should however be noted that the deployment of IMT-2020 is expected to be denser than the deployment of fixed and mobile systems considered in the development of Resolution **752 (WRC-07)** (see Report ITU-R RS.2095).

Four compatibility studies between the EESS/SRS (passive) in the frequency band 36-37 GHz and IMT in the frequency band 37-43.5 GHz have been provided to ITU-R. These studies showed that Sensor H3 is the most sensitive to aggregated interference from IMT systems. According to the results of Studies A, B and C, assuming 317 IMT BSs within the instantaneous field of view (IFOV), when the unwanted emission level of IMT stations is -13 dB(m/MHz), i.e. -43 dB(W/MHz), the aggregate level interference exceedance for Sensor H3, were -4 to 17.4 dB for UE and 5 to 16.7 dB for BS, corresponding to levels of unwanted emissions of -23 to -37.6 dB(W/100 MHz) for UE, and -28 to -36.9 dB(W/100 MHz) for BS depending on the assumptions used (in particular single element or beam forming antenna pattern). Studies A, B and C did not consider apportionment of the EESS (passive) protection criteria.

A new Study D was received that was not fully reviewed and the reason for the differences between the results of this study and the other studies could not be determined. This study considered the single element IMT antenna pattern, the 3 dB apportionment of the EESS (passive) protection criteria, as well as a 2 dB factor for multi-operator aggregation to account for the interference from other IMT-2020 operators' networks. On this basis, assuming 317 – 1 322 IMT BSs within the Sensor H3 IFOV ($16 \text{ km} \times 12 \text{ km}$), Study D showed that the levels of interference exceedance is 26.1 to 32.3 dB, corresponding to levels of unwanted emissions for UE and BS of $-46/-47$ dB(W/100 MHz) to $-52.2/-53.2$ dB(W/100 MHz), respectively.

In addition, Study D scaled the Report ITU-R RS.2095 the fixed service deployment assumption to 1 200 FS stations in the 10 million km^2 measurement area to 1 200 000 IMT-2020 base stations in the same area. Using this assumption, which was not reviewed, the analysis leads to a 35.5 dB negative margin (with a reference to -10 dBW power) above the EESS (passive) protection criteria

and would hence argue for a necessary IMT-2020 unwanted emission level of -45.5 dB(W/100 MHz) for both BS and UE.

Considering that IMT-2020 is designed to provide hot spot coverage and not ubiquitous coverage it was questioned if these results would not be ‘excluded’ according to Recommendation ITU-R RS.2017, which allows for 0.1% in time or area of the 10 000 000 km² to exceed the interference criteria, this would allow for 66 pixels of Sensor H3 to exceed the -166 dB(W/100 MHz) within this area or the corresponding time.

2/1.13/3.2.3.4 FS and IMT

One sharing and compatibility study between the FS and IMT in the frequency band 37.0-43.5 GHz was provided to ITU-R. The study assumed a scenario where an FS system points directly across an IMT deployment area in a dense urban environment. More specifically, the FS transmitter is located 1.1 km directly south of the centre of the IMT deployment area and the FS receiver is located 1.1 km directly north of the centre of the IMT deployment area. The FS station antennas are pointed toward each other.

The results of the study showed that, for 0.8% of the snapshots, the interference from IMT BSs into FS receivers exceeded the interference criterion of $I/N = -10$ dB for the FS system.

Considering that only for a small percentage of snapshots the interference criterion is exceeded under the condition of a small separation distance described above, the study concluded that sharing between the FS and IMT is considered feasible when such a separation distance beyond 1.1 km is kept between a location of a FS station and a deployment area of IMT stations.

Additional studies may be needed to investigate other scenarios which are not considered in the above study.

2/1.13/3.2.3.5 RAS and IMT

Two adjacent frequency band compatibility studies were conducted between the RAS in the frequency band 42.5-43.5 GHz and IMT systems in the frequency band 40.5-42.5 GHz. For one study a uniform density of user equipment and BSs was assumed around RAS stations while one study also considered a clustered deployment density.

In the adjacent frequency band compatibility studies, assuming a -13 dB(m/MHz), i.e. -43 dB(W/MHz), level of unwanted emissions for both IMT user equipment and BSs, separation distances of 38 km and 14 km were obtained between a RAS station and a BS and a user equipment, respectively. The separation distances assuming -30 dB(m/MHz), i.e. -60 dB(W/MHz), became 8 km and 2 km, respectively. In the aggregate interference scenario, if the combined aggregated emissions of both user equipment and BSs are considered, one study obtained separation distances of 5 km for a purely suburban environment. Results of the other studies ranged from 28 km (assuming polarization loss (3 dB) and not considering antenna gain normalization) to 48 km (clustered density, no polarization loss, normalized antenna gain) for mixed urban/suburban environments. Assuming a -30 dB(m/MHz), i.e. -60 dB(W/MHz), level of unwanted emissions for both IMT user equipment and BSs the combined separation distance became 18 km for a clustered deployment density.

No detailed terrain profiles were used in these studies. Considering detailed terrain profiles around RAS stations would lead to different separation distances for RAS stations on a case-by-case basis. Given the expected dimensions of the coordination zones around RAS stations, the protection of RAS stations could be established on a national level.

2/1.13/3.2.4 Frequency band 42.5-43.5 GHz

The frequency range 42.5-43.5 GHz is allocated to the FS, FSS, MS and RAS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies carried out for the FS, FSS (Earth-to-space) and RAS are summarized in the subsections below.

2/1.13/3.2.4.1 FSS (Earth-to-space) and IMT

Several sharing and compatibility studies were conducted between IMT-2020 and the FSS in the Earth-to-space direction in the frequency band 42.5-43.5 GHz. These studies used deterministic and statistical analyses.

Aggregate interference from IMT-2020 into GSO FSS space stations

In the case of aggregate interference from IMT stations into GSO FSS space stations, the results of studies, using parameters provided by the responsible groups of ITU-R, showed that the long-term interference I/N ranged from -43.46 dB to -26.5 dB. When compared with the -10.5 dB I/N protection criterion, in all cases there is a positive margin between 33 dB to 16 dB without apportionment (30 dB to 13 dB with apportionment).

Some studies conducted sensitivity analyses using parameters, assumptions and the agreed course of action on how to vary these parameters developed by ITU-R on how to conduct sharing and compatibility studies, such as up to 5 dB higher antenna element conducted power than that specified in the baseline or 16×16 antenna array. These studies found that the protection criteria were not exceeded with a positive margin.

Some studies conducted other sensitivity analyses using IMT parameters and assumptions, other than those considered by the ITU-R as well as differing from the agreed course of action on how to vary these parameters on how to conduct sharing and compatibility studies, using multiple deviations on the IMT characteristics (e.g. higher or lower IMT deployments, higher IMT BS e.i.r.p., higher IMT BS tilt angle, different antenna element output power and/or antenna array). These studies showed that the long-term interference I/N range was up to -16.4 dB depending on different input data and assumptions and GSO FSS was considered to be protected with at least a 5.9 dB (2.9 dB with apportionment) positive margin.

Aggregate interference from IMT-2020 into non-GSO FSS space stations

In the case of aggregate interference from IMT stations into non-GSO FSS space stations, the results of fixed orbit position studies, based on parameters provided by the responsible groups of the ITU-R, showed that the long-term interference I/N values ranged from -35.9 dB to -49.7 dB for specific positions of the non-GSO satellite orbit. Two studies provided dynamic analyses of non-GSO systems which assess the parameters using Carrier #34 (with 41.7 dBi antenna gain) and Carrier #44 (with 35 dBi antenna gain). One study showed long-term I/N values ranging from -34.8 dB to -38.2 dB. In all cases there is a positive margin between 24.3 dB and 27.7 dB without apportionment.

Another study ran a dynamic simulation of a non-GSO network and found a long-term interference I/N of -21.3 dB corresponding to a positive margin of 10.8 dB (7.8 dB with apportionment). In addition, several other simulations under similar assumptions have resulted in an I/N below -30 dB instead of -21.3 dB.

Some studies conducted sensitivity analyses using IMT parameters and assumptions other than those considered by ITU-R as well as differing from the agreed course of action on how to vary these parameters on how to conduct sharing and compatibility studies, using multiple simultaneous

deviations on the IMT characteristics (i.e. up to 5 dB higher antenna element conducted power than that specified in the baseline or 16×16 antenna array and network loading factor up to 50%). One study provided long-term I/N values from -11.5 dB to -1.9 dB depending on different input data and assumptions. In the worst case, the long-term protection criterion of -10.5 dB will be exceeded by 8.6 dB (11.6 dB with apportionment).

One study (Study H) evaluated a non-GSO system using a combination of parameters from different sources. The study found an $I/N = -7.9$ dB, i.e. a negative margin of 2.6 dB (5.6 dB with apportionment). In addition, several other simulations under similar assumptions resulted in an I/N below -25 dB instead of -7.9 dB, and well below the protection criteria.

Note: Study H used non-GSO parameters not provided by the ITU-R responsible group, but used parameters based on multiple systems filed in the ITU-R SRS database and similar antenna gain provided by the ITU-R responsible group (Carriers #28, #29, and #30).

Some administrations were of the view that, based on the results of studies using IMT parameters and assumptions other than those considered by ITU-R as well as the agreed course of action on how to vary these parameters, mitigation techniques are required to address potential cases of interference and achieve compatibility between IMT stations and FSS space stations.

Interference from FSS earth stations to IMT-2020

For the case of an FSS earth station interfering into IMT, the results of studies showed separation distances between 160 metres to 4 000 metres based on the assumptions used between the FSS earth station and the IMT stations.

In the case of deployment of FSS earth stations at specified locations, when the required separation distance can be maintained between a location of a FSS earth station with a known position and a deployment area of IMT stations, sharing between IMT and the FSS is feasible.

In case of deployment of small FSS earth stations at unspecified locations and IMT stations in the same geographical area the separation distance between the FSS and IMT stations cannot be ensured. Therefore, sharing may or may not be feasible and could be dealt with on a case-by-case basis.

2/1.13/3.2.4.2 FS and IMT

Note: See section 2/1.13/3.2.3.4 above.

2/1.13/3.2.4.3 RAS and IMT

Two in-band sharing studies were conducted between the RAS and IMT in the frequency band 42.5-43.5 GHz. For one study a uniform density of user equipment and BSs was assumed around RAS stations, while another study also considered a clustered deployment density.

For the in-band sharing studies, in the single emitter case, separation distances from a RAS station were obtained to be 68 km and 42 km to a BS and a UE, respectively. If the combined aggregated emissions of both UE and BS were considered, separation distances ranging from 36 km (assuming polarization loss (3 dB) and using lower antenna height) to 57 km (clustered density, no polarization loss, normalized antenna gain and using higher antenna height) were derived for, respectively, purely suburban and mixed urban/suburban environments. These studies used the baseline assumptions as provided by the responsible groups.

No detailed terrain profiles were used in these studies. Considering detailed terrain profiles around RAS stations would lead to different separation distances for RAS stations on a case-by-case basis. Given the expected dimensions of the coordination zones around RAS stations, the protection of RAS stations could be established on a national level.

2/1.13/3.2.5 Frequency range 45.5-47 GHz

The frequency range 45.5-47 GHz, or parts thereof, is allocated to the MS, MSS, RNS and RNSS. The frequency bands adjacent to this frequency range are allocated to the ARS and ARSS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Since no characteristics were provided for the RNS and RNSS, no studies have been done.

No sharing studies between IMT and the MSS for the band 45.5-47 GHz were performed in ITU-R.

A view was expressed that studies submitted to CPM19-2 are indeed ITU-R studies and should be treated accordingly and can be considered as a suitable basis for regulatory conditions.

Two contributions were submitted to CPM19-2 (see Doc. CPM19-2/182 and CPM 19-2/186) regarding the sharing of IMT and GSO MSS (both Earth-to-space and space-to-Earth) in the range 45.5-47 GHz. Different views were expressed regarding the summary of those studies.

View 1:

Some administrations were of the view that the studies received by CPM19-2 (see Documents CPM19-2/182 and CPM 19-2/186) regarding the sharing between IMT and MSS in the 45.5-47 GHz frequency band properly represent the sharing situation and met all the requirement for being included in the CPM text. The studies provide equivalent results, which are furthermore in line with similar sharing studies for other frequency bands towards WRC-19. The methodology used for these studies are the same as for other studies for the same agenda item provided by the responsible ITU-R groups. The studies used parameters provided by responsible ITU-R groups as defined by CPM19-1. Moreover, the studies concluded that sharing is feasible and that the results of these studies can be used as the basis for regulatory methods.

Regarding sharing between IMT and MSS (Earth-to-space), two sharing studies were carried out. The results of both studies indicate that for the uplink direction, the aggregate I/N into the MSS space stations would be at most –33 dB.

For MSS (space-to-Earth), two sharing studies were carried out. The studies provide results in terms of separation distances between an IMT network and an MSS earth station located on land, and probabilities that an IMT network may have the potential to cause interference to an MSS earth station at different separation distances. Separation distances calculated in these studies range between 500 m with a 1% probability of exceedance, to 2 km with extremely low probabilities of exceedance.

View 2:

The contributions which were submitted to CPM19-2 regarding the sharing in the frequency band 45.5-47 GHz of IMT carried out for GSO MSS (both Earth-to-space and space-to- Earth) only. The studies provide results in terms of separation distances between an IMT network located on land and GSO MSS earth station located on land. The case of maritime and airborne ESs and/or BSs and UE were not considered. In Appendix 7 of the RR, minimum coordination distances 500 km are used for the same interference scenarios between the MSS and MS. It is not possible to consider these results as representative case among other scenarios. In these scenarios, compatibility of IMT with GSO MSS (s-E) cannot be ensured.

There are no any compatibility studies related to interference between IMT and non-GSO MSS (Earth-to-space and space-to-Earth). In this case, the compatibility of IMT with non-GSO MSS (Earth-to-space and space-to-Earth) cannot be ensured.

There are no any compatibility studies between IMT and RNS, GSO/non-GSO RNSS (Earth-to-space and space-to- Earth) in the considered frequency band. In this case, compatibility of IMT with RNS/RNSS cannot be ensured.

There are no any compatibility studies between IMT in the band 45.5-47 GHz and ARS/ARSS in the band 47-47.2 GHz. In this case, compatibility of IMT with ARS/ARSS cannot be ensured.

The existing studies do not provide sufficient basis for regulatory methods.

A view was expressed that the new studies were based on arbitrary assumptions and their results were not reviewed or verified during the ITU-R CPM19-2. These new studies may not provide sufficient basis for regulatory methods.

2/1.13/3.2.6 Frequency range 47-47.2 GHz

The frequency range 47-47.2 GHz, or parts thereof, is allocated to the ARS and ARSS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

No studies for this band were performed in ITU-R.

2/1.13/3.2.7 Frequency range 47.2-50.2 GHz

The frequency range 47.2-50.2 GHz, or parts thereof, is allocated to the FS, FSS and MS. The frequency bands adjacent to this frequency range are allocated to the EESS (passive) and SRS (passive). The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the EESS (passive) and for FSS (Earth-to-space) and are summarized in the subsections below.

2/1.13/3.2.7.1 FSS (Earth-to-space) and IMT

Several sharing and compatibility studies between IMT and the FSS in the Earth-to-space direction were conducted in the frequency band 47.2-50.2 GHz. These studies employed deterministic and statistical analyses.

In the case of aggregate interference from IMT stations into a GSO FSS space station, results of the studies using the assumptions provided by the responsible groups showed that the calculated I/N ranged from -37 dB to -30 dB. The difference relates to the used FSS boresight elevation angles and if IMT deployment is in the -3 dB satellite footprint or the whole satellite visible Earth view. One study calculated probability distributions of IMT gain towards the space station and presumed the worst-case value for each IMT transmitter (elevation and azimuth) in the satellite beam and found an I/N of -19 dB without clutter considerations.

For the non-GSO case, two deterministic studies using both a static scenario and single low elevation angle (i.e. 10°) of the non-GSO satellite led to an I/N of -21.7 dB and -35.6 dB. Another study using a statistical analysis and the baseline parameters found an I/N of -37 dB.

A sensitivity analysis was carried out using parameters, assumptions and the agreed course of action on how to vary these parameters developed by ITU-R on how to use the parameters provided in sharing and compatibility studies such as up to a 5 dB higher antenna element conducted power than that specified in the baseline or 16×16 antenna array found that the protection criteria were met with a positive margin from 3.2 to 5.1 dB with a 3 dB apportionment. One study conducted a sensitivity analysis using IMT characteristics other than those considered by ITU-R, as well as differing from the agreed course of action on how to vary these parameters, i.e. a single-entry analysis with no clutter loss and with the IMT BS main beam directed towards the FSS satellite. This study found that under such circumstances there might be interference issues.

For both GSO and non-GSO systems, some administrations were of the view that, based on the results of studies using IMT characteristics other than those provided by the involved groups and in the clarifications and guidance developed by ITU-R on how to use the parameters provided in

sharing and compatibility studies, mitigation techniques are required to address potential cases of interference and achieve compatibility between IMT stations and FSS space stations.

For the case of an FSS earth station interfering into IMT, the results concluded there is a need for a separation distance between 160 metres and 5 000 metres, based on the assumptions used between the FSS earth station and the IMT stations' deployed area.

In the case of deployment of FSS earth stations at specified locations, when the required separation distance can be maintained between a location of a FSS earth station with a known position and a deployment area of IMT stations, sharing between IMT and the FSS is feasible.

In the case of deployment of small FSS earth stations at unspecified locations and IMT stations in the same geographical area, the separation distance between the FSS and IMT stations cannot be ensured. Therefore, sharing may or may not be feasible and could be dealt with on a case-by-case basis.

2/1.13/3.2.7.2 FSS (space-to-Earth) in Region 1 and IMT

See section 2/1.13/3.2.3.1 above.

2/1.13/3.2.7.3 EESS (passive) and IMT

Four studies were received in relation to compatibility between IMT-2020 in the 47.2-50.2 GHz frequency band and the EESS (passive) in the frequency band 50.2-50.4 GHz. The results in the tables below are expressed as:

- interference exceedance relative to the EESS (passive) protection criteria (−166 dB(W/200 MHz)) based on the IMT-2020 parameters provided; and
- corresponding unwanted emission levels to protect the EESS (passive).

Some studies considered the single antenna pattern from Recommendation ITU-R M.2101.

Studies B and C led to the following results for Sensor I1 (applying the apportionment value of 3 dB of the EESS (passive) protection criteria):

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|------------------------------|--|----------------|
| | | UE | BS |
| B | 23.6 | −41.4 | −43.4 |
| C | 21.3 to 28.3 | −39.4 to −46.4 | −41.1 to −48.1 |

In addition, Study B considered a population-based redistribution of the IMT-2020 BSs (capped to a maximum of 10 BS/km²) and led to the following results for Sensor I1 was (applying the apportionment value of 3 dB of the EESS passive protection criteria):

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|------------------------------|--|-------|
| | | UE | BS |
| B | 29.5 | −48.6 | −49.3 |

Study B considered a 2 dB “multi-operator interference factor” to cover the interference falling into the EESS passive band 50.2-50.4 GHz from multiple IMT-2020 operators' channels using the entire

47.2-50.2 GHz frequency band for outdoor deployments and including the possible impact of outdoor UEs connected to indoor BS.

Some studies performed a sensitivity analysis using a beamforming antenna model in the unwanted emission domain. In the absence of IMT-2020 antenna measurement data it was agreed in TG 5/1 that:

- the antenna pattern may remain beamformed to some extent in the adjacent frequency band;
- the Recommendation ITU-R M.2101 model applicable to beamforming gain may in that case underestimate the side-lobe levels (e.g. some simulations have shown that, for an 8×8 array simplified AAS antenna design model with one slant dipole elements, the Recommendation ITU-R M.2101 model appears to be a reasonable match for the side lobes closest to the main beam, but side lobes further from the main beam would be underestimated by this model);
- the “variance” of the interference distribution is much wider compared to the use of a single element pattern and hence a conclusion on average interference would not be appropriate.

Assuming no apportionment, Study D considered an IMT-2020 beamforming antenna pattern and led to the following results for Sensor I1:

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|--------------------------------------|--|------------|
| | | UE | BS |
| D | 8 to 12 (for BS) 5 to 11 (for UE) | –25 to –31 | –31 to –35 |

Study D has a sensitivity analysis that connects the interference criteria’s area allowance to the percentile used to determine the results, the effect of which is to simulate the impact over the entire two million square kilometres.

Study C considered apportionment and an IMT-2020 beamforming antenna pattern and led to the following results for Sensor I1:

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|------------------------------|--|--------------|
| | | UE | BS |
| C | 9.2 to 15.6 | –27.3 to –33.7 | –29 to –35.4 |

Study C considered an IMT unwanted emission distribution (mean value –26/–24.4 dB(W/200 MHz) per BS/UE, standard deviation 2 dB) instead of the baseline fixed value for Sensor I1 (including apportionment) and led to the following results:

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for: | |
|-------|------------------------------|--|----------------|
| | | UE | BS |
| C | 5 to 9.9 | –23.1 to –28 | –24.8 to –29.7 |

2/1.13/3.2.8 Frequency range 50.4-52.6 GHz

The frequency range 50.4-52.6 GHz, or parts thereof, is allocated to the FS, FSS and MS. The frequency bands adjacent to this frequency range are allocated to the EESS (passive) and SRS (passive). The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the EESS (passive) and for the FSS (Earth-to-space) and are summarized in the subsections below.

2/1.13/3.2.8.1 FSS (Earth-to-space) and IMT

Several sharing and compatibility studies between IMT and the FSS in the Earth-to-space direction were conducted in the frequency band 50.4-52.6 GHz noting the FSS allocation is in the frequency band 50.4-51.4 GHz as well as issue 9.1.9⁹. These studies have employed deterministic and statistical analyses using the parameters provided by the responsible groups.

In the case of aggregate interference from IMT stations into a FSS space station, one study concluded that for the worst-case scenario, the mean I/N , is -34 dB for GSO. Another study calculated a value of -30.4 dB mean I/N for a GSO satellite and -21.7 dB for a non-GSO satellite. One study calculated probability distributions of IMT gain towards the non-GSO space station and presumed the worst-case value for each IMT transmitter (elevation and azimuth) in the satellite beam and found an I/N of -19 dB without clutter considerations.

Sensitivity analyses were carried out using parameters' assumptions and the agreed course of action on how to vary these parameters developed by ITU-R on how to use the parameters provided in sharing and compatibility studies such as up to a 5 dB higher antenna element conducted power than that specified in the baseline or 16×16 antenna array. These studies found that the protection criteria were not exceeded with a positive margin.

Some studies considered IMT characteristics that deviate even further (e.g. in terms of denser IMT deployments, higher IMT BS e.i.r.p., higher IMT BS elevation angle, different antenna element output power and/or antenna array), i.e. not in line with the agreed course of action on how to vary these parameters developed by ITU-R.

Some administrations were of the view that, based on the results of studies using IMT characteristics other than those provided by the involved groups and in the clarifications and guidance developed by ITU-R on how to use the parameters provided in sharing and compatibility studies, mitigation techniques are required to address potential cases of interference and achieve compatibility between IMT stations and FSS space stations.

For the case of an FSS earth station interfering into IMT, the results concluded there is a need for a separation distance from 160 metres to 5 km.

In the case of deployment of FSS earth stations at specified locations, when the required separation distance can be maintained between a location of a FSS earth station with a known position and a deployment area of IMT stations, sharing between IMT and the FSS is feasible.

⁹ In accordance with Resolution **162 (WRC-15)**, agenda item 9.1, issue 9.1.9, invites ITU-R to conduct studies considering additional spectrum needs for development of the FSS and conduct sharing and compatibility studies with existing services to determine the suitability of new primary allocations to the FSS in the frequency band 51.4-52.4 GHz (Earth-to-space) limited to FSS feeder links for geostationary orbit use, and the possible associated regulatory actions.

In case of deployment of small FSS earth stations at unspecified locations and IMT stations in the same geographical area the separation distance between the FSS and IMT stations cannot be ensured. Therefore, sharing may or may not be feasible and could be dealt with on a case-by-case basis.

2/1.13/3.2.8.2 EESS (passive) and IMT

Two compatibility studies between the EESS (passive) sensors in the frequency band 52.6-54.25 GHz and IMT systems in the frequency band 50.4-52.6 GHz (Studies A and B) were provided to ITU-R. Among the sensors given in Recommendation ITU-R RS.1861, these studies showed that Sensor J2 is the most sensitive to aggregated interference from IMT systems.

In Study B, under all deployment scenarios, negative margins up to 24.4 dB are calculated (assuming apportionment and multi-operator/channel factor). The impact of a population spatial distribution of BS is important, leading to a potential interference higher as compared to the ITU-R deployment Examples A and B, according to Annex 1 to the TG 5/1 Chairman's Report (see Document [5-1/478](#)), by about 6 dB (when capped to 10 BS/km²) and 9 dB (when uncapped). For the BS interference, the unwanted emission level is -45.3 dB(W/100 MHz). For the UE interference, the unwanted emission level needed is -44.3 dB(W/100 MHz).

In addition, one study (Study C) also addressed the compatibility between EESS (passive) sensors in the 50.2-50.4 GHz frequency band and IMT systems in the 50.4-52.6 GHz frequency band. This study considered a population-based redistribution of the IMT-2020 BSs (capped to a maximum of 10 BS/km²) and led to the following maximum unwanted emission levels in the frequency band 50.2-50.4 GHz for Sensor I1:

- For BS: -49.3 dB(W/200 MHz);
- For UE: -48.6 dB(W/200 MHz).

See also the applicable results related to the compatibility between IMT-2020 in the 47.2-50.2 GHz frequency band and the EESS (passive) in the frequency band 50.2-50.4 GHz, Section 2/1.13/3.2.7.3.

2/1.13/3.2.9 Frequency range 66-71 GHz

The frequency range 66-71 GHz, or parts thereof, is allocated to the ISS, MS, MSS, RNS and RNSS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the ISS and MSS (Earth-to-space) and are summarized in the subsections below. Characteristics were not received for the RNS and RNSS and therefore, studies were not carried out for these services. Studies were also not carried out for the MSS (space-to-Earth).

View 1:

There are no any compatibility studies between IMT and RNS, GSO/non-GSO RNSS (Earth-to-space and space-to-Earth) in the considered frequency band. In this case, compatibility of IMT with RNS/RNSS cannot be ensured and there is no basis for regulatory methods.

View 2:

There were no system characteristics provided for RNS, GSO/non-GSO RNSS (Earth-to-space and space-to-Earth) in the considered frequency band to model such system for the use in sharing studies. Therefore, methods/conditions to protect such system cannot be established.

2/1.13/3.2.9.1 ISS

The study provided a single-entry worst-case analysis for both the BS and UE case for the interference scenario where the ISS DRS is at 1° elevation and at 80° elevation. These two cases emphasized two different situations; the situation where the atmospheric loss is minimized, and the situation where the antenna gain of the BS is maximized. The study showed an interference threshold margin towards the DRS in the range of 38 dB to 127 dB, assuming a protection criterion I_o/N_o of -10 dB.

Therefore, it can be assumed that coexistence between IMT-2020 and the ISS in the 66-71 GHz frequency band is feasible without additional technical or regulatory constraints on IMT.

An additional contribution (see Document CPM19-2/151) was brought to CPM19-2 that provided an aggregated study between IMT-2020 and ISS in the frequency range 66-71 GHz.

View 1:

The contribution indicated an average I/N of less than -47 dB when considering the aggregated interference of IMT-2020 station in the entire visible footprint of the GSO ISS. This study used the characteristics provided by the involved ITU-R groups.

View 2:

There is not possible to draw on the compatibility of IMT-2020 stations and ISS service in the band 66-71 GHz based on the sharing study, provided in Document CPM19-2/151, taking into account the following:

- *a single set of technical parameters for receiving GSO ISS space station was used, which was not provided by responsible ITU-R group;*
- *assumed protection criteria for ISS has no basis and was not agreed by responsible ITU-R group;*
- *definition of coupling loss is not provided and it is not clear how clutter loss model, specified in Recommendation ITU-R P.2108, was applied;*
- *GSO ISS space station beam pointing corresponds to 20 degree elevation angle, which may not represent the worst case in terms of maximum aggregate interference taking into account that lower elevation angles for beampointing would result in increase of -3 dB footprint size and combined effect of atmospheric and clutter losses would be compensated by increase of off-axis e.i.r.p. of IMT-2020 stations within -3 dB footprint;*
- *tile size is not specified in the study, as well as number of simulation steps, it is not clear how BS/UE deployment was done within each tile and how interference was integrated over all the tiles, taking into account that simulation was run on a tile by tile basis;*
- *interference into non-GSO ISS space stations, which are notified in MIFR and may be more sensitive to interference, was not considered.*

The existing studies do not provide sufficient basis for regulatory methods.

View 3:

The following points are in relation to the new study submitted on ISS 66-71 from the multi-administration (Document CPM19-2/151):

- *The study is using the agreed set of parameters decided at TG 5/1 even though parameters were not received at the responsible ITU-R group. No further*

characteristics (e.g. non-GSO ISS) was provided to the responsible ITU-R group to model other ISS system in this frequency band.

- *The study is assessing the interference scenario based on an I/N method, and no protection criteria has been assumed.*
- *The study is using the same definition of coupling loss as defined in all studies at the responsible ITU-R group, and the applicability of clutter loss is explained in P.2108-0, and consistent with the general guidelines provided at the responsible ITU-R group.*
- *The study is representing a pessimistic/gloomy scenario which is close to the worst-case as explained in the contribution and has been shown in the existing single-entry study performed at the responsible ITU-R group on the situation regarding the clutter loss and atmospheric condition.*
- *The study is consistent with the result of the existing study that the interference level is extremely low, therefore supporting the notion of no specific regulatory provision is necessary.*

2/1.13/3.2.9.2 MSS (Earth-to-space)

One study provided a single-entry analysis for a worst-case scenario to evaluate the interference level from IMT-2020 to a MSS receiving satellite, when IMT-2020 is deployed based on the characteristics provided by the involved ITU-R groups. This study considered the potential interference from the IMT-2020 BS and UE to the MSS receiving GSO satellite; where the range of elevation angles to the MSS satellite is from the horizon at 0° elevation to 90° elevation (zenith). In this study, the potential interference level was assessed as no protection criteria for MSS was available for this frequency band in ITU-R. This analysis showed that the interference level from IMT-2020 was from –347 dB(W/MHz) to –176 dB(W/MHz), considering the following assumptions: IMT-2020 BS antenna was pointing lower than 1.8° below the horizon and the IMT-2020 UE was pointing upwards directly to the satellite, the total output powers of BS and UE considered were 27 dB(m/200 MHz) (i.e. –3 dB(W/200 MHz) and 18 dB(m/200 MHz) (i.e. –12 dB(W/200 MHz), respectively (based on the characteristics provided by the involved ITU-R groups).

Two additional contributions (see Documents CPM19-2/152 and CPM19-2/183) were brought to CPM19-2 that provided aggregated interference studies between IMT-2020 and MSS uplink (Earth-to-space) in the frequency range 66-71 GHz.

View 1:

The first contribution assessed three different simulation scenarios considering the entire visible footprint of the MSS satellite, and the most pessimistic scenario showed an I/N of lower than –43 dB for the 99th percentile of the aggregated interference CDF. The second contribution calculated aggregate interference into an MSS space station receiver from IMT-2020 base stations deployed throughout the area of the MSS satellite footprint. The results of this study indicated that aggregate I/N into the MSS space station would be at most –52 dB (for the worst case elevation angle). These studies from both contributions used the characteristics provided by the involved ITU-R groups.

View 2:

The contributions which were submitted to CPM19-2 regarding the sharing in the frequency band 66-71 GHz of IMT carried out for GSO MSS (both Earth-to-space and space-to- Earth) only. The studies provide results in terms of separation distances between an IMT network located on land and GSO MSS earth station located on land. The case of maritime and airborne ESs and/or BSs and UE were not considered. In Appendix 7 of the RR, minimum coordination distances 500 km are used for the same interference scenarios between the MSS and MS. It is not possible to consider

these results as representative case among other scenarios. In these scenarios, compatibility of IMT with GSO MSS (space-to-Earth) cannot be ensured.

There are no any compatibility studies related to interference between IMT and non-GSO MSS (Earth-to-space and space-to-Earth). In this case, the compatibility of IMT with non-GSO MSS (Earth-to-space and space-to-Earth) cannot be ensured.

The existing studies do not provide sufficient basis for regulatory methods.

View 3:

The following points are in relation to the new studies submitted on MSS 66-71 GHz from the multi-administration (Documents CPM19-2/152 and CPM19-2/183):

- *The studies are using the agreed set of parameters decided at. No further characteristics (e.g. maritime and airborne MSS) was provided to the responsible ITU-R group to model such system for sharing studies.*
- *These studies are assessing interference to satellite receiver, hence Appendix 7 of the RR to protect ground earth station is irrelevant.*
- *The studies are using the same definition of coupling loss as defined in all studies at the responsible ITU-R group, and the applicability of clutter loss is explained in P.2108-0, and consistent with the general guidelines at the responsible ITU-R group*
- *The studies are representing pessimistic/gloomy scenarios which are close to the worst-case as explained in the contribution and has been shown in the existing single-entry study performed at the responsible ITU-R group.*
- *The studies are consistent with the result of the existing study that the interference level is extremely low, therefore supporting the notion of no specific regulatory provision is necessary.*

2/1.13/3.2.9.3 MSS (space-to-Earth)

No studies between IMT-2020 and MSS downlink (space-to-Earth) for the frequency band 66-71 GHz were performed in ITU-R.

A view was expressed that studies submitted to CPM19-2 are indeed ITU-R studies and should be treated accordingly and can be considered as a suitable basis for regulatory conditions.

Two contributions (see Documents CPM19-2/153 and CPM19-2/183) were brought to CPM19-2 that provided studies between IMT-2020 and MSS downlink (space-to-Earth) in the frequency range 66-71 GHz.

View 1:

The first contribution has shown that the I/N is less than -10.1 dB if the IMT-2020 network is 600 m away from the receiving MSS earth station. The distances could be different depending on the MSS earth stations considered and the surrounding terrain. The second contribution indicated that a dense cluster of IMT-2020 base stations in an urban area may have the potential to cause interference to an MSS earth station, for different separation distances between the IMT network and the MSS earth station. Probabilities of exceeding example MSS protection criteria were extremely low, e.g. < 0.0001 for separation distances up to 1 km, for an I/N protection value of -10 dB, even under pessimistic assumptions. These studies from both contributions used the characteristics provided by the involved ITU-R groups.

View 2:

The contributions which were submitted to CPM19-2 regarding the sharing in the frequency band 66-71 GHz of IMT carried out for GSO MSS (both Earth-to-space and space-to-Earth) only. The

studies provide results in terms of separation distances between an IMT network located on land and GSO MSS earth station located on land. The case of maritime and airborne ESs and/or BSs and UE were not considered. In Appendix 7 of the RR, minimum coordination distances 500 km are used for the same interference scenarios between the MSS and MS. It is not possible to consider these results as representative case among other scenarios. In these scenarios, compatibility of IMT with GSO MSS (s-E) cannot be ensured.

There are no any compatibility studies related to interference between IMT and non-GSO MSS (Earth-to-space and space-to-Earth). In this case, the compatibility of IMT with non-GSO MSS (Earth-to-space and space-to-Earth) cannot be ensured.

The existing studies do not provide sufficient basis for regulatory methods.

View 3:

The following points are in relation to the new studies submitted on MSS 66-71 GHz from the multi-administration (Documents CPM19-2/153 and CPM19-2/183):

- *The studies are using the agreed set of parameters decided at. No further characteristics (e.g. maritime and airborne MSS) was provided to the responsible ITU-R group to model such system for sharing studies.*
- *These studies to assess the risk of interference from IMT-2020 is a consistent method used in the responsible ITU-R group where the studies are done. This is a valid approach and fully verified when sharing studies were done in the responsible ITU-R group.*
- *The direct application of Appendix 7 of the RR is not appropriate as some of the parameters used in the sharing study is not based on time percentages. Appendix 7 of the RR does not define the separation distance for situation involving IMT-2020.*
- *The interference scenario from IMT-2020 to MSS earth stations is not too gloomy as shown in the studies. The risk of interference from IMT-2020 is very low.*

2/1.13/3.2.10 Frequency range 71-76 GHz

The frequency range 71-76 GHz, or parts thereof, is allocated to the broadcasting service, BSS, FS, FSS, MS and MSS. The frequency bands adjacent to this frequency range are allocated to the ARS, ARSS, RAS and RLS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the FS, RLS and FSS and are summarized in the subsections below. Characteristics were not received for the broadcasting service, ARS and ARSS and therefore, studies were not carried out for these services. Studies were also not carried out for the RAS, BSS and MSS (space-to-Earth).

2/1.13/3.2.10.1 FS

Statistical studies for a single-entry IMT BS case, for different antenna heights of FS receiver where the IMT BS is within the beam of the FS receiver, showed that a separation distance of 970 to 260 m for antenna heights of 10 to 40 m respectively, will ensure that the protection criteria for the FS receiver are met. Alternatively, a separation distance of 250 metres with an azimuth offset of antenna boresights between the IMT BS and FS receiver will also ensure that the protection criterion is met.

Statistical studies for the aggregated case showed that for different antenna heights of FS receiver (from 10 to 40 metres), a separation distance of 720 m from a FS receiver at 10 m will ensure that the protection criteria are met, in general, without separation distances for the aggregate case.

In summary, despite a strong interference potential when an IMT BS is located precisely in the FS receiver antenna boresight direction, the potential interference to FS receiver is limited and sharing would be feasible.

2/1.13/3.2.10.2 RLS

Two studies were received which dealt with the compatibility between IMT-2020 in the frequency bands 71-76 GHz and 81-86 GHz and automotive radar in the frequency band 76-77 GHz (i.e. Radar A of Category 1 from Recommendation ITU-R M.2057). Study A gave a range of IMT unwanted emission levels that were assumed to provide appropriate protection of the automotive radars, while Study B used various IMT-2020 unwanted emission levels to assess the probability of interference.

The IMT stations' spurious emission level assumed in both studies is a constant value over the operating band of automotive radars.

Study A assumed a 99% applicability of the protection criterion of $I/N = -6$ dB and did not apply antenna normalization. The baseline and sensitivity analysis took into account different propagation models (Report ITU-R M.2412 and Recommendation ITU-R P.452); the sensitivity analysis considered the potential effects of the surrounding obstacles. The statistics used for deriving the IMT-2020 maximum unwanted emission limits included the interference cases to automotive radars in the range of 300 m from the BS, while the assumed BS cell radius was 100 m.

Study A showed that to protect automotive radars operating in the 76-77 GHz frequency band, IMT-2020 stations need to comply with the following maximum unwanted emission levels in the band 76-77 GHz:

For baseline analysis:

- For BS: -24.5 dB(m/MHz) (equivalent to -31.5 dB(W/200 MHz));
- For UE: -13 dB(m/MHz) (equivalent to -20 dB(W/200 MHz)).

For sensitivity analysis:

- For BS: -22.6 dB(m/MHz) (equivalent to -29.6 dB(W/200 MHz));
- For UE: -13 dB(m/MHz) (equivalent to -20 dB(W/200 MHz)).

The maximum additional isolation required for the IMT BS unwanted emissions in the frequency band 76-77 GHz for all studied cases is within the range 11.5 dB (baseline) to 9.6 dB (sensitivity analysis). No additional isolation is required for the IMT UE.

Study B found it was not possible to define the value of the unwanted emission limits of IMT-2020 appropriately, taking into account the information provided by the involved groups. Study B reflected that there was no model available for the roll-off of the IMT-2020 unwanted emissions in this out-of-band domain, no measurement of the IMT-2020 antenna pattern in adjacent bands and also concluded that there was no information about the foreseen deployment of IMT-2020 UEs with respect to vehicles for these bands. Notwithstanding that, the study concluded that an unwanted emission limit more stringent than -30 dB(m/MHz) (i.e. -60 dB(W/MHz)) (equivalent to more than 17 dB additional isolation) for both BS and UE is necessary to protect automotive radars in the RLS in the frequency band 76-77 GHz.

2/1.13/3.2.10.3 FSS

A statistical aggregate interference study from the IMT BSs towards FSS earth stations was performed in the 71-76 GHz frequency band. The results showed that with the separation distance of 250 m around the FSS earth station, the aggregate interference level does not exceed the FSS long-term interference threshold, based on the assumptions and input parameters used in this study.

Therefore, according to the results of the study where a long-term interference threshold was applied, it can be assumed that coexistence between IMT-2020 and FSS in the 71-76 GHz band is feasible.

2/1.13/3.2.11 Frequency range 81-86 GHz

The frequency range 81-86 GHz, or parts thereof, is allocated to the FS, FSS, MS, MSS and RAS. The frequency bands adjacent to this frequency range are allocated to the ARS, ARSS, EESS (passive), RAS, RLS and SRS (passive). The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the FS, FSS, RAS (in band and adjacent band), EESS (passive) and RLS and are summarized in the subsections below. Characteristics were not received for the ARS and ARSS and therefore, studies were not carried out for these services. Studies are not needed for the SRS (passive), as this service is dealing with sensors around other planets and no interference issue is expected. Studies were also not carried out for the MSS.

2/1.13/3.2.11.1 EESS (passive)

Three studies were received in relation to the compatibility between IMT-2020 in the 81-86 GHz frequency band and the EESS (passive) in the frequency band 86-92 GHz. The results in the tables below are expressed as:

- interference exceedance relative to the EESS (passive) protection criteria ($-169 \text{ dB(W/100 MHz)}$) based on the IMT-2020 parameters provided; and
- corresponding unwanted emission levels to protect the EESS (passive).

The results below are based on the most restrictive Sensor L3.

Studies A and C considered the IMT single element antenna pattern of Recommendation ITU-R M.2101 and led to the following results for Sensor L3:

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/100 MHz)) for: | |
|-------|---|--|-------|
| | | UE | BS |
| A | 23.6 dB (assuming normalization of antenna pattern, apportionment of the EESS protection criteria and multi-operator interference factors) | -43.5 | -43.6 |
| C | 11.3 | -31.2 | -31.3 |

In addition, Study A performed a sensitivity analysis considering a population-based redistribution of the IMT-2020 BSs (capped to a maximum of 10 BS/km²) and led to the following results for Sensor L3 (assuming normalization of antenna pattern, apportionment of EESS protection criteria, and multi-operator interference factors):

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/100 MHz)) for: | |
|-------|------------------------------|--|-------|
| | | UE | BS |
| A | 29.9 | -49.8 | -49.9 |

Study C performed a sensitivity analysis using a beamforming antenna model in the unwanted emission domain. In the absence of IMT-2020 antenna measurement data it was agreed in TG 5/1 that:

- the antenna pattern may remain beamformed to some extent in the adjacent frequency band;
- the Recommendation ITU-R M.2101 model applicable to beamforming gain may in that case underestimate the side-lobe levels (e.g. some simulations have shown that, for an 8×8 array simplified AAS antenna design model with one slant dipole elements, the Recommendation ITU-R M.2101 model appears to be a reasonable match for the side lobes closest to the main beam, but side lobes further from the main beam would be underestimated by this model);
- the “variance” of the interference distribution is much wider compared to the use of a single element pattern and hence a conclusion on the average interference would not be appropriate.

Study C performed a sensitivity analysis using a beamforming antenna model in the unwanted emission domain (not considering normalization of antenna pattern, apportionment of EESS protection criteria nor multi-operator interference factors) and led to the following results for Sensor L3:

| Study | Interference exceedance (dB) | Level of unwanted emissions to protect EESS (passive) (dB(W/100 MHz)) for: | |
|-------|------------------------------|--|-----|
| | | UE | BS |
| C | -1.3 | -19.9 | -20 |

2/1.13/3.2.11.2 FS

In-band sharing studies were conducted between the FS and IMT systems in the frequency band 81-86 GHz.

Statistical studies for a single-entry case for different antenna heights of the FS receiver (from 10 to 40 metres) showed that a protection distance of 250 to 950 metres will ensure that the protection criteria are met. Alternatively, with a protection distance of 250 metres with a proper deployment on azimuth offset of antenna boresight between IMT BS and the FS receiver (from $\pm 10^\circ$ to 0°), the protection criterion will also be met.

Statistical studies for the aggregate case showed that aggregate interference will decrease with the increase of the distance between the IMT network centre and the FS receiver for certain antenna heights. The protection distance from 0 m (IMT BS located below the FS receiver) to 710 m (for different antenna heights of the FS receiver from 40 to 10 metre) would be needed.

2/1.13/3.2.11.3 RAS (in-band)

Two sharing studies between the RAS and IMT in the frequency band 81-86 GHz were provided to ITU-R.

Statistical results showed that if the combined aggregate interference of both BSs and user equipment is considered, separation distances were 20.5 km for a suburban only environment and ranged from 35 to 49 km for mixed urban/suburban environments. This range was mainly due to the differences in assumed polarization loss (3 or 0 dB) and clutter loss probability (average or 2%).

It should be noted that no detailed terrain profiles were used in these studies. Taking into account detailed terrain profiles around RAS stations would lead to different separation distances for RAS stations on a case-by-case basis.

2/1.13/3.2.11.4 RAS (adjacent band)

Two compatibility studies between the RAS in the frequency range 76-94 GHz and IMT in the frequency band 81-86 GHz were provided to ITU-R.

For both studies a -13 dB(m/MHz) (i.e. -43 dB(W/MHz)) level of unwanted emissions was assumed for both IMT-2020 BSs and user equipment. Statistical results show that if the combined aggregated interference of both BSs and user equipment was considered, separation distances were 1.5 km for a suburban only environment and ranged from 6 to 29 km for mixed urban/suburban environments. This range was mainly due to differences in assumed polarization loss (3 or 0 dB) and antenna gain normalization.

It should be noted that no detailed terrain profiles were used in these studies. Taking into account detailed terrain profiles around RAS stations would lead to different separation distances for RAS stations on a case-by-case basis.

2/1.13/3.2.11.5 RLS

Two studies were received which dealt with the compatibility between IMT-2020 in the frequency bands 71-76 GHz and 81-86 GHz and automotive radar in the frequency band 77-81 GHz (i.e. Radar D of Category 2 from Recommendation ITU-R M.2057). Study A gave a range of IMT unwanted emission levels that were assumed to provide appropriate protection of the automotive radars, while Study B used various IMT-2020 unwanted emission levels to assess the probability of interference.

The IMT stations' spurious emission level assumed in both studies was a constant value over the operating frequency band of automotive radars.

Study A assumed a 99% applicability of the protection criterion of $I/N = -6$ dB and did not apply antenna normalization.

Study A showed that to protect automotive radars operating in the 77-81 GHz frequency band, IMT-2020 stations need to comply with the maximum unwanted emission levels in the frequency band 77-81 GHz:

- For BS: -26.5 dB(m/MHz) (equivalent to -33 dB(W/200 MHz));
- For UE: -28 dB(m/MHz) (equivalent to -35 dB(W/200 MHz)).

The maximum additional isolation required for the IMT-2020 unwanted emissions in the frequency band 77-81 GHz for all studied cases were 13.5 dB for the BS and 15 dB for the UE.

Study B found it was not possible to define the value of the IMT-2020 unwanted emission limits appropriately taking into account information provided by the involved groups. Study B reflected that there was no model available for the roll-off of the IMT-2020 unwanted emissions in this out-of-band domain, no measurement of the IMT-2020 antenna pattern in adjacent bands and also concluded that there was no information about the foreseen deployment of IMT-2020 UEs with respect to vehicles for these bands. Notwithstanding that, the study concluded that an unwanted emission limit more stringent than -30 dBm/MHz (i.e. -60 dB(W/MHz) (equivalent to more than 17 dB additional isolation) for both BS and UE was necessary to protect automotive radars in the RLS in the frequency band 77-81 GHz.

2/1.13/3.2.11.6 FSS

Aggregate interference simulations from IMT BSs towards a FSS space station were performed in the 81-86 GHz frequency band. The results showed that the FSS long-term interference threshold was not exceeded by IMT-2020 BS deployments. Also, aggregate interference simulations from FSS earth stations towards an IMT BS were performed in the 81-86 GHz frequency band. The results showed that, with the separation distance of 250 m around the IMT BS, the aggregate interference level did not exceed the IMT BS interference threshold, based on the assumptions and input parameters used in this study.

2/1.13/4 Methods to satisfy the agenda item

Two alternatives for the IMT identification are contained in the sub-sections. Alternative 1 identifies a frequency band for the terrestrial component of IMT within the LMS. Alternative 2 identifies a frequency band for the terrestrial component of IMT. The following reasons and views are provided for these two alternatives:

Alternative 1

Reasons: It is proposed to limit the identification of IMT by the LMS due to the fact that ITU-R did not undertake sharing and compatibility studies for aeronautical and maritime deployments of IMT-2020. Such an identification provides the same status for IMT in the RR (primary allocation) as it is provided for the existing IMT systems in other frequency bands. According to ITU-R deliverables in the frequency bands above 24 GHz IMT-2020 deployment on ships and airplanes is not expected. Based on the ITU-R studies, sharing conditions developed in the CPM Report for IMT applications in the LMS could not be applicable for IMT applications in the AMS and MMS, therefore the protection of incumbent services will not be ensured.

View 1:

- *ITU-R did not conduct studies in frequency sharing and compatibility for aeronautical and maritime deployment of IMT-2020;*
- *results of ITU-R efforts show that deployment of IMT-2020 aboard aircraft and sea ships is not expected in the frequency bands above 24 GHz;*
- *Based on ITU-R study results the conditions of frequency sharing elaborated in the draft CPM text for IMT applications in LMS may not be used for IMT applications in AMS and MMS, therefore ubiquitous services would not be protected*

View 2:

For all existing IMT bands, identification has been done in a broad way, not limited to LMS. This has enabled innovative applications such as IMT on-board aircraft or on-board ships while ensuring full protection of existing services

Alternative 2

Reasons: A restriction of IMT to the LMS allocation was not felt necessary for existing IMT frequency bands and is not necessary for new IMT frequency bands since the IMT characteristics, which included deployment, are already described in ITU-R Recommendations and Reports.

View 1:

Alternative 2 allows for the operation of IMT-2020 stations within the maritime mobile service in the frequency band 24.25-27.5 GHz and the AMS in the frequency band 25.5-27.5 GHz, which contradicts with the IMT-2020 parameters provided by the responsible ITU-R group limited to LMS deployment. Sharing conditions developed in the CPM Report for IMT deployment in the LMS

could not be applicable for IMT deployment in the AMS and MMS, therefore the protection of incumbent services will not be ensured.

View 2:

For the frequency bands with existing MS allocations, as an application of the MS, IMT should not be limited to a lesser status than the rest of the MS as existing IMT identifications under the MS in the RR have never included this limitation. The AMS was not studied in the context of new MS allocations. Furthermore, any use of IMT aboard ships (i.e. in the MMS) would have low, negligible use (below that of suburban open area density), would likely be within the ship (indoors); and therefore, would not result in any appreciable difference in aggregate interference to other services.

2/1.13/4.1 Item A: Frequency band 24.25-27.5 GHz

2/1.13/4.1.1 Method A1: NOC

No change to the Radio Regulations.

2/1.13/4.1.2 Method A2: Identification of the frequency band 24.25-27.5 GHz for IMT in accordance with the following two alternatives

Alternative 1

Under this alternative, allocate the 24.25-25.25 GHz frequency band to the MS (except aeronautical mobile) on a primary basis in Regions 1 and 2 and identify the 24.25-27.5 GHz frequency band for the terrestrial component of IMT within the LMS in Regions or globally.

Alternative 2

Under this alternative, allocate the 24.25-25.25 GHz frequency band to the MS (except aeronautical mobile) on a primary basis in Regions 1 and 2 and identify the 24.25-27.5 GHz frequency band for the terrestrial component of IMT in Regions or globally.

Reasons and views related to these two alternatives are provided at the beginning of Section 4.

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies. Administrations could consider applying the IMT Resolution and/or modifications to Resolution **750 (Rev.WRC-15)**, or neither, based on the conditions selected when identifying the frequency band for IMT.

2/1.13/4.1.2.1 Condition A2a: Protection measures for the EESS (passive) in the 23.6-24 GHz frequency band

Option 1:

Introduce in Table 1-1 of Resolution **750 (Rev.WRC-19)** limits on unwanted emissions in the frequency band 23.6-24 GHz from IMT BSs and IMT mobile stations within the 24.25-27.5 GHz frequency band (see Section 2/1.13/3.2.1) and add a cross-reference to Resolution **750 (Rev.WRC-19)** in the RR footnote that identifies the frequency band for IMT and revise RR No. **5.338A** accordingly (see Section 2/1.13/5).

*Reasons: The identification of the frequency band 24.25-27.5 GHz to IMT will require limits in Resolution **750 (Rev.WRC-15)** to ensure adjacent band compatibility with the EESS (passive) in the frequency band 23.6-24.0 GHz.*

Option 2:

Introduce in Table 1-2 of Resolution **750 (Rev.WRC-19)** limits on unwanted emissions in the frequency band 23.6-24 GHz from IMT base stations and IMT mobile stations within the 24.25-27.5 GHz frequency band (see section 2/1.13/3.2.1) and add a cross-reference to Resolution **750 (Rev.WRC-19)** in the RR footnote that identifies the frequency band for IMT and revise RR No. **5.338A** accordingly (see section 2/1.13/5).

*Views were expressed that, based on results of the sharing and compatibility studies, the protection criterion for EESS passive sensors would be exceeded, therefore mandatory limits for unwanted emissions of IMT stations would be required to ensure the protection of the EESS (passive) in the frequency band 23.6-24 GHz. Introduction of recommended limits in Table 1-2 of Resolution **750 (Rev.WRC-15)** would not ensure the protection of the EESS (passive) in the frequency band 23.6-24 GHz.*

Option 3:

To develop a WRC Recommendation to include limits on unwanted emissions in the frequency band 23.6-24 GHz from IMT BSs and IMT mobile stations within the 24.25-27.5 GHz frequency band, as appropriate. If RA-19 adopts an ITU-R Recommendation on this issue, the WRC Recommendation described in this option might not be required anymore.

Reasons: The proposed limits on unwanted emissions in the frequency band 23.6-24 GHz from IMT BSs and IMT mobile stations within the 24.25-27.5 GHz frequency band are adequate to protect the existing passive services operating in the 23.6-24.0 GHz band, noting a 250 MHz guardband from the active service band 24.25-27.5 GHz.

Views were expressed that based on experience from WRC-15 this option does not properly address the issue.

Views were expressed that this option contradicts all the ITU-R sharing studies that show that an unwanted emission limit is required to protect EESS passive in the adjacent frequency band 23.6-24 GHz. This limit needs to be mandatory. Recommendations are non-binding and will not ensure the protection of EESS passive.

Views were expressed that, based on results of the sharing and compatibility studies, the protection criterion for EESS passive sensors would be exceeded, therefore mandatory limits for unwanted emissions of IMT stations would be required to ensure the protection of the EESS (passive) in the frequency band 23.6-24 GHz. Recommended limits in WRC Recommendation or ITU-R Recommendation would not ensure the protection of the EESS (passive) in the frequency band 23.6-24 GHz. Reasons, provided for this option do not explain why WRC Recommendation or ITU-R Recommendation is appropriate to protect EESS (passive) sensors.

Option 4:

To develop a WRC Recommendation to include limits on unwanted emissions in the frequency band 23.6-24 GHz from IMT BSs and IMT mobile stations within the 24.25-27.5 GHz frequency band, as appropriate. Table 1-2 of Resolution **750 (Rev.WRC-15)** on “Recommended maximum level of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band” to be shifted to this draft new Recommendation, and to delete Table 1-2 from Resolution **750 (Rev.WRC-15)**. If RA-19 adopts an ITU-R Recommendation on this issue, the WRC Recommendation described in this option might not be required anymore.

Reasons: The proposed limits on unwanted emissions in the frequency band 23.6-24 GHz from IMT BSs and IMT mobile stations within the 24.25-27.5 GHz frequency band are adequate to protect the

existing passive services operating in the 23.6-24.0 GHz band, noting a 250 MHz guardband from the active service band 24.25-27.5 GHz.

Reasons: Table 1-2 of Resolution 750 (Rev.WRC-15) on “Recommended maximum level of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band” need to be shifted from Resolution 750 to new Recommendation since this table provides recommended values and not mandatory limits as in Table 1-1 of the same Resolution 750. As per resolves 2 of Resolution 750 (which is associated with this Table 1-2)

2 to urge administrations to take all reasonable steps to ensure that unwanted emissions of active service stations in the frequency bands and services listed in Table 1-2 below do not exceed the recommended maximum levels contained in that table, noting that EESS (passive) sensors provide worldwide measurements that benefit all countries, even if these sensors are not operated by their country;

This modification to Resolution 750, Table 1-2, is important to correct this confusion of making Recommendation within Resolution. In addition, this new Recommendation will include unwanted emission limit for IMT to protect EESS.

Views were expressed that based on experience from WRC-15 this option does not properly address the issue.

Views were expressed that this option contradicts all the ITU-R sharing studies that show that an unwanted emission limit is required to protect EESS passive. This limit needs to be mandatory. Recommendations are non-binding and will not ensure the protection of EESS passive. This option is also deleting Table 1-2 from Resolution 750 (Rev.WRC-15) which is outside the scope of agenda item 1.13.

Views were expressed that the proposal, under A2a Option 4, to move Table 1-2 from Resolution 750 into a new WRC Recommendation is not in the scope of Resolution 238 (WRC-15) and agenda item 1.13. This is because Table 1-2 relates to numerous bands and services that were not considered under agenda item 1.13. In addition to this, the unwanted emission limits in Table 1-2 are recommended only. Moving Table 1-2 to a WRC Recommendation would not change this fact and is therefore unnecessary. However, such a move would require changes to all the footnotes, articles or other parts of the RR that reference Table 1-2. These changes have not yet been identified by the proponents of this option.

Views were expressed that, based on results of the sharing and compatibility studies, the protection criterion for EESS passive sensors would be exceeded, therefore mandatory limits for unwanted emissions of IMT stations would be required to ensure the protection of the EESS (passive) in the frequency band 23.6-24 GHz. Recommended limits in WRC Recommendation would not ensure the protection of the EESS (passive) in the frequency band 23.6-24 GHz. Transition of recommended limits of unwanted emission from Table 1-2 of Resolution 750 (Rev.WRC-15) into WRC Recommendation falls outside the scope of Resolution 238 (WRC-15) and may drastically change interference environment for EESS passive sensors in the subject frequency bands. Reasons, provided for this option do not explain why WRC Recommendation is appropriate to protect EESS (passive) sensors.

View:

This option called for a number of concerns, and was requested to be deleted from the CPM Text.

Option 4 is in TOTAL CONTRADICTION with WRC-19 agenda item 1.13 and Resolution 238 (WRC-15). This agenda item addresses IMT-2020 in the following band:

- 24.25-27.5 GHz, 37-40.5 GHz, 42.5-43.5 GHz, 45.5-47 GHz, 47.2-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz and 81-86 GHz, which have allocations to the mobile service on a primary basis; and
- 31.8-33.4 GHz, 40.5-42.5 GHz and 47-47.2 GHz, which may require additional allocations to the mobile service on a primary basis.

The proposal to remove Table 1-2 from Resolution 750 (Rev.WRC-15) impact provisions to ensure protection of EESS (passive) in a number of compatibility scenarios that are neither related to the mobile services or IMT systems in the bands above, namely covering the following cases:

- *Protection of the EESS (passive) in the 1 400-1 427 MHz band from the radiolocation, fixed and mobile services in the 1 350-1 400 MHz band.*
- *Protection of the EESS (passive) in the 1 400-1 427 MHz band from the space operation (E-to-s) service in the 1 427-1 429 MHz band.*
- *Protection of the EESS (passive) in the 1 400-1 427 MHz band from the fixed and mobile (except aeronautical mobile) services in the 1 427-1 429 MHz band.*
- *Protection of the EESS (passive) in the 1 400-1 427 MHz band from the fixed and mobile services in the 1 429-1 452 MHz band.*
- *Protection of the EESS (passive) in the 31.3-31.5 GHz band from the fixed satellite service in the 31-31.3 GHz band.*
- *Protection of the EESS (passive) in the 86-92 GHz band from the fixed service in the 81-86 GHz band.*
- *Protection of the EESS (passive) in the 86-92 GHz band from the fixed service in the 92-94 GHz band.*

None of these cases are consistent with WRC-19 agenda item 1.13 and Resolution 238 (WRC-15) and there are hence no justification to propose deletion of Table 1-2 as an option in the CPM text on agenda item 1.13.

In addition, such proposal was never presented in ITU-R and was hence not studied at all. It is therefore introduced in section 4 of the CPM Text (Methods) without any reference to section 3 dealing with the results of studies, i.e. without any idea of the potential consequences on EESS (passive).

Resolution 750 is one of the most essential tools in Radio Regulations to ensure the protection of EESS (passive). It was agreed at WRC-07 after years of studies in ITU-R and careful regulatory considerations and the World Meteorological Organization will have strong objection to see any modification to this Resolution without any study, in particular at WRC-19 that is not mandated to do so.

Finally, it has to be highlighted that this Option 4 is far from being complete. The proposed “Regulatory and procedural considerations” related to this option are missing a large number of necessary elements such as the necessary revisions of Resolution 750 itself, the necessary revisions of RR No. 5.338A and the consequential revisions to Article 5 where RR No. 5.338A is referred to.

This Option 4 is therefore strongly objected.

Option 5:

No condition is necessary.

Reasons: The emission limits defined in the IMT-2020 parameters are adequate to protect the existing passive services operating in the 23.6-24.0 GHz band, noting a 250 MHz guardband from the active service band 24.25-27.5 GHz. Therefore no further conditions are necessary.

Views were expressed that Option 5 contradicts the results of all sharing and compatibility studies presented in ITU-R and does not provide protection to the EESS (passive) in the adjacent frequency band 23.6-24 GHz.

Views were expressed that the regulatory implementation in Options 3, 4 and 5 does not provide protection to the EESS (passive) in the adjacent frequency band 23.6-24 GHz, within which all emissions are prohibited according to footnote RR No. 5.340.

2/1.13/4.1.2.2 Condition A2b: Protection measures for the EESS (passive) in the 50.2-50.4 GHz and 52.6-54.25 GHz frequency bands

Option 1:

Introduce in Table 1-1 of Resolution **750 (Rev.WRC-15)** limits on unwanted emissions in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz from IMT BSs and IMT mobile stations in the frequency band 24.25-27.5 GHz or part thereof.

Add a cross-reference to Resolution **750 (Rev.WRC-15)** in the RR footnote that identifies the frequency band for IMT, and add the 24.25-27.5 GHz frequency band or part thereof to RR No. **5.338A**.

*Views were expressed that unwanted emissions limits for IMT in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz to protect the EESS (passive) derived from the results of the ITU-R compatibility studies (see Section 3) are more stringent than the generic ones from Recommendation ITU-R SM.329. Therefore, mandatory limits of unwanted emissions shall be included into Table 1-1 of Resolution **750 (Rev.WRC-15)**.*

Option 2:

State in a *considering* of the WRC Resolution corresponding to the IMT identification of this frequency band that spurious emission limits of Recommendation ITU-R SM.329 Category B are sufficient to protect the EESS (passive) from the second harmonic of IMT BS emissions in the 26 GHz frequency band.

Reasons: Studies have shown that Category B limits (-30 dB(m/MHz), i.e. -60 dB(W/MHz)) could be considered as sufficient to protect the EESS second harmonic. By stating it in the WRC Resolution would give the adequate rationale for ITU-R and standardization body to ensure that the applicable spurious limit would be compliant.

*Views were expressed that this regulatory option is not based on any sharing and compatibility study. Category B limits in an ITU-R Recommendation do not apply worldwide and may not provide protection to the EESS (passive) in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz, which contradicts the objectives of Resolution **238 (WRC-15)**.*

Views were expressed that conditions related to the second harmonic should be introduced as a requirement in the “resolves” part of the Resolution instead of in the “considering” part.

Option 3:

No condition is necessary.

View 1:

This option contradicts the sharing and compatibility study of ITU-R (see Section 2/1.13/3.2.1.2.1) showing that the more stringent limits to protect the EESS (passive) than the generic ones from Recommendation ITU-R SM.329 are required.

View 2:

No ITU-R studies were performed on the second harmonic that conclusively showed that any additional protections were needed beyond those already specified in relevant ITU-R recommendations on IMT out-of-band emission limits.

View 3:

Imposing limits on unwanted emissions at a separation of 22.7 GHz would create a far-reaching and problematic precedent that would impact all active services operating at one half of any of the frequency bands listed in footnote RR No. 5.340. The protection of the EESS (passive) in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz from emissions below 27.5 GHz is addressed by the existing generic spurious emission limits, as described in Recommendation ITU-R SM.329. Furthermore, footnote RR No. 5.340.1 provides that “The allocation to the Earth exploration-satellite service (passive) and the space research service (passive) in the band 50.2-50.4 GHz should not impose undue constraints on the use of the adjacent bands by the primary allocated services in those bands. (WRC-97).” Although not an immediately adjacent frequency band, imposition of technical rules 22.7 GHz away is inconsistent with the intent of RR No. 5.340.1.

2/1.13/4.1.2.3 Condition A2c: Protection measures for earth stations in the SRS/EESS (25.5-27 GHz (space-to-Earth))

Option 1:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- a) to invite ITU-R to develop an ITU-R Recommendation to assist administrations in protecting existing and future SRS/EESS earth stations operating in the frequency band 25.5-27 GHz;
- b) in addition, administrations should be invited to adopt provisions to protect other services from IMT networks and to ensure the possibility of deploying future SRS/EESS earth stations.

Reasons: Studies have shown that the interference distance remains limited (i.e. a few km for the EESS and a few tens of km for the SRS), i.e. the issue will be mainly on a national level. For cross-border protection of earth stations, coordination procedures in RR Articles 9 and 11 would apply. The ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations. The reference to future SRS/EESS earth station responds to Resolution 238 (WRC-15), which emphasizes the need “to take into account the need to ensure the protection of existing earth stations and the deployment of future receiving earth stations under the EESS (space-to-Earth) and SRS (space-to-Earth) allocation in the frequency band 25.5-27 GHz”.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

In addition to Option 1, modify RR Nos. 5.536A, 5.536B and 5.536C so that these provisions do not apply to IMT stations.

View 1:

In relation to the compatibility between IMT-2020 and SRS/EESS earth stations, provisions RR Nos. 5.536A, 5.536B and 5.536C should either be revised or deleted, taking into account footnote 2 of Resolution 238 (WRC-15).

View 2:

The revision or deletion of RR Nos. 5.536A, 5.536B and 5.536C is outside of the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15).

Option 3:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- a) to invite ITU-R to develop an ITU-R Recommendation to assist administrations in protecting existing and future SRS/EESS earth stations operating in the frequency band 25.5-27 GHz and incorporate this Recommendation into the RR by reference;

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 4:

Protection of other services (in-band and/or adjacent band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Option 5:

No condition is necessary.

View 1:

No condition option does not ensure the protection of existing earth stations and the deployment of future receiving earth stations under the EEES (space-to-Earth) and SRS (space-to-Earth) allocation in the frequency band 25.5-27 GHz, which contradicts the objectives of Resolution 238 (WRC-15).

View 2:

The results of studies indicate coordination distances that pertain to national matters, and thus no conditions are necessary to ensure the protection of earth stations of the SRS/EEES, and RR Articles 9 and 11 should not apply.

2/1.13/4.1.2.4 Condition A2d: Measures related to transmitting earth stations in the FSS (Earth-to-space) at known locations

Option 1:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- a) to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency bands 24.65-25.25 and 27-27.5 GHz;
- b) in addition, administrations should be invited to adopt provisions to ensure the possibility of deploying future FSS earth stations.

Reasons: Studies have shown that the interference distance remains limited (i.e. a few km), i.e. the issue will be mainly on a national level. For cross-border coordination, procedures in RR Articles 9 and 11 would apply. The ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

a) to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency bands 24.65-25.25 and 27-27.5 GHz and incorporate this Recommendation into the RR by reference.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 3:

Protection of other services (in-band and/or adjacent band) by IMT should be contained in a WRC Resolution, cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Option 4:

No condition is necessary.

View 1:

Option 4 does not ensure the evolving needs of the primary FSS, and may impose constraints on FSS earth station deployment, which contradicts the objectives of Resolution 238 (WRC-15).

View 2:

Sharing and compatibility are feasible based on the FSS earth station characteristics, including current/future deployment, provided by the ITU-R involved group. In addition, since IMT is the victim of interference, no FSS earth station uplink protection conditions are needed as this is a matter for the national authority.

2/1.13/4.1.2.5 Condition A2e: Protection measures for the ISS and FSS (Earth-to-space) receiving space stations

Option 1:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- A mandatory limit on the maximum total radiated power (TRP) of IMT BSs of [25/28/31/37] dB(m/200 MHz), i.e. [−5/−2/1/7] dB(W/200 MHz).
- Requiring to take all possible measures to avoid the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal.
- Requiring that the mechanical tilt of IMT BSs be below −10 degrees relative to the horizon with the IMT BS antenna pattern being kept within the limits of approximation envelope according to Recommendation ITU-R M.2101 provisions.
- In addition, administrations should be invited to adopt provisions to limit the maximum density of 1 200 BSs per 10 000 km² for outdoor hot spots within its territory. In case

when area of an administration is lesser than 10 000 km² the number of IMT BS should be reduced proportionally.

Views were expressed that restricting the density of BSs per km² would be difficult for administrations to implement. In addition, it is unclear which reference will be used for calculating the density. Moreover, the relevant area in terms of interference would depend on each satellite footprint, which could cover the territory of multiple administrations.

Other views were expressed that studies show that sharing is feasible based on typical deployment of IMT, therefore all those typical assumptions should not be reflected to mandatory limits as regulatory options.

View:

The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS. Therefore there is no need for the implementation of TRP limits.

View:

The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS and RR No. 21.5 already provides appropriate limits

Option 2:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- A mandatory limit on the total radiated power (TRP) of IMT BSs of [37/40/46] dB(m/200 MHz), i.e. [7/10/16] dB(W/200 MHz).
- Requiring to take all possible measures to avoid the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal.

Different views were expressed regarding the compliance of the above TRP limits with provision RR No. 21.5. One view is that any TRP value above 40 dB(m/200 MHz) does not comply with provision RR No. 21.5. Another view is that the existing provision RR No. 21.5 introduced at WRC-2000 does not reflect current technologies for IMT. In this regard, revision of provision RR No. 21.5 may be required at WRC-19.

View:

The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS. Therefore there is no need for the implementation of TRP limits.

View:

The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS and RR No. 21.5 already provides appropriate limits.

Option 3:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- A mandatory limit on the maximum total radiated power (TRP) of IMT BSs of [25/28/31/37] dB(m/200 MHz), i.e. [−5/−2/1/7] dB(W/200 MHz).
- Requiring that the mechanical tilt of IMT BSs shall be below −10 degrees below the horizon and the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal.
- Antenna pattern shall comply with Recommendation ITU-R M.2101.

Views were expressed that studies show that sharing is feasible based on typical deployment of IMT, therefore all those typical assumptions should not be reflected to mandatory limits as regulatory options.

View:

The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS. Therefore there is no need for the implementation of TRP limits.

View:

The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS.

Option 4:

Alternatively to Options 1, 2 and 3, the elements contained in these options could also be included in a WRC Recommendation.

Views were expressed that based on experience from WRC-15 this option does not properly address the issue.

Option 5:

- Requiring that when deploying outdoor BSs, all possible measures shall be taken to avoid pointing the main beam of each transmitting antenna above the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the antenna of BS is only receiving.

View:

This option is excessively restrictive and is not in line with the results of the sharing studies conducted in TG 5/1. This option does not allow a limited number of indoor terminals with positive elevations. In contrast, Option 6 below allows flexibility for practical IMT deployments. TG 5/1 studies assumed that most BSs are pointing to terminals on the ground and that some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found large positive margins under these assumptions.

Option 6:

- Requiring that when deploying outdoor BSs, it shall be ensured that each antenna is normally¹⁰ transmitting only with the main beam pointing below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the BS is only receiving.

Reasons: Studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, provisions are needed, which are consistent with the assumptions. It is implementable and enforceable by including them in the licence conditions.

View 1:

The condition for main beam pointing is not implementable and could not be enforced by administrations due to the word “normally” used when defining main beam pointing limits. Moreover, the TRP value and antenna pattern of the IMT BS in this option is not defined and in practice any TRP and antenna pattern for the IMT BS could be used. When emissions of an IMT BS in skyward direction will be higher than assumed in the ITU-R studies (TRP 25 dB(m/200 MHz), i.e. –5 dB(W/200 MHz), and an antenna in line with Recommendation ITU-R M.2101), this option will not protect the ISS and FSS.

¹⁰ It is assumed that only a very limited number of indoor terminals with positive elevation will be communicating with base stations.

Option 7:

- To introduce in the Radio Regulations an angular e.i.r.p. mask for the emissions of IMT BSs in the skyward direction as described in section 2/1.13/5 (see Resolution [A113-IMT 26 GHz]).

Reasons: The e.i.r.p. mask is based on a sharing and compatibility study and ensures protection of the ISS and FSS, while providing flexibility for IMT-2020 deployments (there are no separate limits for the mechanical downtilt and e-tilt angles, as well as fixed TRP values), and it is implementable since there are existing examples of the application of off-axis gain limits in the Radio Regulations and ITU-R Recommendations. Moreover the e.i.r.p. mask is fully in line with the IMT parameters provided by the ITU-R responsible group and does not introduce any additional restriction than the assumed parameters and assumptions developed by ITU-R.

Views were expressed that such an angular e.i.r.p. mask would be extremely complicated to implement with active antennas. The analysis that supports this mask is unclear and it is noted that all BSs would need to be pointing in the skyward direction towards the FSS space station, which is unlikely to be representative of IMT deployments. The interference potential depends mainly on the number of simultaneous cases where there is emission in the skyward direction. The e.i.r.p. mask would be unduly restrictive.

Views were expressed that the interference potential depends mainly on the number of simultaneous cases where there is e.i.r.p. high level emission in the skyward direction. The e.i.r.p. mask would restrict occurrence of such situations.

Views were expressed that this regulatory option is not based on any sharing and compatibility study.

Option 8:

- Introducing in the Radio Regulations mandatory efd[↑] limits at the geostationary-satellite orbit by emissions from all the IMT BSs in the territory of an administration implementing IMT system(s) in the frequency band 24.25-27.5 GHz.

Views were expressed that such an efd limit would be extremely complicated to implement. In addition, the methodology which is proposed, does not take into account that there will be a variety of BSs and terminals with evolving characteristics in the satellite footprint. Such a footprint may also cover the territory of several countries, which adds an additional difficulty to the implementation of this requirement.

Option 9:

No condition is necessary.

Reasons: These regulatory options are not necessary since studies show that sharing is feasible without any additional mandatory limits.

View 1:

This option contradicts the results of sharing and compatibility studies, which were based on limitations of the IMT-2020 e.i.r.p. and the assumption that the elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees. The impact of the IMT-2020 BS antenna main beam, pointing in the upper hemisphere without any e.i.r.p. limit, was not assessed. This option would allow IMT operations that have not been studied by ITU-R. This option does not ensure the protection of the ISS and FSS as studies have not demonstrated that the margin would remain positive if neither power limits nor pointing limitations were applied to IMT base stations.

2/1.13/4.1.2.6 Condition A2f: Protection measures for the RAS (23.6-24 GHz)

Option 1:

Inviting ITU-R in the WRC Resolution corresponding to the IMT identification of this frequency band to update existing ITU-R Recommendations or develop new ITU-R Recommendations or Reports, as appropriate, to provide information on possible coordination and protection measures to assist the administrations in this matter.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Option 3:

No condition is necessary.

2/1.13/4.1.2.7 Condition A2g: Protection measures for multiple services

In addition to the options and associated alternatives for protection measures of the different services as described above, additional options are suggested.

Option 1:

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. 9.21 in the corresponding footnote.

View 1:

There are no criteria for the BR to identify concerned administrations and the application of RR No. 9.21 would create an undue burden on administrations and on the BR. It is not implementable and enforceable.

View 2:

Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.

Option 2:

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

Views were expressed that there are no criteria to identify concerned administrations nor a procedure to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.

Option 3:

To invite ITU-R to regularly review the impact of the evolution of IMT technical and operational characteristics (including deployment and base-station density) on sharing and compatibility with other services (e.g. space services) and, as necessary, to take into account the results of these

reviews in the development or revision of ITU-R Recommendations/Reports, e.g. on IMT characteristics.

Views were expressed that ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business, and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15).

Views were expressed that further clarifications are required on the applicability of the implementation and the appropriate course of action is yet to be developed.

Option 4:

To invite ITU-R to regularly update characteristics of IMT deployments (including BS density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments with reporting through BR Director on the results to WRC. This would enable ITU-R to recommend corrective measures to address situations whereby the interference threshold of space stations would be at risk to be exceeded.

Views were expressed that ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business, and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15).

Views were expressed that further clarifications are required on the applicability of the implementation and the appropriate course of action is yet to be developed.

Option 5:

No condition is necessary.

View 1:

Option 4 does not provide protection for incumbent services if Conditions A2a to A2f to protect specific services do not apply.

View 2:

The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbents services, thus there is no need for the addition of some of the conditions indicated in Conditions A2a-A2f.

2/1.13/4.2 Item B: Frequency band 31.8-33.4 GHz

2/1.13/4.2.1 Method B1: NOC

No change to the Radio Regulations due to sharing and compatibility study results between IMT systems and radionavigation systems showing their incompatibility.

2/1.13/4.3 Item C: Frequency band 37-40.5 GHz

2/1.13/4.3.1 Method C1: NOC

No change to the Radio Regulations.

2/1.13/4.3.2 Method C2: Identification of the frequency band 37-40.5 GHz for IMT in accordance with the following two alternatives

Alternative 1

Under this alternative, identify the 37-40.5 GHz frequency band for the terrestrial component of IMT within the LMS in Regions or globally.

Alternative 2

Under this alternative, identify the 37-40.5 GHz frequency band for the terrestrial component of IMT in Regions or globally.

Reasons and views related to these two alternatives are provided at the beginning of section 4.

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies. Administrations could consider applying the IMT Resolution based on the conditions selected when identifying the band for IMT.

2/1.13/4.3.2.1 Condition C2a: Protection measures for the EESS (passive) in the 36-37 GHz frequency band

Option 1:

Introduce mandatory limits on unwanted emissions in the frequency band 36-37 GHz from IMT BSs and IMT mobile stations within the 37-40.5 GHz frequency band in the WRC Resolution corresponding to the IMT identification of this frequency band.

Reasons: Based on results of the sharing and compatibility studies, the protection criterion for EESS passive sensors would be exceeded, therefore mandatory limits for unwanted emissions of IMT stations would be required to ensure the protection of the EESS (passive) in the frequency band 36-37 GHz. Currently, Resolution 750 (Rev.WRC-15) contains only unwanted emission limits for the frequency bands allocated to the EESS (passive), subject to RR No. 5.340 (no active services in the frequency band), which is not the case for the 36-37 GHz frequency band, shared by the EESS (passive) with the FS and MS. In order to avoid possible discrepancies, it is proposed to introduce the above limits in a Resolution, corresponding to the IMT identification. The in-band output power limit (−10 dBW), established in Resolution 752 (WRC-07) for stations in the MS was specified for low-density terrestrial deployments and is not applicable for IMT deployments.

Option 2:

No condition is necessary.

Reasons: Compatibility with EESS (passive) systems operating in the frequency band 36-37 GHz may require that IMT systems comply with some unwanted emission levels. However, the frequency band 36-37 GHz is also allocated on a primary basis to the MS and FS; and, coexistence conditions with the EESS (passive) are currently addressed in Resolution 752 (WRC-07). Thus, EESS (passive) observations in this frequency band already have to accept a certain level of interference. Therefore, it does not seem appropriate to include this frequency band in Resolution 750 (Rev.WRC-15).

Views were expressed that Option 2 (No condition) contradicts the results of the sharing and compatibility studies, showing that the protection criterion for EESS passive sensors would be exceeded. The in-band output power limit (−10 dBW), established in Resolution 752 (WRC-07) for stations in the MS was specified for low-density terrestrial deployments and is not applicable for

IMT deployments, therefore the protection of the EESS (passive) in the adjacent frequency band 36-37 GHz would not be ensured.

2/1.13/4.3.2.2 Condition C2b: Protection measures for the FSS (space-to-Earth)

Option 1:

In a WRC Resolution:

- invite administrations to ensure the necessary balance in the frequency bands 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the MS and FSS, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. high-density applications in the fixed-satellite service (HDFS)) and spectrum available for gateway earth stations;
- to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations from IMT deployments in neighbouring countries;
- in addition, administrations are invited to apply this Recommendation when they decide to protect FSS earth stations from IMT networks and to ensure the possibility of deploying future gateway earth stations.

Reasons: Studies have shown that the separation distance for interference-free operation of FSS earth stations is small (i.e. few km) and the issue will be mainly at a national level. For cross-border coordination, procedures in RR Articles 9 and 11 would apply. ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations.

Views were expressed that for cross-border protection of earth stations, coordination procedures in RR Articles 9 and 11 would apply. ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation which does not have sufficient legal force as it is based on an optional concept nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking, as it does not have legal and procedural support and in no way would address the protection of services of other administrations due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity or otherwise of that decision, if such decision is made unilaterally. In case that the interfering administration does not respond to the invitation, then the protection of the victim service would be put at the mercy of the interfering service.

Views were expressed that protection of FSS earth stations is already covered by RR Articles 9 and 11 and does not need to be covered in other regulatory text. In addition, this option is ambiguous and does not provide any methodology for identifying affected administrations.

Option 3:

For the 37.5-39.5 GHz frequency band: In a WRC Resolution:

- to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations from IMT deployments in neighbouring countries;
- in addition, administrations are invited to apply this Recommendation when they decide to protect FSS earth stations from IMT networks and to ensure the possibility of deploying future gateway earth stations.

For the 39.5-40.5 GHz frequency band: In the footnote containing the IMT identification, administrations should take into account potential constraints to IMT in the frequency band, as appropriate, because of the potential deployment of high-density applications in the FSS in the frequency band 39.5-42 GHz as per RR No. **5.516B**.

In addition, administrations should be invited to ensure the necessary balance in the frequency bands 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the FSS, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. HDFSS) and spectrum available for gateway earth stations.

Reasons: As recognized in the summary of studies, sharing between earth stations at unspecified locations (such as is the case for HDFSS) and IMT may or may not be possible on a case-by-case basis. As such, this option calls for administrations to take that into account and consider potential constraints to IMT, as appropriate, to ensure FSS/IMT compatibility.

*Views were expressed that studies have shown that sharing is feasible between IMT and the FSS. Furthermore, RR No. **5.516B** states that the identification of this frequency band for the HDFSS does not preclude the use of these frequency bands by other services and does not establish priority in the Radio Regulations among the users of these frequency bands. Therefore, a new footnote providing a higher status to the FSS would be in contravention of RR No. **5.516B** and is not appropriate.*

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 4:

In the footnote containing the IMT identification, administrations should take into account potential constraints to IMT in the frequency band, as appropriate, because of the potential deployment of high-density applications in the FSS in the frequency band 39.5-42 GHz as per RR No. **5.516B**.

Option 5:

In the footnote containing the IMT identification, specify that IMT operations should not impede the deployment and use of high-density applications in the fixed-satellite service in the frequency band 39.5-42 GHz as per RR No. **5.516B**.

*A view was expressed that RR No. **5.516B** states that the identification of this frequency band for the HDFSS does not preclude the use of these frequency bands by other services and does not*

establish priority in the Radio Regulations among the users of these frequency bands. Therefore, a new footnote providing a higher status to the FSS would be in contravention of RR No. 5.516B and is not appropriate.

View:

Elevating the status of HDFSS to give it priority over the mobile service (i.e. making it super primary) is inappropriate and outside the scope of agenda item 1.13.

Option 6:

No condition is necessary.

Reasons: Studies have shown that sharing is feasible between IMT and the FSS as outlined in section 2/1.13/3.

2/1.13/4.3.2.3 Condition C2c: Protection measures for the SRS (space-to-Earth)

Option 1:

Develop a WRC Resolution to:

- a) invite ITU-R to develop after WRC-19 an ITU-R Recommendation to assist administrations in ensuring protection of existing and future SRS earth stations operating in the frequency band 37-38 GHz taking into account the required protection criteria;
- b) invite administrations to adopt on a national level provisions to ensure the possibility of deploying future earth stations in the SRS (space-to-Earth).

Reasons: Studies have shown that the separation distance for interference-free operation of SRS (space-to-Earth) earth stations is low and the issue will be mainly at a national level. For cross-border protection of earth stations, coordination procedures in RR Articles 9 and 11 would apply. ITU-R Recommendations would therefore help administrations during the coordination process and for national considerations.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Option 3:

No condition is necessary.

Reasons: Studies have shown that the separation distances are small and could be considered a national issue.

Views were expressed that no condition option contradicts results of sharing and compatibility studies and does not ensure the protection of existing earth stations and the deployment of future receiving earth stations under the SRS (space-to-Earth) allocation in the frequency band 37-38 GHz, which contradicts the objectives of Resolution 238 (WRC-15).

2/1.13/4.3.2.4 Condition C2d: Measures for the SRS (Earth-to-space) and EESS (Earth-to-space)

Option 1:

To introduce RR provisions that IMT-2020 systems operating in the frequency band 37-40.5 GHz shall not claim protection from emissions of SRS (Earth-to-space) and EESS (Earth-to-space) earth stations operating in the frequency band 40-40.5 GHz to ensure future development of the SRS (Earth-to-space) and EESS (Earth-to-space).

Option 2:

No condition is necessary.

Reasons: The mobile service has an existing co-primary allocation providing equal status to the SRS and EESS. Sharing with earth stations in the SRS (Earth-to-space) and EESS (Earth-to-space) are addressed by existing coordination processes in the RR.

Views were expressed that no condition option is not based on any sharing and compatibility study, and may constrain deployment of future earth stations under the SRS (Earth-to-space) and EESS (Earth-to-space) allocations in the frequency band 40-40.5 GHz, which contradicts the objectives of Resolution 238 (WRC-15).

2/1.13/4.3.2.5 Condition C2e: Protection measures for multiple services

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

Option 1:

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. **9.21** in the corresponding footnote.

*Views were expressed that there are no criteria for BR to identify concerned administrations, and the application of RR No. **9.21** would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

Other views were expressed given the small interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.

Option 2:

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

Views were expressed that there are no criteria to identify concerned administrations nor procedure to apply it. This would create an undue burden on administrations and on BR. It is not implementable and enforceable.

Option 3:

No condition is necessary.

2/1.13/4.3.3 Method C3: Identification of the frequency band 37-40.5 GHz for IMT except Region 1 and provide a common 2 GHz of spectrum to the FSS throughout Region 1

Identify the 37-40.5 GHz frequency band for the terrestrial component of IMT except Region 1.

Revise RR No. **5.516B** to provide a common 2 GHz of spectrum to the FSS not shared with IMT (namely in the frequency range 37.5-39.5 GHz) throughout Region 1 that can be used for ubiquitous FSS earth stations (e.g. HDFSS).

View:

To ensure the necessary balance in the frequency bands 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the FSS, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. HDFSS) and spectrum available for gateway earth stations.

Views were expressed that the identification of new frequency ranges for the high-density fixed-satellite service (HDFSS) is not in the scope of Resolution 238 (WRC-15) and agenda item 1.13. It is not appropriate to allocate or identify new frequency ranges to other services and applications that are not within the scope of Resolution 238 (WRC-15) and agenda item 1.13. This is only for the allocation of frequency ranges to the MS and identification of IMT. Method C3 should be deleted from the CPM Report.

2/1.13/4.4 Item D: Frequency band 40.5-42.5 GHz

2/1.13/4.4.1 Method D1: NOC

No change to the Radio Regulations.

2/1.13/4.4.2 Method D2: Identification of the frequency band 40.5-42.5 GHz for IMT in accordance with the following two alternatives

Alternative 1

Under this alternative, upgrade the existing secondary allocation to the MS in the frequency band 40.5-42.5 GHz to a primary allocation in the Table of Frequency Allocations and identify the frequency band for the terrestrial component of IMT within the LMS in Regions or globally.

Alternative 2

Under this alternative, upgrade the existing secondary allocation to the MS in the frequency band 40.5-42.5 GHz to a primary allocation in the Table of Frequency Allocations and identify the frequency band for the terrestrial component of IMT in Regions or globally.

Reasons and views related to these two alternatives are provided at the beginning of section 4.

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies.

2/1.13/4.4.2.1 Condition D2a: Protection measures for the FSS (space-to-Earth)

Option 1:

In a WRC Resolution:

- invite administrations to ensure the necessary balance in the frequency bands 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the MS and FSS, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. the HDFSS) and spectrum available for gateway earth stations;

- to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations from IMT deployments in neighbouring countries;
- in addition, administrations are invited to apply this Recommendation when they decide to protect FSS earth stations from IMT networks and to ensure the possibility of deploying future gateway earth stations.

Views were expressed that for cross-border protection of earth stations, coordination procedures in RR Articles 9 and 11 would apply. ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution, cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Option 3:

In a WRC Resolution:

- to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations from IMT deployments in neighbouring countries;
- in addition, administrations are invited to apply this Recommendation when they decide to protect FSS earth stations from IMT networks and to ensure the possibility of deploying future gateway earth stations.

In the footnote containing the IMT identification, administrations should take into account potential constraints to IMT in the frequency band, as appropriate, because of the potential deployment of high-density applications in the FSS in the frequency band 39.5-42 GHz as per RR No. **5.516B**.

In addition, administrations should be invited to ensure the necessary balance in the frequency bands 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the FSS, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. the HDFSS) and spectrum available for gateway earth stations.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 4:

In the footnote containing the IMT identification, administrations should take into account potential constraints to IMT in the frequency band, as appropriate, because of the potential deployment of high-density applications in the FSS in the frequency band 39.5-42 GHz as per RR No. **5.516B**.

Option 5:

In the footnote containing the IMT identification, specify that IMT operations should not impede the deployment and use of high-density applications in the fixed-satellite service in the frequency band 39.5-42 GHz as per RR No. **5.516B**.

*A view was expressed that RR No. **5.516B** states that the identification of this frequency band for the HDFSS does not preclude the use of these frequency bands by other services and does not establish priority in the Radio Regulations among the users of these frequency bands. Therefore, a new footnote providing a higher status to the FSS would be in contravention of RR No. **5.516B** and is not appropriate.*

View: Elevating the status of HDFSS to give it priority over the mobile service (i.e. making it super primary) is inappropriate and outside the scope of agenda item 1.13.

Option 6:

No condition is necessary.

2/1.13/4.4.2.2 Condition D2b: Protection measures for the RAS**Option 1:**

The RAS frequency band 42.5-43.5 GHz is covered by RR No. **5.149**. Since the protection from interference caused by unwanted emissions into a frequency band used by the RAS is not always straightforward to implement, ITU-R should therefore be invited to update existing ITU-R Recommendations or develop new ITU-R Recommendations, as appropriate, to provide information on possible coordination and protection measures to assist administrations in this matter. In addition, administrations should be invited to implement coordination and protection measures for the RAS stations in the frequency band 42.5-43.5 GHz as required.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article **5** in which the frequency band is identified for IMT.

Option 3:

No condition is necessary.

2/1.13/4.4.2.3 Condition D2c: Protection measures for multiple services

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

Option 1:

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. **9.21** in the corresponding footnote.

View 1:

There are no criteria for BR to identify concerned administrations, and the application of RR No. 9.21 would create an undue burden on administrations and on BR. It is not implementable and enforceable.

View 2:

Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.

Option 2:

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

Views were expressed that there are no criteria to identify concerned administrations nor procedure to apply it. This would create an undue burden on administrations and on BR. It is not implementable and enforceable.

Option 3:

No condition is necessary.

View 1:

Option 4 does not provide protection for incumbent services if Conditions D2a-D2b to protect specific services do not apply.

View 2:

The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbent services, thus there is no need for the addition of some of the conditions indicated in Conditions D2a-D2b.

2/1.13/4.5 Item E: Frequency band 42.5-43.5 GHz

2/1.13/4.5.1 Method E1: NOC

No change to the Radio Regulations.

2/1.13/4.5.2 Method E2: Identification of the frequency band 42.5-43.5 GHz for IMT in accordance with the following two alternatives

Alternative 1

Under this alternative, identify the frequency band for the terrestrial component of IMT within the LMS in Regions or globally.

Reasons and views related to these two alternatives are provided at the beginning of Section 4.

Alternative 2

Under this alternative, identify the frequency band for the terrestrial component of IMT in Regions or globally.

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies.

2/1.13/4.5.2.1 Condition E2a: Protection measures for the FSS (Earth-to-space)

Option 1:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- A mandatory limit on the maximum total radiated power (TRP) of IMT BSs of [20.5/26/40] dB(m/200 MHz), i.e. [−9.5/−4/10] dB(W/200 MHz).
- Requiring to take all possible measures to avoid the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal.
- Requiring that the mechanical tilt of IMT BSs be below −10 degrees relative to the horizon with the IMT BS antenna pattern being kept within the limits of approximation envelope according to Recommendation ITU-R M.2101 provisions.
- In addition, administrations should be invited to adopt provisions to limit the maximum density of 1 200 BSs per 10 000 km² for outdoor hot spots within its territory. In case when area of an administration is lesser than 10 000 km² the number of IMT BS should be reduced proportionally.

Reasons: Conditions in Option 1 are based on sharing and compatibility study and ensures protection of the FSS service. Moreover, all studies use the antenna pattern of IMT BS in accordance with Recommendation ITU-R M.2101, in case of another antenna pattern it might be interference to the FSS receiving space station.

Views were expressed that studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, the limits in this option are overly restrictive and any provisions should be consistent with the assumptions and studies.

Views were expressed that restricting the density of BSs per km² would be difficult for administrations to implement. In addition, it is unclear which reference will be used for calculating the density. Moreover, the relevant area in terms of interference would depend on each satellite footprint, which could cover the territory of multiple administrations.

View:

The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS. Therefore there is no need for the implementation of TRP limits.

View:

The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS and RR No. 21.5 already provides appropriate limits.

Option 2:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- A mandatory limit on the maximum total radiated power (TRP) of IMT BSs of [20.5/26/40] dB(m/200 MHz), i.e. [−9.5/−4/10] dB(W/200 MHz).
- Requiring that the mechanical tilt of IMT BSs shall be below −10 degrees below the horizon and the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal.
- Antenna pattern shall comply with Recommendation ITU-R M.2101.

View:

The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS. Therefore there is no need for the implementation of TRP limits.

Other views were expressed that studies show that sharing is feasible based on typical deployment of IMT, therefore all those typical assumptions should not be reflected to mandatory limits as regulatory options.

View:

The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS and RR No. 21.5 already provides appropriate limits.

Option 3:

Alternatively to Options 1 and 2, the elements contained in these options could also be included in a WRC Recommendation.

Views were expressed that based on experience from WRC-15 this option does not properly address the issue.

Option 4:

- To introduce in the Radio Regulations an angular e.i.r.p. mask for the emissions of IMT BSs in the skyward direction, see Section 2/1.13/5 (Resolution [B113-IMT 40/50 GHz]).

Reasons: The e.i.r.p. mask is based on sharing and compatibility studies and ensures the protection of the FSS, while providing flexibility for IMT-2020 deployments (there are no separate limits for mechanical downtilt and e-tilt angles, as well as fixed TRP values), and it is implementable, since there are existing examples of the application of off-axis gain limits in the Radio Regulations and ITU-R Recommendations.

Views were expressed that such an angular e.i.r.p. mask would be extremely complicated to implement with active antennas. The analysis that supports this mask is unclear and it is noted that all BSs would need to be pointing in the skyward direction towards the FSS space station, which is unlikely to be representative of IMT deployments. The interference potential depends mainly on the number of simultaneous cases where there is emission in the skyward direction. The e.i.r.p. mask would be unduly restrictive.

Further views were expressed that the interference potential depends mainly on the number of simultaneous cases where there is high level e.i.r.p. emission in the skyward direction. The e.i.r.p. mask would restrict occurrence of such situations.

Option 5:

- Requiring that when deploying outdoor BSs, it shall be ensured that each antenna is normally¹¹ transmitting only with the main beam pointing below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the BS is only receiving.

Reasons: Studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, provisions

¹¹ It is assumed that only a very limited number of indoor terminals with positive elevation will be communicating with base stations.

are needed, which are consistent with the assumptions. It is implementable and enforceable by including them in the licence conditions.

Views were expressed that the condition for main beam pointing is not implementable and could not be enforced by administrations due to the word “normally” used when defining the main beam pointing limits. Moreover, the TRP value and antenna pattern of an IMT BS in this option is not defined and in practice any TRP and antenna pattern for an IMT BS could be used. When emissions of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (TRP 25 dB(m/200 MHz), i.e. -5 dB(W/200 MHz) and the antenna in line with Recommendation ITU-R M.2101), this option will not protect the FSS.

Option 6:

- Requiring that when deploying outdoor BSs, all necessary measures shall be taken to ensure that the main beam of each transmitting antenna is pointed below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the BS antenna is only receiving;

View:

This option is excessively restrictive and is not in-line with the results of the sharing studies conducted in TG 5/1. This option does not allow a limited number of indoor terminals with positive elevations. In contrast, Option 5 above allows flexibility for practical IMT deployments. TG 5/1 studies assumed that most BSs are pointing to terminals on the ground and that some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found large positive margins under these assumptions.

Option 7:

No condition necessary.

View 1:

This option contradicts the results of sharing and compatibility studies, which were based on limitations of IMT-2020 e.i.r.p. and the assumption that elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees. The impact of the IMT-2020 BS antenna main beam, pointing in the upper hemisphere without any e.i.r.p. limit, was not assessed. This option would allow IMT operations that have not been studied by ITU-R. This option does not ensure the protection of the FSS as studies have not demonstrated that the margin would remain positive if neither power limits nor pointing limitations were applied to IMT base stations.

View 2:

These regulatory options are not necessary since studies show that sharing is feasible without any additional mandatory limits.

2/1.13/4.5.2.2 Condition E2b: Protection measures for the RAS

Option 1:

The RAS frequency band 42.5-43.5 GHz is covered by RR No. **5.149**. Coexistence with the IMT could be possible with proper mitigation and coordination measures despite the in-band sharing in this frequency band. ITU-R should therefore be invited to update existing ITU-R Recommendations or develop new ITU-R Recommendations, as appropriate, to provide information on possible coordination and protection measures for the RAS and assist administrations in this matter. In addition, administrations should be invited to implement coordination and protection measures for the RAS stations in the frequency band 42.5-43.5 GHz as required.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution, cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Option 3:

No condition is necessary.

2/1.13/4.5.2.3 Condition E2c: Protection measures for multiple services

In addition to the options and associated alternatives for the protection measures for the different services as described above, additional options are suggested.

Option 1:

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. 9.21 in the corresponding footnote.

View 1:

There are no criteria for the BR to identify concerned administrations, and the application of RR No. 9.21 would create an undue burden on administrations and on the BR. It is not implementable and enforceable.

View 2:

Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.

Option 2:

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.

Option 3:

To invite ITU-R to regularly review the impact of the evolution of IMT technical and operational characteristics (including deployment and base-station density) on sharing and compatibility with other services (e.g. space services) and, as necessary, to take into account the results of these reviews in the development or revision of ITU-R Recommendations/Reports, e.g. on IMT characteristics.

Views were expressed that ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business, and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15).

Views were expressed that further clarifications are required on the applicability of the implementation and the appropriate course of action is yet to be developed.

Option 4:

To invite ITU-R to regularly update characteristics of IMT deployments (including BS density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments with reporting through BR Director on the results to WRC. This would enable ITU-R to recommend corrective measures to address situations whereby the interference threshold of space stations would be at risk to be exceeded.

Views were expressed that ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business, and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15).

Views were expressed that further clarifications are required on the applicability of the implementation and the appropriate course of action is yet to be developed.

Option 5:

No condition is necessary.

View 1:

Option 4 does not provide protection for incumbent services if Conditions E2a-E2b to protect specific services do not apply.

View 2:

The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbent services, thus there is no need for the addition of some of the conditions indicated in Conditions E2a-E2b.

2/1.13/4.5.2.4 Condition E2d: Measures related to transmitting earth stations in the FSS (Earth-to-space) at known locations

Option 1:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- a)* to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency band 42.5-43.5 GHz;
- b)* in addition, administrations should be invited to adopt provisions to ensure the possibility of deploying future FSS earth stations.

Reasons: Studies have shown that the interference distance remains limited (i.e. a few km), i.e. the issue will be mainly on a national level. For cross-border coordination, procedures in RR Articles 9 and 11 would apply. The ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations.

Different views were expressed on whether or not this option would ensure the coexistence between existing and future FSS earth stations and IMT.

Views were expressed that the results of studies indicate coordination distances that pertain to national matters, and thus RR Articles 9 and 11 should not apply.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

a) to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency band 42.5-43.5 GHz and incorporate this Recommendation into the RR by reference.

View 1:

Such a recommendation has not been developed and could not be incorporated by reference at WRC-19. In addition, RR Articles 9 and 11 already include procedures for the coexistence with FSS earth stations.

View 2:

The results of studies indicate coordination distances that pertain to national matters and thus RR Articles 9 and 11 should not apply.

View3:

The protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 3:

No condition is necessary.

View 1:

Option 3 does not ensure the evolving needs of the primary FSS, and may impose constraints on FSS earth station deployment, which contradicts the objectives of Resolution 238 (WRC-15).

View 2:

Sharing and compatibility are feasible based on the FSS earth station characteristics, including current/future deployment, provided by the ITU-R involved group. In addition, since IMT is the victim of interference, no FSS earth station uplink protection conditions are needed as this is a matter for the national authority.

2/1.13/4.6 Item F: Frequency band 45.5-47 GHz**2/1.13/4.6.1 Method F1: NOC**

Under this method, because no ITU-R studies have been carried out, no identification of the frequency band for the terrestrial component of IMT would be made.

2/1.13/4.6.2 Method F2: NOC, Proposal for further ITU-R study

No change to the Radio Regulations in WRC-19 and request for further ITU-R studies for submission to a future competent WRC/WRC-23.

Views were expressed that this method is outside the scope of agenda item 1.13 and should be reflected under agenda item 10.

2/1.13/4.6.3 Method F3: Identification of the frequency band 45.5-47 GHz for IMT

Alternative 1

Under this alternative, identify the frequency band for the terrestrial component of IMT within the LMS in Regions or globally, taking into account RR No. **5.553**.

View:

Alternative 1 cannot ensure compatibility of IMT with existing services because no compatibility studies have been carried out of IMT with non-GSO MSS (Earth-to-space and space-to-Earth), RNS, GSO/non-GSO RNSS (Earth-to-space and space-to-Earth) in the considered band and also with ARS/ARSS in the band 47-47.2 GHz.

Alternative 2

Under this alternative, identify the frequency band for the terrestrial component of IMT in Regions or globally, taking into account RR No. **5.553**.

Reasons and views related to these two alternatives are provided at the beginning of section 4.

View:

Alternative 2 cannot ensure compatibility of IMT with existing services because no compatibility studies have been carried out of IMT (including maritime and airborne BSs/UE) with GSO/non-GSO MSS (Earth-to-space and space-to-Earth) (including maritime and airborne ESs), RNS, GSO/non-GSO RNSS (Earth-to-space and space-to-Earth) in the considered band and also with ARS/ARSS in the band 47-47.2 GHz.

2/1.13/4.6.3.1 Condition F3a: Protection measures for the MSS

View 1:

Studies were contributed to CPM19-2 which clearly indicate that no conditions are necessary to protect MSS in the band 45.5-47 GHz. For MSS (Earth-to-space), there is a large protection margin between the aggregate interference from IMT and the level that could potentially cause interference to an MSS space station. For MSS (space-to-Earth), required separation distances between IMT and MSS earth stations are small, and this matter can be treated on a national basis.

View 2:

Views were expressed that conditions, if any, needed to ensure protection of this service were not developed as no ITU-R studies have been done and individual studies submitted to CPM19-2 do not provide a sufficient basis for regulatory measures.

View 3:

Studies submitted to CPM19-2 address only compatibility between GSO LMSS against IMT system and does address interference from IMT to GSO/non-GSO AMSS (Earth-to-space and space-to-Earth) in the band 45.5-47 GHz.

2/1.13/4.6.3.2 Condition F3b: Protection measures for the RNS and RNSS

As no studies have been done with these services, the conditions, if any, needed to ensure protection of these services could not be determined.

2/1.13/4.6.3.3 Condition F3c: Protection measures for multiple services

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

Option 1:

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. **9.21** in the corresponding footnote.

View 1:

*There are no criteria for BR to identify concerned administrations and the application of RR No. **9.21** would create an undue burden on administrations and on BR. It is not implementable and enforceable.*

View 2:

Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.

Option 2:

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on BR. It is not implementable and enforceable.

Option 3:

No condition is necessary.

2/1.13/4.6.4 Method F4: Identification of the frequency band 45.5-47 GHz for IMT and removal of the frequency band from RR No. 5.553

Alternative 1

Under this alternative, identify the frequency band for the terrestrial component of IMT within the LMS in Regions or globally, and removal of the frequency band from RR No. **5.553**.

View:

Alternative 1 cannot ensure compatibility of IMT with existing services because no compatibility studies have been carried out of IMT with non-GSO MSS (Earth-to-space and space-to-Earth), RNS, GSO/non-GSO RNSS (Earth-to-space and space-to-Earth) in the considered band and also with ARS/ARSS in the band 47-47.2 GHz.

Alternative 2

Under this alternative, identify the frequency band for the terrestrial component of IMT in Regions or globally, and removal of the frequency band from RR No. **5.553**.

Reasons and views related to these two alternatives are provided at the beginning of section 4.

*Reasons: Given the fact that the sharing studies show a large margin towards the MSS operating in this frequency band, there is no need to maintain the frequency band 45.5-47 GHz in RR No. **5.553**.*

*Views were expressed that Condition F4 is invalid, because it entails regulatory modifications that are outside the scope of WRC-19 agenda item 1.13 and Resolution **238 (WRC-15)**. The proposed modification to RR No. **5.553** under this method removes interference protection from the space radiocommunication services to which the band 45.5-47 GHz is allocated. Removing interference protection currently provided to these incumbent services is outside the scope of WRC-19 agenda item 1.13 and Resolution **238 (WRC-15)**. Moreover, the consequences of the proposed modification*

to RR No. 5.553 have not been fully investigated. Condition F4 should be deleted from the CPM Report.

View:

Alternative 2 cannot ensure compatibility of IMT with existing services because no compatibility studies have been carried out of IMT (including maritime and airborne BSs/UE) with GSO/non-GSO MSS (Earth-to-space and space-to-Earth) (including maritime and airborne ESs), RNS, GSO/non-GSO RNSS (Earth-to-space and space-to-Earth) in the considered band and also with ARS/ARSS in the band 47-47.2 GHz.

2/1.13/4.7 Item G: Frequency band 47-47.2 GHz

2/1.13/4.7.1 Method G1: NOC

Under this method, because no studies have been carried out, no identification of the frequency band for the terrestrial component of IMT would be made.

2/1.13/4.7.2 Method G2: NOC, Proposal for further ITU-R study

No change to the Radio Regulations in WRC-19 and request for further ITU-R studies for submission to a future competent WRC/WRC-23.

Views were expressed that this method is outside the scope of agenda item 1.13 and should be reflected under agenda item 10.

2/1.13/4.7.3 Method G3: Identification of the frequency band 47-47.2 GHz for IMT

Alternative 1

Under this alternative, even though no studies have been carried out, allocate the frequency band to the LMS and identify the frequency band for the terrestrial component of IMT in Regions or globally within the LMS.

View:

Alternative 1 cannot ensure compatibility of IMT with existing services because no compatibility studies have been carried out of IMT with ARS/ARSS.

Alternative 2

Under this alternative, even though no studies have been carried out, allocate the frequency band to the MS (except aeronautical mobile) and identify the frequency band for the terrestrial component of IMT in Regions or globally.

Reasons and views related to these two alternatives are provided at the beginning of section 4.

Views were expressed that an IMT identification is not appropriate, since no studies were carried out. However no characteristics were received in order for studies to be performed.

Views were expressed that the technical characteristics of the primary services were available for ITU studies in Recommendation ITU-R M.1732-2.

Views were expressed that this band is currently under study in some countries. Proposals to allocate the band to the mobile service and identify the band to IMT may be provided to WRC-19.

View:

Alternative 2 cannot ensure compatibility of IMT with existing services because no compatibility studies have been carried out of IMT with ARS/ARSS.

2/1.13/4.7.3.1 Condition G3a: Protection measures for the ARS and ARSS

As no studies have been done with these services, the conditions, if any, needed to ensure protection of these services could not be determined.

2/1.13/4.7.3.2 Condition G3b: Protection measures for multiple services

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

Option 1:

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. **9.21** in the corresponding footnote.

*Views were expressed that there are no criteria for BR to identify concerned administrations, and the application of RR No. **9.21** would create an undue burden on administrations and on BR. It is not implementable and enforceable.*

Option 2:

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

Views were expressed that there are no criteria to identify concerned administrations nor procedure to apply it. This would create an undue burden on administrations and on BR. It is not implementable and enforceable.

Option 3:

No condition is necessary.

2/1.13/4.8 Item H: Frequency band 47.2-50.2 GHz

2/1.13/4.8.1 Method H1: NOC

No change to the Radio Regulations.

2/1.13/4.8.2 Method H2: Identification of the frequency band 47.2-50.2 GHz for IMT in accordance with the following two alternatives

Alternative 1

Under this alternative, identify the 47.2-50.2 GHz frequency band for the terrestrial component of IMT within the LMS in Regions or globally.

Alternative 2

Under this alternative, identify the 47.2-50.2 GHz frequency band for the terrestrial component of IMT in Regions or globally.

Reasons and views related to these two alternatives are provided at the beginning of section 4.

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies. Administrations could consider applying the IMT Resolution and/or modifications to Resolution **750 (Rev.WRC-15)**, or neither, based on the conditions selected when identifying the frequency band for IMT.

2/1.13/4.8.2.1 Condition H2a: Protection measures for the EESS (passive)

Option 1:

Introduce in Table 1-1 of Resolution **750 (Rev.WRC-15)** limits on unwanted emissions in the frequency band 50.2-50.4 GHz from IMT BSs and IMT mobile stations within the 47.2-50.2 GHz frequency band (see Section 2/1.13/3.2.7) and add a cross-reference to Resolution **750 (Rev.WRC-15)** in the RR footnote that identifies the frequency band for IMT and revise RR No. **5.338A** accordingly.

Option 2:

Introduce in the Radio Regulations (Table 1-1 of Resolution **750 (Rev.WRC-15)**) mandatory limits on unwanted emissions in the frequency band 50.2-50.4 GHz from IMT stations (BS and UE) taking into account RR No. **5.340.1**.

*Views were expressed that there should be no impact of application RR No **5.340.1** on regulatory provisions for this method in case existing technical compatibility studies with respect to protection of the EESS (passive) in the frequency band 50.2-50.4 GHz are justified and use valid assumptions.*

*Views were expressed that RR No. **5.530.1** states that the passive services operating in the 50.2-50.4 GHz band should not impose undue constraints on the use of the adjacent bands by the primary allocated services in those bands.*

Option 3:

No condition necessary.

*Views were expressed that Option 3 contradicts the results of the sharing and compatibility studies and does not provide protection of the EESS (passive) in adjacent frequency band 50.2-50.4 GHz, which contradicts the objectives of Resolution **238 (WRC-15)**.*

2/1.13/4.8.2.2 Condition H2b: Protection measures for the FSS space stations (Earth-to-space)

Option 1:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- A mandatory limit on the maximum total radiated power (TRP) of IMT BSs of [26/40] dB(m/200 MHz), i.e. [–4/10] dB(W/200 MHz).
- Requiring to take all possible measures to avoid the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal.
- Requiring that the mechanical tilt of IMT BSs be below –10 degrees relative to the horizon with the IMT BS antenna pattern being kept within the limits of approximation envelope according to Recommendation ITU-R M.2101 provisions.
- In addition, administrations should be invited to adopt provisions to limit the maximum density of 1 200 BSs per 10 000 km² for outdoor hot spots within its territory. In case when area of an administration is less than 10 000 km² the number of IMT BS should be reduced proportionally.

Views were expressed that studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, the limits in this option are overly restrictive and any provisions should be consistent with the assumptions and studies.

Views were expressed that restricting the density of BSs per km² would be difficult for administrations to implement. In addition, it is unclear which reference will be used for calculating the density. Moreover, the relevant area in terms of interference would depend on each satellite footprint, which could cover the territory of multiple administrations.

Views were expressed that the limitation of the IMT-2020 BS density, as proposed in this option, is not implementable, because the number of outdoor urban hot spots is not limited and this does not ensure the protection for satellite networks of the FSS. Moreover, the antenna pattern of an IMT BS in this option is not defined and in practice any antenna for an IMT BS could be used. When the antenna gain of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the FSS.

Views were expressed that this regulatory option is not based on any sharing and compatibility study, since margins obtained in these studies were based on the assumption that the elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees and the impact of the IMT-2020 BS antenna main beam, pointing in the upper hemisphere, was not assessed, however it is possible in accordance with this option. This option does not ensure the protection of the ISS and FSS.

Other views were expressed that studies show that sharing is feasible based on typical deployment of IMT, therefore all those typical assumptions should not be reflected to mandatory limits as regulatory options.

View:

Sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS. Therefore there is no need for the implementation of TRP limits.

Option 2:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- A mandatory limit on the maximum total radiated power (TRP) of IMT BSs of [26/40] dB(m/200 MHz), i.e. [−4/10] dB(W/200 MHz).
- Requiring that the mechanical tilt of IMT BSs shall be below −10 degrees below the horizon and the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal.
- Antenna pattern shall comply with Recommendation ITU-R M.2101.

Views were expressed that this regulatory option is not based on any sharing and compatibility study, since margins obtained in these studies were based on the assumption that the elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees and the impact of the IMT-2020 BS antenna main beam, pointing in the upper hemisphere, was not assessed, however it is possible in accordance with this option. This option does not ensure the protection of the ISS and FSS.

Other views were expressed that studies show that sharing is feasible based on typical deployment of IMT, therefore all those typical assumptions should not be reflected to mandatory limits as regulatory options.

View: The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS, thus there is no need for the implementation of TRP limits.

View: The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS and RR No. 21.5 already provides appropriate limits.

Option 3:

Alternatively to Options 1 and 2, the elements contained in these options could also be included in a WRC Recommendation.

Views were expressed that based on experience from WRC-15 this option does not properly address the issue.

Option 4:

- To introduce in the Radio Regulations an angular e.i.r.p. mask for the emissions of IMT BSs in the skyward direction, see section 2/1.13/5 (Resolution [B113-IMT 40/50 GHz]).

Option 5:

- Requiring that when deploying outdoor BSs, it shall be ensured that each antenna is normally¹² transmitting only with the main beam pointing below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the BS is only receiving.

Reasons: Studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, provisions are needed, which are consistent with the assumptions. It is implementable and enforceable by including them in the licence conditions.

Views were expressed that the condition for main beam pointing is not implementable and could not be enforced by administrations due to the word “normally” used when defining the main beam pointing limits. Moreover, the TRP value and antenna pattern of an IMT BS in this option is not defined and in practice any TRP and antenna pattern for an IMT BS could be used. When emissions of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (TRP 25 dB(m/200 MHz), i.e. –5 dB(W/200 MHz) and the antenna in line with Recommendation ITU-R M.2101), this option will not protect the FSS.

Option 6:

- Requiring that when deploying outdoor BSs, all necessary measures shall be taken to ensure that the main beam of each transmitting antenna is pointed below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the BS antenna is only receiving;

View:

This option is excessively restrictive and is not in-line with the results of the sharing studies conducted in TG 5/1. This option does not allow a limited number of indoor terminals with positive elevations. In contrast, Option 5 above allows flexibility for practical IMT deployments.

TG 5/1 studies assumed that most BSs are pointing to terminals on the ground and that some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found large positive margins under these assumptions.

Option 7:

No condition necessary.

¹² It is assumed that only a very limited number of indoor terminals with positive elevation will be communicating with base stations.

Views were expressed that this option contradicts the results of sharing and compatibility studies, which were based on limitations of IMT-2020 e.i.r.p. and the assumption that elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees. The impact of the IMT-2020 BS antenna main beam, pointing in the upper hemisphere without any e.i.r.p. limit, was not assessed. This option would allow IMT operations that have not been studied by ITU-R. This option does not ensure the protection of the FSS as studies have not demonstrated that the margin would remain positive if neither power limits nor pointing limitations were applied to IMT base stations.

2/1.13/4.8.2.3 Condition H2c: Measures related to transmitting earth stations in the FSS (Earth-to-space)

Option 1:

For the FSS in the frequency band 47.2-50.2 GHz, the following actions are required:

- ITU-R should be invited to develop ITU-R Recommendations to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency band 47.2-50.2 GHz;
- Administrations are invited to apply this Recommendation to address coexistence between FSS earth stations and IMT networks and to ensure the possibility of deploying future gateway earth stations.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

Coexistence between other services and IMT (in-band and/or adjacent frequency band) should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Option 3:

In the footnote containing the IMT identification, administrations should take into account potential constraints to IMT in the frequency band, as appropriate, because of the potential deployment of high-density applications in the FSS in the 48.2-50.2 GHz band, as per RR No. **5.516B**.

Option 4:

In the footnote containing the IMT identification, specify that IMT operations should not impede the deployment and use of high-density applications in the fixed-satellite service in the frequency band 48.2-50.2 GHz as per RR No. **5.516B**.

Reasons: As recognized in the summary of studies, sharing between earth stations at unspecified locations (such as is the case for the HDFSS) and IMT may or may not be possible on a case-by-case basis. As such, this option calls for administrations to take that into account and consider potential constraints to IMT, as appropriate, to ensure FSS/IMT compatibility.

*A view was expressed that RR No. **5.516B** states that the identification of this frequency band for the HDFSS does not preclude the use of these frequency bands by other services and does not establish priority in the Radio Regulations among the users of these frequency bands. Therefore, a new footnote providing a higher status to the FSS would be in contravention of RR No. **5.516B** and is not appropriate.*

View:

Elevating the status of HDFSS to give it priority over the mobile service (i.e. making it super primary) is inappropriate and outside the scope of agenda item 1.13.

Option 5:

No condition is necessary.

2/1.13/4.8.2.4 Condition H2d: Protection measures for multiple services

In addition to the options and associated alternatives for protection measures of the different services as described above, additional options are suggested.

Option 1:

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. 9.21 in the corresponding footnote.

View 1:

There are no criteria for the BR to identify concerned administrations and the application of RR No. 9.21 would create an undue burden on administrations and on the BR. It is not implementable and enforceable.

View 2:

Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.

Option 2:

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.

Option 3:

To invite ITU-R to regularly review the impact of the evolution of IMT technical and operational characteristics (including deployment and base-station density) on sharing and compatibility with other services (e.g. space services) and, as necessary, to take into account the results of these reviews in the development or revision of ITU-R Recommendations/Reports, e.g. on IMT characteristics.

Views were expressed that the ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC 15).

Views were expressed that further clarifications are required on the applicability of the implementation and the appropriate course of action is yet to be developed.

Option 4:

To invite ITU-R to regularly update characteristics of IMT deployments (including BS density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments with reporting through BR Director on the results to WRC. This would enable ITU-R

to recommend corrective measures to address situations whereby the interference threshold of space stations would be at risk to be exceeded.

Views were expressed that ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business, and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15).

Views were expressed that further clarifications are required on the applicability of the implementation and the appropriate course of action is yet to be developed.

Option 5:

No condition is necessary.

View 1:

Option 5 does not provide protection for incumbent services if Conditions H2a-H2c to protect specific services do not apply.

View 2:

The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbent services, thus there is no need for the addition of some of the conditions indicated in Conditions H2a-H2c.

2/1.13/4.9 Item I: Frequency band 50.4-52.6 GHz

2/1.13/4.9.1 Method I1: NOC

No change to the Radio Regulations.

2/1.13/4.9.2 Method I2: Identification of the frequency band 50.4-52.6 GHz for IMT in accordance with the following two alternatives

Alternative 1

Under this alternative, identify the 50.4-52.6 GHz frequency band for the terrestrial component of IMT within the LMS in Regions or globally.

Alternative 2

Under this alternative, identify the 50.4-52.6 GHz frequency band for the terrestrial component of IMT in Regions or globally.

Reasons and views related to these two alternatives are provided at the beginning of section 4.

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies. Administrations could consider applying the IMT Resolution and/or modifications to Resolution 750 (Rev.WRC-15), or neither, based on the conditions selected when identifying the band for IMT.

2/1.13/4.9.2.1 Condition I2a: Protection measures for the EESS (passive)

Option 1:

Introduce in Table 1-1 of Resolution 750 (Rev.WRC-15) limits on unwanted emissions in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz from IMT BSs and IMT mobile stations

within the 50.4-52.6 GHz frequency band (see Section 2/1.13/3.2.8) and add a cross-reference to Resolution **750 (Rev.WRC-15)** in the RR footnote that identifies the frequency band for IMT and revise RR No. **5.338A** accordingly.

Option 2:

Introduce in the Radio Regulations (Table 1-1 of Resolution **750 (Rev.WRC-15)**) mandatory limits on unwanted emissions in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz from IMT stations (BS and UE) taking into account RR No. **5.340.1**.

*Views were expressed that there should be no impact of application RR No **5.340.1** on regulatory provisions for this method in case existing technical compatibility studies with respect to protection of the EESS (passive) in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz are justified and use valid assumptions.*

*Views were expressed that RR No. **5.530.1** states that the passive services operating in the 50.2-50.4 GHz band should not impose undue constraints on the use of the adjacent bands by the primary allocated services in those bands.*

Option 3:

No condition necessary.

*Views were expressed that Option 3 contradicts the results of the sharing and compatibility studies and does not provide protection of the EESS (passive) in adjacent frequency band 50.2-50.4 GHz, which contradicts the objectives of Resolution **238 (WRC-15)**.*

2/1.13/4.9.2.2 Condition I2b: Protection measures for the FSS (Earth-to-space)

Option 1:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- A mandatory limit on the maximum total radiated power (TRP) of IMT BSs of [26/40] dB(m/200 MHz), i.e. [–4/10] dB(W/200 MHz).
- Requiring to take all possible measures to avoid the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal.
- Requiring that the mechanical tilt of IMT BSs be below –10 degrees relative to the horizon with the IMT BS antenna pattern being kept within the limits of approximation envelope according to Recommendation ITU-R M.2101 provisions.
- In addition, administrations should be invited to adopt provisions to limit the maximum density of 1 200 BSs per 10 000 km² for outdoor hot spots within its territory. In case when area of an administration is less than 10 000 km² the number of IMT BS should be reduced proportionally.

Views were expressed that studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, the limits in this option are overly restrictive and any provisions should be consistent with the assumptions and studies.

Views were expressed that restricting the density of BSs per km² would be difficult for administrations to implement. In addition, it is unclear which reference will be used for calculating the density. Moreover, the relevant area in terms of interference would depend on each satellite footprint, which could cover the territory of multiple administrations.

Other views were expressed that studies show that sharing is feasible based on typical deployment of IMT, therefore all those typical assumptions should not be reflected to mandatory limits as regulatory options.

View:

Sharing and compatibility studies resulted in a high margin of protection to the FSS. Therefore there is no need for the implementation of TRP limits.

Option 2:

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- A mandatory limit on the maximum total radiated power (TRP) of IMT BSs of [26/40] dB(m/200 MHz), i.e. [−4/10] dB(W/200 MHz).
- Requiring that the mechanical tilt of IMT BSs shall be below −10 degrees below the horizon and the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal.
- Antenna pattern shall comply with Recommendation ITU-R M.2101.

Views were expressed that this regulatory option is not based on any sharing and compatibility study, since margins obtained in these studies were based on the assumption that the elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees and the impact of the IMT-2020 BS antenna main beam, pointing in the upper hemisphere, was not assessed, however it is possible in accordance with this option. This option does not ensure the protection of the ISS and FSS.

Other views were expressed that studies show that sharing is feasible based on typical deployment of IMT, therefore all those typical assumptions should not be reflected to mandatory limits as regulatory options.

View:

Sharing and compatibility studies resulted in a high margin of protection to the FSS. Therefore there is no need for the implementation of TRP limits.

Option 3:

Alternatively to Options 1 and 2, the elements contained in these options could also be included in a WRC Recommendation.

Views were expressed that based on experience from WRC-15 this option does not properly address the issue.

Option 4:

- To introduce in the Radio Regulations an angular e.i.r.p. mask for the emissions of IMT BSs in the skyward direction, see section 2/1.13/5 (Resolution **[B113-IMT 40/50 GHZ]**).

Option 5:

- Requiring that when deploying outdoor BSs, it shall be ensured that each antenna is normally¹³ transmitting only with the main beam pointing below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the BS is only receiving.

¹³ It is assumed that only a very limited number of indoor terminals with positive elevation will be communicating with base stations.

Reasons: Studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, provisions are needed, which are consistent with the assumptions. It is implementable and enforceable by including them in the licence conditions.

Views were expressed that the condition for main beam pointing is not implementable and could not be enforced by administrations due to the word “normally” used when defining the main beam pointing limits. Moreover, the TRP value and antenna pattern of an IMT BS in this option is not defined and in practice any TRP and antenna pattern for an IMT BS could be used. When emissions of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (TRP 25 dB(m/200 MHz), i.e. –5 dB(W/200 MHz) and the antenna in line with Recommendation ITU-R M.2101), this option will not protect the FSS.

View:

The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS, thus there is no need for the implementation of TRP limits. The limitation on normally used up tilt provides sufficient certainty that the deployment of IMT systems will not change the coexistence conditions with the FSS/ISS over time.

Option 6:

- Requiring that when deploying outdoor BSs, all necessary measures shall be taken to ensure that the main beam of each transmitting antenna is pointed below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the BS antenna is only receiving;

View:

This option is excessively restrictive and is not in-line with the results of the sharing studies conducted in TG 5/1. This option does not allow a limited number of indoor terminals with positive elevations. In contrast, Option 5 above allows flexibility for practical IMT deployments. TG 5/1 studies assumed that most BSs are pointing to terminals on the ground and that some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found large positive margins under these assumptions.

Option 7:

No condition necessary.

Views were expressed that this option contradicts the results of sharing and compatibility studies, which were based on limitations of IMT-2020 e.i.r.p. and the assumption that elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees. The impact of the IMT-2020 BS antenna main beam, pointing in the upper-hemisphere without any e.i.r.p. limit, was not assessed. This option would allow IMT operations that have not been studied by ITU-R. This option does not ensure the protection of the FSS as studies have not demonstrated that the margin would remain positive if neither power limits nor pointing limitations were applied to IMT base stations.

2/1.13/4.9.2.3 Condition I2c: Protection measures for multiple services

In addition to the options and associated alternatives for the protection measures of the different services as described above, additional options are suggested.

Option 1:

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. 9.21 in the corresponding footnote.

View 1:

There are no criteria for the BR to identify concerned administrations and the application of RR No. 9.21 would create an undue burden on administrations and on the BR. It is not implementable and enforceable.

View 2:

Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.

Option 2:

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.

Option 3:

To invite ITU-R to regularly review the impact of the evolution of IMT technical and operational characteristics (including deployment and base-station density) on sharing and compatibility with other services (e.g. space services) and, as necessary, to take into account the results of these reviews in the development or revision of ITU-R Recommendations/Reports, e.g. on IMT characteristics.

Views were expressed that the ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC 15).

Views were expressed that further clarifications are required on the applicability of the implementation and the appropriate course of action is yet to be developed.

Option 4:

To invite ITU-R to regularly update characteristics of IMT deployments (including BS density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments with reporting through BR Director on the results to WRC. This would enable ITU-R to recommend corrective measures to address situations whereby the interference threshold of space stations would be at risk to be exceeded.

Views were expressed that ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business, and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15).

Views were expressed that further clarifications are required on the applicability of the implementation and the appropriate course of action is yet to be developed.

Option 5:

No condition is necessary.

View 1:

Option 5 does not provide protection for incumbent services if Conditions I2a-I2b to protect specific services do not apply.

View 2:

The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbent services, thus there is no need for the addition of some of the conditions indicated in Conditions I2a-I2b.

2/1.13/4.9.2.4 Condition I2d: Measures related to transmitting earth stations in the FSS (Earth-to-space)

Option 1:

For the FSS in the frequency band 50.4-51.4 GHz, the following actions are required:

- ITU-R should be invited to develop ITU-R Recommendations to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency band 50.4-51.4 GHz;
- administrations are invited to apply this Recommendation to address coexistence between FSS earth stations and IMT networks and to ensure the possibility of deploying future gateway earth stations.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process (in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

No condition is necessary.

2/1.13/4.10 Item J: Frequency band 66-71 GHz

2/1.13/4.10.1 Method J1: NOC

No change to the Radio Regulations.

2/1.13/4.10.2 Method J2: Identification of the frequency band 66-71 GHz for IMT in accordance with the following two alternatives and removal of the frequency band from RR No. 5.553

Alternative 1

Under this alternative, identify the 66-71 GHz frequency band for the terrestrial component of IMT within the land mobile service in Regions or globally, and remove the frequency band from RR No. 5.553.

View:

Alternative 1 cannot ensure compatibility of IMT with existing services because no compatibility studies have been carried out of IMT with non-GSO MSS (Earth-to-space and space-to-Earth), RNS, GSO/non-GSO RNSS (Earth-to-space and space-to-Earth), ISS in the considered band.

Alternative 2

Under this alternative, identify the 66-71 GHz frequency band for the terrestrial component of IMT in Regions or globally, and remove the frequency band from RR No. 5.553.

Reasons and views related to these two alternatives are provided at the beginning of section 4.

View 1:

Given the fact that the sharing studies show a large margin towards the MSS (Earth-to-space) and ISS operating in this frequency band and that the separation distances between IMT and MSS (space-to-Earth) earth stations are limited (i.e. less than a km), there is no need to maintain the frequency band 66-71 GHz in RR No. 5.553.

Views were expressed that Method J2 is invalid, because it entails regulatory modifications that are outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15). The proposed modification to RR No. 5.553 under this method removes interference protection from the SRS in the frequency band 66-71 GHz. Removing interference protection currently provided to the SRS is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15). Moreover, the consequences of the proposed modification to RR No. 5.553 have not been fully investigated. Administrations are in early stages of deploying space networks in the frequency band 66-71 GHz (e.g., USASAT-NGSO-2). Method J2 should be deleted from the CPM Report.

Views were expressed that this is not a Method that will protect existing services and this method should be deleted from the CPM text.

Views were expressed that the course and sequence of actions, scope of work, the validity and the implementability of this method are totally ambiguous, confusing, unclear and incomplete. Moreover, the suppression of any frequency band in the footnote RR No. 5.553 is outside of the mandate of the ITU-R. Consequently, this method should therefore not be included in the CPM text.

View:

Alternative 2 cannot ensure compatibility of IMT with existing services because no compatibility studies have been carried out of IMT (including maritime and airborne BSs/UE) with GSO/non-GSO MSS (Earth-to-space and space-to-Earth) (including maritime and airborne ESs), RNS, GSO/non-GSO RNSS (Earth-to-space and space-to-Earth), ISS in the considered band.

For both alternatives, this method contains potential conditions for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies.

2/1.13/4.10.2.1 Condition J2a: Measures for coexistence with MGWS and other WAS

Option 1:

In order to take into account that the frequency band is intended to be used for IMT and multiple gigabit wireless systems (MGWS) and other wireless access systems (WAS) technologies for similar deployments and that coexistence techniques would ensure local compatibility, reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- that administrations, when implementing or planning to implement IMT and MGWS and other WAS in the frequency band 66-71 GHz, take into account the latest technical characteristics of IMT and MGWS and other WAS, as provided in ITU-R Reports and Recommendations including, when available, coexistence techniques as appropriate;

and

- to invite ITU-R to develop Recommendations and Reports that will assist administrations in ensuring that applications and services in the frequency band 66-71 GHz can utilize the frequency band efficiently including the development of appropriate coexistence techniques between IMT and MGWS and other WAS, where needed.

Reasons: The frequency band 66-71 GHz is intended to be used for both IMT and MGWS/WAS technologies under similar deployment scenarios and, as a consequence, they may operate in the

same locations. The development of appropriate coexistence techniques within the ITU would assist administrations implementing both IMT and MGWS and other WAS in ensuring local compatibility.

Views were expressed that no consensus was reached to include this option due to the fact that many terms above are unclear.

Views were expressed that the coexistence between IMT and WAS/MGWS must be clearly addressed to protect WAS/MGWS in the WRC Resolution. Furthermore these conditions must contain regulatory procedural measures, which are implementable.

Views were expressed that the course and sequence of action, scope of work, the validity and the implementability of this method are totally ambiguous, confusing, unclear and incomplete. Moreover, suppression of any frequency band in the footnote RR No. 5.553 is outside the mandate of ITU-R. Consequently this method should therefore not be included in the CPM text.

Views were expressed that this option is out of the scope of this agenda item 1.13 since A.I 1.13 should only address IMT Identification and should not in any means new identification to MGWS/WAS, neither in a new resolution or in FN. ITU-R WRC Resolution should not be intended to promote MGWS systems or any other systems, which are outside the scope of this agenda item 1.13 of WRC-19. Instead, WRC19 AI 1.13 requested to conduct sharing and compatibility studies between IMT and other primary services within the given frequency bands. The coexistence between the systems within the same service can be addressed in the relevant ITU-R Study Groups and do not require WRC Resolution noting that each administration may decide on the systems to be implemented within its territory, which is a national matter.

Option 2:

This frequency band is intended to be used for IMT implementation. In some countries, this band might be also used by other systems such as wireless access systems (WAS) technologies including multiple gigabit wireless systems (MGWS). Accordingly, coexistence techniques between IMT and other systems may be needed to facilitate local compatibility, which can be reflected in WRC Resolution or Recommendation:

- that administrations wishing to implement IMT in the frequency band 66-71 GHz, consider, as appropriate, coexistence measures with MGWS and other WAS systems, which are either implemented or planned to be implemented, taking into account the relevant ITU-R Reports and Recommendations.

Option 3:

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force as it is based on an optional concept, nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking, as it does not have legal and procedural support and in no way would address the protection of services of other administrations, due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity, or otherwise, of that decision, if such decision is made unilaterally. In case that the interfering administration does not respond to the invitation, then the protection of the victim service would be put at the mercy of the interfering service.

Option 4:

No condition is necessary.

2/1.13/4.10.2.2 Condition J2b: Measures to protect other services

View 1:

Studies were contributed to CPM19-2 which clearly indicate that no conditions are necessary to protect MSS in the band 66-71 GHz. For MSS (Earth-to-space), there is a large protection margin between the aggregate interference from IMT and the level that could potentially cause interference to an MSS space station. For MSS (space-to-Earth), required separation distances between IMT and MSS earth stations are small, and this matter can be treated on a national basis.

View 2:

Views were expressed that conditions, if any, needed to ensure protection of this service were not developed as no ITU-R studies have been done and individual studies submitted to CPM19-2 do not provide a sufficient basis for regulatory measures.

2/1.13/4.10.2.3 Condition J2c: Protection measures for multiple services

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

Option 1:

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. **9.21** in the corresponding footnote.

*Views were expressed that there are no criteria for the BR to identify concerned administrations, and the application of RR No. **9.21** would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

Option 2:

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.

Option 3:

No condition is necessary.

Views were expressed that conditions are required to address the coexistence between MGWS and IMT and that Option 3 should be deleted.

Views were expressed that taking into account the results of studies conducted for this frequency band, as well as the current and planned utilization of the frequency band by services to which the frequency band is currently allocated, the position to identify the frequency band without conditions is proposed.

2/1.13/4.10.3 Method J3: To continue studies on the possibility of identification in the frequency band 66-71 GHz for IMT with a WRC Resolution

In accordance with an associated WRC Resolution, to continue studies on the possibility of the identification for IMT in the frequency band 66-71 GHz for consideration at a future competent

WRC. Modify RR No. **5.553** to indicate this Resolution for the frequency band 66-71 GHz in this footnote.

Views were expressed that studies which have been carried out with MSS (E-s) and ISS have shown the compatibility. The absence of characteristics for RNSS and RNS showed the absence of planned deployment in this band. Therefore, putting forward the identification for IMT to WRC-23 would cause unnecessary delay in the identification and cause undue burden to WRC-23 preparations. In addition, a request for the IMT identification to be considered at a future competent WRC should be addressed under WRC-19 agenda item 10 and is out of the scope of WRC-19 agenda item 1.13.

2/1.13/4.10.4 Method J4: Identification of the frequency band 66-71 GHz for IMT in accordance with the following two alternatives and retention of the frequency band in RR No. 5.553

Alternative 1

Under this alternative, identify the 66-71 GHz frequency band for the terrestrial component of IMT within the land mobile service in Regions or globally, and retain the frequency band in RR No. **5.553**.

Alternative 2

Under this alternative, identify the 66-71 GHz frequency band for the terrestrial component of IMT in Regions or globally, and retain the frequency band in RR No. **5.553**.

Reasons and views related to these two alternatives are provided at the beginning of section 4.

Views were expressed that the course and sequence of actions, scope of work, the validity and the implementability of this method are totally ambiguous, confusing, unclear and incomplete. Consequently, this method should therefore not be included in the CPM text.

For both alternatives, this method contains potential conditions for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies.

2/1.13/4.10.4.1 Condition J4a: Measures for coexistence with MGWS and other WAS

Option 1:

In order to take into account that the frequency band is intended to be used for IMT and multiple gigabit wireless systems (MGWS) and other wireless access systems (WAS) technologies for similar deployments and that coexistence techniques would ensure local compatibility, reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- that administrations, when implementing or planning to implement IMT and MGWS and other WAS in the frequency band 66-71 GHz, take into account the latest technical characteristics of IMT and MGWS and other WAS, as provided in ITU-R Reports and Recommendations including, when available, coexistence techniques as appropriate;
- and
- to invite ITU-R to develop Recommendations and Reports that will assist administrations in ensuring that applications and services in the frequency band 66-71 GHz can utilize the frequency band efficiently including the development of appropriate coexistence techniques between IMT and MGWS and other WAS, where needed.

Reasons: The frequency band 66-71 GHz is intended to be used for both IMT and MGWS/WAS technologies under similar deployment scenarios and, as a consequence, they may operate in the

same locations. The development of appropriate coexistence techniques within the ITU would assist administrations implementing both IMT and MGWS and other WAS in ensuring local compatibility.

Views were expressed that no consensus was reached to include this option due to the fact that many terms above are unclear.

Views were expressed that the coexistence between IMT and WAS/MGWS must be clearly addressed to protect WAS/MGWS in the WRC Resolution. Furthermore these conditions must contain regulatory procedural measures, which are implementable.

Views were expressed that this option is out of the scope of agenda item 1.13 since A.1 1.13 should only address IMT Identification and should not in any means new identification to MGWS/WAS, neither in new resolution or in FN. ITU-R WRC Resolution should not be intended to promote MGWS systems or any other systems, which are outside the scope of agenda item 1.13 of WRC-19. Instead, WRC19 AI 1.13 requested to conduct sharing and compatibility studies between IMT and other primary services within the given frequency bands. The coexistence between the systems within the same service can be addressed in the relevant ITU-R Study Groups and do not require WRC Resolution noting that each administration may decide on the systems to be implemented within its territory, which is a national matter.

Option 2:

This frequency band is intended to be used for IMT implementation. In some countries, this band might be also used by other systems such as wireless access systems (WAS) technologies including multiple gigabit wireless systems (MGWS). Accordingly, coexistence techniques between IMT and other systems may be needed to facilitate local compatibility, which can be reflected in WRC Resolution or Recommendation:

- that administrations wishing to implement IMT in the frequency band 66-71 GHz, consider, as appropriate, coexistence measures with MGWS and other WAS systems, which are either implemented or planned to be implemented, taking into account the relevant ITU-R Reports and Recommendations.

Option 3:

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force as it is based on an optional concept, nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking, as it does not have legal and procedural support and in no way would address the protection of services of other administrations, due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity, or otherwise, of that decision, if such decision is made unilaterally. In case that the interfering administration does not respond to the invitation, then the protection of the victim service would be put at the mercy of the interfering service.

Option 4:

No condition is necessary.

2/1.13/4.10.4.2 Condition J4b: Measures to protect other services

View 1:

Studies were contributed to CPM19-2 which clearly indicate that no conditions are necessary to protect MSS in the band 66-71 GHz. For MSS (Earth-to-space), there is a large protection margin between the aggregate interference from IMT and the level that could potentially cause interference to an MSS space station. For MSS (space-to-Earth), required separation distances between IMT and MSS earth stations are small, and this matter can be treated on a national basis.

View 2:

Views were expressed that conditions, if any, needed to ensure protection of this service were not developed as no ITU-R studies have been done and individual studies submitted to CPM19-2 do not provide a sufficient basis for regulatory measures.

2/1.13/4.11 Item K: Frequency band 71-76 GHz

2/1.13/4.11.1 Method K1: NOC

No change to the Radio Regulations.

2/1.13/4.11.2 Method K2: Identification of the frequency band 71-76 GHz for IMT in accordance with the following two alternatives

Alternative 1

Under this alternative, identify the 71-76 GHz frequency band for the terrestrial component of IMT within the LMS.

Alternative 2

Under this alternative, identify the 71-76 GHz frequency band for the terrestrial component of IMT.

Reasons and views related to these two alternatives are provided at the beginning of section 4.

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies (see section 2/1.13/3.2.10).

2/1.13/4.11.2.1 Condition K2a: Protection measures for the RLS

Introduce in the WRC Resolution corresponding to the IMT identification of this frequency band unwanted emission limits into 76-81 GHz from IMT BS and UE operating on frequency band 71-76 GHz.

2/1.13/4.11.2.2 Condition K2b: Protection measures for the FSS (space-to-Earth)

Option 1:

Invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations.

Views were expressed that for cross-border protection of earth stations, coordination procedures in RR Articles 9 and 11 would apply. The ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process

(in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Option 3:

No condition is necessary.

2/1.13/4.11.2.3 Condition K2c: Protection measures for multiple services

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

Option 1:

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. 9.21 in the corresponding footnote.

View 1:

There are no criteria for the BR to identify concerned administrations, and the application of RR No. 9.21 would create an undue burden on administrations and on the BR. It is not implementable and enforceable.

View 2:

Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.

Option 2:

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

Views were expressed that there are no criteria to identify concerned administrations nor procedure to apply it. This would create an undue burden on administrations and on BR. It is not implementable and enforceable.

Option 3:

No condition is necessary.

View 1:

Option 3 does not provide protection for incumbent services if Conditions K2a-K2b to protect specific services do not apply.

View 2:

The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbent services, thus there is no need for the addition of some of the conditions indicated in Conditions K2a-K2b.

2/1.13/4.12 Item L: Frequency band 81-86 GHz

2/1.13/4.12.1 Method L1: NOC

No change to the Radio Regulations.

2/1.13/4.12.2 Method L2: Identification of the frequency band 81-86 GHz for IMT in accordance with the following two alternatives

Alternative 1

Under this alternative, identify the 81-86 GHz frequency band for the terrestrial component of IMT within the LMS.

Alternative 2

Under this alternative, identify the 81-86 GHz frequency band for the terrestrial component of IMT.

Reasons and views related to these two alternatives are provided at the beginning of section 4.

For both alternatives, this method contains potential conditions, as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies (see section 2/1.13/3.2.11).

2/1.13/4.12.2.1 Condition L2a: Protection measures for the EESS (passive)

Option 1:

Introduce in Table 1-1 of Resolution **750 (Rev.WRC-15)** limits on unwanted emissions in the frequency band 86-92 GHz from IMT BSs and IMT mobile stations within the 81-86 GHz frequency band and add a cross-reference to Resolution **750 (Rev.WRC-15)** in the RR footnote that identifies the frequency band for IMT.

Option 2:

No condition necessary.

Views were expressed that Option 2 contradicts the results of all sharing and compatibility studies presented in ITU-R and does not provide protection to the EESS (passive) in the adjacent frequency band 86-92 GHz.

2/1.13/4.12.2.2 Condition L2b: Protection measures for the RLS

Introduce in the WRC Resolution corresponding to the IMT identification of this frequency band unwanted emission limits into 76-81 GHz from IMT BS and UE operating on frequency band 81-86 GHz.

2/1.13/4.12.2.3 Condition L2c: Protection measures for the RAS

Option 1:

The RAS frequency band 81- 86 GHz is covered by RR No. **5.149**. Coexistence with the IMT could be possible with proper mitigation and coordination measures. ITU-R should be invited to update existing ITU-R Recommendations or develop new ITU-R Recommendations, as appropriate, to provide information on possible coordination and protection measures and assist the administrations in this matter.

Views were expressed that protection measures for other services should not include the development of ITU-R Recommendations since this may be a time-consuming and complex process

(in particular when more than one ITU-R group is involved) and could be opposed by one administration at the level of adoption.

Option 2:

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution, cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

Option 3:

No condition is necessary.

2/1.13/4.12.2.4 Condition L2d: Protection measures for the FSS (Earth-to-space)

Option 1:

- Introducing in the WRC Resolution corresponding to the IMT identification of this frequency band a mandatory limit on the maximum TRP of IMT BSs of [TBD] dB(W/200 MHz) to provide protection to the FSS (Earth-to-space) in the frequency band.
- Requiring that the combined tilt (electrical and mechanical) of IMT BSs should normally not be higher than 0 degrees.

Views were expressed that the condition for electrical tilt is not implementable and could not be enforced by administrations due to the word “normally” used when defining limits of 0 degrees for electrical tilt. Studies also found that the interference impact on satellite receivers is significant even for a low number of outdoor IMT UEs at elevations above 0 degrees. Moreover, the antenna pattern of IMT BS in this option is not defined and in practice any antenna for the IMT BS could be used. When the antenna gain of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the FSS.

Views were expressed that studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevations above 0 degrees. Therefore, provisions are needed which are consistent with the assumptions.

Option 2:

- Introducing in the WRC Resolution corresponding to the IMT identification of this frequency band a mandatory angular e.i.r.p. mask for the emissions of IMT BSs in the skyward direction.

Views were expressed that such an angular e.i.r.p. mask would be extremely complicated to implement with active antennas. The analysis that supports this mask is unclear and it is noted that all BSs would need to be pointing in the skyward direction towards the FSS space station, which is unlikely to be representative of IMT deployments. The interference potential depends mainly on the number of simultaneous cases where there is emission in the skyward direction. The e.i.r.p. mask would be unduly restrictive.

Option 3:

No condition is necessary.

View 1:

This option contradicts the results of sharing and compatibility studies, which were based on limitations of the IMT-2020 e.i.r.p. and the assumption that the elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees. The impact of the IMT-2020 BS antenna main beam,

pointing in the upper hemisphere without any e.i.r.p. limit, was not assessed, however it is possible in accordance with this option. This option does not ensure the protection of the FSS.

View 2:

These regulatory options are not necessary since studies show that sharing is feasible without any additional mandatory limits.

2/1.13/4.12.2.5 Condition L2e: Protection measures for multiple services

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

Option 1:

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. **9.21** in the corresponding footnote.

View 1:

*There are no criteria for the BR to identify concerned administrations, and the application of RR No. **9.21** would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

View 2:

Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.

Option 2:

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.

Option 3:

No condition is necessary.

View 1:

Option 3 does not provide protection for incumbent services if Conditions L2a-L2d to protect specific services do not apply.

View 2:

The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbents services, thus there is no need for the addition of some of the conditions indicated in Conditions L2a-L2d.

2/1.13/5 Regulatory and procedural considerations

2/1.13/5.1 For Item A: Frequency band 24.25-27.5 GHz

2/1.13/5.1.1 For Method A1, see Section 2/1.13/5.14.1

2/1.13/5.1.2 For Method A2

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

22-24.75 GHz

| Allocation to services | | |
|---|--|---|
| Region 1 | Region 2 | Region 3 |
| 24.25-24.45 FIXED <u>MOBILE except aeronautical</u> <u>mobile ADD 5.A113</u> <u>MOD 5.338A*</u> | 24.25-24.45 <u>MOBILE except aeronautical</u> <u>mobile ADD 5.A113</u> <u>MOD 5.338A*</u> RADIONAVIGATION | 24.25-24.45 <u>RADIONAVIGATION</u> FIXED MOBILE <u>ADD 5.A113</u> <u>MOD 5.338A*</u> <u>RADIONAVIGATION</u> |
| 24.45-24.65 FIXED INTER-SATELLITE <u>MOBILE except aeronautical</u> <u>mobile ADD 5.A113</u> <u>MOD 5.338A*</u> | 24.45-24.65 INTER-SATELLITE <u>MOBILE except aeronautical</u> <u>mobile ADD 5.A113</u> <u>MOD 5.338A*</u> RADIONAVIGATION 5.533 | 24.45-24.65 FIXED INTER-SATELLITE MOBILE <u>ADD 5.A113</u> <u>MOD 5.338A*</u> RADIONAVIGATION 5.533 |
| 24.65-24.75 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE <u>MOBILE except aeronautical</u> <u>mobile ADD 5.A113</u> <u>MOD 5.338A*</u> | 24.65-24.75 INTER-SATELLITE <u>MOBILE except aeronautical</u> <u>mobile ADD 5.A113</u> <u>MOD 5.338A*</u> RADIOLOCATION-SATELLITE (Earth-to-space) | 24.65-24.75 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE MOBILE <u>ADD 5.A113</u> <u>MOD 5.338A*</u> 5.533 |

MOD**24.75-29.9 GHz**

| Allocation to services | | |
|--|--|--|
| Region 1 | Region 2 | Region 3 |
| 24.75-25.25 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B <u>MOBILE except aeronautical</u> <u>mobile ADD 5.A113</u> <u>MOD 5.338A*</u> | 24.75-25.25 FIXED-SATELLITE (Earth-to-space) 5.535 <u>MOBILE except aeronautical</u> <u>mobile ADD 5.A113</u> <u>MOD 5.338A*</u> | 24.75-25.25 FIXED FIXED-SATELLITE (Earth-to-space) 5.535 <u>MOBILE ADD 5.A113</u> <u>MOD 5.338A*</u> |
| 25.25-25.5 | FIXED INTER-SATELLITE 5.536 MOBILE <u>ADD 5.A113 MOD 5.338A*</u> Standard frequency and time signal-satellite (Earth-to-space) | |
| 25.5-27 | EARTH EXPLORATION-SATELLITE (space-to Earth) <u>MOD 5.536B **</u> FIXED INTER-SATELLITE 5.536 MOBILE <u>ADD 5.A113 MOD 5.338A*</u> SPACE RESEARCH (space-to-Earth) <u>MOD 5.536C**</u> Standard frequency and time signal-satellite (Earth-to-space) <u>MOD 5.536A**</u> | |
| 27-27.5 FIXED INTER-SATELLITE 5.536 MOBILE <u>ADD 5.A113</u> <u>MOD 5.338A*</u> | 27-27.5 FIXED FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE 5.536 5.537 MOBILE <u>ADD 5.A113 MOD 5.338A*</u> | |

Notes: *MOD **5.338A** is needed for Method A2, Alternatives 1 and 2, Condition A2a, Option 1, for Alternatives 1 and 2, Condition A2b, Option 1 ;

MOD **5.536A, MOD **5.536B** and MOD **5.536C** are needed for Method A2, Alternatives 1 and 2, Condition A2c, Option 2. Under this option, another possibility would also be SUP **5.536A**, SUP **5.536B** and SUP **5.536C**.

Note: MOD **5.338A** should be inserted in band contained in active service band of Resolution **750 (Rev.WRC-15)**.

For Method A2, Alternative 1, Condition A2a**ADD**

5.A113a The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolutions **[A113-IMT 26 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply.][Resolution **[A113-IMT 26 GHZ] (WRC-19)** applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

For Method A2, Alternative 2, Condition A2a, Options 1 and 2

ADD

5.A113b The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolutions **[A113-IMT 26 GHZ]** (WRC-19) and **750 (Rev.WRC-19)** apply.][Resolution **[A113-IMT 26 GHZ]** (WRC-19) applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

For Method A2, Alternative 2, Condition A2a, Options 3, 4 and 5

ADD

5.A113c The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. (WRC-19)

NOC

5.338A In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 30-31.3 GHz, 49.7-50.2 GHz, 50.4-50.9 GHz, 51.4-52.6 GHz, 81-86 GHz and 92-94 GHz, Resolution **750 (Rev.WRC-15)** applies. (WRC-15)

Note: When preparing the text for a proposed new footnote RR No. 5.A113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.A113a, 5.A113b or 5.A113c above could be selected. In addition, only one or none of the texts within square brackets should be kept based on the conditions selected when identifying the band for IMT.

For Method A2, Alternative 1, Condition A2g, Option 1

ADD

5.A113d The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. **9.21**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[A113-IMT 26 GHZ]** (WRC-19) and **750 (Rev.WRC-19)** apply. (WRC-19)

For Method A2, Alternative 1, Condition A2g, Option 2

ADD

5.A113e The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in

the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions [A113-IMT 26 GHZ] (WRC-19) and 750 (Rev.WRC-19) apply. (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.A113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.A113d or 5.A113e above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.

For Method A2, Alternatives 1 and 2, Condition A2a, Option 1, and for Alternatives 1 and 2, Condition A2b, Option 1

MOD

5.338A In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 24.25-[TBD] / [24.45 / 25.25 / 26.5 / 27.5] GHz, 30-31.3 GHz, 49.7-50.2 GHz, 50.4-50.9 GHz, 51.4-52.6 GHz, 81-86 GHz and 92-94 GHz, Resolution **750 (Rev.WRC-1519)** applies. (WRC-1519)

For Method A2, Alternatives 1 and 2, Condition A2c, Option 2

MOD

5.536A Administrations operating earth stations in the Earth exploration-satellite service or the space research service shall not claim protection from stations (except IMT stations) in the fixed and mobile services operated by other administrations. In addition, earth stations in the Earth exploration-satellite service or in the space research service should be operated taking into account the most recent version of Recommendation ITU-R SA.1862. (WRC-1219)

MOD

5.536B In Saudi Arabia, Austria, Bahrain, Belgium, Brazil, China, Korea (Rep. of), Denmark, Egypt, United Arab Emirates, Estonia, Finland, Hungary, India, Iran (Islamic Republic of), Ireland, Israel, Italy, Jordan, Kenya, Kuwait, Lebanon, Libya, Lithuania, Moldova, Norway, Oman, Uganda, Pakistan, the Philippines, Poland, Portugal, the Syrian Arab Republic, Dem. People's Rep. of Korea, Slovakia, the Czech Rep., Romania, the United Kingdom, Singapore, Sweden, Tanzania, Turkey, Viet Nam and Zimbabwe, earth stations operating in the Earth exploration-satellite service in the frequency band 25.5-27 GHz shall not claim protection from, or constrain the use and deployment of, stations (except IMT stations) of the fixed and mobile services. (WRC-1519)

MOD

5.536C In Algeria, Saudi Arabia, Bahrain, Botswana, Brazil, Cameroon, Comoros, Cuba, Djibouti, Egypt, United Arab Emirates, Estonia, Finland, Iran (Islamic Republic of), Israel, Jordan, Kenya, Kuwait, Lithuania, Malaysia, Morocco, Nigeria, Oman, Qatar, Syrian Arab Republic, Somalia, Sudan, South Sudan, Tanzania, Tunisia, Uruguay, Zambia and Zimbabwe, earth stations operating in the space research service in the band 25.5-27 GHz shall not claim protection from, or constrain the use and deployment of, stations (except IMT stations) of the fixed and mobile services. (WRC-1219)

Note: Under this option, an alternative to the modification of RR Nos. 5.536A, 5.536B and 5.536C as proposed above, can be to suppress these three provisions.

For Method A2, Alternatives 2, Condition A2a, Option 2

MOD

RESOLUTION 750 (REV.WRC-~~15~~19)

Compatibility between the Earth exploration-satellite service (passive) and relevant active services

The World Radiocommunication Conference (~~Geneva, 2015~~Sharm el-Sheikh, 2019),

...

resolves

2 to urge administrations to take all reasonable steps to ensure that unwanted emissions of active service stations in the frequency bands and services listed in Table 1-2 below do not exceed the recommended maximum levels contained in that table, noting that EESS (passive) sensors provide worldwide measurements that benefit all countries, even if these sensors are not operated by their country;

...

TABLE 1-2

| EESS (passive) band | Active service band | Active service | Recommended maximum level of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band ¹ |
|---|-----------------------|----------------|--|
| ... | ... | ... | ... |
| <u>23.6-24.0 GHz</u> | <u>24.25-27.5 GHz</u> | <u>Mobile</u> | <u>TBD (see section 2/1.13/3.2 and the views below)</u> |
| <p><i>View 1:</i> Views were expressed that the cross reference to Section 2/1.13/3.2.1 does not reflect the latest information regarding the unwanted emission limits. There have been several proposals of values during CPM19-2, including: -20, -28, -32, -32 to -35, -32 to -37, -32 to -42, -33.5, -37, -42, -49.3 and -55 dB(W/200 MHz) for IMT base stations and -20, -24 to -28, -28, -28 to -30, -28 to -38, -29.7, -37, -38, -45 and -51 dB(W/200 MHz) for IMT mobile stations. Further discussion is needed for the selection of a proposed value.</p> <p><i>View 2:</i> The United States and the Republic of Korea request that unwanted emission limits of -20 dB(W/200 MHz) be included (BS/UE) in the range of options for the 24 GHz band.</p> <p><i>View 3:</i> Based on the results of studies conducted by ITU-R, some administrations are of the view that unwanted emission limits in the band 23.6-24.0 GHz, to protect EESS(passive) from IMT operating within 24.25-27.5 GHz, should be considered within the ranges:</p> <ul style="list-style-type: none"> – IMT BS: -32 to -37 dB(W/200 MHz) – IMT UE: -28 to -30 dB(W/200 MHz) <p><i>View 4:</i> The values -42 dB(W/200 MHz) (BS) and -38 dB(W/200 MHz) (UE) were derived based on the baseline assumptions of ITU-R and the assumption of beamforming antenna. It is noted that less stringent values have often not been</p> | | | |

justified with any technical background and are sometimes proposed with the rationale that EESS (passive) should not constraint IMT, which is against the ITU principles.

View 5:

The following values for unwanted emission limits were received at CPM19-2.

–20, –28, –32, –32 to –35, –32 to –37, –32 to –42, –33.5, –37, –42, –49.3 and –55 dB(W/200 MHz) for BS and –20, –24 to –28, –28, –28 to –30, –28 to –38, –29.7, –37, –38, –45 and –51 dB(W/200 MHz).

View 6:

View were expressed that the following values for the unwanted emission limits that resulted from majority of the studies conducted in TG 5/1 on EESS protection within 23.6-24 GHz and supported by majority of Regional Groups and administrations in CPM19-2 should be as follow:

For BS: –20, –28, –32, –32 to –35, –32 to –37, –33.5, –37 dB(W/200 MHz), and

For UE: –20, –24 to –28, –28, –28 to –30, –29.7, –37 dB(W/200 MHz)

The adoption of the above values will be enough for protection of EESS services which also could be feasible for IMT implementation. Any consideration of more stringent unwanted emission limit values for over-protection requirement by certain ITU membership will make deployment of IMT systems within 24.25-27.5 GHz not feasible. The adoption of values above –32 dB(W/200 MHz) will even increase the system complexity, reduce IMT system performance and increase equipment cost significantly.

View 7:

The view was expressed that when using baseline assumptions agreed in ITU-R (i.e. single element pattern, baseline BS distribution, apportionment of EESS (passive) protection criteria)), studies depict very similar results, leading to the following range of necessary IMT-2020 stations unwanted emissions levels:

For BS: from –49 to –42 dB(W/200 MHz)

For UE: from –45 to –38 dB(W/200 MHz)

View 8:

Concerns were expressed about a number of unwanted emission limits that were suggested to CPM19-2 without any technical studies supporting the values (in particular the proposal made orally for a –20 dB(W/200 MHz) limit for both BS and UE) or introducing unjustified new assumptions to artificially decrease the potential impact of IMT-2020 on EESS (passive) (e.g. the manufacturing factor) in order to propose relaxed unwanted emission limits that obviously will not provide any protection of EESS (passive).

View 9:

The view was expressed that without new compelling elements (e.g. antenna pattern measurements), in particular on relevant IMT-2020 antenna model, only levels of –55 dB(W/200 MHz) (for BS) and –51 dB(W/200 MHz) (for UE) resulting from study B would fully ensure protection of all existing and under development EESS (passive) sensors in the band 23.6-24 GHz.

View 10:

Unwanted emission limits more stringent than –33.5 dB(W/200 MHz) for IMT base stations and –29.7 dB(W/200 MHz) for IMT user equipment should not be considered for inclusion in Resolution 750 (Rev.WRC-15). During CPM19-2, proposals for unwanted emission limits included: –20, –28, –32, –32 to –35, –33.5 dB(W/200 MHz) for IMT base stations and –20, –24 to –28, –28, –28 to –30, –29.7 dB(W/200 MHz) for IMT mobile stations among other more conservative limits. While there is a need to protect EESS (passive) operations in the band 23.6-24.0 GHz, it is also important to recognize that imposing overly conservative limits prevents efficient use of spectrum.

View 11:

Views were expressed that the optimal conditions will see IMT using the band 24.25-27.5 GHz while ensuring the protection of EESS (passive) in the 23.6-24 GHz band. Studies submitted to TG 5/1 showed that values no more stringent than the following are required:

–35 to –32 dB(W/200 MHz) for IMT BS.

–28 to –30 dB(W/200 MHz) for IMT UE.

As unwanted emissions will not in reality exceed these upper limits, and levels for most IMT stations will in practice be lower with some margin, less onerous values can also be considered.

View 12:

CEPT recently adopted unwanted emission values of –42 dB(W/200 MHz) (for BS case) and –38 dB(W/200 MHz) (for UE case) to be applied to IMT-2020 systems to ensure protection of EESS (passive) sensors in the 23.4-26 GHz (see Decision ECC/DEC/(18)06).

| | | | |
|-----|-----|-----|-----|
| ... | ... | ... | ... |
|-----|-----|-----|-----|

Notes to Table 1-2:

¹ The unwanted emission power level is to be understood here as is understood to mean the level measured at the antenna port, unless specified in terms of total radiated power.

...

For Method A2, Alternatives 2, Condition A2a, Option 3

Note 1: Due to time constraints, the text in this draft new Recommendation has not yet been fully reviewed. WRC-19 is invited to carefully examine the text with a view to resolving any issues.

ADD

DRAFT NEW RECOMMENDATION [26GHZ LIMITS] (WRC-19)

Unwanted emission limit of IMT mobile stations operating in the frequency band 24.25-27.5 GHz to facilitate compatibility with EESS (passive) in the frequency band 23.6-24.0 GHz

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a) that Report ITU-R M.2292-0 specifies the characteristics of terrestrial IMT-Advanced systems for frequency sharing/ interference analyses;
- b) that Recommendations ITU-R M.1581 and ITU-R M.2071 specify the generic unwanted emission characteristics of IMT-2000 and IMT-Advanced mobile stations, respectively;
- c) that Resolution **238 (WRC-15)** has invited ITU-R to study the compatibility between the mobile service and other primary services in the 24.25-27.5 GHz band;
- d) that the unwanted emissions into the frequency band 23.6-24.0 GHz from IMT stations operating in the frequency band 24.25-27.5 GHz need to be limited in order to facilitate compatibility with EESS (passive) in the frequency band 23.6-24.0 GHz;
- e) that stringent limits may lead to an increase in size or in complexity of IMT radio equipment, but will in general increase protection of other radio services from interference;
- f) the need to facilitate global harmonization, circulation of equipment, roaming and to promote economies of scale;
- g) that ITU-R may revise existing Recommendations or develop new Recommendations for the frequency arrangements of IMT networks after WRC-19 to include the frequency band 24.25-27.5 GHz,

recognizing

- a) that limitation of unwanted emissions from IMT stations facilitates compatibility with EESS (passive) in the frequency band 23.6-24.0 GHz;
- b) that the unwanted emission limits of the IMT stations will:
 - help manage the risk of interference from IMT usage;
 - help achieve global harmonization of mobile stations;

- c) that the unwanted emission limits of the IMT mobile stations need to be technically feasible from the point of view of practical implementation of IMT mobile stations;
- d) that administrations deploying IMT systems may take other measures in addition to the unwanted emission limits specified in *recommends* 1 and 2 to further improve the compatibility with the service EESS (passive), depending on national conditions;
- e) that according to No. **5.340**, all emissions are prohibited in the 23.6-24 GHz band,

noting

that EESS (passive) sensors provide worldwide measurements that may benefit all countries, even if these sensors are not operated by their country,

recommends

1 to urge administrations to take all reasonable steps to ensure that unwanted emissions of active service stations in the frequency bands and services listed in Table 1 below do not exceed the recommended maximum levels contained in that table;

2 that administrations should, when deciding on the relevant IMT unwanted emissions of an IMT mobile station operating in the frequency band 24.25-27.5 GHz, take all possible mitigation measures including IMT channel bandwidth to facilitate compatibility with passive satellite services in the frequency band 23.6-24.0 GHz.

TABLE 1

| EESS (passive) band | Active service band | Active service | Recommended unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band |
|---------------------|---------------------|----------------|--|
| 23.6-24.0 GHz | 24.25-27.5 GHz | Mobile | For IMT-2020 UE: <i>TBD</i> (see section 2/1.13/3.2 and the views below) For IMT-2020 BS: <i>TBD</i> (see section 2/1.13/3.2 and the views below) |

View 1:

Views were expressed that the cross reference to Section 2/1.13/3.2.1 does not reflect the latest information regarding the unwanted emission limits. There have been several proposals of values during CPM19-2, including: -20, -28, -32, -32 to -35, -32 to -37, -32 to -42, -33.5, -37, -42, -49.3 and -55 dB(W/200 MHz) for IMT base stations and -20, -24 to -28, -28, -28 to -30, -28 to -38, -29.7, -37, -38, -45 and -51 dB(W/200 MHz) for IMT mobile stations. Further discussion is needed for the selection of a proposed value.

View 2:

The United States and the Republic of Korea request that unwanted emission limits of -20 dB(W/200 MHz) be included (BS/UE) in the range of options for the 24 GHz band.

View 3:

Based on the results of studies conducted by ITU-R, some Administrations are of the view that unwanted emission limits in the band 23.6-24.0 GHz, to protect EESS(passive) from IMT operating within 24.25-27.5 GHz, should be considered within the ranges:

- *IMT BS: -32 to -37 dB(W/200 MHz)*
- *IMT UE: -28 to -30 dB(W/200 MHz)*

View 4:

The values -42 dB(W/200 MHz) (BS) and -38 dB(W/200 MHz) (UE) were derived based on the baseline assumptions of ITU-R and the assumption of beamforming antenna. It is noted that less stringent values have often not been justified with any technical background and are sometimes proposed with the rationale that EESS (passive) should not constrain IMT, which is against the ITU principles.

View 5:

The following values for unwanted emission limits were received at CPM19-2.

–20, –28, –32, –32 to –35, –32 to –37, –32 to –42, –33.5, –37, –42, –49.3 and –55 dB(W/200 MHz) for BS and –20, –24 to –28, –28, –28 to –30, –28 to –38, –29.7, –37, –38, –45 and –51 dB(W/200 MHz).

View 6:

View were expressed that the following values for the unwanted emission limits that resulted from majority of the studies conducted in TG 5/1 on EESS protection within 23.6-24GHz and supported by majority of Regional Groups and Administrations in CPM19-2 should be as follow:

For BS: –20, –28, –32, –32 to –35, –32 to –37, –33.5, –37 dB(W/200 MHz), and

For UE: –20, –24 to –28, –28, –28 to –30, –29.7, –37 dB(W/200 MHz)

The adoption of the above values will be enough for protection of EESS services which also could be feasible for IMT implementation. Any consideration of more stringent unwanted emission limit values for over-protection requirement by certain ITU membership will make deployment of IMT systems within 24.25-27.5GHz not feasible. The adoption of values above –32 dB(W/200 MHz) will even increase the system complexity, reduce IMT system performance and increase equipment cost significantly.

View 7:

The view was expressed that when using baseline assumptions agreed in ITU-R (i.e. single element pattern, baseline BS distribution, apportionment of EESS (passive) protection criteria)), studies depict very similar results, leading to the following range of necessary IMT-2020 stations unwanted emissions levels:

For BS : from –49 to –42 dB(W/200 MHz)

For UE :from –45 to –38 dB(W/200 MHz)

View 8:

Concerns were expressed about a number of unwanted emission limits that were suggested to CPM19-2 without any technical studies supporting the values (in particular the proposal made orally for a -20 dB(W/200 MHz) limit for both BS and UE) or introducing unjustified new assumptions to artificially decrease the potential impact of IMT-2020 on EESS (passive) (e.g. the manufacturing factor) in order to propose relaxed unwanted emission limits that obviously will not provide any protection of EESS (passive).

View 9:

The view was expressed that without new compelling elements (e.g. antenna pattern measurements), in particular on relevant IMT-2020 antenna model, only levels of -55 dB(W/200 MHz) (for BS) and -51 dB(W/200 MHz) (for UE) resulting from study B would fully ensure protection of all existing and under development EESS (passive) sensors in the band 23.6-24 GHz.

View 10:

Unwanted emission limits more stringent than –33.5 dB(W/200 MHz) for IMT base stations and –29.7 dB(W/200 MHz) for IMT user equipment should not be considered for inclusion in Res. 750 (Rev.WRC-15). During CPM 19-2, proposals for unwanted emission limits included: –20, –28, –32, –32 to –35, –33.5 dB(W/200 MHz) for IMT base stations and –20, –24 to –28, –28, –28 to –30, –29.7 dB(W/200 MHz) for IMT mobile stations among other more conservative limits. While there is a need to protect EESS (passive) operations in the band 23.6-24.0 GHz, it is also important to recognize that imposing overly conservative limits prevents efficient use of spectrum.

View 11:

Views were expressed that the optimal conditions will see IMT using the band 24.25-27.5 GHz while ensuring the protection of EESS (passive) in the 23.6-24 GHz band. Studies submitted to TG 5/1 showed that values no more stringent than the following are required:

–35 to –32 dB(W/200 MHz) for IMT BS.

–28 to –30 dB(W/200 MHz) for IMT UE.

As unwanted emissions will not in reality exceed these upper limits, and levels for most IMT stations will in practice be lower with some margin, less onerous values can also be considered.

View 12:

CEPT recently adopted unwanted emission values of –42 dB(W/200 MHz) (for BS case) and –38 dB(W/200 MHz) (for UE case) to be applied to IMT-2020 systems to ensure protection of EESS (passive) sensors in the 23.4-26 GHz (see Decision ECC/DEC/(18)06).

For Method A2, Alternatives 2, Condition A2a, Option 4

Note 1: Due to time constraints, the text in this draft new Recommendation has not yet been fully reviewed. WRC-19 is invited to carefully examine the text with a view to resolving any issues.

View:

This option called for a number of concerns, and was requested to be deleted from the CPM Text.

Option 4 is in TOTAL CONTRADICTION with WRC-19 agenda item 1.13 and Resolution 238 (WRC-15). This agenda item addresses IMT-2020 in the following band:

- *24.25-27.5 GHz, 37-40.5 GHz, 42.5-43.5 GHz, 45.5-47 GHz, 47.2-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz and 81-86 GHz, which have allocations to the mobile service on a primary basis; and*
- *31.8-33.4 GHz, 40.5-42.5 GHz and 47-47.2 GHz, which may require additional allocations to the mobile service on a primary basis.*

The proposal to remove Table 1-2 from Resolution 750 (Rev.WRC-15) impact provisions to ensure protection of EESS (passive) in a number of compatibility scenarios that are neither related to the mobile services or IMT systems in the bands above, namely covering the following cases:

- *Protection of the EESS (passive) in the 1 400-1 427 MHz band from the radiolocation, fixed and mobile services in the 1 350-1 400 MHz band.*
- *Protection of the EESS (passive) in the 1 400-1 427 MHz band from the space operation (E-to-s) service in the 1 427-1 429 MHz band.*
- *Protection of the EESS (passive) in the 1 400-1 427 MHz band from the fixed and mobile (except aeronautical mobile) services in the 1 427-1 429 MHz band.*
- *Protection of the EESS (passive) in the 1 400-1 427 MHz band from the fixed and mobile services in the 1 429-1 452 MHz band.*
- *Protection of the EESS (passive) in the 31.3-31.5 GHz band from the fixed satellite service in the 31-31.3 GHz band.*
- *Protection of the EESS (passive) in the 86-92 GHz band from the fixed service in the 81-86 GHz band.*
- *Protection of the EESS (passive) in the 86-92 GHz band from the fixed service in the 92-94 GHz band.*

None of these cases are consistent with WRC-19 agenda item 1.13 and Resolution 238 (WRC-15) and there are hence no justification to propose deletion of Table 1-2 as an option in the CPM text on agenda item 1.13.

In addition, such proposal was never presented in ITU-R and was hence not studied at all. It is therefore introduced in Section 4 of the CPM Text (Methods) without any reference to Section 3 dealing with the results of studies, i.e. without any idea of the potential consequences on EESS (passive).

Resolution 750 is one of the most essential tool in Radio Regulations to ensure the protection of EESS (passive). It was agreed at WRC-07 after years of studies in ITU-R and careful regulatory considerations and the World Meteorological Organization will have strong objection to see any modification to this Resolution without any study, in particular at WRC-19 that was is not mandated to do so.

Finally, it has to be highlighted that this Option 4 is far from being complete. The proposed “Regulatory and procedural considerations” related to this option are missing a large number of

necessary elements such as the necessary revisions of Resolution 750 itself, the necessary revisions of RR No. 5.338A and the consequential revisions to Article 5 where RR No. 5.338A is referred to. This Option 4 is therefore strongly objected.

ADD

DRAFT NEW RECOMMENDATION [EESS COMPATIBILITY] (WRC-19)

Compatibility between the Earth exploration-satellite service (passive) and relevant active services

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a) that primary allocations have been made to various space services such as the fixed-satellite service (Earth-to-space), the space operation service (Earth-to-space) and the inter-satellite service and/or to terrestrial services such as the fixed service, the mobile service and the radiolocation service, hereinafter referred to as “active services”, in frequency bands adjacent or nearby to frequency bands allocated to the Earth exploration-satellite service (EESS) (passive) subject to No. 5.340;
- b) that unwanted emissions from active services have the potential to cause unacceptable interference to EESS (passive) sensors;
- c) that, for technical or operational reasons, the general limits in Appendix 3 may be insufficient in protecting the EESS (passive) in specific frequency bands;
- d) that, in many cases, the frequencies used by EESS (passive) sensors are chosen to study natural phenomena producing radio emissions at frequencies fixed by the laws of nature, and therefore shifting frequency to avoid or mitigate interference problems is not possible;
- e) that, in many cases, the frequency bands adjacent or nearby to passive service frequency bands are used and will continue to be used for various active service applications;
- f) that it is necessary to ensure equitable burden sharing for achieving compatibility between active and passive services operating in adjacent or nearby frequency bands;
- g) that Report ITU-R M.2292-0 specifies the characteristics of terrestrial IMT-Advanced systems for frequency sharing/interference analyses;
- h) that Recommendations ITU-R M.1581 and ITU-R M.2071 specify the generic unwanted emission characteristics of IMT-2000 and IMT-Advanced mobile stations, respectively;
- i) that Resolution 238 (WRC-15) has invited ITU-R to study the compatibility between the mobile service and other primary services in the 24.25-27.5 GHz band;
- j) that the unwanted emissions into the frequency band 23.6-24.0 GHz from IMT stations operating in the frequency band 24.25-27.5 GHz need to be limited in order to facilitate compatibility with passive satellite services in the frequency band 23.6-24.0 GHz;
- k) that too stringent limits may lead to an increase in size, cost or in complexity of IMT radio equipment;
- l) the need to facilitate global harmonization, circulation of equipment, roaming and to promote economies of scale;

- m)* that Recommendation ITU-R M.1036 provides the frequency arrangements of IMT networks that will be updated to include the frequency band 24.25-27.5 GHz;
- n)* that the frequency band 1 400-1 427 MHz is used for measuring soil moisture, and also for measuring sea-surface salinity and vegetation biomass,

recognizing

- a)* that Recommendation ITU-R RS.1029 provides the interference criteria for satellite passive remote sensing;
- b)* that studies documented in Report ITU-R SM.2092 do not consider point-to-multipoint communication links in the fixed service in the frequency bands 1 350-1 400 MHz and 1 427-1 452 MHz;
- c)* that limitation of unwanted emissions from IMT stations is one of the factors to facilitate compatibility with passive satellite services in the frequency band 23.6-24.0 GHz;
- d)* that the unwanted emission limits of the IMT stations will:
 - help manage the risk of interference from mobile usage;
 - help achieve global harmonization of mobile stations;
- e)* that the unwanted emission limits of the IMT mobile stations need to be technically feasible from the point of view of practical implementation of IMT mobile stations;
- f)* that different unwanted emission limits for IMT mobile stations operating in the 24.25-27.5 GHz band may be considered, including:
 - IMT-2020 UE: TBD (within the range –20 to –34 dB(W/200 MHz));
 - IMT-2020 BS: TBD (within the range –20 to –42 dB(W/200 MHz));
- g)* that administrations deploying IMT systems may take other measures in addition to the unwanted emission limits specified in *recommends* 1 and 2 to further improve the compatibility with the service passive satellite services, depending on national conditions,

noting

- a)* that EESS (passive) sensors provide worldwide measurements that may benefit all countries, even if these sensors are not operated by their country,
- b)* that the compatibility studies between relevant active and passive services operating in adjacent and nearby frequency bands are documented in Report ITU-R SM.2092;
- c)* that the compatibility studies between IMT systems in the frequency bands 1 375-1 400 MHz and 1 427-1 452 MHz and EESS (passive) systems in the frequency band 1 400-1 427 MHz are documented in Report ITU-R RS.2336,

recommends

- 1 to urge administrations to take all reasonable steps to ensure that unwanted emissions of active service stations in the frequency bands and services listed in Table 1 below do not exceed the recommended maximum levels contained in that table, noting that EESS (passive) sensors provide worldwide measurements that benefit all countries, even if these sensors are not operated by their country;
- 2 that administrations should, when deciding on the relevant IMT unwanted emissions of an IMT mobile station operating in the frequency band 24.25-27.5 GHz, take all possible mitigation measures including IMT channel bandwidth to facilitate compatibility with passive satellite services in the frequency band 23.6-24.0 GHz.

TABLE 1

| EESS (passive) band | Active service band | Active service | Recommended unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band |
|---------------------|---------------------|-----------------------------------|--|
| 1 400-1 427 MHz | 1 350-1 400 MHz | Radiolocation ² | –29 dBW in the 27 MHz of the EESS (passive) band |
| | | Fixed | –45 dBW in the 27 MHz of the EESS (passive) band for point-to-point |
| | | Mobile | –60 dBW in the 27 MHz of the EESS (passive) band for mobile service stations except transportable radio-relay stations –45 dBW in the 27 MHz of the EESS (passive) band for transportable radio-relay stations |
| | 1 427-1 429 MHz | Space operation (E-to-s) | –36 dBW in the 27 MHz of the EESS (passive) band |
| | 1 427-1 429 MHz | Mobile except aeronautical mobile | –60 dBW in the 27 MHz of the EESS (passive) band for mobile service stations except IMT stations and transportable radio-relay stations ³ –45 dBW in the 27 MHz of the EESS (passive) band for transportable radio-relay stations |
| | | Fixed | –45 dBW in the 27 MHz of the EESS (passive) band for point-to-point |
| | 1 429-1 452 MHz | Mobile | –60 dBW in the 27 MHz of the EESS (passive) band for mobile service stations except IMT stations, transportable radio-relay stations and aeronautical telemetry stations –45 dBW in the 27 MHz of the EESS (passive) band for transportable radio-relay stations –28 dBW in the 27 MHz of the EESS (passive) band for aeronautical telemetry stations ³ |
| | | Fixed | –45 dBW in the 27 MHz of the EESS (passive) band for point-to-point |
| 23.6-24.0 GHz | 24.25-27.5 GHz | Mobile | For IMT-2020 UE: TBD (see Section 2/1.13/3.2 and the views below) For IMT-2020 BS: TBD (see Section 2/1.13/3.2 and the views below) |

View 1:

Views were expressed that the cross reference to Section 2/1.13/3.2.1 does not reflect the latest information regarding the unwanted emission limits. There have been several proposals of values during CPM19-2, including: –20, –28, –32, –32 to –35, –32 to –37, –32 to –42, –33.5, –37, –42, –49.3 and –55 dB(W/200 MHz) for IMT base stations and –20, –24 to –28, –28, –28 to –30, –28 to –38, –29.7, –37, –38, –45 and –51 dB(W/200 MHz) for IMT mobile stations. Further discussion is needed for the selection of a proposed value.

View 2:

The United States and the Republic of Korea request that unwanted emission limits of –20 dB(W/200 MHz) be included (BS/UE) in the range of options for the 24 GHz band.

View 3:

Based on the results of studies conducted by ITU-R, some Administrations are of the view that unwanted emission limits in the band 23.6-24.0 GHz, to protect EESS (passive) from IMT operating within 24.25-27.5 GHz, should be considered within the ranges:

- *IMT BS: –32 to –37 dB(W/200 MHz)*
- *IMT UE: –28 to –30 dB(W/200 MHz)*

View 4:

The values -42 dB(W/200 MHz) (BS) and -38 dB(W/200 MHz) (UE) were derived based on the baseline assumptions of ITU-R and the assumption of beamforming antenna. It is noted that less stringent values have often not been justified with any technical background and are sometimes proposed with the rationale that EESS (passive) should not constraint IMT, which is against the ITU principles.

View 5:

The following values for unwanted emission limits were received at CPM19-2.

-20 , -28 , -32 , -32 to -35 , -32 to -37 , -32 to -42 , -33.5 , -37 , -42 , -49.3 and -55 dB(W/200 MHz) for BS and -20 , -24 to -28 , -28 , -28 to -30 , -28 to -38 , -29.7 , -37 , -38 , -45 and -51 dB(W/200 MHz).

View 6:

Views were expressed that the following values for the unwanted emission limits that resulted from majority of the studies conducted in TG 5/1 on EESS protection within 23.6-24GHz and supported by majority of Regional Groups and Administrations in CPM19-2 should be as follow:

For BS: -20 , -28 , -32 , -32 to -35 , -32 to -37 , -33.5 , -37 dB(W/200 MHz), and

For UE: -20 , -24 to -28 , -28 , -28 to -30 , -29.7 , -37 dB(W/200 MHz)

The adoption of the above values will be enough for protection of EESS services which also could be feasible for IMT implementation. Any consideration of more stringent unwanted emission limit values for over-protection requirement by certain ITU membership will make deployment of IMT systems within 24.25-27.5GHz not feasible. The adoption of values above -32 dB(W/200 MHz) will even increase the system complexity, reduce IMT system performance and increase equipment cost significantly.

View 7:

The view was expressed that when using baseline assumptions agreed in ITU-R (i.e. single element pattern, baseline BS distribution, apportionment of EESS (passive) protection criteria)), studies depict very similar results, leading to the following range of necessary IMT-2020 stations unwanted emissions levels:

For BS : from -49 to -42 dB(W/200 MHz)

For UE :from -45 to -38 dB(W/200 MHz)

View 8:

Concerns were expressed about a number of unwanted emission limits that were suggested to CPM19-2 without any technical studies supporting the values (in particular the proposal made orally for a -20 dB(W/200 MHz) limit for both BS and UE) or introducing unjustified new assumptions to artificially decrease the potential impact of IMT-2020 on EESS (passive) (e.g. the manufacturing factor) in order to propose relaxed unwanted emission limits that obviously will not provide any protection of EESS (passive).

View 9:

The view was expressed that without new compelling elements (e.g. antenna pattern measurements), in particular on relevant IMT-2020 antenna model, only levels of -55 dB(W/200 MHz) (for BS) and -51 dB(W/200 MHz) (for UE) resulting from study B would fully ensure protection of all existing and under development EESS (passive) sensors in the band 23.6-24 GHz.

View 10:

Unwanted emission limits more stringent than -33.5 dB(W/200 MHz) for IMT base stations and -29.7 dB(W/200 MHz) for IMT user equipment should not be considered for inclusion in Resolution 750 (Rev.WRC-15). During CPM 19-2, proposals for unwanted emission limits included: -20 , -28 , -32 , -32 to -35 , -33.5 dB(W/200 MHz) for IMT base stations and -20 , -24 to -28 , -28 , -28 to -30 , -29.7 dB(W/200 MHz) for IMT mobile stations among other more conservative limits. While there is a need to protect EESS (passive) operations in the band 23.6-24.0 GHz, it is also important to recognize that imposing overly conservative limits prevents efficient use of spectrum.

View 11:

Views were expressed that the optimal conditions will see IMT using the band 24.25-27.5 GHz while ensuring the protection of EESS (passive) in the 23.6-24 GHz band. Studies submitted to TG 5/1 showed that values no more stringent than the following are required:

-35 to -32 dB(W/200 MHz) for IMT BS.

-28 to -30 dB(W/200 MHz) for IMT UE.

As unwanted emissions will not in reality exceed these upper limits, and levels for most IMT stations will in practice be lower with some margin, less onerous values can also be considered.

View 12:

CEPT recently adopted unwanted emission values of -42 dB(W/200 MHz) (for BS case) and -38 dB(W/200 MHz) (for UE case) to be applied to IMT-2020 systems to ensure protection of EESS (passive) sensors in the 23.4-26 GHz (see Decision ECC/DEC/(18)06).

| | | | |
|------------------------|---------------|---------------------------------------|--|
| 31.3-31.5 GHz | 30.0-31.0 GHz | Fixed-satellite (E-to-s) ⁴ | -9 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 56 dBi -20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 56 dBi |
| 86-92 GHz ⁵ | 81-86 GHz | Fixed | -41 - 14(f - 86) dB(W/100 MHz) for $86.05 \leq f \leq 87$ GHz -55 dB(W/100 MHz) for $87 \leq f \leq 91.95$ GHz where f is the centre frequency of the 100 MHz reference bandwidth expressed in GHz |
| | 92-94 GHz | Fixed | -41 - 14(92 - f) dB(W/100 MHz) for $91 \leq f \leq 91.95$ GHz -55 dB(W/100 MHz) for $86.05 \leq f \leq 91$ GHz where f is the centre frequency of the 100 MHz reference bandwidth expressed in GHz |

Notes to Table 1:

- ¹ The unwanted emission power level is to be understood here as the level measured at the antenna port.
- ² The mean power is to be understood here as the total power measured at the antenna port (or an equivalent thereof) in the frequency band 1 400-1 427 MHz, averaged over a period of the order of 5 s.
- ³ The frequency band 1 429-1 435 MHz is also allocated to the aeronautical mobile service in eight Region 1 administrations on a primary basis exclusively for the purposes of aeronautical telemetry within their national territory (No. **5.342**).
- ⁴ The recommended maximum levels apply under clear-sky conditions. During fading conditions, these levels may be exceeded by earth stations when using uplink power control.
- ⁵ Other maximum unwanted emission levels may be developed based on different scenarios provided in Report ITU-R F.2239 for the frequency band 86-92 GHz.

MOD

RESOLUTION 750 (REV.WRC-~~15~~19)

Compatibility between the Earth exploration-satellite service (passive) and relevant active services

The World Radiocommunication Conference (~~Geneva, 2015~~Sharm el-Sheikh, 2019),

...

resolves

...

~~2 ————— to urge administrations to take all reasonable steps to ensure that unwanted emissions of active service stations in the frequency bands and services listed in Table 1-2 below do not exceed the recommended maximum levels contained in that table, noting that EESS (passive) sensors provide worldwide measurements that benefit all countries, even if these sensors are not operated by their country;~~

...

TABLE 1.2

| EESS (passive) band | Active service band | Active service | Recommended maximum level of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band ¹ |
|------------------------|---------------------|---------------------------------------|--|
| 1 400–1 427 MHz | 1 350–1 400 MHz | Radiolocation ² | –29 dBW in the 27 MHz of the EESS (passive) band |
| | | Fixed | –45 dBW in the 27 MHz of the EESS (passive) band for point-to-point |
| | | Mobile | –60 dBW in the 27 MHz of the EESS (passive) band for mobile service stations except transportable radio-relay stations –45 dBW in the 27 MHz of the EESS (passive) band for transportable radio-relay stations |
| | 1 427–1 429 MHz | Space operation (E-to-s) | –36 dBW in the 27 MHz of the EESS (passive) band |
| | 1 427–1 429 MHz | Mobile except aeronautical mobile | –60 dBW in the 27 MHz of the EESS (passive) band for mobile service stations except IMT stations and transportable radio-relay stations ³ –45 dBW in the 27 MHz of the EESS (passive) band for transportable radio-relay stations |
| | | Fixed | –45 dBW in the 27 MHz of the EESS (passive) band for point-to-point |
| | 1 429–1 452 MHz | Mobile | –60 dBW in the 27 MHz of the EESS (passive) band for mobile service stations except IMT stations, transportable radio-relay stations and aeronautical telemetry stations –45 dBW in the 27 MHz of the EESS (passive) band for transportable radio-relay stations –28 dBW in the 27 MHz of the EESS (passive) band for aeronautical telemetry stations ³ |
| | | Fixed | –45 dBW in the 27 MHz of the EESS (passive) band for point-to-point |
| 31.3–31.5 GHz | 30.0–31.0 GHz | Fixed-satellite (E-to-s) ⁴ | –9 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 56 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 56 dBi |
| 86–92 GHz ⁵ | 81–86 GHz | Fixed | –41–14(f –86) dBW/100 MHz for 86.05 ≤ f ≤ 87 GHz –55 dBW/100 MHz for 87 ≤ f ≤ 91.95 GHz where f is the centre frequency of the 100 MHz reference bandwidth expressed in GHz |
| | 92–94 GHz | Fixed | –41–14(92– f) dBW/100 MHz for 91 ≤ f ≤ 91.95 GHz –55 dBW/100 MHz for 86.05 ≤ f ≤ 91 GHz where f is the centre frequency of the 100 MHz reference bandwidth expressed in GHz |

Notes to Table 1.2:

¹_____The unwanted emission power level is to be understood here as the level measured at the antenna port.

²_____The mean power is to be understood here as the total power measured at the antenna port (or an equivalent thereof) in the frequency band 1 400–1 427 MHz, averaged over a period of the order of 5 s.

³_____The frequency band 1 429–1 435 MHz is also allocated to the aeronautical mobile service in eight Region 1 administrations on a primary basis exclusively for the purposes of aeronautical telemetry within their national territory (No. ~~5.342~~).

⁴_____The recommended maximum levels apply under clear sky conditions. During fading conditions, these levels may be exceeded by earth stations when using uplink power control.

⁵_____Other maximum unwanted emission levels may be developed based on different scenarios provided in Report ITU-R F.2239 for the frequency band 86–92 GHz.

2/1.13/5.2 For Item B: Frequency band 31.8-33.4 GHz, see Section 2/1.13/5.14.2

2/1.13/5.3 For Item C: Frequency band 37-40.5 GHz

2/1.13/5.3.1 For Method C1, see Section 2/1.13/5.14.3

2/1.13/5.3.2 For Method C2

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

34.2-40 GHz

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 37-37.5 | FIXED MOBILE except aeronautical mobile <u>ADD 5.B113</u> SPACE RESEARCH (space-to-Earth) 5.547 | |
| 37.5-38 | FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile <u>ADD 5.B113</u> SPACE RESEARCH (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547 | |

| | |
|----------------|---|
| 38-39.5 | FIXED FIXED-SATELLITE (space-to-Earth) MOBILE <u>ADD 5.B113</u> Earth exploration-satellite (space-to-Earth) 5.547 |
| 39.5-40 | FIXED FIXED-SATELLITE (space-to-Earth) <u>MOD***</u> 5.516B MOBILE <u>ADD 5.B113/5.C113**</u> MOBILE-SATELLITE (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547 |

Notes: **ADD **5.C113** to be used instead of ADD **5.B113** for Method C2, Alternative 2, Condition C2b, Options 3, 4 and 5

***MOD in front of **5.516B** is needed for Method C3

For Method C2, Alternative 1, Condition C2a

ADD

5.B113a The frequency band 37-40.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolution [B113-IMT 40/50 GHZ] (WRC-19) applies.] (WRC-19)

For Method C2, Alternative 2, Condition C2a

ADD

5.B113b The frequency band 37-40.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution [B113-IMT 40/50 GHZ] (WRC-19) applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.B113** included in the modification of RR Article 5 provided above, either of footnotes RR Nos. **5.B113a** or **5.B113b** above could be selected. In addition, only one or none of the texts within square brackets should be kept based on the conditions selected when identifying the band for IMT.*

For Method C2, Alternative 1, Condition C2e, Option 1

ADD

5.B113c The frequency band 37-40.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. **9.21**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio

Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

For Method C2, Alternative 1, Condition C2e, Option 2

ADD

5.B113d The frequency band 37-40.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.B113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.B113c or 5.B113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.

For Method C2, Alternative 2, Condition C2b, Options 3, 4 and 5

ADD

5.B113e The frequency band 37-39.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.B113 included in the modification of RR Article 5 provided above, footnote RR No. 5.B113e above could be selected.

For Method C2, Alternative 2, Condition C2b, Options 3 and 4

ADD

5.C113a The frequency band 39.5-40.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Because of the potential deployment of high-density applications in the fixed-satellite service in the band 39.5-42 GHz (see No. 5.516B), administrations should take into account potential constraints to IMT in this band, as appropriate. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

Note: Footnote RR No. 5.C113a provided above should be used instead of footnote RR No. 5.B113 for this frequency band for Method C2, Alternative 2, Condition C2b, Options 3 and 4.

For Method C2, Alternative 2, Condition C2b, Option 5

ADD

5.C113b The frequency band 39.5-40.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. In segments of this band identified for use by high-density applications in the fixed-satellite service (39.5-40.5 GHz in Region 1, 40.0-40.5 GHz in Region 2, and 40.0-40.5 GHz in Region 3), IMT operations should not impede the deployment and use of high-density applications in the fixed-satellite service. Resolution **[B113-IMT 40/50 GHZ]** (WRC-19) applies. (WRC-19)

Note: Footnote RR No. 5.C113b provided above should be used instead of footnote RR No. 5.B113 for this frequency band for Method C2, Alternative 2, Condition C2b, Option 5.

For Method C2, Alternative 1, Condition C2d, Option 1

ADD

5.B113f The frequency band 37-40.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. In the frequency band 40-40.5 GHz, IMT stations shall not claim protection from, nor constrain the use and development of, earth stations of the Earth exploration-satellite service and space research service. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ]** (WRC-19) applies. (WRC-19)

Note 1: The issue of not constraining the use and development of stations of other services has been discussed at previous WRCs and views were expressed that this is not implementable.

Note 2: When preparing the text for a proposed new footnote RR No. 5.B113 included in the modification of RR Article 5 provided above, footnote RR No. 5.B113f above could be selected.

Another text for footnote RR No. 5.B113 is provided in Section 2/1.13/5.13.1 as footnote RR No. 5.B113g.

2/1.13/5.3.3 For Method C3

See views in section 2/1.13/4.3.2.2.

Views were expressed that the identification of new frequency ranges for the high-density fixed satellite service (HDFSS) is not in the scope of Resolution 238 (WRC-15) and agenda item 1.13. It is not appropriate to allocate or identify new frequency ranges to other services and applications that are not within the scope of Resolution 238 (WRC-15) and agenda item 1.13. This is only for the allocation of frequency ranges to the MS and identification of IMT. Condition C2b, Option 3 should be deleted from the CPM Report.

MOD

5.516B The following bands are identified for use by high-density applications in the fixed-satellite service:

17.3-17.7 GHz (space-to-Earth) in Region 1,

| | |
|----------------------|--------------------------------------|
| 18.3-19.3 GHz | (space-to-Earth) in Region 2, |
| 19.7-20.2 GHz | (space-to-Earth) in all Regions, |
| <u>37.5-39.5 GHz</u> | <u>(space-to-Earth) in Region 1,</u> |
| 39.5-40 GHz | (space-to-Earth) in Region 1, |
| 40-40.5 GHz | (space-to-Earth) in all Regions, |
| 40.5-42 GHz | (space-to-Earth) in Region 2, |
| 47.5-47.9 GHz | (space-to-Earth) in Region 1, |
| 48.2-48.54 GHz | (space-to-Earth) in Region 1, |
| 49.44-50.2 GHz | (space-to-Earth) in Region 1, |
| and | |
| 27.5-27.82 GHz | (Earth-to-space) in Region 1, |
| 28.35-28.45 GHz | (Earth-to-space) in Region 2, |
| 28.45-28.94 GHz | (Earth-to-space) in all Regions, |
| 28.94-29.1 GHz | (Earth-to-space) in Region 2 and 3, |
| 29.25-29.46 GHz | (Earth-to-space) in Region 2, |
| 29.46-30 GHz | (Earth-to-space) in all Regions, |
| 48.2-50.2 GHz | (Earth-to-space) in Region 2. |

This identification does not preclude the use of these bands by other fixed-satellite service applications or by other services to which these bands are allocated on a co-primary basis and does not establish priority in these Radio Regulations among users of the bands. Administrations should take this into account when considering regulatory provisions in relation to these bands. See Resolution **143 (WRC-03)***. (WRC-03~~19~~)

2/1.13/5.4 For Item D: Frequency band 40.5-42.5 GHz

2/1.13/5.4.1 For Method D1, see Section 2/1.13/5.14.4

2/1.13/5.4.2 For Method D2

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD**40-47.5 GHz**

| Allocation to services | | |
|--|--|--|
| Region 1 | Region 2 | Region 3 |
| 40.5-41 FIXED FIXED-SATELLITE (space-to-Earth) <u>MOBILE ADD 5.D113</u> BROADCASTING BROADCASTING-SATELLITE <u>Mobile</u> 5.547 | 40.5-41 FIXED FIXED-SATELLITE (space-to-Earth) 5.516B <u>MOBILE ADD 5.D113</u> BROADCASTING BROADCASTING-SATELLITE <u>Mobile</u> Mobile-satellite (space-to-Earth) 5.547 | 40.5-41 FIXED FIXED-SATELLITE (space-to-Earth) <u>MOBILE ADD 5.D113</u> BROADCASTING BROADCASTING-SATELLITE <u>Mobile</u> 5.547 |
| 41-42.5 | FIXED FIXED-SATELLITE (space-to-Earth) 5.516B <u>MOBILE ADD 5.D113</u> BROADCASTING BROADCASTING-SATELLITE <u>Mobile</u> 5.547 5.551F 5.551H 5.551I | |

For Method D2, Alternative 1**ADD**

5.D113a The frequency band 40.5-42.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.] (WRC-19)

For Method D2, Alternative 2**ADD**

5.D113b The frequency band 40.5-42.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.D113** included in the modification of RR Article 5 provided above, either of footnotes RR Nos. **5.D113a** or **5.D113b***

above could be selected. In addition, the text within square brackets should be kept or suppressed based on the conditions selected when identifying the band for IMT.

For Method D2, Alternative 1, Condition D2c, Option 1

ADD

5.D113c The frequency band 40.5-42.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. **9.21**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

For Method D2, Alternative 1, Condition D2c, Option 2

ADD

5.D113d The frequency band 40.5-42.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.D113** included in the modification of RR Article 5 provided above, either of footnotes RR Nos. **5.D113c** or **5.D113d** above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

For Method D2, Alternative 2, Condition D2a, Options 3 and 4

ADD

5.D113e The frequency band 40.5-42.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Because of the potential deployment of high-density applications in the fixed-satellite service in the band 39.5-42 GHz (see No. **5.516B**), administrations should take into account potential constraints to IMT in this band, as appropriate. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.D113** included in the modification of RR Article 5 provided above, footnote RR No. **5.D113e** above could be selected.*

For Method D2, Alternative 2, Condition D2a, Option 5

ADD

5.D113f The frequency band 40.5-42.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and

does not establish priority in the Radio Regulations. In segments of this band identified for use by high-density applications in the fixed-satellite service (40.5-42 GHz in Region 2), IMT operations should not impede the deployment and use of high-density applications in the fixed-satellite service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.D113 included in the modification of RR Article 5 provided above, footnote RR No. 5.D113f above could be selected.

Another text for footnote RR No. 5.D113 is provided in Section 2/1.13/5.13.1 as footnote RR No. 5.B113i.

2/1.13/5.5 For Item E: Frequency band 42.5-43.5 GHz

2/1.13/5.5.1 For Method E1, see Section 2/1.13/5.14.5

2/1.13/5.5.2 For Method E2

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

40-47.5 GHz

| Allocation to services | | |
|-------------------------------|---|-----------------|
| Region 1 | Region 2 | Region 3 |
| 42.5-43.5 | FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE except aeronautical mobile <u>ADD 5.E113</u> RADIO ASTRONOMY 5.149 5.547 | |

For Method E2, Alternative 1

ADD

5.E113a The frequency band 42.5-43.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.] (WRC-19)

For Method E2, Alternative 2

ADD

5.E113b The frequency band 42.5-43.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.] (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.E113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.E113a or 5.E113b above could be selected. In addition, the text within square brackets should be kept or suppressed based on the conditions selected when identifying the band for IMT.

For Method E2, Alternative 1, Condition E2c, Option 1

ADD

5.E113c The frequency band 42.5-43.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. 9.21. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

For Method E2, Alternative 1, Condition E2c, Option 2

ADD

5.E113d The frequency band 42.5-43.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.E113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.E113c or 5.E113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.

Another text for footnote RR No. 5.E113 is provided in section 2/1.13/5.13.1 as footnote RR No. 5.B113g.

2/1.13/5.6 For Item F: Frequency band 45.5-47 GHz**2/1.13/5.6.1 For Method F1, see Section 2/1.13/5.14.6****2/1.13/5.6.2 For Method F2, see Section 2/1.13/5.13.7 and Section 2/1.13/5.14.6****2/1.13/5.6.3 For Methods F3 and F4****ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**
(See No. 2.1)**MOD****40-47.5 GHz**

| Allocation to services | | |
|-------------------------------|---|-----------------|
| Region 1 | Region 2 | Region 3 |
| 43.5-47 | MOBILE 5.553 <u>ADD 5.F113</u> MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554 | |

For Method F3, Alternative 1**ADD**

5.F113a The frequency band 45.5-47 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT), taking into account No. **5.553**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolution **[B113-IMT 40/50 GHZ]** (WRC-19) applies.] (WRC-19)

For Method F3, Alternative 2**ADD**

5.F113b The frequency band 45.5-47 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT), taking into account No. **5.553**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[B113-IMT 40/50 GHZ]** (WRC-19) applies.] (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.F113 included in the modification of RR Article 5 provided above, footnotes RR No. 5.F113a or 5.F113b above could be selected. The text within square brackets should be kept or suppressed based on the conditions selected when identifying the frequency band for IMT.

For Method F3, Alternative 2, Condition F3c, Option 1

ADD

5.F113c The frequency band 45.5-47 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. 9.21. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution [B113-IMT 40/50 GHZ] (WRC-19) applies. (WRC-19)

For Method F3, Alternative 2, Condition F3c, Option 2

ADD

5.F113d The frequency band 45.5-47 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution [B113-IMT 40/50 GHZ] (WRC-19) applies. (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.F113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.F113c or 5.F113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.

For Method F4, Alternative 1

ADD

5.F113e The frequency band 45.5-47 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolution [B113-IMT 40/50 GHZ] (WRC-19) applies.] (WRC-19)

For Method F4, Alternative 2

ADD

5.F113f The frequency band 45.5-47 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution [B113-IMT 40/50 GHZ] (WRC-19) applies.] (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.F113 included in the modification of RR Article 5 provided above, footnotes RR No. 5.F113e or 5.F113f above could be selected. The text within square brackets should be kept or suppressed based on the conditions selected when identifying the frequency band for IMT.

For Method F4

MOD

5.553 In the bands 43.5-45.57 GHz and 66-71 GHz, stations in the land mobile service may be operated subject to not causing harmful interference to the space radiocommunication services to which these bands are allocated (see No. 5.43). (WRC-200019)

2/1.13/5.7 For Item G: Frequency band 47-47.2 GHz

2/1.13/5.7.1 For Method G1, see Section 2/1.13/5.14.7

2/1.13/5.7.2 For Method G2, see Section 2/1.13/5.13.7 and Section 5.14.7

2/1.13/5.7.3 For Method G3

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

40-47.5 GHz

| Allocation to services | | |
|-------------------------------|---|-----------------|
| Region 1 | Region 2 | Region 3 |
| 47-47.2 | AMATEUR AMATEUR-SATELLITE <u>MOBILE except aeronautical mobile ADD 5.G113</u> | |

For Method G3, Alternative 1

ADD

5.G113a The frequency band 47-47.2 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution [B113-IMT 40/50 GHZ] (WRC-19) applies.] (WRC-19)

For Method G3, Alternative 2

ADD

5.G113b The frequency band 47-47.2 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.] (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.G113 included in the modification of RR Article 5 provided above, footnote RR No. 5.G113a or 5.G113b above could be selected. The text within square brackets should be kept or suppressed based on the conditions selected when identifying the frequency band for IMT.

For Method G3, Alternative 2, Condition G3b, Option 1

ADD

5.G113c The frequency band 47-47.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. 9.21. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

For Method G3, Alternative 2, Condition G3b, Option 2

ADD

5.G113d The frequency band 47-47.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.G113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.G113c or 5.G113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.

2/1.13/5.8 For Item H: Frequency band 47.2-50.2 GHz**2/1.13/5.8.1 For Method H1, see Section 2/1.13/5.14.8****2/1.13/5.8.2 For Method H2****ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**

(See No. 2.1)

MOD**40-47.5 GHz**

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 47.2-47.5 | FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE <u>ADD 5.H113</u> 5.552A | |

MOD**47.5-51.4 GHz**

| Allocation to services | | |
|---|---|----------|
| Region 1 | Region 2 | Region 3 |
| 47.5-47.9 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 (space-to-Earth) 5.516B 5.554A MOBILE <u>ADD 5.H113</u> | 47.5-47.9 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE <u>ADD 5.H113</u> | |
| 47.9-48.2 | FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE <u>ADD 5.H113</u> 5.552A | |
| 48.2-48.54 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE <u>ADD 5.H113</u> | 48.2-50.2 FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.338A* 5.552 MOBILE <u>ADD 5.H113</u> | |

| | |
|---|--------------------------------------|
| 48.54-49.44 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE <u>ADD 5.H113</u> 5.149 5.340 5.555 | |
| 49.44-50.2 FIXED FIXED-SATELLITE (Earth-to-space) <u>5.338A*</u> -5.552 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE <u>ADD 5.H113</u> <u>MOD 5.338A*</u> | 5.149 <u>MOD 5.338A*</u> 5.340 5.555 |

Note: *MOD 5.338A is needed for Method H2, Alternatives 1 and 2, Condition H2a, Options 1 and 2, and for Alternative 1, Condition H2d, Options 1 and 2.

For Method H2, Alternative 1, Condition H2a

ADD

5.H113a The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolutions **[B113-IMT 40/50 GHZ]** (WRC-19) and **750 (Rev.WRC-19)** apply.][Resolution **[B113-IMT 40/50 GHZ]** (WRC-19) applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

For Method H2, Alternative 2, Condition H2a

ADD

5.H113b The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolutions **[B113-IMT 40/50 GHZ]** (WRC-19) and **750 (Rev.WRC-19)** apply.][Resolution **[B113-IMT 40/50 GHZ]** (WRC-19) applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.H113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.H113a or 5.H113b above could be selected. In addition, only one or none of the texts within square brackets should be kept based on the conditions selected when identifying the band for IMT.

For Method H2, Alternative 1, Condition H2d, Option 1

ADD

5.H113c The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained

under No. **9.21**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply. (WRC-19)

For Method H2, Alternative 1, Condition H2d, Option 2

ADD

5.H113d The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.H113** included in the modification of RR Article 5 provided above, either of footnotes RR Nos. **5.H113c** or **5.H113d** above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

For Method H2, Alternatives 1 and 2, Condition H2a, Option 1, and for Alternative 1, Condition H2d, Options 1 and 2

MOD

5.338A In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 30-31.3 GHz, 49.7-50.2 GHz, **[47.2/49.2/50]-50.2 GHz**, 50.4-50.9 GHz, 51.4-52.6 GHz, 81-86 GHz and 92-94 GHz, Resolution **750 (Rev.WRC-~~15~~19)** applies. (WRC-~~15~~19)

For Method H2, Alternative 2, Condition H2c, Option 3

ADD

5.H113e The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Because of the potential deployment of high-density applications in the fixed-satellite service in the band 47.5-50.2 GHz (see No. **5.516B**), administrations should take into account potential constraints to IMT in this band, as appropriate. Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.H113** included in the modification of RR Article 5 provided above, footnote RR No. **5.H113e** above could be selected.*

For Method H2, Alternative 2, Condition H2c, Option 4

ADD

5.H113f The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. In segments of this band identified for use by high-density applications in the fixed-satellite service in the Earth-to-space direction (48.2-50.2 GHz in Region 2), IMT operations should not impede the deployment and use of the fixed-satellite service. Resolutions [B113-IMT 40/50 GHZ] (WRC-19) and 750 (Rev.WRC-19) apply. (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.H113 included in the modification of RR Article 5 provided above, footnote RR No. 5.H113f above could be selected.

2/1.13/5.9 For Item I: Frequency band 50.4-52.6 GHz

2/1.13/5.9.1 For Method I1, see Section 2/1.13/5.14.9

2/1.13/5.9.2 For Method I2

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

47.5-51.4 GHz

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 50.4-51.4 | FIXED FIXED-SATELLITE (Earth-to-space) 5.338A * MOBILE <u>ADD 5.I113</u> Mobile-satellite (Earth-to-space) <u>MOD 5.338A</u> * | |

MOD**51.4-55.78 GHz**

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 51.4-52.6 | FIXED 5.338A* MOBILE ADD 5.I113 MOD 5.338A* 5.547 5.556 | |

Note: *MOD 5.338A is needed for Method I2, Alternatives 1 and 2, Condition I2a, Option 1, and for Alternative 1, Condition I2c, Options 1 and 2.

For Method I2, Alternative 1, Condition I2a**ADD**

5.I113a The frequency band 50.4-52.6 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply.][Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

For Method I2, Alternative 2, Condition I2a**ADD**

5.I113b The frequency band 50.4-52.6 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply.][Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.I113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.I113a or 5.I113b above could be selected. In addition, only one or none of the texts within square brackets should be kept based on the conditions selected when identifying the band for IMT.

For Method I2, Alternative 1, Condition I2c, Option 1**ADD**

5.I113c The frequency band 50.4-52.6 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. 9.21. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply. (WRC-19)

For Method I2, Alternative 1, Condition I2c, Option 2

ADD

5.II13d The frequency band 50.4-52.6 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions [B113-IMT 40/50 GHZ] (WRC-19) and 750 (Rev.WRC-19) apply. (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.II13 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.II13c or 5.II13d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.

For Method I2, Alternatives 1 and 2, Condition I2a, Option 1, and for Alternative 1, Condition I2c, Options 1 and 2

MOD

5.338A In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 30-31.3 GHz, 49.7-50.2 GHz, 50.4-~~[50.6/50.9 GHz, 51.4-52.6 GHz]~~, 81-86 GHz and 92-94 GHz, Resolution 750 (Rev.WRC-~~15~~19) applies. (WRC-~~15~~19)

2/1.13/5.10 For Item J: Frequency band 66-71 GHz

2/1.13/5.10.1 For Method J1, see Section 2/1.13/5.14.10

2/1.13/5.10.2 For Methods J2 and J4

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD**66-81 GHz**

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 66-71 | INTER-SATELLITE MOBILE <u>MOD*</u> 5.553 5.558 <u>ADD 5.J113</u> MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554 | |

Note: *MOD 5.553 is needed for Method J2.

For Method J2, Alternative 1, Condition J2a, Option 2 and Method J4, Alternative 1, Condition J4a, Option 2

ADD

5.J113a The frequency band 66-71 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolution **[C113-IMT 66/71 GHZ] (WRC-19)** applies.] (WRC-19)

For Method J2, Alternative 2, Condition J2a, Option 1 and Method J4, Alternative 2, Condition J4a, Option 1

ADD

5.J113b The frequency band 66-71 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of the frequency band 66-71 GHz by the mobile service is also for the implementation of wireless access systems. [Resolution **[C113-IMT 66/71 GHZ] (WRC-19)** applies.] (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.J113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.J113a or 5.J113b above could be selected. In addition, the text within square brackets should be kept or suppressed based on the conditions selected when identifying the band for IMT.

For Method J2, Alternative 1, Condition J2c, Option 1**ADD**

5.J113c The frequency band 66-71 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. **9.21**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[C113-IMT 66/71 GHZ] (WRC-19)** applies. (WRC-19)

For Method J2, Alternative 1, Condition J2c, Option 2**ADD**

5.J113d The frequency band 66-71 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[C113-IMT 66/71 GHZ] (WRC-19)** applies. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.J113** included in the modification of RR Article 5 provided above, either of footnotes RR Nos. **5.J113c** or **5.J113d** above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

For Method J2, Alternatives 1 and 2, Condition J2b, Option 1**MOD**

5.553 In the bands 43.5-47 GHz ~~and 66-71 GHz~~, stations in the land mobile service may be operated subject to not causing harmful interference to the space radiocommunication services to which ~~these~~ this bands ~~are~~ is allocated (see No. **5.43**). (WRC-~~2000~~19)

2/1.13/5.10.3 For Method J3**ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**(See No. **2.1**)

MOD**66-81 GHz**

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 66-71 | INTER-SATELLITE MOBILE MOD 5.553 5.558 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554 | |

MOD

5.553 In the bands 43.5-47 GHz and 66-71 GHz, stations in the land mobile service may be operated subject to not causing harmful interference to the space radiocommunication services to which these bands are allocated (see No. **5.43**). See also Resolution 238 (Rev.WRC-19). (WRC-200019)

2/1.13/5.11 For Item K: Frequency band 71-76 GHz

2/1.13/5.11.1 For Method K1, see Section 2/1.13/5.14.11

2/1.13/5.11.2 For Method K2

ARTICLE 5**Frequency allocations**

Section IV – Table of Frequency Allocations
 (See No. **2.1**)

MOD**66-81 GHz**

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 71-74 | FIXED FIXED-SATELLITE (space-to-Earth) MOBILE <u>ADD 5.K113</u> MOBILE-SATELLITE (space-to-Earth) | |

| | |
|-------|---|
| 74-76 | FIXED FIXED-SATELLITE (space-to-Earth) MOBILE <u>ADD 5.K113</u> BROADCASTING BROADCASTING-SATELLITE Space research (space-to-Earth) 5.561 |
|-------|---|

For Method K2, Alternative 1

ADD

5.K113a The frequency band 71-76 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolution **[E113-IMT 70/80 GHZ] (WRC-19)** applies.] (WRC-19)

For Method K2, Alternative 2

ADD

5.K113b The frequency band 71-76 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[E113-IMT 70/80 GHZ] (WRC-19)** applies.] (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.K113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.K113a or 5.K113b above could be selected. In addition, the text within square brackets should be kept or suppressed based on the conditions selected when identifying the band for IMT.

For Method K2, Alternative 1, Condition K2c, Option 1

ADD

5.K113c The frequency band 71-76 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. 9.21. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[E113-IMT 70/80 GHZ] (WRC-19)** applies. (WRC-19)

For Method K2, Alternative 1, Condition K2c, Option 2

ADD

5.K113d The frequency band 71-76 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution [E113-IMT 70/80 GHz] (WRC-19) applies. (WRC-19)

Note: When preparing the text for a proposed new footnote RR No. 5.K113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.K113c or 5.K113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.

2/1.13/5.12 For Item L: Frequency band 81-86 GHz

2/1.13/5.12.1 For Method L1, see Section 2/1.13/5.14.12

2/1.13/5.12.2 For Method L2

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

81-86 GHz

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 81-84 | FIXED 5.338A* FIXED-SATELLITE (Earth-to-space) MOBILE ADD 5.L113 MOBILE-SATELLITE (Earth-to-space) RADIO ASTRONOMY Space research (space-to-Earth) 5.149 5.561A 5.338A* | |
| 84-86 | FIXED 5.338A* FIXED-SATELLITE (Earth-to-space) 5.561B MOBILE ADD 5.L113 RADIO ASTRONOMY 5.149 5.338A* | |

Note: * Moving **5.338A** is needed for Method L2, Alternatives 1 and 2, Condition L2a, Option 1, and for Alternative 1, Condition L2e, Options 1 and 2.

For Method L2, Alternative 1, Condition L2a

ADD

5.L113a The frequency band 81-86 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolutions **[E113-IMT 70/80 GHZ]** (WRC-19) and **750 (Rev.WRC-19)** apply.][Resolution **[E113-IMT 70/80 GHZ]** (WRC-19) applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

For Method L2, Alternative 2, Condition L2a

ADD

5.L113b The frequency band 81-86 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolutions **[E113-IMT 70/80 GHZ]** (WRC-19) and **750 (Rev.WRC-19)** apply.][Resolution **[E113-IMT 70/80 GHZ]** (WRC-19) applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.L113** included in the modification of RR Article 5 provided above, either of footnotes RR Nos. **5.L113a** or **5.L113b** above could be selected. In addition, only one or none of the texts within square brackets should be kept based on the conditions selected when identifying the band for IMT.*

For Method L2, Alternative 1, Condition L2e, Option 1

ADD

5.L113c The frequency band 81-86 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. **9.21**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[E113-IMT 70/80 GHZ]** (WRC-19) and **750 (Rev.WRC-19)** apply. (WRC-19)

For Method L2, Alternative 1, Condition L2e, Option 2

ADD

5.L113d The frequency band 81-86 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to

the land mobile service. Resolutions [**E113-IMT 70/80 GHz**] (WRC-19) and **750 (Rev.WRC-19)** apply. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.L113** included in the modification of RR Article 5 provided above, either of footnotes RR Nos. **5.L113c** or **5.L113d** above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

2/1.13/5.13 For some items

2/1.13/5.13.1 For Alternative 2 of Methods C2, D2, E2

ADD

5.B113g The frequency band 37-43.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Because of the potential deployment of high-density applications in the fixed-satellite service in the bands 39.5-40 GHz in Region 1, 40-40.5 GHz in all Regions and 40.5-42 GHz in Region 2 (see No. **5.516B**), administrations should further take into account potential constraints to IMT in these bands, as appropriate. Resolution [**B113-IMT 40 GHz**] (WRC-19) applies. (WRC-19)

*Note: The text of footnote RR No. **5.B113g** would be used for footnotes RR Nos. **5.B113**, **5.D113** and **5.E113** in sections 2/1.13/5.3.2, 2/1.13/5.3.3 and 2/1.13/5.3.4, respectively.*

2/1.13/5.13.2 For the relevant condition(s) and option(s) of Method A2

Note 1: For those administrations proposing a new IMT Resolution, multiple options are presented below for each condition, noting that the option of not applying that condition may also be considered. Administrations may consider applying all, some or none of these conditions.

Note 2: Due to time constraints, the text in this draft new Resolution has not been fully reviewed yet. WRC-19 is invited to carefully examine the text with a view to resolving any issues.

Note 3: Views were expressed that regulatory examples should be of a mandatory nature without any subject or qualifier in the text.

*Note 4: The preamble of this Resolution should be aligned with that of draft new Resolution [**B113-IMT 40/50 GHz**]*

*Note 5: The [For Condition X, Option Y] identifier should be aligned with that of draft new Resolution [**B113-IMT 40/50 GHz**] to [Only if applying Condition X, Option Y, otherwise delete this provision]*

Note 6: The provisions in this Resolution could alternatively also be included in a WRC Recommendation.

ADD

DRAFT NEW RESOLUTION [A113-IMT 26 GHZ] (WRC-19)

International Mobile Telecommunications in frequency band 24.25-27.5 GHz

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that International Mobile Telecommunications (IMT), including IMT-2000, IMT-Advanced and IMT-2020, is the ITU vision of global mobile access;
- b)* that International Mobile Telecommunications (IMT), including IMT-2000, IMT-Advanced and IMT-2020, is intended to provide telecommunication services on a worldwide scale, regardless of location and type of network or terminal;
- c)* that the evolution of IMT is being studied within ITU-R;
- d)* that harmonized worldwide bands for IMT are desirable in order to achieve global roaming and the benefits of economies of scale;
- e)* that IMT systems are now being evolved to provide diverse usage scenarios and applications such as enhanced mobile broadband, massive machine-type communications and ultra-reliable and low-latency communications;
- f)* that ultra-low latency and very high bit-rate applications of IMT will require larger contiguous blocks of spectrum than those available in frequency bands that are currently identified for use by administrations wishing to implement IMT;
- g)* that the properties of higher frequency bands, such as shorter wavelength, would better enable the use of advanced antenna systems including MIMO and beam-forming techniques in supporting enhanced broadband;

[For Condition A2g, Option 3]

- h)* that ITU-R has studied, in preparation for WRC-19, sharing and compatibility with services allocated in the frequency band 24.25-27.5 GHz and its adjacent band, based on characteristics available at that time;
- i)* that identification of frequency bands allocated to the mobile service on a co-primary basis for IMT may change the sharing situation regarding applications of services to which the frequency band is already allocated, and may require additional regulatory actions;
- j)* that the results of ITU-R compatibility studies of IMT-2020 systems are probabilistic, and therefore the deployment parameters of IMT-2020 systems that affect compatibility with satellite receivers may vary during practical implementation and deployment of IMT-2020 networks;
- k)* that the identification of frequency bands for IMT-2020 requires technical and regulatory measures to ensure compatibility with and future development of incumbent services having an allocation in identified frequency bands;
- l)* the need to protect existing services and to allow for their continued development when considering frequency bands for possible additional allocations to any service;

[For Condition A2e, Option 6]

m) that the pointing elevation of the main beam (electrical and mechanical) should normally be below the horizon for outdoor base stations;

[For Condition A2e, Option 6]

n) that the coverage of outdoor hotspot has been assumed in sharing studies to be achieved with the deployment of base stations communicating with terminals on the ground and a very limited number of indoor terminals with positive elevation, resulting in an elevation of the main beam of outdoor base stations normally below the horizon, thus with high discrimination towards the satellites,

noting

Recommendation ITU-R M.2083 “IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond”,

recognizing

a) that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band by any application of the services to which it is allocated;

[For Condition A2a Option 1]

b) that Resolution **750 (Rev.WRC-19)** establishes limits on unwanted emissions in the frequency band 23.6-24 GHz from IMT base stations and IMT mobile stations within the [24.25-27.5 GHz] frequency band;

[For Condition A2b Option 1]

c) that Resolution **750 (Rev.WRC-19)** establishes limits on unwanted emissions in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz from IMT base stations and IMT mobile stations within the frequency band [24.25-27.5 GHz];

[For Condition A2b Option 2]

d) that spurious emission limits of Recommendation ITU-R SM.329 Category B (–60 dB(W/MHz)) are sufficient to protect the EESS (passive) within the bands 50.2-50.4 GHz and 52.6-54.25 GHz from the second harmonic of IMT base station emissions in the 24.25-27.5 GHz band,

resolves

Note: The order of appearance of *resolves* 1 and 2 in this Resolution is yet to be decided, according to the two Options below.

| Option 1 | Option 2 |
|--|--|
| <p>[For Conditions A2c Option 4, A2d Option 3, A2e Options 1, 2, 3, 5, 6, 7, 8, A2f Option 2, A2g Option 2]</p> <p>1 in order to ensure the coexistence between IMT in the frequency band 24.25-27.5 GHz as identified by WRC-19 in Article 5 of the Radio Regulations and other services to which the frequency band is allocated including the protection of these other services, administrations shall apply the condition(s);</p> | <p>1 that administrations wishing to implement IMT consider the use of frequency band 24.25-27.5 GHz identified for IMT in No. 5.A113, and the benefits of harmonized utilization of the spectrum for the terrestrial component of IMT taking into account the latest relevant ITU-R Recommendations;</p> |

| | |
|--|---|
| 2 that administrations wishing to implement IMT consider the use of frequency band 24.25-27.5 GHz identified for IMT in No. 5.A113 , and the benefits of harmonized utilization of the spectrum for the terrestrial component of IMT taking into account the latest relevant ITU-R Recommendations; | [For Conditions A2c Option 4, A2d Option 3, A2e Options 1, 2, 3, 5, 6, 7, 8, A2f Option 2, A2g Option 2] 2 in order to ensure the coexistence between IMT in the frequency band 24.25-27.5 GHz as identified by WRC-19 in Article 5 of the Radio Regulations and other services to which the frequency band is allocated including the protection of these other services, administrations shall apply the condition(s); |
|--|---|

[For Condition A2c Option 4]

1 the operation of IMT within the frequency band 24.25-27.5 GHz shall protect the existing and future SRS/EESS earth stations;

[For Condition A2d Option 3]

2 the operation of IMT within the frequency band 24.25-27.5 GHz shall protect the existing and future FSS earth stations;

[For Condition A2e Option 1]

3 that all potential measures shall be taken to keep the electrical tilt of IMT base-station beams to be not higher than 0 degrees relative to the horizontal and the mechanical tilt of IMT base stations be below –10 degrees relative to the horizon and IMT BS antenna pattern should be kept within the limits of approximation envelope according to Recommendation ITU-R M.2101. In addition, IMT base stations shall comply with the TRP limits given in Table 1:

TABLE 1

TRP* limits for IMT base stations

| Frequency bands | dB(W/200 MHz) |
|-----------------|---------------|
| 24.25-27.5 GHz | [–5/–2/1/7] |

* Total radiated power (TRP) is the sum of all power radiated by an antenna connected to a transmitter. This level applies for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing, carrier configurations).

[For Condition A2e Option 2]

4 that all potential measures shall be taken to avoid the elevation angle of the antenna main beam of IMT base stations to be higher than 0 degrees relative to the horizontal. In addition, IMT base stations shall comply with the TRP limits given in Table 1:

TABLE 1

TRP* limits for IMT base stations

| Frequency bands | dB(W/200 MHz) |
|-----------------|---------------|
| 24.25-27.5 GHz | [7/10/16] |

* Total radiated power (TRP) is the sum of all power radiated by an antenna connected to a transmitter. This level applies for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing, carrier configurations).

[For Condition A2e, Option 3]

5 that the mechanical tilt of IMT base stations be below -10 degrees relative to the horizon and the elevation angle of the antenna main beam of IMT base stations not to be higher than 0 degrees relative to the horizontal. The antenna pattern shall comply with Recommendation ITU-R M.2101. In addition, IMT base stations shall comply with the TRP limits given in Table 1:

TABLE 1
TRP* limits for IMT base stations

| Frequency bands | dB(W/200 MHz) |
|-----------------|---------------|
| 24.25-27.5 GHz | $[-5/-2/1/7]$ |

* Possible example of definition of TRP: Total radiated power (TRP) is the sum of all power radiated by an antenna connected to a transmitter. This level applies for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing, carrier configurations).

[For Condition A2e, Option 5]

6 that, when deploying outdoor base stations, all possible measures shall be taken to avoid pointing the main beam of each transmitting antenna above the horizon and the antenna shall have mechanical pointing below the horizon except when the antenna of base station is only receiving;

[For Condition A2e, Option 6]

7 that, when deploying outdoor base stations, it shall be ensured that each antenna normally¹ transmits only with the main beam pointing below the horizon and the antenna shall have mechanical pointing below the horizon except when the base station is only receiving;

[For Condition A2e, Option 7]

8 that, in order to protect satellite reception in the frequency band 24.25-27.5 GHz, IMT base stations shall comply with the following e.i.r.p. masks for the emissions:

| Elevation angle | Maximum e.i.r.p. dB(W/200 MHz) |
|-------------------------|--------------------------------|
| $5 \leq \Theta \leq 15$ | $17 - 1.3(\Theta - 5)$ |
| $15 < \Theta \leq 25$ | 4 |
| $25 < \Theta \leq 55$ | $4 - 0.43(\Theta - 25)$ |
| $55 < \Theta \leq 90$ | -8.9 |

[For Condition A2e, Option 8]

9 that, in order to protect satellite reception in the frequency band 24.25-27.5 GHz, administrations implementing IMT system(s) within their territory ensure, in accordance with the definition in Annex 1 and calculation methodology contained in Annex 2 to this Resolution, that the equivalent power flux-density, $\text{epfd}\uparrow$, produced at any point in the geostationary-satellite orbit by emissions from all the IMT base stations in their territory in the frequency bands listed in Table X, for all conditions and for all methods of modulation, shall not exceed the limits given in Table X for

¹ With reference to *considering n*) it is assumed that only a very limited number of indoor terminals with positive elevation will be communicating with base stations.

the specified percentages of time. These limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions (with appropriate losses and degradations, if applicable), into a reference antenna and in the reference bandwidth specified in Table X, for all pointing directions towards the Earth's surface visible from any given location in the geostationary-satellite orbit;

TABLE X

Limits to the $epfd\uparrow$ radiated by IMT base stations in the mobile service in certain frequency bands

| Frequency bands | $epfd\uparrow$ (dB(W/m ²)) | Percentage of time, probability or location | Reference bandwidth (MHz) | Reference antenna beamwidth and reference radiation pattern (see Annex 1) |
|-----------------|--|---|---------------------------|---|
| 24.65-25.25 GHz | [-151.6 + 10 log (α)] | [80%] | [1] | [0.8°] Recommendation ITU-R S.672-4, $L_s = [-25]$ |
| 27.0-27.5 GHz | | | | |

Views were expressed that the $epfd\uparrow$ limits at Table X should be normalized relative to a reference circular area at the surface of the earth (for example 50 000 sq. km) from which this level is aggregated at any point of GSO arc in a reference bandwidth (for example 200 MHz)

where α is defined as follows:

α : $epfd\uparrow$ adjustment factor (to take into account the number of simultaneously transmit IMT base stations within the overlapping area of $A_{-3dB, \max}$ and A_{country})

- For the case where " $A_{\text{country}} \geq A_{-3dB, \max}$ ":
 $\alpha = 1$;
- For the case where " $A_{-3dB, \max} > A_{\text{country}} \geq 20\,000$ (km²):

$$\alpha = \left(\frac{A_{\text{country}} \left(\text{km}^2 \right)}{A_{-3dB, \max} \left(\text{km}^2 \right)} \right)$$

- For the case where " $A_{\text{country}} < 20\,000$ (km²):

$$\alpha = 0.0176$$

$A_{-3dB, \max}$: area covered by -3 dB contour of reference antenna beam (towards 15 degrees elevation angle) (i.e. 1 135 833 (km²))

A_{country} : land mass area of an administration implementing IMT system(s) (km²)

Note 1: As an example of α in relation to the country's area, the following table is provided for further review of Table X above.

Note 2: Due to time constraints, the table below has not yet been fully reviewed. WRC-19 is invited to carefully examine the text with a view to resolving any issues.

| Country's area (A_{country} , (km ²)) | Reference area ($A_{-3\text{dB,max}}$ (km ²)) | α | epfd \uparrow limit (dB(W/m ²)) |
|--|---|----------|--|
| 21 | 1 135 833 | 0.0176 | −169.1 |
| 1 000 | | 0.0176 | −169.1 |
| 20 000 | | 0.0176 | −169.1 |
| 50 000 | | 0.0440 | −165.1 |
| 377 974 | | 0.333 | −156.3 |
| 800 000 | | 0.704 | −153.1 |
| 1 135 833 | | 1 | −151.6 |
| 17 098 242 | | 1 | −151.6 |

[For Condition A2f, Option 2]

10 the operation of IMT within the frequency band 24.25-27.5 GHz shall protect the existing and future RAS stations in the frequency band 23.6-24 GHz;

[For Condition A2g, Option 2]

11 in the case that there is uncertainty on whether or not sharing between IMT and other services/systems is feasible, such case shall be treated on a case-by-case basis subject to the agreement to be obtained from the concerned administrations;

invites administrations

[For Condition A2c, Option 1]

1 to adopt provisions to protect other services from IMT networks and to ensure the possibility of deploying future SRS/EESS earth stations;

[For Condition A2d, Option 1]

2 to adopt provisions to ensure the possibility of deploying future FSS earth stations;

[For Condition A2e, Option 1]

3 to adopt provisions to limit the maximum density of 1 200 BSs per 10 000 km² for outdoor hot spots within its territory. In case when area of an administration is lesser than 10 000 km² the number of IMT BS should be reduced proportionally,

Note: Concerns were expressed about *invites administrations* adopting provisions.

invites ITU-R

1 to develop harmonized frequency arrangements to facilitate IMT deployment in the frequency band 24.25-27.5 GHz, taking into account the results of sharing and compatibility studies;

[For Condition A2a, Options 3 and 4]

2 to develop a new ITU-R Recommendation, to include unwanted emission limits in the frequency band 23.6-24.0 GHz from IMT base stations within the 24.25-27.5 GHz frequency band, as appropriate;

[For Condition A2c, Option 1]

3 to develop an ITU-R Recommendation to assist administrations in protecting existing and future SRS/EESS earth stations operating in the frequency band 25.5-27 GHz;

[For Condition A2c, Option 3]

4 to develop an ITU-R Recommendation to assist administrations in protecting existing and future SRS/EESS earth stations operating in the frequency band 25.5-27 GHz, provided that this Recommendation is incorporated by reference into the Radio Regulations;

[For Condition A2d, Option 1]

5 to develop an ITU-R Recommendation to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency band 24.25-27.5 GHz;

[For Condition A2d, Option 2]

6 to develop an ITU-R Recommendation to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency band 24.25-27.5 GHz provided that this Recommendation is incorporated by reference into the Radio Regulations;

[For Condition A2e, Option 8]

7 to update the calculation methodology contained in Annex 2 to this Resolution as appropriate, and to develop ITU-R Recommendations and/or Reports, if necessary, for a suitable methodology to calculate the $\text{epfd}\uparrow$ level produced by all IMT base stations within the territory of an administration referred to in *resolves* 1a9 above;

[For Condition A2f, Option 1]

8 to update existing ITU-R Recommendations or develop a new ITU-R Recommendation, as appropriate, to provide information and assistance to the administrations on possible coordination and protection measures for the radio astronomy service in the frequency band 23.6-24 GHz from the IMT deployment;

[For Condition A2g, Option 3]

Example 1:

9 to regularly update characteristics of IMT deployments (including base-station density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments;

Example 2:

9 to regularly review the impact of the evolution of IMT technical and operational characteristics (including deployment and base-station density) on sharing and compatibility with other services (e.g. space services) and, as necessary, to take into account the results of these reviews in the development or revision of ITU-R Recommendations/Reports, e.g. on IMT characteristics;

Example 3:

9 to regularly review the impact of the evolution of IMT technical and operational characteristics (including deployment and base-station density) on sharing and compatibility with other services (e.g. space services) and, as necessary, to take into account the results of these reviews in the development or revision of ITU-R Recommendations/Reports;

[For Condition A2g, Option 4]

10 to regularly update characteristics of IMT deployments (including BS density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments with reporting through BR Director on the results to WRC,

instructs the Director of the Radiocommunication Bureau

[For Condition A2e, Option 8]

1 to develop the software to calculate and validate the $epfd_{\uparrow}$ level produced by all IMT base stations within the territory of the concerned administrations in accordance with the calculation methodology contained in Annex 2 to this Resolution and make it available to those administrations, and to provide training and manuals, along with any assistance requested by administrations to enable them to comply with *resolves* 1a9 above;

Note: Further clarification with the BR is needed to assess if this instruction can be implemented and the associated costs. Views are expressed in Section 4.

[For Condition A2g, Option 4]

2 to report to a future competent conference on the results of studies in *invites ITU-R* 10 above.

[For Condition A2e, Option 8]

ANNEX 1 TO RESOLUTION [A113-IMT 26 GHZ] (WRC-19)

Definition of equivalent power flux-density (epfd)

The equivalent power flux-density is defined as the sum of the power flux-densities produced at a geostationary-satellite system receive station in the geostationary orbit by all the transmit IMT base stations within its territory, taking into account the off-axis discrimination of a reference receiving antenna assumed to be pointing in its nominal direction. The equivalent power flux-density is calculated using the following formula:

$$epfd = 10 \log \left[\sum_{i=1}^{N_a} 10^{\frac{P_i - A_{bs,i} - A_{g,i} L_{clutter,i} - PD}{10}} \cdot \frac{G_t(\theta_i)}{4\pi d_i^2} \cdot \frac{G_r(\varphi_i)}{G_{r,max}} \right]$$

where:

N_a : number of simultaneously transmit IMT base stations within its territory, taking into account network loading factor (0.2) and a reference receiving antenna beam pattern assumed to be pointing in its nominal direction (i.e. number of all concerned IMT base stations \times networking loading factor (0.2))

i : index of the transmit IMT base station

P_i : RF power averaged by TDD activity factor (0.8), at the input of the antenna of the transmit IMT base station (dBW) in the reference bandwidth (i.e. maximum RF power $- 0.97 (= 10 \log (0.8))$ (dBW))

$A_{bs,i}$: the attenuation due to beam spreading (dB) over the interference path from the simulated IMT deployment location (n) to the satellite detailed in Recommendation ITU-R P.619

- $A_{g,i}$: the attenuation due to atmospheric gasses (dB) over the interference path from the simulated IMT deployment location (n) to the satellite detailed in Recommendation ITU-R P.619
- $L_{clutter,i}$: the average clutter loss in the interference path for location (n) (dB), calculated using the entire cumulative distribution of clutter losses as detailed in Recommendation ITU-R P.2108
- PD : the polarization discrimination (dB)
- θ_i : off-axis angle between the boresight of the transmit IMT base station and the direction of the geostationary-satellite system receive station
- $G_t(\theta_i)$: transmit antenna gain (as a ratio) of the IMT base station in the direction of the geostationary-satellite system receive station
- d_i : distance (m) between the transmit IMT base station and the geostationary-satellite system receive station
- φ_i : off-axis angle between the boresight of the antenna of the geostationary-satellite system receive station and the direction of the i -th IMT base transmit station
- $G_r(\varphi_i)$: receive antenna gain (as a ratio) of the geostationary-satellite system receive station in the direction of the i -th transmit IMT base station
- $G_{r,max}$: maximum gain (as a ratio) of the antenna of the geostationary-satellite system receive station
- $epfd$: computed equivalent power flux-density (dB(W/m²)) in the reference bandwidth.

Note: Recommendation ITU-R S.672-4 shall be used only for the calculation of interference from IMT base stations in the mobile service into geostationary-satellite systems in the fixed-satellite service. In all cases of L_s , the parabolic main beam equation shall start at zero.

ANNEX 2 TO RESOLUTION [A113-IMT 26 GHZ] (WRC-19)

Methodology for calculation of equivalent power flux-density

This section describes the methodology to calculate $epfd\uparrow$ from IMT base stations (IMT-BS) into a GSO satellite according to definition in Annex 1 above. In order to proceed the calculation, the specific information for newly deployed IMT-BS shall be defined and submitted to administrations.

Based on Inputs § 1 below, the latest $epfd\uparrow$ level at the GSO satellite longitude (defined as 15 degrees elevation angle seen from IMT-BS) can be calculated, together with the levels derived from the previously deployed IMT-BS within the area of territory of administration or the area covered by -3 dB contour of reference antenna beam (towards 15 degrees elevation angle). This calculated $epfd\uparrow$ will then be compared with the limit to give a go/no go decision.

1 Inputs

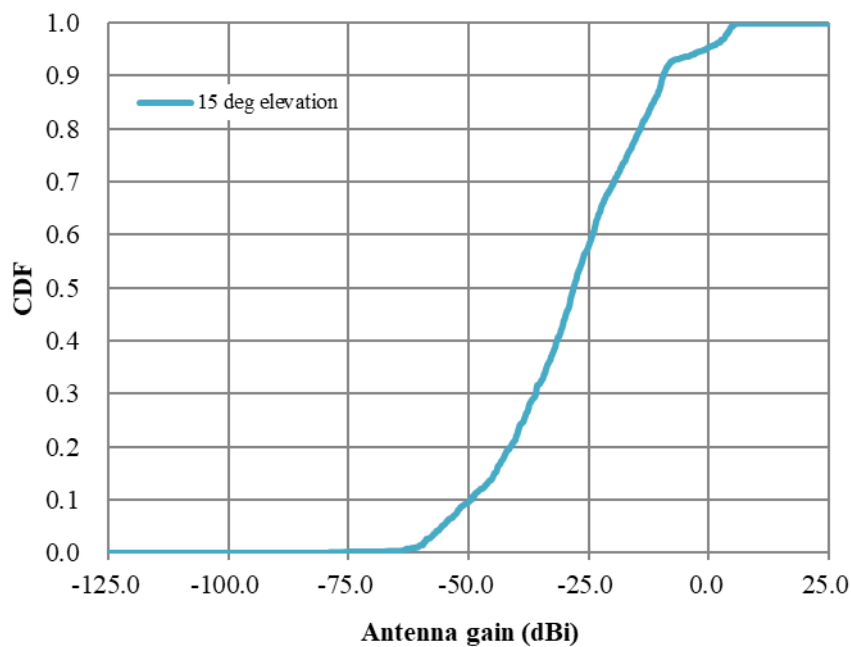
1.1 IMT-BS parameters

The following parameters are used for calculation of equivalent power flux-density expressed in § 2:

| Parameter | Name | Unit | Example |
|-----------------------------|-------------------|-----------|--|
| Location (latitude) | Plati | degrees | Tokyo (N 35.6581) |
| Location (longitude) | Plongi | degrees | Tokyo (E 139.7411) |
| Maximum antenna input power | Pi | dB(W/MHz) | -25 dB(W/MHz) |
| Polarization discrimination | PD | dB | 3 (dB) |
| Maximum antenna gain | | dBi | 23 (dBi) for 8×8 antenna array |
| Maximum e.i.r.p. density | | dB(W/Hz) | -5 dB(W/MHz) |
| Antenna pattern | | N/A | Rec. ITU-R M. 2101 |
| Off-axis gain | Gt (θ_i) | dBi | See Figure below as example (for 15 degrees elevation angle) |
| Network loading factor | | % | 20% |
| TDD activity factor | | % | 80% |

Regarding the antenna pattern and off-axis gain towards GSO, IMT-BS antenna uses beam forming antennas. The figure below shows an example of antenna gain distribution of IMT-BS towards a satellite with 15 degrees elevation angles.

Example of IMT BS antenna gain towards satellite



(The figure above is derived from Monte-Carlo simulations performed with 10 000 snapshots based on Recommendation ITU-R M.2101.)

1.2 Propagation parameters

| Parameter | Name | Unit | Example |
|---------------------------------------|---------------|------|-------------------|
| Attenuation due to beam spreading | A_{bs} | dB | Rec. ITU-R P.619 |
| Attenuation due to atmospheric gasses | A_g | dB | Rec. ITU-R P.619 |
| Clutter loss | $L_{clutter}$ | dB | Rec. ITU-R P.2108 |

1.3 GSO system parameters

The following parameters was already agreed and defined at TG 5/1 as GSO system parameters.

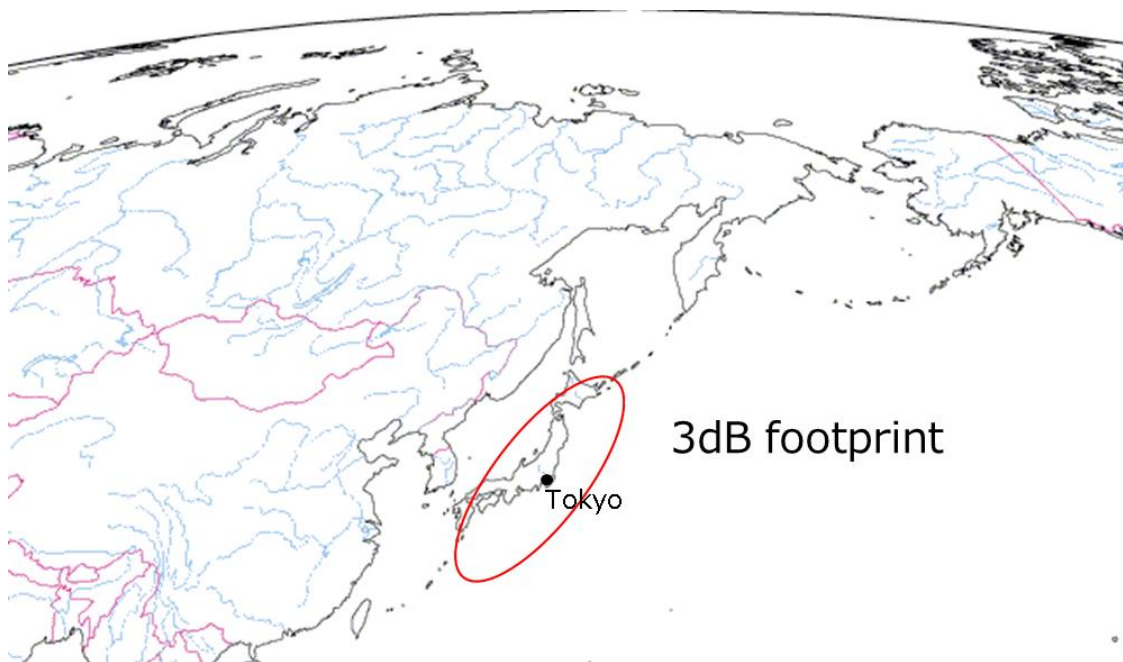
| Parameter | Value | Note |
|--|--|---------------------|
| Receive frequency | 24.65-25.25, 27-27.5 GHz | |
| System noise temperature (T_{sys}) | 400 K | |
| Satellite antenna receive gain (G_r) | Section 1.1 of Annex 1 of Rec. ITU-R S.672-4 LS=-25 | Peak value 46.6 dBi |

Satellite orbital position (OP_{GSO}) would be calculated using IMT-BS location (see § 1.1) and its elevation angle of 15 degrees towards the GSO position for worst-case.

The worst-case satellite beam footprint configuration will also be calculated and defined (see the following figure at Tokyo as an example of worst-case footprint).

FIGURE

Example of footprint pointing to Tokyo as 15 degrees elevation angle (considered as worst-case)



2 Methodology for calculation of equivalent power flux-density

The methodology to calculate equivalent power flux-density from IMT-2020 base stations towards FSS satellite station is as follows:

i)

The following equation (A-1) is defined to calculate all IMT base stations (i) within the territory of administration or within the area covered by -3 dB contour of reference satellite antenna beam.

$$I_i = P_{IMT} + G_{IMT,i} - PL_i - A_{bs,i} - A_{g,i} - L_{clutter,i} - PD + G_{sat,i} \quad (dBW/Hz) \quad i = \{1, 2 \dots N\} \quad (A-1)$$

where:

- I_i : is the interference power spectrum density (dB(W/Hz)) received at the satellite from each IMT-2020 station deployed in location (i);
- P_{IMT} : is the maximum transmit power (dB(W/Hz)) of an IMT-2020 base station;
- $G_{IMT,i}$: is the IMT-2020 station antenna gain (dBi) corresponding to the elevation angle to the satellite, which can be calculated using the simulation methodology detailed in Recommendation ITU-R M.2101;
- PL_i : is the free space basic transmission loss (dB) over the interference path from the simulated IMT-2020 deployed location (i) to the satellite detailed in Recommendation ITU-R P.619;
- $A_{bs,i}$: is the attenuation due to beam spreading (dB) over the interference path from the simulated IMT-2020 deployed location (i) to the satellite detailed in Recommendation ITU-R P.619;
- $A_{g,i}$: is the attenuation due to atmospheric gasses (dB) over the interference path from the simulated IMT-2020 deployed location (i) to the satellite detailed in Recommendation ITU-R P.619;
- $L_{clutter,i}$: is the average clutter loss in the interference path for location (i) (dB), calculated using the entire cumulative distribution of clutter losses as detailed in Recommendation ITU-R P.2108;
- PD : is the polarization discrimination (dB);
- $G_{sat,i}$: is the gain of the satellite receive antenna (dBi) in the direction of the IMT-2020 deployed location (i);
- N : is the number of IMT-2020 BSs simulated.

ii)

The aggregated interference power density from IMT BSs are calculated by equations (A-2a).

$$I_{agg_BS} = 10 \log_{10} \left(P_{DL} \cdot \sum_{i=1}^{N_{BS} \cdot A_f} \frac{I_{BS,i}}{10} \right) \quad (A-2a)$$

where:

- I_{agg_BS} : is the aggregated interference power density at the satellite receiver from IMT-2020 BSs (dB(W/MHz));
- P_{DL} : is BS TDD activity factor (as a ratio);
- N_{BS} : is the number of IMT-2020 BSs to be deployed within the territory of administration or within the area covered by -3 dB contour of reference satellite antenna beam;
- A_f : is the IMT-2020 network loading factor (as a ratio);

$I_{BS,i}$: is the interference power spectrum density (dB(W/Hz)) received at the satellite from each IMT-2020 BS deployed in location (i);

iii)

The equivalent power flux-density from IMT base stations are calculated by equation (A-3).

$$epfd_{BS} = 10 \log_{10} \left[\sum_{i=1}^{N_a} 10^{\frac{P_i - A_{bs,i} - A_{g,i} - L_{clutter,i} - PD}{10}} \cdot \frac{G_t(\theta_i)}{4\pi d_i^2} \cdot \frac{G_r(\phi_i)}{G_{r,max}} \right] \quad (A-3)$$

where:

- N_a : number of simultaneously transmit IMT base stations within its territory, taking into account network loading factor and a reference receiving antenna beam pattern assumed to be pointing in its nominal direction (i.e. number of all concerned IMT stations \times Network loading factor)
- P_i : RF power averaged by TDD activity factor, at the input of the antenna of the transmit IMT base station (dBW) in the reference bandwidth
- θ_i : off-axis angle between the boresight of the transmit IMT base station and the direction of the geostationary-satellite system receive station
- $G_t(\theta_i)$: transmit antenna gain (as a ratio) of the IMT base station in the direction of the geostationary-satellite system receive station
- d_i : distance (m) between the transmit IMT base station and the geostationary-satellite system receive station
- ϕ_i : off-axis angle between the boresight of the antenna of the geostationary-satellite system receive station and the direction of the i -th IMT base transmit station
- $G_r(\phi_i)$: receive antenna gain (as a ratio) of the geostationary-satellite system receive station in the direction of the i -th transmit IMT base station
- $G_{r,max}$: maximum gain (as a ratio) of the antenna of the geostationary-satellite system receive station
- $epfd_{BS}$: computed equivalent power flux-density (dB(W/m²)) from IMT BSs in the reference bandwidth.

From equations (A-2a) and (A-3), the equivalent power flux-density is expressed by equation (A-4).

$$epfd_{BS} = I_{agg_BS} + 10 \log_{10} \left(\frac{4\pi}{\lambda^2} \right) - 10 \log_{10} G_{r,max} \quad (A-4)$$

where:

λ : wave length (m).

2/1.13/5.13.3 For the relevant condition(s) and option(s) of all Methods that contain TRP limits as a condition

Note: The definitions of TRP below are examples and need to be further discussed at WRC-19 together with other proposals so that WRC-19 can then decide on the definition and where to include it in the RR.

For Methods A2, E2, H2 and I2, Conditions A2e, E2a, H2b and I2b, Options 1 and 3:

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section II – Power limits for terrestrial stations

MOD

TABLE 21-2 (REV.WRC-~~15~~19)

| Frequency band | Service | Limit as specified in Nos. |
|---|---|-----------------------------------|
| ... | ... | ... |
| ... | ... | ... |
| 17.7-18.4 GHz 18.6-18.8 GHz 19.3-19.7 GHz 22.55-23.55 GHz 24.45-24.75 GHz (Regions 1 and 3) 24.75-25.25 GHz (Region 3) 25.24-25.29.5 GHz | Fixed-satellite Earth exploration-satellite Space research Inter-satellite | 21.2, 21.3, 21.5 and 21.5A |
| ... | ... | ... |

MOD

21.5 3) The power delivered by a transmitter to the antenna or, where applicable, total radiated power of a station in the fixed or mobile services shall not exceed +13 dBW in frequency bands between 1 GHz and 10 GHz, or +10 dBW in frequency bands above 10 GHz, except as cited in No. **21.5A**. (WRC-~~2000~~19)

View:

No agreement was reached in regard to the definition of TRP with respect to the application of this definition to multi-element active antenna systems. Without clarity on the definition of TRP, the inclusion of TRP into RR No. 21.5 was considered not appropriate.

ARTICLE 1

Terms and definitions

Section VI – Characteristics of emissions and radio equipment

ADD

1.XXX *total radiated power (TRP)*: Multiplication of maximum power of one active element of antenna array and number of active elements taking into account losses in antenna system. (WRC-19)

View:

An alternative definition for TRP could be considered as “total power radiated by an antenna array system in all directions.”

APPENDIX 4 (REV.WRC-15)

Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III

ANNEX 1

Characteristics of stations in the terrestrial services¹

Footnotes to Tables 1 and 2

¹ The Radiocommunication Bureau shall develop and keep up-to-date forms of notice to meet fully the statutory provisions of this Appendix and related decisions of future conferences. Additional information on the items listed in this Annex together with an explanation of the symbols is to be found in the Preface to the BR IFIC (Terrestrial Services).

MOD

TABLE 1 (REV.WRC-1519)
Characteristics for terrestrial services

| Column No. | Item identifier | <div>Notice related to</div> <div>Description of data items and requirements</div> |
|------------|-----------------|--|
| ... | ... | ... |
| 8.X | 8AX | <u>total radiated power (in dBW) for stations with active antenna systems</u> |
| ... | ... | ... |

For Methods A2, Condition A2e, Option 2:

ARTICLE 1

Terms and definitions

Section VI – Characteristics of emissions and radio equipment

ADD

1.XXX *total radiated power (TRP):* TBD (WRC-19)

Note: The definition of TRP will be considered at WRC-19

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section II – Power limits for terrestrial stations

ADD

21.5B The limits given in No. **21.5** do not apply to
 Nos. **5.A113a/5.A113b/5.A113c/5.A113d/5.A113e.** (WRC-19)

2/1.13/5.13.4 For the relevant condition(s) and option(s) of Methods C2, D2, E2, F3, G3, H2 and I2

Note 1: Due to time constraints, the text in this draft new Resolution has not been fully reviewed yet. WRC-19 is invited to carefully examine the text with a view to resolving any issues.

Note 2: For those administrations proposing a new IMT Resolution, multiple options are presented below for each condition, noting that the option of not applying that condition may also be considered. Administrations may consider applying all, some or none of these conditions.

Note 3: Views were expressed that regulatory examples should be of a mandatory nature without any subject or qualifier in the text.

Editor's Note: The text on "[For Condition X, Option Y]" and their numbering (i.e., "X", "Y", ...) in this draft Resolution need to be aligned with those agreed in section 4.

Note 4: The provisions in this Resolution could alternatively also be included in a WRC Recommendation.

ADD

DRAFT NEW RESOLUTION [B113-IMT 40/50 GHz] (WRC-19)

**International Mobile Telecommunications in frequency bands
[37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz]**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that International Mobile Telecommunications (IMT), including IMT-2000, IMT-Advanced and IMT-2020, is intended to provide telecommunication services on a worldwide scale, regardless of location and type of network or terminal;
- b)* that the evolution of IMT is being studied within ITU-R;
- c)* that adequate and timely availability of spectrum and supporting regulatory provisions is essential to realize the objectives in Recommendation ITU-R M.2083;
- d)* that there is a need to continually take advantage of technological developments in order to increase the efficient use of spectrum and facilitate spectrum access;
- e)* that IMT systems are now being evolved to provide diverse usage scenarios and applications such as enhanced mobile broadband, massive machine-type communications and ultra-reliable and low-latency communications;
- f)* that ultra-low latency and very high bit-rate applications of IMT will require larger contiguous blocks of spectrum than those available in frequency bands that are currently identified for use by administrations wishing to implement IMT;
- g)* that the properties of higher frequency bands, such as shorter wavelength, would better enable the use of advanced antenna systems including MIMO and beam-forming techniques in supporting enhanced broadband;
- h)* that harmonized worldwide bands for IMT are desirable in order to achieve global roaming and the benefits of economies of scale;

[Only if applying Condition E2c Option 4, H2d Option 4, I2c Option 4, otherwise delete this provision]

i) that ITU-R has studied, in preparation for WRC-19, sharing and compatibility with services allocated in the frequency bands [37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz] and their adjacent bands, based on the characteristics available at that time;

[Only if applying Condition E2c Option 4, H2d Option 4, I2c Option 4, otherwise delete this provision]

j) that the results of ITU-R compatibility studies of IMT-2020 systems are probabilistic, and therefore the deployment parameters of IMT-2020 systems that affect compatibility with satellite receivers may vary during practical implementation and deployment of IMT-2020 networks;

[Only if applying Condition E2c Option 4, H2d Option 4, I2c Option 4, otherwise delete this provision]

k) that identification of frequency bands allocated to the mobile service for IMT may change the sharing situation regarding applications of services to which the frequency band is already allocated, and may require additional regulatory actions;

[Only if applying Condition E2c Option 4, H2d Option 4, I2c Option 4, otherwise delete this provision]

l) that the identification of frequency bands for IMT-2020 requires technical and regulatory measures to ensure compatibility with and future development of incumbent services having an allocation in identified frequency bands;

m) the need to protect existing services and to allow for their continued development when considering frequency bands for possible additional allocations to any service;

[Only if applying Condition E2a Option 5, H2b Option 5, I2b Option 5, otherwise delete this provision]

n) that the pointing elevation of the main beam (electrical and mechanical) should normally be below the horizon for outdoor base stations;

[Only if applying Condition E2a Option 5, H2b Option 5, I2b Option 5, otherwise delete this provision]

o) that the coverage of outdoor hotspot has been assumed in sharing studies to be achieved with the deployment of base stations communicating with terminals on the ground and a very limited number of indoor terminals with positive elevation, resulting in an elevation of the main beam of outdoor base stations normally below the horizon, thus with high discrimination towards the satellites;

[Only if applying Condition D2b Option 1, E2b Option 1, otherwise delete this provision]

p) that the frequency band 42.5-43.5 GHz is allocated to the radio astronomy service on a primary basis,

noting

Recommendation ITU-R M.2083 “IMT Vision –Framework and overall objectives of the future development of IMT for 2020 and beyond”,

recognizing

- a) that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band by any application of the services to which it is allocated;
- b) the identification of high-density applications in the fixed-satellite service in the space-to-Earth direction in the bands 39.5-40 GHz in Region 1, 40-40.5 GHz in all Regions and 40.5-42 GHz in Region 2 and in the Earth-to-space direction in the bands 47.5-47.9 GHz in Region 1, 48.2-48.54 GHz in Region 1, 49.44-50.2 GHz in Region 1 and 48.2-50.2 GHz in Region 2 (see No. **5.516B**);
- c) that Resolution **752 (WRC-07)** established a power limit of –10 dBW for stations in the mobile service in the 36-37 GHz band in order to facilitate sharing between active and passive services in this band;
- d) that the relevant standards organizations have standardized an unwanted emission level of –13 dBm/MHz from IMT stations operating in the 37-40 GHz band, which is below the limit in *recognizing c*);
- e) that for the purpose of protecting the radio astronomy service in the frequency band 42.5-43.5 GHz, No. **5.149** applies,

resolves

Note: The order of appearance of *resolves* 1 and 2 in this Resolution is yet to be decided, according to the two Options below.

| Option 1 | Option 2 |
|---|---|
| <p><i>[Only if applying Conditions C2a Option 1, C2b Option 2, C2c Option 2, D2a Option 2, D2b Option 2, E2a Options 1, 2, 4, and 5, E2b Option 2, H2b Options 1, 2, 4, and 5, H2c Option 2, I2b Options 1, 2, 4, and 5, otherwise delete this provision]</i></p> <p>1 in order to ensure the coexistence between IMT in the frequency band[s] [37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz] as identified by WRC-19 in Article 5 of the Radio Regulations and other services to which the frequency band is allocated including the protection of these other services, administrations shall apply the condition(s);</p> | <p>1 that administrations wishing to implement IMT consider the use of frequency band[s] [37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz] identified for IMT in No[s]. [5.B113, 5.C113, 5D.113] and the benefits of harmonized utilization of the spectrum for the terrestrial component of IMT taking into account the latest relevant ITU-R Recommendation;</p> |
| <p>2 that administrations wishing to implement IMT consider the use of frequency band[s] [37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz] identified for IMT in No[s]. [5.B113, 5.C113, 5D.113] and the benefits of harmonized utilization of the spectrum for the terrestrial component of IMT taking into account the latest relevant ITU-R Recommendation;</p> | <p><i>[Only if applying Conditions C2a Option 1, C2b Option 2, C2c Option 2, D2a Option 2, D2b Option 2, E2a Options 1, 2, 4, and 5, E2b Option 2, H2b Options 1, 2, 4, and 5, H2c Option 2, I2b Options 1, 2, 4, and 5, otherwise delete this provision]</i></p> <p>2 in order to ensure the coexistence between IMT in the frequency band[s] [37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz] as identified by WRC-19 in Article 5 of the Radio Regulations and other services to which the frequency band is allocated including the protection of these other services, administrations shall apply the condition(s);</p> |

[Only if applying Condition C2a Option 1, otherwise delete this provision]

1 that unwanted emissions of IMT stations brought into use in the frequency bands and services listed in Table 1 below shall not exceed the corresponding limits in that table, subject to the specified conditions;

TABLE 1

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from IMT-2020 stations in a specified bandwidth within the EESS (passive) band ¹ |
|---------------------|---------------------|----------------|---|
| 36-37 GHz | 37-40.5 GHz | Mobile | [TBD*] dB(W/100 MHz) for BS and [TBD*] dB(W/100 MHz) for UE. |

¹ The unwanted emission power level is understood to be in terms of total radiated power (TRP) in the unwanted domain. TRP is the aggregate of the radiated power from all antenna elements.

...

*Note *: See Section 2/1.13/3.2.3.3*

[Only if applying Condition C2b Option 2, D2a Option 2, otherwise delete this provision]

2 the operation of IMT within the frequency bands 37-40.5 GHz and 40.5-42.5 GHz shall protect the existing and future FSS receiving earth stations;

[Only if applying Condition H2c Option 2, otherwise delete this provision]

2bis the operation of IMT in the frequency band 47.2-50.2 GHz shall ensure coexistence with the existing and future FSS transmitting earth stations;

[Only if applying Condition C2c Option 2, otherwise delete this provision]

3 the operation of IMT within the frequency band 37-38 GHz shall protect the existing and future SRS receiving earth stations;

[Only if applying Condition D2b Option 2, E2b Option 2, otherwise delete this provision]

4 the operation of IMT within the frequency bands 40.5-42.5 GHz and 42.5-43.5 GHz shall protect the existing and future RAS stations in the frequency band 42.5-43.5 GHz;

[Only if applying Condition E2a Option 1, H2b Option 1, I2b Option 1, otherwise delete this provision]

5 all necessary measures shall be taken to ensure that the elevation angle of the antenna main beam of IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz shall not be higher than 0 degrees relative to the horizontal, and the mechanical tilt of these IMT base stations shall be below –10 degrees relative to the horizon and the antenna pattern shall be kept within the limits of approximation envelope according to Recommendation ITU-R M.2101. In addition, IMT base stations shall comply with the TRP limits given in Table 2:

TABLE 2

TRP limits for IMT base stations

| Frequency bands | dB(W/200 MHz) |
|---------------------------------|---------------|
| 42.5-43.5 GHz | [–9.5/–4/10] |
| 47.2-50.2 GHz and 50.4-51.4 GHz | [–4/10] |

[Only if applying Condition E2a Option 2, H2b Option 2, I2b Option 2, otherwise delete this provision]

6 that the mechanical tilt of these IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz shall be below -10 degrees relative to the horizon, and the elevation angle of the antenna main beam of IMT base stations shall not be higher than 0 degrees relative to the horizontal, and the antenna pattern shall comply with Recommendation ITU-R M.2101. In addition, IMT base stations shall comply with the TRP limits given in Table 3:

TABLE 3
TRP limits for IMT base stations

| Frequency bands | dB(W/200 MHz) |
|---------------------------------|----------------|
| 42.5-43.5 GHz | $[-9.5/-4/10]$ |
| 47.2-50.2 GHz and 50.4-51.4 GHz | $[-4/10]$ |

[Only if applying Condition E2a Option 4, H2b Option 4, I2b Option 4, otherwise delete this provision]

7 that IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz shall comply with the e.i.r.p. masks for the emissions in Table 3:

TABLE 3
e.i.r.p. masks for the emissions of IMT base stations

| Elevation angle | Maximum e.i.r.p. dB(W/200 MHz) |
|-------------------------|--------------------------------|
| $5 \leq \Theta \leq 10$ | $12.5 + N - 0.9 \cdot \Theta$ |
| $10 < \Theta \leq 34$ | $3.5 + N - 0.5(\Theta - 10)$ |
| $34 < \Theta \leq 70$ | $-8.5 + N - 0.35(\Theta - 34)$ |
| $70 < \Theta \leq 90$ | $-21.1 + N$ |

Note to Table 3: $N = 0$ for the frequency band 42.5-43.5 GHz and $N = 5.6$ for the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz.

[Only if applying Condition E2a Option 5, H2b Option 5, I2b Option 5, otherwise delete this provision]

8 that, when deploying outdoor IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz, it shall be ensured that each antenna normally¹ transmits only with the main beam pointing below the horizon and the antenna shall have mechanical pointing below the horizon except when the base station is only receiving;

[Only if applying Condition E2a Option 6, H2b Option 6, I2b Option 6, otherwise delete this provision]

¹ With reference to *considering z2*) it is assumed that only a very limited number of indoor terminals with positive elevation will be communicating with base stations.

9 that, when deploying outdoor IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz, all practical measures shall be taken to ensure that for each antenna its main beam is pointed below the horizon except when the base station is only receiving;

invites administrations

[Only if applying Condition C2b Option 1, C2b Option 3, D2a Option 1, D2a Option 3, otherwise delete this provision]

Example 1

1 to ensure the necessary balance in the frequency band 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the mobile service and fixed-satellite service, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. the HDFSS) and spectrum available for gateway earth stations;

Example 2

1 to ensure that, when considering, nationally or regionally, the spectrum to be used for IMT, due attention is paid to the need for spectrum for earth stations that could be deployed in a ubiquitous manner (i.e. small user earth stations) and for earth stations that could be coordinated (i.e. gateways) in both downlink (37.5-42.5 GHz) and uplink (42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz) directions, taking into account spectrum identified for the HDFSS as per No. **5.516B**;

Example 3

1 to ensure that, when considering, nationally or regionally, the spectrum to be used for IMT, due attention is paid to the need for spectrum for other services to which the frequency band 37-43.5 GHz band is allocated, including FSS earth stations that could be deployed in ubiquitous manner (i.e. small user earth stations) in the frequency bands 39.5-40.5 GHz in Region 1, 40-40.5 GHz in all Regions and 40.5-42 GHz in Region 2, as per No. **5.516B**;

Example 4

1 when considering the spectrum to be used for IMT, to take into account the need for spectrum for earth stations at unspecified points as well as those used for gateways, and further take into account spectrum identified for the HDFSS as per No. **5.516B**;

[Only if applying Condition C2b Option 1, C2b Option 3, D2a Option 1, D2a Option 3, E2d Option 1, H2c Option 1, I2d Option 1, otherwise delete this provision]

2 to adopt provisions to enable the deployment of future gateway FSS earth stations in the frequency bands 37.5-40.5 GHz, 40.5-42.5 GHz, 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz, or portions thereof;

[Only if applying Condition C2c Option 1, C2d Option 1, otherwise delete this provision]

3 to adopt provisions to enable the deployment of future earth stations in the SRS (space-to-Earth) in the frequency band 37-38 GHz and the SRS (Earth-to-space) and EESS (Earth-to-space) in the frequency band 40-40.5 GHz;

[Only if applying Condition D2b Option 1, E2b Option 1, otherwise delete this provision]

4 to implement, coordination and protection measures for the RAS stations in the frequency band 42.5-43.5 GHz as required;

[Only if applying Condition E2a Option 1, H2b Option 1, I2b Option 1, otherwise delete this provision]

5 to adopt provisions to limit the maximum density of 1 200 IMT base stations per 10 000 km² for outdoor hot spots within its territory. In case when area of an administration is less than 10 000 km² the number of IMT base stations should be reduced proportionally,

invites ITU-R

1 to develop harmonized frequency arrangements to facilitate IMT deployment in the frequency bands [37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz] taking into account the results of sharing and compatibility studies;

2 to continue providing guidance to ensure that IMT can meet the telecommunication needs of the developing countries and rural areas in the context of the studies referred to above;

3 to develop generic unwanted emission characteristics for mobile and base stations of the terrestrial radio interfaces of IMT-2020;

[Only if applying Condition C2b Option 1, C2b Option 3, D2a Option 1, D2a Option 3, E2d Option 1, E2d Option 2, H2c Option 1, I2d Option 1, otherwise delete this provision]

4 to develop an ITU-R Recommendation to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating in the frequency bands 37.5-40.5 GHz, 40.5-42.5 GHz, 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz, from IMT deployments in neighbouring countries;

[Only if applying Condition C2c, Option 1, otherwise delete this provision]

Example 1

5 to develop an ITU-R Recommendation to assist administrations in protecting of existing and future SRS earth stations operating in the frequency band 37-38 GHz taking into account the required protection criteria;

Example 2

5 to develop ITU-R Recommendations, as appropriate, to provide information on possible coordination and protection measures for the existing and future SRS earth stations operating in the frequency band 37-38 GHz;

[Only if applying Condition D2b Option 1, E2b Option 1, otherwise delete this provision]

6 to update existing ITU-R Recommendations or develop new ITU-R Recommendations, as appropriate, to provide information on possible coordination and protection measures for the RAS stations in the frequency band 42.5-43.5 GHz;

[Only if applying Condition E2c Option 4, H2d Option 4, I2c Option 4, otherwise delete this provision]

7 to regularly update characteristics of IMT deployments (including base station density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments;

[Only if applying Condition E2c Option 3, H2d Option 3, I2c Option 3, otherwise delete this provision]

Example 1

8 to regularly review the impact of the evolution of IMT technical and operational characteristics (including deployment and base-station density) on sharing and compatibility with other services (e.g. space services) and, as necessary, to take into account the results of these

reviews in the development or revision of ITU-R Recommendations/Reports, e.g. on IMT characteristics,

Example 2

8 to regularly review the impact of the evolution of IMT technical and operational characteristics (including deployment and base-station density) on sharing and compatibility with other services (e.g. space services) and, as necessary, to take into account the results of these reviews in the development or revision of ITU-R Recommendations/Reports,

[Only if applying Condition E2c Option 4, H2d Option 4, I2c Option 4, otherwise delete this provision]

instructs the Secretary-General

to report to a future competent conference on the results of studies in *invites ITU-R 7* above.

2/1.13/5.13.5 For option 1 of condition J2a of Method J2 and option 1 of condition J4a of Method J4

Note 1: Due to time constraints, the text in this draft new Resolution has not yet been fully reviewed. WRC-19 is invited to carefully examine the text with a view to resolving any issues.

Views were expressed that the proposed draft new Resolution under Method J2, Condition J2a, Option 1 are out of the scope of agenda item 1.13 since A.I 1.13 should only address IMT Identification and should not in any means new identification to MGWS/WAS, neither in new resolution or in FN. ITU-R WRC Resolution should not be intended to promote MGWS systems or any other systems, which are outside the scope of this agenda item 1.13 of WRC-19. Instead, WRC19 AI 1.13 requested to conduct sharing and compatibility studies between IMT and other primary services within the given frequency bands. The co-existence between the systems within the same service can be addressed in the relevant ITU-R Study Groups and do not require WRC Resolution noting that each administration may decide on the systems to be implemented within its territory, which is a national matter.

ADD

DRAFT NEW RESOLUTION [C113-IMT 66/71 GHZ-J2A OPTION1] (WRC-19)

Use of the band 66-71 GHz for International Mobile Telecommunications (IMT) and measures for coexistence with Multiple Gigabit Wireless Systems (MGWS) and other Wireless Access Systems (WAS)

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

a) that International Mobile Telecommunications (IMT), including IMT-2000, IMT-Advanced and IMT-2020, is intended to provide telecommunication services on a worldwide scale regardless of location and type of network or terminal;

b) that the evolution of IMT is being studied within ITU-R;

- c) that harmonized worldwide bands and harmonized frequency arrangements for IMT and MGWS/other WAS are highly desirable in order to achieve global roaming and the benefits of economies of scale;
- d) that adequate and timely availability of spectrum and supporting regulatory provisions are essential to realize the objectives in Recommendation ITU-R M.2083;
- e) that IMT systems are envisaged to provide increased peak data rates and capacity that may require a larger bandwidth;
- f) that IMT and MGWS/other WAS are intended to provide telecommunication services on a worldwide scale;
- g) that the lower adjacent band, 57-66 GHz, is used for MGWS/other WAS,

noting

- a) Resolutions **223 (Rev.WRC-15)**, **224 (Rev.WRC-15)** and **225 (Rev.WRC-12)**, which also relate to IMT;
- b) that Recommendation ITU-R M.2083 provides IMT Vision – “Framework and overall objectives of the future development of IMT for 2020 and beyond”;
- c) that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band by any application of the services to which it is allocated;
- d) Recommendation ITU-R M.2003-2 on Multiple Gigabit Wireless Systems in frequencies around 60 GHz;
- e) that Multiple Gigabit Wireless Systems (MGWS) are widely used for fixed, semi-fixed (transportable) and portable mobile devices for a variety of broadband applications;
- f) Report ITU-R M.2227-2 on use of Multiple Gigabit Wireless Systems in frequencies around 60 GHz,

recognizing

that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band by any application of the services to which it is allocated,

resolves

that administrations wishing to implement IMT in the frequency band 66-71 GHz under the provisions in No. **5.J113**, who have implemented or are wishing to implement MGWS and other WAS in the same frequency band, consider coexistence between them taking into account the relevant ITU-R Reports and Recommendations (see *invites ITU-R 2 and 3*),

invites administrations

invites ITU-R

- 1 to develop harmonized frequency arrangements to facilitate IMT deployment in the frequency band 66-71 GHz taking into account the results of sharing and compatibility studies;
- 2 to develop ITU-R Recommendations and Reports that will assist administrations in ensuring that applications and services in the band 66-71 GHz can utilize the band efficiently including the development of appropriate coexistence techniques between IMT and WAS where needed;

3 to regularly review the impact of the evolution of IMT technical and operational characteristics (including deployment and base-station density) on sharing and compatibility with other services (e.g. space services) and, as necessary, to take into account the results of these reviews in the development or revision of ITU-R Recommendations/Reports, e.g. on IMT characteristics”.

2/1.13/5.13.6 For option 2 of condition J2a of Methods J2 and option 2 of condition J4a of Method J4

Note 1: Due to time constraints, the text in this draft new Resolution has not yet been fully reviewed. WRC-19 is invited to carefully examine the text with a view to resolving any issues.

Views were expressed that a technology neutral approach under the existing primary mobile service allocation should be taken on the 66-71 GHz frequency range by recognizing existing applications already operating in countries within the entire 57-71 GHz frequency range. Studies regarding coexistence should neither hinder the development of either technology, nor impact the ongoing standard developments that could cause unnecessary delays. If such a study on co-existence is undertaken, administrations should conduct this work within the ITU-R Study Groups without an associated WRC Resolution.

ADD

DRAFT NEW RESOLUTION [C113-IMT 66/71 GHZ-J2A OPTION 2] (WRC-19)

Use of the band 66-71 GHz for International Mobile Telecommunications (IMT) and coexistence with other systems

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* [that International Mobile Telecommunications (IMT), including IMT-2000, IMT-Advanced and IMT-2020, is intended to provide telecommunication services on a worldwide scale regardless of location and type of network or terminal;
- b)* that the evolution of IMT is being studied within ITU-R;
- c)* that the frequency bands 450-470 MHz, 470-698 MHz, 694/698-960 MHz, 1 427-1 518 MHz, 1 710-2 025 MHz, 2 110-2 200 MHz, 2 300-2 400 MHz, 2 500-2 690 MHz, 3 300-3 400 MHz, 3 400-3 600 MHz, 3 600-3 700 MHz, 4 800-4 990 MHz or parts thereof, are identified either worldwide, or by regional or national footnotes for use by administrations wishing to implement IMT;
- d)* that harmonized worldwide bands and harmonized frequency arrangements for IMT are highly desirable in order to achieve global roaming and the benefits of economies of scale;
- e)* that adequate and timely availability of spectrum and supporting regulatory provisions is essential to realize the objectives in Recommendation ITU-R M.2083;
- f)* that IMT systems are envisaged to provide increased peak data rates and capacity that may require a larger bandwidth;
- g)* that IMT systems are intended to provide telecommunication services on a worldwide scale;

h) that MGWS and other WAS systems are implemented and planned to be implemented in certain countries;

i) that the lower adjacent band, 57-66 GHz, is used for MGWS/other WAS in certain countries,

noting

a) Resolutions **223 (Rev.WRC-15)**, **224 (Rev.WRC-15)** and **225 (Rev.WRC-12)**, which also relate to IMT;

b) that Recommendation ITU-R M.2083 provides IMT Vision – “Framework and overall objectives of the future development of IMT for 2020 and beyond”,

recognizing

that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band by any application of the services to which it is allocated,

resolves

1 to invite administrations wishing to implement IMT in accordance with No. **5.J113** in the frequency band 66-71 GHz to make it available for the terrestrial component of IMT with due consideration to the benefits of harmonized utilization of the spectrum for the terrestrial component of IMT, taking into account the services to which the frequency band is currently allocated;

2 to invite administrations wishing to implement IMT in the frequency band 66-71 GHz in accordance with No. **5.J113** to consider measures for coexistence between IMT and other systems within mobile service allocation (e.g. MGWS and other WAS) that are implemented, or planned to be implemented, in certain countries taking into account the relevant ITU-R Reports and Recommendations,

invites ITU-R

1 to develop harmonized frequency arrangements to facilitate IMT deployment in the frequency band 66-71 GHz;

2 to develop ITU-R Recommendations and Reports, as necessary, to facilitate coexistence in the band 66-71 GHz between IMT and other systems of the mobile service (e.g. MGWS/other WAS), where needed;

3 to review relevant ITU-R Recommendations/Reports, as necessary, taking into account the impact on sharing and compatibility.

2/1.13/5.13.7 For the relevant condition(s) and option(s) of Methods F2, G2 and J3

Note: Due to time constraints, the text in this draft new Resolution has not yet been fully reviewed. WRC-19 is invited to carefully examine the text with a view to resolving any issues.

MOD

RESOLUTION 238 (WRC-~~15~~19)

Studies on frequency-related matters for International Mobile Telecommunications identification ~~including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency bands~~range between 24.25 and 86 45.5-47 GHz, 47-47.2 GHz and 66-71 GHz for the future development of International Mobile Telecommunications for 2020 and beyond

The World Radiocommunication Conference (Geneva, 2015~~Sharm el-Sheikh, 2019~~),

considering

- a) that International Mobile Telecommunications (IMT) is intended to provide telecommunication services on a worldwide scale, regardless of location and type of network or terminal;
- b) that IMT systems have contributed to global economic and social development;
- c) that IMT systems are now being evolved to provide diverse usage scenarios and applications such as enhanced mobile broadband, massive machine-type communications and ultra-reliable and low-latency communications;
- d) that ultra-low latency and very high bit rate applications of IMT will require larger contiguous blocks of spectrum than those available in frequency bands that are currently identified for use by administrations wishing to implement IMT;
- e) that it may be suitable to examine higher frequency bands for these larger blocks of spectrum;
- f) that there is a need to continually take advantage of technological developments in order to increase the efficient use of spectrum and facilitate spectrum access;
- g) that the properties of higher frequency bands, such as shorter wavelength, would better enable the use of advanced antenna systems including MIMO and beam-forming techniques in supporting enhanced broadband;
- h) that ITU-T has initiated the study of network standardization for IMT for 2020 and beyond;
- i) that adequate and timely availability of spectrum and supporting regulatory provisions is essential to realize the objectives in Recommendation ITU-R M.2083;
- j) that harmonized worldwide bands and harmonized frequency arrangements for IMT are highly desirable in order to achieve global roaming and the benefits of economies of scale;
- k) that the frequency band 45.5-47 GHz is allocated to the MS, MSS, RNS and RNSS and, in accordance with No. 5.553, in the band 43.5-47 GHz stations in the land mobile service may be operated subject to not causing harmful interference to the space radiocommunication systems to which this band is allocated;
- l) that the frequency band 66-71 GHz, or parts thereof, is allocated to the ISS, MS, MSS, RNS and RNSS and, in accordance with No. 5.553, in the band 66-71 GHz stations in the land

mobile service may be operated subject to not causing harmful interference to the space radiocommunication systems to which this band is allocated;

m) that, in accordance with *resolves to invite ITU-R 2* of Resolution **238 (WRC-15)**, it was necessary to conduct and complete in time for WRC-19 the appropriate sharing and compatibility studies, taking into account the protection of services to which the bands 45.5-47 GHz, 47-47.2 GHz and 66-71 GHz are allocated on a primary basis;

n) that, during preparation for WRC-19:

– in the bands 45.5-47 GHz and 47-47.2 GHz, sharing and compatibility studies were not carried out;

– in the band 66-71 GHz, sharing and compatibility studies were carried out for the ISS and MSS (Earth-to-space). Studies were not carried out for RNS and RNSS and for MSS (space-to-Earth);

o) that the band 66-71 GHz is expected to be used for Mobile Broadband/Multiple Gigabit Wireless Systems (MGWS) including technologies that meet the IMT requirements and for those that do not;

~~k~~p) that identification of frequency bands allocated to mobile service for IMT may change the sharing situation regarding applications of services to which the frequency band is already allocated, and may require additional regulatory actions;

~~l~~q) the need to protect existing services and to allow for their continued development when considering frequency bands for possible additional allocations to any service,

noting

a) Resolutions **223 (Rev.WRC-15)**, **224 (Rev.WRC-15)**, **225 (Rev.WRC-12)**, **[A113-IMT 26GHz] (WRC-19)**, which also relate to IMT;

~~a~~b) that Resolution ITU-R 65 addresses the principles for the process of development of IMT for 2020 and beyond, and that Question ITU-R 77-7/5 considers the needs of developing countries in the development and implementation of IMT;

~~b~~c) that Question ITU-R 229/5 seeks to address the further development of IMT;

~~e~~d) that IMT encompasses both IMT-2000, IMT-Advanced, and IMT-2020 collectively, as described in Resolution ITU-R 56-2;

~~e~~e) Recommendation ITU-R M.2083, on the framework and objectives of the future development of IMT for 2020 and beyond;

~~e~~f) that Report ITU-R M.2320 addresses future technology trends of terrestrial IMT systems;

~~f~~g) Report ITU-R M.2376, on technical feasibility of IMT in the frequency bands above 6 GHz;

~~g~~h) that Report ITU-R M.2370 analyses trends impacting future IMT traffic growth beyond the year 2020 and estimates global traffic demands for the period 2020 to 2030;

~~h~~i) that there are ongoing studies within ITU-R on the propagation characteristics for mobile systems in higher frequency bands;

~~i~~j) the relevance of provisions in Nos. **5.340**, **5.516B**, **5.547**, ~~and 5.553~~, and 5.558 which may need to be taken into account in studies;

~~j~~k) that the FSS allocation in the frequency band 24.65-25.25 GHz was made by WRC-12;~~i~~

l) Recommendation ITU-R M.2003-2 on Multiple Gigabit Wireless Systems in frequencies around 60 GHz;

m) Report ITU-R M.2227-2 on use of Multiple Gigabit Wireless Systems in frequencies around 60 GHz,

recognizing

a) that no identification of the frequency bands 45.5-47 GHz, 47-47.2 GHz and 66-71 GHz for the terrestrial component of IMT was made at WRC-19 due to lack of studies in accordance with Resolution 238 (WRC-15), and therefore further studies between IMT and the services to which these bands are currently allocated on a primary basis need to be addressed;

b) that identification of frequency bands for IMT should take into account the use of the bands by other services and the evolving needs of these services;

c) that there should be no additional regulatory or technical constraints imposed on services to which the band is currently allocated on a primary basis;

d) that there is a lead time between the allocation of frequency bands by world radiocommunication conferences and the deployment of systems in those bands, and that timely availability of wide and contiguous blocks of spectrum is therefore important to support the development of IMT;

e) that frequency bands allocated to passive services on an exclusive basis are not suitable for an allocation to the mobile service;

f) that any identification of frequency bands for IMT should take into account the use of the bands by other services and the evolving needs of these services;

g) that there should be no additional regulatory or technical constraints imposed to services to which the band is currently allocated on a primary basis,

resolves to invite ITU-R

1 to invite [a future competent WRC/WRC-23] to consider the identification of the frequency bands 45.5-47 GHz, 47-47.2 GHz and 66-71 GHz for the terrestrial component of IMT, based on the sharing and compatibility studies for protection of services to which these frequency bands are allocated on a primary basis;

2 to conduct and complete in time for WRC-23¹⁹ the appropriate studies to determine the spectrum needs for the terrestrial component of IMT in the frequency range between 24.25 GHz and 86 GHz, taking into account:

- technical and operational characteristics of terrestrial IMT systems that would operate in this frequency range, including the evolution of IMT through advances in technology and spectrally efficient techniques;
- the deployment scenarios envisaged for IMT-2020 systems and the related requirements of high data traffic such as in dense urban areas and/or in peak times;
- the needs of developing countries;
- the time-frame in which spectrum would be needed;

~~23~~ to conduct and complete in time for WRC-~~23~~¹⁹ the appropriate sharing and compatibility studies¹, taking into account the protection of services to which the band is allocated on a primary basis, for the frequency bands:

- ~~24.25–27.5 GHz², 37–40.5 GHz, 42.5–43.5 GHz,~~ 45.5–47 GHz, ~~47.2–50.2 GHz, 50.4–52.6 GHz,~~ 66–76 GHz and 81–86 GHz, which have allocations to the mobile service on a primary basis; and
- ~~31.8–33.4 GHz, 40.5–42.5 GHz and~~ 47–47.2 GHz, which may require additional allocations to the mobile service on a primary basis,

invites ITU-R

1 to continue and complete in time for [a future competent WRC/WRC-23] the appropriate sharing and compatibility studies to protect services to which the frequency bands 45.5–47 GHz, 47–47.2 GHz and 66–71 GHz are allocated on a primary basis;

2 to study the technical and regulatory conditions for the use of IMT in the frequency band 66–71 GHz in order to protect the aeronautical mobile service,

further resolves

1 to invite CPM~~23~~¹⁹-1 to define the date by which technical and operational characteristics needed for sharing and compatibility studies are to be available, to ensure that studies referred to in *resolves to invite ITU-R* can be completed in time for consideration at WRC-~~23~~¹⁹;

2 to invite WRC-~~19~~²³ to consider, based on the results of the above studies, additional spectrum allocations to the mobile service on a primary basis and to consider identification of frequency bands for the terrestrial component of IMT; the bands to be considered being limited to part or all of the bands listed in *resolves to invite ITU-R* ~~23~~,³

invites administrations

to participate actively in these studies by submitting contributions to ITU-R.

2/1.13/5.13.8 For the relevant condition(s) and option(s) of Methods K2 and L2

Note 1: The text for this draft new Resolution was contributed to ITU-R and, due to time constraints, has not yet been discussed and reviewed. WRC-19 is invited to carefully examine the text with a view to resolving any issues.

Note 2: A cross-reference to Resolution 750 (Rev.WRC-19), for example, within a recognizing, should be included in relation to Condition L2a, Option 1, which establishes limits on unwanted emissions in the frequency band 86–92 GHz from IMT base stations and IMT mobile stations within the 81–86 GHz frequency band.

Note 3: The preamble of this Resolution should be aligned with that of draft new Resolution [B113-IMT 40/50 GHz]

¹ Including studies with respect to services in adjacent bands, as appropriate.

~~² When conducting studies in the band 24.5–27.5 GHz, to take into account the need to ensure the protection of existing earth stations and the deployment of future receiving earth stations under the EESS (space to Earth) and SRS (space to Earth) allocation in the frequency band 25.5–27 GHz.~~

Note 4: The provisions in this Resolution could alternatively also be included in a WRC Recommendation.

A view was expressed that the new values for limits in Table X1 proposed for inclusion (as shown in Table X1 below) are based on a new study, presented in Document CPM19-2/192 as an update to study B in the final Report of TG 5/1. This new study has not been reviewed within TG 5/1 or within CPM19-2 framework. The study provides significantly more stringent limits, both for IMT BS and UE, than those included in Table X1 as outcome of TG 5/1 work (except for UE in the band 77-81 GHz). The study appears to have several technical issues originating from a non-consistent implementation of the technical parameters recommended by WP 5D for coexistence studies in TG 5/1, and certain additional over-pessimistic assumptions. This appears to be the basis for the large gap between the values coming from the outcome of TG 5/1 and the new proposed values. Administrations should treat this proposal with caution due to the indicated reasons.

Another view was expressed that the proposed values in Document CPM19-2/192 are updates to those already provided in the sharing and compatibility studies which were acknowledged by TG 5/1. Some of the current values in Table X1 are based on assumptions that underestimated the impact of IMT unwanted emissions into the automotive radar (e.g. not using beamforming antenna for the BS or not considering the combined effect of placing UEs at the cell edge with full power and in the vicinity of the vehicle). In the absence of models for certain parameters such as the decay of unwanted emissions over frequencies or the deployment scenarios (e.g. Recommendation ITU-R M.2101 and TG 5/1 Chairman's Report), worst case scenario assumptions were used. The proposed new values in Table X1 overcome this general assumption and demonstrate more stringent limits in some scenarios and less stringent limits for some other scenarios than the one from TG 5/1. The new proposed unwanted emission limits are meant to replace the "less than" values by adequate regulatory limits. Administrations are invited to consider the proposed values in order to protect automotive radars operating under the RLS in the 76-81 GHz band in the light of future autonomous driving vehicles.

ADD

DRAFT NEW RESOLUTION [E113-IMT 70/80 GHz] (WRC-19)

International Mobile Telecommunications in frequency bands 71-76 and 81-86 GHz

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that International Mobile Telecommunications (IMT), including IMT-2000, IMT-Advanced and IMT-2020, is intended to provide telecommunication services on a worldwide scale, regardless of location and type of network or terminal;
- b)* that the evolution of IMT is being studied within ITU-R;
- c)* that harmonized worldwide bands for IMT are desirable in order to achieve global roaming and the benefits of economies of scale;
- d)* that adequate and timely availability of spectrum and supporting regulatory provisions is essential to realize the objectives in Recommendation ITU-R M.2083;
- e)* that ITU-R has studied, in preparation for WRC-19, sharing and compatibility with services allocated in the frequency bands [71-76 GHz and 81-86 GHz] and their adjacent bands;

- f)* that there is a need to continually take advantage of technological developments in order to increase the efficient use of spectrum and facilitate spectrum access;
- g)* that WRC-19 identified the frequency bands [71-76 GHz and 81-86 GHz] for IMT with certain regulatory conditions to address protection of services to which the band is allocated on a primary basis;
- h)* that IMT systems are now being evolved to provide diverse usage scenarios and applications such as enhanced mobile broadband, massive machine-type communications and ultra-reliable and low-latency communications;
- i)* that the identification of frequency bands for IMT requires technical and regulatory measures to ensure compatibility with and future development of incumbent services having an allocation in the identified frequency bands;
- j)* that ultra-low latency and very high bit-rate applications of IMT will require larger contiguous blocks of spectrum than those available in frequency bands that are currently identified for use by administrations wishing to implement IMT;
- k)* that the properties of higher frequency bands, such as shorter wavelength, would better enable the use of advanced antenna systems including MIMO and beam-forming techniques in supporting enhanced broadband;
- l)* that ITU-R has studied, in preparation for WRC-19, sharing and compatibility with services allocated in the frequency bands 71-76 GHz and 81-86 GHz and their adjacent bands, based on characteristics available at that time;
- m)* that any identification of frequency bands for IMT should take into account the use of the bands by other services and the evolving needs of these services,

noting

- a)* Resolutions **223 (Rev.WRC-15)**, **224 (Rev.WRC-15)** and **225 (Rev.WRC-12)**, which also relate to IMT;
- b)* Recommendation ITU-R M.2083 provides IMT Vision – “Framework and overall objectives of the future development of IMT for 2020 and beyond”;
- c)* that currently operating mobile communication systems may evolve to IMT in their existing frequency bands;
- d)* that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band by any application of the services to which it is allocated;
- e)* that Resolution ITU-R 65 addresses the principles for the process of development of IMT for 2020 and beyond, and that Question ITU-R 77-7/5 considers the needs of developing countries in the development and implementation of IMT;
- f)* that Report ITU-R M.2320 addresses future technology trends of terrestrial IMT systems;
- g)* Report ITU-R M.2376, on technical feasibility of IMT in the frequency bands above 6 GHz,

recognizing

- a)* that for some administrations the only way of implementing IMT would be spectrum re-farming;

b) that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band by any application of the services to which it is allocated;

c) that there is a lead time between the allocation of frequency bands by world radiocommunication conferences and the deployment of systems in those bands, and that timely availability of wide and contiguous blocks of spectrum is therefore important to support the development of IMT;

d) that identification of frequency bands for IMT should take into account the use of the bands by other services and the evolving needs of these services,

resolves

1 in order to ensure the coexistence between IMT in the frequency bands 71-76 GHz and 81-86 GHz as identified by WRC-19 in Article 5 of the Radio Regulations and other services to which the frequency band is allocated including the protection of these other services, administrations shall apply the conditions as stated below;

[For Condition K2a, L2b]

2 that, in order to protect the radiolocation service in the frequency band 76-81 GHz, the unwanted emission limits into the 76-81 GHz band from IMT BSs and UEs operating in the 71-76 GHz and 81-86 GHz bands shall comply with the limits given in Table X1:

TABLE X1

Limits of unwanted emissions into 76-81 GHz from IMT stations

| Station | 76-77 GHz dB(W/200 MHz) | 77-81 GHz dB(W/200 MHz) |
|---------|----------------------------|----------------------------|
| BS | [TBD/-29.6/-31.5/<-37/-53] | [TBD/-33/<-37/-42] |
| UE | [TBD/-20/<-37/-47] | [TBD/-33/-35/<-37] |

[For Condition K2b Option 2]

3 the operation of IMT within the frequency band 71-76 GHz shall protect the existing and future FSS earth stations;

[For Condition L2a Option 1 is not applicable in this Resolution]

[For Condition L2c Option 2]

4 the operation of IMT within the frequency band 81-86 GHz shall protect the existing and future RAS stations in the frequency bands 81-86 GHz and 76-94 GHz;

[For Condition L2d Option 1A]

5 that the combined tilt (electrical and mechanical) of IMT base stations should normally not be higher than 0 degrees relative to the horizontal. In addition, IMT base stations shall comply with the TRP limits given in Table X2:

TABLE X2

TRP limits for IMT base stations

| Frequency bands | dB(W/200 MHz) |
|-----------------|---------------|
| 81-86 GHz | [TBD] |

[For Condition L2d Option 1B]

6 that the combined tilt (electrical and mechanical) of IMT base stations shall not be higher than 0 degrees relative to the horizontal. In addition, IMT base stations shall comply with the TRP limits given in Table X3:

TABLE X3

TRP limits for IMT base stations

| Frequency bands | dB(W/200 MHz) |
|-----------------|---------------|
| 81-86 GHz | [TBD] |

[For Condition L2d Option 2]

7 that, in order to protect satellite reception in the frequency band 81-86 GHz, IMT base stations shall comply with the following e.i.r.p. masks for the emissions:

| Elevation angle | Maximum e.i.r.p. dB(W/200 MHz) |
|-------------------------|--------------------------------|
| $5 \leq \Theta \leq 15$ | TBD |
| $15 < \Theta \leq 25$ | TBD |
| $25 < \Theta \leq 55$ | TBD |
| $55 < \Theta \leq 90$ | TBD |

Note: The order of appearance of *resolves* 1a and 1b above in this Resolution is yet to be decided. Furthermore, the place of *resolves* 1b is also yet to be decided (i.e. *resolves* or *invites administrations*). CPM 19-2 is invited to address the issue with a view to deciding on the matter.

invites ITU-R

1 to develop harmonized frequency arrangements to facilitate IMT deployment in the frequency bands 71-76 and 81-86 GHz taking into account the results of sharing and compatibility studies;

[For Condition K2b Option 1]

2 to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations in the frequency bands 71-76 GHz from IMT deployments in neighbouring countries;

[For Condition L2c Option 1]

3 to update existing ITU-R Recommendations or develop new ITU-R Recommendations, as appropriate, to provide information and assistance to the administrations on possible coordination and protection measures for the radio astronomy service in the frequency bands 81-86 GHz and 76-94 GHz from the IMT deployment.

2/1.13/5.13.9 For the relevant condition(s) and option(s) of Methods A2, H2, L2 and I2

Note: Due to time constraints, contributions regarding the active service band for bands other than 26 GHz in Resolution 750 (Rev.WRC-15) were not discussed.

MOD

RESOLUTION 750 (REV.WRC-1519)

**Compatibility between the Earth exploration-satellite service (passive)
and relevant active services**

The World Radiocommunication Conference ([Geneva, 2015](#)[Sharm el-Sheikh, 2019](#)),

...

resolves

1 that unwanted emissions of stations brought into use in the frequency bands and services listed in Table 1-1 below shall not exceed the corresponding limits in that table, subject to the specified conditions;

...

TABLE 1-1

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band ¹ |
|--|--|------------------------|---|
| ... | ... | ... | ... |
| <i>Note: The row below applies only to Condition A2a Option 1</i> | | | |
| 23.6-24 GHz | 24.25-27.5 GHz or 24.25-26.5 GHz or 24.25-25.25 GHz or 24.25-24.45 GHz | Mobile | TBD (see section 2/1.13/3.2 and the views below) |
| <p><i>View 1:</i> Views were expressed that the cross reference to Section 2/1.13/3.2.1 does not reflect the latest information regarding the unwanted emission limits. There have been several proposals of values during CPM19-2, including: -20, -28, -32, -32 to -35, -32 to -37, -32 to -42, -33.5, -37, -42, -49.3 and -55 dB(W/200 MHz) for IMT base stations and -20, -24 to -28, -28, -28 to -30, -28 to -38, -29.7, -37, -38, -45 and -51 dB(W/200 MHz) for IMT mobile stations. Further discussion is needed for the selection of a proposed value.</p> <p><i>View 2:</i> The United States and the Republic of Korea request that unwanted emission limits of -20 dB(W/200 MHz) be included (BS/UE) in the range of options for the 24 GHz band.</p> <p><i>View 3:</i></p> | | | |

Based on the results of studies conducted by ITU-R, some Administrations are of the view that unwanted emission limits in the band 23.6-24.0 GHz, to protect EESS(passive) from IMT operating within 24.25-27.5 GHz, should be considered within the ranges:

- *IMT BS: -32 to -37 dB(W/200 MHz)*
- *IMT UE: -28 to -30 dB(W/200 MHz)*

View 4:

The values -42 dB(W/200 MHz) (BS) and -38 dB(W/200 MHz) (UE) were derived based on the baseline assumptions of ITU-R and the assumption of beamforming antenna. It is noted that less stringent values have often not been justified with any technical background and are sometimes proposed with the rationale that EESS (passive) should not constraint IMT, which is against the ITU principles.

View 5:

The following values for unwanted emission limits were received at CPM19-2.

-20, -28, -32, -32 to -35, -32 to -37, -32 to -42, -33.5, -37, -42, -49.3 and -55 dB(W/200 MHz) for BS and -20, -24 to -28, -28, -28 to -30, -28 to -38, -29.7, -37, -38, -45 and -51 dB(W/200 MHz).

View 6:

View were expressed that the following values for the unwanted emission limits that resulted from majority of the studies conducted in TG 5/1 on EESS protection within 23.6-24 GHz and supported by majority of Regional Groups and administrations in CPM19-2 should be as follow:

For BS: -20, -28, -32, -32 to -35, -32 to -37, -33.5, -37 dB(W/200 MHz), and

For UE: -20, -24 to -28, -28, -28 to -30, -29.7, -37 dB(W/200 MHz)

The adoption of the above values will be enough for protection of EESS services which also could be feasible for IMT implementation. Any consideration of more stringent unwanted emission limit values for over-protection requirement by certain ITU membership will make deployment of IMT systems within 24.25-27.5 GHz not feasible. The adoption of values above -32 dB(W/200 MHz) will even increase the system complexity, reduce IMT system performance and increase equipment cost significantly.

View 7:

The view was expressed that when using baseline assumptions agreed in ITU-R (i.e. single element pattern, baseline BS distribution, apportionment of EESS (passive) protection criteria)), studies depict very similar results, leading to the following range of necessary IMT-2020 stations unwanted emissions levels:

For BS: from -49 to -42 dB(W/200 MHz)

For UE: from -45 to -38 dB(W/200 MHz)

View 8:

Concerns were expressed about a number of unwanted emission limits that were suggested to CPM19-2 without any technical studies supporting the values (in particular the proposal made orally for a -20 dB(W/200 MHz) limit for both BS and UE) or introducing unjustified new assumptions to artificially decrease the potential impact of IMT-2020 on EESS (passive) (e.g. the manufacturing factor) in order to propose relaxed unwanted emission limits that obviously will not provide any protection of EESS (passive).

View 9:

The view was expressed that without new compelling elements (e.g. antenna pattern measurements), in particular on relevant IMT-2020 antenna model, only levels of -55 dB(W/200 MHz) (for BS) and -51 dB(W/200 MHz) (for UE) resulting from study B would fully ensure protection of all existing and under development EESS (passive) sensors in the band 23.6-24 GHz.

View 10:

Unwanted emission limits more stringent than -33.5 dB(W/200 MHz) for IMT base stations and -29.7 dB(W/200 MHz) for IMT user equipment should not be considered for inclusion in WRC Res 750. During CPM19-2, proposals for unwanted emission limits included: -20, -28, -32, -32 to -35, -33.5 dB(W/200 MHz) for IMT base stations and -20, -24 to -28, -28, -28 to -30, -29.7 dB(W/200 MHz) for IMT mobile stations among other more conservative limits. While there is a need to protect EESS (passive) operations in the band 23.6-24.0 GHz, it is also important to recognize that imposing overly conservative limits prevents efficient use of spectrum.

View 11:

Views were expressed that the optimal conditions will see IMT using the band 24.25-27.5 GHz while ensuring the protection of EESS (passive) in the 23.6-24 GHz band. Studies submitted to TG 5/1 showed that values no more stringent than the following are required:

-35 to -32 dB(W/200 MHz) for IMT BS.

-28 to -30 dB(W/200 MHz) for IMT UE.

As unwanted emissions will not in reality exceed these upper limits, and levels for most IMT stations will in practice be lower with some margin, less onerous values can also be considered.

View 12:

Views were expressed that in order to protect existing and future EESS passive sensors, operating in the band 23.6-24 GHz, the following unwanted emission limits for IMT-2020 stations shall apply:

–49.3 dB(W/200 MHz) for BS and –45 dB(W/200 MHz) for UE.

Those limits are based on results of the sharing studies for Sensor F6, representing existing satellite system and would be essential for protection of future passive sensor instruments under development, which would operate with increased sensitivity.

In the absence of any proofs from mobile industry, justifying the use of beamformed antenna pattern in the unwanted emissions domain (e.g. antenna pattern measurements and corresponding IMT-2020 antenna model) as well as uncertainty on correctness of deployment related parameters for IMT-2020 networks, those values could not be relaxed.

View 13:

CEPT recently adopted unwanted emission values of –42 dB(W/200 MHz) (for BS case) and –38 dB(W/200 MHz) (for UE case) to be applied to IMT-2020 systems to ensure protection of EESS (passive) sensors in the 23.4-26 GHz (see Decision ECC/DEC/(18)06).

| | | | |
|-----|-----|-----|-----|
| ... | ... | ... | ... |
|-----|-----|-----|-----|

Note: The row below applies only to Condition A2b Option 1

| | | | |
|---------------|--|---------------|-------------------------------------|
| 50.2-50.4 GHz | <u>24.25-27.5 GHz</u> <u>or</u> <u>24.25-25.25 GHz</u> <u>or</u> <u>24.25-24.45 GHz</u> <u>or</u> <u>24.25-TBD GHz</u> | <u>Mobile</u> | <u>TBD (see section 2/1.13/3.2)</u> |
| ... | ... | ... | ... |

Note: The row below applies only to Condition H2a Options 1 and 2

| | | | |
|---------------|----------------------|---------------|-------------------------------------|
| 50.2-50.4 GHz | <u>47.2-50.2 GHz</u> | <u>Mobile</u> | <u>TBD (see section 2/1.13/3.2)</u> |
| ... | ... | ... | ... |

Note: The row below applies only to Condition I2a Options 1 and 2

| | | | |
|---------------|----------------------|---------------|-------------------------------------|
| 50.2-50.4 GHz | <u>50.4-52.6 GHz</u> | <u>Mobile</u> | <u>TBD (see section 2/1.13/3.2)</u> |
| ... | ... | ... | ... |

Note: The row below applies only to Condition A2b Option 1

| | | | |
|----------------|--|---------------|-------------------------------------|
| 52.6-54.25 GHz | <u>24.25-27.5 GHz</u> <u>or</u> <u>24.25-25.25 GHz</u> <u>or</u> <u>24.25-24.45 GHz</u> <u>or</u> <u>24.25-TBD GHz</u> | <u>Mobile</u> | <u>TBD (see section 2/1.13/3.2)</u> |
| ... | ... | ... | ... |

| | | | |
|--|----------------------|---------------|-------------------------------------|
| <i>Note: The row below applies only to Condition I2a Options 1 and 2</i> | | | |
| 52.6-54.25 GHz | <u>50.4-52.6 GHz</u> | <u>Mobile</u> | <u>TBD (see section 2/1.13/3.2)</u> |
| ... | ... | ... | ... |
| <i>Note: The row below applies only to Condition L2a Option 1</i> | | | |
| <u>86-92 GHz</u> | <u>81-86 GHz</u> | <u>Mobile</u> | <u>TBD (see section 2/1.13/3.2)</u> |
| ... | ... | ... | ... |

¹ The unwanted emission power level is to be understood here as/is understood to mean the level measured at the antenna port, unless specified in terms of total radiated power.

...

2/1.13/5.14 For all items, for Methods A1, B1, C1, D1, E1, F1, F2, G1, G2, H1, I1, J1, K1 and L1 (NOC)

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

2/1.13/5.14.1 For Method A1 (NOC)

NOC

22-24.75 GHz

NOC

24.75-29.9 GHz

2/1.13/5.14.2 For Method B1 (NOC)

NOC

29.9-34.2 GHz

2/1.13/5.14.3 For Method C1 (NOC)

NOC

34.2-40 GHz

NOC

40-47.5 GHz

2/1.13/5.14.4 For Method D1 (NOC)

NOC

40-47.5 GHz

2/1.13/5.14.5 For Method E1 (NOC)

NOC

40-47.5 GHz

2/1.13/5.14.6 For Method F1 (NOC) and Method F2

NOC

40-47.5 GHz

2/1.13/5.14.7 For Method G1 (NOC) and Method G2

NOC

40-47.5 GHz

2/1.13/5.14.8 For Method H1 (NOC)

NOC

40-47.5 GHz

NOC

47.5-51.4 GHz

2/1.13/5.14.9 For Method I1 (NOC)

NOC

47.5-51.4 GHz

NOC

51.4-55.78 GHz

2/1.13/5.14.10 For Method J1 (NOC)

NOC

66-81 GHz

2/1.13/5.14.11 For Method K1 (NOC)

NOC

66-81 GHz

2/1.13/5.14.12 For Method L1 (NOC)

NOC

81-86 GHz

2/1.13/5.15 For all items, for all Methods, except Method F2, G2 and J3 for which a modification of Resolution 238 (WRC-15) is proposed

SUP

RESOLUTION 238 (WRC-15)

Studies on frequency-related matters for International Mobile Telecommunications identification including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency range between 24.25 and 86 GHz for the future development of International Mobile Telecommunications for 2020 and beyond

Agenda item 1.16

1.16 to consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution 239 (WRC-15);

Resolution 239 (WRC-15) – *Studies concerning Wireless Access Systems including radio local area networks in the frequency bands between 5 150 MHz and 5 925 MHz*

2/1.16/1 Executive summary

Section 2/1.16/2 provides background information about the development of wireless access systems (WAS)/radio local area networks (RLAN) usage and work at previous WRCs related to WAS/RLAN.

Section 2/1.16/3 describes:

- the results of ITU-R studies for the technical and operational requirements for RLANs taking into account that previous studies indicated the minimum spectrum requirement for RLANs using the 5 GHz frequency range in the year 2018 is estimated to be 880 MHz;
- the sharing and compatibility studies conducted by the ITU-R in accordance with Resolution 239 (WRC-15) for various frequency ranges;
- analyses of the results of studies for various frequency ranges: 5 150-5 250 MHz, 5 250-5 350 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz, and 5 850-5 925 MHz.

Methods to satisfy the agenda item are included in section 2/1.16/4.

The frequency bands considered under this agenda item, i.e. 5 150-5 250 MHz, 5 250-5 350 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz and 5 850-5 925 MHz, are denoted by the letters **A**, **B**, **C**, **D**, and **E**, respectively. When multiple methods are proposed for a particular frequency band, the methods are expressed by the associated letter and a numerical suffix (Method **A1**, Method **A2**, etc.); when only one method is proposed for a particular frequency band, the method is expressed by the associated letter (**B**, **C**, etc.).

For the 5 150-5 250 MHz frequency band, six methods (including NOC) are proposed (**A1**, **A2**, **A3**, **A4**, **A5** and **A6**); for the 5 250-5 350 MHz and for the 5 350-5 470 MHz frequency bands, only one method (NOC) is proposed (**B** and **C** respectively); for the 5 725-5 850 MHz frequency band, three methods (including NOC) are proposed (**D1**, **D2** and **D3**); and for the 5 850-5 925 MHz frequency band only one method (NOC) is proposed (**E**).

Finally, the regulatory and procedural considerations can be found in Section 2/1.16/5.

2/1.16/2 Background

RLANs have proven to be a success in conjunction with other fixed and mobile networks at providing affordable and ubiquitous broadband wireless access to the Internet. Introduced by some administrations in the 2.4 GHz band and subsequently expanded into some of the 5 GHz frequency bands, RLANs, specifically Wi-Fi devices, now carry approximately half of all global Internet

Protocol (IP) traffic¹⁴. In fact, mobile carriers have increased their reliance on Wi-Fi offload, voice-over-Wi-Fi, and similar technologies¹⁵. As technology evolves to meet increasing performance demands and traffic on broadband WAS increases, the use of wider bandwidth channels in order to support high data rates creates a need for additional spectrum.

RR No. **5.446A** specifies that the use of the bands 5 150-5 350 MHz and 5 470-5 725 MHz by the stations in the mobile, except aeronautical mobile, service shall be in accordance with Resolution **229 (Rev.WRC-12)**.

Since WRC-03, the demand for mobile broadband applications especially for WAS/RLANs has been growing rapidly. Resolution **239 (WRC-15)** states “that the results of ITU-R studies indicate that the minimum spectrum need for WAS/RLAN in the 5 GHz frequency range in the year 2018 is estimated at 880 MHz; this figure includes 455-580 MHz already utilized by non-IMT mobile broadband applications operating within the 5 GHz range resulting in 300-425 MHz additional spectrum being required”.

One issue WRC-15 examined was the possibility of additional global allocations to the mobile service (MS) for terrestrial mobile broadband applications, including in the 5 GHz range, to facilitate contiguous spectrum for WAS/RLAN. This is to enable the use of wider channel bandwidths to support higher data throughput. The studies performed by ITU-R in preparation for WRC-15 indicated that if the WAS/RLAN mitigation measures were limited to the regulatory provisions of Resolution **229 (Rev.WRC-12)**, sharing between WAS/RLAN and the Earth exploration-satellite service (EESS) (active) systems in the frequency band 5 350 to 5 470 MHz may not be feasible, as well as being insufficient to ensure protection of certain radar types in this frequency band. For these cases, sharing may only be feasible if additional WAS/RLAN mitigation measures are implemented. However, no agreement was reached on the applicability of any additional WAS/RLAN mitigation techniques (see Section 1/1.1/3.2.11 of the [Report of the CPM to WRC-15](#)).

No agreement was reached on the conclusions of the studies for the frequency band 5 725-5 850 MHz (see Section 1/1.1/3.2.12 of the [Report of the CPM to WRC-15](#)). As such, WRC-15 concluded no change (NOC) for these frequency bands and established a WRC-19 agenda item to continue the work.

Resolution **239 (WRC-15)**, calls for ITU-R to:

- study WAS/RLAN technical characteristics and operational requirements in the 5 GHz frequency range;
- perform sharing and compatibility studies between WAS/RLAN applications and incumbent services in the frequency bands 5 150-5 350 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz and 5 850-5 925 MHz while ensuring the protection of incumbent services including their current and planned use;
- consider enabling outdoor WAS/RLAN operations in the frequency band 5 150-5 350 MHz;
- consider potential MS allocations to accommodate WAS/RLAN operations in the 5 350-5 470 MHz and 5 725-5 850 MHz frequency bands; and

¹⁴ *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015-2020*, pp. 24-25 (3 Feb. 2016), available at <http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.pdf>.

¹⁵ *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015-2020*, p. 25 (3 Feb. 2016).

– identify potential WAS/RLAN use in the 5 850-5 925 MHz frequency band.

2/1.16/3 Summary and analysis of the results of ITU-R studies

2/1.16/3.1 Technical and operational requirements for WAS/RLANs

Further information on technical and operational requirements for WAS/RLANs considered in sharing and compatibility studies other than those referred to in Resolution **229 (Rev.WRC-12)** can be found in the WDPDN Report ITU-R M.[RLAN REQ-PAR].

2/1.16/3.2 Sharing and compatibility studies

2/1.16/3.2.1 Frequency band 5 150-5 250 MHz

The frequency band 5 150-5 250 MHz is allocated to various services as contained in the Radio Regulations (RR) Table of Frequency Allocations including associated footnotes thereto:

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 5 150-5 250 | FIXED-SATELLITE (Earth-to-space) 5.447A MOBILE except aeronautical mobile 5.446A 5.446B AERONAUTICAL RADIONAVIGATION 5.446 5.446C 5.447 5.447B 5.447C | |

The studies described in the subsections below for the 5 150-5 250 MHz frequency band did not address the impact of out-of-band emissions.

2/1.16/3.2.1.1 FSS for non-GSO MSS feeder uplinks and the WAS/RLAN

The studies described in this section assumed several WAS/RLAN e.i.r.p. distributions as contained in the WDPDN Report ITU-R M.[RLAN REQ-PAR].

When 5 150-5 250 MHz was originally allocated to the fixed-satellite service (Earth-to-space) feeder links of non-geostationary-satellite systems in the mobile-satellite service (i.e. MSS feeder uplinks) at WRC-95, the expectation was that multiple non-geostationary MSS systems would share the band (see RR No. **5.447A**), which some administrations are of the view that this expectation has not been met. Other administrations are of the view that this expectation has been met.

MSS operators have been licensed by different administrations to use the 5 091-5 250 MHz range for feeder uplinks from earth stations to non-GSO MSS satellites. The feeder uplinks have been in continuous use globally since 1998. These MSS systems provide vital communication links to underserved areas and are often the only communication link available in these remote areas.

It is also important to recognize that, some countries have allowed RLAN outdoor deployments on a national basis, due to the growing demand for RLAN connectivity. One study from an administration which presently allows RLANs to operate in 5 150-5 250 MHz up to 1 Watt conducted power and a power spectral density (PSD) of 17 dBm/MHz with an allowance for a 6 dBi antenna gain (i.e. a total 36 dBm e.i.r.p., with emissions at elevations above 30 degrees restricted to 21 dBm or less) showed that RLANs could protect the non-GSO mobile-satellite

service (MSS) feeder links when typical deployment characteristics were taken into account¹⁶. The study conducted a parametric analysis, testing to a range of protection values, including -6 dB I/N , -10.5 dB I/N , and -12.2 dB I/N .¹⁷ Results were determined by applying the survey information and the figure of 2% of RLANs operating outdoors, using directional and omnidirectional antennas, and conducted power limits that would minimize co-channel interference between the RLAN systems and in turn minimize the likelihood of harmful interference to the operating MSS system. The resulting e.i.r.p. distributions are provided in the WDPDN Report ITU-R M.[RLAN SHARING 5 150-5 250 MHz] as well as in the WDPDN Report ITU-R M.[RLAN REQ-PAR]. The study analysed RLAN aggregate interference into satellites in the system over a continuous six-day period during which the long-term CDMA channel capacity or radio-frequency power loss never exceeded 1%. Accordingly, the study found no impact to the satellite constellation capacity or satellite RF power and hence no harmful interference to the MSS systems using the 5 150-5 250 MHz frequency band for FSS feeder links. Considering the results of this study, RLANs could potentially operate outdoors and at higher powers in the 5 150-5 250 MHz frequency band. For outdoor Access Point (AP) antennas, 78% are assumed to employ antennas that are omnidirectional in the azimuth plane and facing with the main beam generally downward in the vertical plane; 16% employ a 6 dBi directional antenna with 50 degrees of down tilt; and 6% employ a 12 dBi directional antenna with 30 degrees of down tilt. This study represents a typical deployment for the country in which this study was carried out, where outdoor deployments need to comply with emissions constrained in elevations higher than 30 degrees to be less than 125 mW e.i.r.p.

One separate comparison showed that higher power and outdoor operation of any RLAN described above could potentially result in up to 30 dB more e.i.r.p. for RLAN emission elevation angles ≤ 30 degrees and up to 15 dB more e.i.r.p. for elevation angles > 30 degrees, compared with that prescribed by Resolution **229 (Rev.WRC-12)**. It should also be noted that RLAN operations include a wide distribution of devices operating at a range of e.i.r.p. values.

Two other sharing studies (where interference was assumed as exceeding -12.2 dB I/N ¹⁸) conducted for the northern part of Region 2 and for Europe, both support the above comparison. These studies indicate high levels of interference that impact the performance of this MSS system in terms of interference-to-noise ratio (I/N) and of capacity. I/N values of up to $+3$ dB were predicted, with a probability of 50% of exceedance, for the northern portion of Region 2 and up to -5.4 dB for Europe. Capacity and coverage of the MSS system are each shown to be reduced by a percentage of up to 8%.

In addition, measurements made at the satellites by an incumbent MSS system operator have indicated an increase in noise level of 2 dB in their 5 096-5 250 MHz feeder uplink in the region where one administration has permitted outdoor RLANs since 2014. This increase matches the results of the sharing study for the northern part of Region 2 described immediately above. This increase implies an interference level 10 times greater than the objective given in current ITU-R Recommendations.

¹⁶ Characteristics were determined by a survey of market data, device certification data, best practices and actual deployments. Study results were determined by applying the survey information and the figure of 2% of RLANs operating outdoors, using directional and omnidirectional antennas, and conducted power limits that would minimize co-channel interference between the RLAN systems and in turn minimize the likelihood of harmful interference to the operating MSS system.

¹⁷ These values were not agreed to or confirmed by the concerned ITU-R group.

¹⁸ This value was not agreed to or confirmed by the concerned ITU-R group.

Another sharing study (where interference was assumed as exceeding -12.2 dB I/N^5) focused on evaluation of conditions that enable sharing and compatibility between RLAN and MSS. In this study, as mitigation measures, limitation of the number of outdoor access points and the maximum e.i.r.p. dependent on antenna elevation angles are considered. The conditions of the maximum e.i.r.p. are assumed to be the same as described in *resolves 4* in Resolution **229 (Rev.WRC-12)** for the 5 250-5 350 MHz frequency band. The results of the study show that if the number of outdoor RLANs is limited, the total interference level from RLANs is lower than the threshold for MSS feeder links. Since the 5 250-5 350 MHz frequency band is adjacent to the 5 150-5 250 MHz frequency band, considering that these sub-bands may be used at the same time (for example, 160 MHz channel mode in IEEE 802.11ac/ax), the aim of this study was to look at the feasibility of the equivalent technical conditions in 5 250-5 350 MHz.

Another study examined the impact to another non-GSO MSS system sharing the spectrum, which is the COMPASS-MSS system over Asia. The study shows that the COMPASS-MSS system feeder link would suffer interference (where interference was assumed as exceeding -12.2 dB I/N^5) from RLAN access points for more than 90% of the time if the RLAN devices are 5.3% outdoor used.

Another study considered RLAN deployments over Europe, North Africa and part of Asia and the Middle East and concluded that RLAN outdoor operation (up to 5.3%) would cause harmful interference to the MSS feeder link (where interference was assumed as exceeding -12.2 dB I/N^5). This study considered the HIBLEO-X constellation and an e.i.r.p. of 1 W and even 4 W. This study also specifically considered the proposal for outdoor use with a limitation of e.i.r.p. to 125 mW for RLAN antenna elevation angles in excess of 30 degrees from the horizon by applying a constant discrimination, and concluded that this mitigation technique would not solve the interference problem (where interference was also assumed as exceeding -12.2 dB I/N^5). However, a parametric investigation allowed to show that up to 3% maximum outdoor RLAN can be deployed with a maximum e.i.r.p. of 200 mW, in that case, limited RLANs outdoor applications (like unmanned systems (within the mobile except aeronautical mobile allocation)) can be envisaged. This study also assessed in-vehicle usage of low e.i.r.p. RLAN devices (up to 40 mW). Simulations have shown that the same level of protection offered by the indoor usage is achieved for MSS when combining a low e.i.r.p. up to 40 mW and restricted to in-car use. Measured attenuation of high speed train carriages at such frequency suggests that higher e.i.r.p. may be acceptable for trains. In-vehicle (car and trains) usage restriction is an effective measure to mitigate the level of interference into the MSS feeder link.

No agreement was reached on the results of all these studies as outlined above.

2/1.16/3.2.1.2 ARNS and WAS/RLAN

This frequency band is used for sense and avoid systems and the typical technical characteristics are given in Recommendation ITU-R M.2007 “*Characteristics of and protection criteria for radars operating in the aeronautical radionavigation service in the frequency band 5 150-5 250 MHz*”. These systems were characterized after the initial introduction of the WAS/RLANs under Resolution **229 (WRC-03)**. It should also be noted that the sharing studies carried out when the frequency band was allocated to mobile service on a primary basis for the implementation of WAS/RLAN assumed 1% accidental outdoor usage at 200 mW e.i.r.p.

In one deterministic, single-entry case example compatibility study, the results showed that the effective measures for reducing interference for airborne sense and avoid systems operation are to be developed to enable the usage of outdoor WAS/RLAN in the 5 150-5 250 MHz frequency band. One approach based on the worst-case results may be the reduction of e.i.r.p. values of WAS/RLAN transmitters approximately by 20 dB while increasing the receiver sensitivity can be considered as the effective method for reducing interference. Such method allows to compensate the absence of

additional fading in the walls which provided sharing of WAS/RLAN systems with the aeronautical radionavigation service (ARNS) systems operating in the considered frequency band.

Without development of such measures for reducing the interference, a view was expressed that the decision of possible outdoor WAS/RLAN systems usage in the considered frequency band cannot be made.

Consideration of statistical analysis looking at multi-source interference could result in different protection distances. Further studies using an aggregate interference are needed for realistic results.

Another study is submitted that is focused on evaluation of conditions that enable sharing and compatibility. In this study, as mitigation measures, limitation of the number of outdoor RLANs, restriction of the location of outdoor RLANs and the maximum e.i.r.p. dependent on antenna elevation angles are considered. The conditions of maximum e.i.r.p. are assumed to be the same as described in *resolves* 4 in Resolution **229 (Rev.WRC-12)** for the 5 250-5 350 MHz frequency band. Since the 5 250-5 350 frequency band is adjacent to the 5 150-5 250 MHz frequency band, considering that these sub-bands may be used at the same time (for example, 160 MHz channel mode in IEEE 802.11ac/ax), the aim of this study was to look at the feasibility of the equivalent technical conditions in 5 250-5 350 MHz. The results of the study show that if the number of outdoor RLANs is limited, and the distance between RLANs and ARNS systems is larger than a specific protection distance, the total interference level from RLANs is lower than the threshold for ARNS systems with an adequate probability.

Another minimum coupling loss (MCL) coexistence study showed that an outdoor RLAN relaxation without any mitigation technique would cause harmful interference to the ARNS. However, it was shown that the same level of protection offered by the indoor usage is achieved when combining a low e.i.r.p. of 40 mW and a restricted in-car use and up to 200 mW e.i.r.p. for high speed train carriages case. In-vehicle usage (cars and trains) restriction is an effective measure to mitigate the level of interference into the ARNS.

2/1.16/3.2.1.3 Aeronautical mobile telemetry and WAS/RLAN pursuant to RR No. 5.446C

Pursuant to RR No. **5.446C**, “in Region 1 (except in Algeria, Saudi Arabia, Bahrain, Egypt, United Arab Emirates, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Syrian Arab Republic, Sudan, South Sudan and Tunisia) and in Brazil, the band 5 150-5 250 MHz is also allocated to the aeronautical mobile service on a primary basis, limited to aeronautical telemetry transmissions from aircraft stations (see No. **1.83**), in accordance with Resolution **418 (Rev.WRC-12)***. These stations shall not claim protection from other stations operating in accordance with Article 5. No. **5.43A** does not apply”.

One study indicated that MCL calculations showed that outdoor usage with the e.i.r.p. values recognized in Resolution **229 (Rev.WRC-12)** cannot ensure the coexistence of outdoor RLANs and the aeronautical mobile telemetry (AMT). However, this study showed that AMT systems can have the same level of protection established by Resolution **229 (Rev.WRC-12)**, when combining a low e.i.r.p. (up to 40 mW) with in-car use and up to 200 mW for high speed train carriages case.

The study did not consider cross-border coordination between AMT and WAS/RLAN. Operations of both services are at the discretion of national regulatory authorities (i.e. administrations). Since administrations authorize national deployment of AMT and RLANs, they can request implementation of mitigation techniques to manage sharing between these services at the national level.

2/1.16/3.2.2 Frequency band 5 250-5 350 MHz

The frequency band 5 250-5 350 MHz is allocated to various services as contained in the RR Table of Frequency Allocations including associated footnotes thereto.

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 5 250-5 255 | EARTH EXPLORATION-SATELLITE (active) MOBILE except aeronautical mobile 5.446A 5.447F RADIOLOCATION SPACE RESEARCH 5.447D 5.447E 5.448 5.448A | |
| 5 255-5 350 | EARTH EXPLORATION-SATELLITE (active) MOBILE except aeronautical mobile 5.446A 5.447F RADIOLOCATION SPACE RESEARCH (active) 5.447E 5.448 5.448A | |

2/1.16/3.2.2.1 EESS (active) and the WAS/RLAN and radar systems and the WAS/RLANs

The current WAS/RLAN operating parameters are specified in Resolution **229 (Rev.WRC-12)**.

Since the adoption of Resolution **229** at WRC-03, millions of WAS/RLAN (e.g. Wi-Fi) devices have been deployed in the 5 250-5 350 MHz frequency band.

In preparation for WRC-19, studies in response to *invites ITU-R c*) of Resolution **239 (WRC-15)** have shown that changing the WAS/RLAN operating conditions in the 5 250-5 350 MHz frequency band as given in Resolution **229 (Rev.WRC-12)**, would not ensure protection of the radiodetermination service and EESS (active) sensors. Furthermore, the current WAS/RLAN operating conditions in the 5 250-5 350 MHz frequency band are sufficient for the operating needs of WAS/RLAN users.

2/1.16/3.2.3 Frequency band 5 350-5 470 MHz

The frequency band 5 350-5 470 MHz, or parts thereof, is allocated to the EESS, RLS, ARNS, SRS and RNS. The details of these allocations can be found in RR Article **5**.

2/1.16/3.2.3.1 EESS (active) and the WAS/RLAN

Previous ITU-R sharing studies show that sharing between RLAN and the EESS (active) systems in the 5 350-5 470 MHz frequency band would not be feasible unless additional RLAN mitigation measures are implemented. After further study of currently available mitigation measures, study results show that there are no feasible mitigation techniques to facilitate sharing between RLAN and EESS (active) in this band.

2/1.16/3.2.3.2 Radar systems and the WAS/RLANs

The regulatory provisions in the 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz frequency bands contained in Resolution **229 (Rev.WRC-12)** are insufficient to ensure protection of certain radar types in the 5 350-5 470 MHz frequency band. After further study of currently available mitigation measures, study results show that there are no feasible mitigation techniques to facilitate sharing between RLAN and the different radar systems in the 5 350-5 470 MHz frequency band.

2/1.16/3.2.4 Frequency band 5 725-5 850 MHz

The frequency band 5 725-5 850 MHz is allocated to various services as contained in the RR Table of Frequency Allocations including associated footnotes thereto.

| Allocation to services | | |
|--|---|----------|
| Region 1 | Region 2 | Region 3 |
| 5 725-5 830 FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur 5.150 5.451 5.453 5.455 | 5 725-5 830 RADIOLOCATION Amateur 5.150 5.453 5.455 | |
| 5 830-5 850 FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.451 5.453 5.455 | 5 830-5 850 RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.453 5.455 | |

The studies described in the subsections below for the 5 725-5 850 MHz frequency band did not address the impact of out-of-band emissions.

In this band a number of systems/applications operate in several countries in Region 1 including road transport and traffic telematics (RTTT), wireless industrial applications (WIA), broadband fixed wireless access (BFWA) and short-range devices (SRD) in addition to the designation of this band worldwide as an industrial, scientific and medical (ISM) band. Some of these applications use WAS/RLAN technologies, operate at various power levels and use mitigation techniques (including dynamic frequency selection (DFS)) to enable sharing with the incumbent services operating in this band. Appropriate mitigation measures may be required to be applied to WAS/RLAN in these Region 1 countries, in order to achieve coexistence between WAS/RLAN and these systems/applications, if WRC-19 decides to allocate the frequency band 5 725-5 850 MHz to the mobile service in Region 1, with the purpose to accommodate WAS/RLAN use. Some administrations in Region 1 have regulations allowing generic WAS/RLAN use in the frequency band 5 725-5 850 MHz that requires the same DFS implementation as BFWA and WIA to enable sharing with their incumbent services.

In Region 2, the 5 725-5 825 MHz frequency band is also used by WAS including RLANs. The fixed-satellite service (FSS) allocation in 5 725-5 850 MHz frequency band is in Region 1 only, therefore wireless WAS/RLAN and FSS sharing issues are not relevant in Regions 2 and 3.

In addition, RR No. **5.453** includes over 40 countries from Regions 1 and 3 which have allocated the 5 650-5 850 MHz frequency band to the fixed service (FS) and MS on a primary basis for which the provisions of Resolution **229 (Rev.WRC-12)** do not apply. Some of these countries operate WAS/RLANs technology under this footnote and one country in Region 3 operates ITS (intelligent transport systems) under the mobile allocation of this footnote.

2/1.16/3.2.4.1 Radar systems and the WAS/RLANs

In one study of a single interferer to the ground-based radiolocation radars, the protection distances range from several tens of kilometres for outdoor WAS/RLAN and indoor WAS/RLAN as well.

Consideration of multi-source interference result in additional increase of the required protection distance defined by the WAS/RLAN transmitter density and directivity characteristics of the considered radar. Thus based on this one study providing compatibility of WAS/RLAN with the radars operating in this frequency band will be difficult.

It should be noted that the current DFS techniques are not sufficient to protect the new frequency hopping radars modes operating in some countries in the 5 725-5 850 MHz frequency band. No new elements have been presented on any additional mitigation techniques that could be used to provide protection to these new frequency hopping radars operating modes.

2/1.16/3.2.4.2 FSS (allocated only in Region 1) and WAS/RLANs

One study has been conducted with a variety of assumptions and interference environment. The initial conclusion was that sharing would be difficult without implementation of mitigation techniques.

Another study showed that by limiting the WAS/ RLANs to indoor only operations and a maximum e.i.r.p. of 200 mW sharing, including associated mitigation techniques, can be achieved between WAS/RLANs and the FSS, operating in Region 1 only, in the 5 725-5 850 MHz frequency band.

2/1.16/3.2.5 Frequency band 5 850-5 925 MHz

The frequency band 5 850-5 925 MHz is allocated to various services as contained in the RR Table of Frequency Allocations including associated footnotes thereto.

| Allocation to services | | |
|---|---|--|
| Region 1 | Region 2 | Region 3 |
| 5 850-5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.150 | 5 850-5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Amateur Radiolocation 5.150 | 5 850-5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Radiolocation 5.150 |

The mobile service is co-primary in the 5 850-5 925 MHz frequency band in all three Regions. Applications under the mobile service in this frequency band have already been implemented in various countries throughout the world. Therefore any sharing analysis carried out under this agenda item should not prejudice usages of the mobile service while not imposing any additional constraints on other services to which the band is allocated.

Some concerns were raised about different applications operating under the primary mobile service in this band. Some sharing studies carried out so far on a national or regional basis looking at WAS (RLAN) as an interferer into ITS showed the need for appropriate separation distances, in cases of co-channel operation. As a result, work by some administrations and regional groups on possible mitigation techniques, was initiated to help improve the compatibility between individual RLAN devices and ITS applications. However, based upon the results of these studies so far, conclusions under this agenda item could not be reached.

This band is also allocated to the FSS for uplink operations in all three ITU Regions supporting a variety of FSS applications including broadband service and studies should take account the protection of the current and planned FSS use.

2/1.16/4 Methods to satisfy the agenda item

Regulatory procedures associated with some of the methods as described below are provided by the proponents of the methods in question, reflect the view of proponents, and were presented and discussed by ITU-R.

Note: In case that reference is made to a specific country or regional situation in regard to the use of certain frequency bands under agenda item 1.16, since this may reflect the situation in that country thus it should not be generalized to give the impression that these conditions would be applicable to other countries or regions.

The frequency bands investigated under this agenda item, i.e. 5 150-5 250 MHz, 5 250-5 350 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz and 5 850-5 925 MHz, are denoted by the letters **A, B, C, D, and E**, respectively. The following convention has been used for method numbering.

- If multiple methods are proposed for a particular frequency band, the methods are expressed by the associated letter and a numerical suffix. For example, the six methods proposed for the 5 150-5 250 MHz frequency band are denoted by **Method A1, Method A2, Method A3, Method A4, Method A5 and Method A6**.
- If only one method is proposed for a particular frequency band, the method is expressed by the associated letter. For instance, the only method proposed for the 5 250-5 350 MHz frequency band is denoted by **Method B**.

2/1.16/4.1 Frequency band A, 5 150-5 250 MHz

2/1.16/4.1.1 Method A1: No change to the RR

No changes are proposed to the RR, with the exception of the suppression of Resolution **239 (WRC-15)**. The provisions of Resolution **229 (Rev.WRC-12)** applied to RLAN in this band should be retained to protect incumbents.

2/1.16/4.1.2 Method A2: Revision to Resolution 229 (Rev.WRC-12) to enable outdoor RLAN operations including possible associated conditions for new e.i.r.p. limits

Revisions to Resolution **229 (Rev.WRC-12)** are proposed in order to enable outdoor RLAN operations including possible associated conditions for new e.i.r.p. limits while addressing the protection of incumbent services.

2/1.16/4.1.3 Method A3: Revision to Resolution 229 (Rev.WRC-12) to enable outdoor RLAN operations by applying the same conditions of use as defined for the 5 250-5 350 MHz frequency band in *resolves* 4 of Resolution 229 (Rev.WRC-12)

Revisions to Resolution **229 (Rev.WRC-12)** are proposed to align the technical and regulatory conditions for the 5 150-5 250 MHz frequency band with those defined for the adjacent frequency band 5 250-5 350 MHz in *resolves* 4 of Resolution **229 (Rev.WRC-12)** to protect incumbent services.

2/1.16/4.1.4 Method A4: Revisions to Resolution 229 (Rev.WRC-12) to facilitate limited RLAN outdoor operation and RLAN in-vehicle (cars and trains) usage operation with associated e.i.r.p. levels

Revisions to Resolution **229 (Rev.WRC-12)** are proposed to facilitate a limited RLAN outdoor operation for unmanned systems (within the mobile except aeronautical mobile allocation) with a maximum e.i.r.p. of 200 mW, an in-car use with e.i.r.p. levels up to 40 mW and in-train use up to

200 mW e.i.r.p., which provides the same level of protection established by Resolution **229 (Rev.WRC-12)** for incumbent services.

2/1.16/4.1.5 Method A5: Revisions to Resolution 229 (Rev.WRC-12) to enable in-car use of RLAN operation with e.i.r.p. up to 40 mW

Revisions to Resolution **229 (Rev.WRC-12)** are proposed to enable RLAN in-car use associated with e.i.r.p. levels up to 40 mW¹⁹ and under condition that the additional propagation loss due to the car hull is at least 15 dB, to provide the same level of protection established by Resolution **229 (Rev.WRC-12)** to incumbent services.

2/1.16/4.1.6 Method A6: Revision to Resolution 229 (Rev.WRC-12) to enable outdoor RLAN operations including associated conditions for new e.i.r.p. limits and out-of-band emission limits

Revisions to Resolution **229 (Rev.WRC-12)** are proposed in order to enable outdoor RLAN operations including associated conditions for new e.i.r.p. limits while addressing the protection of incumbent services in the band and also in the adjacent 5 250-5 350 MHz frequency band.

2/1.16/4.2 Frequency band B, 5 250-5 350 MHz

2/1.16/4.2.1 Method B: No change to the RR

Only one method is proposed, with no change to the RR, except suppression of Resolution **239 (WRC-15)**. The provisions of Resolution **229 (Rev.WRC-12)** continue to be applied to RLAN in this band to protect incumbents.

2/1.16/4.3 Frequency band C, 5 350-5 470 MHz

2/1.16/4.3.1 Method C: No change to the RR

Only one method is proposed, with no change to the RR, except suppression of Resolution **239 (WRC-15)**.

2/1.16/4.4 Frequency band D, 5 725-5 850 MHz

2/1.16/4.4.1 Method D1: No change to the RR

No changes are proposed to the RR, with the exception of the suppression of Resolution **239 (WRC-15)**.

2/1.16/4.4.2 Method D2: A new Regional primary MS allocation

Allocate the 5 725-5 850 MHz frequency band to the mobile service on a primary basis in some Regions to accommodate WAS/RLAN use restricted to indoor operation with e.i.r.p. limits up to 200 mW including associated mitigation techniques and together with the revision of Resolution **229 (Rev.WRC-12)**.

2/1.16/4.4.3 Method D3: Accommodate WAS/RLAN in a new footnote

This method accommodates WAS/RLAN in a new footnote having a mobile primary allocation.

¹⁹ E.i.r.p. of WAS/RLAN systems transmitters located inside vehicle should not exceed 40 mW currently proposed without taking into account losses due to the vehicle body.

2/1.16/4.5 Frequency band E, 5 850-5 925 MHz

2/1.16/4.5.1 Method E: No change to the RR

Only one method is proposed, with no change to the RR, except suppression of Resolution **239** (WRC-15).

2/1.16/5 Regulatory and procedural considerations

2/1.16/5.1 Frequency band A, 5 150-5 250 MHz

2/1.16/5.1.1 For Method A1

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

NOC

4 800-5 250 MHz

| Allocation to services | | |
|-------------------------------|--|-----------------|
| Region 1 | Region 2 | Region 3 |
| 5 150-5 250 | FIXED-SATELLITE (Earth-to-space) 5.447A MOBILE except aeronautical mobile 5.446A 5.446B AERONAUTICAL RADIONAVIGATION 5.446 5.446C 5.447 5.447B 5.447C | |

2/1.16/5.1.2 For Method A2

MOD

RESOLUTION 229 (REV.WRC-~~12~~19)

Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz by the mobile service for the implementation of wireless access systems including radio local area networks

The World Radiocommunication Conference ([Geneva, 2012](#)[Sharm el-Sheikh, 2019](#)),

considering

a) that WRC-03 allocated the bands 5 150-5 350 MHz and 5 470-5 725 MHz on a primary basis to the mobile service for the implementation of wireless access systems (WAS), including radio local area networks (RLANs);

- b) that WRC-03 decided to make an additional primary allocation for the Earth exploration-satellite service (EESS) (active) in the band 5 460-5 570 MHz and space research service (SRS) (active) in the band 5 350-5 570 MHz;
- c) that WRC-03 decided to upgrade the radiolocation service to a primary status in the 5 350-5 650 MHz band;
- d) that the band 5 150-5 250 MHz is allocated worldwide on a primary basis to the fixed-satellite service (FSS) (Earth-to-space), this allocation being limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service (No. **5.447A**);
- e) that the band 5 150-5 250 MHz is also allocated to the mobile service, on a primary basis, in some countries (No. **5.447**) subject to agreement obtained under No. **9.21**;
- f) that the band 5 250-5 460 MHz is allocated to the EESS (active) and the band 5 250-5 350 MHz to the SRS (active) on a primary basis;
- g) that the band 5 250-5 725 MHz is allocated on a primary basis to the radiodetermination service;
- h) that there is a need to protect the existing primary services in the 5 150-5 350 MHz and 5 470-5 725 MHz bands;
- i) that results of studies in ITU-R indicate that sharing in the band 5 150-5 250 MHz between WAS, including RLANs, and the FSS is feasible under specified conditions;
- j) that studies have shown that sharing between the radiodetermination and mobile services in the bands 5 250-5 350 MHz and 5 470-5 725 MHz is only possible with the application of mitigation techniques such as dynamic frequency selection;
- k) that there is a need to specify an appropriate e.i.r.p. limit and, where necessary, operational restrictions for WAS, including RLANs, in the mobile service in the bands 5 250-5 350 MHz and 5 470-5 570 MHz in order to protect systems in the EESS (active) and SRS (active);
- l) that the deployment density of WAS, including RLANs, will depend on a number of factors including intrasystem interference and the availability of other competing technologies and services;
- m) that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;
- n) that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;
- o) that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band,

further considering

- a) that the interference from a single WAS, including RLANs, complying with the operational restrictions under *resolves* 2 will not on its own cause any unacceptable interference to FSS receivers on board satellites in the band 5 150-5 250 MHz;
- b) that such FSS satellite receivers may experience an unacceptable effect due to the aggregate interference from these WAS, including RLANs, especially in the case of a prolific growth in the number of these systems;

c) that the aggregate effect on FSS satellite receivers will be due to the global deployment of WAS, including RLANs, and it may not be possible for administrations to determine the location of the source of the interference and the number of WAS, including RLANs, in operation simultaneously,

noting

a) that, prior to WRC-03, a number of administrations have developed regulations to permit indoor and outdoor WAS, including RLANs, to operate in the various bands under consideration in this Resolution;

b) that, in response to Resolution **229 (WRC-03)***, ITU-R developed Report ITU-R M.2115, which provides testing procedures for implementation of dynamic frequency selection,

recognizing

a) that in the band 5 600-5 650 MHz, ground-based meteorological radars are extensively deployed and support critical national weather services, according to footnote No. **5.452**;

~~b) — that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;~~

~~c) — that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;~~

~~b)~~ that the performance and interference criteria of spaceborne active sensors in the EESS (active) are given in Recommendation ITU-R RS.1166;

~~c)~~ that a mitigation technique to protect radiodetermination systems is given in Recommendation ITU-R M.1652;

~~f) — that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band;~~

~~d)~~ that Recommendation ITU-R RS.1632 identifies a suitable set of constraints for WAS, including RLANs, in order to protect the EESS (active) in the 5 250-5 350 MHz band;

~~e)~~ that Recommendation ITU-R M.1653 identifies the conditions for sharing between WAS, including RLANs, and the EESS (active) in the 5 470-5 570 MHz band;

~~f)~~ that the stations in the mobile service should also be designed to provide, on average, a near-uniform spread of the loading of the spectrum used by stations across the band or bands in use to improve sharing with satellite services;

~~g)~~ that WAS, including RLANs, provide effective broadband solutions, future demand has increased since the frequency range was first identified for this application;

~~h)~~ that there is a need for administrations to ensure that WAS, including RLANs, meet the required mitigation techniques, for example, through equipment or standards compliance procedures,

* *Note by the Secretariat:* This Resolution was revised by WRC-12.

resolves

1 that the use of these bands by the mobile service ~~will be~~^{is} for the implementation of WAS, including RLANs, as described in the most recent version of Recommendation ITU-R M.1450;

2 that in the band 5 150-5 250 MHz, stations in the mobile service shall be restricted to ~~indoor use with a maximum mean e.i.r.p. conducted output of 1 W provided the maximum antenna gain does not exceed 6 dBi (i.e. a total maximum mean e.i.r.p. of 36 dBm)¹, and, of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band or equivalently 0.25 mW/25 kHz in any 25 kHz band~~ in addition, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band, and, for the outdoor operation of stations in the mobile service the maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon shall not exceed 125 mW (21 dBm), and finally, for WAS/RLAN transmitters operating in the 5 150-5 250 MHz band, all unwanted emissions outside of the 5 150-5 350 MHz band shall not exceed an e.i.r.p. of -27 dBm/MHz;

~~3 — that administrations may monitor whether the aggregate pfd levels given in Recommendation ITU-R S.1426² have been, or will be exceeded in the future, in order to enable a future competent conference to take appropriate action;~~

~~4~~³ that in the band 5 250-5 350 MHz, stations in the mobile service shall be limited to a maximum mean e.i.r.p. of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band. Administrations are requested to take appropriate measures that will result in the predominant number of stations in the mobile service being operated in an indoor environment. Furthermore, stations in the mobile service that are permitted to be used either indoors or outdoors may operate up to a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band, and, when operating above a mean e.i.r.p. of 200 mW, these stations shall comply with the following e.i.r.p. elevation angle mask where θ is the angle above the local horizontal plane (of the Earth):

| | |
|--|--|
| -13 dB(W/MHz) | for $0^\circ \leq \theta < 8^\circ$ |
| -13 - 0.716(θ - 8) dB(W/MHz) | for $8^\circ \leq \theta < 40^\circ$ |
| -35.9 - 1.22(θ - 40) dB(W/MHz) | for $40^\circ \leq \theta \leq 45^\circ$ |
| -42 dB(W/MHz) | for $45^\circ < \theta$; |

~~5~~⁴ that administrations may exercise some flexibility in adopting other mitigation techniques, provided that they develop national regulations to meet their obligations to achieve an equivalent level of protection to the EESS (active) and the SRS (active) based on their system characteristics and interference criteria as stated in Recommendation ITU-R RS.1632;

¹ In the context of this Resolution, “mean e.i.r.p.” refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

~~² -124 - 20 log₁₀($h_{SAT}/1\,414$) dB(W/(m² - 1 MHz)), or equivalently, -140 - 20 log₁₀($h_{SAT}/1\,414$) dB(W/(m² - 25 kHz)), at the FSS satellite orbit, where h_{SAT} is the altitude of the satellite (km).~~

~~65~~ that in the band 5 470-5 725 MHz, stations in the mobile service shall be restricted to a maximum transmitter power of 250 mW³² with a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band;

~~76~~ that in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, systems in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

~~87~~ that, in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, the mitigation measures found in Annex 1 to Recommendation ITU-R M.1652-1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems,

invites administrations

to ~~adopt~~consider appropriate ~~regulation if they intend to permit~~measures when allowing the operation of stations in the mobile service using the e.i.r.p. elevation angle mask referred in *resolves* ~~43 above~~, to ensure the equipment is operated in compliance with this mask,

invites ITU-R

~~1 ——— to continue work on regulatory mechanisms and further mitigation techniques to avoid incompatibilities which may result from aggregate interference into the FSS in the band 5 150-5 250 MHz from a possible prolific growth in the number of WAS, including RLANS;~~

~~21~~ to continue studies on mitigation techniques to provide protection of EESS from stations in the mobile service~~;~~₁

~~32~~ to continue studies on suitable test methods and procedures for the implementation of dynamic frequency selection, taking into account practical experience.

2/1.16/5.1.3 For Method A3

MOD

RESOLUTION 229 (REV.WRC-~~12~~19)

Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz by the mobile service for the implementation of wireless access systems including radio local area networks

The World Radiocommunication Conference (~~Geneva, 2012~~Sharm el-Sheikh, 2019),

considering

a) that WRC-03 allocated the bands 5 150-5 350 MHz and 5 470-5 725 MHz on a primary basis to the mobile service for the implementation of wireless access systems (WAS), including radio local area networks (RLANS);

³² Administrations with existing regulations prior to WRC-03 may exercise some flexibility in determining transmitter power limits.

- b) that WRC-03 decided to make an additional primary allocation for the Earth exploration-satellite service (EESS) (active) in the band 5 460-5 570 MHz and space research service (SRS) (active) in the band 5 350-5 570 MHz;
- c) that WRC-03 decided to upgrade the radiolocation service to a primary status in the 5 350-5 650 MHz band;
- d) that the band 5 150-5 250 MHz is allocated worldwide on a primary basis to the fixed-satellite service (FSS) (Earth-to-space), this allocation being limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service (No. **5.447A**);
- e) that the band 5 150-5 250 MHz is also allocated to the mobile service, on a primary basis, in some countries (No. **5.447**) subject to agreement obtained under No. **9.21**;
- f) that the band 5 250-5 460 MHz is allocated to the EESS (active) and the band 5 250-5 350 MHz to the SRS (active) on a primary basis;
- g) that the band 5 250-5 725 MHz is allocated on a primary basis to the radiodetermination service;
- h) that there is a need to protect the existing primary services in the 5 150-5 350 MHz and 5 470-5 725 MHz bands;
- i) that results of studies in ITU-R indicate that sharing in the band 5 150-5 250 MHz between WAS, including RLANs, and the FSS is feasible under specified conditions;
- j) that studies have shown that sharing between the radiodetermination and mobile services in the bands 5 250-5 350 MHz and 5 470-5 725 MHz is only possible with the application of mitigation techniques such as dynamic frequency selection;
- k) that there is a need to specify an appropriate e.i.r.p. limit and, where necessary, operational restrictions for WAS, including RLANs, in the mobile service in the bands 5 250-5 350 MHz and 5 470-5 570 MHz in order to protect systems in the EESS (active) and SRS (active);
- l) that the deployment density of WAS, including RLANs, will depend on a number of factors including intrasystem interference and the availability of other competing technologies and services;
- m) that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;
- n) that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;
- o) that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band,

further considering

- a) that the interference from a single WAS, including RLANs, complying with the operational restrictions under *resolves* 2 will not on its own cause any unacceptable interference to FSS receivers on board satellites in the band 5 150-5 250 MHz;
- b) that such FSS satellite receivers may experience an unacceptable effect due to the aggregate interference from these WAS, including RLANs, especially in the case of a prolific growth in the number of these systems;

c) that the aggregate effect on FSS satellite receivers will be due to the global deployment of WAS, including RLANs, and it may not be possible for administrations to determine the location of the source of the interference and the number of WAS, including RLANs, in operation simultaneously,

noting

a) that, prior to WRC-03, a number of administrations have developed regulations to permit indoor and outdoor WAS, including RLANs, to operate in the various bands under consideration in this Resolution;

b) that, in response to Resolution **229 (WRC-03)***, ITU-R developed Report ITU-R M.2115, which provides testing procedures for implementation of dynamic frequency selection,

recognizing

a) that in the band 5 600-5 650 MHz, ground-based meteorological radars are extensively deployed and support critical national weather services, according to footnote No. **5.452**;

~~b) that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;~~

~~c) that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;~~

~~b)~~ that the performance and interference criteria of spaceborne active sensors in the EESS (active) are given in Recommendation ITU-R RS.1166;

~~c)~~ that a mitigation technique to protect radiodetermination systems is given in Recommendation ITU-R M.1652;

~~f) that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band;~~

~~d)~~ that Recommendation ITU-R RS.1632 identifies a suitable set of constraints for WAS, including RLANs, in order to protect the EESS (active) in the 5 250-5 350 MHz band;

~~e)~~ that Recommendation ITU-R M.1653 identifies the conditions for sharing between WAS, including RLANs, and the EESS (active) in the 5 470-5 570 MHz band;

~~f)~~ that the stations in the mobile service should also be designed to provide, on average, a near-uniform spread of the loading of the spectrum used by stations across the band or bands in use to improve sharing with satellite services;

~~g)~~ that WAS, including RLANs, provide effective broadband solutions, future demand has increased since the frequency range was first identified for this application;

~~h)~~ that there is a need for administrations to ensure that WAS, including RLANs, meet the required mitigation techniques, for example, through equipment or standards compliance procedures,

* *Note by the Secretariat:* This Resolution was revised by WRC-12.

resolves

1 that the use of these bands by the mobile service ~~will be~~ is for the implementation of WAS, including RLANs, as described in the most recent version of Recommendation ITU-R M.1450;

~~2 that in the band 5 150-5 250 MHz, stations in the mobile service shall be restricted to indoor use with a maximum mean e.i.r.p.¹ of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band or equivalently 0.25 mW/25 kHz in any 25 kHz band;~~

~~3 that administrations may monitor whether the aggregate pfd levels given in Recommendation ITU-R S.1426² have been, or will be exceeded in the future, in order to enable a future competent conference to take appropriate action;~~

~~4~~² that in the bands ~~5 150-5 250 MHz and~~ 5 250-5 350 MHz, stations in the mobile service shall be limited to a maximum mean e.i.r.p. of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band. Administrations are requested to take appropriate measures that will result in the predominant number of stations in the mobile service being operated in an indoor environment. Furthermore, stations in the mobile service that are permitted to be used either indoors or outdoors may operate up to a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band, and, when operating above a mean e.i.r.p. of 200 mW, these stations shall comply with the following e.i.r.p. elevation angle mask where θ is the angle above the local horizontal plane (of the Earth):

| | |
|--|--|
| -13 dB(W/MHz) | for $0^\circ \leq \theta < 8^\circ$ |
| -13 - 0.716(θ - 8) dB(W/MHz) | for $8^\circ \leq \theta < 40^\circ$ |
| -35.9 - 1.22(θ - 40) dB(W/MHz) | for $40^\circ \leq \theta \leq 45^\circ$ |
| -42 dB(W/MHz) | for $45^\circ < \theta$; |

~~5~~³ that administrations may exercise some flexibility in adopting other mitigation techniques, provided that they develop national regulations to meet their obligations to achieve an equivalent level of protection to the EESS (active) and the SRS (active) based on their system characteristics and interference criteria as stated in Recommendation ITU-R RS.1632;

~~6~~⁴ that in the band 5 470-5 725 MHz, stations in the mobile service shall be restricted to a maximum transmitter power of 250 mW³¹ with a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band;

~~7~~⁵ that in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, systems in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

¹ ~~In the context of this Resolution, “mean e.i.r.p.” refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.~~

² ~~-124 - 20 log₁₀($h_{SAT}/1\,414$) dB(W/(m² - 1 MHz)), or equivalently, -140 - 20 log₁₀($h_{SAT}/1\,414$) dB(W/(m² - 25 kHz)), at the FSS satellite orbit, where h_{SAT} is the altitude of the satellite (km).~~

³¹ Administrations with existing regulations prior to WRC-03 may exercise some flexibility in determining transmitter power limits.

~~86~~ that, in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, the mitigation measures found in Annex 1 to Recommendation ITU-R M.1652-1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems,

invites administrations

to ~~adopt~~consider appropriate ~~regulation if they intend to permit~~measures when allowing the operation of stations in the mobile service using the e.i.r.p. elevation angle mask referred in *resolves* 42 above, to ensure the equipment is operated in compliance with this mask,

invites ITU-R

~~1 ——— to continue work on regulatory mechanisms and further mitigation techniques to avoid incompatibilities which may result from aggregate interference into the FSS in the band 5 150-5 250 MHz from a possible prolific growth in the number of WAS, including RLANs;~~

~~21~~ to continue studies on mitigation techniques to provide protection of EESS from stations in the mobile service~~;~~

~~32~~ to continue studies on suitable test methods and procedures for the implementation of dynamic frequency selection, taking into account practical experience.

2/1.16/5.1.4 For Method A4

No change to the preamble (*considering, noting and recognizing* parts) of Resolution **229 (Rev.WRC-12)**.

MOD

RESOLUTION 229 (REV.WRC-~~12~~19)

Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz by the mobile service for the implementation of wireless access systems including radio local area networks

The World Radiocommunication Conference (~~Geneva, 2012~~Sharm el-Sheikh, 2019),

...

resolves

1 that the use of these bands by the mobile service ~~will be~~is for the implementation of WAS, including RLANs, as described in the most recent version of Recommendation ITU-R M.1450;

2 that in the band 5 150-5 250 MHz, indoor stations in the mobile service shall ~~be restricted to indoor use~~operate with a maximum mean e.i.r.p.¹ of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band or equivalently 0.25 mW/25 kHz in any 25 kHz band. Outdoor usage shall be restricted to unmanned systems (within the mobile except aeronautical

¹ In the context of this Resolution, “mean e.i.r.p.” refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

mobile allocation) with a maximum mean e.i.r.p. of 200 mW. Moreover, the in-car use shall operate with a maximum e.i.r.p. of 40 mW and the in-train use with a maximum e.i.r.p. of 200 mW;

...

2/1.16/5.1.5 For Method A5

No change to the preamble (*considering, noting and recognizing* parts) of Resolution 229 (Rev.WRC-12).

MOD

RESOLUTION 229 (REV.WRC-~~12~~19)

Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz by the mobile service for the implementation of wireless access systems including radio local area networks

The World Radiocommunication Conference (~~Geneva, 2012~~Sharm el-Sheikh, 2019),

...

resolves

1 that the use of these bands by the mobile service ~~will be~~is for the implementation of WAS, including RLANs, as described in the most recent version of Recommendation ITU-R M.1450;

2 that in the band 5 150-5 250 MHz, stations in the mobile service shall be restricted to indoor ~~or in-car~~ use. When placed inside of buildings they shall work with a maximum mean e.i.r.p.¹ of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band or equivalently 0.25 mW/25 kHz in any 25 kHz band. The in-car use shall operate with a maximum e.i.r.p. of 40 mW, excluding losses in the car hull, provided that the additional propagation loss in the car hull is at least 15 dB;

...

¹ In the context of this Resolution, “mean e.i.r.p.” refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

2/1.16/5.1.6 For Method A6

MOD

RESOLUTION 229 (REV.WRC-~~12~~19)

**Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz
by the mobile service for the implementation of wireless access systems
including radio local area networks**

The World Radiocommunication Conference ([Geneva, 2012](#)[Sharm el-Sheikh, 2019](#)),

considering

- a)* that WRC-03 allocated the bands 5 150-5 350 MHz and 5 470-5 725 MHz on a primary basis to the mobile service for the implementation of wireless access systems (WAS), including radio local area networks (RLANs);
- b)* that WRC-03 decided to make an additional primary allocation for the Earth exploration-satellite service (EESS) (active) in the band 5 460-5 570 MHz and space research service (SRS) (active) in the band 5 350-5 570 MHz;
- c)* that WRC-03 decided to upgrade the radiolocation service to a primary status in the 5 350-5 650 MHz band;
- d)* that the band 5 150-5 250 MHz is allocated worldwide on a primary basis to the fixed-satellite service (FSS) (Earth-to-space), this allocation being limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service (No. **5.447A**);
- e)* that the band 5 150-5 250 MHz is also allocated to the mobile service, on a primary basis, in some countries (No. **5.447**) subject to agreement obtained under No. **9.21**;
- f)* that the band 5 250-5 460 MHz is allocated to the EESS (active) and the band 5 250-5 350 MHz to the SRS (active) on a primary basis;
- g)* that the band 5 250-5 725 MHz is allocated on a primary basis to the radiodetermination service;
- h)* that there is a need to protect the existing primary services in the 5 150-5 350 MHz and 5 470-5 725 MHz bands;
- i)* that results of studies in ITU-R indicate that sharing in the band 5 150-5 250 MHz between WAS, including RLANs, and the FSS is feasible under specified conditions;
- j)* that studies have shown that sharing between the radiodetermination and mobile services in the bands 5 250-5 350 MHz and 5 470-5 725 MHz is only possible with the application of mitigation techniques such as dynamic frequency selection;
- k)* that there is a need to specify an appropriate e.i.r.p. limit and, where necessary, operational restrictions for WAS, including RLANs, in the mobile service in the bands 5 250-5 350 MHz and 5 470-5 570 MHz in order to protect systems in the EESS (active) and SRS (active);
- l)* that the deployment density of WAS, including RLANs, will depend on a number of factors including intrasystem interference and the availability of other competing technologies and services;

m) that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;

n) that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;

o) that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band,

further considering

a) that the interference from a single WAS, including RLANs, complying with the operational restrictions under *resolves* 2 will not on its own cause any unacceptable interference to FSS receivers on board satellites in the band 5 150-5 250 MHz;

b) that such FSS satellite receivers may experience an unacceptable effect due to the aggregate interference from these WAS, including RLANs, especially in the case of a prolific growth in the number of these systems;

c) that the aggregate effect on FSS satellite receivers will be due to the global deployment of WAS, including RLANs, and it may not be possible for administrations to determine the location of the source of the interference and the number of WAS, including RLANs, in operation simultaneously,

noting

a) that, prior to WRC-03, a number of administrations have developed regulations to permit indoor and outdoor WAS, including RLANs, to operate in the various bands under consideration in this Resolution;

b) that, in response to Resolution **229 (WRC-03)***, ITU-R developed Report ITU-R M.2115, which provides testing procedures for implementation of dynamic frequency selection,

recognizing

a) that in the band 5 600-5 650 MHz, ground-based meteorological radars are extensively deployed and support critical national weather services, according to footnote No. **5.452**;

~~b) that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;~~

~~e) that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;~~

~~b)~~ that the performance and interference criteria of spaceborne active sensors in the EESS (active) are given in Recommendation ITU-R RS.1166;

~~c)~~ that a mitigation technique to protect radiodetermination systems is given in Recommendation ITU-R M.1652;

~~f) that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band;~~

* *Note by the Secretariat:* This Resolution was revised by WRC-12.

- ~~g~~d) that Recommendation ITU-R RS.1632 identifies a suitable set of constraints for WAS, including RLANs, in order to protect the EESS (active) in the 5 250-5 350 MHz band;
- ~~h~~e) that Recommendation ITU-R M.1653 identifies the conditions for sharing between WAS, including RLANs, and the EESS (active) in the 5 470-5 570 MHz band;
- ~~i~~f) that the stations in the mobile service should also be designed to provide, on average, a near-uniform spread of the loading of the spectrum used by stations across the band or bands in use to improve sharing with satellite services;
- ~~j~~g) that WAS, including RLANs, provide effective broadband solutions, future demand has increased since the frequency range was first identified for this application;
- ~~k~~h) that there is a need for administrations to ensure that WAS, including RLANs, meet the required mitigation techniques, for example, through equipment or standards compliance procedures,

resolves

- 1 that the use of these bands by the mobile service ~~will be~~is for the implementation of WAS, including RLANs, as described in the most recent version of Recommendation ITU-R M.1450;
- 2 that in the band 5 150-5 250 MHz, stations in the mobile service shall be restricted to ~~indoor use with~~ a maximum ~~mean e.i.r.p.~~ conducted output of 1 W provided the maximum antenna gain does not exceed 6 dBi (i.e. a total maximum mean e.i.r.p. of 36 dBm)¹, and, ~~of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band or equivalently 0.25 mW/25 kHz in any 25 kHz band~~ in addition, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band, and, for the outdoor operation of stations in the mobile service the maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon shall not exceed 125 mW (21 dBm). For WAS/RLAN transmitters operating in the 5 150-5 250 MHz band, all unwanted emissions outside of the 5 150-5 350 MHz band shall not exceed an e.i.r.p. of -27 dBm/MHz. Any unwanted emissions that fall into the band 5 250-5 350 MHz shall be attenuated below the channel power by at least 26 dB. This bandwidth, measured at the 26 dB attenuation level, may fall into the 5 250-5 350 MHz band; however, if the occupied bandwidth also falls within the 5 250-5 350 MHz band, the portion of the emission that resides in the 5 250-5 350 MHz band shall be subject to *resolves 3, 6 and 7*;
- ~~3 ——— that administrations may monitor whether the aggregate pfd levels given in Recommendation ITU-R S.1426² have been, or will be exceeded in the future, in order to enable a future competent conference to take appropriate action;~~
- ~~4~~3 that in the band 5 250-5 350 MHz, stations in the mobile service shall be limited to a maximum mean e.i.r.p. of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band. Administrations are requested to take appropriate measures that will result in the predominant number of stations in the mobile service being operated in an indoor environment. Furthermore, stations in the mobile service that are permitted to be used either indoors or outdoors may operate up to a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of

¹ In the context of this Resolution, “mean e.i.r.p.” refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

~~² $-124 - 20 \log_{10}(h_{SAT}/1\,414)$ dB(W/(m² - 1 MHz)), or equivalently, $-140 - 20 \log_{10}(h_{SAT}/1\,414)$ dB(W/(m² - 25 kHz)), at the FSS satellite orbit, where h_{SAT} is the altitude of the satellite (km).~~

50 mW/MHz in any 1 MHz band, and, when operating above a mean e.i.r.p. of 200 mW, these stations shall comply with the following e.i.r.p. elevation angle mask where θ is the angle above the local horizontal plane (of the Earth):

| | |
|---|--|
| -13 dB(W/MHz) | for $0^\circ \leq \theta < 8^\circ$ |
| -13 - 0.716($\theta - 8$) dB(W/MHz) | for $8^\circ \leq \theta < 40^\circ$ |
| -35.9 - 1.22($\theta - 40$) dB(W/MHz) | for $40^\circ \leq \theta \leq 45^\circ$ |
| -42 dB(W/MHz) | for $45^\circ < \theta$; |

⁵⁴ that administrations may exercise some flexibility in adopting other mitigation techniques, provided that they develop national regulations to meet their obligations to achieve an equivalent level of protection to the EESS (active) and the SRS (active) based on their system characteristics and interference criteria as stated in Recommendation ITU-R RS.1632;

⁶⁵ that in the band 5 470-5 725 MHz, stations in the mobile service shall be restricted to a maximum transmitter power of 250 mW³² with a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band;

⁷⁶ that in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, systems in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

⁸⁷ that, in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, the mitigation measures found in Annex 1 to Recommendation ITU-R M.1652-1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems,

invites administrations

to ~~adopt~~^{consider} appropriate ~~regulation if they intend to permit~~^{measures when allowing} the operation of stations in the mobile service using the e.i.r.p. elevation angle mask ~~referred~~ⁱⁿ ~~resolves~~ ^{43 above}, to ensure the equipment is operated in compliance with this mask,

invites ITU-R

~~1 — to continue work on regulatory mechanisms and further mitigation techniques to avoid incompatibilities which may result from aggregate interference into the FSS in the band 5 150-5 250 MHz from a possible prolific growth in the number of WAS, including RLANS;~~

~~21~~ to continue studies on mitigation techniques to provide protection of EESS from stations in the mobile service~~;~~

~~32~~ to continue studies on suitable test methods and procedures for the implementation of dynamic frequency selection, taking into account practical experience.

³² Administrations with existing regulations prior to WRC-03 may exercise some flexibility in determining transmitter power limits.

2/1.16/5.2 Frequency band B, 5 250-5 350 MHz**2/1.16/5.2.1 For Method B****ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**
(See No. 2.1)**NOC****5 250-5 570 MHz**

| Allocation to services | | |
|-------------------------------|--|-----------------|
| Region 1 | Region 2 | Region 3 |
| 5 250-5 255 | EARTH EXPLORATION-SATELLITE (active) MOBILE except aeronautical mobile 5.446A 5.447F RADIOLOCATION SPACE RESEARCH 5.447D 5.447E 5.448 5.448A | |
| 5 255-5 350 | EARTH EXPLORATION-SATELLITE (active) MOBILE except aeronautical mobile 5.446A 5.447F RADIOLOCATION SPACE RESEARCH (active) 5.447E 5.448 5.448A | |

2/1.16/5.3 Frequency band C, 5 350-5 470 MHz**2/1.16/5.3.1 For Method C****ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**
(See No. 2.1)

NOC**5 250-5 570 MHz**

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 5 350-5 460 | EARTH EXPLORATION-SATELLITE (active) 5.448B RADIOLOCATION 5.448D AERONAUTICAL RADIONAVIGATION 5.449 SPACE RESEARCH (active) 5.448C | |
| 5 460-5 470 | EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION 5.448D RADIONAVIGATION 5.449 SPACE RESEARCH (active) 5.448B | |

2/1.16/5.4 Frequency band D, 5 725-5 850 MHz**2/1.16/5.4.1 For Method D1****ARTICLE 5****Frequency allocations**

Section IV – Table of Frequency Allocations
(See No. 2.1)

NOC**5 570-6 700 MHz**

| Allocation to services | | |
|--|---|----------|
| Region 1 | Region 2 | Region 3 |
| 5 725-5 830 FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur 5.150 5.451 5.453 5.455 | 5 725-5 830 RADIOLOCATION Amateur 5.150 5.453 5.455 | |
| 5 830-5 850 FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.451 5.453 5.455 | 5 830-5 850 RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.453 5.455 | |

2/1.16/5.4.2 For Method D2

MOD

5 570-6 700 MHz

| Allocation to services | | |
|---|---|---|
| Region 1 | Region 2 | Region 3 |
| 5 725-5 830 FIXED-SATELLITE (Earth-to-space) <u>MOBILE except aeronautical mobile ADD 5.A116</u> RADIOLOCATION Amateur 5.150 5.451 5.453 5.455 | 5 725-5 830 RADIOLOCATION Amateur 5.150 5.453 5.455 | 5 725-5 830 <u>MOBILE except aeronautical mobile</u> RADIOLOCATION Amateur 5.150 5.453 5.455 |
| 5 830-5 850 FIXED-SATELLITE (Earth-to-space) <u>MOBILE except aeronautical mobile ADD 5.A116</u> RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.451 5.453 5.455 | 5 830-5 850 RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.453 5.455 | 5 830-5 850 <u>MOBILE except aeronautical mobile</u> RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.453 5.455 |

ADD

5.A116 The use of the band 5 725-5 850 MHz in Region 1 by the stations in the mobile, except aeronautical mobile, service shall be in accordance with Resolution **229 (Rev.WRC-19)**. (WRC-19)

MOD

RESOLUTION 229 (REV.WRC-~~12~~19)

Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz ~~and~~, 5 470-5 725 MHz and 5 725-5 850 MHz by the mobile service for the implementation of wireless access systems including radio local area networks

The World Radiocommunication Conference (~~Geneva, 2012~~Sharm el-Sheikh, 2019),

considering

a) that WRC-03 allocated the bands 5 150-5 350 MHz and 5 470-5 725 MHz on a primary basis to the mobile service for the implementation of wireless access systems (WAS), including radio local area networks (RLANs);

- b) that WRC-03 decided to make an additional primary allocation for the Earth exploration-satellite service (EESS) (active) in the band 5 460-5 570 MHz and space research service (SRS) (active) in the band 5 350-5 570 MHz;
 - c) that WRC-03 decided to upgrade the radiolocation service to a primary status in the 5 350-5 650 MHz band;
 - d) that the band 5 150-5 250 MHz is allocated worldwide on a primary basis to the fixed-satellite service (FSS) (Earth-to-space), this allocation being limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service (No. **5.447A**);
 - e) that the band 5 150-5 250 MHz is also allocated to the mobile service, on a primary basis, in some countries (No. **5.447**) subject to agreement obtained under No. **9.21**;
 - f) that the band 5 250-5 460 MHz is allocated to the EESS (active) and the band 5 250-5 350 MHz to the SRS (active) on a primary basis;
 - g) that the band 5 250-5 ~~725~~**850** MHz is allocated on a primary basis to the radiodetermination service;
 - h) that the band 5 725-5 850 MHz is allocated in Region 1 only, on a primary basis to the fixed-satellite service (FSS) (Earth-to-space);
 - ~~h~~i) that there is a need to protect the existing primary services in the 5 150-5 350 MHz and 5 470-5 ~~725~~**850** MHz bands;
 - ~~i~~j) that results of studies in ITU-R indicate that sharing in the bands 5 150-5 250 MHz and 5 725-5 850 MHz (Region 1 only) between WAS, including RLANs, and the FSS is feasible under specified conditions;
 - ~~j~~k) that studies have shown that sharing between the radiodetermination and mobile services in the bands 5 250-5 350 MHz and 5 470-5 725 MHz is only possible with the application of mitigation techniques such as dynamic frequency selection;
 - ~~k~~l) that there is a need to specify an appropriate e.i.r.p. limit and, where necessary, operational restrictions for WAS, including RLANs, in the mobile service in the bands 5 250-5 350 MHz and 5 470-5 570 MHz in order to protect systems in the EESS (active) and SRS (active);
 - ~~l~~m) that the deployment density of WAS, including RLANs, will depend on a number of factors including intrasystem interference and the availability of other competing technologies and services;
 - n) that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;
 - o) that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;
 - p) that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band,
- further considering*
- a) that the interference from a single WAS, including RLANs, complying with the operational restrictions under *resolves* 2 will not on its own cause any unacceptable interference to FSS receivers on board satellites in the bands 5 150-5 250 MHz and 5 725-5 850 MHz (Region 1 only);

- b) that such FSS satellite receivers may experience an unacceptable effect due to the aggregate interference from these WAS, including RLANs, especially in the case of a prolific growth in the number of these systems;
- c) that the aggregate effect on FSS satellite receivers will be due to the global deployment of WAS, including RLANs, and it may not be possible for administrations to determine the location of the source of the interference and the number of WAS, including RLANs, in operation simultaneously,

noting

- a) that, prior to WRC-03, a number of administrations have developed regulations to permit indoor and outdoor WAS, including RLANs, to operate in the various bands under consideration in this Resolution;
- b) that, in response to Resolution **229 (WRC-03)***, ITU-R developed Report ITU-R M.2115, which provides testing procedures for implementation of dynamic frequency selection,

recognizing

- a) that in the band 5 600-5 650 MHz, ground-based meteorological radars are extensively deployed and support critical national weather services, according to footnote No. **5.452**;
- ~~b) — that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;~~
- ~~c) — that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;~~
- ~~b)~~ that the performance and interference criteria of spaceborne active sensors in the EESS (active) are given in Recommendation ITU-R RS.1166;
- ~~c)~~ that a mitigation technique to protect radiodetermination systems is given in Recommendation ITU-R M.1652;
- ~~f) — that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band;~~
- ~~g)~~ that Recommendation ITU-R RS.1632 identifies a suitable set of constraints for WAS, including RLANs, in order to protect the EESS (active) in the 5 250-5 350 MHz band;
- ~~h)~~ that Recommendation ITU-R M.1653 identifies the conditions for sharing between WAS, including RLANs, and the EESS (active) in the 5 470-5 570 MHz band;
- ~~f)~~ that the stations in the mobile service should also be designed to provide, on average, a near-uniform spread of the loading of the spectrum used by stations across the band or bands in use to improve sharing with satellite services;
- ~~g)~~ that WAS, including RLANs, provide effective broadband solutions, future demand has increased since the frequency range was first identified for this application;
- ~~h)~~ that there is a need for administrations to ensure that WAS, including RLANs, meet the required mitigation techniques, for example, through equipment or standards compliance procedures,

* *Note by the Secretariat:* This Resolution was revised by WRC-12.

resolves

- 1 that the use of these bands by the mobile service ~~will be~~^{is} for the implementation of WAS, including RLANs, as described in the most recent version of Recommendation ITU-R M.1450;
- 2 that in the band 5 150-5 250 MHz, stations in the mobile service shall be restricted to indoor use with a maximum mean e.i.r.p.¹ of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band or equivalently 0.25 mW/25 kHz in any 25 kHz band;
- 3 that administrations may monitor whether the aggregate pfd levels given in Recommendation ITU-R S.1426² have been, or will be exceeded in the future, in order to enable a future competent conference to take appropriate action;
- 4 that in the band 5 250-5 350 MHz, stations in the mobile service shall be limited to a maximum mean e.i.r.p. of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band. Administrations are requested to take appropriate measures that will result in the predominant number of stations in the mobile service being operated in an indoor environment. Furthermore, stations in the mobile service that are permitted to be used either indoors or outdoors may operate up to a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band, and, when operating above a mean e.i.r.p. of 200 mW, these stations shall comply with the following e.i.r.p. elevation angle mask where θ is the angle above the local horizontal plane (of the Earth):

| | |
|--|--|
| −13 dB(W/MHz) | for $0^\circ \leq \theta < 8^\circ$ |
| −13 − 0.716(θ − 8) dB(W/MHz) | for $8^\circ \leq \theta < 40^\circ$ |
| −35.9 − 1.22(θ − 40) dB(W/MHz) | for $40^\circ \leq \theta \leq 45^\circ$ |
| −42 dB(W/MHz) | for $45^\circ < \theta$; |
- 5 that administrations may exercise some flexibility in adopting other mitigation techniques, provided that they develop national regulations to meet their obligations to achieve an equivalent level of protection to the EESS (active) and the SRS (active) based on their system characteristics and interference criteria as stated in Recommendation ITU-R RS.1632;
- 6 that in the band 5 470-5 725 MHz, stations in the mobile service shall be restricted to a maximum transmitter power of 250 mW³ with a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band;
- 7 that in Region 1 only in the band 5 725-5 850 MHz, stations in the mobile service shall be restricted to indoor⁴ use with a maximum mean e.i.r.p.¹ of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band;

¹ In the context of this Resolution, “mean e.i.r.p.” refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

² $-124 - 20 \log_{10} (h_{SAT}/1\,414)$ dB(W/(m² · 1 MHz)), or equivalently, $-140 - 20 \log_{10} (h_{SAT}/1\,414)$ dB(W/(m² · 25 kHz)), at the FSS satellite orbit, where h_{SAT} is the altitude of the satellite (km).

³ Administrations with existing regulations prior to WRC-03 may exercise some flexibility in determining transmitter power limits.

⁴ In this context “indoor only” should be considered as “no fixed outdoor usage” to allow for accidental outdoor usage by mobile terminals.

~~7~~⁸ that in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, systems in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

9 that in Region 1 only in the band 5 725-5 850 MHz, stations in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

~~8~~¹⁰ that, in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, the mitigation measures found in Annex 1 to Recommendation ITU-R M.1652-1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems~~;~~_;

11 that in Region 1 only in the band 5 725-5 850 MHz, the mitigation measures found in Annex 1 to Recommendation ITU-R M.1652-1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems.

invites administrations

to ~~adopt~~^{consider} appropriate ~~regulation if they intend to permit~~^{measures when allowing} the operation of stations in the mobile service using the e.i.r.p. elevation angle mask ~~referred~~ⁱⁿ *resolves* 4 ~~above~~[;], to ensure the equipment is operated in compliance with this mask,

invites ITU-R

~~1 ——— to continue work on regulatory mechanisms and further mitigation techniques to avoid incompatibilities which may result from aggregate interference into the FSS in the band 5 150-5 250 MHz from a possible prolific growth in the number of WAS, including RLANS;~~

~~2~~¹ to continue studies on mitigation techniques to provide protection of EESS from stations in the mobile service~~;~~_;

~~3~~² to continue studies on suitable test methods and procedures for the implementation of dynamic frequency selection, taking into account practical experience.

Note: It should be noted that footnote 3 of Resolution **229 (Rev.WRC-12)** (“Administrations with existing regulations prior to WRC-03 may exercise some flexibility in determining transmitter power limits”) may need to be revisited by WRC-19 in particular regarding its duration and scope of applications including reference to the countries or subregions that are benefiting from this grandfathering.

2/1.16/5.4.3 For Method D3

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

ADD

5.B116 *Additional allocation:* in, [*Country name*], the band 5 725-5 850 MHz is also allocated to the mobile service on a primary basis. (WRC-19)

2/1.16/5.5 For the frequency band 5 850-5 925 MHz**2/1.16/5.5.1 For Method E****NOC**

5 570-6 700 MHz

| Allocation to services | | |
|---|---|--|
| Region 1 | Region 2 | Region 3 |
| 5 850-5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.150 | 5 850-5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Amateur Radiolocation 5.150 | 5 850-5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Radiolocation 5.150 |

2/1.16/5.6 For all frequency bands and all Methods**SUP****RESOLUTION 239 (WRC-15)**

**Studies concerning Wireless Access Systems including radio local
area networks in the frequency bands between
5 150 MHz and 5 925 MHz**

Agenda item 9.1

9 *to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:*

9.1 *on the activities of the Radiocommunication Sector since WRC-15;*

NOTE: Nine issues have been identified by CPM19-1 under this agenda item.

(See Chapter 6 regarding RR No. **5.441B**)

Agenda item 9.1(9.1.1)

2/9.1.1 Resolution 212 (Rev.WRC-15)

Implementation of International Mobile Telecommunications in the frequency bands 1 885-2 025 MHz and 2 170-2 200 MHz

2/9.1.1/1 Executive summary

Pursuant to Resolution **212 (Rev.WRC-15)**, the technical and operational studies for the implementation of International Mobile Telecommunications (IMT) in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz were conducted by the ITU-R. The studies considered the issue of coexistence and compatibility of the terrestrial component of IMT (composed of base station(s) (BS(s)) and user equipment (UE) and later on referred to as IMT BS(s) and IMT UE(s)) and the satellite component of IMT (composed of mobile-satellite service (MSS) space stations and mobile earth station(s) (MES(s)) and later on referred to as IMT space station(s) and IMT MES(s)) in neighbouring countries/different concerned countries/adjacent geographical areas across different countries for four interference scenarios, and concluded as follows:

- For Scenario A1, in the 1 980-2 010 MHz frequency band, it was observed that the level of potential interference from IMT BS into IMT space stations is high, while the level of potential interference from IMT UE into IMT space stations is low. The studies have identified technical and operational measures to mitigate the potential interference from IMT BS and IMT UE. For IMT UEs, the measures can wholly eliminate the potential excess interference. For IMT BSs, there is no agreement on whether the measures can wholly eliminate the potential excess interference.
- For Scenario A2, in the frequency band 2 170-2 200 MHz, it was observed that potential interference from IMT BS into IMT MES may occur. The potential interference may be mitigated by one or more of: assessment of terrain and clutter effects and system characteristics, deployment environments, and separation distance. Given the varying characteristics of the border area across various countries, administrations can bilaterally determine the appropriate mitigation techniques on a case-by-case basis.
- For Scenario B1, in the frequency band 1 980-2 010 MHz, potential interference from IMT MESs to IMT BSs and IMT UEs, could be managed by bilateral/multilateral negotiation, in which actual technical/operational characteristics and mitigation measures for satellite and terrestrial components of IMT could be taken into account.
- For Scenario B2, in the frequency band 2 170-2 200 MHz, potential interference from the IMT space stations to IMT UEs, could be managed by bilateral/multilateral negotiation, in which actual technical/operational characteristics and mitigation measures for satellite and terrestrial components of IMT could be taken into account.

Details of studies are documented in the working document towards a PDN [Recommendation or Report] ITU-R M.[MSS&IMT-ADVANCED SHARING].

2/9.1.1/2 Background

The frequency bands 1 885-2 025 MHz and 2 110-2 200 MHz have been identified in the Radio Regulations (RR) for use by IMT. Within these broader frequency ranges, the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz are allocated to the FS, MS and MSS on a co-primary basis. The MSS allocation is in the Earth-to-space direction in the 1 980-2 010 MHz frequency band, and in the space-to-Earth direction in the 2 170-2 200 MHz frequency band. Both the satellite and terrestrial components of IMT have been deployed or are being considered for further deployment within the 1 980-2 010 MHz and 2 170-2 200 MHz frequency bands.

Resolution **212 (Rev.WRC-15)** invites *“ITU-R to study possible technical and operational measures to ensure coexistence and compatibility between the terrestrial component of IMT (in the mobile service) and the satellite component of IMT (in the mobile service and the mobile-satellite service) in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz where those frequency bands are shared by the mobile service and the mobile-satellite service in different countries, in particular for the deployment of independent satellite and terrestrial components of IMT and to facilitate development of both the satellite and terrestrial components of IMT”*.

In accordance with Resolution **212 (Rev.WRC-15)**, coexistence and compatibility between the terrestrial component of IMT (in the MS) and the satellite component of IMT (in the MS and the MSS) in neighbouring countries/different concerned countries/adjacent geographical areas across different countries were studied to facilitate the development of both the satellite and terrestrial components of IMT.

For the satellite component of IMT, the technical and operational characteristics used in the studies were based on the specifications from Recommendation ITU-R M.1850-2. It should be noted that some parameters used in the studies (e.g. bandwidth and satellite e.i.r.p.) differ from those currently in Recommendation ITU-R M.1850-2, as a consequence of technical development of the satellite component of IMT. The use of these parameters is still being studied in ITU-R. However, those differences do not affect the conclusions of the calculations in Scenarios A1 and A2.

The parameters for the terrestrial component of IMT used in the studies are based on Report ITU-R M.2292, and the methodology for modelling and simulating the terrestrial IMT network is given in Recommendation ITU-R M.2101. It should be noted that in addition to the values specified in Report ITU-R M.2292, one study employed different values for some of the parameters (noise figure, antenna gain and body loss), as a consequence of technical development of the terrestrial component of IMT, such as Machine Type Communication (MTC) as contained in Recommendation ITU-R M.2012. The use of these assumed IMT MTC UE parameters, which are still being studied in ITU-R, resulted in different conclusions from those results for IMT UEs related to the scenario of potential interference from IMT space stations into terrestrial receivers.

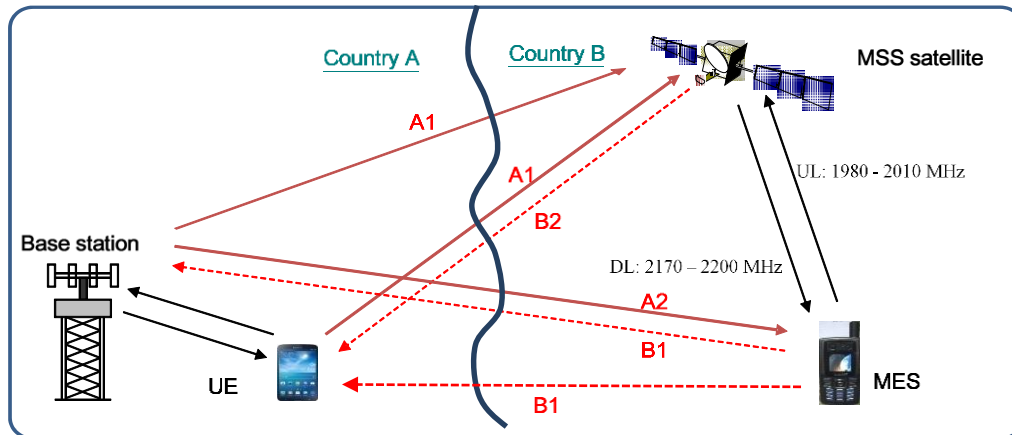
The protection criterion for IMT-Advanced is provided in Report ITU-R M.2292-0 as $I/N = -6$ dB. Additional studies were performed by ITU-R with the protection criterion of $I/N = -10$ dB in order to assess the impact of lower I/N values on the compatibility between the satellite and terrestrial components of IMT operating in neighbouring countries.

The recommended frequency arrangements for terrestrial IMT are contained in Recommendation ITU-R M.1036-5.

2/9.1.1/3 Summary and analysis of the results of ITU-R studies

Recommendations [ITU-R M.2101](#), [ITU-R M.1457-13](#), [ITU-R M.2012-3](#), [ITU-R M.1850-2](#) and [ITU-R M.2047-0](#), and Report [ITU-R M.2292](#) are relevant to WRC-19 agenda item 9.1, issue 9.1.1.

Potential interference scenarios between the IMT space stations and MES and the IMT BS and UE are illustrated as follows:



The working document towards a PDN [Recommendation or Report] ITU-R M.[MSS&IMT-ADVANCED SHARING] documents the ITU-R studies conducted for the coexistence and the compatibility between the satellite component of IMT and the terrestrial component of IMT in neighbouring countries/different concerned countries/adjacent geographical areas across different countries in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz.

2/9.1.1/3.1 Summary of results of interference from IMT BSs and IMT UEs to IMT space stations (Scenario A1)

Studies of the uplink interference analysis into IMT space stations in geostationary-satellite orbit (GSO), low-Earth orbit (LEO), medium-Earth orbit (MEO) and highly elliptical orbit (HEO) from IMT UE and IMT BS in the frequency bands 1 980-2 010 MHz were conducted and the results for all the different scenarios and cases are summarized below (a negative margin indicates interference exceeding the criterion).

Given the lack of protection criterion for compatibility studies between the terrestrial and satellite components of IMT, ITU-R considers that the most appropriate criteria to be used for studies is 6% (−12.2 dB I/N).

IMT UE interference into GSO IMT space station:

- The studies of aggregate interference from IMT UEs into a GSO satellite show a −2.8 to 27.1 dB margin with respect to the I/N protection criterion of −12.2 dB and a 3.4 to 33.3 dB margin with respect to the I/N protection criterion of −6 dB.
- A study of aggregate interference from a MTC UE into a GSO satellite shows a −7.2 to 14.6 dB margin with respect to the I/N protection criterion of −12.2 dB and a −1.0 to 20.8 dB margin with respect to the I/N protection criterion of −6 dB. The parameters for the MTC UE used in the study are still under review and the results may have to be updated once the parameters are finalized.
- The studies of worst-case single-entry interference from an IMT UE into a GSO IMT space station show a −1.6 to 26.9 dB margin with respect to the I/N protection criterion

of -12.2 dB and a 4.6 to 33.1 dB margin with respect to the I/N protection criterion of -6 dB.

- A study of worst-case single-entry interference from an MTC UE into a GSO IMT space station shows a -2.7 to 5.3 dB margin with respect to the I/N protection criterion of -12.2 dB and a 3.5 to 11.5 dB margin with respect to the I/N protection criterion of -6 dB. The parameters for the MTC UE used in the study are still under review and the results may have to be updated once the parameters are finalized.

IMT BS interference into GSO IMT space station:

- The studies of aggregate interference from IMT BSs into a GSO satellite show a -52.4 to -19.5 dB margin with respect to the I/N protection criterion of -12.2 dB and a -46.2 to -13.3 dB margin with respect to the I/N protection criterion of -6 dB. Another study shows a -44.7 to -9.4 dB margin with respect to the I/N protection criterion of -12.2 dB and a -38.5 to -3.2 dB margin with respect to the I/N protection criterion of -6 dB. These ranges and associated assumptions are under review within ITU-R.
- The studies of worst-case single-entry interference from IMT BSs into a GSO satellite show a -20.7 to 0.4 dB margin with respect to the I/N protection criterion of -12.2 dB and a -14.5 to 6.6 dB margin with respect to the I/N protection criterion of -6 dB.

IMT UE interference into MEO IMT space station:

- Using the methodology of static analysis, the studies of aggregate interference from IMT UEs into an MEO satellite show a 5.5 to 22.7 dB margin with respect to the I/N protection criterion of -12.2 dB and a 11.7 to 28.9 dB margin with respect to the I/N protection criterion of -6 dB. The parameters for the studies are still under review and the results may need to be updated once the parameters are finalized.
- Using the Monte Carlo methodology, a study of aggregate interference from IMT UEs into a MEO satellite shows a margin of -0.1 dB with respect to the I/N protection criterion of -12.2 dB, when the distance between the nearest IMT BS and the boresight of the satellite beam is 500 km. The assumptions and methodology used in this study are still under review.
- The studies of worst-case single-entry interference from an IMT UE into a MEO satellite show a 2.6 dB margin with respect to the I/N protection criterion of -12.2 dB.

IMT BS interference into MEO IMT space station:

- Using the methodology of static analysis, the studies of aggregate interference from IMT BSs into a MEO satellite show a -37.9 to -16.2 dB margin with respect to the I/N protection criterion of -12.2 dB and a -31.7 to -10 dB margin with respect to the I/N protection criterion of -6 dB. The parameters for the studies are still under review and the results may need to be updated once the parameters are finalized.
- Using the Monte Carlo methodology, a study of aggregate interference from IMT BSs into a MEO satellite shows a margin of -41.8 dB with respect to the I/N protection criterion of -12.2 dB, when the distance between the nearest IMT BS and the boresight of the satellite beam is 500 km. The assumptions and methodology used in this study are still under review.
- The studies of worst-case single-entry interference from a IMT BS into a MEO satellite show a -1.1 dB margin with respect to the I/N protection criterion of -12.2 dB.

IMT UE interference into HEO IMT space station:

- The studies of aggregate interference from IMT UEs into an HEO satellite show a 3.2 to 25.8 dB margin with respect to the *I/N* protection criterion of -12.2 dB and a 9.4 to 32 dB margin with respect to the *I/N* protection criterion of -6 dB.
- The studies of worst-case single-entry interference from a IMT UE into an HEO satellite show a 2.7 to 20.6 dB margin with respect to the *I/N* protection criterion of -12.2 dB and a 8.9 to 26.8 dB margin with respect to the *I/N* protection criterion of -6 dB.

IMT BS interference into HEO IMT space station:

- The studies of aggregate interference from IMT BSs into an HEO satellite show a -44.4 to -16.1 dB margin with respect to the *I/N* protection criterion of -12.2 dB and a -38.2 to -9.9 dB margin with respect to the *I/N* protection criterion of -6.0 dB. The parameters for the studies are still under review and the results may need to be updated once the parameters are finalized.
- The studies of worst-case single-entry interference from an IMT BS into an HEO satellite show a -11.8 to 5.1 dB margin with respect to the *I/N* protection criterion of -12.2 dB and a -5.6 to 11.3 dB margin with respect to the *I/N* protection criterion of -6 dB.

IMT UE interference into LEO IMT space station:

- The studies of aggregate interference from IMT UEs into a LEO satellite show a 0.2 to 15.0 dB margin with respect to the *I/N* protection criterion of -12.2 dB and a 6.4 to 21.2 dB margin with respect to the *I/N* protection criterion of -6 dB.
- The studies of worst-case single-entry interference from an IMT UE into a LEO satellite show a -5.1 to 19.4 dB margin with respect to the *I/N* protection criterion of -12.2 dB and a 1.1 to 25.6 dB margin with respect to the *I/N* protection criterion of -6 dB.

IMT BS interference into LEO IMT space station:

- The studies of aggregate interference from IMT BSs into a LEO satellite show a -39.5 to -23.9 dB margin with respect to the *I/N* protection criterion of -12.2 dB and a -33.3 to -17.7 dB margin with respect to the *I/N* protection criterion of -6 dB. The parameters for the studies are still under review and the results may need to be updated once the parameters are finalized.
- The studies of worst-case single-entry interference from a IMT BS into a LEO satellite show a -11.2 to -2.7 dB margin with respect to the *I/N* protection criterion of -12.2 dB and a -5 to 3.5 dB margin with respect to the *I/N* protection criterion of -6 dB.

The studies showed that the interference margins are dependent on the location, the elevation angle of the IMT satellite component in relation to the terrestrial transmitters, the geographical area from where the aggregate interference is estimated and cell density of the terrestrial component of IMT in that geographic area.

The summary of these worst-case results shows that the level of interference from IMT BS into the IMT space stations is high, while the level of interference from IMT UE into the IMT space stations is low. The level of interference may be reduced as a result of mitigation techniques.

Several technical and operational measures were identified in the studies with the potential to mitigate the interference from IMT BSs into the IMT space stations.

With respect to the IMT BS, these measures include application of dynamic frequency resource blocks assignment through frequency and scheduler agility, use of antennas with improved performance compared to Recommendation ITU-R F.1336, orientation of the IMT BS antenna to minimize transmissions in the direction of the GSO satellite and use of real deployment environments and propagation effects like clutter and terrain loss.

A study to illustrate the potential impact of some of these measures was performed. A commercially available IMT BS antenna was modelled, with all IMT BS antennas assumed to be deployed with nulls in the direction of the GSO satellite. Also, a modified terrestrial IMT activity factor of 20% was considered. With these measures, the studies showed a reduction of the potential exceedance by 24.7 dB, leading to a margin of -27.7 dB for the worst-case scenario for the assumed IMT space station's protection criterion of $I/N = -12.2$ dB and a margin of -21.5 dB for the assumed $I/N = -6$ dB. Due to time constraints, this study was not reviewed by ITU-R and questions have been raised about the applicability of the modelling criteria.

With respect to the satellite component of IMT, the following potential technical and operational mitigation measures have been identified: optimal orbital positions, narrower spot beams with sharper roll-off, satellite beam forming and nulling, use of satellite diversity, dynamic frequency management through frequency and scheduler agility, use of the ancillary terrestrial component (ATC)/complementary ground component (CGC) systems, actual antenna pattern of IMT space station's receiver antenna, and use of protection criteria based on actual system performance and available margins.

A study to illustrate the potential impact of steeper GSO IMT station's receiving antenna gain roll-off and targeted nulls through beam forming was performed. These result in reduction due to mitigation from IMT space station of 30.8 dB. Another study raised concerns regarding the ability of the IMT space station to implement these measures in practice, and to be able to reduce interference to the extent suggested. The above studies are still under review and the results need to be updated once they are mutually agreed by the concerned parties.

In this connection, these results are still under review within ITU-R, in particular the extent to which such mitigation techniques could address the interference issue, and the values contained in these studies as well as the appropriateness or otherwise of combination of both satellite and terrestrial mitigation measures may be considered are yet to be verified and agreed upon.

The summary of these results show that, following the application of mitigation techniques, the level of interference from IMT BS into IMT space stations can be reduced, while the level of interference from IMT UE into IMT space stations can be eliminated.

2/9.1.1/3.2 Summary of results of interference from IMT BSs to IMT MESs (Scenario A2)

In the frequency band 2 170-2 200 MHz, interference analyses were carried out for IMT BS interference into a number of IMT MES with different antenna gain and receiver noise power to predict the interference into IMT MESs over a 100% land path with and without clutter effect, and a 100% sea path. The Recommendation ITU-R P.452-16 propagation model was used to estimate the propagation loss and from this propagation loss the resulting separation distances were obtained for several IMT BSs with various e.i.r.p. levels to predict the interference into IMT MESs over various paths (land and sea). A static analysis was done for propagation losses not exceeded for time percentages of 1%, 10% and 50% over 100% land path with and without clutter effect and 100% sea path.

Given the lack of protection criterion for compatibility studies between the terrestrial and satellite components of IMT, ITU-R considers that the most appropriate criteria to be used for studies is 6% (-12.2 dB I/N). The results of the studies undertaken for a range of values are summarized below.

The minimum separation distance between a single IMT BS and IMT MES of the systems studied over a 100% land path using I/N protection criterion of -12.2 dB varied in different studies:

- for $p = 1\%$, studies had results that varied from 230 to 338 km, 144.3 to 360 km, and 172.8 to 294 km;
- for $p = 10\%$, studies had results that varied from 48 to 123 km, 48 to 150 km, and 37.8 to 82.3 km;
- for $p = 50\%$, studies had results that varied from 35 to 51 km, 26.6 to 80 km, and 31.0 to 44.9 km.

The minimum separation distance between a single IMT BS and IMT MES of the systems studied over a 100% sea path using I/N protection criterion of -12.2 dB varied in different studies:

- for $p = 1\%$, studies had results that varied from 360 to 550 km, 233.8 to 600 km, and 282.7 to 469 km;
- for $p = 10\%$, studies had results that varied from 118 to 232 km, 69.8 to 232 km, and 84.5 to 177.6 km;
- for $p = 50\%$, studies had results that varied from 35 to 51 km, 26.6 to 98 km, and 31.0 to 44.9 km.

It should be noted that the results provided are for the macro IMT BS deployment scenario. For the micro urban deployment scenarios using I/N protection criterion of -12.2 dB, the separation distance varied between 35 km and 57 km, and 27.7 and 50.9 km for $p = 10\%$ over 100% land and 100% sea paths.

The minimum separation distances between a single IMT BS and IMT MES over a 100% land path using an I/N protection criterion of -6 dB varied from 188 to 303 km for $p = 1\%$, 39 to 91 km for $p = 10\%$, and 32 to 46 km for $p = 50\%$.

The minimum separation distances between a single IMT BS and IMT MES over a 100% sea path using an I/N protection criterion of -6 dB varied from 300 to 482 km for $p = 1\%$, 93 to 188 km for $p = 10\%$, and 32 to 46 km for $p = 50\%$.

The separation distance is dependent on the type of IMT MES, deployment environment of the IMT BSs, the time variability (p -value) and other parameters (e.g. latitude of transmitter and receiver, etc.) considered as part of the path configuration in Recommendation ITU-R P.452-16, and the gains of the transmit and receive antennas. Taking into account the actual propagation path profile with terrain and clutter losses (buildings and etc.) the separation distances between IMT MES and IMT BS will be significantly decreased.

Potential interference from IMT BSs into IMT MESs can be managed by the current cross-border coordination provisions in the RR. Since the actual technical/operational characteristics are expected to be exchanged, such bilateral coordination results can provide more flexibility than worst-case compatibility analysis. Furthermore, coordination may allow for the use of actual technical/operational characteristics such as more realistic parameters of radio stations and actual local propagation conditions, including actual terrain and clutter effects.

2/9.1.1/3.3 Summary of results of interference from IMT MESs to IMT BSs and IMT UEs (Scenario B1)

In the frequency band 1 980-2 010 MHz, separation distances were calculated between a single IMT MES transmitter and IMT terrestrial receivers of various types. The separation distances required for the compatibility between the terrestrial and satellite components of IMT were observed to be dependent on the time variability (p -value) considered as part of the propagation model and the

characteristics of the IMT MESs, IMT BSs and IMT UEs. The table below specifies the separation distance determined as part of the studies:

| Separation distance results (in km) | | | | | | |
|--|---------------|----------------|-----------------|----------------|---------------|----------------|
| Percentage of time setting in ITU-R P.452-16 | IMT BS | | IMT handheld UE | | IMT MTC* UE | |
| | $I/N = -6$ dB | $I/N = -10$ dB | $I/N = -6$ dB | $I/N = -10$ dB | $I/N = -6$ dB | $I/N = -10$ dB |
| 100% land path | | | | | | |
| $p = 1\%$ | 255 to 348 | 280 to 373 | 128 to 192 | 155 to 219 | 196 to 257 | 223 to 281 |
| $p = 10\%$ | 58 to 131 | 72 to 160 | 12 to 29 | 18 to 36 | 31 to 47 | 37 to 65 |
| $p = 50\%$ | 38 to 54 | 40 to 69 | ≤ 12 | 10 to 15 | 13 to 19 | 15 to 22 |
| 100% sea path | | | | | | |
| $p = 1\%$ | 402 to 586 | 446 to 631 | 220 to 308 | 257 to 349 | 315 to 412 | 356 to 455 |
| $p = 10\%$ | 137 to 250 | 160 to 283 | 39 to 71 | 53 to 88 | 74 to 118 | 91 to 142 |
| $p = 50\%$ | 37 to 54 | 40 to 69 | ≤ 12 | 10 to 15 | 13 to 19 | 15 to 22 |
| *: Machine-type communication. | | | | | | |

It is possible that the separation distances between IMT MES and IMT stations may be further reduced by considering actual propagation path terrain profiles and clutter losses (e.g. buildings, vegetation, etc.).

2/9.1.1/3.4 Summary of results of interference from the IMT space stations to IMT UEs (Scenario B2)

In the frequency band 2 170-2 200 MHz, studies of downlink interference analysis into IMT UEs from IMT space stations (GSO, LEO and HEO) were conducted and the summary of the results for all the different scenarios and cases are summarized below.

In the case of outdoor IMT UEs, the results show that, for some IMT space stations, the downlink interference to IMT UEs does not exceed the protection criterion of $I/N = -6$ dB, while for other IMT space stations the interference to IMT UEs exceeds the protection criterion. A summary and analysis of the results of studies for the various IMT space stations are provided as follows:

- the interference from GSO system 1 exceeded the protection criterion by 8.9 dB;
- the interference from GSO system 2 exceeded the protection criterion by 0.9 dB;
- the interference from GSO system 3 and HEO system 4 does not exceed the protection criterion;
- the interference from LEO system 5 exceeded the protection criterion by 1 dB;
- in all cases of indoor IMT UEs, the results show high positive margin, i.e. no potential risk of downlink interference into indoor IMT UEs from all the IMT space stations.

See the working document towards a PDN [Recommendation or Report] ITU-R M.[MSS&IMT-ADVANCED SHARING] for details of systems 1, 2, 3, 4 and 5 above.

One study indicated that, in the case of outdoor IMT UEs assuming MTC, the interference from the IMT space stations exceeded the protection criterion by 3.0 to 22.9 dB, depending on the characteristics of IMT satellite component. This exceedance is due to different characteristics and parameters employed in the study for the IMT MTC UEs (0 dB body loss, 3 dBi antenna gain and

5 dB noise figure). Depending on the characteristics and parameters of the IMT satellite component, there is some risk of the indoor interference threshold being exceeded for MTC UEs.

It should be noted that if the protection criterion of $I/N = -10$ dB is used, the exceedance of the protection criterion is increased by 4 dB relative to the results of the protection criterion of $I/N = -6$ dB for all study scenarios.

The wide range of exceedance values across the studies performed indicate that the exceedance value is sensitive to the characteristics of the IMT satellite component and the IMT UEs which are expected to vary from deployment to deployment scenario.

The interference threshold used in the studies for IMT UE receivers translates to the following power flux-density (pfd) values for the assumed values of IMT UE antenna gain, body loss, receiver noise figure and protection criterion I/N :

| Type of IMT UE receiver | $I/N = -6$ dB | $I/N = -10$ dB |
|---|-------------------------------------|-------------------------------------|
| IMT handheld UE (antenna gain = -3 dBi, body loss = 4 dB, receiver noise figure = 9 dB) | -105.8 dB(W/(m ² · MHz)) | -109.8 dB(W/(m ² · MHz)) |
| IMT MTC UE (antenna gain = 3 dBi, body loss = 0 dB, receiver noise figure = 5 dB) | -119.8 dB(W/(m ² · MHz)) | -123.8 dB(W/(m ² · MHz)) |

Where interference would exceed the protection criterion for terrestrial IMT UEs, one mitigation would be for the IMT satellite component to modify its operation or design to reduce the downlink pfd in certain territories, where this can be achieved without significantly impacting on the MSS coverage to adjacent countries.

With respect to the satellite component of IMT, the following potential technical and operational mitigation measures have been identified which may be employed to mitigate the interference into terrestrial IMT UEs: narrower spot beams and steeper roll-off from the boresight of the antenna, antenna steering, beam forming, beam nulling, and dynamic frequency management.

2/9.1.1/4 Conclusions

Studies have been performed to evaluate the coexistence and compatibility of terrestrial and satellite components of IMT deployed in neighbouring countries/different concerned countries/adjacent geographical areas across different countries. The studies cover scenarios for IMT satellite component with different characteristics, and terrestrial IMT deployments in several different environments.

2/9.1.1/4.1 Interference from IMT BSs and IMT UEs to IMT space stations (Scenario A1)

In the frequency band 1 980-2 010 MHz, it was observed that the level of potential interference from IMT BS into IMT space stations is high, while the level of potential interference from IMT UE into IMT space stations is low.

Several technical and operational measures related to coexistence and compatibility between terrestrial and satellite IMT deployments for minimizing and mitigating the interference into the IMT space stations from terrestrial IMT stations have been identified in section 2/9.1.1/3.1 above and further detailed in the working document towards a PDN [Recommendation or Report] ITU-R M.[MSS&IMT-ADVANCED SHARING].

The studies of these technical and operational measures show that the potential interference from IMT UEs can be addressed through implementation of these mitigation measures by administrations to facilitate coexistence and compatibility between terrestrial and satellite deployments in their respective countries.

The studies of these technical and operational measures show that the potential interference from IMT BSs can be reduced. There are two views on this matter:

- some countries consider that, through implementation of mitigation measures, it is possible to partially reduce, but not wholly eliminate, potential excess interference. Additional measures should be considered to enable compatibility;
- some countries consider that, through implementation of mitigation measures, it is possible to wholly eliminate potential excess interference.

The implementation of mitigation measures may be considered on a case-by-case basis by administrations.

2/9.1.1/4.2 Interference from IMT BSs to IMT MESs (Scenario A2)

In the frequency band 2 170-2 200 MHz, it was observed that potential interference from IMT BSs into IMT MESs may occur.

The potential interference may be mitigated by one or more of: assessment of terrain and clutter effects and system characteristics, deployment environments, and separation distance.

Given the varying characteristics of the border area across various countries, administrations can bilaterally determine the appropriate mitigation techniques on a case-by-case basis.

2/9.1.1/4.3 Interference from IMT MESs to IMT BSs and IMT UEs (Scenario B1)

In the frequency band 1 980-2 010 MHz, the results of studies show that a separation distance is dependent on the type of IMT MES, IMT BS and IMT UE, and conditions of the propagation model including terrain and clutter effects.

The studies evaluating the interference between IMT terrestrial stations and IMT MES show that geographical separation at the border of two countries would be required. The geographical separation determined in the studies was observed to be larger for a sea-based border than a land-based border.

Potential interference from IMT MESs to IMT BSs and IMT UEs could be managed by bilateral/multilateral negotiation, in which actual technical/operational characteristics and mitigation measures for satellite and terrestrial components of IMT could be taken into account.

2/9.1.1/4.4 Interference from IMT space stations to IMT UEs (Scenario B2)

In the frequency band 2 170-2 200 MHz, the results of studies show that the downlink interference from IMT space stations to IMT UEs may exceed the protection criterion depending on the characteristics of IMT satellite component and those of IMT UEs.

Potential interference from IMT space stations to IMT UEs could be managed by bilateral/multilateral negotiation, in which actual technical/operational characteristics and mitigation measures for satellite and terrestrial components of IMT could be taken into account.

Several technical and operational measures related to coexistence and compatibility between terrestrial and satellite IMT deployments for minimizing and mitigating the interference into the IMT UEs from IMT space stations have been identified in section 2/9.1.1/3.4 above and further detailed in the working document towards a PDN [Recommendation or Report] ITU-R M.[MSS&IMT-ADVANCED SHARING].

With respect to the results of studies on WRC-19 agenda item 9.1, issue 9.1.1, the following views were expressed:

View 1:

View 1 is based on Resolution ITU-R 2-7 *resolves* 2: “*that the scope of CPM shall be to prepare a consolidated report to be used in support of the work for World Radiocommunication Conferences, based on: the inclusion, to the extent possible, of reconciled differences in approaches as contained in the source material, or, in the case where the approaches cannot be reconciled, the inclusion of the differing views and their justification*”.

- 1) The scope of Resolution **212 (Rev. WRC-15)** pertains to coexistence between the terrestrial and satellite components of IMT in different countries, which are not necessarily adjacent. Studies and measurements show that there is a significant risk of interference between non-adjacent countries.
- 2) It should be noted that the protection criterion for IMT-Advanced UE of $I/N = -10$ dB is not in line with any ITU-R Recommendation/Report. The protection criteria of $I/N = -10$ dB for the IMT-Advanced BS has been justified based on Report ITU-R M.2109-0, which applies for different frequency bands and different interference scenarios. Therefore, conclusions should be based only on the agreed criterion of -6 dB I/N as contained in Report ITU-R M.2292-0 “Characteristics of terrestrial IMT-Advanced systems for frequency sharing/interference analyses”, which is the accepted source of reference parameters for terrestrial IMT. It is noted that the proposed terrestrial IMT protection criteria of $I/N = -10$ dB does not appear in Report ITU-R M.2292-0, and is thus considered as still under study within ITU-R.
- 3) It should be noted that parameters for MTC of the terrestrial component of IMT are not in line with Report ITU-R M.2292-0 and should not be taken into account in study results. It is also noted that the parameters used for MTC interference analysis do not appear within Recommendation ITU-R M.2012-3 “Detailed Specifications of the terrestrial radio interfaces of International Mobile Telecommunications Advanced (IMT-Advanced),” which was approved in 2018.
- 4) Regarding Scenario A1, there is currently no provision in the Radio Regulations that would prevent interference from IMT base stations to IMT space stations and there is no coordination process between the administration responsible for the MS and the administration responsible for the MSS and no process to identify the concerned administrations. Potential interference in the frequency band 1 980-2 010 MHz from IMT terrestrial systems to the MSS satellite can be regulated by establishing an e.i.r.p. limit with the value 20 dB(m/5 MHz) on IMT stations. It is proposed that the e.i.r.p. limit be applied through inclusion of a footnote to the Table of Frequency Allocations in Article 5 of the Radio Regulations or through a modification to the *resolves* part of Resolution **212 (Rev.WRC-15)**.
- 5) Regarding Scenario A2, potential interference in the frequency band 2 170-2 200 MHz from IMT stations to MSS ESs can be regulated by the current provisions on border coordination which are contained in No. **9.16**, No. **9.17**, No. **9.18** and Appendix 7 of the Radio Regulations.
- 6) Regarding Scenario B1, potential interference in the frequency band 1 980-2 010 MHz from MES to IMT BS can be addressed by the current provisions on border coordination which are contained in Nos. **9.15** and **9.17** of the Radio Regulations. Changes to Appendix 7 (Table 7a) are proposed to include relevant parameter values for terrestrial IMT systems.

- 7) Regarding Scenario B2, Note 3 to the existing power flux-density (pfd) coordination threshold values in Table 5-2 of Appendix 5 of the Radio Regulations for other terrestrial services, which states “The coordination thresholds in the band 2 160-2 170 MHz (Region 2) and 2 170-2 200 MHz (all Regions) to protect other terrestrial services do not apply to IMT systems, as the satellite and the terrestrial components are not intended to operate in the same area or on common frequencies within these bands,” contains some ambiguity regarding the protection of the terrestrial component of IMT. Furthermore, usage of the current pfd threshold Table 5-2 of Appendix 5 of the Radio Regulations overprotects terrestrial IMT. Potential interference in the frequency band 2 170-2 200 MHz from MSS satellites to IMT terrestrial systems can be addressed by establishing a new coordination threshold pfd level, for instance – 108.8 dB(W/(m² · MHz)), to avoid unnecessary coordination. It is proposed to include the new pfd coordination threshold in Table 5-2 of RR Appendix 5 in the frequency band 2 170-2 200 MHz for protection of terrestrial stations of IMT systems, together with creating a new Note 11 stating “The coordination thresholds in the frequency band 2 170-2 200 MHz (all Regions) apply to protect terrestrial stations of IMT systems” and delete the very end of Note 3 starting from “as the satellite and terrestrial components”.

View 2:

- 1) View 2 considers that the scope of WRC-19 agenda item 9.1, issue 9.1.1 is strictly limited to the study of possible technical and operational measures to ensure coexistence and compatibility between the terrestrial component of IMT and the satellite component of IMT in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz in adjacent geographical areas, as noted in Resolution 212 (Rev.WRC-15). In addition, regulatory measures or any changes to the Radio Regulations are outside the scope of a WRC-19 agenda item 9.1 issue.
- 2) The ITU-R studies concluded that technical and operational measures studied and developed pursuant to Resolution 212 (Rev.WRC-15) are sufficient to ensure coexistence and compatibility between the terrestrial and satellite components of IMT in adjacent geographical areas in different countries for all scenarios. Additionally, technical and operational measures made possible through availability of newer technologies could further facilitate compatibility between the two components of IMT. Therefore, there is no need for any changes to the Radio Regulations under this agenda item issue. Because of the unique and varying system characteristics and deployment scenarios of the satellite and terrestrial components of IMT in adjacent geographic areas in different countries, bilateral/multilateral discussions between affected administrations provide greater operational flexibility while ensuring coexistence between the two components deployed in different countries.
- 3) Other studies suggest the need for changes to the Radio Regulations. However, these studies are based on unrealistic IMT deployment assumptions regarding the use of the terrestrial and satellite components of IMT between non-adjacent countries in different/distant geographical areas. Additionally, no conclusions were drawn during the study cycle to justify any regulatory restrictions or changes to the Radio Regulations, and no studies have been performed in any of the ITU-R groups to justify the values/parameters in the proposed regulatory constraints. Accordingly, these conclusions and the proposed regulatory examples are outside of the scope of WRC-19 agenda item 9.1, issue 9.1.1 as Resolution 212 (Rev.WRC-15) is limited to the study of technical and operational measures to ensure coexistence and compatibility between the terrestrial and satellite components of IMT in adjacent geographical areas in different countries.

WRC-19 is invited to consider the matter with a view to address these views, as appropriate.

Agenda item 9.1(9.1.5)

2/9.1.5 Resolution 764 (WRC-15)

Consideration of the technical and regulatory impacts of referencing Recommendations ITU-R M.1638-1 and ITU-R M.1849-1 in Nos. 5.447F and 5.450A of the Radio Regulations

2/9.1.5/1 Executive summary

Based on different studies regarding the technical and regulatory impacts of referencing Recommendations ITU-R M.1638-1 and ITU-R M.1849-1 in RR Nos. 5.447F and 5.450A, different approaches (as alternatives for addressing the issue) were suggested for regulatory examples.

Approach A updates both footnotes by removing the references and replacing them with the sentence “Resolution 229 (Rev.WRC-12) applies”.

Approach B updates both footnotes by removing the references to the Recommendations and replacing them with a reference to RR No. 5.446A.

2/9.1.5/2 Background

WRC-03 allocated the 5 150-5 350 MHz and 5 470-5 725 MHz frequency bands to the mobile service on a primary basis for the implementation of wireless access systems (WAS) including radio local area networks (RLANs) subject to Resolution 229 (Rev.WRC-12). WRC-03 also decided that the radiolocation service, the Earth exploration-satellite service (active) and the space research service (active) (RR No. 5.447F) and the radiodetermination service (RR No. 5.450A) shall not impose on the mobile service more stringent protection criteria, based on system characteristics and interference criteria, than those stated in Recommendations ITU-R M.1638-0 and ITU-R RS.1632-0, which were incorporated by reference.

During the WRC-15 study cycle, Recommendation ITU-R M.1638-0 was revised. In this revision process, thirteen new radars with different system characteristics were included in Recommendation ITU-R M.1638-1, and the technical characteristics and protection criteria for ground-based meteorological radars were removed and relocated to Recommendation ITU-R M.1849-1. Additionally, several new meteorological radars were added to Recommendation ITU-R M.1849-1 during this revision process (see also section 2/9.1.5/3.2).

Consistent with the provisions of Resolution 27 (Rev.WRC-12), for an ITU-R Recommendation (e.g. ITU-R M.1638), the reference in the Radio Regulations shall continue to apply to the earlier version incorporated by reference until such time as a competent WRC agrees to incorporate the new version. Given the potential impact on the widespread deployment of RLANs in the 5 250-5 350 MHz and 5 470-5 725 MHz frequency bands and the provisions of RR Nos. 5.447F and 5.450A, WRC-15 decided to study this matter under WRC-19 agenda item 9.1, issue 9.1.5.

If the references to either or both of the two Recommendations remain in the footnotes, the question of the revision of RR Nos. 5.447F and 5.450A would have to be re-addressed in the future (e.g. under agenda item 2) to consider any future updates of Recommendations ITU-R M.1638 and ITU-R M.1849, most probably with the same arguments as those currently developed under WRC-19 agenda item 9.1, issue 9.1.5.

Recommendation ITU-R M.1849-1 provides technical and operational aspects of ground-based meteorological radars. There were nine ground-based meteorological radars which were removed from Recommendation ITU-R M.1638-0. Eight of those radars in Recommendation ITU-R M.1849-0 were retained in Recommendation ITU-R M.1849-1. In addition, five other ground-based meteorological radars from Recommendation ITU-R M.1849-0 were retained and one additional

new radar was added into Recommendation ITU-R M.1849-1, resulting in six radars that were not previously in Recommendation ITU-R M.1638-0 being included in Recommendation ITU-R M.1849-1. ITU-R also provided a summary of the radars operating in the frequency bands 5 250-5 350 MHz and 5 470-5 725 MHz as contained in Recommendations ITU-R M.1638-0, ITU-R M.1638-1, ITU-R M.1849-0 and ITU-R M.1849-1.

For the bands 5 150-5 350 MHz and 5 470-5 725 MHz, the coexistence between WAS/RLAN and the radiolocation service is regulated by No. **5.446A**.

5.446A The use of the bands 5 150-5 350 MHz and 5 470-5 725 MHz by the stations in the mobile, except aeronautical mobile, service shall be in accordance with Resolution **229 (Rev.WRC-12)**. (WRC-19)

2/9.1.5/3 Summary and analysis of the results of ITU-R studies

2/9.1.5/3.1 Summary of technical and operational studies

2/9.1.5/3.1.1 Approach A

To address the situation described in section 2/9.1.5/2 above, a first proposed approach is to delete the second sentence of the footnotes, where the Recommendations are referenced, and clarify that the provisions of Resolution **229 (Rev.WRC-12)** apply in this case, such as presented in section 2/9.1.5/4.1 below.

This approach is a long-term solution that would avoid reopening the issue of technical and regulatory impacts of referencing new Recommendation versions in RR Nos. **5.447F** and **5.450A**. This should in particular be seen in the light of the fact that, in practice, the coexistence between WAS/RLAN and radars is not driven by those two footnotes but by Resolution **229 (Rev.WRC-12)** that defines the conditions for the mobile service to operate in these bands.

2/9.1.5/3.1.2 Approach B

Another alternative that would maintain the sharing conditions between WAS/RLANs and radars would be to delete portions of the sentence of the footnotes, where the Recommendations are referenced, and retain the provisions “shall not impose more stringent technical and operational limits upon the mobile service than those in RR No. **5.446A**” (see 2/9.1.5/4.2 below). This approach is a long-term solution that would avoid reopening the issue of technical and regulatory impacts of referencing new Recommendation versions in RR Nos. **5.447F** and **5.450A**.

2/9.1.5/3.2 List of relevant ITU-R Recommendations

Recommendations ITU-R M.1638-0, ITU-R M.1638-1, ITU-R M.1849-0 and ITU-R M.1849-1.

2/9.1.5/4 Conclusions

Two approaches were suggested to address WRC-19 agenda item 9.1, issue 9.1.5 as outlined in the sub-sections 2/9.1.5/4.1 and 2/9.1.5/4.2. In any case, Resolution **764 (WRC-15)** should be suppressed as shown in sub-section 2/9.1.5/4.3 below.

2/9.1.5/4.1 Approach A

To delete the second sentence of the footnotes, where the Recommendations are referenced, and introduce the sentence “Resolution **229 (Rev.WRC-12)** applies” as shown in the regulatory example below:

MOD

5.447F In the frequency band 5 250-5 350 MHz, stations in the mobile service shall not claim protection from the radiolocation service, the Earth exploration-satellite service (active) and the space research service (active). Resolution 229 (Rev.WRC-12) applies~~These services shall not impose on the mobile service more stringent protection criteria, based on system characteristics and interference criteria, than those stated in Recommendations ITU-R M.1638-0 and ITU-R RS.1632-0.~~ (WRC-1519)

MOD

5.450A In the frequency band 5 470-5 725 MHz, stations in the mobile service shall not claim protection from radiodetermination services. Resolution 229 (Rev.WRC-12) applies~~Radiodetermination services shall not impose on the mobile service more stringent protection criteria, based on system characteristics and interference criteria, than those stated in Recommendation ITU-R M.1638-0.~~ (WRC-1519)

2/9.1.5/4.2 Approach B

To delete the references to the Recommendations and refer to No. **5.446A** instead as shown in the regulatory example below:

MOD

5.447F In the frequency band 5 250-5 350 MHz, stations in the mobile service shall not claim protection from the radiolocation service, the Earth exploration-satellite service (active) and the space research service (active).~~These services shall not impose on the mobile service more stringent protection criteria, based on system characteristics and interference criteria, than those stated in Recommendations ITU-R M.1638-0 and ITU-R RS.1632-0~~ while the radiolocation service, the Earth exploration-satellite service (active) and the space research service (active) shall not impose more stringent technical and operational limits upon the mobile service other than those in No. 5.446A. (WRC-1519)

MOD

5.450A In the frequency band 5 470-5 725 MHz, stations in the mobile service shall not claim protection from radiodetermination services.~~Radiodetermination services shall not impose on the mobile service more stringent protection criteria, based on system characteristics and interference criteria, than those stated in Recommendation ITU-R M.1638-0~~ while the radiodetermination services shall not impose more stringent technical and operational limits upon the mobile service other than those in No. 5.446A. (WRC-1519)

2/9.1.5/4.3 For Approaches A and B

SUP

RESOLUTION 764 (WRC-15)

**Consideration of the technical and regulatory impacts of referencing
Recommendations ITU-R M.1638-1 and ITU-R M.1849-1
in Nos. 5.447F and 5.450A of the Radio Regulations**

Agenda item 9.1(9.1.8)

2/9.1.8 Issue 3) in the Annex to Resolution 958 (WRC-15)

Urgent studies required in preparation for the 2019 World Radiocommunication Conference

3) *Studies on the technical and operational aspects of radio networks and systems, as well as spectrum needed, including possible harmonized use of spectrum to support the implementation of narrowband and broadband machine-type communication infrastructures, in order to develop Recommendations, Reports and/or Handbooks, as appropriate, and to take appropriate actions within the ITU Radiocommunication Sector (ITU-R) scope of work.*

2/9.1.8/1 Executive summary

Machine Type Communications (MTC), which are also known as Machine-to-Machine (M2M) communications or Internet of Things (IoT), describe communication between devices that do not require human intervention. An increasingly large number of MTC devices, with a range of performance and operational requirements, are expected to communicate due to further improvements of low-cost and low complexity device types requiring high reliability techniques, for instance in the field of traffic safety, traffic efficiency, smart grid, e-health, wireless industry automation, augmented reality, remote tactile control and tele-protection.

The results of ITU-R studies of the current and future spectrum use for narrowband and broadband MTC performed, as expressed in Resolution **958 (WRC-15)**, concluded that there is no need for any regulatory action in the Radio Regulations with regard to specific spectrum intended for use by those applications. Nonetheless, there are other mechanisms, which could facilitate the harmonized use of spectrum to support the implementation of narrowband and broadband MTC infrastructures, including ITU-R Recommendations or Reports.

2/9.1.8/2 Background

WRC-15 decided that urgent studies should be carried out “to support the implementation of narrowband and broadband machine-type communication infrastructures” under WRC-19 agenda item 9.1, issue 9.1.8, and that the Director of the Radiocommunication Bureau reports on these studies under agenda item 9.1 of WRC-19, based on the results of studies, as appropriate. This was decided taking into account the rapid growth expected for MTC and the advantages of wireless technologies instead of cabling, for instance: reduced complexity of installation, no damage to cables, increased machine deployment, mobility and flexibility.

There are ITU-R Resolutions such as Resolution ITU-R 54-2 “Studies to achieve harmonization for short-range devices” and Resolution ITU-R 66 “Studies related to wireless systems and applications for the development of the Internet of Things”. Furthermore, Resolution ITU-R 66 recognizes “that IoT is a concept encompassing various platforms, applications, and technologies that are, and will continue to be, implemented under a number of radiocommunication services”. In accordance with Resolution ITU-R 66, the ITU-R developed Report ITU-R SM.2423.

2/9.1.8/3 Summary and analysis of the results of ITU-R studies

2/9.1.8/3.1 Summary and analysis of the results of ITU-R studies related to WRC-19 agenda item 9.1, issue 9.1.8

Report ITU-R M.2440-0 addresses the use of the terrestrial component of IMT for narrowband and broadband MTC and studies the technical and operational aspects of radio networks and systems, as

well as spectrum needed, including possible harmonized use of spectrum to support the implementation of narrowband and broadband MTC infrastructures.

Existing spectrum already identified for IMT in the Radio Regulations and the frequency bands under study for IMT identification may also be utilized for narrowband and broadband MTC. Harmonized frequency arrangements for the terrestrial component of IMT are provided in Recommendation ITU-R M.1036.

The harmonized use of existing spectrum identified for IMT systems provides economies of scale to facilitate the deployment of narrowband and broadband IMT-based MTC ecosystems in a timely and cost effective manner. Such harmonized use of narrowband MTC ecosystems may include the use of the same IMT frequency arrangements within a certain region or number of administrations based on their needs. Example(s) for possible harmonized use of narrowband MTC, based on IMT frequency arrangements provided by Recommendation ITU-R M.1036, can be found in Report ITU-R M.2440-0.

For non-IMT technologies, PDN Report ITU-R M.[NON_IMT.MTC_USAGE] studies the technical and operational aspects of MTC applications by non-IMT mobile systems, and presents information on MTC applications including wireless industrial automation. The Report considers the use of radio local area network (RLAN) technologies to support various applications, including MTC.

The harmonized use of existing spectrum used by RLAN systems at suitable power levels provides economies of scale to facilitate the deployment of non-IMT MTC ecosystems in a timely and cost effective manner. Example(s) of the use of possible harmonized spectrum for non-IMT MTC applications based on RLAN technologies in Recommendation ITU-R M.1450, can be found in PDN Report ITU-R M.[NON_IMT.MTC_USAGE].

2/9.1.8/3.2 List of other ITU-R Recommendations and Reports

Recommendations ITU-R M.1450, ITU-R M.1457, ITU-R M.2002, ITU-R M.2012, ITU-R M.2083, ITU-R SM.1896 and ITU-R SM.2103. Reports ITU-R SM.2153 and ITU-R M.2224.

2/9.1.8/4 Conclusions

ITU-R studies of the current and future spectrum use for narrowband and broadband MTC, performed as expressed in Resolution **958 (WRC-15)**, concluded that there is no need to take any regulatory action in the Radio Regulations with respect to specific spectrum for the use of those applications in the Radio Regulations. Nonetheless, there may be other ways to address the harmonized use of spectrum to support the implementation of narrowband and broadband MTC.

The study of technical and operational aspects including the potential harmonized spectrum usage to support the implementation of narrowband and broadband MTC infrastructures could be further accomplished through the course of the work in ITU-R Study Groups including the development of ITU-R Recommendations, Reports and/or Handbooks, as appropriate. Possible example(s) of the potential harmonized use of IMT-based MTC, based on IMT frequency arrangements provided by Recommendation ITU-R M.1036, can be found in Report ITU-R M.2440-0 and for non-IMT technologies in PDN Report ITU-R M.[NON_IMT.MTC_USAGE].

CHAPTER 3

Satellite services

(Agenda items 1.4, 1.5, 1.6, 7, 9.1 (issues 9.1.2, 9.1.3, 9.1.9))

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Agenda item 1.4

1.4 to consider the results of studies in accordance with Resolution 557 (WRC-15), and review, and revise if necessary, the limitations mentioned in Annex 7 to Appendix 30 (Rev.WRC-15), while ensuring the protection of, and without imposing additional constraints on, assignments in the Plan and the List and the future development of the broadcasting-satellite service within the Plan, and existing and planned fixed-satellite service networks;

Resolution 557 (WRC-15) – Consideration of possible revision of Annex 7 to Appendix 30 of the Radio Regulations.

3/1.4/1 Executive summary

WRC-15 adopted Resolution 557 (WRC-15) to study possible revisions of the limitations mentioned in Annex 7 to Appendix 30 (Rev.WRC-15) of the Radio Regulations (RR).

It should be noted that the broadcasting-satellite service (BSS) not subject to RR Appendix 30 (12.5-12.7 GHz, in Region 3) is not the subject of consideration in accordance with Resolution 557 (WRC-15).

It should be emphasized that studies calling for revision of Annex 7 to RR Appendix 30 (Rev.WRC-15) under Resolution 557 (WRC-15) in no way was intended to have any impact whatsoever to the integrity of RR Appendix 30 for Regions 1 and 3.

The Annex 7 to RR Appendix 30 (Rev.WRC-15) contains several orbital position limitations for proposed modifications to the Region 2 Plan and for proposed new or modified assignments in the Regions 1 and 3 List applicable to specific parts of the frequency band 11.7-12.7 GHz.

There are no orbital position limitations in RR Appendix 30A. One can already apply for and use the entire feeder-link frequency band within the restricted portions of the Annex 7 to RR Appendix 30 (Rev.WRC-15) arc. As a result, it is not necessary to analyse the impact of removing limitations that do not exist.

Should WRC-19 decide to remove some or all the current limitations on the use of the orbital arc for Regions 1 and 3 BSS networks as contained in Annex 7 to RR Appendix 30 (Rev.WRC-15), priority on the use of these new orbital positions should be given to those countries in Regions 1 and 3 with Plan assignments with equivalent downlink protection margin values in the RR Appendix 30 equal or below -10 dB, and with neither frequency assignments included in the List nor for which complete RR Appendix 4 information has been received by the Bureau in accordance with the provisions of § 4.1.3 of RR Appendix 30 (Rev.WRC-15). See draft new Resolution [B14-PRIORITY] (WRC-19) and draft new Resolution [D14-ENTRY-INTO-FORCE] (WRC-19).

3/1.4/2 Background

In order to simplify the readiness of the limitations of Annex 7 to RR Appendix 30 (Rev.WRC-15), the following nomenclature was retained as shown in Table 3/1.4/2-1. The geographical presentation of Annex 7 to RR Appendix 30 (Rev.WRC-15) limitations A1 and A2 is shown in Figure 3/1.4/2-1.

TABLE 3/1.4/2-1

Annex 7 to RR Appendix 30 (Rev.WRC-15) limitations

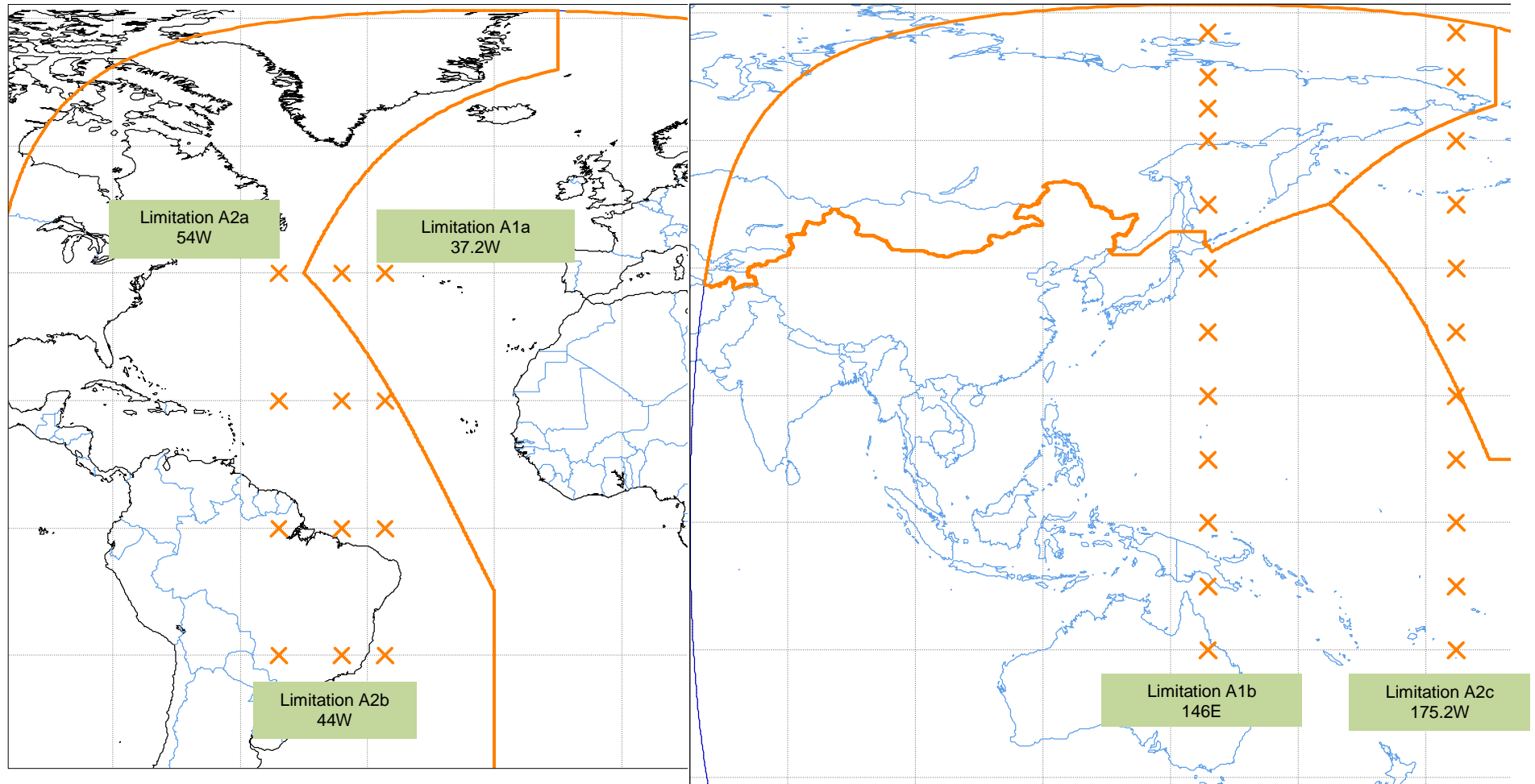
| Annex 7 limitation | Region and service of interfering assignments | Region and service of impacted assignments | Frequency band | Limitation description |
|--------------------|---|--|----------------|--|
| A1a | Region 1 BSS | Region 2 FSS (Atlantic) | 11.7-12.2 GHz | No assignments in the Region 1 List further west than 37.2° W |
| A1b | | Region 2 FSS (Pacific) | | No assignments in the Region 1 List further east than 146° E |
| | | Region 3 BSS subject to RR Appendix 30 | | |
| A2a | Region 2 BSS | Region 1 FSS (Atlantic) | 12.5-12.7 GHz | No modification in the Region 2 Plan further east than 54° W |
| A2b | | Region 1 BSS subject to RR Appendix 30 | 12.2-12.5 GHz | No modification in the Region 2 Plan further east than 44° W |
| A2c | | Region 3 FSS | 12.2-12.7 GHz | No modification in the Region 2 Plan further west than 175.2° W |
| | | Region 1 BSS subject to RR Appendix 30 | 12.2-12.5 GHz | |
| | | Region 1 FSS (Pacific) | 12.5-12.7 GHz | |
| A3a | Region 1 BSS | Region 2 FSS | 11.7-12.2 GHz | No assignments in the Regions 1 and 3 List outside specific allowable portions of the orbital arc between 37.2° W and 10° E |
| A3b | | | | Maximum e.i.r.p. of 56 dBW for assignments in the Regions 1 and 3 List at specific allowable portions of the orbital arc between 37.2° W and 10° E |
| A3c | | | | Maximum power flux-density of −138 dB(W/(m² · 27 MHz)) at any point in Region 2 by assignments in the Regions 1 and 3 List located at 4° W and 9° E |
| B | Region 2 BSS | Region 2 BSS subject to RR Appendix 30 | 12.2-12.7 GHz | Required agreement of administrations having assignments to space stations in the same cluster when an administration may locate a satellite within this cluster |

FIGURE 3/1.4/2-1

Geographical presentation of Annex 7 to RR Appendix 30 (Rev.WRC-15) limitations A1 and A2

Atlantic ocean region
Limitations "A1a", "A2a", "A2b"

Pacific ocean region
Limitations "A1b", "A2c"



Different regional allocations to the fixed-satellite service (FSS) and BSS in the 11.7-12.7 GHz frequency range are causing several interregional sharing situations between these services. BSS and FSS networks from different Regions may operate simultaneously and share orbit resource in their respective Regions. Annex 7 to RR Appendix **30 (Rev.WRC-15)** contains several orbital position limitations for proposed new or modified assignments in the Regions 1 and 3 List (limitations A1a, A1b, A3a, A3b, A3c) and for proposed modifications to the Region 2 Plan (limitations A2a, A2b, A2c) applicable to specific parts of the frequency band 11.7-12.7 GHz.

The FSS in the same frequency band is not subject to orbital position limitations.

Revision/elimination of the Annex 7 to RR Appendix **30** orbital position limitations would ensure BSS an additional orbital resource.

3/1.4/3 Summary and analysis of the results of ITU-R studies

Detailed analysis of each study can be found in the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANEX7]. Moreover, it was shown that the deletion of each limitation is independent of the other and the deletion of multiple limitations has no cumulative effect.

3/1.4/3.1 Review of the Radio Regulations and existing documentation

3/1.4/3.1.1 Current allocations in the 11.7-12.7 GHz frequency band

The frequency band 11.7-12.7 GHz is allocated to different services as shown in Table 3/1.4/3.1.1-1.

TABLE 3/1.4/3.1.1-1

The current allocation to services in 11.7-12.7 GHz

| Allocation to services | | |
|---|---|---|
| Region 1 | Region 2 | Region 3 |
| 11.7-12.5 FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492 5.487 5.487A | 11.7-12.1 FIXED 5.486 FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.488 Mobile except aeronautical mobile 5.485 | 11.7-12.2 FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492 5.487 5.487A |
| | 12.1-12.2 FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.488 5.485 5.489 | |
| | 12.2-12.7 FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492 | 12.2-12.5 FIXED FIXED-SATELLITE (space-to-Earth) 5.484B MOBILE except aeronautical mobile BROADCASTING 5.487 5.484A |

| | | |
|---|---|---|
| 12.5-12.75 FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B (Earth-to-space) 5.494 5.495 5.496 | 5.487A 5.488 5.490 12.7-12.75 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE except aeronautical mobile | 12.5-12.75 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B MOBILE except aeronautical mobile BROADCASTING- SATELLITE 5.493 |
|---|---|---|

3/1.4/3.1.2 Relevant provisions in the Radio Regulations

RR Appendix **30** has detailed provisions and associated coordination triggers both for modifications to the Region 2 Plan and/or Regions 1 and 3 List. In particular, the relevant provisions and associated technical criteria are:

- Article 4 of RR Appendix **30** → procedure for proposed modifications to the Region 2 Plan or Regions 1 and 3 List to coordinate with FSS or BSS subject to RR Appendix **30**.
- Article 7 of RR Appendix **30** → procedure for BSS not subject to RR Appendix **30** or FSS networks to coordinate with BSS Plan or List assignments or previously filed modifications to the Region 2 Plan or Regions 1 and 3 List.
- Annex 1 to RR Appendix **30** (Sections 1, 3, 6) → criteria to determine if a proposed modification to the Region 2 Plan or proposed new or modified assignments in the Regions 1 and 3 List needs to coordinate with FSS or BSS subject to RR Appendix **30** networks or BSS networks in the frequency band 12.5-12.7 GHz in Region 3.
 - The criteria here are coordination threshold power flux-density (pfd) masks.
- Annex 4 to RR Appendix **30** → criteria to determine if FSS or BSS not subject to RR Appendix **30** (see text in “Executive summary” concerning BSS in the frequency band 12.5-12.7 GHz in Region 3 above) network needs to coordinate with the BSS Plan or List assignments or previously filed modifications to the Region 2 Plan or Regions 1 and 3 List.
 - The criteria here are coordination threshold pfd masks applicable in the BSS service area.
- Annex 6 to RR Appendix **30** → criteria for sharing between services including summary of the assumptions used to develop the pfd levels contained in Annexes 1 and 4 to RR Appendix **30**.
- Annex 7 to RR Appendix **30** → orbital position limitations on proposed modifications to the Region 2 Plan or for proposed new or modified assignments in Regions 1 and 3 List, specifically applicable to Region 2 BSS in 12.2-12.7 GHz and to Region 1 BSS in 11.7-12.2 GHz. Annex 7 also contains associated e.i.r.p. limits for Region 1 BSS in the portion of the arc.

Annex 6 to RR Appendix **30** is particularly useful in understanding the derivation of the Annexes 1 and 4 to RR Appendix **30** coordination threshold pfd masks, with respect to the earth station characteristics considered and the allowable $\Delta T/T$ value.

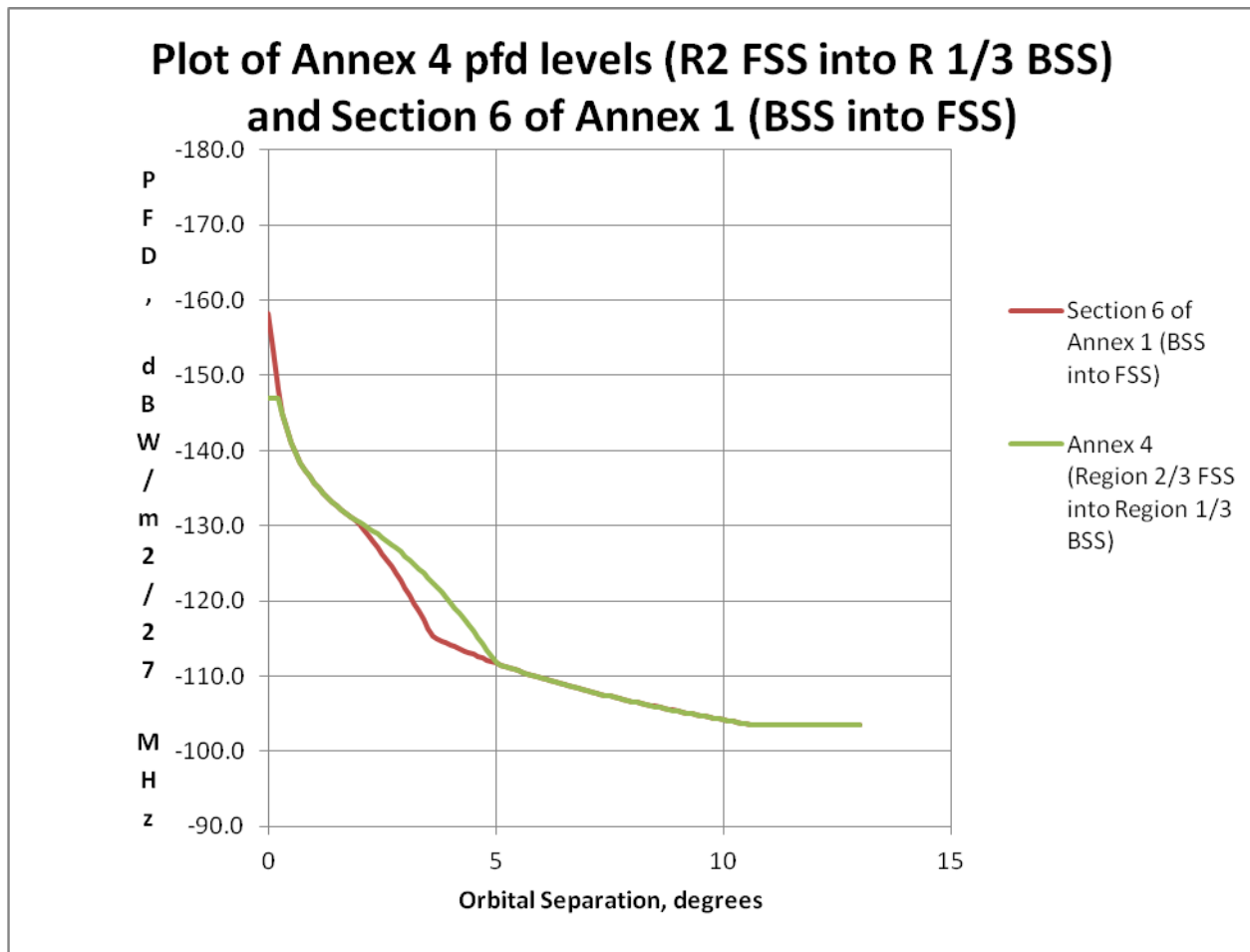
3/1.4/3.1.3 Some limitations and criteria applied to FSS and BSS subject to RR Appendix 30

In particular, it is interesting to consider the relationship between Annexes 1, 4, 6 and 7 to RR Appendix **30**, and to assess the factors that may have driven adoption of those provisions as well as noting factors that may have changed since WRC-03.

Some comments on the relationship between Annexes 1, 4, 6 and 7 to RR Appendix **30** (see also Figure 3/1.4/3-1):

- Section 1 of Annex 1 to RR Appendix **30** includes a hard limit of $-103.6 \text{ dBW/m}^2/27 \text{ MHz}$ for proposed new or modified assignments in the Regions 1 and 3 List. This is equivalent to roughly a peak e.i.r.p. of $58.5 \text{ dBW}/27 \text{ MHz}$.
- For minimum orbital separations equal to or more than 10.57° the highest pfd level without triggering coordination of FSS in any Region vis-à-vis BSS service area under Annex 4 to RR Appendix **30** (or, for BSS vis-à-vis seeking agreement with FSS in Section 6 of Annex 1 to RR Appendix **30**) is also $-103.6 \text{ dBW/m}^2/27 \text{ MHz}$.
- For orbital separations less than 0.23° the highest operating pfd level without triggering coordination of FSS in any Region vis-à-vis BSS under Annex 4 to RR Appendix **30** is $-147 \text{ dBW/m}^2/27 \text{ MHz}$ (see Figure 3/1.4/3-1).
- For orbital separations less than 0.054° the highest operating pfd level without triggering coordination of BSS in any Region vis-à-vis FSS under Section 6 of Annex 1 to RR Appendix **30** is $-158.2 \text{ dBW/m}^2/27 \text{ MHz}$ ($-186.5 \text{ dBW/m}^2/40 \text{ kHz}$) (see Figure 3/1.4/3-1).
- Section 3 of Annex 7 to RR Appendix **30** allows use of certain orbital positions by Regions 1 and 3 BSS List assignments in the shared with FSS part of the arc between Regions 1 and 2 in the Atlantic ocean side if the BSS peak e.i.r.p. level does not exceed $56 \text{ dBW}/27 \text{ MHz}$, which is several dB lower than that in Section 1/Annex 1 and Annex 4 to RR Appendix **30**.
- Different minimum and maximum earth station antenna sizes and associated noise temperature for FSS and BSS in all Regions (see Annex 6 to RR Appendix **30**) led to different coordination threshold pfd masks for protecting each service.
 - For small orbital separations, larger earth station antennas lead to more stringent allowed pfd levels.
 - For large orbital separations, smaller earth station antennas lead to more stringent allowed pfd levels.

FIGURE 3/1.4/3-1

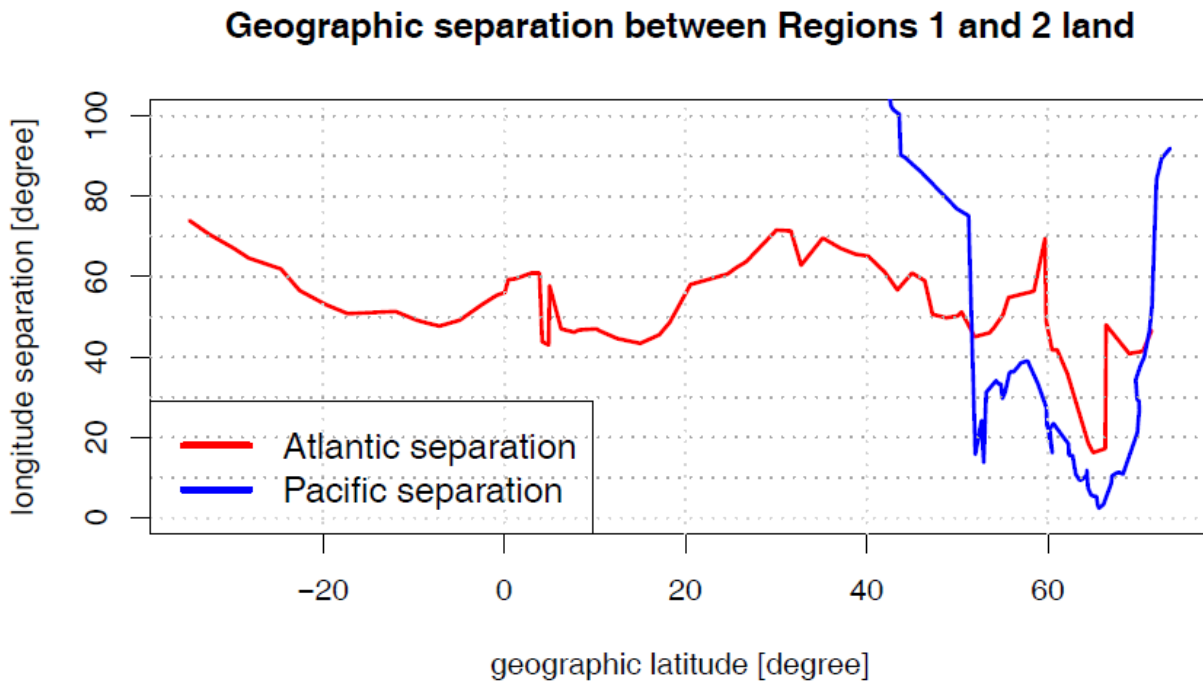


Other factors that are likely related to the development of the sharing criteria:

- Different expected operating e.i.r.p. levels for FSS and BSS.
 - Larger discrepancies could lead to more interference to FSS and larger orbital separations are needed to avoid triggering coordination.
- Difference in coverage areas and associated beam roll off between networks serving the different Regions.
 - Areas served by BSS and FSS in adjacent Regions are separated generally by large bodies of water with boundaries running north-south assuming that the service areas are limited to land.
 - Greater geographic discrimination facilitates sharing assuming that the service areas of FSS and BSS are not close to each other, which should at least be taken into account between Regions 1 and 2 especially in the Atlantic Ocean side.

Figure 3/1.4/3-2 illustrates the difference in the extent of the geographical separation between Regions 1 and 2 in the Atlantic and Pacific regions. Plotted curves represent the separation between the land territories of Regions 1 and 2, measured in degrees (longitude separation), as a function of the geographical latitude due to the presence of the Atlantic and Pacific Oceans, respectively.

FIGURE 3/1.4/3-2



It can be seen from the figure that the geographical separation in the Atlantic region is uniform, and it does not decrease below 40 degrees (except in the case of Iceland and Greenland and that is less than 2% of the total border length), whereas in the Pacific region the separation drops below 40 degrees (over about 50% of the border length) and even falls below 20 degrees in a certain range of latitudes (over about 25% of the border), reaching a minimum value of about 2 degrees. At such separations it is difficult to expect effective geographical discrimination in certain areas of the Pacific region.

In the following sections, the use since WRC-03 of the shared orbital arc resource is evaluated as more FSS and BSS networks have been brought into use and planned in the shared part of the orbital arc, between Regions 1 and 2 under the current Annex 7 to RR Appendix 30 (Rev.WRC-15) regime.

3/1.4/3.1.4 Definition of the term “implemented” networks used in Resolution 557 (WRC-15)

Recognizing b) of Resolution 557 (WRC-15) refers to “BSS networks implemented in accordance with the current provisions of Annex 7 to Appendix 30”.

For the avoidance of doubt, the “implemented” networks referred to in this document are related to Regions 1 and 3 BSS networks in the orbital arc 37.2° W and 10° E:

- for which complete RR Appendix 4 information had been received by the Bureau under § 4.1.3 of RR Appendix 30 prior to 28 November 2015, and
- for which complete RR Appendix 4 information had been received by the Bureau under § 4.1.12 of RR Appendix 30 prior to 23 November 2019, and
- for which the complete due diligence information, in accordance with Annex 2 to Resolution 49 (Rev.WRC-15), had been received by the Bureau prior to 23 November 2019, and

- for which complete RR Appendix 4 information had been received by the Bureau under § 5.1.2 of RR Appendix 30 prior to 23 November 2019, and
- brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 23 November 2019.

3/1.4/3.2 Annex 7 limitation “A1a” (i.e. No assignments in the Region 1 List further west than 37.2° W in the frequency band 11.7-12.2 GHz)

3/1.4/3.2.1 Review of the limitation “A1a”

Limitation “A1a” calls for “No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further west than 37.2° W”. This restriction in the orbital position was designed to protect FSS in Region 2 in the frequency band 11.7-12.2 GHz on the Atlantic Ocean side.

3/1.4/3.2.2 Summary of studies

Details of sharing studies are contained in § 6 and Appendix 1 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

Due to the Atlantic Ocean, which provides geographical separation between the coverage areas in Region 1 and Region 2, the potential for interference between the FSS and the BSS in these Regions is significantly reduced. There may be enough geographic discrimination provided by the Atlantic Ocean to protect the FSS in Region 2 from BSS operating in 11.7-12.2 GHz in Region 1.

The sharing studies show that in all the cases the needed additional discrimination to complete coordination depends largely on the available orbital separation between the interfering and interfered-with network. In addition to that, usage of increased antenna sizes and improved antenna patterns represent factors that influence and could improve the sharing situation.

The sharing studies show that by assuming 20 dB due to geographic discrimination, representative BSS and FSS networks serving different Regions can co-exist without triggering coordination with orbital separations as small as 0.5 degrees (for FSS vs BSS) and 2 degrees (for BSS vs FSS), considering the carrier parameters and a coverage area within the –6 dB antenna gain contour. These small orbital separations further demonstrate that the restriction in the orbital position further west than 37.2° W could be suppressed to allow an RR Appendix 30 Region 1 List system at an orbital position further west than 37.2° W.

Another study shows that by applying 20 dB due to geographical discrimination, which could be feasible due to presence of the Atlantic Ocean between Regions 1 and 2, the coordination problems would be minimal for orbital separations as small as 1.6 degrees (for BSS vs FSS) and 1.3 degrees (for FSS vs BSS), depending on the combination of interfering peak e.i.r.p. and earth station receiving antenna diameter.

Furthermore, there are a large number of notified Region 2 FSS networks in the orbital arc above the Atlantic Ocean. It could be difficult for some new Region 1 BSS filings at orbital positions further west than 37.2° W and intended to operate in the area close to Region 2 to complete coordination. Therefore, it could be necessary for new BSS networks to modify the service area and/or decrease the maximum e.i.r.p. over the area close to Region 2 in case of certain orbital separations with respect to existing FSS networks in order to overcome all coordination problems with Region 2 FSS networks with earlier dates of receipt of the coordination request information.

In specific situations, with respect to new FSS versus new BSS networks with certain orbital separations (i.e. new Region 2 FSS networks intending to operate in the service area close to the Region 1 border and new Region 1 BSS networks filed before them further west than 37.2° W

intending to operate in the service area close to Region 2 border), deletion of limitation “A1a” could require that such new FSS networks in Region 2 modify their service area and/or decrease their maximum e.i.r.p. over the area close to Region 1 to complete the coordination. For such specific cases administrations concerned with such coordination problems would need to make additional efforts to overcome coordination problems to find a mutually acceptable solution.

To mitigate the problems associated with deployment at certain orbital separations of new FSS and new BSS networks having very close service areas, it was agreed, as a compromise solution, to use for identification of the need for coordination under Annex 4 to RR Appendix **30** of new Region 2 FSS network with new Region 1 BSS network which occupies an orbital position further west than 37.2° W, the test points for orbital separation between FSS and BSS space station less than 4.2° instead of the service area.

However, for all other cases the relaxation of limitation “A1a” would lead to the situation where coordination is feasible, and in some cases not required, and would not require additional efforts by administrations in the coordination process for new Region 2 FSS networks.

Regarding assignments in the Regions 1 and 3 Plan, the studies demonstrate the protection of the Plan without any potential impact.

Regarding networks in the Regions 1 and 3 List located further east than 37.2° W for which the procedure of Article 4 of RR Appendix **30** has been completed or initiated, the studies demonstrate the protection of Article 4 networks without any potential impact.

Regarding networks in the Regions 1 and 3 List located further east than 37.2° W for which the procedure of Article 4 of RR Appendix **30** would be initiated after the possible deletion of this limitation, the studies demonstrate that in very few limited cases and for very specific conditions, a new Article 4 network located further east than 37.2° W and for which the procedure of Article 4 would be initiated after the possible deletion of this limitation could be impacted with the deletion of limitation “A1a” compared to the same situation without the deletion of such limitation. However the impact has been shown to be minimal.

3/1.4/3.2.3 Analysis of the results of the studies

Limitation “A1a” which calls for “No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further west than 37.2° W” can be deleted, noting in specific cases the necessity of additional efforts by administrations concerned in order to successfully resolve the cases of coordination between new Region 1 BSS and new Region 2 FSS networks submitted after WRC-19 at an orbital position further west than 37.2° W having certain orbital separation. For such cases was proposed a compromise solution as described in section 3/1.4/3.2.2 above.

3/1.4/3.3 Annex 7 limitation “A1b” (i.e. No assignments in the Region 1 List further east than 146° E in the frequency band 11.7-12.2 GHz)

3/1.4/3.3.1 Review of the limitation “A1b”

Limitation “A1b” calls for “No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further east than 146° E”. This restriction in the orbital position was designed to protect FSS in Region 2 in the frequency band 11.7-12.2 GHz on the Pacific Ocean side and Region 3 BSS subject to RR Appendix **30**.

3/1.4/3.3.2 Summary of studies

Details of sharing studies are contained in § 7 and Appendix 2 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

There may be enough geographic discrimination provided by the Pacific Ocean to protect the FSS in Region 2 on the Pacific Ocean side and Region 3 BSS subject to RR Appendix 30 from BSS operating in 11.7-12.2 GHz in Region 1, except in the specific case of the Bering Strait area where there is no geographical discrimination.

The sharing studies show that in all the cases the needed additional discrimination to complete coordination depends largely on the available orbital separation between the interfering and interfered-with network. In addition to that, usage of increased antenna sizes and improved antenna patterns represent factors that influence and could improve the sharing situation.

The sharing studies show that by assuming 20 dB due to geographic discrimination, representative BSS and FSS networks serving different Regions can coexist with orbital separations as small as 0.5 degrees (for FSS vs BSS) and 2 degrees (for BSS vs FSS), depending on the carrier parameters and considering a coverage area within the –6 dB antenna gain contour. It is important to stress that this 20 dB due to geographic discrimination would not be achieved in the areas around the Bering Strait and pfd coordination limits could be exceeded except in cases where the aim points of satellite beams in question (Region 1 BSS and Region 2 FSS) are sufficiently separated²⁰. Analysis of certain orbital separations further demonstrate that the restriction in the orbital position further east than 146° E could be suppressed to allow an RR Appendix 30 Region 1 List networks at an orbital position further east than 146° E. However, there could be some specific cases (e.g. same orbital location and very close service areas) that suggest additional efforts could be needed by concerned administrations to resolve such coordination cases.

If limitation “A1b” is suppressed and in case a new Region 1 BSS network is located further east than 146° E, certain new Region 2 FSS satellite networks serving Region 2 may not be allowed to produce high pfd levels in Region 1 areas without triggering coordination, where today they comply with Annex 4 to RR Appendix 30 pfd trigger levels for larger orbital separations as, in order not to trigger coordination, they have to comply with Annex 4 pfd trigger levels for smaller orbital separations than existing Region 2 FSS filings at the same orbital locations. Nevertheless, there are already many FSS networks situated very near to BSS networks.

As for new possible BSS networks, due to the significant number of current FSS networks filed further east than 146° E, it could be difficult for these new networks to complete coordination with Region 2 FSS networks with earlier dates of receipt of the coordination request information.

Therefore, it could be necessary to limit the service area and/or decrease the maximum e.i.r.p. over the area close to Region 2 in order to overcome all coordination problems with Region 2 FSS networks with earlier dates of receipt of the coordination request information. It has to also be stressed the current situation gives considerable overprotection to FSS networks.

In areas with limited geographical separation between Regions 1 and 2 (i.e. Chukotka and Alaska) where the Region 2 FSS and Region 1 BSS coverage areas are very close, new Region 2 FSS satellite networks filed could require additional efforts by administrations in the coordination process for the case of small orbital separations. However, for all other cases the relaxation of this limitation would not bring any additional constraints for new Region 2 FSS networks.

²⁰ For instance, in case the Region 1 BSS pfd level produced in the Region 2 territory is limited by the value $-158.2 \text{ dBW/m}^2/27 \text{ MHz}$ ($-186.5 \text{ dB(W/(m}^2 \cdot 40 \text{ kHz))}$) (see Annex 4), the Region 2 FSS protection will be guaranteed even at orbital separations less than 0.054 degrees.

Another study shows that by applying 20 dB due to geographic discrimination, which could be feasible due to the presence of the Pacific Ocean between Regions 1 and 2 except areas around the Bering Strait, in this part of the orbital arc, the coordination problems would be minimal for orbital separations as small as 1.7 degrees (for BSS vs FSS), depending on the combination of interfering peak e.i.r.p. and earth station receiving antenna diameter.

It should be noted that this 20 dB due to geographic discrimination would not be achieved in the areas around the Bering Strait.

The sharing studies show that in the case of absence of geographic discrimination representative BSS and FSS networks serving different Regions can coexist with orbital separations of 3.5 degrees (for Region 2 FSS vs Region 1 BSS) and 5.8 degrees (for Region 2 BSS vs Region 1 FSS), depending on the carrier parameters (for the edge of coverage limited to the -6 dB antenna gain contour case), assuming that a protected part of the service area is over land.

Regarding assignments in the Regions 1 and 3 Plan, the studies demonstrate the protection of the Plan without any potential impact.

Regarding networks in the Regions 1 and 3 List located further west than 146° E for which the procedure of Article 4 of RR Appendix 30 has been completed or initiated, the studies demonstrate the protection of Article 4 networks without any potential impact.

Regarding networks in the Regions 1 and 3 List located further west than 146° E for which the procedure of Article 4 of RR Appendix 30 would be initiated after the possible deletion of this limitation, the studies demonstrate that in very few limited cases and for very specific conditions, a new Article 4 network located further west than 146° E for which the procedure of Article 4 would be initiated after the possible deletion of this limitation could be impacted with the deletion of limitation "A1b" compared to the same situation without deletion of such limitation. However the impact is assumed to be minimal.

3/1.4/3.3.3 Analysis of the results of the studies

Limitation "A1b" which calls for "No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further east than 146° E" cannot be deleted due to the limited geographical separation between Regions 1 and 2 (i.e. Chukotka and Alaska).

3/1.4/3.4 Annex 7 limitation "A2a" (i.e. No modifications in the Region 2 Plan further east than 54° W in the frequency band 12.5-12.7 GHz)

3/1.4/3.4.1 Review of the limitation "A2a"

Limitation "A2a" calls for "No broadcasting satellite serving an area in Region 2 and using a frequency in the band 12.5-12.7 GHz shall occupy a nominal orbital position further east than 54° W". This restriction in the orbital position was designed to protect FSS in Region 1 in the frequency band 12.5-12.7 GHz on the Atlantic Ocean side.

3/1.4/3.4.2 Summary of studies

Details of sharing studies are contained in § 8 and Appendix 3 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

Due to the Atlantic Ocean, which provides geographical separation between the coverage areas in Region 1 and Region 2, the potential for interference between the FSS and the BSS in these Regions is significantly reduced. There may be enough geographic discrimination provided by the Atlantic Ocean to protect the FSS in Region 1 from BSS operating in 12.5-12.7 GHz in Region 2.

The sharing studies show that in all the cases the needed additional discrimination to complete coordination depends largely on the applied orbital separation between the interfering and interfered-with network. In addition to that, usage of increased antenna sizes and improved antenna patterns represent factors that influence and could improve the sharing situation.

The sharing studies show that by assuming 20 dB due to geographic discrimination, representative BSS and FSS networks serving different Regions can coexist without triggering coordination with orbital separations as small as 0.5 degrees (for FSS vs BSS) and 1.9 degrees (for BSS vs FSS), depending on the carrier parameters and considering a coverage area limited to the –6 dB antenna gain contour. These small orbital separations further demonstrate that the restriction in the orbital position further east than 54° W could be suppressed to allow an RR Appendix 30 modifications to the Region 2 Plan at an orbital position further east than 54° W.

Another study shows that by applying 20 dB due to geographic discrimination, which could be feasible due to the presence of the Atlantic Ocean between Regions 1 and 2, the coordination problems would be minimal for orbital separations as small as 1.8 degrees (for BSS vs FSS) and 1.6 degrees (for FSS vs BSS), depending on the combination of interfering peak e.i.r.p. and earth station receiving antenna diameter.

Furthermore, there are a large number of notified Region 1 FSS networks in the orbital arc above the Atlantic Ocean. It could be difficult for some new Region 2 BSS filings at orbital positions further east than 54° W and intended to operate in the area close to Region 1 to complete coordination. Therefore, it could be necessary to new BSS networks to modify the service area and/or decrease the maximum e.i.r.p. over the area close to Region 1 in case of small orbital separations with respect to existing FSS networks in order to overcome all coordination problems with Region 1 FSS networks with earlier dates of receipt of the coordination request information.

In specific situations with respect to new FSS versus new BSS networks with certain orbital separations (i.e. new Region 1 FSS network intending to operate in the service area close to the Region 2 border and with very close service areas of new FSS and BSS networks filed before them further east than 54° W), deletion of limitation “A2a” could require that such new FSS networks in Region 1 modify their service area and/or decrease their maximum e.i.r.p. over the area close to Region 2 to complete the coordination. For such specific cases administrations concerned with such coordination problem would need to make additional efforts to overcome coordination problems to find a mutually acceptable solution.

To mitigate the problems associated with deployment at certain orbital separations of new FSS and new BSS networks having very close service areas, it was agreed, as a compromise solution, to use to use for identification of the need for coordination under Annex 4 to RR Appendix 30 of new Region 1 FSS network with new Region 2 BSS network which occupies an orbital position further east than 54° W, the test points for orbital separation between FSS and BSS space station less than 4.2° instead of the service area.

However, for all other cases the relaxation of limitation “A2a” would lead to the situation where coordination is feasible, and in some cases not required, and would not require additional efforts by administrations in the coordination process for new Region 2 FSS networks.

Regarding assignments in the Region 2 Plan, the studies demonstrate the protection of the Plan without any potential impact.

Regarding Region 2 networks located further west than 54° W for which the procedure of Article 4 of RR Appendix 30 has been completed or initiated, the studies demonstrate the protection of Article 4 networks without any potential impact.

3/1.4/3.4.3 Analysis of the results of the studies

Limitation “A2a” which calls for “No broadcasting satellite serving an area in Region 2 and using a frequency in the band 12.5-12.7 GHz shall occupy a nominal orbital position further east than 54° W” can be deleted, noting, in specific cases, the necessity of additional efforts by administrations concerned in order to successfully resolve the cases of coordination between new Region 2 BSS and new Region 1 FSS networks submitted after WRC-19 at an orbital position further east than 54° W having certain orbital separation. For such cases a compromise solution was proposed as described in section 3/1.4/3.4.2 above.

3/1.4/3.5 Annex 7 limitation “A2b” (i.e. No modifications in the Region 2 Plan further east than 44° W in the frequency band 12.2-12.5 GHz)

3/1.4/3.5.1 Review of the limitation “A2b”

Limitation “A2b” calls for “No modification in the Region 2 Plan further east than 44° W in the band 12.2-12.5 GHz”. This restriction in the orbital position was designed to protect the Region 1 BSS subject to RR Appendix 30 in the frequency band 12.2-12.5 GHz from BSS operating in Region 2.

3/1.4/3.5.2 Summary of studies

Details of sharing studies are contained in § 9 and Appendix 4 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

Due to the Atlantic Ocean, which provides geographical separation between the coverage areas in Region 1 and Region 2, the potential for interference between the BSS in these Regions is significantly reduced. However there may be enough geographic discrimination provided by the Atlantic Ocean to protect the BSS in Region 1 from BSS operating in 12.2-12.5 GHz in Region 2.

The sharing studies show that in all the cases the needed additional discrimination to complete coordination depends largely on the available orbital separation between the interfering and victim network. In addition to that, usage of increased antenna sizes and improved antenna patterns represent factors that influence and could improve the sharing situation.

The sharing studies show that representative BSS networks serving different Regions can coexist without triggering coordination with orbital separations as small as 2 degrees (Region 2 BSS vs Region 1 BSS) and 2.1 degrees (Region 1 BSS versus Region 2 BSS), depending on the carrier parameters and geographic discrimination assumed and considering a coverage area limited to the –6 dB antenna gain contour. These small orbital separations further demonstrate that the restriction in the orbital position further east than 44° W could be suppressed to allow a RR Appendix 30 Region 2 Plan modification at an orbital position further east than 44° W.

Another study shows that by applying 20 dB due to geographic discrimination, which could be feasible due to the presence of the Atlantic Ocean between Regions 1 and 2, the coordination problems would be minimal for orbital separations as small as 2.2 degrees (for Region 2 BSS vs. Region 1 BSS) and 2.1 degrees (for Region 1 BSS versus Region 2 BSS), depending on the combination of interfering peak e.i.r.p. and earth station receiving antenna diameter.

Regarding assignments in the Region 2 Plan, the studies demonstrate the protection of the Plan without any potential impact.

Regarding Region 2 networks located further west than 44° W for which the procedure of Article 4 has been completed or initiated, the studies demonstrate the protection of Article 4 networks without any potential impact.

3/1.4/3.5.3 Analysis of the results of the studies

Limitation “A2b” which calls for “No modification in the Region 2 Plan further east than 44° W in the band 12.2-12.5 GHz” can be deleted.

3/1.4/3.6 Annex 7 limitation “A2c” (i.e. No modifications in the Region 2 Plan further west than 175.2° W in the frequency band 12.2-12.7 GHz)

3/1.4/3.6.1 Review of the limitation “A2c”

Limitation “A2c” calls for “No broadcasting satellite serving an area in Region 2 and using a frequency in the band 12.2-12.7 GHz shall occupy a nominal orbital position further west than 175.2° W”. This restriction in the orbital position was designed to protect FSS in Region 1 in the frequency band 12.5-12.7 GHz, BSS in Region 1 subject to RR Appendix 30 in the frequency band 12.2-12.5 GHz and FSS in Region 3 in the frequency band 12.2-12.7 GHz on the Pacific Ocean side.

3/1.4/3.6.2 Summary of studies

Details of sharing studies are contained in § 10 and Appendix 5 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

The sharing studies show that in all the cases the needed additional discrimination to complete coordination depends largely on the available orbital separation between the interfering and interfered-with network. In addition to that, usage of increased antenna sizes and improved antenna patterns represent factors that influence and could improve the sharing situation.

The sharing studies show that by assuming 20 dB due to geographic discrimination, representative BSS and FSS networks serving different Regions can coexist without triggering coordination with orbital separations as small as 0.5 degrees (for Region 1 FSS versus Region 2 BSS) and 1.9 degrees (for Region 2 BSS versus Region 1 FSS), depending on the carrier parameters and considering a coverage area limited to the –6 dB antenna gain contour. It is important to stress that this 20 dB due to geographic discrimination would not be achieved in the areas around the Bering Strait, therefore significant service area separation would not be achieved, so that orbital separation between networks would be the only source of discrimination.

The sharing study shows that in the case of absence of geographic discrimination representative BSS and FSS networks serving different Regions can coexist with orbital separations of 4.4 degrees (for Region 1 FSS versus Region 2 BSS) and 5.8 degrees (for Region 2 BSS versus Region 1 FSS), depending on the carrier parameters (for the edge of coverage limited to the –6 dB antenna gain contour case).

However, there could be some specific cases (e.g. same orbital location and very close service areas) that suggest additional efforts by concerned administrations to resolve such coordination cases.

Another study shows that by applying 20 dB due to geographic discrimination, which could be feasible due to presence of the Pacific Ocean between Regions 1 and 2 in this part of the orbital arc, the coordination problems would be minimal for orbital separations as small as 1.6 degrees (for Region 2 BSS versus Region 3 FSS) and 1.6 degrees (for Region 3 FSS versus Region 2 BSS), depending on the combination of interfering peak e.i.r.p. and earth station receiving antenna diameter. It should be noted that this 20 dB due to geographic discrimination would not be achieved in the areas around the Bering Strait and pfd coordination limits could be exceeded.

If limitation “A2c” is suppressed and in case a new Region 2 BSS network is located further west than 175.2° W, certain new Region 1 and 3 FSS satellite networks serving Regions 1 and 3 may not

be allowed to create high pfd levels in Region 2 areas without triggering coordination, where today they comply with Annex 4 to RR Appendix 30 pfd trigger levels for larger orbital separations as, in order not to trigger coordination, they have to comply with Annex 4 pfd trigger levels for smaller orbital separations than existing Region 1 and 3 FSS filings at the same orbital locations. Nevertheless, there are already many FSS networks situated very near to BSS networks.

As for new possible BSS networks, due to the significant number of current FSS network filed further west than 175.2° W, it could be difficult for these new networks to complete coordination with Region 1 and 3 FSS networks with earlier dates of receipt of the coordination request information.

Therefore it could be necessary to limit the service area and/or decrease the maximum e.i.r.p. over the area close to Region 2 in order to overcome all coordination problems with Region 2 FSS networks with earlier dates of receipt of the coordination request information. It has to also be stressed the current situation gives considerable overprotection to FSS networks.

In areas with limited geographical separation between Regions 1 and 2 (i.e. Chukotka and Alaska) where the Region 1 FSS and Region 2 BSS coverage areas are very close, new Regions 1 and 3 FSS satellite networks filed could require additional efforts by administrations in the coordination process for the case of small orbital separations.

However, for all other cases the relaxation of limitation “A2c” would not bring any additional constraints for new Regions 1 and 3 FSS satellite networks.

If it were not for small geographical spacing between Regions 1 and 2 around the Bering Strait these small orbital separations could further demonstrate that the restriction in the orbital position “further west than 175.2° W” could be suppressed to allow RR Appendix 30 Region 2 networks at orbital positions further “west than 175.2° W”.

Regarding assignments in the Region 2 Plan, the studies demonstrate the protection of the Plan without any potential impact.

Regarding Region 2 networks located further east than 175.2° W for which the procedure of Article 4 of RR Appendix 30 has been completed or initiated, the studies demonstrate the protection of Article 4 networks without any potential impact.

3/1.4/3.6.3 Analysis of the results of the studies

Limitation “A2c” which calls for “No modification in the Region 2 Plan further west than 175.2° W in the band 12.2-12.7 GHz” cannot be deleted due to the limited geographical separation between Regions 1 and 2 (i.e. Chukotka and Alaska).

3/1.4/3.7 Annex 7 limitation “A3a” (i.e. No assignments in the Regions 1 and 3 List outside specific positions in the frequency band 11.7-12.2 GHz)

3/1.4/3.7.1 Review of the limitation “A3a”

Section 3 of Annex 7 to RR Appendix 30 defines orbital position and e.i.r.p. limitations in the orbital arc 37.2° W-10° E, which were developed to preserve access to the geostationary-satellite orbit by the Region 2 FSS in the frequency band 11.7-12.2 GHz. The limitations state that the orbital position associated with any proposed new or modified assignment in the Regions 1 and 3 List of additional uses shall lie within one of the portions of the orbital arc listed in the table below.

TABLE 3/1.4/3.7.1-1

**Allowable portions of the orbital arc between 37.2° W and 10° E for assignments
in the Regions 1 and 3 Plan and List**

| Allowable orbital position | | | | | | | | | | |
|----------------------------|--------------------------|----------------------|----------------------|----------------------|----------------------|--------------------|------|--------------------|--------------------|------|
| 37.2° W to 36° W | 33.5° W to 32.5° W | 30° W to 29° W | 26° W to 24° W | 20° W to 18° W | 14° W to 12° W | 8° W to 6° W | 4° W | 2° W to 0° E | 4° E to 6° E | 9° E |

NOTE - Table 3/1.4/3.7.1-1 is similar to Table 1 in Annex 7 to RR Appendix 30.

3/1.4/3.7.2 Summary of studies

Details of sharing studies are contained in § 11 and Appendix 6 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

Study 1 shows that regarding intra-service sharing (i.e. Region 1 BSS vs Region 1 BSS), a noise increase by 0–7.85 dB in the worst case of the interference level (relative to the $\Delta T/T$ obtained from two networks in adjacent allowable portions and only for two orbital positions - relative of ~6%) will be received by an earth station with antenna size 40 cm (that an incumbent is forced to accept in case WRC-19 would decide to remove the Annex 7 limitation A3a (Section A3 of Annex 7 to RR Appendix 30) if no additional specific measures would be considered. This result was obtained in a sequential analysis of all allowable portions of the orbital arc considering only two interfering satellites in compliance with Annex 1 pfd mask when they are placed in the adjacent allowable portions in the worst positions in terms of causing interference, and it is recognized that the interference will be higher if more than two interfering satellites are to be considered. Therefore, there may be a risk that an existing satellite network implementing earth stations with antenna size 40 cm under the current regulatory regime defined by current orbit limitations in Annex 7 to RR Appendix 30, would not be able to continue its operation due to the possible additional level of interference that an incumbent might be forced to accept, unless no additional specific measures are considered. Such situation would be in contradiction to *recognizing b*) of Resolution 557 (WRC-15), stating: “that existing FSS networks operating in the frequency bands mentioned in *considering b*) and BSS networks implemented in accordance with the current provisions of Annex 7 to RR Appendix 30 shall continue to be protected”. Study 1 shows that the current protection criteria in Annex 1 do not provide protection of antennas smaller than 60 cm for Region 1 and 3 BSS, in particular antenna size 40 cm, however, the situation is much better with antenna size 45 cm.

At present there are five assignments in the orbital arc 37.2° W-10° E having antennas smaller than 60 cm in three different orbital locations sent to the Bureau before WRC-15: 33.5° W, 30° W, 4.8° E. According to Study 1 noise increase in the worst case of the interference level for these orbital locations, and antenna 40 cm amount to 0.25/0.23 dB, 1.1/1.1 dB, 2.16/2.4 dB accordingly. But all mentioned assignments have antenna size 45 cm, except the one in 4.8° E having antennas of 40 cm, so noise increase will be smaller for antenna size 45 cm than mentioned.

NOTE – Values of noise increase are taken from Appendix 6, Section 1.1.1, of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

Study 2 calculates the pfd mask required to protect existing networks implementing earth stations with antenna size less than 0.60 m (40 cm and 45 cm).

Studies 1 and 2 show the necessity to develop protection measures (see § 11.3.2 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7]) for implemented networks which are located in the allowable portions of the orbital arc 37.2° W-10° E with antenna

sizes lower than 60 cm, from new possible network in previously forbidden arc portions, if the Annex 7 limitation “A3a” is suppressed.

Study 3 provides an assessment of the existing levels of protection of receiving stations with small antennas, in particular antenna size of 40 cm and examines to what extent the current regulatory framework allows to implement networks, using antennas smaller than 60 cm, while maintaining the same level of protection $\Delta T/T=6\%$, as defined by Annex 1 (Section 1) by determining the level of interference and $\Delta T/T$ that may be currently caused by space stations (compliant with Annex 1 pfd mask) located in the adjacent allowable orbital arc positions (see §§ 11.2-11.4. and Section 3 of Appendix 6 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7]).

Additional studies show that forbidden arc portions protect networks with “small” antennas from allowed by Annex 1 interference at which $\Delta T/T=6-41.27\%$, but the same levels of interference can be caused by networks located in allowable arc portions (see §§ 11.2-11.4 and Section 3.7 of Appendix 6 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7]). Besides only part of forbidden arc portion provides protection to “small” antennas, that compensates lower selectivity ranges, so part of the forbidden arc portion can be eliminated from the point of view of preserving the protection of implemented²¹ networks with “small” antennas from networks complying with Annex 1 pfd mask.

Thus, by itself, the presence of forbidden arc sections does not guarantee 6% interference level to earth stations with small antennas from networks complying with Annex 1 pfd mask.

Therefore, it cannot be claimed that forbidden arc portions always provide protection for a station with a “small” antenna, the presence of forbidden arc portions only reduces the probability of causing interference greater than 6% by networks in compliance with Annex 1 pfd mask.

However, in conclusion Study 3 determined that the network filed both in the allowable and forbidden portions of the orbital arc and being in compliance with Annex 1 pfd mask may cause interference to the earth station with 40 cm antenna resulting in $\Delta T/T$ up to 41.27% and such levels of interference must be accepted.

Due to the nature of the Annex 1 pfd mask, only part of the forbidden arc portion provides protection from networks complying with this mask to networks with antenna sizes lower than 60 cm therefore part of the forbidden arc portion can be eliminated.

Study 4 shows possible implications to efficient protection of BSS satellite networks operating in this orbital arc with receiving earth station antennas of diameters smaller than 60 cm.

The current pfd protection masks that serve for the protection of Regions 1 and 3 planned BSS networks do not include the protection of receiving earth station antennas with diameters smaller than 60 cm. For example, between 2° and 5° of orbital separation the 45 cm receiving earth station antenna needs up to 7.2 dB bigger protection. Therefore, in the case of revision or complete suppression of this limitation, currently implemented² receiving earth station antennas with diameters smaller than 60 cm might not be sufficiently protected.

Study 5 shows that for antenna sizes greater than or equal to 60 cm, the deletion of the Annex 7 limitation “A3a” will not impact Regions 1 and 3 BSS networks located within the allowable portions of the orbital arc 37.2° W-10° E for which the procedure of Article 4 has been completed or initiated, given that the pfd mask for intra-service sharing in BSS in Regions 1 and 3 (i.e. Section 1 of Annex 1 of RR Appendix 30), was developed for these antenna sizes.

²¹ See § 3/1.4/3.1.4.

Study 6 shows that the level of EPM/pfd degradation caused by Regions 1 and 3 networks located within the allowable portions of the orbital arc in accordance to Table 1 of Annex 7 to RR Appendix 30, and for which the procedure of Article 4 of RR Appendix 30 would be initiated after the possible deletion of this limitation with respect to potential Region 1 BSS networks located within the forbidden arc according to Table 1 of Annex 7 to RR Appendix 30, is lower than the degradation caused to Region 1 BSS networks located within the allowable portions of the orbital arc in accordance to Table 1 of Annex 7 to RR Appendix 30.

3/1.4/3.7.3 Analysis of the results of the studies

Limitation “A3a” which calls for “No modification in the Regions 1 and 3 List outside specific allowable portions of the orbital arc between 37.2° W and 10° E in the band 11.7-12.2 GHz” can be deleted, subject to additional measures ensuring the protection of, and without imposing additional constraints on, assignments in the Plan and in the List which are located in the allowable portion of the orbital arc 37.2° W-10° E and including those which have antenna sizes lower than 60 cm (see Section 11.3 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7]).

3/1.4/3.8 Annex 7 limitation “A3b” (i.e. Maximum e.i.r.p. 56 dBW for assignments in the Regions 1 and 3 for specific positions in the frequency band 11.7-12.2 GHz)

3/1.4/3.8.1 Review of the limitation “A3b”

Section 3 of Annex 7 to RR Appendix 30 defines orbital position and e.i.r.p. limitations in the orbital arc 37.2° W-10° E, which were developed to preserve access to the geostationary-satellite orbit by the Region 2 FSS in the frequency band 11.7-12.2 GHz.

This specific limitation (i.e. Annex 7 limitation “A3b”) states Region 1 BSS networks located within the allowable portion of the orbital arc 37.2° W-10° E but not coincident with any nominal orbital position in the Plan at the date of entry into force of the Final Acts of the 1977 Conference shall not transmit an e.i.r.p. greater than 56 dBW.

This constraint was historically developed as the Annex 7 to RR Appendix 30 limitation “A3a” to protect Region 2 FSS networks. As for operational constraints, it is not always feasible to locate the Region 1 BSS network at the exact orbital position; it was decided to give some flexibility on the restricted orbital arc allowable in the orbital arc 37.2° W-10° E but in the same time to not put too many constraints into Region 2 FSS, it was decided to limit the power of these Region 1 BSS which are not located at the exact nominal orbital position.

Until the revision of Annex 7 to RR Appendix 30 by the WRC-2000, networks located within this arc but not coincident with any nominal orbital position in the 1977 Plan were obliged to reduce their e.i.r.p. by 8 dB compared to that appearing in the Regions 1 and 3 Plan. WRC-2000 reviewed this strong constraint and decided to keep this concept but with less reduction and finally agreed to this 56 dBW limit.

TABLE 3/1.4/3.8.1-1

Portions of the orbital arc between 37.2° W and 10° E for assignments in the Regions 1 and 3 List with maximum e.i.r.p. of 56 dBW

| Orbital position with maximum e.i.r.p. of 56 dBW limitation |
|---|
|] 36.8° W ; 36° W] |
|] 33.5° W ; 32.5° W] |

| |
|---------------------|
|] 30° W ; 29° W] |
| [26° W ; 25.2° W [|
|] 24.8° W ; 24° W] |
| [20° W ; 19.2° W [|
|] 18.8° W ; 18° W] |
| [14° W ; 13.2° W [|
|] 12.8° W ; 12° W] |
| [8° W ; 7.2° W [|
|] 6.8° W ; 6° W] |
| [2° W ; 1.2° W [|
|] 0.8° W ; 0° E] |
| [4° E ; 4.8° E [|
|] 5.2° E ; 6° E] |

3/1.4/3.8.2 Summary of studies

As this reduction of e.i.r.p. was to only protect Region 2 FSS in addition of Annex 7 to RR Appendix **30** limitation “A3a”, studies performed under Section 2 of Appendix 6 and Section 2 of Appendix 1 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7] are also applicable to this case.

3/1.4/3.8.3 Analysis of the results of the studies

As studies in Annex 6 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7] show the feasibility to suppress the Annex 7 limitation “A3a” without the necessity to impose e.i.r.p. limitation to Region 1 BSS networks depending on their specific orbital position, *de facto* the Annex 7 to RR Appendix **30** limitation “A3b” could also be suppressed.

3/1.4/3.9 Annex 7 limitation “A3c” (i.e. Maximum pfd of $-138 \text{ dB(W/m}^2 \cdot 27 \text{ MHz)}$) in Region 2 by assignments in the Regions 1 and 3 List at 4° W and 9° E in the frequency band 11.7-12.2 GHz)

3/1.4/3.9.1 Review of the limitation “A3c”

Orbital positions 4° W and 9° E were initially not coincident with any nominal orbital position in the Plan at the date of entry into force of the Final Acts of the 1977 Conference but were added by WRC-2000 during the replanning process following specific requests made by two administrations. As a compromise solution, WRC-2000 agreed these two specific requests subject to some additional protection measure over Region 2 to specifically protect Region 2 FSS networks.

3/1.4/3.9.2 Summary of studies

As this specific pfd limit over Region 2 was to only protect Region 2 FSS for these two specific orbital positions, studies performed under Section 2 of Appendix 6 and Section 2 of Appendix 1 to the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7] are also applicable to this case.

3/1.4/3.9.3 Analysis of the results of the studies

As studies in Appendix 6 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7] show the feasibility to suppress the Annex 7 to RR Appendix **30** limitation “A3a” without the necessity to impose additional pfd limits over Region 2 to Region 1 BSS

networks depending on their specific orbital position, *de facto* the Annex 7 limitation “A3c” could also be suppressed.

3/1.4/3.10 Annex 7 limitation “B” (i.e. Region 2 cluster in the frequency band 12.2-12.7 GHz)

3/1.4/3.10.1 Review of the limitation “B”

The Region 2 BSS Plan is based on the grouping of the space stations in nominal orbital positions of $\pm 0.2^\circ$ from the centre of the cluster of satellites. Administrations may locate those satellites within a cluster at any orbital position within that cluster, provided they obtain the agreement of administrations having assignments to space stations in the same cluster.

It is proposed to keep limitation “B” unchanged and not suppress it.

3/1.4/4 Methods to satisfy the agenda item

The methods to satisfy the agenda item are considered below for each Annex 7 to RR Appendix 30 limitation as defined in Table 3/1.4/2-1.

There are two methods proposed under agenda item 1.4. Method A is No Change and Method B removes certain orbital limitations from Annex 7 of RR Appendix 30. The removal of limitations A1a) and A2a) is based on a compromise regulatory framework under which the Bureau would examine the coordination threshold with FSS pfd masks of Annex 4 of RR Appendix 30, at the BSS test points, for FSS and BSS orbital separations of less than 4.2 degrees, and at the BSS service area, for orbital separations greater than or equal to 4.2 degrees. Such compromise solution has no impact on Region 3. Views were expressed that the orbital separation, 4.2 degrees, should be larger to ensure the new Region 2 FSS is not negatively impacted, while others expressed the view that the orbital separation should be smaller to provide new Region 1 BSS more flexibility. However, it was agreed to propose the 4.2 degree as a very delicate compromise between 2 and 10.57 degrees of FSS/BSS orbital separations.

Any additional measures ensuring the protection of the implemented networks in the Regions 1 and 3 List shall cease in accordance with the period of operation of assignments in the List specified in § 4.1.24 of Article 4 RR Appendix 30 (Rev.WRC-15).

3/1.4/4.1 Method A: No change

This method proposes no change to Annex 7 to RR Appendix 30 and suppression of Resolution 557 (WRC-15).

3/1.4/4.2 Method B: Deletion of some limitations of Annex 7, addition of draft new Resolutions [A14-LIMITA3] (WRC-19), [B14-PRIORITY] (WRC-19), [D14-ENTRY-INTO-FORCE] (WRC-19) and application of draft new Resolution [C14-LIMITA1A2] (WRC-19) with revised criteria for protection of new BSS networks with respect to limitations “A1a” and “A2a”

This method proposes to delete the following limitations of Annex 7 to RR Appendix 30:

- limitations “A1a” and “A2a” and the application for cases of certain orbital separations between new FSS and new BSS networks of draft new Resolution [C14-LIMIT-A1A2] (WRC-19) with revised criteria for protection of new BSS networks;
- limitations “A2b”, “A3b”, “A3c”;
- limitations “A3a” accompanied by draft new Resolution [A14-LIMITA3] (WRC-19) to guarantee the protection of frequency assignments with earth station receiving

antenna size smaller than 60 cm (40 cm and 45 cm), in accordance with the criteria of RR Appendix **30 (Rev.WRC-15)**.

This method proposes to retain limitations “A1b”, “A2c” and “B”.

This method also proposes the application of draft new Resolution **[B14-PRIORITY] (WRC-19)** after the removal of the relevant limitations in Annex 7 to RR Appendix **30 (Rev.WRC-15)**, giving priority to national assignments in the Regions 1 and 3 Plan with equivalent downlink protection margin values equal or below –10 dB. Considering the importance of this draft new Resolution **[B14-PRIORITY] (WRC-19)** to help administrations to improve equitable access to satellite orbit resources by providing priority to administrations with a degraded reference situation, this method proposes to apply as of 23 November 2019 the revised Annex 7 of RR Appendix **30**. To this effect, a revision of RR Article **59** and a draft new Resolution **[D14-ENTRY-INTO-FORCE] (WRC-19)** are proposed.

In addition, this method proposes suppression of Resolution **557 (WRC-15)**.

3/1.4/5 Regulatory and procedural considerations

The regulatory and procedural considerations to satisfy the agenda item are considered below for each of the proposed methods defined in section 3/1.4/4.

It should be noted that all proposed methods implicitly assume suppression (SUP) of Resolution **557 (WRC-15)**.

3/1.4/5.1 For Method A

APPENDIX 30 (REV.WRC-15)*

**Provisions for all services and associated Plans and List¹ for
the broadcasting-satellite service in the frequency bands
11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1)
and 12.2-12.7 GHz (in Region 2) (WRC-03)**

NOC

ANNEX 7 (REV.WRC-03)

Orbital position limitations

SUP

RESOLUTION 557 (WRC-15)

**Consideration of possible revision of Annex 7 to
Appendix 30 of the Radio Regulations**

3/1.4/5.2 For Method B

ARTICLE 59

Entry into force and provisional application of the Radio Regulations (WRC-12)

ADD

59.15 The other provisions of these Regulations, as revised by WRC-19, shall enter into force on 1 January 2021, with the following exceptions: (WRC-19)

ADD

59.16 — the revised provisions for which other effective dates of application are stipulated in Resolution:
draft new Resolution [D14-ENTRY-INTO-FORCE] (WRC-19) (WRC-19)

APPENDIX 30 (REV.WRC-15)*

Provisions for all services and associated Plans and List¹ for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)

MOD

ANNEX 7 (REV.WRC-03)

Orbital position limitations ADD YY, ADD ZZ

MOD

- 1) No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further ~~west than 37.2° W or further~~ east than 146° E.

YY See Resolution [A14-LIMITA3] (WRC-19).

ZZ Resolution [C14-LIMITA1A2] (WRC-19) applies to broadcasting satellites serving areas in Region 1 in the band 11.7-12.2 GHz from nominal orbital positions further west than 37.2° W and broadcasting satellites serving areas in Region 2 in the band 12.5-12.7 GHz from nominal orbital positions further east than 54° W.

MOD

- 2) No broadcasting satellite serving an area in Region 2 and using a frequency in the band 12.2-12.7 GHz that involves an orbital position different from that contained in the Region 2 Plan shall occupy a nominal orbital position:

- ~~a) further east than 54° W in the band 12.5-12.7 GHz; or~~
~~b) further east than 44° W in the band 12.2-12.5 GHz; or~~
~~c) further west than 175.2° W in the band 12.2-12.7 GHz.~~

However, modifications necessary to resolve possible incompatibilities during the incorporation of the Regions 1 and 3 feeder-link Plan into the Radio Regulations shall be permitted.

SUP

- 3) The purpose of the following orbital position and e.i.r.p. limitations is to preserve access to the geostationary-satellite orbit by the Region 2 fixed-satellite service in the band 11.7-12.2 GHz. Within the orbital arc of the geostationary-satellite orbit between 37.2° W and 10° E, the orbital position associated with any proposed new or modified assignment in the Regions 1 and 3 List of additional uses shall lie within one of the portions of the orbital arc listed in Table 1. The e.i.r.p. of such assignments shall not exceed 56 dBW, except at the positions listed in Table 2.

SUP

TABLE 1

Allowable portions of the orbital arc between 37.2° W and 10° E for new or modified assignments in the Regions 1 and 3 Plan and List

| Orbital position | 37.2° W to 36° W | 33.5° W to 32.5° W | 30° W to 29° W | 26° W to 24° W | 20° W to 18° W | 14° W to 12° W | 8° W to 6° W | 4° W ¹ | 2° W to 0° | 4° E to 6° E | 9° E ¹ |
|------------------|------------------------|--------------------------|----------------------|----------------------|----------------------|----------------------|--------------------|-------------------|------------------|--------------------|-------------------|
|------------------|------------------------|--------------------------|----------------------|----------------------|----------------------|----------------------|--------------------|-------------------|------------------|--------------------|-------------------|

¹ Proposed new or modified assignments in the List which involve this orbital position shall not exceed the power flux-density limit $-138 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ at any point in Region 2.

SUP

TABLE 2

Nominal positions in the orbital arc between 37.2° W and 10° E at which the e.i.r.p. may exceed the limit of 56 dBW

| Orbital position | 37° W $\pm 0.2^\circ$ | 33.5° W | 30° W | 25° W $\pm 0.2^\circ$ | 19° W $\pm 0.2^\circ$ | 13° W $\pm 0.2^\circ$ | 7° W $\pm 0.2^\circ$ | 4° W ¹ | 1° W $\pm 0.2^\circ$ | 5° E $\pm 0.2^\circ$ | 9° E ¹ |
|------------------|--------------------------|---------|-------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|-------------------------|-------------------------|-------------------|
|------------------|--------------------------|---------|-------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|-------------------------|-------------------------|-------------------|

¹ Proposed new or modified assignments in the List which involve this orbital position shall not exceed the power flux-density limit $-138 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ at any point in Region 2.

NOC

B The Region 2 Plan is based on the grouping of the space stations in nominal orbital positions of $\pm 0.2^\circ$ from the centre of the cluster of satellites. Administrations may locate those satellites within a cluster at any orbital position within that cluster, provided they obtain the agreement of administrations having assignments to space stations in the same cluster. (See § 4.13.1 of Annex 3 to Appendix **30A**.)

ADD**DRAFT NEW RESOLUTION [A14-LIMITA3] (WRC-19)**

**Protection of implemented BSS networks in the orbital arc of the
geostationary-satellite orbit between 37.2° W and 10° E
in the frequency band 11.7-12.2 GHz**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that the provisions applying to the broadcasting-satellite service (BSS) in the frequency bands 11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3 are contained in Appendix **30**;
- b)* that systems in the fixed-satellite service (FSS) and the broadcasting-satellite service share the frequency band 11.7-12.2 GHz;
- c)* that WRC-19 suppressed the limitation in Section 3 Annex 7 to Appendix **30 (Rev.WRC-15)** which determined allowable portions of the orbital arc between 37.2° W and 10° E for new or modified assignments in the frequency band 11.7-12.2 GHz in the Regions 1 and 3 List;
- d)* that Section 1 of Annex 1 to Appendix **30 (Rev.WRC-15)** provides criteria used for determination of coordination requirements for frequency assignments of Regions 1 and 3 Plan and List;
- e)* that Section 1 of Annex 1 to Appendix **30 (Rev.WRC-15)** pfd mask values are based on the parameters adopted by WRC-2000 based on the minimum earth station receiving antenna size of 60 cm;
- f)* that the use of this frequency band by the BSS is subject to the coordination procedure of Article 4 of Appendix **30 (Rev.WRC-19)**,

noting

- a)* that the ITU Radiocommunication Sector (ITU-R) has carried out a significant amount of studies in preparation for conferences on BSS planning, and has developed a number of Reports and Recommendations;
- b)* that within the orbital arc of the geostationary-satellite orbit between 37.2° W and 10° E before WRC-19 there were limitations on the use of some orbital positions for any proposed new or

modified assignment in the Regions 1 and 3 List of additional uses in the frequency band 11.7-12.2 GHz;

- c) that some networks with earth station receiving antenna size smaller than 60 cm were successfully implemented within the orbital arc mentioned in *noting b)*, in view of protection due to the presence of limitations on the use of orbital positions in this orbital arc;
- d) that with the deletion of orbital position limitations, the protection of satellite assignments mentioned in *noting c)* shall be ensured;
- e) that the geostationary-satellite orbit between 37.2° W and 10° E is widely used by Region 1 BSS and Region 2 FSS networks;
- f) that equitable access to and efficient use of the 12 GHz frequency range should be encouraged,

resolves

1 that this Resolution is applicable only to implemented¹ networks with earth station receiving antenna size smaller than 60 cm (40 cm and 45 cm) as outlined in Annex 1 of this Resolution;

2 that frequency assignments of the networks mentioned in *resolves 1* above are considered by the Bureau as being affected by a proposed new or modified assignment in the List filed to the GSO orbital positions mentioned in Annex 1 to this Resolution, only if the following conditions specified in Annex 1 of Appendix 30 (**Rev.WRC-19**) are met:

- the minimum orbital spacing between the wanted and interfering space stations, under worst-case station-keeping conditions, is less than 9°;
- the reference equivalent downlink protection margin corresponding to at least one of the test points of that wanted assignment, including cumulative effect of any previous modification to the List or any previous agreement, falls more than 0.45 dB below 0 dB, or if already negative, more than 0.45 dB below that reference equivalent protection margin value;

3 that for cases, when a proposed new assignment in the List is filed within the geostationary orbital arc between 37.2° W and 10° E in orbital arc segments that differ from those in Annex 1 to this Resolution, appropriate provisions of Annex 1 Appendix 30 (**Rev.WRC-19**) to

¹ For the avoidance of doubt, the “implemented” networks referred to are related to Regions 1 and 3 BSS networks in the orbital arc 37.2° W and 10° E:

- for which complete Appendix 4 information had been received by the Bureau under § 4.1.3 of Appendix 30 prior to 28 November 2015, and
- for which complete Appendix 4 information had been received by the Bureau under § 4.1.12 of Appendix 30 prior to 23 November 2019, and
- for which the complete due diligence information, in accordance with Annex 2 to Resolution 49 (**Rev.WRC-15**), had been received by the Bureau prior to 23 November 2019, and
- for which complete Appendix 4 information had been received by the Bureau under § 5.1.2 of Appendix 30 prior to 23 November 2019, and
- brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 23 November 2019.

determine the need for coordination, continue to be applied with respect to relevant frequency assignments of satellite networks mentioned in *resolves* 1.

ANNEX 1 TO DRAFT NEW RESOLUTION [A14-LIMITA3] (WRC-19)

Satellite networks and orbital arc segments for which this Resolution is applicable

| Satellite networks for which this Resolution applies | | | | | Orbital arc segments where the conditions specified in <i>resolves</i> 2 of this Resolution apply |
|--|--------------------------------|-------------------|--------------------------------------|-------------------|--|
| Orbital position | Earth station antenna size, cm | Satellite network | Date of receipt of part A submission | Notice Id Part II | |
| 33.5° W | 45 | UKDIGISAT-4C | 09.10.2014 | TBD | 36.0° W < $\theta \leq 35.36^\circ$ W; 31.64° W $\leq \theta < 30.0^\circ$ W; 29.0° W < $\theta \leq 28.58^\circ$ W; |
| 30.0° W | 45 | HISPASAT-1 | 08.02.2000 | 99500256 | 34.92° W $\leq \theta < 33.5^\circ$ W; 32.5° W < $\theta \leq 31.86^\circ$ W; 28.14° W $\leq \theta < 26.0^\circ$ W; |
| | | HISPASAT-37A | 19.11.2014 | 117560019 | |
| 4.8° E | 40 | SIRIUS-N-BSS | 17.11.2014 | 118560003 | 0 < $\theta \leq 2.85^\circ$ E; 6.75° E $\leq \theta < 9.0^\circ$ E; 9° E < $\theta \leq 10^\circ$ E; |

Where θ is the orbital position within the orbital segment defined in the table above.

NOTE - Currently, the proposed table contains all possible satellite networks that could comply with the conditions specified in resolves 1. WRC-19 will update this table to reflect the satellite networks that in fact comply with these conditions.

ADD

DRAFT NEW RESOLUTION [B14-PRIORITY] (WRC-19)

Additional temporary regulatory measures following deletion of part of Annex 7 to Appendix 30 by WRC-19

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a) that some national assignments especially those of developing countries in the Regions 1 and 3 Plan have equivalent downlink protection margin values in the RR Appendix 30 equal or below -10 dB;
- b) that implementation of a national assignment in the Regions 1 and 3 Plan with an equivalent downlink protection margin equal or below -10 dB would be difficult;

c) that any modification of orbital position and other parameters of a national assignment in the Appendix **30** Plan would require a corresponding modification of the orbital position and other parameters in the Appendix **30A** feeder-link Plan,

recognizing

a) that Article 44 of the ITU Constitution stipulates that: *“In using frequency bands for radio services, Member States shall bear in mind that radio frequencies and any associated orbits, including the geostationary-satellite orbit, are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulations, so that countries or groups of countries may have equitable access to those orbits and frequencies, taking account the special needs of the developing countries and the geographical situation of particular countries”*;

b) that Resolution 71 (Rev. Busan, 2014) of the Plenipotentiary Conference, ITU includes the ITU strategic plan for 2016-2019, which contains, as one of the strategic objectives of ITU-R: *“Meet, in a rational, equitable, efficient, economical and timely way, the ITU membership’s requirements for radio-frequency spectrum and satellite-orbit resources, while avoiding harmful interference”*,

resolves

1 that as of 23 March 2020 and for a period until 21 May 2020, the special procedure outlined in the Attachment to this Resolution shall be applied in respect of submissions of Regions 1 and 3 administrations under § 4.1.3 of Appendices **30** and **30A** in Regions 1 and 3 meeting the specified requirements in § 1 of the Attachment to the Resolution at an orbital position of orbital arcs for which the Annex 7 to Appendix **30 (Rev.WRC-15)** limitations were suppressed by WRC-19. Submissions sent before 23 March 2020 shall be returned to the administration;

2 that as of 23 November 2019 and for a period until 21 May 2020, all submissions under § 4.1.3 of Appendices **30** and **30A** in Regions 1 and 3 not meeting the specified requirements in § 1 of the Attachment to the Resolution at an orbital position within orbital arcs for which the Annex 7 to Appendix **30 (Rev.WRC-15)** limitations were suppressed by WRC-19 shall be considered as received by BR on the 22 May 2020,

instructs the Director of the Radiocommunication Bureau

to identify the administrations that meet the conditions of Section 1 of the Attachment to this Resolution and inform these administrations accordingly.

ATTACHMENT TO DRAFT NEW RESOLUTION [B14-PRIORITY] (WRC-19)

Additional temporary regulatory measures following deletion of part of Annex 7 to Appendix 30 by WRC-19

1 The special procedure described in this attachment can only be applied once by an administration with:

- a) no frequency assignments included in the List or for which complete Appendix **4** information has been received by the Bureau in accordance with the provision of § 4.1.3 of Appendix **30**; and
- b) an assignment in the Regions 1 and 3 Plan of Appendix **30** when the equivalent downlink protection margin (EPM) value corresponding to a test point of its national assignment in

the Regions 1 and 3 Plan is equal or below -10 dB for at least 50% of the total number of EPM values of the assignment in the Regions 1 and 3 Plan in Appendix **30**.

2 Administrations seeking to apply this special procedure shall submit their request to the Bureau, with the information specified in § 4.1.3 of Appendices **30** and **30A**, in particular this information shall include:

- a)* in the cover letter to the Bureau, the information that the administration requests the use of this special procedure together with the name of the Plan assignments for which condition defined in § 1 above is met;
- b)* a service area is limited to the national territory as defined in the GIMS software application;
- c)* a set of maximum 20 test points inside the national territory;
- d)* a minimal ellipse determined by the set of test points submitted in *c)* above. An administration may request the Bureau to create such diagram;
- e)*¹ maximum ten consecutive odd or even channels with standard Appendix **30** assigned frequencies in the same polarization for a Region 1 administration or twelve consecutive odd or even channels with standard Appendix **30** assigned frequencies in the same polarization for a Region 3 administration with a bandwidth of 27 MHz;
- f)* a corresponding submission for the Appendix **30A** feeder-link Plan in compliance with the principle defined in items *b)*, *c)*, *d)* and *e)* above.

3 Upon receipt of the complete information from an administration sent under § 2 above, the Bureau shall process the submissions in date order in accordance with Article 4 of Appendices **30** and **30A**.

4 The notifying administration shall request the subsequent WRCs to consider the inclusion in the Appendices **30** and **30A** Plans as a replacement of its national assignments appearing in the Plans, pursuant to paragraph 4.1.27 of Article 4 of Appendices **30** and **30A**.

NOTE: During the development of Methods, it was proposed to apply draft new Resolution [C14-LIMITA1A2] (WRC-19) to FSS/BSS orbital separations of between 2 and 10.57 degrees. The value of 4.2 degrees in this Resolution represents a very delicate compromise.

¹ In case of submission for the Appendix **30A** feeder-link Plan in the 14 GHz band, the maximum ten channels for a Region 1 administration or twelve channels for a Region 3 administration with a bandwidth of 27 MHz could be in different polarization.

ADD

DRAFT NEW RESOLUTION [C14-LIMITA1A2] (WRC-19)

Need for coordination of Region 2 FSS networks in the frequency band 11.7-12.2 GHz with respect to the Region 1 BSS assignments located further west than 37.2° W and of Region 1 FSS networks in the frequency band 12.5-12.7 GHz with respect to the Region 2 BSS assignments located further east than 54° W

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a) that WRC-15 decided to conduct studies on, review, and identify possible revisions to, if necessary, the limitations mentioned in Annex 7 to Appendix **30 (Rev.WRC-15)**, while ensuring the protection of, and without imposing additional constraints on, assignments in the Plan and in the List and the future of broadcasting-satellite service (BSS) networks and existing fixed-satellite service (FSS) networks;
- b) that the provisions applying to the frequency assignments of the BSS in the frequency bands 11.7-12.5 GHz in Region 1 and 12.2-12.7 GHz in Region 2 are contained in Appendix **30**;
- c) that the FSS has primary allocations in the frequency bands 12.5-12.75 GHz in Region 1 and 11.7-12.2 GHz in Region 2;
- d) that the BSS has primary allocations in the frequency bands 11.7-12.5 GHz in Region 1 and 12.2-12.7 GHz in Region 2;
- e) that WRC-19 suppressed the limitation in Annex **7** to Appendix **30** that prevented broadcasting satellites serving an area in Region 1 and using frequency assignments in the frequency band 11.7-12.2 GHz at orbital positions further west than 37.2° W;
- f) that WRC-19 suppressed the limitation in Annex **7** to Appendix **30** that prevented broadcasting satellites serving an area in Region 2 and using frequency assignments in the frequency band 12.5-12.7 GHz at orbital positions further east than 54° W;
- g) that the result of those suppressions shall ensure the protection of, and cannot impose additional constraints on, assignments in the Plan and the List and the future development of the BSS within the Plan, and existing and planned FSS networks,

recognizing

- a) that existing FSS networks operating in the frequency bands mentioned in *considering c)* and BSS frequency assignments in the Plan and List implemented in accordance with the provisions of Annex 7 to Appendix **30 (Rev.WRC-15)** prior to WRC-19 shall continue to be protected;
- b) that the frequency bands 11.7-12.5 GHz in Region 1 and 12.2-12.7 GHz in Region 2 are widely used by BSS networks, subject to the provisions of Annex 7 to Appendix **30 (Rev.WRC-15)** prior to WRC-19;
- c) that the frequency bands 12.5-12.75 GHz in Region 1 and 11.7-12.2 GHz in Region 2 are widely used by FSS networks,

resolves

- 1 that, in the frequency band 11.7-12.2 GHz, with respect to § 7.1 a), 7.2.1 a), 7.2.1 b) and 7.2.1 c) of Article 7 of Appendix **30**, the need for coordination of a transmitting space station in the FSS of Region 2 with a transmitting space station in the BSS of Region 1 at an orbital position further west than 37.2° W and with minimum geocentric orbital separation less than 4.2 degrees between FSS and BSS space stations, the conditions in Annex 1 to this Resolution apply instead of those contained in Annex 4 to Appendix **30**;
- 2 that, in the frequency band 12.5-12.7 GHz, with respect to § 7.1 a), 7.2.1 a) and 7.2.1 c) of Article 7 of Appendix **30**, the need for coordination of a transmitting space station in the FSS of Region 1 with a transmitting space station in the BSS of Region 2 at an orbital position further east than 54° W and not within its clusters in the Region 2 Plan of Appendix **30**, and with minimum geocentric orbital separation less than 4.2 degrees between FSS and BSS space stations, the conditions in Annex 2 to this Resolution apply instead of those contained in Annex 4 to Appendix **30**;
- 3 that, except the cases specified in *resolves* 1 and 2, the conditions in Annex 4 to Appendix **30** continue to apply.

ANNEX 1 TO DRAFT NEW RESOLUTION [C14-LIMITA1A2] (WRC-19)

With respect to § 7.1 a), 7.2.1 a), 7.2.1 b) and 7.2.1 c) of Article 7 of Appendix **30**, coordination of a transmitting space station in the fixed-satellite service (FSS) (space-to-Earth) of Region 2 is required with a broadcasting-satellite station serving an area in Region 1 and using a frequency assignment in the frequency band 11.7-12.2 GHz with a nominal orbital position further west than 37.2° W when, under assumed free-space propagation conditions, the power flux-density at any test point within the service area of the overlapping frequency assignments in the BSS exceeds the following values:

| | | | | | |
|------------------------------|----------------------------------|-----|-------|---|-----------|
| -147 | dB (W/(m ² · 27 MHz)) | for | 0° | ≤ | θ < 0.23° |
| -135.7 + 17.74 log θ | dB (W/(m ² · 27 MHz)) | for | 0.23° | ≤ | θ < 2.0° |
| -136.7 + 1.66 θ ² | dB (W/(m ² · 27 MHz)) | for | 2.0° | ≤ | θ < 3.59° |
| -129.2 + 25 log θ | dB (W/(m ² · 27 MHz)) | for | 3.59° | ≤ | θ < 4.2° |

where θ is the minimum geocentric orbital separation in degrees between the wanted and interfering space stations, taking into account the respective east-west station-keeping accuracies.

ANNEX 2 TO DRAFT NEW RESOLUTION [C14-LIMITA1A2] (WRC-19)

With respect to § 7.1 a), 7.2.1 a) and 7.2.1 c) of Article 7 of Appendix **30**, coordination of a transmitting space station in the fixed-satellite service (FSS) (space-to-Earth) of Region 1 is required with a broadcasting-satellite station serving an area in Region 2 and using a frequency assignment in the frequency band 12.5-12.7 GHz with a nominal orbital position further east than 54° W and not within its clusters in the Region 2 Plan of Appendix **30** when, under assumed free-space propagation conditions, the power flux-density at any test point within the service area of the overlapping frequency assignments in the BSS exceeds the following values:

| | | | | | |
|----------------------|----------------------------------|-----|-------|---|-----------|
| -147 | dB (W/(m ² · 27 MHz)) | for | 0° | ≤ | θ < 0.23° |
| -135.7 + 17.74 log θ | dB (W/(m ² · 27 MHz)) | for | 0.23° | ≤ | θ < 1.8° |

$$-134.0 + 0.89 \theta^2 \quad \text{dB (W/(m}^2 \cdot 27 \text{ MHz))} \quad \text{for} \quad 1.8^\circ \leq \theta < 4.2^\circ$$

where θ is the minimum geocentric orbital separation in degrees between the wanted and interfering space stations, taking into account the respective east-west station-keeping accuracies.

ADD

DRAFT NEW RESOLUTION [D14-ENTRY-INTO-FORCE] (WRC-19)

Provisional application of certain provisions of the Radio Regulations as revised by the 2019 World Radiocommunication Conference

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that this conference has, in accordance with its terms of reference, adopted a partial revision to the Radio Regulations (RR), which will enter into force on 1 January 2021;
- b)* that some of the provisions, as amended by this conference, need to apply provisionally before that date;
- c)* that, as a general rule, new and revised Resolutions and Recommendations enter into force at the time of the signing of the Final Acts of a conference,

resolves

that, as of 23 November 2019, the following provisions of the RR, as revised or established by this conference, shall provisionally apply: Annex 7 to Appendix 30.

SUP

RESOLUTION 557 (WRC-15)

Consideration of possible revision of Annex 7 to Appendix 30 of the Radio Regulations

Agenda item 1.5

1.5 to consider the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service and take appropriate action, in accordance with Resolution 158 (WRC-15);

Resolution 158 (WRC-15) – *Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service.*

3/1.5/1 Executive summary

WRC-19 agenda item 1.5 considers the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion (ESIM) communicating with geostationary (GSO) space stations in the fixed-satellite service (FSS). The studies under this agenda item considered three types of ESIM: aeronautical, maritime and land, depending on the type of vehicle on which they are installed.

Studies have been carried out on sharing and compatibility between ESIM and space as well as terrestrial services allocated in the frequency bands above. Not all studies have been concluded. The studies carried out so far have identified example provisions to protect such services and example guidelines to assist an administration wishing to authorize ESIM to operate on the territory under its jurisdiction.

There are various responsibilities for the authorization and operation of ESIM and their interference management. These responsibilities are described in the draft new Resolution **[A15] (WRC-19)** in section 3/1.5/5 below.

For this agenda item, two methods have been identified:

Method A

This method proposes no changes to the RR and suppression of Resolution **158 (WRC-15)**.

Method B

This method proposes to add a new footnote No. **5.A15** in RR Article **5** and a reference to a new WRC Resolution providing the conditions for the operation of ESIM and protection of the services to which the frequency bands are allocated, and consequential suppression of Resolution **158 (WRC-15)**. An example modification to RR Appendix **4** called for by the new WRC Resolution is also included.

3/1.5/2 Background

ESIM are earth stations that communicate with GSO FSS space stations but operate on platforms in motion in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz. There are three types of ESIM:

- ESIM on aircraft (aeronautical ESIM);
- ESIM on ships (maritime ESIM), and
- ESIM on land vehicles (land ESIM).

Any of the three types of ESIM can be used to provide broadband communications, including Internet connectivity.

Moreover, under Method B, for the operation of ESIM, examples of the technical, operational and regulatory responsibilities of administrations and entities responsible for the operation, authorization and the interference management of the various types of ESIM (on board aircraft, on board vessels and on board land vehicles) are defined and contained in the draft new Resolution [A15] (WRC-19).

3/1.5/3 Summary and analysis of the results of ITU-R studies

3/1.5/3.1 Operation of ESIM in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz

In accordance with Resolution **158 (WRC-15)**, ESIM need to protect the existing services and their future development without undue constraints to which the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands are allocated: the fixed service (FS), the mobile service (MS), the Earth exploration-satellite service (EESS), the meteorological-satellite service, the fixed-satellite service (FSS), including the non-GSO mobile-satellite service (MSS) feeder links operating in the FSS and the broadcasting-satellite service (BSS) feeder links.

The following sections provide examples on how ESIM can protect the existing services to which the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands are allocated.

3/1.5/3.2 Sharing studies with terrestrial services

3/1.5/3.2.1 Frequency band 17.7-19.7 GHz

The ITU-R examined sharing conditions for ESIM with terrestrial services in the 17.7-19.7 GHz frequency band and concluded that there would be potential interference from transmitting stations of terrestrial services to ESIM receivers. The ESIM therefore should operate under the condition of not claiming protection from terrestrial services operating in accordance with RR.

3/1.5/3.2.2 Frequency band 27.5-29.5 GHz

The ITU-R examined sharing conditions between ESIM and terrestrial services in the 27.5-29.5 GHz frequency band and concluded that there would be potential interference to receiving stations of terrestrial services from ESIM transmitters. Therefore, aeronautical and maritime ESIM should operate under the specified technical, operational and regulatory conditions to avoid causing unacceptable interference to receiving stations of terrestrial services operating in accordance with RR.

Land ESIM need to operate under the condition of not causing unacceptable interference to receiving stations of terrestrial services operating in accordance with RR.

Further information is provided in the relevant parts of the draft new Resolution [A15] (WRC-19).

3/1.5/3.3 Sharing studies with space services

3/1.5/3.3.1 Sharing studies with the EESS (passive)

The ITU-R examined sharing conditions for receiving ESIM with the EESS (passive) in the 18.6-18.8 GHz frequency band. This frequency band is used by EESS (passive) in remote sensing by Earth exploration. In this frequency band EESS (passive) and ESIM are both receiving. Therefore, no interference can be caused by ESIM into the EESS (passive).

3/1.5/3.3.2 Sharing studies with the meteorological-satellite service

The ITU-R examined sharing conditions for receiving ESIM with the meteorological-satellite service in the 18 GHz range²². In this frequency band the meteorological-satellite earth station and ESIM are both receiving. Therefore, no interference can be caused by ESIM into the meteorological-satellite receiver station.

3/1.5/3.3.3 Sharing studies with the EESS (Earth-to-space)

The ITU-R noted that the use of ESIM in the 27.5-29.5 GHz frequency band would not change the current interference environment with respect to the secondary EESS in the 28.5-29.5 GHz range, provided that ESIM operate within the envelope of GSO FSS networks.

3/1.5/3.3.4 Sharing studies with the FSS

3/1.5/3.3.4.1 GSO FSS networks

With respect to GSO FSS satellite networks of other administrations, the ITU-R concluded that ESIM need to remain within the envelope of the satellite network with which these ESIM communicate. In order to implement this, the notifying administration of the GSO FSS network with which ESIM communicate needs to send to the Bureau the relevant RR Appendix 4 information related to the characteristics of the ESIM intended to communicate with the space station of that GSO FSS network. Upon receipt of this information, the Bureau needs to examine it and publish the results in a Special Section of the BR IFIC. If, following this examination, the Bureau concludes that ESIM are not within the envelope of the satellite network, it would return the information to the notifying administration with the reasons thereof.

3/1.5/3.3.4.2 Non-GSO FSS systems

3/1.5/3.3.4.2.1 Frequency band 17.7-18.6 GHz (Resolution 158, *recognizing further e*))

In this frequency band, since non-GSO FSS earth stations and ESIM are both receiving, no interference can be caused by ESIM into the non-GSO FSS receiving earth stations.

With respect to the interference into receiving ESIM, it was noted that no protection could be claimed by ESIM from non-GSO FSS systems operating in the frequency band 17.8-18.6 GHz in accordance with RR provisions, including RR No. **22.5C**. Further information with respect to the above is included in the draft new Resolution [A15] (WRC-19).

3/1.5/3.3.4.2.2 Frequency band 18.8-19.3 GHz (Resolution 158, *recognizing further f*) and *b*))

In this frequency band, since non-GSO FSS earth stations and ESIM are both receiving, no interference can be caused by ESIM into the non-GSO FSS receiving earth stations.

Since GSO FSS networks communicating with ESIM would operate under technical and operational measures contained in the relevant coordination agreements in application of RR Nos. **9.12A** and **9.13**, ESIM would not require any additional protection.

3/1.5/3.3.4.2.3 Frequency band 27.5-28.6 GHz (Resolution 158, *recognizing further e*) and *b*))

In this frequency band, transmitting ESIM have the potential to interfere with non-GSO FSS satellite receivers. Results of studies to date show that ESIM that comply with *resolves* 1.1.1 of the

²² See RR No. **5.519** for specific frequency ranges.

draft new Resolution [A15] (WRC-19) and the provisions contained in Annex 1 to the draft new Resolution [A15] (WRC-19) would protect non-GSO FSS satellite receivers in this frequency band.

3/1.5/3.3.4.2.4 Frequency band 28.6-29.1 GHz (Resolution 158, recognizing further f) and b))

In this frequency band RR Nos. **9.12A** and **9.13** apply.

Some views were expressed that the provisions of RR Nos. **9.12A** and **9.13** together with *resolves* 1.1.1 of the draft new Resolution [A15] (WRC-19) provide enough assurance that ESIM would not cause interference to non-GSO FSS space station receivers.

Some other views were expressed that transmitting ESIM have the potential to interfere with non-GSO satellite receivers and that ESIM should comply with *resolves* 1.1.1 of the draft new Resolution [A15] (WRC-19) and the provisions contained in Annex 1 to the draft new Resolution [A15] (WRC-19) so that ESIM protect non-GSO satellite receivers in this frequency band.

Studies are ongoing to determine whether ESIM should comply with any provisions so that ESIM avoid causing interference to non-GSO satellite receivers.

3/1.5/3.3.4.3 Sharing with non-GSO MSS feeder links operating in the FSS

3/1.5/3.3.4.3.1 Frequency band 19.3-19.7 GHz (Resolution 158, recognizing further g))

In this frequency band RR No. **9.11A** applies and non-GSO MSS feeder-link systems using the frequency band 19.3-19.7 GHz (space-to-Earth) are not subject to the provisions of RR No. **22.2**. Further, the use of this frequency band for other non-GSO FSS systems, or for the cases indicated in RR Nos. **5.523C** and **5.523E**, is not subject to the provisions of RR No. **9.11A**, but is subject to RR Articles **9** (except RR No. **9.11A**) and **11** procedures, and to the provisions of RR No. **22.2** (RR No. **5.523D**).

In this frequency band, ESIM and non-GSO MSS feeder-link earth stations are both receiving, so no interference can be caused from one into the other.

3/1.5/3.3.4.3.2 Frequency band 29.1-29.5 GHz (Resolution 158, recognizing further h) and j))

In this frequency band RR No. **9.11A** applies and non-GSO MSS feeder-link systems using the frequency band 29.1-29.5 GHz (Earth-to-space) are not subject to the provisions of RR No. **22.2**, except as indicated in RR Nos. **5.523C** and **5.523E**, where such use is not subject to the provisions of RR No. **9.11A** and shall continue to be subject to RR Articles **9** (except RR No. **9.11A**) and **11** procedures, and to the provisions of RR No. **22.2** (RR No. **5.535A**).

In this frequency band, ESIM could potentially interfere with non-GSO satellite receivers with which MSS feeder-link earth stations communicate. Studies are ongoing to determine whether any additional provisions are needed so that ESIM avoid causing interference to non-GSO MSS space stations.

Some views were expressed that *resolves* 1.1.7 (Option 1), if retained, and Annex 1 of the draft new Resolution [A15] (WRC-19) provide for the protection of non-GSO MSS feeder links from ESIM communicating with GSO FSS networks.

Some other views were expressed that the provisions of RR No. **9.11A** together with *resolves* 1.1.1 of the draft new Resolution [A15] (WRC-19) provide enough assurance that ESIM would not cause interference to space station receivers of non-GSO MSS feeder links. This view is consistent with *resolves* 1.1.7 (Option 2), if retained, of the draft new Resolution [A15] (WRC-19).

3/1.5/3.3.4.4 Sharing studies with BSS feeder links

3/1.5/3.3.4.4.1 Frequency bands 17.7-18.1 GHz (Resolution 158, *recognizing further a*) and 18.1-18.4 GHz (Resolution 158, *recognizing further c*)

In this frequency band, ESIM are receiving and BSS feeder-link earth stations are transmitting. The ITU-R concluded that ESIM should not claim protection from BSS feeder-link earth stations operating in accordance with the RR and should not affect the future development of BSS feeder-link earth stations.

3/1.5/3.3.4.4.2 Frequency band 27.5-29.5 GHz (Resolution 158, *recognizing further i*)

In this frequency band, ESIM are transmitting and GSO FSS satellites with which BSS feeder-link earth stations communicate are receiving.

The ITU-R concluded that the course of action contained in section 3/1.5/3.3.4.1 for the protection of other GSO FSS networks would protect GSO FSS satellite receivers with which BSS feeder-link earth stations communicate.

3/1.5/3.3.4.5 Sharing studies between ESIM and non-GSO MSS feeder-link earth stations operating in the opposite direction in the frequency band 19.3-19.6 GHz

In this frequency band, ESIM are receiving and non-GSO MSS feeder-link earth stations are transmitting and RR No. **5.523B** applies. The ITU-R concluded that ESIM should not claim protection from non-GSO MSS feeder-link earth stations operating in accordance with the RR and should not affect the future development of non-GSO MSS feeder-link earth stations.

3/1.5/4 Methods to satisfy the agenda item

3/1.5/4.1 Method A

No changes to the RR and suppression of Resolution **158 (WRC-15)**.

3/1.5/4.2 Method B

Add a new footnote in RR Article **5** that refers to a new WRC Resolution [**A15**] (**WRC-19**) with technical, operational and regulatory conditions for the operation of ESIM while ensuring protection of allocated services and consequential suppression of Resolution **158 (WRC-15)**.

3/1.5/5 Regulatory and procedural considerations

3/1.5/5.1 For Method A

NOC

ARTICLES

SUP

RESOLUTION 158 (WRC-15)

Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service

3/1.5/5.2 For Method B

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. 2.1)

MOD

15.4-18.4 GHz

| Allocation to services | | |
|---|---|---|
| Region 1 | Region 2 | Region 3 |
| 17.7-18.1 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A <u>ADD 5.A15</u> (Earth-to-space) 5.516 MOBILE | 17.7-17.8 FIXED FIXED-SATELLITE (space-to-Earth) 5.517 <u>ADD 5.A15</u> (Earth-to-space) 5.516 BROADCASTING-SATELLITE Mobile 5.515 | 17.7-18.1 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A <u>ADD 5.A15</u> (Earth-to-space) 5.516 MOBILE |
| | 17.8-18.1 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A <u>ADD 5.A15</u> (Earth-to-space) 5.516 MOBILE 5.519 | |
| 18.1-18.4 | FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B <u>ADD 5.A15</u> (Earth-to-space) 5.520 MOBILE 5.519 5.521 | |

MOD**18.4-22 GHz**

| Allocation to services | | |
|---|---|--|
| Region 1 | Region 2 | Region 3 |
| 18.4-18.6 | FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.A15 MOBILE | |
| 18.6-18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B ADD 5.A15 MOBILE except aeronautical mobile Space research (passive) 5.522A 5.522C | 18.6-18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.522B ADD 5.A15 MOBILE except aeronautical mobile SPACE RESEARCH (passive) 5.522A | 18.6-18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B ADD 5.A15 MOBILE except aeronautical mobile Space research (passive) 5.522A |
| 18.8-19.3 | FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.523A ADD 5.A15 MOBILE | |
| 19.3-19.7 | FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 5.523B 5.523C 5.523D 5.523E ADD 5.A15 MOBILE | |

MOD**24.75-29.9 GHz**

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 27.5-28.5 | FIXED 5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 ADD 5.A15 MOBILE 5.538 5.540 | |
| 28.5-29.1 | FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 ADD 5.A15 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540 | |
| 29.1-29.5 | FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.523C 5.523E 5.535A 5.539 5.541A ADD 5.A15 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540 | |

Method B Option 1:**ADD**

5.A15 The operation of earth stations in motion communicating with geostationary FSS space stations in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz shall be subject to draft new Resolution [A15] (WRC-19). (WRC-19)

Method B Option 2:**ADD**

5.A15 The operation of earth stations in motion communicating with geostationary FSS space stations in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, or portions thereof, shall be subject to draft new Resolution [A15] (WRC-19). (WRC-19)

Method B (continued)**ADD****DRAFT NEW RESOLUTION [A15] (WRC-19)**

Use of the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz by earth stations in motion (ESIM) communicating with geostationary space stations in the fixed-satellite service

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that there is a need for global broadband mobile-satellite communications, and that some of this need could be met by allowing earth stations in motion (ESIM) to communicate with space stations of geostationary-satellite orbit (GSO) fixed-satellite service (FSS) operating in the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space);
- b)* that appropriate regulatory and interference management mechanisms are necessary for the operation of ESIM;
- c)* that the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) are also allocated to terrestrial and space services used by a variety of different systems and these existing services and their future development need to be protected from the operation of ESIM,

recognizing

- a)* that the administration authorizing ESIM on territory under its jurisdiction has the right to require that ESIM referred to above only use those assignments associated with GSO FSS networks which have been successfully coordinated, notified, brought into use and recorded in the MIFR with a favourable finding under Article 11, including Nos. 11.31, 11.32 or 11.32A, where applicable;

b) that for cases of incomplete coordination under No. **9.7** of the GSO FSS network with assignments to be used by ESIM, the operation of ESIM on those assignments in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz needs to be in accordance with the provisions of No. **11.42** with respect to any recorded frequency assignment which was the basis of the unfavourable finding under No. **11.38**;

c) that any course of action taken under this Resolution has no impact on the original date of receipt of the frequency assignments of the GSO FSS satellite network with which ESIM communicate or on the coordination requirements of that satellite network;

d) that the operation of any type of ESIM (land, maritime and aeronautical) within the territory(-ies), territorial waters and airspace under the jurisdiction of an administration, shall be carried out only if authorized by that administration,

resolves

1 that for any ESIM communicating with a GSO FSS space station in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, or portions thereof, the following conditions shall apply:

1.1 with respect to space services in the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands, ESIM shall comply with the following conditions:

Option 1:

1.1.1 with respect to satellite networks or systems of other administrations, the ESIM characteristics shall remain within the envelope of the satellite network with which these ESIM communicate;

Option 2:

1.1.1 with respect to satellite networks or systems of other administrations, the ESIM characteristics shall remain within the envelope of the satellite network with which these ESIM communicate and the satellite network, when using ESIM, shall not cause more interference and shall not claim more protection than was coordinated when using typical earth stations in this satellite network;

1.1.2 that the notifying administration of the GSO FSS network, with which ESIM communicate, shall ensure that ESIM operation complies with coordination agreements for the frequency assignments of this GSO FSS network under the relevant provisions of the Radio Regulations;

1.1.3 for the implementation of *resolves* 1.1.1 above, the notifying administration of the GSO FSS network with which ESIM communicate shall send to the Bureau under this Resolution the relevant Appendix 4 information related to the characteristics of the ESIM intended to communicate with the space station of that GSO FSS network, together with the commitment that the ESIM operation shall be in conformity with the Radio Regulations and this Resolution;

Option 1 (examination of ESIM in relation to a GSO satellite network recorded in the MIFR)

1.1.4 upon receipt of the information provided in accordance with *resolves* 1.1.3 above, the Bureau shall examine it in relation to the requirements referred to in *resolves* 1.1.1 based on the information recorded in the MIFR and any other reliable information available to it and publish the results in a Special Section of the BR IFIC;

Option 2 (examination of ESIM in relation to a GSO satellite at either coordination stage or subsequently recorded in the MIFR)

1.1.4 upon receipt of the information provided in accordance with *resolves* 1.1.3 above, the Bureau shall examine it in relation to the requirements referred to in *resolves* 1.1.1 based on the complete information submitted. If, following this examination, the Bureau concludes that the ESIM characteristics are within the envelope of the satellite network, the Bureau shall publish the results for information in the BR IFIC, otherwise the information shall be returned to the notifying administration;

Option 1 (examination of ESIM in relation to a GSO satellite network recorded in the MIFR)

1.1.5 if, following the examination referred to in *resolves* 1.1.4 above, the Bureau concludes that ESIM characteristics are not within the envelope of the GSO satellite network, the information shall be returned to the notifying administration;

Option 2 (examination of ESIM in relation to a GSO satellite at either coordination stage or subsequently recorded in the MIFR)

1.1.5 should the Bureau find, prior to entering the characteristics for a network into the MIFR, that the information submitted under *resolves* 1.1.3 is not in compliance with the requirements of *resolves* 1.1.1, the corresponding information previously published by the Bureau under *resolves* 1.1.4 shall be suppressed;

1.1.6 for the protection of non-GSO FSS systems operating in the frequency band 27.5-28.6/29.1 GHz, ESIM communicating with GSO FSS networks shall comply with the provisions contained in Annex 1 to this Resolution;

Option 1

1.1.7 for the protection of non-GSO MSS feeder links operating in the frequency band 29.1-29.5 GHz, ESIM communicating with GSO FSS networks shall comply with the provisions contained in Annex 1 to this Resolution;

Reasons: Studies are still on-going with the regard to the actual outcome of this particular item. Furthermore, although coexistence issues may be resolved through coordination, specific provisions would ensure protection in the absence of reaching an agreement through coordination efforts.

Option 2

1.1.7 is not needed;

Reasons: The band 29.1-29.5 GHz is allocated co-primarily to GSO FSS and to non-GSO MSS feeder links, and hence, coordination in this case is on a first-come-first-served basis. The concern arises when GSO FSS is the first comer and also operates ESIM. When non-GSO MSS feeder links comes latter, *resolves* 1.1.7 requires the operational ESIM to comply to conditions in Annex 1 of the draft new Resolution. It will not be feasible for an ESIM to protect non-GSO MSS feeder links once it has been operational. Also, *resolves* 1.1.7 inadvertently is establishing priority to non-GSO MSS over GSO FSS. The Radio Regulations in force, together with *resolves* 1.1.1 of the draft new Resolution [A15] (WRC-19) provide enough assurance that ESIM would not cause interference to space station receivers of non-GSO MSS feeder links.

1.1.8 ESIM shall not claim protection from non-GSO FSS systems operating in the frequency band 17.8-18.6 GHz in accordance with the Radio Regulations, including No. 22.5C;

1.1.9 ESIM shall not claim protection from BSS feeder link earth stations operating in the frequency band 17.7-18.4 GHz in accordance with the Radio Regulations and shall not affect their future development;

1.2 with respect to terrestrial services in the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands ESIM shall comply with the following conditions:

1.2.1 the receiving ESIM in the 17.7-19.7 GHz frequency band shall not claim protection from terrestrial services in the above-mentioned frequency band operating in accordance with the Radio Regulations and shall not affect the future development of these services;

1.2.2 the transmitting aeronautical and maritime ESIM in the 27.5-29.5 GHz frequency band shall not cause unacceptable interference to terrestrial services in the above-mentioned frequency band operating in accordance with the Radio Regulations and shall not affect the future development of these services and Annex 2 applies;

1.2.3 the transmitting land ESIM in the 27.5-29.5 GHz frequency band shall not cause unacceptable interference to terrestrial services in neighbouring countries in the above-mentioned frequency band operating in accordance with the Radio Regulations and shall not affect the future development of these services and Annex 3 with appropriate title applies;

View 1: regarding *resolves* 1.2.2 and 1.2.3 above, the part of the sentence “*and shall not affect the future development of these services*” shall be removed, because the protection of the future development of terrestrial services in the band 27.5-29.5 GHz is already fully ensured by the pfd mask indicated in Annex 2 and because retaining that sentence creates a provision under which the pfd mask in Annex 2 could be periodically reviewed, thus creating a detrimental uncertainty on the technical conditions to be met by ESIM.

View 2: regarding *resolves* 1.2.2 above, the part of the sentence “*and shall not affect the future development of these services*” shall be maintained and applied to existing terrestrial services and its future development as this text is an element cited in *resolves to invite ITU-R* and *considering g)* of Resolution 158 (WRC-15). Moreover, the obligations of the notifying administration of ESIM to protect terrestrial services is not limited to only comply with the pfd as contained in Annex 2 of this Resolution due to the fact that the validity and accuracy of pfd is yet to be verified and examined. Moreover, the proponents of this view are of the strong opinion that reference to *resolves* 1.2.3 in view 1 directly or indirectly refers to Annex 3 which has not been agreed by CPM19-2 in its totality.

Option 1

1.2.4 for the implementation of *resolves* 1.2.2 and 1.2.3 above, the notifying administration responsible for the GSO FSS satellite network with which ESIM communicate shall submit to the Bureau together with the Appendix 4 data referred to in *resolves* 1.1.2 a commitment undertaking that in case of unacceptable interference, upon receipt of a report of interference, take necessary action to immediately eliminate this interference or reduce interference to an acceptable level;

Option 2

1.2.4 may not be needed due to the fact that is covered somewhere else in other parts of this Resolution;

Option 1

1.2.5 that for the protection of terrestrial services operating in the frequency band 27.5-29.5 GHz, the aeronautical and maritime ESIM shall comply with the provisions contained in Annex 2 of this Resolution;

Option 2

1.2.5 any transmitting aeronautical or maritime ESIM that conforms to the requirements in Annex 2 to this Resolution are considered to not cause unacceptable interference to terrestrial stations under *resolves* 1.2.2 above;

Option 3

1.2.5 for the implementation of *resolves* 1.2.2 above, any transmitting aeronautical or maritime ESIM that conforms to the requirements in Annex 2 to this Resolution shall be deemed to have met its obligation to terrestrial stations;

Option 4

1.2.5 is not needed due to the fact that compliance with the requirements in Annex 2 would not release the notifying administration from its obligation not to cause unacceptable interference to any stations in the terrestrial service in accordance with the Radio Regulations. Moreover, the concept of pfd used in Article 21 of the Radio Regulations is part of the Radio Regulations to protect the area in which the terrestrial services are deployed. However, it does not protect the assignment of the terrestrial services due to the fact that there are two provisions of Article 9 (i.e. Nos. 9.17 and 9.18) to this effect;

2 that ESIM shall not be used or relied upon for safety-of-life applications;

3 that for the implementation of this Resolution, administrations may consider relevant parts of Annex 3 when considering to authorize ESIM as well as in their bilateral or multilateral negotiations (this part of the Resolution may be more appropriate to be an *invites*, depending on the content of Annex 3);

4 that the administration responsible for the GSO FSS satellite network with which the ESIM communicate shall ensure that:

4.1 techniques to maintain pointing accuracy with the associated GSO FSS satellite without inadvertently tracking adjacent GSO satellites; are employed for the operation of ESIM;

4.2 all necessary measures are taken so that ESIM are subject to permanent monitoring and control by a Network Control and Monitoring Centre (NCMC) or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility (this *resolves* should be assessed against the content of Annex 3);

4.3 measures, when required, are taken to limit the operation of ESIM to the territory or territories under the jurisdiction of the administrations authorizing ESIM;

4.4 a point of contact is provided for the purpose of tracing any suspected cases of unacceptable interference from ESIM;

5 that in case of unacceptable interference caused by any type of ESIM:

5.1 the administration of the country in which the ESIM is authorized shall cooperate with an investigation into the matter and provide, where possible, any required information on the operation of ESIM and a point of contact to provide such information;

5.2 the administration of the country in which the ESIM is authorized and the notifying administration of the satellite network with which the ESIM communicate shall, jointly or individually, as the case may be, upon receipt of a report of interference shall take required action to eliminate or reduce interference to an acceptable level;

Note: in resolves 5.1 and 5.2 the administration authorizing ESIM is the administration providing the radio licence to the vehicle on which the ESIM operate.

6 that the application of this Resolution does not provide regulatory status to ESIM different from that derived from the GSO FSS network with which they communicate taking into account the provisions referred to in this Resolution,

instructs the Director of the Radiocommunication Bureau

1 to take any necessary actions for the implementation of this Resolution;

2 to take any necessary actions to facilitate the implementation of this Resolution, including assisting in resolving interference, if any;

3 to report to future WRCs any difficulties or inconsistencies encountered in the implementation of this Resolution,

invites administrations

1 to collaborate, to the maximum extent practicable, for the implementation of this Resolution, in particular for resolving interference, if any;

2 to consider Annex 3 when authorizing an ESIM, as well as for bilateral or multilateral negotiations,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of the International Maritime Organization (IMO) and of the Secretary General of the International Civil Aviation Organization (ICAO).

ANNEX 1 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Provisions for ESIM to protect space services in the frequency band 27.5-29.5 GHz

1 In order to protect those non-GSO FSS systems referred to in *resolves* 1.1.6 of this Resolution, ESIM shall comply with the following provisions:

a) the level of equivalent isotropically radiated power (e.i.r.p.) density emitted by an ESIM in a geostationary-satellite network in the 27.5-28.6/29.1 GHz frequency band shall not exceed the following values for any off-axis angle ϕ which is 3° or more off the main-lobe axis of an ESIM antenna and outside 3° of the GSO:

| <i>Off-axis angle</i> | <i>Maximum e.i.r.p. density</i> |
|----------------------------------|--|
| $3^\circ \leq \phi \leq 7^\circ$ | $28 - 25 \log \phi \text{ dB(W/40 kHz)}$ |
| $7^\circ < \phi \leq 9.2^\circ$ | 7 dB(W/40 kHz) |
| $9.2^\circ < \phi \leq 48^\circ$ | $31 - 25 \log \phi \text{ dB(W/40 kHz)}$ |
| $48^\circ < \phi \leq 180^\circ$ | -1 dB(W/40 kHz) |

Option 1

b) for any ESIM that does not meet the condition *a)* above, outside of 3° of the GSO arc, the maximum ESIM on-axis e.i.r.p. shall not exceed 55 dBW for emission bandwidths up to and

including 100 MHz. For emission bandwidths larger than 100 MHz, the maximum ESIM on-axis e.i.r.p. may be increased proportionately.

Option 2

b) for any ESIM that does not meet the condition *a)* above, outside of 3° of the GSO arc, the maximum ESIM on-axis e.i.r.p. shall not exceed 55 dBW for emission bandwidths of 100 MHz. For emission bandwidths smaller or larger than 100 MHz, the maximum ESIM on-axis e.i.r.p. may be decreased or increased proportionately, as appropriate.

Option 1

2 In order to protect those non-GSO MSS feeder-links referred to in *resolves* 1.1.7 Option 1 of this Resolution, ESIM shall comply with the following:

Note: Appropriate measures to be developed based on the outcome of ongoing studies to protect non-GSO MSS feeder-links referred to in *resolves* 1.1.7 Option 1 of this Resolution.

Option 2

Consistent with *resolves* 1.1.7 Option 2, item 2 is not required.

ANNEX 2 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Provisions for maritime and aeronautical ESIM to protect terrestrial services in the frequency band 27.5-29.5 GHz

PART 1: MARITIME ESIM

1 The notifying administration of the GSO FSS satellite network with which a maritime ESIM communicates shall ensure compliance of the maritime ESIM with the following conditions:

1.1 the minimum distances from the low-water mark as officially recognized by the coastal State beyond which maritime ESIM can operate without the prior agreement of any administration is (60 to 120 km, with preference to 60 to 70 km, depending on the results of studies)* in the 27.5-29.5 GHz frequency band. Any transmissions from maritime ESIM within the minimum distance shall be subject to the prior agreement of the concerned coastal State;

* WRC-19 is invited to consider this range and decide upon a single value.

1.2 the maximum maritime ESIM e.i.r.p. spectral density towards the horizon shall be limited to 12.98 dB(W/1 MHz). Transmissions from maritime ESIM with higher e.i.r.p. spectral density levels towards the territory of any coastal state shall be subject to the prior agreement of the concerned coastal State together with the mechanism by which this level is to be maintained.

PART 2: AERONAUTICAL ESIM

Option 1 (this option is associated with option 4 of *resolves* 1.2.5 of the Resolution)

The part below is only a guidance to administrations facilitating the bilateral and multilateral coordination/agreement among the concerned administrations.

Option 2 (this option is associated with options 1, 2 and 3 of *resolves* 1.2.5 of the Resolution)

The part below is intended as provisions for aeronautical ESIM to protect terrestrial services operating in the frequency band 27.5-29.5 GHz for the implementation of *resolves* 1.2.2.

Option 3 (this option is associated with options 1, 2 and 3 of *resolves* 1.2.5 of the Resolution)

The part below is intended as provisions for aeronautical ESIM that could protect terrestrial services operating in the frequency band 27.5-29.5 GHz for the implementation of *resolves* 1.2.2.

2 The notifying administration of the GSO FSS satellite network with which an aeronautical ESIM communicates shall ensure compliance of the aeronautical ESIM with the following conditions:

2.1 when within line-of-sight of the territory of an administration, the maximum pfd produced at the surface of the Earth on the territory of an administration by emissions from a single aeronautical ESIM shall not exceed:

Option 1

| | | | |
|--|---------------------------------|-----|---|
| $\text{pfd}(\delta) = -124.7$ | (dB(W/m ² · 14 MHz)) | for | $0^\circ \leq \delta \leq 0.01^\circ$ |
| $\text{pfd}(\delta) = -120.9 + 1.9 \cdot \log_{10}(\delta)$ | (dB(W/m ² · 14 MHz)) | for | $0.01^\circ \leq \delta \leq 0.3^\circ$ |
| $\text{pfd}(\delta) = -116.2 + 11 \cdot \log_{10}(\delta)$ | (dB(W/m ² · 14 MHz)) | for | $0.3^\circ < \delta \leq 1^\circ$ |
| $\text{pfd}(\delta) = -116.2 + 18 \cdot \log_{10}(\delta)$ | (dB(W/m ² · 14 MHz)) | for | $1^\circ < \delta \leq 2^\circ$ |
| $\text{pfd}(\delta) = -117.9 + 23.7 \cdot \log_{10}(\delta)$ | (dB(W/m ² · 14 MHz)) | for | $2^\circ < \delta \leq 8^\circ$ |
| $\text{pfd}(\delta) = -96.5$ | (dB(W/m ² · 14 MHz)) | for | $8^\circ < \delta \leq 90.0^\circ$ |

where δ is the angle of arrival of the radio-frequency wave (degrees above the horizon).

Option 2

| | | | |
|--|-----------------------------|-----|-------------------------------------|
| $\text{pfd}(\delta) = -122.7$ | (dBW/m ² /1 MHz) | for | $0^\circ \leq \delta \leq 2^\circ$ |
| $\text{pfd}(\delta) = -122.7 + 2 * (\delta - 2)$ | (dBW/m ² /1 MHz) | for | $2^\circ < \delta \leq 2.3^\circ$ |
| $\text{pfd}(\delta) = -122.6 + 1.5 * (\delta - 2)$ | (dBW/m ² /1 MHz) | for | $2.3^\circ < \delta \leq 7.9^\circ$ |
| $\text{pfd}(\delta) = -113.9$ | (dBW/m ² /1 MHz) | for | $7.9^\circ < \delta \leq 90^\circ$ |

where δ is the angle of arrival of the radio-frequency wave (degrees above the horizon);

Note: With respect to Options 1 and 2 above, the effect of aggregate interference from multiple aeronautical ESIM still needs to be agreed upon, including the validity and accuracy of these masks.

Option 1

2.2 unless agreement from concerned administrations, aeronautical ESIM shall not transmit below 5/6/TBD km of altitude above the territory of the administration concerned;

Option 2

2.2 is not needed. A minimum altitude is not required since the compliance with a pfd mask in 1.1 above is sufficient to protect terrestrial services;

Note: With respect to Options 1 and 2 above, the approach of using a minimum altitude to be complied with still needs to be agreed upon.

2.3 higher pfd levels than those provided in 2.1 within an administration produced by aeronautical ESIM on the surface of the Earth above shall be subject to the prior agreement of that administration;

2.4 within the territory under the jurisdiction of an administration where the ESIM operate, aeronautical ESIM shall comply with the bilateral or multilateral agreements of the concerned administrations.

Note: Due to lack of time and the complexity of the issue, the parts of contributions addressing Annex 3, including section 3/1.5/5.2.1 and section 3/1.5/5.2.2 were not discussed in detail at CPM19-2. Therefore, the contents of this Annex and those sections are presented as in input Document [CPM19-2/1](#).

ANNEX 3 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

Land ESIM and overall responsibilities for the operation of all three ESIM types

or

Guidelines to assist administrations to authorize ESIM in the frequency band 27.5-29.5 GHz

Note: The title needs to be revised in order to align with the responsibilities stipulated in the ITU CS.

Note: It is necessary to carefully review the responsibility and obligation of each entity in this Annex with regard to the mandatory actions mentioned below.

Note: Once the content of this Annex is reviewed and agreed, the list of administrations below could be reduced or deleted, as appropriate, to reflect only the entities involved.

Note: For the operation of ESIM, the technical, operational and regulatory responsibilities of entities operating various types of ESIM (on board aircraft, on board vessels and on board land vehicles) need to be defined:

- a) notifying administration of the ESIM assignments corresponding to the satellite networks on which the ESIM operate;
- b) satellite operators of ESIM assignments;
- c) the gateway administration which facilitates the radiocommunication connection between the ESIM terminal and the satellite space station;
- d) administrations on territory (air space, territorial water and land) of which the ESIM terminal will operate.

How the responsibilities mentioned above are assumed by each of these four entities and how the interference management system would be performed need to be defined.

It is understood that there would be a monitoring and control station to take necessary actions in regard with “enabling” and “disabling” the operation of the ESIM terminals. If such actions are envisaged to be performed by the entities mentioned in a), b) and c) above, then it should be clear how such responsibilities are shared between these entities. On the other hand if such “enabling” and “disabling” functions are divided or shared by these three entities, then the responsibility of the fourth entity (the entity on the territory under the jurisdiction of which the ESIM terminals would be located) could act? Suppose that such “enabling” and “disabling” functions are totally performed outside the control of the fourth entity, then that entity which, in fact, licensed the operation of the ESIM terminals has no authority or responsibility on the function of the ESIM terminals that it authorized/licensed. However, according to the *resolves* of Resolution 1 (Rev.WRC-03) that fourth

entity is legally responsible towards other administrations in regard with any potential interference that may occur.

In addition, in case that interference caused by the operation of ESIM terminals to the terrestrial or space services of other administrations, the appropriate course of action and operational procedure on how rapidly reduce the interference to the acceptable level or its elimination is also not addressed, at all.

Shared responsibilities among various entities and administrations need to be defined.

1 For the purpose of this Annex, the entities below are defined as follows:

- a) Administration A is the administration on the territory of which an ESIM operates.
- b) Administration B is the administration on the territory of which a potentially interfered-with FS receiver is located.
- c) Administration C is the administration on the territory of which the ESIM gateway is located. The ESIM gateway is TBD.
- d) Administration D is the notifying administration of the GSO FSS network with which the ESIM communicate.
- e) Administration E is the administration on the territory of which the Network Control and Monitoring Centre (NCMC) is located. The NCMC is TBD.
- f) Administration F is the administration whose licence is mutually recognized by Administration A when an ESIM is operating on the territory under the jurisdiction of Administration A.

Note - An additional guideline may be considered to suggest that administrations authorizing ESIM should notify so to the Bureau.

g) the ESIM network operator is TBD.

or

g) the ESIM network operator is the service provider that uses capacity on the satellite communicating with the ESIM.

The following guidelines are provided for all administrations involved in the authorization and operation of ESIM in the 27.5-29.5 GHz and 17.7-19.7 GHz frequency bands:

2 With regard to Land ESIM (L-ESIM), the administration authorizing L-ESIM has the right to require:

- a) That L-ESIM operate within the territory under the jurisdiction of another administration shall only do so if authorized by that administration.
- b) The operator of any ESIM network within which the L-ESIM operate ensure that such L-ESIM only have the capability to *limit operations to/operate within* the territory of administrations having authorized those L-ESIM.

or

b) That the ESIM network operator ensures that such L-ESIM have the capability to limit operations to the territory of administrations having authorized those L-ESIM.

c) The administration authorizing L-ESIM shall require that the ESIM network operator put in place all necessary measures so that its L-ESIM are subject to permanent monitoring and

control by a NCMC or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility.

d) The operator of the ESIM network within which the L-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from L-ESIM.

3 With regard to Maritime ESIM (M-ESIM), the administration authorizing M-ESIM has the right to require:

a) That M-ESIM operating within the territorial waters under the jurisdiction of another administration shall only do so if authorized by that administration.

b) The operator of any ESIM network within which the M-ESIM operate ensure that such M-ESIM only have the capability to *limit operations/operate* within the territorial waters of administrations having authorized those M-ESIM.

c) The administration authorizing M-ESIM shall require that the ESIM network operator put in place all necessary measures so that its M-ESIM are subject to permanent monitoring and control by an NCMC or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility.

d) The administration authorizing M-ESIM shall require that the ESIM network operator provide a point of contact for the purpose of tracing any suspected cases of interference from M-ESIM.

3.1 The Administration C on the territory of which the ESIM Gateway is located and the network operator of M-ESIM operating in the international waters are responsible for compliance with all necessary actions related to the implementation of the M-ESIM licensing procedures adopted in the “Flag of the Vessel” State.

4 With regard to Aeronautical ESIM (A-ESIM), the administration authorizing A-ESIM has the right to require:

a) That A-ESIM operate within the territorial airspace under the jurisdiction of an administration only if authorized by that administration.

or

a) The administration authorizing A-ESIM shall require that A-ESIM operating within the national controlled airspace under the jurisdiction of another administration shall only do so if authorized by that administration.

b) That the ESIM network operator ensures that such A-ESIM have the capability to limit operations to the territorial airspace of administrations having authorized those A-ESIM.

or

b) The administration authorizing A-ESIM shall require that the ESIM network operator ensure that such A-ESIM only have the capability to operate within the national controlled airspace of administrations having authorized those A-ESIM.

or

b) The operator of any ESIM network within which the A-ESIM operate ensure that such A-ESIM have the capability to limit operations to the territorial airspace of administrations having authorized those A-ESIM.

c) That the ESIM network operator provide a point of contact for the purpose of tracing any suspected cases of interference from A-ESIM.

or

c) The administration authorizing A-ESIM shall require that the ESIM network operator put in place all necessary measures so that its A-ESIM are subject to permanent monitoring and control by an NCMC or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility.

d) The administration authorizing A-ESIM shall require that the ESIM network operator provide a point of contact for the purpose of tracing any suspected cases of interference from A-ESIM.

4.1 The Administration C on the territory of which the ESIM Gateway is located and the network operator of A-ESIM operating in the international airspace are responsible for compliance with all necessary actions related to the implementation of the A-ESIM licensing procedures adopted in the “Flag of the Aircraft” State.

5 At the regional or multi-country level, mutual recognition of national licences (authorizations) for the operation of ESIM is allowed subject to bilateral or multilateral agreements between the interested States on free circulation, cross-border movement and use of different types of ESIM considered in the Resolution.

Note: Due to lack of time the guidelines for the A-ESIM case have not been considered in detail. Conditions similar to the L-ESIM and M-ESIM cases, but tailored for A-ESIM operational characteristics, need to be given further consideration.

3/1.5/5.2.1 Example modification to Appendix 4 to implement *resolves* 1.1.2 to draft new Resolution [A15] (WRC-19)

APPENDIX 4 (REV.WRC-15)

Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III

ANNEX 2

Characteristics of satellite networks, earth stations or radio astronomy stations² (Rev.WRC-12)

Footnotes to Tables A, B, C and D

MOD

TABLE A
GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,
EARTH STATION OR RADIO ASTRONOMY STATION (Rev.WRC-15/19)

| Items in Appendix | A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION | Advance publication of a geostationary-satellite network | Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9 | Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9 | Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A) | Notification or coordination of a non-geostationary-satellite network | Notification or coordination of an earth station (including notification under Appendices 30A or 30B) | Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5) | Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5) | Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8) | Items in Appendix | Radio astronomy |
|--------------------|---|--|--|--|--|---|---|---|--|---|--------------------|-----------------|
| A.18 | COMPLIANCE WITH NOTIFICATION OF AIRCRAFT EARTH STATION(S) | | | | | | | | | | A.18 | |
| A.18.a | a commitment that the characteristics of the aircraft earth station (AES) in the aeronautical mobile-satellite service are within the characteristics of the specific and/or typical earth station published by the Bureau for the space station to which the AES is associated Required only for the band 14-14.5 GHz, when an aircraft earth station in the aeronautical mobile-satellite service communicates with a space station in the fixed-satellite service | | | | + | + | | | | | A.18.a | |
| A.19 | COMPLIANCE WITH § 6.26 OF ARTICLE 6 OF APPENDIX 30B | | | | | | | | | | A.19 | |
| A.19.a | a commitment that the use of the assignment shall not cause unacceptable interference to, nor claim protection from, those assignments for which agreement still needs to be obtained Required if the notice is submitted under § 6.25 of Article 6 of Appendix 30B | | | | | | | | | + | A.19.a | |
| <u>A.20</u> | <u>COMPLIANCE WITH resolves 1.1.2 OF DRAFT NEW RESOLUTION [A15] (WRC-19)</u> | | | | | | | | | | <u>A.20</u> | - |
| <u>A.20.a</u> | <u>indicator (yes) if an assignment for the 27.5-29.5 GHz and/or 17.7-19.7 GHz band in the satellite network will be used by ESIM</u> | - | - | - | - | - | <u>0</u> | - | - | - | <u>A.20.a</u> | - |
| <u>A.20.b</u> | <u>if yes under A.20.a, a commitment that the ESIM operation would be in conformity with the Radio Regulations and draft new Resolution [A15] (WRC-19) (including its Annexes)</u> | - | - | - | - | - | <u>1</u> | - | - | | <u>A.20.b</u> | - |

3/1.5/5.2.2 Example consequential suppression of Resolution 158 (WRC-15)**SUP****RESOLUTION 158 (WRC-15)**

Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service

Agenda item 1.6

*1.6 to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), in accordance with Resolution **159 (WRC-15)**;*

Resolution 159 (WRC-15) – *Studies of technical, operational issues and regulatory provisions for non-geostationary fixed-satellite services satellite systems in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space).*

3/1.6/1 Executive summary

WRC-19 agenda item 1.6 addresses the development of technical, operational and regulatory provisions in the 50/40 GHz frequency bands to facilitate sharing between non-GSO and GSO fixed-satellite services (FSS)/broadcasting-satellite service (BSS)/mobile-satellite service (MSS) systems.

There are currently no regulatory provisions for sharing between non-GSO systems and GSO networks in the 50/40 GHz frequency bands. In addition, there are no mechanisms in the RR establishing coordination procedures applicable to non-GSO systems operating within the FSS and BSS allocations in frequency bands in the 37.5 to 51.4 GHz frequency range.

ITU-R studies in the 50/40 GHz frequency bands have been conducted on sharing between non-GSO systems and GSO FSS and BSS networks. These studies concluded that developing epfd limits based on the operational parameters for a single, specific, non-GSO system results in spectrum inefficiencies for other non-GSO systems.

On the other hand, these studies identify an alternative methodology that provides more flexibility on the design and operation of non-GSO systems operating in the 50/40 GHz frequency bands and concludes that the protection of GSO networks is possible based on an assessment of aggregate interference from multiple non-GSO systems, with different configurations and orbits.

Other ITU-R studies were unable to conclude on the appropriate epfd limits to protect GSO FSS and BSS networks from the operation of non-GSO FSS systems, due to the number of possible configurations and the complexity of the non-GSO FSS systems that can be considered.

While there may not be an agreement on epfd limits, there is general consensus that it is possible to achieve compatibility in the 50/40 GHz frequency bands that would allow non-GSO FSS systems to operate while ensuring protection to GSO satellite networks in the FSS, MSS, and BSS, based on a decrease in availability and capacity loss.

WRC-19 agenda item 1.6 also considered the protection of the Earth exploration-satellite service (EESS) (passive) and radio astronomy services in adjacent bands.

ITU-R studies of compatibility between non-GSO FSS systems and EEES (passive) have shown that the limits currently in Resolution **750 (Rev.WRC-15)** are not sufficient for the protection of EEES (passive). Methods to address compatibility between non-GSO FSS and EEES (passive) propose new unwanted emission limits for inclusion in Resolution **750 (Rev.WRC-15)**.

New limits to Resolution **750 (Rev.WRC-15)** have also been proposed to address compatibility issues between GSO FSS and EEES (passive), Resolution **159 (WRC-15)** calls for the examination of the aggregate FSS interference. Some sharing studies under this agenda item have shown that GSO FSS networks alone operating at the existing limits on unwanted emission power from the FSS in Resolution **750 (Rev.WRC-15)** for 49.7-50.2 GHz and 50.4-50.9 GHz would exceed the

protection criteria for EESS (passive) in 50.2-50.4 GHz, and therefore the aggregate unwanted emissions from GSO and non-GSO FSS together in the 49.7-50.2 GHz and 50.4-50.9 GHz bands would also exceed the protection criteria of EESS (passive) systems unless both GSO and non-GSO limits are modified. Some administrations are of the view that the modification of GSO limits may be out of the scope of this agenda item.

Compatibility studies between RAS and non-GSO FSS systems showed that substantial filtering of out-of-band emissions and perhaps other mitigation methods would be required to ensure compatibility between RAS and FSS (space-to-Earth) operations. Geographic separation from RAS stations would be needed to ensure compatibility between RAS and FSS (Earth-to-space).

Two methods have been proposed to respond to this agenda item.

3/1.6/2 Background

Advances in satellite design, manufacturing and launch service capabilities have enabled the deployment of non-GSO FSS constellations. Additionally, the advances in antenna and terminal technology have enabled the development of the 50/40 GHz frequency bands for both GSO FSS/BSS and non-GSO FSS.

There are currently no regulatory provisions for sharing between non-GSO systems and GSO networks in the 50/40 GHz frequency bands. Moreover, there are no existing mechanisms in the RR establishing coordination procedures applicable to non-GSO systems operating within the FSS allocations in frequency bands in the 37.5 to 51.4 GHz range, such as the application of RR No. **9.12**. This also contributes to uncertainty among potential operators of non-GSO satellite systems in these bands.

To address these issues, WRC-15 established agenda item 1.6 for WRC-19: *“to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) in accordance with Resolution **159 (WRC-15)**”*.

3/1.6/3 Summary and analysis of the results of ITU-R studies

Non-GSO FSS and GSO FSS/BSS studies

The results of the studies carried out in ITU-R showed that compatibility between non-GSO FSS satellite systems using circular orbits and GSO FSS/BSS networks in the 50/40 GHz frequency bands is achievable. The results of all studies demonstrated that the criterion of a 10% increase in the unavailability caused by interference was met taking into account the operational scenarios for tracking the non-GSO satellites and operational mitigation techniques.

Non-GSO FSS and EESS (passive) studies

Several compatibility studies carried out in ITU-R between non-GSO FSS systems and EESS (passive) have shown that the limits currently in Resolution **750 (Rev.WRC-15)** are not sufficient for the protection of EESS (passive) in the adjacent band 50.2-50.4 GHz. These studies showed that unwanted emission limits in the range of $-51.3 \dots -69.8$ dB(W/200 MHz) for non-GSO FSS user equipment and in the range of $-27 \dots -66$ dB(W/200 MHz) for gateways would be required to meet the EESS (passive) protection criteria in Recommendation ITU-R RS.2017; these studies did not exhaustively explore all the possible mitigation methods. One study demonstrated that a 3 dB decrease of the input power to the non-GSO FSS earth station antenna flange may be appropriate to meet the EESS (passive) protection criteria.

3/1.6/3.1 Studies regarding propagation and sharing considerations between non-GSO and GSO systems

ITU-R studies have shown that in the 50/40 GHz frequency bands, propagation impairments such as rain, cloud and gaseous absorption exist that can substantially affect FSS and BSS satellite links. Not only are rain fade and gaseous absorption propagation effects more severe than in lower frequency bands, but effects such as cloud attenuation can also have a significant impact to the FSS and BSS intra-service sharing environment in the 50/40 GHz frequency bands. Thus, higher margins of atmospheric fade can exist as compared to lower frequency bands when evaluating sharing criteria between non-GSO and GSO systems in the 50/40 GHz frequency bands. These propagation impairments should be taken into account on both, the wanted and interfering paths in the downlink direction, noting that there may be differences in the attenuation experienced by each path but with limited impact on the total degradation of the link for some specific scenarios.

3/1.6/3.2 Studies regarding non-GSO FSS and GSO FSS/BSS sharing

The objective is to identify the means to enable use of the 50/40 GHz frequency bands by non-GSO systems that will ensure protection of co-frequency GSO FSS and BSS networks from unacceptable interference, thereby enhancing spectrum use. Ten studies have been presented including discussions of the derivation of epfd masks and propagation considerations that must be taken into account for the development of appropriate regulatory provisions in the 50/40 GHz frequency bands.

Non-GSO and GSO FSS Study 1 presents an analysis of the generation of epfd mask based on low-Earth orbit (LEO) constellations of 2 000 and 4 000 satellites. The LEO constellations are at an altitude of 1 200 km and a minimum service elevation angle of 45°.

The analysis presents a background on the methodology for deriving aggregate epfd limits based on procedures carried out in lower frequency bands using Recommendations ITU-R S.1503, ITU-R P.618 and the sharing considerations given in Recommendation ITU-R S.1323. Given that this analysis deduced epfd↓ masks based on a particular representative LEO constellation, the epfd↓ masks are system specific and they are variable, depending on the particular operations of the non-GSO constellation chosen for defining a particular mask. The analysis shows that situations can arise where a particular system cannot meet a specific limit mask (deduced from a different system) but meets the GSO protection criteria given in Recommendation ITU-R S.1323. An analysis is also presented that shows the effect of accounting for propagation losses on the interfering path. The result of this study shows that there can be a significant operational margin available to the GSO when propagation impairments are taken into account.

Non-GSO and GSO FSS Study 2 provides a simulation and results of a study of the sharing between a non-GSO FSS satellite system in a circular equatorial orbit and a GSO network in the 48/38 GHz frequency bands. The results show the epfd and I/N statistics, the C/N and $C/(N+I)$ curves of the GSO network, and the effect on availability due to interference from the non-GSO system. Based on the input assumptions, the results show that the unavailability targets in Recommendation ITU-R S.1323 of 10% increase are met and suggest that the epfd levels for the non-GSO system could be acceptable. It is noted that the results are based on a single non-GSO FSS system. This study acknowledges that it is necessary to consider aggregation effects taking into account different constellation types rather than a single equatorial circular orbit non-GSO system.

This study was expanded to consider the methodology of percentage increase in unavailability described in Recommendation ITU-R S.1323, which was used as the basis for the preliminary draft new Recommendation ITU-R S.[50/40 GHZ FSS SHARING METHODOLOGY]. The results demonstrated that the percentage increase in unavailability caused by interference from a non-GSO system was below the proposed 3% metric, which suggests that this metric could serve as the

single-entry limit for new non-GSO FSS systems to protect GSO satellite networks in the subject frequency ranges.

Non-GSO and GSO FSS Study 3 presents a comparison of the LEO system presented in non-GSO and GSO FSS Study 1 and the MEO system presented in non-GSO and GSO FSS Study 2. The purpose of the comparison in this study is to present an assessment of potential sharing between these two systems, with a view to maximize spectral efficiency in the 50/40 GHz frequency bands.

The analysis provides a comparison of the representative interference profiles derived in the studies from non-GSO and GSO FSS Study 1 and non-GSO and GSO FSS Study 2 relating to non-GSO constellations in LEO and MEO orbits. The analysis shows that the methodology used in both studies derives a potential epfd mask on the basis of the relevant non-GSO system considered; therefore, they are completely dependent on the characteristics of the systems being evaluated. While using this methodology, potential epfd masks can be developed for a particular system; consequently, it is difficult to define epfd masks that would allow all non-GSO systems to operate and provide for maximum spectrum efficiency while assuring that GSO protection criteria will always be observed.

The analysis also shows that if masks are developed for the operation of one particular non-GSO system, a separate non-GSO system may not be able to meet the requirements from that mask. However, each system independently, and even in composite form, is able to meet the protection criteria given in Recommendation ITU-R S.1323 with excess margin available.

Non-GSO and GSO FSS Study 4 considers, both the uplink and downlink interference from two different non-GSO systems into a GSO network at varying elevation angles. The two non-GSO systems modelled were a LEO system at 1 200 km and a MEO system at 8 062 km. Two sets of five earth stations with five different elevation angles to the GSO were simulated, with the victim and interfering earth stations always being co-located. This study did not include any propagation impairments other than free-space path loss. If other attenuation losses such as rain and cloud attenuation, which have significant impact on both the wanted and interfering signal, are taken into account, then the resulting I/N ratios would be lower.

- For the first interference scenario (LEO and GSO), in the downlink, the study shows that the receiving GSO earth stations at lower elevation angles to the GSO satellite were more susceptible to interference from non-GSO systems. In the uplink, the interference into a GSO satellite from LEO earth stations was studied showing low levels of interference at the GSO satellite from earth stations located at most elevation angles to the GSO. When the elevation angles of the earth stations to the GSO were increased, the results showed higher levels of interference, but for small percentages of time.
- For the second interference scenario (MEO and GSO), the study shows that receiving GSO earth stations at lower elevation angles to the satellite receive lower I/N ratios from the equatorial MEO system. When earth stations with higher elevation angles to the GSO were studied, higher levels of interference were received, with the greatest impact to earth stations with elevation angles of 10° and 0° to the GSO. No geostationary arc avoidance was used in the MEO study. In terms of the uplink interference to the GSO satellite, the I/N levels were found to be relatively low (under the conditions assumed), except for when the interfering earth stations were located at high elevation angles to the GSO.

Non-GSO and GSO FSS Study 5 is an analysis with a circular orbit LEO non-GSO FSS system using parameters similar to the 3ECOM-2 satellite network (BR IFIC 2788), as an example of a typical non-GSO constellation deployment. The system consists of 12 orbits with 28 satellites in each orbit, which provides a total of 336 satellites in the system.

Assuming that the protection criterion for GSO FSS networks is a 10% increase to unavailability caused by the interference, the criterion was not exceeded for GSO beams from both low latitude and medium latitude scenarios in this study. The level of emissions from the non-GSO system depicted in this document were acceptable based on the assumptions in this study. Although the downlink pfd values of the non-GSO system exceeded the pfd requirement in RR Table 21-4, the compatibility between these two FSS systems depicted in this document was achieved. Given that the non-GSO FSS system downlink transmitting power would need to be decreased to meet the RR Table 21-4 pfd limits, this lower power would further aid the sharing of non-GSO and GSO systems.

With the parameters of non-GSO and GSO systems depicted in Study 5, the calculated epfd limits were $-152 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for uplink and $-148 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for downlink. These calculated results are for this specific case of frequency sharing between non-GSO and GSO systems.

Non-GSO and GSO FSS Study 6 is an analysis regarding interference by a non-GSO system to a GSO system in 50/40 GHz frequency bands under different conditions in two scenarios.

The configuration and orbital parameters of the simulated non-GSO system is extracted from 3ECOM-3 filing with some characteristics modification to scale it in the 50/40 GHz frequency bands. The worst-case geometry location for the non-GSO system is calculated based on Recommendation ITU-R S.1503 and standard propagation models are used for simulations as referenced in Recommendation ITU-R P.525 and Recommendation ITU-R P.618 to model free-space loss and rain attenuation.

The operational scenarios for tracking the non-GSO satellites are as follows:

Scenario 1:

- Minimum elevation angle: 20°
- GSO avoidance angle: 2°
- The interfering non-GSO satellite is chosen based on the highest elevation angle.

Scenario 2:

- Minimum elevation angle: 40°
- GSO avoidance angle: 10°
- The interfering non-GSO satellite is chosen based on the highest elevation angle.

Based on Recommendation ITU-R S.1323, if the criterion is a 10% increase in the unavailability caused by interference, the increase in unavailability from a non-GSO system for Scenario 1 has not been met but for Scenario 2 it has been met. Then the interference from non-GSO system with Scenario 2 tracking strategy depicted in this document is acceptable.

The effects of interference on the user terminal antenna are greater than on the gateway antenna.

By the change in some of the parameters in tracking strategy, it is possible to decrease interference from a non-GSO system. Therefore, it could be concluded that frequency sharing between GSO and non-GSO satellite systems is possible provided that appropriate tracking strategies are used.

Non-GSO and GSO FSS Study 7 is an analysis of the operation of non-GSO systems into GSO networks that use adaptive coding and modulation (ACM). This analysis discusses the operation of ACM in GSO systems and potential procedures in terms of impact on data rate that can be taken into account for protection of these types of ACM operations. The analysis produces several results regarding the impact of non-GSO systems on GSO operations using ACM. The analysis concludes

that further work is required to address how to account for the operations of non-GSO systems and the protection of GSO operations employing ACM.

In non-GSO and GSO FSS Study 8, for every $C/(N+I)$ value of any GSO link, it is possible to determine the corresponding unavailability purely due to propagation effects using Recommendation ITU-R P.618. Limiting the increase of such unavailability (or decrease in capacity for networks using adaptive coding) is the basis to establish the constraints to be imposed to non-GSO systems. Indeed, the non-GSO interference on the GSO links should be limited in a way that the unavailability of the GSO systems is not increased above a defined level that is often expressed in percentage of the unavailability due to propagation effects. For GSO networks using ACM, the non-GSO interference should be limited in a way that it is at the origin of a specific maximum percentage of decrease in the amount of throughput of the GSO network. Using this approach, the permissible interference levels induced by non-GSO systems on a GSO link may be completely independent of the characteristics or number of non-GSO system(s) and are only dependent on the GSO link to be protected. Based on this approach, maximum interference levels can be transformed into aggregate *epfd* limits.

Given that this approach assumes that deep rain fades on the GSO link may occur at the same time as high interference events from the non-GSO systems, the method might be overprotective for GSO links.

Non-GSO and GSO FSS Study 9 verifies the applicability of the methodology to calculate the increase in unavailability of three identical forward GSO reference links (gateway-to-user) from interference of non-GSO systems. It was assumed that the rain fade of the wanted links and the interference links was 100% correlated in the space-to-Earth direction given the limitations of the software. The percentage of unavailability due to the combined impact of the rain and the non-GSO interference was determined for the overall uplink and downlink, using the respective C/N objective for each system. The increase in unavailability is given by the ratio of the percentage of unavailability with interference and without interference. Results demonstrate that the highest increase in unavailability created by one non-GSO system for the overall uplink and downlink was 0.7%, using the respective C/N objective for each system. The increase in unavailability is given by the ratio of the percentage of unavailability with interference and without interference. It is also shown that when a larger GSO arc avoidance angle is applied, the increase in unavailability of the GSO link is reduced. The absence of GSO arc avoidance leads to high increases in unavailability. Finally, it is noted that most of the increase in unavailability is caused by interference into the downlink segments of the GSO links, while the impact on the uplink is almost negligible. Consequently, mitigation measures or regulatory limits to protect GSO networks would be more effective in the space-to-Earth direction.

Non-GSO and GSO FSS Study 10 is a sharing study on the long-term impact to the spectral efficiency of a GSO system employing ACM that is subjected to interference from a non-GSO system. The results show that during rain fading events, the reduction in spectral efficiency is mostly due to the degradation in the carrier-to-noise ratio due to rain attenuation.

Two interference scenarios from a non-GSO system into the downlink of a GSO network were considered. In the first case, the GSO earth station was at a higher latitude (Saskatoon, Canada) and the interference had minimal impact on the spectral efficiency of a link employing ACM. In the second case, the GSO earth station was assumed to be at a lower latitude (Lima, Peru). The analysis and calculations show that even with high peaks in I/N (up to 33 dB), the reduction in the long-term time averaged spectral efficiency for the second case was about 2%.

In addition, an analysis relating the degradation in spectral efficiency of a link employing ACM to the duration of I/N interference burst was performed. Taking into account the wide dynamic range

of C/N over which ACM systems can operate, short bursts of interference with high I/N levels do not substantially degrade the performance of an ACM system.

3/1.6/3.3 Studies regarding non-GSO FSS and EESS (passive) considerations

Resolution **159 (WRC-15)** also calls for studies regarding protection of EESS (passive) systems in the frequency bands 36-37 GHz and 50.2-50.4 GHz from planned non-GSO systems, including the study of aggregate FSS interference effects from networks and systems operating or planning to operate in these bands. Current out-of-band limits for FSS earth stations operating in the channels adjacent to the 50.2-50.4 GHz EESS (passive) band are specified in Resolution **750 (Rev.WRC-15)**.

FSS-EESS (passive): Study 1 examined the interference into the 50.2-50.4 GHz frequency band through two methodologies and determined that interference caused by the four specific non-GSO systems analysed does not aggregate on a power basis for small percentages of time but that the aggregate interference environment is from the dominant link. This study demonstrated that to maintain the non-GSO contribution to the established aggregate FSS interference environment allowed by Resolution **750 (Rev.WRC-15)**, the aggregate power in excess of -166 dB(W/200 MHz) for no more than 0.01% of the time over an area of 2 000 000 km² in the frequency band 50.2-50.4 GHz was calculated to be 0.2 dB higher than what is currently experienced from a single FSS non-GSO system with MEOSAT-X characteristics. To remove this minor excess and maintain the existing non-GSO FSS interference profile, a 3 dB decrease of the input power to the antenna flange may be appropriate for the new FSS non-GSO satellite systems.

FSS-EESS (passive): Study 2 examined the interference into the 36-37 GHz frequency band and indicated that the probability of exceeding the acceptable EESS interference level is at least two orders of magnitude lower than the 0.1% criterion in the 36-37 GHz frequency band.

FSS-EESS (passive): Study 3 was an interference analysis in the 50.2-50.4 GHz frequency band examining all four EESS sensor types over nine different measurement areas across the world. This study explored the effects of gateway and user terminal and additionally considered the aggregate effects of multiple non-GSO systems. This study determined that the worst-case aggregate interference for gateways exceeded the protection criteria specified by Recommendation ITU-R RS.2017 by 74.3 dB using an out-of-band power of 0 dB(W/200 MHz) reducing the out-of-band power to -10 dB(W/200 MHz), which is the current limit for gateways in Resolution **750 (Rev.WRC-15)**, the exceedance would be 64.3 dB, however, the needed out-of-band limit to meet the protection criteria would be the same. When considering GSO and non-GSO interference separately, it was demonstrated that the GSO FSS gateway earth stations can cause 25.3 dB of exceedance at elevation angles below 70 degrees and as much as 74.3 dB with elevation angles above 70 degrees when considering an input power of 0 dB(W/200 MHz). Non-GSO FSS earth stations (aggregate of gateways and user terminals) caused 58.8 dB of exceedance of the protection criteria when considering an input power of 0 dB(W/200 MHz) reducing the out-of-band power to -10 dB(W/200 MHz), which is the current limit for gateways in Resolution **750 (Rev.WRC-15)**, the exceedance would be 48.8 dB, however the needed out-of-band limit to meet the protection criteria would be the same. When considering how interference from multiple non-GSO systems aggregates, the analyses demonstrated that aggregation could increase the exceedance of the EESS protection criteria by more than 11 dB over the exceedance that was calculated for a single system, depending on specific systems considered and in what order they are analysed.

FSS-EESS (passive): Study 4 examined the interference in the 50.2-50.4 GHz frequency band and determined that limits provided in Resolution **750 (Rev.WRC-15)** were not sufficient to meet the interference criteria. An additional attenuation of up to 17 dB for gateway links and up to 44 dB for service links would still be required. These values are determined by the sensitivity of the push-broom sensor. To protect the conical and the mechanical nadir sensors, attenuation of 3.3 dB and

18 dB would be required for gateways and user terminals, respectively. With respect to the 36-37 GHz frequency band, the study showed that when using a worst-case of out-of-band emission (OOBE) mask, the interference criteria was not exceeded for the EESS sensors studied in the 36-37 GHz frequency band and for the non-GSO FSS systems modelled. As such, a more refined study to better model OOBE into the EESS (passive) systems was not undertaken. These results suggest that non-GSO FSS systems and EESS (passive) systems in the 37 GHz range are compatible.

FSS-EESS (passive): Study 5 determined that an out-of-band limit to protect the EESS (passive) in the 50.2-50.4 GHz band of -44.1 dB(W/200 MHz) would be needed for GSO FSS gateways and -58.1 for GSO FSS user equipment (without any constraint on the GSO FSS elevation angle, to possibly relax the out-of-band limits for the GSO FSS earth stations), -48.7 dB(W/200 MHz) for non-GSO gateway earth stations and a limit of -51.3 dB(W/200 MHz) is needed for user terminals. This is assuming a 3 dB apportionment of the EESS (passive) protection criterion.

FSS-EESS (passive): Study 6 results have shown that the protection criteria for GSO EESS (passive) systems is exceeded by 46 dB. Therefore -66 dB(W/200 MHz) for non-GSO gateway earth stations is needed if there is no avoidance angle for the non-GSO FSS earth stations. In order to protect GSO EESS (passive) systems in the 50.2-50.4 GHz frequency band, the GSO avoidance angle for the non-GSO FSS earth stations should not be less than 10° when the OOB emissions from each FSS ES is limited to -20 dB(W/200 MHz).

These studies did not consider the impact on GSO FSS networks or non-GSO FSS systems of constraining operations to not exceed the EESS (passive) protection criteria in Recommendation ITU-R RS.2017. Additionally, studies between the EESS (passive) and FSS did not fully consider all possible interference mitigation techniques.

3/1.6/3.4 Studies regarding non-GSO FSS and RAS considerations

Studies have been carried out in working document towards a WD PDN Report ITU-R S.[50/40 GHz ADJACENT BAND STUDIES] to assess the impact of a LEO and MEO non-GSO system into RAS operations in the 42.5-43.5 GHz, 48.94-49.04 GHz and 51.4-54.25 GHz frequency bands.

3/1.6/3.4.1 Non-GSO (Earth-to-space)

One study provided generic calculations for separation distances between a single non-GSO FSS earth station operating in the 50.4-51.4 GHz frequency band and a RAS station operating at 48.94-49.04 GHz and 51.4-53.4 GHz frequency bands. The study investigated in-band sharing and also compatibility in the out-of-band and spurious domains.

The separation distances for protection of the spectral-line observation of RAS stations in the frequency band 48.94-49.04 GHz from the in-band emission of non-GSO FSS ES in single emitter scenario vary from 46 km up to 129 km. Separation distances for protection of the RAS stations operating in the frequency band 51.4-53.4 GHz from the out-of-band emission of non-GSO FSS ES operating in the frequency band 50.4-51.4 GHz vary from 14 km up to 120 km. Separation distances for protection of the RAS stations operating in the frequency band 51.4-54.25 GHz from the spurious emissions of non-GSO FSS ES operating in the frequency band 50.4-51.4 GHz vary from distances less than 1 km up to 37 km.

These separation distances were obtained using technical parameters directly from Recommendation ITU-R SM.1541-6 for the non-GSO FSS ES and do not take into account the terrain profile for the interfering signal and also the deployment density of the earth stations. The separation distances could be adjusted to more realistic values by taking into account actual terrain profiles and more realistic non-GSO FSS ES parameters.

3/1.6/3.4.2 Non-GSO (space-to-Earth)

Studies of non-GSO FSS system downlinks operating in the frequency band 37.5-42.5 GHz showed that substantial filtering of the satellite emissions, or other operational measures by FSS operators, would be needed to satisfy the requirements of RR Nos. **5.551H** and **5.551I** to protect the RAS operating in the frequency band 42.5-43.5 GHz.

3/1.6/3.5 Studies regarding non-GSO FSS to non-GSO FSS mitigation considerations

The objective of this study was to determine the effectiveness of mitigation techniques such as orbital avoidance angles and earth station diversity in reducing in-line interference events, thereby allowing for sharing between next-generation non-GSO FSS constellations. Up to three non-GSO FSS systems were simulated simultaneously. The study concludes that these mitigation techniques are effective in reducing the number of in-line interference events that exceed an I/N threshold of -12.2 dB, as well as the duration of the longest and average interference events and the value of the worst-case exceedance.

3/1.6/4 Methods to satisfy the agenda item

Two methods are proposed to address WRC-19 agenda item 1.6. These methods are described below.

There are two issues within WRC-19 agenda item 1.6:

Issue 1: Developing a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space). There are two methods to address this issue.

One method proposes to add footnotes to RR Article **5** that subjects non-GSO FSS and MSS systems to coordination provisions, add provisions to RR Article **22** in order to protect GSO satellite networks, and establishes a consultation group to coordinate aggregate interference in order to protect GSO satellite networks.

The other method is to carry forward the studies to ensure the protection of GSO satellite networks under WRC-19 agenda item 1.6 to a new WRC-23 agenda item towards the development of epfd limits.

Issue 2: Modifying Resolution 750 (Rev.WRC-15)

For the method that proposes to revise Resolution **750 (Rev.WRC-15)** for the protection of EESS (passive) in the band 50.2-50.4 GHz, 2 general options are considered (see end of section 5):

- OPTION A: Revision of limits for non-GSO systems only;
- OPTION B: Revision of limits for both GSO networks and non-GSO systems

An appropriate time-frame for these revisions to become effective would need to be determined. Additional options have been proposed to this effect. Techniques for non-GSO systems aside from an input power limit could also be considered to protect passive sensing while ensuring efficient use of the spectrum.

Some administrations are of the view that modifications to Resolution **750 (Rev.WRC-15)** for GSO networks are not within the scope of this agenda item, since Resolution **159 (WRC-15)** calls for studies of technical operational issues and regulatory provisions on non-GSO FSS systems.

Some administrations are of the view that due to the explicit call of Resolution **159 (WRC-15)** to study aggregate FSS interference effects modifications to Resolution **750 (Rev.WRC-15)** for GSO networks are within the scope of the agenda item.

3/1.6/4.1 Method A of Issue 1

This method presents a regulatory and technical implementation to modify RR Article **22** to include provisions to enable the operation of non-GSO systems, based upon the time allowance for the C/N value specified in the short-term performance objective and the decrease in spectral efficiency (for networks using ACM) of the specified short-term and long-term performance objectives of the reference GSO links contained in WD towards a PDN Recommendation ITU-R S.[50/40REFERENCE LINKS].

The technical approaches to developing sharing criteria for the 50/40 GHz frequency bands should focus on providing approaches that maximize spectrum efficiency for non-GSO FSS systems, while protecting GSO networks. This method provides the regulatory provisions that ITU-R sharing studies have found to be an efficient manner of promoting maximum spectrum use in the 50/40 GHz frequency bands. Applying this method results in additional spectrum efficiency gained when designing non-GSO protection based on multiple configurations and orbits and the ability to keep track of aggregation factors.

This method includes the following modifications to the Radio Regulations:

- There are four options to add RR No. **5.A16** to subject the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) to the provisions of RR No. **9.12** to address the coordination between non-GSO FSS systems.
- Modify RR Article **22** to include a single-entry permissible time allowance for degradation in terms of C/N specified in the short-term and long-term performance objectives of GSO FSS networks in the 50/40 GHz frequency bands in order to protect GSO FSS satellite networks from non-GSO FSS systems operating in the subject frequency ranges. The short-term and long-term performance objectives are associated to the availability and spectral efficiency of the GSO link, respectively.
- Modify RR Article **22** to include aggregate time allowance for degradation in terms of C/N of GSO FSS networks in order to protect GSO FSS satellite networks from multiple non-GSO FSS systems operating in the subject frequency ranges and develop a new WRC Resolution providing the procedure to ensure that aggregate limits will not be exceeded.
- Incorporate by reference new ITU-R Recommendation containing the GSO reference links, which will be used to verify the compliance of non-GSO systems with single-entry and aggregate limits.
- There is an option to incorporate by reference the new PDN Recommendation ITU-R S.[50/40 GHz FSS sharing] that contains, *inter alia*, the methodology for determining conformity of non-GSO systems to the single-entry limits to protect the GSO networks.
- Add a new footnote RR No. **5.B16** in the frequency bands 39.5-40 GHz and 40-40.5 GHz in all Regions to address the coordination between MSS and non-GSO FSS systems.
- Modify the unwanted emission limits for the FSS in Resolution **750 (Rev.WRC-15)** to protect EESS (passive) systems operating in the band 50.2-50.4 GHz from harmful interference from FSS systems operating in the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz.

3.1.6/4.2 Method B of Issue 1

Method B is to carry forward the studies to ensure the protection of GSO satellite networks under WRC-19 agenda item 1.6 to a new WRC-23 agenda item towards the development of epfd limits.

Resolution **159 (WRC-15)** indicates that technical and regulatory studies, under this agenda item, shall focus exclusively on the development of equivalent power flux-density limits to protect GSO FSS satellite networks from non-GSO FSS systems as appropriate.

There are views that developing appropriate equivalent power flux-density limits is still not satisfied and if the relevant epfd limits are still not agreed upon in time for WRC-19, the studies conducted to protect the GSO satellite network, under this agenda item, should be carried forward to a new WRC-23 agenda item and should be modelled after Resolution **159 (WRC-15)**.

3/1.6/5 Regulatory and procedural considerations

The regulatory and procedural considerations to satisfy the agenda item are considered below for each of the proposed methods defined in section 3/1.6/4.

3/1.6/5.1 For Method A of Issue 1

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

34.2-40 GHz

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 37.5-38 | FIXED FIXED-SATELLITE (space-to-Earth) <u>ADD 5.A16</u> MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547 | |
| 38-39.5 | FIXED FIXED-SATELLITE (space-to-Earth) <u>ADD 5.A16</u> MOBILE Earth exploration-satellite (space-to-Earth) 5.547 | |
| 39.5-40 | FIXED FIXED-SATELLITE (space-to-Earth) 5.516B <u>ADD 5.A16</u> MOBILE MOBILE-SATELLITE (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547 <u>ADD 5.B16</u> | |

MOD**40-47.5 GHz**

| Allocation to services | | |
|---|---|---|
| Region 1 | Region 2 | Region 3 |
| 40-40.5 | EARTH EXPLORATION-SATELLITE (Earth-to-space) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B <u>ADD 5.A16</u> MOBILE MOBILE-SATELLITE (space-to-Earth) SPACE RESEARCH (Earth-to-space) Earth exploration-satellite (space-to-Earth) <u>ADD 5.B16</u> | |
| 40.5-41 FIXED FIXED-SATELLITE (space-to-Earth) <u>ADD 5.A16</u> BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 | 40.5-41 FIXED FIXED-SATELLITE (space-to-Earth) 5.516B <u>ADD 5.A16</u> BROADCASTING BROADCASTING-SATELLITE Mobile Mobile-satellite (space-to-Earth) 5.547 | 40.5-41 FIXED FIXED-SATELLITE (space-to-Earth) <u>ADD 5.A16</u> BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 |
| 41-42.5 | FIXED FIXED-SATELLITE (space-to-Earth) 5.516B <u>ADD 5.A16</u> BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 5.551F 5.551H 5.551I | |
| ... | | |
| 47.2-47.5 | FIXED FIXED-SATELLITE (Earth-to-space) 5.552 <u>ADD 5.A16</u> MOBILE 5.552A | |

MOD**47.5-51.4 GHz**

| Allocation to services | | |
|--|--|----------|
| Region 1 | Region 2 | Region 3 |
| 47.5-47.9 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 <u>ADD 5.A16</u> (space-to-Earth) 5.516B 5.554A MOBILE | 47.5-47.9 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 <u>ADD 5.A16</u> MOBILE | |

information is received by the Bureau after 1 January 2021, is subject to the application of the provisions of No. **9.12** for coordination with other non-geostationary-satellite systems in the fixed-satellite service, but not with non-geostationary systems in other services. Non-GSO systems in the fixed-satellite service in these frequency bands shall operate in accordance with draft new Resolution [A16] (WRC-19). No. **22.2** shall continue to apply. (WRC-19)

Option 3:

ADD

5.A16 The use of the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by a non-geostationary-satellite system in the fixed-satellite service is subject to the application of the provisions of No. **9.12** for coordination with other non-geostationary-satellite systems in the fixed-satellite service. (WRC-19)

Option 4:

ADD

5.A16 The use of the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by a non-geostationary-satellite system in the fixed-satellite service is subject to the application of the provisions of No. **9.12**. (WRC-19)

Option 1:

ADD

5.B16 The use of the frequency bands 39.5-40 and 40-40.5 GHz by the mobile-satellite service (space-to-Earth) and non-geostationary-satellite systems in the fixed-satellite service (space-to-Earth) is subject to coordination under No. **9.11A**. (WRC-19)

Option 2:

ADD

5.B16 The use of the frequency bands 39.5-40 and 40-40.5 GHz by non-geostationary-satellite systems in the mobile-satellite service (space-to-Earth) and non-geostationary-satellite systems in the fixed-satellite service (space-to-Earth) for which complete coordination information is received by the Bureau after 1 January 2021, is subject to coordination under No. **9.12**. (WRC-19)

Option 3:

ADD

5.B16 In the frequency bands 39.5-40 GHz and 40-40.5 GHz, the provisions No. **22.2** also applies to non-geostationary systems in the fixed-satellite service with respect to geostationary-satellite networks in the mobile-satellite service. (WRC-19)

Method A (continued)**MOD**

5.338A In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 30-31.3 GHz, 49.7-50.2 GHz, 50.4-50.9 GHz, 51.4-52.6 GHz, 81-86 GHz and 92-94 GHz, Resolution **750 (Rev.WRC-1519)** applies. (WRC-1519)

ARTICLE 22**Space services¹****Section II – Control of interference to geostationary-satellite systems****ADD**

22.5L 9) A non-geostationary system in the fixed-satellite service in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) shall not exceed:

- a single entry of 3% of the time allowance for the C/N value specified in the short-term performance objective associated with the shortest percentage of time (lowest C/N) for each GSO reference link; and

Option 1:

- a 3% reduction in time-averaged spectral efficiency as associated with the long-term performance objective for each GSO reference link using adaptive coding and modulation.

Note: The term “time-averaged” means averaged over a period of a year, in accordance with Recommendation ITU-R P.618. A view was expressed that further clarification may be required on the reference point for which the reduction in spectral efficiency is considered.

Option 2:

- a 3% reduction in reserve capacity as associated with the long-term performance objective defined over one year for each GSO reference link using adaptive coding and modulation.

Note: The term “reserve capacity” is used in Recommendation ITU-R S.1323, but for which there are no examples for calculation and would require further clarification in Option 2. To date, Option 2 has not been studied in the ITU-R, but considers the same principle as in Recommendation ITU-R S.1323.

These calculations shall be performed using the GSO reference links contained in WD towards a PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] and the methodology provided in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY]. The epfd levels from the non-GSO FSS system should be derived using the most recent version of Recommendation ITU-R S.1503. (WRC-19)

ADD

22.5M 10) Administrations operating or planning to operate non-geostationary-satellite systems in the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz shall ensure that the aggregate interference to GSO FSS, MSS and BSS networks does not exceed 10% of the short- and long-term performance objectives by applying the provisions of draft new Resolution [A16] (WRC-19). (WRC-19).

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations^{1, 2, 3, 4, 5, 6, 7, 8, 9} (WRC-15)

Section II – Procedure for effecting coordination^{12, 13}

Sub-Section IIA – Requirement and request for coordination

MOD

9.35 a) examine that information with respect to its conformity with No. **11.31**^{MOD 19}; ~~___~~ (WRC-~~2000~~19)

MOD

¹⁹ **9.35.1** The Bureau shall include the detailed results of its examination under No. **11.31** of compliance with the limits in Tables **22-1** to **22-3** or the applicable single-entry limits in No. **22.5L** of Article **22** in the publication under No. **9.38**. (WRC-~~2000~~19)

ADD

DRAFT NEW RESOLUTION [A16] (WRC-19)

Protection of geostationary FSS, BSS and MSS) networks from unacceptable interference from non-GSO FSS systems in the 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz frequency bands

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

a) that the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz are allocated, *inter alia*, on a primary basis to the fixed-satellite service (FSS) in all Regions;

- b) that the frequency bands 40.5-41 GHz and 41-42.5 GHz are allocated, on a primary basis to the broadcasting-satellite service (BSS) in all regions;
 - c) that the frequency bands 39.5-40 GHz and 40-40.5 GHz are allocated, on a primary basis to the mobile-satellite service (MSS) in all regions;
 - d) that Article **22** contains regulatory and technical provisions on sharing between GSO and non-GSO FSS systems in these bands in *considering a*);
 - e) that, in accordance with No. **22.2**, non-geostationary-satellite orbit (non-GSO) systems shall not cause unacceptable interference to geostationary-satellite orbit (GSO) FSS and broadcasting-satellite service (BSS) networks and, unless otherwise specified in the Radio Regulations, shall not claim protection from GSO FSS and BSS satellite networks;
 - f) that non-GSO FSS systems would benefit from increased certainty that would result from the quantification of technical regulatory measures required for protection of GSO satellite networks operating in the bands referred to in *considering a*), *b*) and *c*) above;
 - g) that GSO FSS, MSS, and BSS networks can be protected without placing undue constraints on non-GSO FSS systems in the bands in *considering a*), *b*) and *c*) above;
 - h) that WRC-19 modified Article **22** to limit single-entry and aggregate permissible time allowance for degradation in terms of C/N by non-GSO FSS systems to GSO satellite networks, based on WD PDN Recommendation ITU-R S.[50/40 Reference Links and PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] in the bands in *considering a*);
 - i) that the operating parameters and orbital characteristics on non-GSO FSS systems are usually inhomogeneous;
 - j) that, as a result of this inhomogeneity, the time allowance for the C/N value specified in the short-term performance objective associated with the shortest percentage of time (lowest C/N) or decrease of the long-term throughput (spectral efficiency) caused to reference GSO FSS links by non-GSO FSS systems is likely to vary between such systems;
 - k) that the aggregate interference levels from multiple non-geostationary FSS systems will be related to the actual number of systems sharing a frequency band based on the single-entry operational use of each system;
 - l) that to protect GSO FSS, MSS, and BSS networks in the frequency bands listed in *considering a*) from unacceptable interference, the aggregate impact of interference caused by all co-frequency non-GSO FSS systems should not exceed the maximum aggregate impact specified in No. **22.5M** of the Radio Regulations;
 - m) that to achieve the level of protection of GSO reference links given in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY], administrations operating or planning to operate non-GSO FSS systems will need to agree cooperatively through consultation meetings;
 - n) that the aggregate level of the time allowance for the C/N value specified in the short-term performance objective associated with the shortest percentage of time (lowest C/N) of GSO reference link is likely to be the summation of single-entry levels caused by non-GSO FSS systems,
- recognizing*
- a) that non-GSO FSS systems may need to implement interference mitigation techniques, such as orbital avoidance angles, earth station site diversity, and GSO arc avoidance, to facilitate sharing of frequencies among non-GSO FSS systems and to protect GSO networks;

- b) that administrations operating or planning to operate non-GSO FSS systems will need to agree cooperatively through consultation meetings to share the aggregate interference impact allowance for all non-GSO FSS systems operating in the frequency bands listed in *considering a)* in a manner that achieves the level of protection for GSO FSS, MSS and BSS networks that is stated in No. **22.5M** of the Radio Regulations;
- c) that, taking into account the single-entry allowance in No. **22.5L**, the aggregated impact of all non-GSO FSS systems can be computed without the need for specialized software tools based on the results of the single-entry impact for each system;
- d) the need for administrations operating non-GSO FSS systems in the frequency bands listed in *considering a)* to agree cooperatively through consultation meetings takes on particular urgency whenever there could be aggregate interference at levels higher than the aggregate impact allowance from operational non-GSO FSS systems;
- e) that representatives of administrations operating or planning to operate GSO FSS, MSS and BSS networks are encouraged to be involved in the determinations made pursuant to *recognizing b)*;
- f) that in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), signals experience high levels of attenuation due to atmospheric effects such as rain, cloud cover and gaseous absorption;
- g) that given these expected high levels of fading, it is desirable for GSO networks and non-GSO FSS systems to implement fade counter measures such as automatic level control, power control and adaptive coding and modulation,

noting

- a) that PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] contains the methodology for determining conformity to the single-entry and aggregate limits to protect the GSO networks;
- b) that Recommendation ITU-R S.1503 provides guidance on how to compute the epfd levels from a non-GSO system into GSO earth stations and satellites;
- c) that WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] contains GSO satellite system characteristics to be considered in non-GSO/GSO frequency sharing analyses in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz,

resolves

Option 1:

- 1 that administrations operating or planning to operate non-geostationary FSS systems in the frequency bands referred to in *considering a)* above, shall, in collaboration, take all necessary steps, including, if necessary, by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference impact to geostationary FSS, MSS and BSS satellite networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate protection limits – that is, the time allowance for the C/N value specified in the short-term performance objective associated with the shortest percentage of time (lowest C/N) for each GSO reference link and the decrease in time-averaged spectral efficiency for links using Adaptive Coding and Modulation listed in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] by more than 10%, as determined pursuant to No. **22.5M** of the Radio Regulations;

NOTE: The term “time-averaged” means averaged over a period of a year, in accordance with Recommendation ITU-R P.618. A view was expressed that further clarification may be required on the reference point for which the reduction in spectral efficiency is considered.

Option 2:

1 that administrations operating or planning to operate non-geostationary FSS systems in the frequency bands referred to in *considering a)* above, shall, in collaboration, take all necessary steps, including, if necessary, by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference impact to geostationary FSS, MSS and BSS satellite networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate protection limits – that is, the time allowance for the C/N value specified in the short-term performance objective associated with the shortest percentage of time (lowest C/N) each GSO reference link and the decrease in reserve capacity for long term performance objective specified over one year for links using Adaptive Coding and Modulation listed in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] by more than 10%, as determined pursuant to No. **22.5M** of the Radio Regulations;

NOTE: The term “reserve capacity” is used in Recommendation ITU-R S.1323, but for which there are no examples for calculation and would require further clarification in Option 2. To date, Option 2 has not been studied in the ITU-R, but considers the same principle as in Recommendation ITU-R S.1323.

2 that to carry out the obligations in *resolves 1* above, administrations operating or planning to operate non-geostationary FSS systems shall agree cooperatively through regular consultation discussions referred to in *recognizing b)* to ensure that operations of all non-GSO networks do not exceed the aggregate level of protection for geostationary satellite networks;

3 that to carry out the obligations of *resolves 2* above, administrations shall take into account the GSO satellite characteristics listed in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] when applying the methodology contained in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] and the results of the aggregate impact to GSO networks calculated by validation software;

Option 1:

4 that administrations shall use the methodology in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] to determine conformity to the aggregate limits to protect the GSO reference links in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS];

Option 2:

No *resolves 4*.

5 that administrations (including representatives of administrations operating GSO FSS, MSS and BSS networks) participating in a consultation meeting are allowed to use their own software in conjunction with any software tools used by the BR for the calculation and verification of the aggregate limits given in PDN Recommendation ITU-R S.[50/40 FSS GHz SHARING METHODOLOGY], subject to the agreement of the consultation meeting;

6 that administrations, in carrying out their obligations under *resolves 1* above, shall take into account only those non-geostationary FSS systems with frequency assignments in the frequency bands referred to in *considering a)* above that have met the criteria listed in Annex 2 to this Resolution through appropriate information provided in the course of consultation discussions referred to in *resolves 2*;

7 that administrations, in developing agreements to carry out their obligations under *resolves* 1 above, shall establish mechanisms to ensure that all potential FSS system and network notifying administrations and operators are given full visibility of and the opportunity to participate in the process;

Option 1:

8 that participation in the consultation process by administrations operating or planning to operate non-GSO FSS systems that are subject to this Resolution is required, and that failure by a responsible administration to participate in the consultation process does not relieve that administration of obligations under *resolves* 1 above, nor does it remove their systems from consideration in any aggregate calculations by the consultation group;

Option 2:

8 the obligation in *resolves* 2 above begins to apply when a fourth non-geostationary FSS systems with frequency assignments in the frequency bands referred to in *considering a)* meets the criteria listed in Annex 2 to this Resolution;

9 that each administration, in the absence of an agreement reached at consultation meetings referred to in *resolves* 2, shall ensure that each of its non-GSO FSS systems subject to this Resolution are operated in accordance with reduced single-entry interference impact allowances, calculated by the apportionment of the aggregate allowance commensurate to the number of simultaneously operating non-GSO systems, so as to ensure that the aggregate allowance in No. **22.5M** is not exceeded in operation;

10 that, in specific implementation of *resolves* 8 above, if the consultation discussions show that there would be an exceedance of the aggregate allowance from non-GSO FSS systems in operation, every operational non-GSO FSS system shall reduce its emissions:

Option 1: *pro rata* by the amount of the exceedance of the aggregate allowance;

Option 2: or by means of appropriate modifications to their systems;

11 that the administrations participating at the consultation discussion referred to in *resolves* 2 shall designate one convener to be responsible for communicating to the Bureau, such as shown in Annex 1 that the results of the aggregate non-GSO system operational calculation and sharing determinations made in application of *resolves* 1, 8, and 9 above, without regard to whether such determinations result in any modifications to the published characteristics of their respective systems, providing a draft record of each consultation meeting, and posting the approved record,

invites the Radiocommunication Bureau

to participate in the consultation meetings in *resolves* 2 as an observer and to provide advice as necessary with respect to the results of the aggregate interference impact calculation performed according to *resolves* 1,

instructs the Radiocommunication Bureau

1 to publish in the International Frequency Information Circular (BR IFIC), the information referred to in *resolves* 7;

2 to exclude the aggregate calculations given in No. **22.5M** as part of a satellite network examination under No. **11.31**,

urges administrations

to provide the Radiocommunication Bureau and all participants to the consultation meetings with the methodology, assumptions and inputs used in conjunction with *resolves* 3.

ANNEX 1 TO DRAFT NEW RESOLUTION [A16] (WRC-19)

List of geostationary networks characteristics and format of the result of the aggregate calculation to be provided to BR for publication for information

I GSO networks characteristics to be used in the calculation of aggregate emissions from non-GSO FSS systems

I-1 GSO networks characteristics

WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS].

I-2 Non-GSO satellite system constellation parameters

For each non-GSO satellite system, the following parameters should be provided to BR for publication in the aggregate calculation:

- notifying administration;
- number of space stations used in aggregate calculations;
- single-entry contribution to the aggregate of each non-GSO FSS system.

II Results of the aggregate epfd calculation

ANNEX 2 TO DRAFT NEW RESOLUTION [A16] (WRC-19)

List of criteria for the application of *resolves* 5

- 1 Submission of Coordination or Notification Information.
- 2 Entry into satellite manufacturing or procurement agreement, and entry into satellite launch agreement.

The non-geostationary FSS system operator should possess:

- i) evidence of a binding agreement for the manufacture or procurement of its satellites, and
- ii) evidence of a binding agreement to launch its satellites.

The manufacturing or procurement agreement should identify the contract milestones leading to the completion of manufacture or procurement of satellites required for the service provision, and the launch agreement should identify the launch date, launch site and launch service provider. The notifying administration is responsible for authenticating the evidence of agreement.

The information required under this criterion may be submitted in the form of a written commitment by the responsible administration.

- 3 As an alternative to satellite manufacturing or procurement and launch agreements, evidence of guaranteed funding arrangements for the implementation of the project would be accepted. The notifying administration is responsible for authenticating the evidence of these arrangements and for providing such evidence to other interested administrations in furtherance of its obligations under this Resolution.

3/1.6/5.2 For Method B of Issue 1

MOD

RESOLUTION 159 ([REV.WRC-1519](#))

Studies of technical, operational issues and regulatory provisions for non-geostationary fixed-satellite services satellite systems in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space)

The World Radiocommunication Conference ([Sharm el-Sheikh Geneva, 20152019](#)),

TBD

3/1.6/5.3 Issue 2: EESS (passive)

MOD

RESOLUTION 750 (REV.WRC-1519)

Compatibility between the Earth exploration-satellite service (passive) and relevant active services

...

Option A: Revision of non-GSO limits

TABLE 1-1

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band ¹ |
|---------------------|---------------------|----------------|--|
| 1 400-1 427 MHz | 1 427-1 452 MHz | Mobile | –72 dBW in the 27 MHz of the EESS (passive) band for IMT base stations –62 dBW in the 27 MHz of the EESS (passive) band for IMT mobile stations ^{2, 3} |

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band¹ |
|--------------------------------|--------------------------------|------------------------------|---|
| 23.6-24.0 GHz | 22.55-23.55 GHz | Inter-satellite | –36 dBW in any 200 MHz of the EESS (passive) band for non-geostationary (non-GSO) inter-satellite service (ISS) systems for which complete advance publication information is received by the Bureau before 1 January 2020, and –46 dBW in any 200 MHz of the EESS (passive) band for non-GSO ISS systems for which complete advance publication information is received by the Bureau on or after 1 January 2020 |
| 31.3-31.5 GHz | 31-31.3 GHz | Fixed (excluding HAPS) | For stations brought into use after 1 January 2012: –38 dBW in any 100 MHz of the EESS (passive) band. This limit does not apply to stations that have been authorized prior to 1 January 2012 |

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band ¹ |
|------------------------|------------------------|--|--|
| 50.2-50.4 GHz | 49.7-50.2 GHz | Fixed-satellite (E-to-s) ⁴ | <p><u>Option 1:</u> <u>For stations operating with non-GSO systems brought into use after the date of entry into force of the Final Acts of WRC-07 and before the date of entry into force of the Final Acts of WRC-19:</u> For stations <u>operating with GSO networks</u> brought into use after the date of entry into force of the Final Acts of WRC-07: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi <u>For stations operating with non-GSO systems brought into use after the date of entry into force of the Final Acts of WRC-19:</u> <u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</u> <u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u></p> <p><u>Option 2:</u> <u>For stations operating with non-GSO systems brought into use after the date of entry into force of the Final Acts of WRC-07 and for which complete coordination information was submitted before date of entry into force of the Final Acts of WRC-19:</u> For stations <u>operating with GSO networks</u> brought into use after the date of entry into force of the Final Acts of WRC-07: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi <u>For stations operating with non-GSO systems for which complete coordination information was submitted after the date of entry into force of the Final Acts of WRC-19:</u> <u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</u> <u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u></p> |

| | | | |
|---------------|---------------|--|---|
| 50.2-50.4 GHz | 50.4-50.9 GHz | Fixed-satellite (E-to-s) ⁴ | <p>Option 1:</p> <p><u>For stations operating with non-GSO systems brought into use after the date of entry into force of the Final Acts of WRC-07 and before the date of entry into force of the Final Acts of WRC-19:</u></p> <p><u>For stations operating with GSO networks brought into use after the date of entry into force of the Final Acts of WRC-07:</u></p> <p><u>–10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</u></p> <p><u>–20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u></p> <p><u>For stations operating with non-GSO systems brought into use after the date of entry into force of the Final Acts of WRC-19:</u></p> <p><u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</u></p> <p><u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u></p> <p>For stations brought into use after the date of entry into force of the Final Acts of WRC-07:</p> <p>–10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</p> <p>–20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p> <p>Option 2:</p> <p><u>For stations operating with non-GSO systems brought into use after the date of entry into force of the Final Acts of WRC-07 and for which complete coordination information was submitted before date of entry into force of the Final Acts of WRC-19:</u></p> <p><u>For stations operating with GSO networks brought into use after the date of entry into force of the Final Acts of WRC-07:</u></p> <p><u>–10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</u></p> <p><u>–20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u></p> <p><u>For stations operating with non-GSO systems for which complete coordination information was submitted after the date of entry into force of the Final Acts of WRC-19:</u></p> <p><u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</u></p> <p><u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u></p> <p>For stations brought into use after the date of entry into force of the Final Acts of WRC-07:</p> <p>–10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</p> |
|---------------|---------------|--|---|

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band ¹ |
|---------------------|---------------------|----------------|--|
| | | | –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi |
| 52.6-54.25 GHz | 51.4-52.6 GHz | Fixed | For stations brought into use after the date of entry into force of the Final Acts of WRC-07: –33 dBW in any 100 MHz of the EESS (passive) band |

Note: See section 3/1.6/3.3 Studies regarding non-GSO FSS and EESS (passive) considerations

Option B: Revision of GSO and non-GSO limits

TABLE 1-1

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band ¹ |
|---------------------|---------------------|---------------------------------------|--|
| 1 400-1 427 MHz | 1 427-1 452 MHz | Mobile | –72 dBW in the 27 MHz of the EESS (passive) band for IMT base stations –62 dBW in the 27 MHz of the EESS (passive) band for IMT mobile stations ^{2, 3} |
| 23.6-24.0 GHz | 22.55-23.55 GHz | Inter-satellite | –36 dBW in any 200 MHz of the EESS (passive) band for non-geostationary (non-GSO) inter-satellite service (ISS) systems for which complete advance publication information is received by the Bureau before 1 January 2020, and –46 dBW in any 200 MHz of the EESS (passive) band for non-GSO ISS systems for which complete advance publication information is received by the Bureau on or after 1 January 2020 |
| 31.3-31.5 GHz | 31-31.3 GHz | Fixed (excluding HAPS) | For stations brought into use after 1 January 2012: –38 dBW in any 100 MHz of the EESS (passive) band. This limit does not apply to stations that have been authorized prior to 1 January 2012 |
| 50.2-50.4 GHz | 49.7-50.2 GHz | Fixed-satellite (E-to-s) ⁴ | Option 1: For stations brought into use after the date of entry into force of the Final Acts of WRC-07 <u>and before the date of entry into force of the Final Acts of WRC-19:</u> –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi <u>For stations operating with non-GSO systems brought into use after the date of entry into force of the Final Acts of WRC-19:</u> <u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</u> <u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u> <u>For stations operating with GSO systems brought into use after the date of entry into force of the Final Acts of WRC-19:</u> |

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band ¹ |
|---------------------|---------------------|----------------|---|
| | | | <p><u>TBD</u> dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</p> <p><u>TBD</u> dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p> <p>Option 2:</p> <p>For stations brought into use after the date of entry into force of the Final Acts of WRC-07 <u>and for which complete coordination information was submitted before date of entry into force of the Final Acts of WRC-19:</u></p> <p>–10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</p> <p>–20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p> <p><u>For stations operating with non-GSO systems for which complete coordination information was submitted after the date of entry into force of the Final Acts of WRC-19:</u></p> <p><u>TBD</u> dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</p> <p><u>TBD</u> dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p> <p><u>For stations operating with GSO systems for which complete coordination information was submitted after the date of entry into force of the Final Acts of WRC-19:</u></p> <p><u>TBD</u> dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</p> <p><u>TBD</u> dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p> <p>Option 3:</p> <p><u>For GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and whose complete notification information is received prior to TBD date to be decided by WRC-19:</u></p> <p>–10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</p> <p>–20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p> <p><u>For GSO stations for which complete notification information is received by the Bureau after TBD date to be decided by WRC-19,</u></p> <p><u>TBD</u> in any 200 MHz of the EESS (passive) band</p> <p><u>For non-GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and before TBD date</u></p> <p>–10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</p> |

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band ¹ |
|---------------------|---------------------|---------------------------------------|--|
| | | | <p><u>–20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u> <u>For non-GSO stations brought into use after TBD date</u> <u>TBD dBW into the 200 MHz of the EESS (passive) band</u></p> |
| 50.2-50.4 GHz | 50.4-50.9 GHz | Fixed-satellite (E-to-s) ⁴ | <p>Option 1: For stations <u>operating with GSO networks or stations operating with non-GSO networks</u> brought into use after the date of entry into force of the Final Acts of WRC-07 and non-GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and before the date of entry into force of the Final Acts of WRC-19: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi <u>For stations operating with non-GSO systems brought into use after the date of entry into force of the Final Acts of WRC-19:</u> <u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</u> <u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u></p> <p>Option 2: For stations <u>operating with GSO networks or stations operating with non-GSO networks</u> brought into use after the date of entry into force of the Final Acts of WRC-07 and non-GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and for which complete coordination information was submitted before date of entry into force of the Final Acts of WRC-19: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi <u>For stations operating with non-GSO systems for which complete coordination information was submitted after the date of entry into force of the Final Acts of WRC-19:</u> <u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</u> <u>TBD dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u></p> <p>Option 3: <u>For GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and whose complete notification information is received prior to TBD date to be decided by WRC-19:</u></p> |

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band ¹ |
|------------------------|------------------------|----------------|---|
| | | | <p><u>–10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</u></p> <p><u>–20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u></p> <p><u>For GSO stations for which complete notification information is received by the Bureau after <i>TBD</i> date to be decided by WRC-19,</u></p> <p><u><i>TBD</i> in any 200 MHz of the EESS (passive) band</u></p> <p><u>For non-GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and before <i>TBD</i> date</u></p> <p><u>–10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</u></p> <p><u>–20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</u></p> <p><u>For non-GSO stations brought into use after <i>TBD</i> date</u></p> <p><u><i>TBD</i> dBW into the 200 MHz of the EESS (passive) band</u></p> |
| 52.6-54.25 GHz | 51.4-52.6 GHz | Fixed | <p>For stations brought into use after the date of entry into force of the Final Acts of WRC-07:</p> <p>–33 dBW in any 100 MHz of the EESS (passive) band</p> |

Note: See section 3/1.6/3.3 Studies regarding non-GSO FSS and EESS (passive) considerations

Agenda item 7

7 *to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution 86 (Rev.WRC-07), in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit;*

Resolution **86 (Rev.WRC-07)** – *Implementation of Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference*

Agenda item 7(A)

3/7/1 Issue A – Bringing into use of frequency assignments to all non-GSO systems, and consideration of a milestone-based approach for the deployment of non-GSO systems in specific frequency bands and services

3/7/1.1 Executive summary

The ITU-R studied both the bringing into use of frequency assignments to non-geostationary satellite (non-GSO) systems, and the possibility of adopting a milestone-based approach for the deployment of non-GSO systems composed of multiple, multi-satellite constellations, in particular frequency bands. The ITU-R studies have led to two general conclusions, one related to the concept of the bringing into use and the other related to the milestone-based approach for the deployment of non-GSO systems, each with multiple options for implementation.

The first general conclusion is that the bringing into use of frequency assignments to non-GSO systems should continue to be achieved by the deployment of one satellite into one of the notified orbital planes within seven years of the date of receipt of the advance publication of information (API) or request for coordination, as applicable. This conclusion applies for frequency assignments for all non-GSO systems in all frequency bands and services. However, four options are proposed with respect to the minimum period during which a satellite has to be maintained in a notified orbital plane:

- 90 days (as currently required for fixed-satellite service (FSS) and mobile-satellite service (MSS) non-GSO systems in the Rule of Procedure (RoP) for RR No. **11.44**),
- some period less than 90 days,
- no fixed period for the bringing into use (BIU) of frequency assignments to all non-GSO satellites systems,
- a period less than or equal to 90 days for the BIU of frequency assignments subject to section II of Article 9 of the RR, but no fixed period otherwise.

The second general conclusion is that a new WRC Resolution should be adopted to implement a milestone-based approach for the deployment of non-GSO systems in specific frequency bands and services. This milestone-based approach would provide an additional period beyond the seven-year regulatory period for the deployment of the number of satellites, as notified and/or recorded, with the objective to help ensure that the Master International Frequency Register (MIFR) reasonably reflects the actual deployment of such non-GSO systems. One approach and several options of possible implementations are proposed with respect to the milestone periods, the required percentage of

satellites deployed to satisfy each milestone, the consequences of failing to meet a milestone, and appropriate transitional measures to fairly and equitably address the case of the recorded frequency assignments to non-GSO systems already brought into use, and that have reached the end of their seven-year regulatory period before a date to be decided by the WRC, but where the non-GSO system has not been fully deployed.

3/7/1.2 Background

WRC-12 and WRC-15 adopted into the RR a series of specific provisions, including RR No. **11.44B**, that clarified the requirements for the bringing into use (BIU) and the bringing back into use (BBIU) of frequency assignments to a space station in a GSO satellite network. However, there are no provisions in the RR that specifically address the BIU of frequency assignments to space stations in non-GSO systems. In this context and in order to complete the recording of frequency assignments to non-GSO systems, it has been the practice of the Bureau to declare their BIU successfully completed when one satellite is deployed into a notified orbital plane and capable of transmitting and/or receiving those frequency assignments. This practice, reflected for FSS and MSS non-GSO systems in section 2 of the Rules of Procedure for RR No. **11.44**, has been used for a number of years. Furthermore, it has been used irrespective of the number of satellites or of the number of orbital planes indicated in the notification information provided under RR No. **11.2**.

However, in its report to WRC-15 on the experience in the application of regulatory procedures and other related matters, the Director of the Radiocommunication Bureau stated that:

“Taking into account of the numerous non-GSO systems received so far by the Bureau, and the possible speculative nature of such submissions that could lead to spectrum warehousing and resurgence of so-called “paper satellite networks” the conference may wish to consider redefining the notion of bringing into use for non-GSO satellite networks.”

WRC-15 invited the ITU-R to examine, under the standing WRC agenda item 7, the possible development of regulatory provisions beyond those under RR Nos. **11.25** and **11.44** on the non-GSO FSS/MSS systems and the implications of the application of such milestones to non-GSO FSS/MSS systems brought into use after WRC-15.

3/7/1.3 Summary and analysis of the results of ITU-R studies

Under RR No. **11.44**, frequency assignments to non-GSO systems, irrespective of service or frequency band, are to be brought into use within the seven-year regulatory period, and no studies considered changing the seven-year period. However, the studies concluded that it would be unrealistic to expect to have all the satellites of a system, in some cases consisting of hundreds or thousands of satellites, to be deployed within this seven-year regulatory period. Therefore, the BIU of frequency assignments of non-GSO systems cannot always be considered as a confirmation of the full deployment of these systems, but instead may in some cases be just an indication of the commencement of deployment of satellites capable of using the frequency assignments.

The BIU of frequency assignments to a non-GSO system is a prerequisite for securing rights and protections for the frequency assignments for the entire non-GSO system. The studies concluded that the BIU would be achieved with the deployment of one satellite into one of the notified orbital planes within the seven-year period. However, the rights and associated protections for the frequency assignments as initially recorded would continue to be retained if further actions are taken within a reasonable period of time following the end of the seven-year regulatory period to ensure that the characteristics of the recorded frequency assignments of the non-GSO system reflect its deployment. These actions could consist of a series of deployment milestones that would apply for a specified period after the end of the seven-year regulatory period. A milestone-based approach

would balance the need to prevent spectrum warehousing, especially in congested frequency bands, and the need to recognize the technical and operational challenges associated with this type of non-GSO system.

To assist in resolving issue A under WRC-19 agenda item 7, the following guiding principles were developed:

- 1) The BIU process should be separate from any follow-up actions required to maintain the rights and protections for the recorded frequency assignments to non-GSO systems.
- 2) The successful completion of the BIU process for non-GSO systems does not require the deployment of all satellites in the system by the end of the seven-year regulatory period.
- 3) Appropriate time should be given to allow the completion of the deployment of non-GSO systems.
- 4) Appropriate transitional measures should be considered to address the implications of any new milestones adopted by WRC-19.
- 5) The milestone-based approach should be applied to all non-GSO systems in specific space services in specific frequency bands.
- 6) Concurrently with the development of a milestone-based approach, methodologies should be developed for the implementation of RR Nos. **9.58**, **11.43A**, and **11.43B** relating to the regulatory treatment of the adjustments to the characteristics of frequency assignments to non-GSO systems.
- 7) The milestone-based approach should provide incentives to notifying administrations to deploy satellites in a timely manner, as a failure to meet a given milestone for a non-GSO system will result in consequences.
- 8) The milestone-based approach should be developed in such a way as to not constrain the development of non-GSO systems.

These principles also advance the efficient, rational and economical use of spectrum and orbital resources and improve the transparency of the deployment of non-GSO systems.

3/7/1.3.1 Bringing into use of frequency assignments to non-GSO systems

The ITU-R concluded that the BIU of frequency assignments to non-GSO systems, as reflected in RR Article **11**, should apply equally to all non-GSO systems, whether the frequency assignments are, for example, to a single-satellite non-GSO system/network, or to a multi-plane, multi-satellite constellation non-GSO system. One advantage to focusing on the large-system implementation issues separate from BIU under RR No. **11.44** is the avoidance of creating differences in BIU between non-GSO systems.

In addition, the BIU of frequency assignments to non-GSO systems should mean that at least one satellite capable of transmitting or receiving the frequency assignments has been deployed in a notified orbital plane²³ (see RoP on RR No. **11.44**, applicable to FSS and MSS) (Ed. of 2017)). For the purposes of the studies a satellite qualifies as deployed in a notified orbital plane when its orbital characteristics are in accordance with the RR Appendix **4** parameters that describe (one of) the notified orbital plane(s), in particular the orbit altitude(s) and inclination. The ITU-R studies led to the development of an understanding on the meaning of the term “notified orbital plane” in the context of BIU (see the examples in section 3/7/1.5.1.1 below). This understanding also has

²³ The term “notified orbital plane” is understood to mean the actual orbit of the satellites within the plane and not the orbital plane *sensu stricto* i.e. the two-dimensional infinite surface that contains the orbit of the satellite.

implications for the discussion of the milestone-based deployment approach described in section 3/7/1.3.2 below.

In addition to the continuous-operation options for non-GSO systems that use satellites in circular or elliptical orbital planes, there may need to be some special considerations for BIU of frequency assignments to non-GSO systems that do not ultimately operate in an orbital plane around the Earth or more generally, those that are not subject to section II of Article 9 of the RR. For example, some non-GSO satellites in the space operations service and or space research service are designed for non-Earth orbit missions, including deep-space missions, that either never enter orbit around the Earth or are in Earth orbit for relatively short periods of time. It is worth mentioning that the frequency assignments to these types of non-GSO systems are typically not subject to section II of Article 9 of the RR. These frequency assignments could be considered brought into use when the notifying administration confirms a successful launch and deployment of a space station with the capability of transmitting or receiving the frequency assignments, or by some mechanism other than deployment into a notified orbital plane for some period up to 90 days. An exception to the general BIU conclusion expressed above may be needed for such systems.

The issue of BIU for overlapping frequency assignments of more than one non-GSO system by the use of the same spacecraft is being studied by the ITU-R. It should also be noted that no technical basis has been developed within the ITU-R in this study cycle to determine how much deviation could be tolerated between the characteristics of the notified orbital planes and the characteristics of the orbital planes associated with any deployed space stations. In absence of any guidance, there may not be any difference in the regulatory treatment of frequency assignments used by a non-GSO space station irrespective of the order of magnitude of the difference between the notified characteristics of the orbital planes and those of the space station deployed for the purpose of BIU.

The ITU-R identified four options for the period for which the satellite capable of transmitting or receiving the frequency assignments must be deployed in a notified orbital plane for the purposes of the BIU of frequency assignments to a non-GSO satellite system. The four different options are shown in Table 3/7/1.3.1-1 below:

TABLE 3/7/1.3.1-1
Options relating to the continuous period for confirming BIU

| Options | Descriptions |
|---------|---|
| A | A continuous period of at least 90 days in a notified orbital plane of a satellite with the capability of transmitting or receiving the frequency assignments. <i>Applicable to some non-GSO systems based on RoP on RR No. 11.44 (Ed. of 2017).</i> |
| B | A continuous period of X days (one to 90, to be defined) of deployment in a notified orbital plane of a satellite with the capability of transmitting or receiving the frequency assignments. <i>The 90-day duration may not be required for the non-GSO administration/operator to determine that a space station with the capability has been deployed in a notified orbital plane.</i> |
| C | No fixed period. <i>Administration informs the Bureau of BIU once it confirms deployment of a space station with the capability of transmitting/receiving the frequency assignments into one of the notified orbital planes¹.</i> |
| D | A continuous period of X days (one to 90, to be defined) of deployment in a notified orbital plane of a satellite with the capability of transmitting or receiving frequency assignments, subject to section II of Article 9 of the RR. No fixed period otherwise. |

¹ The studies have shown that for some services, e.g. the radionavigation-satellite service, no fixed period is required. Instead, the administration/operator requires only as long as it takes to confirm the deployment into a notified orbital plane of a satellite with the capability of transmitting or receiving the frequency assignments. This

can vary from system to system, but will not require 90 or more continuous days of deployment. For this reason, no fixed continuous period is required for these particular systems.

The first three options above for the BIU aspect apply to frequency assignments to all non-GSO systems that ultimately orbit the Earth.

3/7/1.3.2 Establishment of a milestone-based approach for alignment of non-GSO system deployment with MIFR entries in specific frequency bands and services

3/7/1.3.2.1 Description of the milestone-based approach and options

The ITU-R concluded that there is a need for a milestone-based approach for specific services in specific frequency bands that recognizes that constellations of non-GSO systems may generally take more time than seven years to be fully deployed in accordance with the notified characteristics of the frequency assignments.

The milestone-based approach would only apply to frequency assignments of a given non-GSO system in specific frequency bands and services, that have been brought into use in accordance with RR No. **11.44** (and any other associated provisions adopted by WRC-19).

The milestone-based approach does not impact the BIU status, but instead defines further actions to be taken within a set period of time following the end of the seven-year regulatory period to ensure that the characteristics of the recorded frequency assignments of the non-GSO system reflect its deployment.

In defining the timeline and objectives of the milestone-based approach, a balance has been sought between the need to prevent warehousing of the orbital/spectrum resources and the operational requirements related to the deployment of a non-GSO system.

Under each of the milestones of this process, the number of satellites deployed into one or more notified orbital planes, with the confirmed capability of transmitting or receiving the frequency assignments, will be compared with the minimum number of satellites required as per the milestone.

If the number of satellites deployed is equal to or greater than the number of satellites required, the characteristics of recorded assignments, in particular the total number of satellites recorded in the MIFR as comprising the non-GSO system, will be kept unchanged. Otherwise, failing to meet a milestone will result in consequences (e.g., reduction of time between milestones and/or adjustments to the MIFR entry based on a deployment factor²⁴). The different options of possible implementations are presented in Table 3/7/1.3.2-1 below:

²⁴ A “Deployment Factor” (DF) is considered to address the consequences of failing to meet a particular milestone, and leads to a scaling of the constellation based on the number of satellites actually deployed as of a milestone date. For example, should an administration with a 1 000 satellite system deploy 250 satellites as of a milestone requiring 33% of a system’s satellites to have been deployed, a deployment factor of “three” would mean that the MIFR entry for the 1 000 satellites would be reduced to 750 satellites (reflecting 250 deployed satellites multiplied by the deployment factor associated with that milestone).

TABLE 3/7/1.3.2-1

Options of possible implementations for the milestone-based approach

| Milestone timing (*1) Number of years after the end of the seven-year regulatory period | | Minimum required percentage of satellites to be deployed to meet the milestone (*2) | | Deployment Factor | |
|---|-----------------|--|--------------|-------------------|------|
| M1 | 1 | P1 | A1 & F1: 10% | DF1 | 10 |
| | 2 | | B1: 8.33% | | 12 |
| | | | C1 & D1: 10% | | 10 |
| | | | G1: 30% | | 3.33 |
| | | | E1: 10% | | 10 |
| 4 | | | | | |
| M2 | 3 | P2 | A2 & F2: 33% | DF2 | 3.03 |
| | 4 | | C2: 30% | | 3.33 |
| | 5 | | B2: 25% | | 4 |
| | | | D2: 50% | | 2 |
| | 7 | | E2: 75% | | 1.34 |
| | 2+A (*3 and *4) | | G2: 60% | | 1.66 |
| M3 | 5 | P3 | A3: 75% | DF3 | 1.34 |
| | 6 | | B3: 75% | | 1.34 |
| | | | F3: 100% | | 1 |
| | 7 | | C3: 90% | | 1.11 |
| | 8 | | D3: 100% | | 1 |
| | | | E3: 100% | | 1 |
| 2+A+B (*5) | G3: 100% | 1 | | | |

(*1) Initial timing is the date of receipt by the Bureau of the relevant complete information under RR No. **9.1** or No. **9.1A** of Article **9**, as appropriate.

(*2) In this column, (A1, A2, A3) (B1, B2, B3), (C1, C2, C3), (D1, D2, D3), (E1, E2, E3), (F1, F2, F3) and (G1, G2, G3) represents all the combinations of three milestones identified in the studies for the implementation of the milestone-based approach. For four of the options, (A1, A2, A3), (C1, C2, C3), (E1, E2, E3) and (G1, G2, G3), the date for commencement of the milestone process based on the end of the seven-year regulatory period is 1 January 2021. For Option (D1, D2, D3 & F1, F2, F3) an alternative date of commencement is 23 November 2019. For option (B1, B2, B3), the date of commencement is 1 January 2023.

(*3) A & B are variables: $12 \text{ months} \leq A, B \leq 30 \text{ months}$ based on the conditions met.

(*4) $A = (\text{number of satellites launched} / 30\% \text{ of the total number of satellites in the MIFR}) * 30$.

Where the resulting number calculated should be rounded up to the greatest whole number.

(*5) $B = (\text{number of satellites launched} / 60\% \text{ of the total number of satellites in the MIFR}) * 30$.

Where the resulting number calculated should be rounded up to the greatest whole number.

The absence of technical basis to determine how much deviation could be tolerated between the characteristics of the orbital planes notified and the characteristics of the orbital planes associated with any deployed space stations is also problematic under the milestone-based approach. It is important to note that there are many reasons why placing a space station on plane corresponding exactly to the notified orbital plane may not be doable or even recommended (e.g. collision avoidance between space stations of different non-GSO systems). However, in absence of any guidance, there may not be any difference in the regulatory treatment of non-GSO space stations deployed on orbital planes not identical to those notified irrespective of the order of magnitude of the differences.

A new WRC Resolution should be adopted to implement a milestone-based approach for the deployment of non-GSO systems in specific frequency bands and services.

The study of the issue of the same spacecraft counting for milestones of more than one non-GSO system with overlapping frequency assignments has not yet concluded in ITU-R.

3/7/1.3.2.2 Descriptions of the transitional measures and associated options

WRC-15 also invited the ITU-R to study the possibility of adopting a milestone-based approach for the deployment of non-GSO FSS/MSS systems, and the implications of applying these milestones to non-GSO FSS/MSS systems brought into use after WRC-15. One aspect of these implications relates to the consideration of transitional measures for non-GSO systems with frequency assignments brought into use and having reached the end of their seven-year regulatory period prior to the entry into force of the provisions adopted by WRC-19 related to the milestone-based approach.

Depending on the non-GSO systems to which WRC-19 decides to apply the milestone-based approach, transitional measures may be required to ensure that the operators of systems subject to this approach have enough time to re-evaluate and adjust their deployment plans. In this context, the transitional measures may also depend on the characteristics of the milestone-based approach adopted by WRC-19 and more specifically the timelines and associated level of deployment for each milestone. Two options have been identified for transitional measures:

3/7/1.3.2.2.1 Option 1

This option would consist of applying identical milestones, associated timelines and required levels of deployment both to non-GSO systems with frequency assignments that have reached the end of their regulatory period prior to a date to be set by the conference, and to non-GSO systems for which the regulatory periods end on or after that date. In this context, the only difference between the two categories of non-GSO systems referred to above with respect to the application of any potential milestone-based approach described in Table 3/7/1.3.2-1 will be the reference point for the commencement of the milestone period. For non-GSO systems with frequency assignments reaching the end of their seven-year regulatory period after a date to be set by the Conference, the commencement of the milestone period will be the actual date of the end of the seven-year regulatory period. For the non-GSO systems with a regulatory period that ends before the date to be set by the Conference, the commencement of the milestone process is based on that date. Options studied for the date to be set include 23 November 2019 (the first day after the end of the conference), 1 January 2021, and 1 January 2023. In some cases, the date selected is directly connected to an option in Table 3/7/1.3.2-1.

3/7/1.3.2.2.2 Option 2

This option would consist of having different sets of milestones for which timing and duration, depend on whether or not the non-GSO systems with frequency assignments brought into use have reached the end of their seven-year regulatory period prior to the entry into force of the relevant provisions adopted by WRC-19 under Issue A. In this context, not only would there be a different reference point for the commencement of the milestone-based approach but the actual approach (i.e. associated timelines) would be different and would depend upon the date of the end of their seven-year regulatory period.

The regular milestone-based approach would have a duration, referred to as “ d ”. The exact duration d depends on the option in Table 3/7/1.3.2-1 which needs to be decided by WRC-19.

Extra time would be granted to non-GSO systems for which the end of the seven-year regulatory period comes before the date of the commencement of the regular milestone-based approach. Considering that:

- R designates the date of the end of the seven-year regulatory period;
- $M_{transitional}$ (MT) is the date of the beginning of the transitional milestone-based approach;
- $M_{regular}$ (MR) is the date of the beginning of the regular milestone-based approach;

- M_{final} (MF) which corresponds to $MR + d$ and is only used to describe the stretching as explained below.

Depending on the position of R with respect to MT and MR , three cases can be distinguished:

- non-GSO systems for which the end of the seven-year regulatory period R is after MR will have to apply the regular milestone-based approach with a duration of d . The milestone-based approach will start on day R and end on day $R + d$;
- non-GSO systems for which the end of the seven-year regulatory period R is between MT and MR will benefit from stretched milestone timelines. The milestone process for such systems will start on day R and end on day $MF = MR + d$, and have a duration of D (with $D = MF - R > d$);
- non-GSO systems for which the end of the seven-year regulatory period R is before MT will also benefit from stretched milestone timelines, starting on MT and ending on $MF = MR + d$. In this case, the duration $D = MF - MT > d$.

The periods between the different milestones are stretched by a factor of D/d , compared to those under the regular milestone-based approach (see Table 3/7/1.3.2-1).

The dates MT and MR have to be chosen in a range between the end of WRC-19 and seven years after the end of WRC-19, which is the range where the end of the seven-year regulatory period can fall for systems submitted prior to the end of WRC-19.

Furthermore, the date MR should not be later than the end of WRC-19 + d . The networks which are submitted after WRC-15 and before the end of WRC-19 have had sufficient visibility on the implementation of the milestone-based approach.

The transitional milestone-based approach can be associated with any implementation of the regular milestone-based approach as shown in Table 3/7/1.3.2-1 except for those where the total length of the milestone period is not known *a priori*.

Option 2 is presented here in a generic form, which requires some calculations for the milestone duration where the transitional measures apply. Under this option, once WRC-19 has made a decision on the two dates, MT and MR , the milestones for the systems where the transitional measures apply can be calculated once and for all, and represented in a table format in the Resolution. The numerical examples below are provided for a better understanding of this methodology for transitional measures. They are based on the B1, B2, and B3 options as shown in Table 3/7/1.3.2-1 (with $d = \text{six years}$, and a milestone every two years).

So far, one date has been discussed for the beginning of the transitional measures (MT): 1 July 2022 and another date has been discussed for the beginning of the regular milestones (MR): 1 January 2024.

Example: MT is 1 July 2022, MR is 1 January 2024, d is 6 years

| | End of regulatory period | Start of the process | 1st milestone | 2nd milestone | 3rd milestone | Comment |
|---------------------------------------|--------------------------|----------------------|---------------|---------------|---------------|--|
| Network A | 01/01/2021 | 01/07/2022 | 30/12/2024 | 02/07/2027 | 01/01/2030 | Transitional measure (stretched milestone process) |
| Network B ($MT < R < MR$) | 01/01/2023 | 01/01/2023 | 31/08/2025 | 31/10/2027 | 01/01/2030 | Transitional measure (stretched milestone process) |
| Network C $M=R$ | 01/01/2024 | 01/01/2024 | 01/01/2026 | 01/01/2028 | 01/01/2030 | Start of the regular milestone process |

| | | | | | | |
|-----------------------------|------------|------------|------------|------------|------------|---|
| Network D M>R | 01/01/2027 | 01/01/2027 | 01/01/2029 | 01/01/2031 | 01/01/2033 | Future networks (regular milestone process) |
|-----------------------------|------------|------------|------------|------------|------------|---|

3/7/1.4 Methods to satisfy Issue A

To satisfy Issue A, one method was developed that comprises two separate elements. The first element addresses the BIU of frequency assignments to non-GSO systems. The second element introduces the implementation of milestones for maintaining the recording in the MIFR of assignments to non-GSO systems in specific frequency bands and services, which provide administrations with the ability to use a period longer than the regulatory period in RR No. **11.44** to complete deployment of all satellites and orbital planes in the notified non-GSO system. For both of these elements various options are described below.

Under this method, the Conference is invited to instruct ITU-R to conduct studies for the development of a technical basis for determining tolerances for various orbital parameters of non-GSO space stations. The Conference is invited to also provide instructions to the Radiocommunication Bureau on how to treat cases of variations in orbital parameters for non-GSO space stations pending the conclusion of the studies.

3/7/1.4.1 Bringing into use

For the BIU of frequency assignments to non-GSO systems of the method referred to above, four options have been identified.

These four options involve the incorporation of a form of Section 2 of the Rules of Procedure for RR No. **11.44** into the Radio Regulations. To this effect, one option requires deployment for a continuous period of at least 90 days in a notified orbital plane of a satellite with the capability of transmitting or receiving the frequency assignments. The second option requires such deployment for a continuous period of between one and 90 days. A third option is for deployment with no fixed period for BIU. The fourth option consists of differentiating frequency assignments to non-GSO satellite systems subject to section II of Article **9** for which a successful BIU will require the deployment of at least one satellite with the capability of transmitting or receiving these frequency assignments for a continuous period of at least X days (X between 1 and 90 days, to be defined) and no fixed period otherwise.

The first three options apply a single BIU approach that applies to frequency assignments to all non-GSO systems that ultimately orbit the Earth. In addition to the above, there may need to be some special considerations for BIU non-GSO systems that do not ultimately operate in an orbital plane around the Earth. These non-GSO systems and networks must be considered brought into use when the notifying administration confirms a successful launch of a space station with the capability of transmitting or receiving the frequency assignments, or by some mechanism other than deployment into a notified orbital plane for some period up to 90 days.

Modifications or addition of provisions in RR Article **11** for the implementation of this method would also be required.

Consideration should also be given to addressing tolerances for some of the orbital characteristics, such as the altitude and the inclination of orbits of non-GSO satellites, associated with recorded frequency assignments.

3/7/1.4.2 Milestone-based approach

For the milestone-based approach, approach with several options of possible implementations have been identified to provide time beyond the seven-year regulatory period to complete the deployment

of the satellites associated with recorded frequency assignments to a non-GSO system (see section 3/7/1.3.2.1 and Table 3/7/1.3.2-1).

A prerequisite for application of the milestone-based approach to the frequency assignments of a given non-GSO system is that the frequency assignments are considered to have been brought into use in accordance with RR No. **11.44** and any other associated provisions as may be adopted by WRC-19 for the BIU of frequency assignments to non-GSO systems.

Under this method, a new WRC Resolution would be adopted to specify the frequency bands and services to which the approach applies, the number of milestones, the milestone period, the required percentage of satellites deployed to satisfy the milestones, and the consequences of failing to meet a milestone (which results in reduction of time between milestones and/or adjustments to the MIFR entry based on a deployment factor). Appropriate transitional arrangements would also be included in the same new WRC Resolution. Following the non-compliance with a milestone, the Resolution will specify the timeline and the processing for the submission by a notifying administration of a consequential modification to the characteristics of the recorded frequency assignments to its non-GSO system.

Provisions for the implementation of this method would also be required.

The new WRC Resolution would be referred to in an appropriate Article of the Radio Regulations.

Since the number of satellites deployed could fluctuate after the milestone period, it may be important to update the information recorded in the MIFR. Such a process could be contained in the Resolution. However, there is no consensus on the need to include such a process in the Resolution.

3/7/1.5 Regulatory and procedural considerations for Issue A

NOTE: A number of the example provisions below include references to current Appendix 4 elements. Proposals based on these examples will need to reflect any updated Appendix 4 references as decided by WRC-19.

3/7/1.5.1 Bringing into use (BIU)

Examples of regulatory implementation of the Method described in section 3/7/1.4.1 on the BIU of frequency assignments to non-GSO satellite systems are provided below.

3/7/1.5.1.1 BIU Options A and B: incorporation of the RoP in Article 11 with a fixed period for BIU

ARTICLE 11

Notification and recording of frequency assignments^{1, 2, 3, 4, 5, 6, 7, 8} (WRC-15)

Section II – Examination of notices and recording of frequency assignments in the Master Register

MOD

11.44 The notified date²⁴, **MOD**²⁵, **MOD**²⁶ of bringing into use of any frequency assignment to a space station of a satellite network or system shall be not later than seven years following the date of receipt by the Bureau of the relevant complete information under No. **9.1** or **9.2** in the case of satellite networks or systems not subject to Section II of Article **9** or under

No. **9.1A** in the case of satellite networks or systems subject to Section II of Article 9. Any frequency assignment not brought into use within the required period shall be cancelled by the Bureau after having informed the administration at least three months before the expiry of this period. (WRC-1519)

NOC

²⁴ 11.44.1

MOD

²⁵ **11.44.2** The notified date of bringing into use of a frequency assignment to a space station ~~in the geostationary-satellite orbit~~ of a satellite network or system shall be the date of the commencement of the ~~ninety-day~~ continuous period defined in No. **11.44B** or [MOD] No. 11.44C, as applicable. (WRC-1219)

MOD

²⁶ **11.44.3**, ~~and 11.44B.1~~ and 11.44C.3 Upon receipt of this information and whenever it appears from reliable information available that a notified frequency assignment has not been brought into use in accordance with No. **11.44**, ~~and/or No. 11.44B~~, or [MOD] No. 11.44C, as the case may be, the consultation procedures and subsequent applicable course of action prescribed in No. **13.6** shall apply, as appropriate. (WRC-1519)

MOD

11.44C ~~(SUP-WRC-03)~~ A frequency assignment to a space station in a non-geostationary-satellite orbit with the “Earth” as the reference body shall be considered as having been brought into use when a space station in the non-geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained on one of the notified orbital planes^{ADD AA} of the non-geostationary-satellite system for a continuous period of X days, (where $1 \leq X \leq 90$)^{ADD BB}. The notifying administration shall so inform the Bureau within 30 days from the end of the X-day period^{MOD 26, ADD CC}. On receipt of the information sent under this provision, the Bureau shall make that information available on the ITU website as soon as possible and shall publish it in the BR IFIC subsequently. (WRC-19)

Note - For footnote AA, there are two options presented below.

BIU Options A and B Option 1:**ADD**

AA 11.44C.1 In examining information provided by an administration in application of Nos. [MOD] **11.44C**, the following data items in Table A in Annex 2 of Appendix 4 shall be used, as appropriate, to determine if at least one of the orbital planes of the space stations in the non-geostationary-satellite system deployed corresponds to one of the notified orbits:

- Item A.4.b.4.a, the inclination of the orbital plane of the space station;
- Item A.4.b.4.d, the altitude of the apogee of the space station;
- Item A.4.b.4.e, the altitude of the perigee of the space station; and
- Item A.4.b.5.c, the argument of the perigee of the orbit of the space station (only for orbits whose altitudes of the apogee and perigee are different). (WRC-19)

BIU Options A and B Option 2:**ADD**

AA 11.44C.1 For purposes of No. [MOD] **11.44C**, the term “notified orbital plane” means an orbital plane of the non-GSO system, as provided to the Bureau in the most recent advance publication, coordination or notification information for the system’s frequency assignments, that possesses the general characteristics of Items A.4.b.4.a through A.4.b.4.f, and A.4.5.c (only for orbits whose altitudes of the apogee and perigee are different) in Table A of Annex 2 to Appendix 4. (WRC-19)

BIU Options A and B (continued)**ADD**

BB 11.44C.2 A frequency assignment to a space station in a non-geostationary-satellite system with a reference body that is not “Earth” shall be considered as having been brought into use when the notifying administration informs the Bureau that a space station with the capability of transmitting or receiving that frequency assignment has been deployed and operated in accordance with the notification information. (WRC-19)

ADD

CC 11.44C.4 A frequency assignment to a space station in a non-geostationary-satellite orbit with a notified date of bringing into use more than $X + 30$ days, where $1 \leq X \leq 90$ prior to the date of receipt of the notification information shall also be considered as having been brought into use if the notifying administration confirms, when submitting the notification information for this assignment, that a space station in a notified orbital plane (see also No. [ADD] **11.44C.1**) with the capability of transmitting or receiving that frequency assignment has been deployed and maintained as provided for in No. [MOD] **11.44C** for a continuous period of time from the notified date of bringing into use until the date of receipt of the notification information for this frequency assignment. (WRC-19)

MOD

11.49 Wherever the use of a recorded frequency assignment to a space station of a satellite network or to all space stations of a non-geostationary satellite system is suspended for a period exceeding six months, the notifying administration shall inform the Bureau of the date on which such use was suspended. When the recorded assignment is brought back into use, the notifying administration shall, subject to the provisions of Nos. **11.49.1 or 11.49.2 as when**-applicable, so inform the Bureau, as soon as possible. On receipt of the information sent under this provision, the Bureau shall make that information available as soon as possible on the ITU website and shall publish it in the BR IFIC. The date on which the recorded assignment is brought back into use²⁸. **ADD DD, ADD EE, ADD FF** shall be not later than three years from the date on which the use of the frequency assignment was suspended, provided that the notifying administration informs the Bureau of the suspension within six months from the date on which the use was suspended. If the notifying administration informs the Bureau of the suspension more than six months after the date on which the use of the frequency assignment was suspended, this three-year time period shall be reduced. In this case, the amount by which the three-year period shall be reduced shall be equal to the amount of time that has elapsed between the end of the six-month period and the date that the Bureau is informed of the suspension. If the notifying administration informs the Bureau of the suspension more than 21 months after the date on which the use of the frequency assignment was suspended, the frequency assignment shall be cancelled. (WRC-~~15~~19)

ADD

DD 11.49.2 The date of bringing back into use of a frequency assignment to a space station in the non-geostationary satellite orbit with the “Earth” as the reference body shall be the date of the commencement of the X, where $1 \leq X \leq 90$ -day period defined below. A frequency assignment to a space station in the non-geostationary-satellite orbit shall be considered as having been brought back into use when a space station in the non-geostationary satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained on one of the notified orbital planes for a continuous period of X days, where $1 \leq X \leq 90$. The notifying administration shall so inform the Bureau within 30 days from the end of the X, where $1 \leq X \leq 90$ -day period. (WRC-19)

ADD

^{EE} **11.49.3** A frequency assignment to a space station in a non-geostationary satellite system with a reference body that is not “Earth” shall be considered as having been brought back into use when the notifying administration informs the Bureau that a space station with the capability of transmitting or receiving that frequency assignment has been deployed and operated in accordance with the notification information. (WRC-19)

BIU Options A and B Option 1:**ADD**

^{FF} **11.49.4** In examining information provided by an administration in application of No. [ADD] **11.49.2**, the following data items in Table A in Annex II of Appendix 4 shall be used, as appropriate, to determine if at least one of the orbital planes of the space stations in the non-geostationary-satellite system deployed corresponds to one of the notified orbits:

- Item A.4.b.4.a, the inclination of the orbital plane of the space station;
- Item A.4.b.4.d, the altitude of the apogee of the space station;
- Item A.4.b.4.e, the altitude of the perigee of the space station; and
- Item A.4.b.5.c, the argument of the perigee of the orbit of the space station (only for orbits whose altitudes of the apogee and perigee are different). (WRC-19)

BIU Options A and B Option 2:**ADD**

^{FF} **11.49.4** For purposes of No. [ADD] **11.49.2**, the term “notified orbital plane” means an orbital plane of the non-GSO system, as provided to the Bureau in the most recent advance publication, coordination or notification information for the system’s frequency assignments, that possesses the general characteristics of Items A.4.b.4.a through A.4.b.4.f, and Item A.4.b.5.c (only for orbits whose altitudes of the apogee and perigee are different) in Table A of Annex 2 to Appendix 4. (WRC-19)

3/7/1.5.1.2 BIU Option C: incorporation of the RoP in Article 11 with no fixed period for BIU

ARTICLE 11

Notification and recording of frequency assignments^{1, 2, 3, 4, 5, 6, 7, 8} (WRC-15)

Section II – Examination of notices and recording of frequency assignments in the Master Register

MOD

11.44 The notified date^{24, 25, [MOD]}²⁶ of bringing into use of any frequency assignment to a space station of a satellite network or system shall be not later than seven years following the date of receipt by the Bureau of the relevant complete information under No. **9.1** or **9.2** in the case of satellite networks or systems not subject to Section II of Article **9** or under No. **9.1A** in the case of satellite networks or systems subject to Section II of Article **9**. Any frequency assignment not brought into use within the required period shall be cancelled by the Bureau after having informed the administration at least three months before the expiry of this period. (WRC-~~15~~¹⁹)

NOC

²⁴ **11.44.1**

MOD

²⁵ **11.44.2** The notified date of bringing into use of a frequency assignment to a space station ~~in the geostationary-satellite orbit~~ of a satellite network or system shall be the date of the commencement of the ~~ninety-day~~ continuous period defined in No. **11.44B** ~~or [MOD] No. 11.44C~~, as applicable. (WRC-~~12~~¹⁹)

MOD

²⁶ **11.44.3**, ~~and 11.44B.1~~, and 11.44C.2 Upon receipt of this information and whenever it appears from reliable information available that a notified frequency assignment has not been brought into use in accordance with No. **11.44** and/or No. **11.44B**, ~~or [MOD] No. 11.44C~~, as the case may be, the consultation procedures and subsequent applicable course of action prescribed in No. **13.6** shall apply, as appropriate. (WRC-~~15~~¹⁹)

MOD

11.44C ~~(SUP-WRC-03)~~ A frequency assignment to a space station in a non-geostationary satellite orbit shall be considered as having been brought into use when a space station in the non-geostationary-satellite orbit with the capability of transmitting or receiving that frequency

assignment has been deployed on one of the notified orbital planes^{ADD AA} of the non-geostationary-satellite system^{ADD BB}. The notifying administration shall so inform the Bureau within 30 days after the notified date of bringing into use^{MOD 26, ADD CC}. On receipt of the information sent under this provision, the Bureau shall make that information available on the ITU website as soon as possible and shall publish it in the BR IFIC subsequently. (WRC-19)

Note - Two options for footnote AA are presented below:

BIU Option C Option 1:

ADD

^{AA} **11.44C.1** In examining information provided by an administration in application of Nos. [MOD] **11.44C** or **11.49**, the following data items in Table A in Annex 2 of Appendix 4 shall be used, as appropriate, to determine if at least one of the orbital planes of the space stations in the non-geostationary-satellite system deployed corresponds to one of the notified orbits:

- Item A.4.b.4.a, the inclination of the orbital plane of the space station;
- Item A.4.b.4.d, the altitude of the apogee of the space station;
- Item A.4.b.4.e, the altitude of the perigee of the space station, and
- Item A.4.b.5.c, the argument of the perigee of the orbit of the space station (only for orbits whose altitudes of the apogee and perigee are different). (WRC-19)

BIU Option C Option 2:

ADD

^{AA} **11.44C.1** For purposes of No. [MOD] **11.44C**, the term “notified orbital plane” means an orbital plane of the non-GSO system, as provided to the Bureau in the most recent advance publication, coordination or notification information for the system’s frequency assignments, that possesses the general characteristics of items A.4.b.4.a through A.4.b.4.f and A.4.5.c (only for orbits whose altitudes of the apogee and perigee are different) in Table A of Annex 2 to Appendix 4. (WRC-19)

BIU Option C (continued)

ADD

^{BB} **11.44C.2** A frequency assignment to a space station in a non-geostationary-satellite system with a reference body that is not “Earth” shall be considered as having been brought into use when the notifying administration informs the Bureau that a space station with the capability of transmitting or receiving that frequency assignment has been deployed and operated in accordance with the notification information. (WRC-19)

ADD

CC **11.44C.3** A frequency assignment to a space station in a non-geostationary-satellite orbit with a notified date of bringing into use more than 30 days prior to the date of receipt of the notification information shall also be considered as having been brought into use if the notifying administration confirms, when submitting the notification information for this assignment, that a space station in a notified orbital plane (see also No. [ADD] **11.44C.1**) with the capability of transmitting or receiving that frequency assignment has been deployed and maintained as provided for in No. [MOD] **11.44C**, for a continuous period of time from the notified date of bringing into use until the date of receipt of the notification information for this frequency assignment. (WRC-19)

MOD

11.49 Wherever the use of a recorded frequency assignment to a space station of a satellite network or to all space stations of a non-geostationary satellite system is suspended for a period exceeding six months, the notifying administration shall inform the Bureau of the date on which such use was suspended. When the recorded assignment is brought back into use, the notifying administration shall, subject to the provisions of Nos. **11.49.1** or 11.49.2 ~~when as~~ applicable, so inform the Bureau, as soon as possible. On receipt of the information sent under this provision, the Bureau shall make that information available as soon as possible on the ITU website and shall publish it in the BR IFIC. The date on which the recorded assignment is brought back into use²⁸ ADD DD, ADD EE shall be not later than three years from the date on which the use of the frequency assignment was suspended, provided that the notifying administration informs the Bureau of the suspension within six months from the date on which the use was suspended. If the notifying administration informs the Bureau of the suspension more than six months after the date on which the use of the frequency assignment was suspended, this three-year time period shall be reduced. In this case, the amount by which the three-year period shall be reduced shall be equal to the amount of time that has elapsed between the end of the six-month period and the date that the Bureau is informed of the suspension. If the notifying administration informs the Bureau of the suspension more than 21 months after the date on which the use of the frequency assignment was suspended, the frequency assignment shall be cancelled. (WRC-15¹⁹)

ADD

DD **11.49.2** A frequency assignment to a space station in the non-geostationary-satellite orbit shall be considered as having been brought back into use when a space station in the non-geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained on one of the notified orbital planes. The notifying administration shall so inform the Bureau within 30 days from the date of the resumption of the use of this frequency assignment. (WRC-19)

ADD

EE 11.49.3 A frequency assignment to a space station in a non-geostationary satellite system with a reference body that is not “Earth” shall be considered as having been brought back into use when the notifying administration informs the Bureau that a space station with the capability of transmitting or receiving that frequency assignment has been deployed and operated in accordance with the notification information. (WRC-19)

BIU Option C Option 1:**ADD**

FF 11.49.4 In examining information provided by an administration in application of No. [ADD] **11.49.2**, the following data items in Table A in Annex 2 of Appendix 4 shall be used, as appropriate, to determine if at least one of the orbital planes of the space stations in the non-geostationary-satellite system deployed corresponds to one of the notified orbits:

- Item A.4.b.4.a, the inclination of the orbital plane of the space station;
- Item A.4.b.4.d, the altitude of the apogee of the space station;
- Item A.4.b.4.e, the altitude of the perigee of the space station; and
- Item A.4.b.5.c, the argument of the perigee of the orbit of the space station (only for orbits whose altitudes of the apogee and perigee are different). (WRC-19)

BIU Option C Option 2:**ADD**

FF 11.49.4 For the purposes of No. [ADD] **11.49.2**, the term “notified orbital plane” means an orbital plane of the non-GSO system, as provided to the Bureau in the most recent advance publication, coordination or notification information for the system’s frequency assignments, that possesses the general characteristics of Items A.4.b.4.a through A.4.b.4.f, and Item A.4.b.5.c in Table A of Annex 2 to Appendix 4. (WRC-19)

Editor’s note: The entire section below is an addition to the existing text in the draft CPM report on WRC-19 agenda item issue A.

3/7/1.5.1.3 BIU Option D: incorporation of the RoP in Article 11 with fixed period for the BIU of frequency assignment subject to Section II of Article 9 of the RR but no fixed period otherwise

ARTICLE 11

Notification and recording of frequency assignments^{1, 2, 3, 4, 5, 6, 7, 8} (WRC-15)

Section II – Examination of notices and recording of frequency assignments in the Master Register

MOD

11.44 The notified date²⁴, MOD²⁵, MOD²⁶ of bringing into use of any frequency assignment to a space station of a satellite network or system shall be not later than seven years following the date of receipt by the Bureau of the relevant complete information under No. **9.1** or **9.2** in the case of satellite networks or systems not subject to Section II of Article **9** or under No. **9.1A** in the case of satellite networks or systems subject to Section II of Article **9**. Any frequency assignment not brought into use within the required period shall be cancelled by the Bureau after having informed the administration at least three months before the expiry of this period. (WRC-~~15~~¹⁹)

NOC

11.41.1

MOD

²⁵ **11.44.2** The notified date of bringing into use of a frequency assignment to a space station ~~in the geostationary satellite orbit~~ of a satellite network or system shall be the date of the commencement of the ~~ninety day~~ continuous period defined in No. **11.44B** or No. 11.44C, as applicable. (WRC-~~12~~¹⁹)

MOD

²⁶ **11.44.3**, ~~and 11.44B.1~~ and 11.44C.2 Upon receipt of this information and whenever it appears from reliable information available that a notified frequency assignment has not been brought into use in accordance with No. **11.44** ~~and/or~~ No. **11.44B**, [MOD] No. 11.44C or [MOD] No. 11.44Cbis, as the case may be, the consultation procedures and subsequent applicable course of action prescribed in No. **13.6** shall apply, as appropriate. (WRC-~~15~~¹⁹)

MOD

11.44C ~~(SUP-WRC-03)~~ A frequency assignment to a space station in a non-geostationary-satellite orbit subject to section II of Article 9 with the “Earth” as the reference body shall be considered as having been brought into use when a space station in the non-geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained on one of the notified orbital planes^{ADD AA} of the non-geostationary satellite system for a continuous period of X days, (where $1 \leq X \leq 90$)^{ADD BB}. The notifying administration shall so inform the Bureau within 30 days from the end of the X-day period^{MOD 26, ADD CC}. On receipt of the information sent under this provision, the Bureau shall make that information available on the ITU website as soon as possible and shall publish it in the BR IFIC subsequently. (WRC-19)

ADD

11.44Cbis A frequency assignment to a space station in a non-geostationary orbit not subject to section II of Article 9 shall be considered as having brought into use when a space station in the non-geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed on one of the notified orbital planes of the non-geostationary satellite system^{ADD AA, ADD BB}. The notifying administration shall so inform the Bureau as soon as possible but not later than 30 days after the end of the period referred to in No. **11.44**. On receipt of the information sent under this provision, the Bureau shall make that information available on the ITU website as soon as possible and shall publish it in the BR IFIC subsequently. (WRC-19)

ADD

^{BB} **11.44C.2** A frequency assignment to a space station in a non-geostationary-satellite system with a reference body that is not “Earth” shall be considered as having been brought into use when the notifying administration informs the Bureau that a space station with the capability of transmitting or receiving that frequency assignment has been deployed and operated in accordance with the notification information. (WRC-19)

BIU Option D Option 1:**ADD**

^{AA} **11.44C.1** In examining information provided by a notifying administration in application of Nos. **11.44C**, or **11.44Cbis** for frequency assignments subject to section II of Article 9, the following data items in Table B in Annex 2 of Appendix 4 shall be used, as appropriate, to determine if at least one of the orbital planes of the space stations in the non-geostationary satellite system deployed corresponds to one of the notified orbits:

- Item A.4.b.4.a, the inclination of the orbital plane of the space station;
- Item A.4.b.4.d, the altitude of the apogee of the space station;
- Item A.4.b.4.e, the altitude of the perigee of the space station, and

- Item A.4.b.5.c, the argument of the perigee of the orbit of the space station (only for orbits whose altitudes of the apogee and perigee are different). (WRC-19)

BIU Option D Option 2:

ADD

AA **11.44C.1** For purposes of No. [MOD] **11.44C** or No. [MOD] **11.44Cbis**, the term “notified orbital plane” means an orbital plane of the non-GSO system, as provided to the Bureau in the most recent advance publication, coordination or notification information for the system’s frequency assignments, that possesses the general characteristics of Items A.4.b.4.a through A.4.b.4.f, and Item A.4.b.5.c (only for orbits whose altitudes of the apogee and perigee are different) in Table A of Annex 2 to Appendix 4. (WRC-19)

BIU Option D (continued)

ADD

CC **11.44C.3** A frequency assignment to a space station in a non-geostationary satellite orbit subject to section II of Article 9 with a notified date of bringing into use more than X+30 days prior to the date of receipt of the notification information shall also be considered as having been brought into use if the notifying administration confirms, when submitting the notification information for this assignment, that a space station in a notified orbital plane (see also No. **11.44C.1**) with the capability of transmitting or receiving that frequency assignment has been deployed and maintained as provided for in No. **11.44C** for a continuous period of time from the notified date of bringing into use until the date of receipt of the notification information for this frequency assignment. (WRC-19)

MOD

11.49 Wherever the use of a recorded frequency assignment to a space station of a satellite network or to all space stations of a non-geostationary satellite system is suspended for a period exceeding six months, the notifying administration shall inform the Bureau of the date on which such use was suspended. When the recorded assignment is brought back into use, the notifying administration shall, subject to the provisions of Nos. 11.49.1, 11.49.2 or 11.49.3, when as applicable, so inform the Bureau, as soon as possible. On receipt of the information sent under this provision, the Bureau shall make that information available as soon as possible on the ITU website and shall publish it in the BR IFIC. The date on which the recorded assignment is brought back into use²⁸, ADD DD, ADD EE, ADD FF, ADD G shall be not later than three years from the date on which the use of the frequency assignment was suspended, provided that the notifying administration informs the Bureau of the suspension within six months from the date on which the use was suspended. If the notifying administration informs the Bureau of the suspension more than six months after the date on which the use of the frequency assignment was suspended, this three-year time period shall be reduced. In this case, the amount by which the three-year period shall be reduced shall be equal to the amount of time that has elapsed between the end of the six-month period and the date that the Bureau is informed of the suspension. If the notifying administration informs the Bureau of the

suspension more than 21 months after the date on which the use of the frequency assignment was suspended, the frequency assignment shall be cancelled. (WRC-1519)

NOC

28 11.49.1

ADD

DD 11.49.2 The date of bringing back into use of a frequency assignment to a space station in the non-geostationary-satellite orbit subject to section II of Article 9, with the “Earth” as the reference body, shall be the date of the commencement of the X-day period, (where $1 \leq X \leq 90$). A frequency assignment to a space station in the non-geostationary-satellite orbit subject to section II of Article 9 shall be considered as having been brought back into use when a space station in the non-geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained on one of the notified orbital planes for a continuous period of X days. The notifying administration shall so inform the Bureau within 30 days from the end of the X-day period. (WRC-19)

ADD

EE 11.49.3 A frequency assignment to a space station in the non-geostationary satellite orbit not subject to section II of Article 9 shall be considered as having been brought back into use when a space station in the non-geostationary satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed on one of the notified orbital planes. The notifying administration shall so inform the Bureau as soon as possible but not later than 30 days after the end of the end of the suspension period as defined in No. 11.49. (WRC-19)

ADD

FF 11.49.4 A frequency assignment to a space station in a non-geostationary satellite system with a reference body that is not “Earth” shall be considered as having been brought back into use when the notifying administration informs the Bureau that a space station with the capability of transmitting or receiving that frequency assignment has been deployed and operated in accordance with the notification information. (WRC-19)

BIU Option D Option 1:**ADD**

GG **11.49.5** In examining information provided by an administration in application of Nos. [ADD] **11.49.2** or [ADD] **11.49.3**, the following data items in Table A in Annex 2 of Appendix 4 shall be used, as appropriate, to determine if at least one of the orbital planes of the space stations in the non-geostationary-satellite system deployed corresponds to one of the notified orbits:

- Item A.4.b.4.a, the inclination of the orbital plane of the space station;
- Item A.4.b.4.d, the altitude of the apogee of the space station;
- Item A.4.b.4.e, the altitude of the perigee of the space station; and
- Item A.4.b.5.c, the argument of the perigee of the orbit of the space station (only for orbits whose altitudes of the apogee and perigee are different). (WRC-19)

BIU Option D Option 2:**ADD**

GG **11.49.3** For purposes of Nos. [ADD] **11.49.2** or [ADD] **11.49.3**, the term “notified orbital plane” means an orbital plane of the non-GSO system, as provided to the Bureau in the most recent advance publication, coordination or notification information for the system’s frequency assignments, that possesses the general characteristics of Items A.4.b.4.a through A.4.b.4.f, and Item A.4.b.5.c (only for orbits whose altitudes of the apogee and perigee are different) in Table A of Annex 2 to Appendix 4. (WRC-19)

3/7/1.5.2 Milestone-based approach**3/7/1.5.2.1 Modification of Radio Regulations to reference draft new Resolution [A7(A)-NGSO-MILESTONES] into Article 11**

For a milestone-based approach contained in a WRC Resolution to be mandatorily applied to non-GSO systems in specific frequency bands, the Resolution would need to be included in the Radio Regulations with a mandatory reference. The example proposed allows the implementation of any of the options listed in Table 3/7/1.3.2-1.

ARTICLE 11

**Notification and recording of frequency
assignments^{1, 2, 3, 4, 5, 6, 7, 8} (WRC-15)**

ADD

**Section III – Maintenance of the recording of frequency assignments to non-GSO satellite
systems in the Master Register (WRC-19)**

ADD

11.51 For frequency assignments to some non-GSO satellite systems in specific frequency bands and services, draft new Resolution [A7(A)-NGSO-MILESTONES] (WRC-19) shall apply. (WRC-19)

3/7/1.5.2.2 Modification of RR Article 13

Based on the milestone-based approach, there may be a difference between the number of satellites deployed and the number of satellites recorded in the MIFR during the milestone process. This should be taken into account in the application of RR No. 13.6.

ARTICLE 13**Instructions to the Bureau****Section II – Maintenance of the Master Register and of World Plans by the Bureau****MOD**

13.6 *b)* whenever it appears from reliable information available that a recorded assignment has not been brought into use, or is no longer in use, or continues to be in use but not in accordance with the notified required characteristics^{ADD 1} as specified in Appendix 4, the Bureau shall consult the notifying administration and request clarification as to whether the assignment was brought into use in accordance with the notified characteristics or continues to be in use in accordance with the notified characteristics. Such a request shall include the reason for the query. In the event of a response and subject to the agreement of the notifying administration the Bureau shall cancel, suitably modify, or retain the basic characteristics of the entry. If the notifying administration does not respond within three months, the Bureau shall issue a reminder. In the event the notifying administration does not respond within one month of the first reminder, the Bureau shall issue a second reminder. In the event the notifying administration does not respond within one month of the second reminder, action taken by the Bureau to cancel the entry shall be subject to a decision of the Board. In the event of non-response or disagreement by the notifying administration, the entry will continue to be taken into account by the Bureau when conducting its examinations until the decision to cancel or modify the entry is made by the Board. In the event of a response, the Bureau shall inform the notifying administration of the conclusion reached by the Bureau within three months of the administration's response. When the Bureau is not in a position to comply with the three-month deadline referred to above, the Bureau shall so inform the notifying administration together with the reasons therefor. In case of disagreement between the notifying administration and the Bureau, the matter shall be carefully investigated by the Board, including taking into account submissions of additional supporting materials from administrations through the Bureau within the deadlines as established by the Board. The application of this provision shall not preclude the application of other provisions of the Radio Regulations. (WRC-15/19)

ADD

¹ **13.6.1** See also No. ADD **11.51**, frequency assignments to non-geostationary-satellite systems recorded in the Master Register. (WRC-19)

3/7/1.5.2.3 Proposed example of draft new Resolution**3/7/1.5.2.3.1 Example Resolution**

For the example Resolution below, “Effective Date” refers to the date on or after which the end of the seven-year regulatory period for non-geostationary systems subject to the Resolution marks the start of the milestone-based approach without transition measures. For the Resolution text, “Effective Date” would be replaced with a specific date decided by WRC-19.

ADD**DRAFT NEW RESOLUTION [A7(A)-NGSO-MILESTONES] (WRC-19)**

A milestone-based approach for the implementation of frequency assignments to space stations in a non-geostationary-orbit satellite system in certain frequency bands and services

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that filings for frequency assignments to non-geostationary satellites systems composed of hundreds to thousands of non-GSO satellites have been received by ITU since 2011 in particular in frequency bands allocated to the fixed-satellite service (FSS) or the mobile-satellite service (MSS);
- b)* that design considerations, availability of launch vehicles to support multiple satellite launches, and other factors mean that notifying administrations may require longer than the regulatory period stipulated in No. **11.44** to complete implementation of non-GSO systems referred to in *considering a)*;
- c)* that any discrepancies between the deployed number of orbital planes/satellites per orbital plane of a non-GSO system and the Master Register have, to date, not significantly impinged upon the efficient use of the orbital/spectrum resource in any frequency band used by non-GSO systems;
- d)* that the bringing into use and the recording in the Master International Frequency Register (MIFR) of frequency assignments to space stations in non-GSO systems by the end of the period referred to in No. **11.44** do not require the confirmation by the notifying administration of the deployment of all the satellites associated with these frequency assignments;
- e)* that ITU-R studies have shown that the adoption of a milestone-based approach will provide a regulatory mechanism to help ensure that the MIFR reasonably reflects the actual deployment of such non-GSO satellite systems in certain frequency bands and services, and improve the efficient use of the orbital/spectrum resource in those frequency bands and services;

f) that in defining the timeline and objective criteria for the milestone-based approach, there is a need to seek a balance between the prevention of spectrum warehousing, the proper functioning of coordination mechanisms, and the operational requirements related to the deployment of a non-geostationary satellite system;

g) that extensions to milestones are undesirable, as they create uncertainty with respect to the non-GSO FSS system with which other systems must coordinate,

recognizing

a) No. [MOD] **11.44C** addresses the bringing into use of frequency assignments to non-GSO satellite systems;

b) that any new regulatory mechanism for management of frequency assignments to non-GSO systems in the Master Register should not impose an unnecessary burden;

c) that since No. **13.6** is applicable to non-GSO systems with frequency assignments that were confirmed to have been brought into use prior to the Effective Date in the frequency bands and services to which this Resolution applies, transitional measures are required to provide affected notifying administrations the opportunity to either confirm deployment of satellites in accordance with the notified required characteristics as specified in Appendix **4**, or to complete deployment in accordance with this Resolution;

d) that for frequency assignments to non-GSO system brought into use and having reach the end of the period referred to in No. **11.44** prior to the Effective Date in the frequency bands and services to which this Resolution applies, affected notifying administrations should be given the opportunity to either confirm the completion of the deployment of satellites in accordance with the Appendix **4** characteristics of their recorded frequency assignments, or be given sufficient time to complete deployment in accordance with this Resolution;

e) that it is not necessary or appropriate for the Bureau, in the interest of improving the efficient use of the orbital/spectrum resource or otherwise, to routinely use the procedures of No. **13.6** to seek confirmation of the deployment of the number of satellites in notified orbital planes for non-geostationary-satellite orbit systems in frequency bands and services not listed in *resolves* 1 of this Resolution;

f) that No. **11.49** addresses the suspension of recorded frequency assignments to a space station of a satellite network or to space stations of a non-geostationary satellite system,

recognizing further

that this Resolution relates to those aspects of non-GSO systems to which *resolves* 1 applies with regard to the notified required characteristics as specified in Appendix **4**. The conformity of the notified required characteristics of the non-GSO systems other than those referred to in *recognizing d)* above is outside the scope of this Resolution,

noting

that for the purpose of this Resolution:

- the term “frequency assignments” is understood to refer to frequency assignments to a space station of a non-geostationary satellite system;
- the term “notified orbital plane” means an orbital plane of the non-GSO system, as provided to the Bureau in the most recent advance publication, coordination or notification information for the system’s frequency assignments, that possesses the general characteristics of Items A.4.b.4.a through A.4.b.4.f, and Item A.4.b.5.c (only for

orbits whose altitudes of the apogee and perigee are different) in Table A of Annex 2 to Appendix 4;

- the term “total number of satellites” is understood to mean the sum of the various values of Appendix 4 data item A.4.b.4.b associated with the notified orbital planes,

resolves

- 1 that this Resolution applies to frequency assignments to non-geostationary satellite systems brought into use in accordance with Nos. **11.44** and [MOD] **11.44C**, in the frequency bands and for the services listed in the Table below:

NOTE: There is a view that for any frequency band where the milestone based approach is intended to apply, it should apply to all co-primary satellite services in the band that are subject to coordination under No. **9.12**. Another view is that the milestone process should only apply to intended services, irrespective of coordination requirements. This aspect has not been fully examined in ITU-R deliberations.

Editor's Note: Tables below are all new to the CPM text:

Frequency bands and services for application of the milestone-based approach

| Bands (GHz) | Space radiocommunication services | | |
|-------------|--|----------------------------------|--|
| | Region 1 | Region 2 | Region 3 |
| 10.70-11.70 | FIXED-SATELLITE (space-to-Earth) FIXED-SATELLITE (Earth-to-space) | FIXED-SATELLITE (space-to-Earth) | |
| 11.70-12.50 | FIXED-SATELLITE (space-to-Earth) | | |
| 12.50-12.70 | FIXED-SATELLITE (space-to-Earth) FIXED-SATELLITE (Earth-to-space) | FIXED-SATELLITE (space-to-Earth) | Option 1: FIXED-SATELLITE (space-to-Earth) Option 2: BROADCASTING-SATELLITE FIXED-SATELLITE (space-to-Earth) |
| 12.7-12.75 | FIXED-SATELLITE (space-to-Earth) FIXED-SATELLITE (Earth-to-space) | FIXED-SATELLITE (Earth-to-space) | Option 1: FIXED-SATELLITE (space-to-Earth) Option 2: BROADCASTING-SATELLITE FIXED-SATELLITE (space-to-Earth) |
| 12.75-13.25 | FIXED-SATELLITE (Earth-to-space) | | |
| 13.75-14.50 | FIXED-SATELLITE (Earth-to-space) | | |
| 17.30-17.70 | FIXED-SATELLITE (space-to-Earth) FIXED-SATELLITE (Earth-to-space) | None | FIXED-SATELLITE (Earth-to-space) |

| Bands (GHz) | Space radiocommunication services | | |
|-------------|---|---|--|
| | Region 1 | Region 2 | Region 3 |
| 17.70-17.80 | FIXED-SATELLITE (space-to-Earth) FIXED-SATELLITE (Earth-to-space) | FIXED-SATELLITE (space-to-Earth) | FIXED-SATELLITE (space-to-Earth) FIXED-SATELLITE (Earth-to-space) |
| 17.80-18.10 | FIXED-SATELLITE (space-to-Earth) FIXED-SATELLITE (Earth-to-space) | | |
| 18.10-19.30 | FIXED-SATELLITE (space-to-Earth) | | |
| 19.30-19.60 | Option 1: FIXED-SATELLITE (space-to-Earth) (except non-GSO MSS feeder links) FIXED-SATELLITE (Earth-to-space) (except non-GSO MSS feeder links) Option 2: FIXED-SATELLITE (space-to-Earth) (Earth-to-space) | | |
| 19.60-19.70 | Option 1: FIXED-SATELLITE (space-to-Earth) (except non-GSO MSS feeder links) (Earth-to-space) Option 2: FIXED-SATELLITE (space-to-Earth) (Earth-to-space) | | |
| 19.70-20.10 | FIXED-SATELLITE (space-to-Earth) | FIXED-SATELLITE (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) | FIXED-SATELLITE (space-to-Earth) |
| 20.10-20.20 | FIXED-SATELLITE (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) | | |
| 27.00-27.50 | | FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE | |
| 27.50-29.50 | Option 1: FIXED-SATELLITE (Earth-to-space) (except non-GSO MSS feeder links) Option 2: FIXED-SATELLITE (Earth-to-space) | | |
| 29.50-29.90 | FIXED-SATELLITE (Earth-to-space) | FIXED-SATELLITE (Earth-to-space) MOBILE-SATELLITE (Earth-to-space) | FIXED-SATELLITE (Earth-to-space) |
| 29.90-30.00 | FIXED-SATELLITE (Earth-to-space) MOBILE-SATELLITE (Earth-to-space) | | |
| 37.50-38.00 | FIXED-SATELLITE (space-to-Earth) | | |
| 38.00-39.50 | FIXED-SATELLITE (space-to-Earth) | | |
| 39.50-40.50 | FIXED-SATELLITE (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) | | |
| 40.50-41.25 | FIXED-SATELLITE (space-to-Earth) BROADCASTING-SATELLITE | | |
| 47.20-50.20 | FIXED-SATELLITE (Earth-to-space) | | |
| 50.40-51.40 | FIXED-SATELLITE (Earth-to-space) | | |

In addition to the frequency bands contained in the table above, for which consensus was agreed for inclusion in the example of a draft new WRC Resolution, other frequency bands

were proposed. These frequency bands, for which no consensus to include in the example draft new WRC Resolution was reached at CPM, are shown in the table below.

| Bands (MHz) | Region1 | Region 2 | Region 3 |
|--------------------|---|-----------------|-----------------|
| 137-137.025 | MOBILE-SATELLITE (space-to-Earth) | | |
| 137.025-137.175 | Mobile-satellite (space-to-Earth) | | |
| 137.175-137.825 | MOBILE-SATELLITE (space-to-Earth) | | |
| 137.825-138 | Mobile-satellite (space-to-Earth) | | |
| 137-138 | MOBILE-SATELLITE (space-to-Earth) | | |
| 148-149.9 | MOBILE-SATELLITE (Earth-to-space) | | |
| 399.9-400.05 | MOBILE-SATELLITE (Earth-to-space) | | |
| 400.15-401 | MOBILE-SATELLITE (space-to-Earth) | | |
| Bands (GHz) | Region 1 | Region 2 | Region 3 |
| 1.980-2.010 | MOBILE-SATELLITE (Earth-to-space) | | |
| 2.170-2.200 | MOBILE-SATELLITE (space-to-Earth) | | |
| 3.400-4.200 | FIXED-SATELLITE (space-to-Earth) | | |
| 5.091-5.150 | Option 1: FIXED-SATELLITE (Earth-to-space) Option 2: FIXED-SATELLITE (Earth-to-space) AERONAUTICAL MOBILE-SATELLITE (R) | | |
| 5.150-5.250 | FIXED-SATELLITE (Earth-to-space) | | |
| 5.725-5.85 | FIXED-SATELLITE (Earth-to-space) | | |
| 5.85-6.70 | FIXED-SATELLITE (Earth-to-space) | | |
| 6.70-6.725 | FIXED-SATELLITE (Earth-to-space) FIXED-SATELLITE (space-to-Earth) | | |
| 6.725-7.025 | FIXED-SATELLITE (space-to-Earth) | | |
| 7.025-7.075 | FIXED-SATELLITE (Earth-to-space) FIXED-SATELLITE (space-to-Earth) | | |
| 7.250-7.375 | Option 1: FIXED-SATELLITE (space-to-Earth) Option 2: FIXED-SATELLITE (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) | | |
| 7.375-7.45 | FIXED-SATELLITE (space-to-Earth) | | |
| 7.45-7.55 | Option 1: FIXED-SATELLITE (space-to-Earth) Option 2: FIXED-SATELLITE (space-to-Earth) METEOROLOGICAL-SATELLITE (space-to-Earth) | | |
| 7.55-7.75 | FIXED-SATELLITE (space-to-Earth) | | |
| 7.90-8.175 | FIXED-SATELLITE (Earth-to-space) | | |

| | | | |
|-------------|--|--|---|
| 8.175-8.215 | Option 1: FIXED-SATELLITE (Earth-to-space) Option 2: FIXED-SATELLITE (Earth-to-space) METEOROLOGICAL -SATELLITE (Earth-to-space) | | |
| 8.215-8.40 | FIXED-SATELLITE (Earth-to-space) | | |
| 14.5-14.8 | FIXED-SATELLITE SERVICE (Earth-to-space) | | |
| 15.43-15.63 | FIXED-SATELLITE (Earth-to-space) | | |
| 20.2-21.2 | Option 1: FIXED-SATELLITE (space-to-Earth) Option 2: FIXED-SATELLITE (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) | | |
| 21.4-22.0 | BROADCASTING-SATELLITE | | BROADCASTING-SATELLITE |
| 24.65-24.75 | FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE | | FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE |
| 24.75-25.25 | FIXED-SATELLITE (Earth-to-space) | | |
| 30-31 | Option 1: FIXED-SATELLITE (Earth-to-space) Option 2: FIXED-SATELLITE (Earth-to-space) MOBILE-SATELLITE (Earth-to-space) | | |
| 42.5-43.5 | FIXED-SATELLITE (Earth-to-space) | | |
| 43.5-47 | Option 1: MOBILE-SATELLITE Option 2: MOBILE-SATELLITE RADIONAVIGATION-SATELLITE | | |

Normal process

2 that for the frequency assignments to which *resolves* 1 applies, and for which the end of the seven-year regulatory period is “*Effective Date*” or later, the notifying administration shall communicate to the Bureau the required deployment information in accordance with Annex 1 to this Resolution no later than 30 days after the end of the regulatory period specified in No. MOD **11.44** or 30 days after the end of the bringing into use period referred to in No. MOD **11.44C**, whichever comes later;

Transition Options 1+2

3 that for frequency assignments to which *resolves* 1 applies, and for which the end of the seven-year regulatory period specified in No. MOD **11.44** has expired prior to “*Effective Date*”, the notifying administration shall communicate to the Bureau the required deployment information in accordance with Annex 1 to this Resolution no later than 30 days after the “*Effective Date*”;

NOTE: Values of M, P and DF in this Resolution are taken from options of implementations in the options 3/7/1.3.2.1.

Normal process and Transition Options 1+2

- 4 that upon receipt of the required deployment information submitted in accordance with *resolves* 2 or 3 above, the Bureau shall:
- a) promptly make this information available “as received” on the ITU website;
 - b) add a remark to the Master Register entry if available or to latest notification information, as appropriate, stating that the assignments are subject to the application of this Resolution if the number of satellites communicated to the Bureau under *resolves* 2 or 3 above is less than P3% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in the BR IFIC (Part I-S) for the frequency assignments; and
 - c) publish the results of action taken pursuant to *resolves* 4b) above in the BR IFIC and the ITU website;

Normal process and Transition Options 1+2 and post-milestone procedures alternative 1

- 5 that, if the number of satellites (rounded down to the lower integer) communicated to the Bureau under *resolves* 2 or 3 above is P3% or between P3% and 100%, as applicable, of the total number of satellites indicated in the latest notification information published in the BR IFIC (Part I-S) for the frequency assignments, *resolves* 6 to 14 of this Resolution are not applicable;

Normal process and Transition Options 1+2 and post-milestone procedures alternative 2

- 5 that, if the number of satellites (rounded down to the lower integer) communicated to the Bureau under *resolves* 2 or 3 above is P3% or between P3% and 100%, as applicable, of the total number of satellites indicated in the latest notification information published in the BR IFIC (Part I-S) for the frequency assignments, no further action is required under the subsequent *resolves* of this Resolution;

Normal process and Transition Option 1

- 6 that, for the frequency assignments to which *resolves* 2 applies, the notifying administration shall communicate to the Bureau the required deployment information in accordance with Annex 1 to this Resolution for the milestone period mentioned in subsections a) through c) of this *resolves* 6:

- a) no later than 30 days after the expiry of the “M1”-year period after the end of the seven-year period referred to in No. **11.44**;
- b) no later than 30 days after the expiry of the “M2”-year period after the end of the seven-year period referred to in No. **11.44**;
- c) no later than 30 days after the expiry of the “M3”-year period after the end of the seven-year period referred to in No. **11.44**;

- 7 that, for the frequency assignments to which *resolves* 3 applies, the notifying administration shall communicate to the Bureau the required deployment information in accordance with Annex 1 to this Resolution for the milestone period mentioned in subsections a) through c) of this *resolves* 7:

- a) no later than DD/MM/202X (corresponding to 30 days after the expiry of the “M1”-year period after the “Effective Date”);
- b) no later than DD/MM/202Y (corresponding to 30 days after the expiry of the “M2”-year period after the “Effective Date”);
- c) no later than DD/MM/20ZZ (corresponding to 30 days after the expiry of the “M3”-year period after the “Effective Date”);

Normal process and Transition Option 2

6 that, for the frequency assignments to which *resolves* 2 applies having the end of the of the seven-year regulatory period specified in No. MOD **11.44** expiring on or after the “commencement date of the regular milestone-based approach (MR)”, the notifying administration shall communicate to the Bureau the required deployment information in accordance with Annex 1 to this Resolution for the milestone period mentioned in subsections *a)* through *c)* of this *resolves* 6:

- a)* no later than 30 days after the expiry of the “M1”-year period after the end of the seven-year period referred to in No. **11.44**;
- b)* no later than 30 days after the expiry of the “M2”-year period after the end of the seven-year period referred to in No. **11.44**;
- c)* no later than 30 days after the expiry of the “M3”-year period after the end of the seven-year period referred to in No. **11.44**;

7 that the frequency assignments to which *resolves* 3 applies, and for the frequency assignments to which *resolves* 2 applies having the end of the of the seven-year regulatory period specified in No. MOD **11.44** expiring before the “commencement date of the regular milestone-based approach (MR)”, the notifying administration shall communicate to the Bureau the required deployment information in accordance with Annex 1 to this Resolution for the appropriate milestone date of satellite networks mentioned in the Table of Annex 2 to this Resolution associated to the above frequency assignments:

- a)* no later than 30 days after the D-M1-date;
- b)* no later than 30 days after the D-M2-date;
- c)* no later than 30 days after the D-M3-date;

Normal process and Transition Options 1+2

8 that, upon receipt of the required deployment information submitted in accordance with *resolves* 6 or 7, the Bureau shall:

- a)* promptly make this information available “*as received*” on the ITU website;
- b)* conduct an examination of the information provided for compliance with the minimum number of satellites to be deployed as prescribed for each period in *resolves* 9*a)*, 9*b)* or 9*c)* as appropriate;
- c)* modify the Master Register entry if available or latest notification information, as appropriate, for the frequency assignments to the system to remove the remark stating that the assignments are subject to the application of this Resolution if the number communicated to the Bureau under *resolves* 6, or *resolves* 7, is “P3%” (rounded down to the lower integer) or above of the total number of satellites indicated in the Master Register entry for the non-geostationary satellite system;
- d)* publish this information and its findings in the BR IFIC;

Normal process and Transitional Option 1+2

9 that, the notifying administration shall also submit to the Bureau, no later than 90 days after the expiry of the milestone period referred to in *resolves* 6*a)*, 6*b)*, 6*c)* or *resolves* 7*a)*, 7*b)*, 7*c)*, as appropriate, the modifications to the characteristics of the notified or recorded frequency assignments if the number of space stations declared as deployed,

- a)* under *resolves* 6*a)* or 7*a)*, as appropriate, is less than “P1”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in the BR IFIC (Part I-S) for the frequency assignments. In this

case, the modified total number of satellites shall not be greater than “DF1” times the number of space stations declared as deployed under *resolves 6a)* or *7a)*;

- b) under *resolves 6b)* or *7b)*, as appropriate, is less than “P2”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments. In this case, the modified total number of satellites shall not be greater than “DF2” times the number of space stations declared as deployed under *resolves 6b)* or *7b)*;
- c) under *resolves 6c)* or *7c)*, as appropriate, is less than “P3”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments. In this case, the modified total number of satellites shall not be greater than “DF3” times the number of space stations declared as deployed under *resolves 6c)* or *7c)*;

Note: If P3 is 100%, there would be no rounding down and no need to apply DF3 (which would be 1).

9bis that the Bureau shall, no later than forty-five (45) days before any deadline for submission by a notifying administration under *resolves 2*, *resolves 3*, subsections *a)*, *b)* or *c)* of *resolves 6* and subsections *a)*, *b)* or *c)* of *resolves 7*, send a reminder to the notifying administration to provide the information required;

Section of the Resolution dealing with the treatment of the notices for modification submitted in accordance with resolves 9

Treatment of the notices for modification (PART-IS)

10 that, upon receipt of the modifications to the characteristics of the notified or recorded frequency assignments as referred to in *resolves 9*:

- a) the Bureau shall promptly make this information available “as received” on the ITU website;
- b) the Bureau shall conduct an examination for compliance with the maximum number of satellites as per *resolves 9a)*, *9b)* or *9c)* and Nos. **11.43A/11.43B**, as appropriate;
 - i) should the Bureau reach a favourable finding under No. **11.31**; and
 - ii) should the modifications be limited to the reduction of the number of orbital planes (Appendix 4 data item A.4.b.1) and the modifications to the RAAN (Appendix 4 data item A.4.b.4.g) the longitude of the ascending node (Appendix 4 data item XX) and the date and time of epoch (Appendix 4 data items XX and YY) associated with the remaining orbital planes or the reduction of the number of space stations per plane (Appendix 4 data item A.4.b.4.b) and the modifications of the initial phase of the space stations (Appendix 4 data item A.4.b.4.h) within planes; and
 - iii) should the notifying administration provide a commitment stating that the characteristics as modified will not cause more interference or require more protection than the characteristics provided in the latest modification information published in PART I-S of the BR IFIC for the frequency assignments (see Appendix 4 data item A.20)
- c) the Bureau, for the purpose of No. **11.43B**, shall not treat these modifications as new notifications of frequency assignments and shall retain the original dates of entry of the frequency assignments in the Master Register;

- d) the Bureau shall ensure the remark stating that the assignments are subject to the application of this Resolution as defined in *resolves* 6 or 7 is retained until the milestone process of this Resolution is complete
- e) the Bureau shall publish the information provided and its findings in the BR IFIC;

Note: An example of the implementation of resolves 10c)iii) of this option for modification information is presented in section 3/7/1.5.2.3.2 below.

End of the section of the Resolution dealing with the treatment of the notices for modification submitted in accordance with Resolves 9

Section of the Resolution on the non-submission of the deployment information and their associated consequences

Alternative 1

11 that, if a notifying administration fails to communicate the information required under *resolves* 2 or *resolves* 3, *resolves* 6a), 6b) or 6c) or *resolves* 7a), 7b) or 7c), as appropriate, the Bureau shall promptly send to the notifying administration a reminder asking the administration to provide the required information within thirty (30) days from the date of reminder from the Bureau;

11bis that, if a notifying administration fails to provide information after the reminder sent under *resolves* 11, the Bureau shall send to the notifying administration a second reminder asking it to provide the required information within fifteen (15) days from the date of the second reminder;

11ter that, if a notifying administration fails to provide the required information under *resolves* 11 and 11bis, the Bureau shall treat the case as it would treat a non-response case under No. **13.6**, and continue to take the entry into account when conducting its examinations until the decision is made by the Board to cancel the entry or modify the entry by suppressing the notified orbital parameters of all satellites not listed in the last complete deployment information submitted under *resolves* 6 or 7, as appropriate;

Alternative 2

11 that if the notifying administration fails to provide the required information under *resolves* 6a), 6b) or 6c) or *resolves* 7a), 7b) or 7c), as appropriate, the 90-day period referred to in *resolves* 9, as applicable, shall be reduced by the amount of time elapsed between the date as set forth in the relevant part of *resolves* 6 or 7, as applicable, and the actual date of the submission of the required deployment information in accordance with Annex 1;

11bis that if the notifying administration fails to submit the modifications to the characteristics of the frequency assignments within the 90-day period referred to in *resolves* 9, or within any modified period of time resulting from the application of *resolves* 11, the Bureau shall no longer consider the frequency assignments under subsequent examinations under Nos. **9.36**, **11.32** or **11.32A**; frequency assignments subject to subsection IA of Article **9** shall not cause harmful interference to, nor claim protection from, other frequency assignments recorded in the Master Register with a favourable finding under No. **11.31**;

Note: The 90-day period refers to the period to provide the information for the reduced constellation.

End of the section of the Resolution on the non-submission of the deployment information and their associated consequences

Section of the Resolution on the use of the same spacecraft for more than one filing with overlapping frequency assignments

Alternative 1

12 that the same spacecraft shall not be used under *resolves* 6 and 7 for overlapping frequency assignments of more than one filing;

Note: The implications of resolves 12 are under study within ITU. No conclusions have yet been reached. The methodology and course of action to implement this method need to be specified.

Alternative 2

Resolves 12 is not needed.

NOTE: No provision in Resolution [A7(a)-NGSO-MILESTONES] is needed or appropriate for this subject.

End of the section on the use of the same spacecraft for more than one filing with overlapping frequency assignments

Section of the Resolution on the suspensions of a Recorded frequency assignments

Alternative 1

13 that, for frequency assignments suspended under No. **11.49**, the date of bringing back into use of frequency assignments shall be no later than the date set as per No. **11.49** or the date of the first next milestone as per *resolves* 6a), 6b) or 6c) or *resolves* 7a), 7b) or 7c) as appropriate, whichever date comes first;

14 that the suspension of frequency assignments in accordance with No. **11.49** does not extend the milestone period as specified in *resolves* 6a), 6b) or 6c) or *resolves* 7a), 7b) or 7c), as applicable, nor reduce the requirements associated with any of the remaining milestones as derived from *resolves* 6a), 6b) or 6c) or *resolves* 7a), 7b) or 7c), as appropriate;

Alternative 2

13 that the suspension of the use of frequency assignments under No. **11.49** at any point prior to the end of the applicable milestone periods specified in *resolves* 6a), 6b) or 6c) or *resolves* 7a), 7b) or 7c) of this Resolution shall not alter or reduce the requirements associated with any of the remaining milestones as derived from *resolves* 6a), 6b) or 6c) or *resolves* 7a), 7b) or 7c) of this Resolution, as applicable;

End of the Section of the Resolution on the suspension of a recorded frequency assignments

Note: In the discussion of this Resolution, the need to address the post-milestone approach was raised. To this effect additional resolves were suggested. No consensus was reached for the inclusion of these resolves in the Resolution.

Section of the Resolution on the post-milestone procedures

Alternative 1

Note: There would be a need for a new or modified remark associated with the post-milestone procedures to be included in the MIFR. This may be included in resolves 8bis, if appropriate.

15 that every two years after the date specified in *resolves* 2 or 3 subject to validation of *resolves* 5 or *resolves* 6c) or *resolves* 7c), as appropriate, the notifying administration shall

communicate to the Bureau, within thirty days after the end of each two-year period, the complete deployment information in accordance with Annex 1 to this Resolution;

16 that, if a notifying administration fails to implement *resolves* 15, the Bureau shall send to the notifying administration a reminder asking it to provide the required information within thirty days;

17 that, if the notifying administration does not apply No. **11.49** for the non-geostationary-satellite system and if the total number of satellites provided under *resolves* 15 and 16, as appropriate, is for the second consecutive time lower than “90%” of the total number of satellites (rounded down to the lower integer) indicated in the Master Register, *resolves* 18 to 21 apply;

18 that, in application of *resolves* 17, the Bureau shall request the notifying administration to provide, within thirty days, the updated notified orbital parameters in order to adjust them to the total number of satellites provided under *resolves* 15 or 16;

19 that, fifteen days before the expiry of the date referred in *resolves* 18, the Bureau shall send a reminder of the deadline to the administration;

20 that, if the notifying administration does not provide information requested under *resolves* 18, the frequency assignments shall be cancelled by the Bureau;

21 that, upon receipt of the modifications to the characteristics of the notified or recorded frequency assignments as referred to in *resolves* 18, the Bureau shall,

- a) promptly make this information available “as received” on the ITU website;
- b) conduct an examination for compliance with the maximum number of satellites as per *resolves* 17, and either
 - i) conduct an examination under No. **11.31** when these modifications are limited to the reduction of the number of orbital planes (Appendix 4 data item A.4.b.1) and the modifications to the RAAN (Appendix 4 data item A.4.b.4.g) the longitude of the ascending node (Appendix 4 data item XX) and the date and time of epoch (Appendix 4 data items XX and YY) associated with the remaining orbital planes or the reduction of the number of space stations per plane (Appendix 4 data item A.4.b.4.b) and the modifications of the initial phase of the space stations (Appendix 4 data item A.4.b.4.h) within planes and, if favourable, not treat these modifications as new notifications of assignments and shall retain their original dates; or
 - ii) apply Nos. **11.43A** and **11.43B** when these modifications covered other Appendix 4 data items than those referred to in *i) above*; and
- c) publish the information provided and its findings in the BR IFIC,

Alternative 2

Resolves 15 through 21 are not necessary

NOTE: No provision in Resolution [A7(A)-NGSO-MILESTONES] is needed for this subject.

End of the section of the Resolution on the post-milestone procedures

instructs the Radiocommunication Bureau

1 to take the necessary actions to implement this Resolution and report to subsequent WRCs on the results of the implementation of this Resolution.

ANNEX 1 TO DRAFT NEW
RESOLUTION [A7(A)-NGSO-MILESTONES] (WRC-19)

Information to be submitted about the deployed space stations

Option 1 for Annex 1

A Identity of the satellite system

- a)* Name of the satellite system
- b)* Name of the notifying administration
- c)* Country symbol
- d)* Reference to the advance publication information or to the request for coordination, as applicable
- e)* Reference to the notification.

B Spacecraft manufacturer

In cases where a contract for satellite procurement covers more than one satellite, the relevant information shall be submitted for each satellite:

- a)* Name of the spacecraft manufacturer
- b)* Number of satellites procured.

C Launch services provider

In cases where a contract for launch procurement covers more than one satellite, the relevant information shall be submitted for each satellite:

- a)* Name of the launch vehicle provider
- b)* Name of the launch vehicle
- c)* Name and location of the launch facility
- d)* Launch date.

D Space station characteristics

For each spacecraft:

- a)* Name of the spacecraft
- b)* Orbital characteristics of the spacecraft (see **11.44C.4**)
- c)* Frequency assignments that the space station can transmit or receive.

Option 2 for Annex 1

ANNEX 1 TO DRAFT NEW
RESOLUTION [A7(A)-NGSO-MILESTONES] (WRC-19)

Information to be submitted about the deployed space stations

A Satellite system information

- a)* Name of the satellite system
- b)* Name of the notifying administration

- c) Country symbol
- d) Reference to the advance publication information or to the request for coordination, as applicable
- e) Reference to the notification
- f) Number of space stations currently deployed.

B Space station information to be provided for each space station currently deployed

Space station manufacturer

- a) Name of the space station manufacturer
- b) Date of execution of the contract
- c) Contractual “delivery window”
- d) Number of space stations procured.

Launch services provider

- a) Name of the launch vehicle provider
- b) Date of execution of the contract
- c) Name of the launch vehicle
- d) Name and location of the launch facility
- e) Launch date.

Space station characteristics

- a) Name of the space station
- b) Orbital characteristics of the spacecraft
- c) Frequency band(s) present on board the spacecraft (i.e. frequency bands within which frequency assignments are capable to be transmitted or received by the spacecraft).

Option 3 for Annex 1

ANNEX 1 TO DRAFT NEW
RESOLUTION [A7(A)-NGSO-MILESTONES] (WRC-19)

Information to be submitted about the deployed space stations

A Satellite system information

- 1 Name of the satellite system
- 2 Name of the notifying administration
- 3 Total number of space stations deployed.

B Launch information to be provided for each deployed space station

- 1 Name of the launch vehicle provider
- 2 Name and location of the launch facility
- 3 Launch date.

**ANNEX 2 TO DRAFT NEW
RESOLUTION [A7(A)-NGSO-MILESTONES] (WRC-19)**

Table for the transitional measures Option 2

Table for the transitional measures

| ADM | SAT_SYSTEM NAME | API received date | CRC received date | API or CRC n° | R date | D-M1 date | D-M2 date | D-date |
|------------|----------------------------|----------------------------------|----------------------------------|--------------------------|---------------|----------------------|----------------------|---------------|
| | | | | | | | | |

NOTE: The above table will be calculated during WRC-19, by using the method described in Annex 2 of the CPM Report for WRC-19 agenda item 7 Issue A, and by taking into account all the satellite networks subject to this Resolution (frequency bands, services), where the end of the seven-year regulatory period comes before the beginning of the regular milestone-based approach.

3/7/1.5.2.3.2 Modification to Appendix 4

A modification to RR Appendix 4 is needed for implementation of modification information. The example below implements *resolves* 10 c)iii) by providing in RR Appendix 4 the commitment referenced there.

APPENDIX 4 (REV.WRC-15)

**Consolidated list and tables of characteristics for use in the
application of the procedures of Chapter III**

ANNEX 2

**Characteristics of satellite networks, earth stations
or radio astronomy stations² (Rev.WRC-12)**

Footnotes to Tables A, B, C and D

MOD

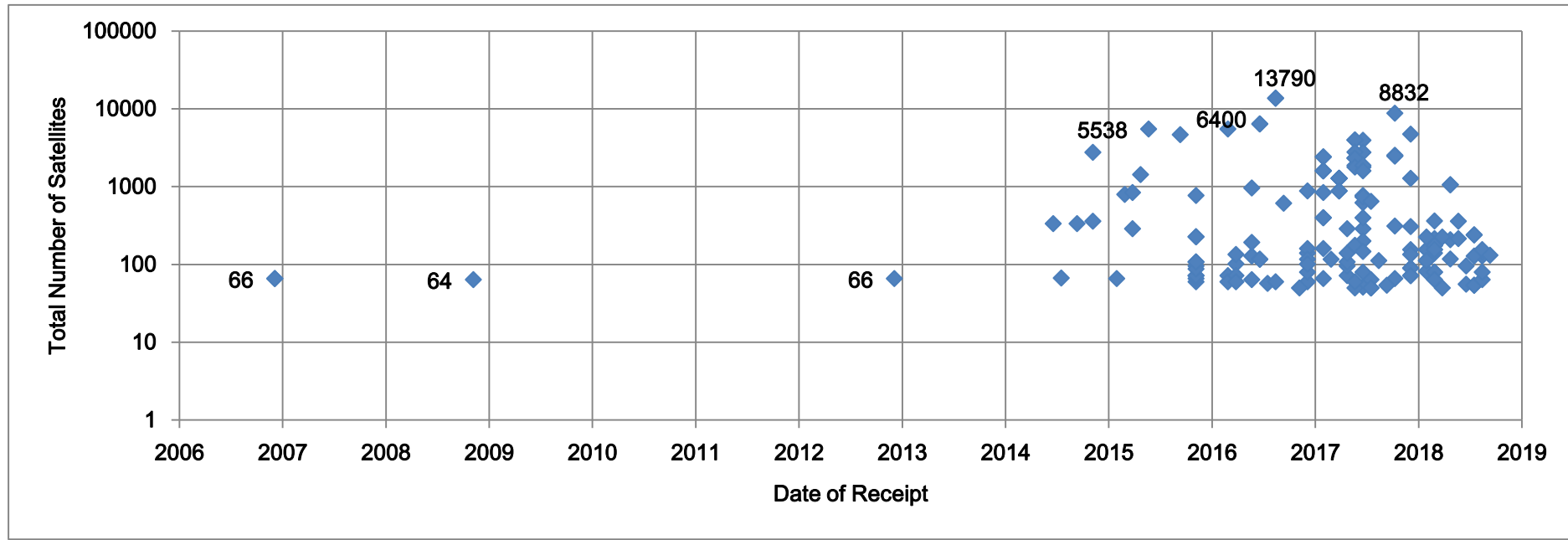
TABLE A
GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,
EARTH STATION OR RADIO ASTRONOMY STATION (Rev.WRC-1219)

| Items in Appendix | A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION | Advance publication of a geostationary- satellite network | Advance publication of a non- geostationary-satellite network subject to coordination under Section II of Article 9 | Advance publication of a non- geostationary-satellite network not subject to coordination under Section II of Article 9 | Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A) | Notification or coordination of a non- geostationary-satellite network | Notification or coordination of an earth station (including notification under Appendices 30A or 30B) | Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5) | Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5) | Notice for a satellite network in the fixed- satellite service under Appendix 30B (Articles 6 and 8) | Items in Appendix | Radio astronomy |
|-------------------|---|--|--|--|---|---|---|---|--|--|-------------------|-----------------|
| *** | *** | | | | | | | | | | *** | |
| A.18 | COMPLIANCE WITH NOTIFICATION OF AIRCRAFT EARTH STATION(S) | | | | | | | | | | A.18 | |
| A.18.a | a commitment that the characteristics of the aircraft earth station (AES) in the aeronautical mobile-satellite service are within the characteristics of the specific and/or typical earth station published by the Bureau for the space station to which the AES is associated Required only for the band 14-14.5 GHz, when an aircraft earth station in the aeronautical mobile-satellite service communicates with a space station in the fixed-satellite service | | | | + | + | | | | | A.18.a | |
| A.19 | COMPLIANCE WITH § 6.26 OF ARTICLE 6 OF APPENDIX 30B | | | | | | | | | | A.19 | |
| A.19.a | a commitment that the use of the assignment shall not cause unacceptable interference to, nor claim protection from, those assignments for which agreement still needs to be obtained Required if the notice is submitted under § 6.25 of Article 6 of Appendix 30B | | | | | | | | | + | A.19.a | |
| A.20 | COMPLIANCE WITH resolves 6bis OF RESOLUTION [A7(a)-NGSO-MILESTONES] (WRC-19) | | | | | | | | | | A.20 | |
| A.20.a | a commitment stating that the characteristics as modified will not cause more interference or require more protection than the characteristics provided in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary satellite system | | | | | | 0 | | | | | |

ANNEX 1 TO SECTION 3/7/1 (AGENDA ITEM 7, ISSUE A)

Submission statistics of non-GSO satellite systems until IFIC 2885

The following figure shows tendency of the total number of satellites of non-GSO satellite systems submitted to ITU before 11 December 2018 (IFIC 2885), and only those of numbers equal to or larger than 50 are illustrated. The total number of satellites begins to exceed 100 after May 2014 and increases sharply from 2015 and the maximum number of satellites is 13 790 submitted in July 2016.



ANNEX 2 TO SECTION 3/7/1 (AGENDA ITEM 7, ISSUE A)

Calculation of the milestone periods for transitional measures Option 2

This Annex provides 1) the general principle of calculating the milestones for systems for which the end of the seven-year regulatory period is before the beginning of the regular milestone-based approach (MR), and 2) a table with the calculated milestones for each system subject to this Resolution.

1) General principle of calculating the transitional milestones

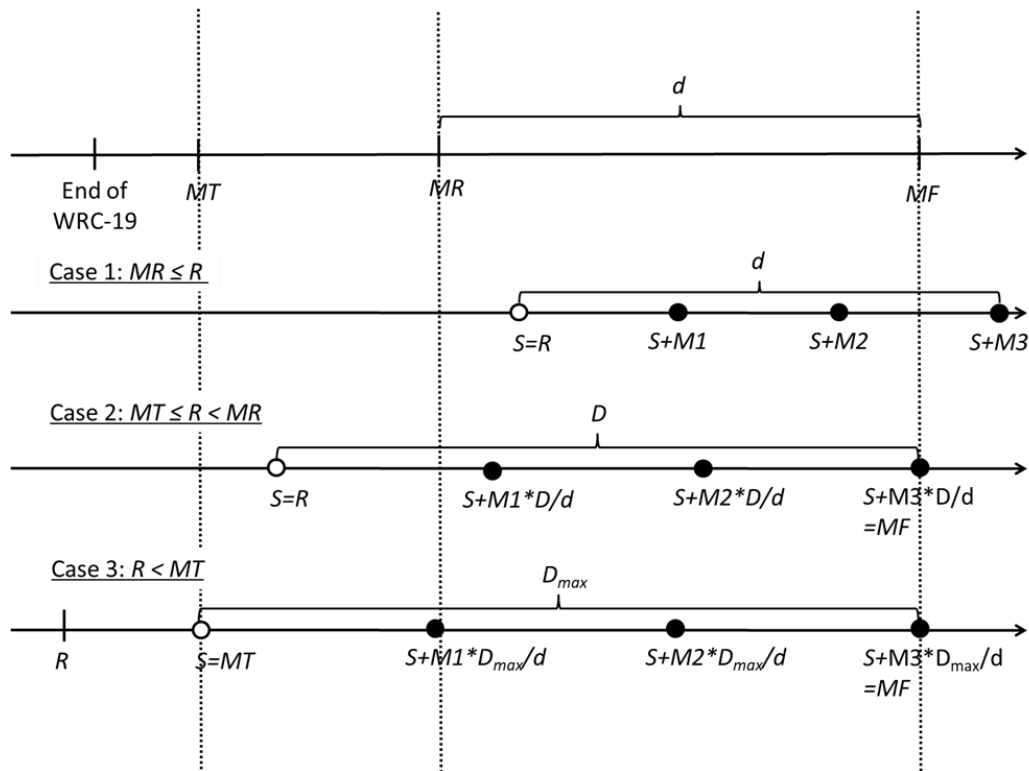
Considering that:

R designates the date of the end of the seven-year regulatory period:

- MT is the date of the beginning of the transitional milestone-based approach;
- MR is the date of the beginning of the regular milestone-based approach;
- MF which corresponds to $MR + d$ and is only used to describe the stretching;
- d is the duration of the regular milestone-based approach.

Depending on the position of end of the seven-year regulatory period (R) with respect to the beginning of the transitional milestone-based approach (MT) and the beginning of the regular milestone-based approach (MR), one can distinguish three cases:

- non-GSO systems for which the end of the seven-year regulatory period R is after MR will have to apply the regular milestone-based approach with a duration of d . The milestone-based approach will start on day R and end on day $R + d$;
- non-GSO systems for which the end of the seven-year regulatory period R is between MT and MR will benefit from stretched milestone timelines. The milestone process for such systems will start on day R and end on day $MF = MR + d$, and have a duration of D (with $D = MF - R > d$);
- non-GSO systems for which the end of the seven-year regulatory period R is before MT will also benefit from stretched milestone timelines, starting on MT and ending on $MF = MR + d$. In this case, we note the duration D_{max} with ($D_{max} = MF - MT > d$).



For systems for which the end of the seven-year regulatory period is before the beginning of the regular milestone-based approach (MR), the periods between the different milestones are stretched by a factor of D/d , compared to those under the regular milestone-based approach as shown in the table below:

| | Milestone in years | Stretched process | | Regular process |
|--------------------|--------------------|-----------------------------|-----------------------|-----------------|
| | | $R < MT$ | $MT \leq R < MR$ | $MR \leq R$ |
| Start S | | $S = MT$ | $S = R$ | $S = R$ |
| Milestone 1 | M1 years | $D1 = M1 * 365 * D_{max}/d$ | $D1 = M1 * 365 * D/d$ | $D1 = M1 * 365$ |
| Milestone 2 | M2 years | $D2 = M2 * 365 * D_{max}/d$ | $D2 = M2 * 365 * D/d$ | $D2 = M2 * 365$ |
| Milestone 3 | M3 years | $D3 = M3 * 365 * D_{max}/d$ | $D3 = M3 * 365 * D/d$ | $D3 = M3 * 365$ |

Agenda item 7(B)

3/7/2 Issue B – Application of coordination arc in the Ka-band, to determine coordination requirements between the FSS and other satellite services

3/7/2.1 Executive summary

WRC-19 agenda item 7, Issue B, proposes the introduction of the coordination arc with a value of 8 degrees as coordination criteria between fixed-satellite service (FSS) and mobile-satellite service (MSS) systems and MSS systems, in the frequency bands 29.5-30 GHz (Earth-to-space)/19.7-20.2 GHz (space-to-Earth) in all 3 Regions, as substitution of the existing trigger of coordination $\Delta T/T > 6\%$. Considering that according to the current RR, to determine whether coordination under RR No. **9.7** is required between FSS vs. FSS satellite networks, a coordination arc of 8° is the coordination criteria applied in this same frequency band, the proposal is based on the following principles:

- Results of studies show that earth station terminals used in the MSS and FSS in the Ka-band are quite similar. Therefore, it can be considered that the coordination arc that currently trigger coordination between FSS systems in an effective and efficient manner, can be applied to trigger coordination between MSS and FSS systems and MSS systems.
- Introduction of the coordination arc will reduce the number of administrations identified for coordination, reducing the number of coordination processes and resulting in a reduction of required resources in administrations, operators, Bureau, etc.
- Administration will always have the possibility to request application of RR No. **9.41** to include additional satellite networks affected, taking into account the $\Delta T/T > 6\%$ criteria.

3/7/2.2 Background

Evolution of technology and in particular the development of precise tracking systems, has allowed that terminals on board of systems in motion used in the MSS have characteristics comparable to fixed earth stations. As a result of this, WRC-15 approved the use of earth stations in motion under the FSS (Resolution **156 (WRC-15)**) in the same frequency bands considered under WRC-19 agenda item 7, Issue B.

Currently in the Radio Regulations, to determine whether coordination under RR No. **9.7** is required, in the frequency bands 29.5-30 GHz (Earth-to-space)/19.7-20.2 GHz (space-to-Earth) in all 3 Regions the following criteria is applied:

- FSS vs FSS: Coordination arc of 8°
- FSS vs MSS: $\Delta T/T > 6\%$
- MSS vs MSS: $\Delta T/T > 6\%$

In addition, in the FSS vs FSS coordination, administrations can always request application of RR No. **9.41** to include additional satellite networks that would be affected taking into account the $\Delta T/T > 6\%$ criteria.

Taking into account that the coordination arc criteria is used to determine coordination between FSS systems and it works in an effective and efficient way, WRC-19 agenda item 7, Issue B studies the possibility to apply this same coordination criteria to determine if coordination is required between MSS systems and between MSS and FSS systems.

3/7/2.3 Summary and analysis of the results of ITU-R studies

Studies comparing all MSS and FSS earth stations contained in the ITU SRS database, in the portion of the Ka frequency band under consideration, in terms of antenna patterns and antenna sizes (maximum gain) used in each service, showed that MSS earth station parameters are quite similar to those used by the FSS earth stations. The studies also showed that all satellite networks with frequency assignments in the MSS also have frequency assignments in the FSS.

Another study analysed, case by case, the regulatory implications when substituting $\Delta T/T > 6\%$ by coordination arc, analysing the different situations of coordination between the FSS and MSS services that may occur, taking also into account the status of the existing and incoming FSS and MSS assignments. As a result of these two studies, Issue B proposes the introduction of the coordination arc with a value of 8 degrees as coordination criteria between FSS and MSS systems and between MSS systems, in the frequency bands 29.5-30 GHz (Earth-to-space)/19.7-20.2 GHz (space-to-Earth) in all 3 Regions, as substitution of the existing trigger of coordination $\Delta T/T > 6\%$.

3/7/2.4 Method to satisfy Issue B

Use of the coordination arc with a value of 8 degrees as coordination criteria, to determine if coordination is required between FSS and MSS systems and between MSS systems in the frequency bands 29.5-30 GHz (Earth-to-space)/19.7-20.2 GHz (space-to-Earth), in all 3 Regions, replacing the existing coordination criteria $\Delta T/T > 6\%$, without any modifications to the status of allocations in these frequency bands.

Administrations can always request application of RR No. **9.41** to include additional satellite networks that would be affected taking into account the $\Delta T/T > 6\%$ criteria.

3/7/2.5 Regulatory and procedural considerations for Issue B

APPENDIX 5 (Rev.WRC-15)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

TABLE 5-1 (Rev.WRC-1519)

Technical conditions for coordination
(see Article 9)

| Reference of Article 9 | Case | Frequency bands (and Region) of the service for which coordination is sought | Threshold/condition | Calculation method | Remarks |
|------------------------|--|--|---|--------------------|--|
| No. 9.7 GSO/GSO | A station in a satellite network using the geostationary-satellite orbit (GSO), in any space radiocommunication service, in a frequency band and in a Region where this service is not subject to a Plan, in respect of any other satellite network using that orbit, in any space radiocommunication service in a frequency band and in a Region where this service is not subject to a Plan, with the exception of the coordination between earth stations operating in the opposite direction of transmission | <p>1) 3 400-4 200 MHz 5 725-5 850 MHz (Region 1) and 5 850-6 725 MHz 7 025-7 075 MHz</p> <p>2) 10.95-11.2 GHz 11.45-11.7 GHz 11.7-12.2 GHz (Region 2) 12.2-12.5 GHz (Region 3) 12.5-12.75 GHz (Regions 1 and 3) 12.7-12.75 GHz (Region 2) and 13.75-14.8 GHz</p> | <p>i) Bandwidth overlap, and ii) any network in the fixed-satellite service (FSS) and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 7^\circ$ of the nominal orbital position of a proposed network in the FSS</p> <p>i) Bandwidth overlap, and ii) any network in the FSS or broadcasting-satellite service (BSS), not subject to a Plan, and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 6^\circ$ of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan iii) in the <u>frequency</u> band 14.5-14.8 GHz any network in the space research service (SRS) or FSS not subject to a Plan and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 6^\circ$ of the nominal orbital position of a proposed network in the SRS or FSS not subject to a Plan</p> | | With respect to the space services listed in the threshold/condition column in the frequency bands in 1), 2), <i>2bis</i>), 3), <u>3bis</u>), 4), 5), 6), 7) and 8), an administration may request, pursuant to No. 9.41, to be included in requests for coordination, indicating the networks for which the value of $\Delta T/T$ calculated by the method in § 2.2.1.2 and 3.2 of Appendix 8 exceeds 6%. When the Bureau, on request by an affected administration, studies this information pursuant to No. 9.42, the calculation method given in § 2.2.1.2 and 3.2 of Appendix 8 shall be used |

TABLE 5-1 (*continued*) (Rev.WRC-~~15~~19)

| Reference of Article 9 | Case | Frequency bands (and Region) of the service for which coordination is sought | Threshold/condition | Calculation method | Remarks |
|--|------|--|--|--------------------|---------|
| No. 9.7 GSO/GSO (<i>cont.</i>) | | 2 <i>bis</i>) 13.4-13.65 GHz (Region 1) | i) Bandwidth overlap, and ii) any network in the space research service (SRS) or any network in the FSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 6^\circ$ of the nominal orbital position of a proposed network in the FSS or SRS | | |
| | | 3) 17.7- 20.2 19.7 GHz, (Regions 2 and 3), 17.3- 20.2 19.7 GHz (Region 1) and 27.5- 30 29.5 GHz | i) Bandwidth overlap, and ii) any network in the FSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 8^\circ$ of the nominal orbital position of a proposed network in the FSS | | |
| | | <u>3<i>bis</i>) 19.7-20.2 GHz and 29.5-30 GHz</u> | <u>i) Bandwidth overlap, and ii) any network in the FSS or in the MSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 8^\circ$ of the nominal orbital position of a proposed network in the FSS or in the MSS.</u> | | |
| | | 4) 17.3-17.7 GHz (Regions 1 and 2) | i) Bandwidth overlap, and ii) a) any network in the FSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 8^\circ$ of the nominal orbital position of a proposed network in the BSS, or | | |

| | | | | | |
|--|--|--|--|--|--|
| | | | b) any network in the BSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 8^\circ$ of the nominal orbital position of a proposed network in the FSS | | |
|--|--|--|--|--|--|

TABLE 5-1 (continued) (Rev.WRC-1519)

| Reference of Article 9 | Case | Frequency bands (and Region) of the service for which coordination is sought | Threshold/condition | Calculation method | Remarks |
|--------------------------------------|------|--|--|--------------------|---------|
| No. 9.7 GSO/GSO (cont.) | | 5) 17.7-17.8 GHz | i) Bandwidth overlap, and ii) a) any network in the FSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 8^\circ$ of the nominal orbital position of a proposed network in the BSS, or b) any network in the BSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 8^\circ$ of the nominal orbital position of a proposed network in the FSS NOTE – No. 5.517 applies in Region 2. | | |
| | | 6) 18.0-18.3 GHz (Region 2) 18.1-18.4 GHz (Regions 1 and 3) | i) Bandwidth overlap, and ii) any network in the FSS or meteorological-satellite service and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 8^\circ$ of the nominal orbital position of a proposed network in the FSS or the meteorological-satellite service | | |

TABLE 5-1 (*continued*) (Rev.WRC-~~15~~19)

| Reference of Article 9 | Case | Frequency bands (and Region) of the service for which coordination is sought | Threshold/condition | Calculation method | Remarks |
|--|------|--|--|--------------------|--------------------------|
| No. 9.7 GSO/GSO (<i>cont.</i>) | | <p>6<i>bis</i>) 21.4-22 GHz (Regions 1 and 3)</p> <p>7) Bands above 17.3 GHz, except those defined in § 3), <u>3<i>bis</i></u> and 6)</p> <p>8) Bands above 17.3 GHz except those defined in § 4), 5) and 6<i>bis</i>)</p> | <p>i) Bandwidth overlap; and</p> <p>ii) any network in the BSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 12^\circ$ of the nominal orbital position of a proposed network in the BSS (see also Resolutions 554 (WRC-12) and 553 (WRC-12)).</p> <p>i) Bandwidth overlap, and</p> <p>ii) any network in the FSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 8^\circ$ of the nominal orbital position of a proposed network in the FSS (see also Resolution 901 (Rev.WRC-07))</p> <p>i) Bandwidth overlap, and</p> <p>ii) any network in the FSS or BSS, not subject to a Plan, and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 16^\circ$ of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan, except in the case of a network in the FSS with respect to a network in the FSS (see also Resolution 901 (Rev.WRC-07))</p> | | No. 9.41 does not apply. |

TABLE 5-1 (*continued*) (Rev.WRC-~~15~~19)

| Reference of Article 9 | Case | Frequency bands (and Region) of the service for which coordination is sought | Threshold/condition | Calculation method | Remarks |
|--|------|---|---|--------------------|---|
| No. 9.7 GSO/GSO (<i>cont.</i>) | | 9) All frequency bands, other than those in 1), 2), 2 <i>bis</i>), 3), <u>3<i>bis</i></u>), 4), 5), 6), 6 <i>bis</i>), 7) and 8), allocated to a space service, and the <u>frequency</u> bands in 1), 2), 2 <i>bis</i>), 3), <u>3<i>bis</i></u>), 4), 5), 6), 6 <i>bis</i>), 7) and 8) where the radio service of the proposed network or affected networks is other than the space services listed in the threshold/condition column, or in the case of coordination of space stations operating in the opposite direction of transmission | i) Bandwidth overlap, and ii) Value of $\Delta T/T$ exceeds 6% | Appendix 8 | In application of Article 2A of Appendix 30 for the space operation functions using the guardbands defined in § 3.9 of Annex 5 of Appendix 30, the threshold/condition specified for the FSS in the <u>frequency</u> bands in 2) applies. In application of Article 2A of Appendix 30A for the space operation functions using the guardbands defined in § 3.1 and 4.1 of Annex 3 of Appendix 30A, the threshold/condition specified for the FSS in the <u>frequency</u> bands in 7) applies |

Reasons: Extend the coordination arc to consider MSS in the frequency bands 29.5-30 GHz and 19.7-20.2 GHz.

Agenda item 7(C)

3/7/3 Issue C – Issues for which consensus was achieved in ITU-R and a single method has been identified

3/7/3.1 Executive summary

Issue C is a collection of several different topics that are viewed as being straightforward and for which consensus was readily achieved within ITU-R and a single method has been identified. The issues address such things as resolving inconsistencies in regulatory provisions, clarifying certain existing practices, or increasing transparency in the regulatory process. The issues are separately numbered in the following sections.

3/7/3.2 Background

3/7/3.2.1 Background for Issue C1

Further review of the provisions dealing with any changes to the characteristics of an assignment submitted under provisions of RR No. **11.43A** of RR Article **11**, and that submitted under paragraph 8.13 of Article 8 of RR Appendix **30B** and confirmed as having been brought into use, reveals that there is a regulatory inconsistency between the objectives of the two provisions/paragraph as follows:

“8.13 A notice of a change in the characteristics of an assignment already recorded, as specified in Appendix 4, shall be examined by the Bureau under § 8.8 and § 8.9, as appropriate. Any changes to the characteristics of an assignment that has been notified and confirmed as having been brought into use shall be brought into use within eight years from the date of the notification of the modification. Any changes to the characteristics of an assignment that has been notified but not yet brought into use shall be brought into use within the period provided for in §§ 6.1, 6.31 or 6.31bis of Article 6. (WRC-12)”

“11.43A A notice of a change in the characteristics of an assignment already recorded, as specified in Appendix 4, shall be examined by the Bureau under Nos. 11.31 to 11.34, as appropriate. Any change to the characteristics of an assignment that has been recorded and confirmed as having been brought into use shall be brought into use within five years from the date of the notification of the modification. Any change to the characteristics of an assignment that has been recorded but not yet brought into use shall be brought into use within the period provided for in No. 11.44. (WRC-07)”

It is to be emphasized that the concept of the text of paragraph 8.13 of Article 8 of RR Appendix **30B** was borrowed/taken from provisions of RR No. **11.43A** of RR Article **11**. However, in so doing an important element as contained in RR No. **11.43A** which referred to any change to the characteristics of an assignment that has been *recorded* and confirmed as having been brought into use was changed to *notified* and confirmed as having been brought into use, which is quite different.

An assignment may be notified but due to one or other reasons not yet recorded in the MIFR, but the notifying administration might have brought that assignment into use and its date of bringing it into use might have been confirmed.

It is also worth mentioning that an assignment may be notified but being returned to its notifying administration on relevant regulatory grounds. That assignment shall not be benefited as being recorded.

3/7/3.2.2 Background for Issue C2

RR Appendix **30B** consists of two blocks/sub-bands of 250 MHz each in the 13-11 GHz frequency band, i.e. 10.70-10.95 GHz, 11.2-11.45 GHz for downlink and 12.75-13.0 GHz, 13.0-13.25 GHz for uplink. Submission from administrations when applying Article 6 of RR Appendix **30B** for additional use usually covers both blocks/sub-bands of 250 MHz mentioned above or may only submit either of the two blocks for additional use or while successfully applying Article 6 for the two blocks/sub-bands, when applying Article 8, only bring into use one block/sub-band of the 13-11 GHz.

There is no provision in the Appendix prohibiting, strictly speaking, to allow administrations to submit an application for one of the blocks/sub-bands in an explicit submission of one of the blocks/sub-bands under RR Appendix **30B**. This concept is analogous to that stipulated in footnote 4 associated with paragraph 6.1 of Article 6 of the Appendix. However, there is no specific provision authorizing that application when submitting RR Appendix **4** for either of two sub-bands. Nevertheless, the Rules of Procedure relating to paragraphs 6.5 of Article 6 of the RR Appendix **30B** in its sub-paragraph 1 stipulates that:

Quote

“1 The planning exercise and the interference analysis were made by WARC Orb-88 for the whole band of 300 MHz (6/4 GHz) or 500 MHz (13/11 GHz) on a co-channel basis. It may happen that two administrations conclude agreement on the shared use of the frequency bands. In the compatibility examination by the Bureau, the mutual interference between non-overlapping frequency assignments shall not be taken into consideration in formulating findings”.

Unquote

The Rules of Procedure were established in order that a dispute between two administrations relating to the use of the entire frequency bands (two blocks/sub-bands) on a given orbital position could be satisfactorily resolved. The adoption of the Rules mentioned above permitted each of these two administrations using one of the two blocks/sub-bands, each of 250 MHz be used at two closely orbital positions.

3/7/3.2.3 Background for Issue C3

Issue C3 addresses the consequences for not replying to the letters from the Bureau initiated by a request for its assistance by a notifying administration seeking the inclusion of the territory of a foreign administration under § 6.6 of RR Appendix **30B**.

An administration intending to convert an RR Appendix **30B** allotment into an assignment, introduce an additional system²⁵ or modify the characteristics of an assignment in the RR Appendix **30B** List, must submit the information specified in RR Appendix **4** to the Bureau. Following the receipt of the notice, the Bureau examines and publishes it in a Special Section of the BR IFIC. Among other things, this Special Section can contain two types of requirements to seek and obtain the agreement of those affected administrations whose:

- allotments in the RR Appendix **30B** Plan or assignments in the RR Appendix **30B** List or those already examined by the Bureau (requirements identified under § 6.5 of RR Appendix **30B**), or
- territories have been included in the service area of the assignment under consideration (requirements associated with § 6.6 of RR Appendix **30B**).

²⁵ See § 2.6 of RR Appendix **30B**.

It is important to note that under the current regulatory framework, there is a specific provision (§ 6.13) in RR Appendix **30B** to seek the assistance of the Bureau in case of a non-response of an affected administration identified under § 6.5 of RR Appendix **30B** within the four-month comment period. In case of a non-response to the letters from the Bureau initiated under § 6.13, 6.14 and 6.14*bis* of RR Appendix **30B**, it will be deemed that this administration, identified under § 6.5 of RR Appendix **30B** has agreed as per § 6.15 of RR Appendix **30B**. However, none of the provisions referred above (§ 6.13 to 6.15) applies in the case of affected administrations identified under § 6.6 of RR Appendix **30B**. In fact, there is not a single regulatory mechanism in RR Appendix **30B** to seek the assistance of the Bureau in this case. For a request for the assistance of the Bureau on issue relating to the inclusion of the territory of an administration, the notifying administration, in its request to the Bureau and the Bureau, in its subsequent letters to the affected administration, have to invoke RR No. **13.1** for this matter. Furthermore, the current Radio Regulations do not specify any action from the Bureau with respect to an administration that did not respond to any of its letters initiated under RR No. **13.1**. This implies that the inclusion of the territory of an administration identified under § 6.6 of RR Appendix **30B** can only result from a formal agreement of this administration and, in no circumstance, results from a non-response to neither the original request for inclusion of its territory nor any subsequent letters from the Bureau on this matter.

3/7/3.2.4 Background for Issue C4

Normally, at the end of the coordination process for Regions 1 and 3 under Article 4 of RR Appendices **30** and **30A** and when a network is about to be implemented, two separate but identical notices are submitted for entry into the List under § 4.1.12 for Regions 1 and 3 or for the modifications to the Plans under § 4.2.16 for Region 2 and for Notification under §§ 5.1.1 and 5.1.2 of RR Appendices **30** and **30A**, respectively, at the same time. Therefore, it would reduce the workload of both administrations and the Bureau if one notice could be submitted, treated as, and examined in respect of the relevant provisions of Articles 4 and 5 of RR Appendices **30/30A**, respectively. In respect of RR Appendix **30A**, it would seem that this would be in particular of value for notification of receiving space stations and typical earth stations while specific earth stations probably in many cases would be subject to separate notices as the requirements change with time.

Looking at the RR Appendix **4** information required for notices under § 4.1.12 or § 4.2.16 and § 5.1.1/5.1.2, these would seem to be identical for entry into the List for Regions 1 and 3 or modification of the Plans for Region 2 and notification. Therefore, the data requirements of RR Appendix **4** should not create any practical difficulties in having a single notice submitted to complete both processes under the relevant provisions of Articles 4 and 5 of RR Appendices **30/30A**.

3/7/3.2.5 Background for Issue C5

Pursuant to RR No. **11.46**, the Bureau allows notifying administrations six months to resubmit their notified frequency assignments which were returned due to an unfavourable finding with respect to RR Nos. **11.32**, **11.32A** or **11.33**. Any notification resubmitted beyond six months is considered as a new notification with a new date of receipt and would be subject to cost-recovery fees. However, neither RR No. **11.46** nor any other provision in the Radio Regulations requires the Bureau to send a reminder to the notifying administration at any point during the six-month period. If the notifying administration resubmits the notice to the Bureau beyond the required six-month period, the Bureau assigns a new date of receipt and reviews whether the notice complies with the period in RR No. **11.44.1** or RR No. **11.43A** and takes the appropriate action. In the case that a notice resubmitted beyond the six-month deadline is receivable, cost-recovery fees would be required for the resubmitted assignments. Addressing this lack of a reminder would be beneficial to

administrations who may have experienced difficulties receiving or addressing the Bureau's return of notice and the need to ensure that frequency assignments that are in use are properly recorded in the Master Register.

3/7/3.2.6 Background for Issue C6

Normally, at the end of the coordination process under Article 6 of RR Appendix **30B** and when a network is about to be implemented, systems are submitted for entry into the List under § 6.17 and for notification under § 8.1 at the same time. This is logical since both these two provisions refer to actions following the completion of the coordination process and since they are both required to implement the network.

Enabling, as an option, administrations to submit one notice and request in a letter to the Bureau that it should be treated both in respect of entry into the List and notification would simplify the processing and reduce the workload of the Bureau and administrations. However, this is not possible under the current provisions of RR Appendix **30B** (§ 6.17). In addition, the data items required for the submission under § 6.17 and for notification under § 8.1 are not the same.

3/7/3.2.7 Background for Issue C7

Taking into account that the possibility of obtaining agreement from affected administrations for a specified period would considerably facilitate the tasks of those administrations applying Article 4 of RR Appendices **30** and **30A** as well as Article 6 of RR Appendix **30B**, it is proposed to amend RR Appendices **30A** and **30B** to be harmonized among RR Appendices **30**, **30A** and **30B**.

3/7/3.3 Summary and analysis of the results of ITU-R studies

3/7/3.3.1 Summary and analysis of the results of ITU-R studies for Issue C1

ITU-R has analysed the implications of aligning the text of paragraph 8.13 of Article 8 of RR Appendix **30B** with that of RR No. **11.43A** of RR Article **11** and found no disadvantages with such alignment.

3/7/3.3.2 Summary and analysis of the results of ITU-R studies for Issue C2

It will be helpful for administrations to reach agreement on the shared use of the frequency bands if an explicit submission of one of the blocks/sub-bands under RR Appendix **30B** is allowed. ITU-R has analysed the implications of adding the text of paragraph **6.1bis** of Article 6 of RR Appendix **30B** and found that an additional provision would be beneficial to the administrations.

3/7/3.3.3 Summary and analysis of the results of ITU-R studies for Issue C3

The possibility of modifying the Radio Regulations to clearly stipulate that an administration identified under § 6.6 of Appendix **30B** cannot be subject to § 6.13 to § 6.15 of Appendix **30B** was analysed and does not seem to be problematic although not essential.

3/7/3.3.4 Summary and analysis of the results of ITU-R studies for Issue C4

Given that the RR Appendix **4** information required for notices submitted under § 4.1.12 for Regions 1 and 3 or § 4.2.16 for Region 2 and § 5.1.1/5.1.2, are identical there are no negative consequences in allowing a single notice to be treated as, and examined in respect of, the relevant provisions of Articles 4 and 5 of RR Appendices **30/30A**.

3/7/3.3.5 Summary and analysis of the results of ITU-R studies for Issue C5

When the Bureau determines unfavourable findings for notified frequency assignments under RR Nos. **11.37** or **11.38**, a notice can be resubmitted within the six-month period pursuant to RR

No. **11.46** from the date of the Bureau notice to avoid a new date of receipt. Such timely resubmission would not require additional cost-recovery fees.

In addition to the Part III-S publication, the Bureau will transmit a communication to the notifying administration informing them of the returned assignments. While the Part III-S publication will identify the specific assignments and administrations for which the unfavourable finding was given, there is no clear indication in Part III-S under which provision (RR Nos. **11.36**, **11.37**, or **11.38**) the assignments are being returned. However, the communication that the Bureau transmits to notifying administrations provides a specific indication of which assignments are being returned, the relevant administrations for which the unfavourable finding was determined, and the provision under which the assignments are returned. Pursuant to RR No. **11.46**, a six-month deadline is established from the date of the letter from the Bureau to resubmit the assignments returned under RR No. **11.37** or **11.38**.

If there is a difficulty in receiving the Bureau's communication returning the notified frequency assignments with an unfavourable finding or the notifying administration has not yet successfully addressed the matter, the notifying administration may fail to timely resubmit its notice and lose its initial date of receipt for those frequency assignments and ultimately be treated as a new notification. A late filed resubmission triggers a review of whether those assignments comply with the seven-year period required in RR No. **11.44.1** and could result in those assignments being suppressed requiring a restart of the RR Articles **9** and **11** satellite registration process.

3/7/3.3.6 Summary and analysis of the results of ITU-R studies for Issue C6

If one submission is to be treated both in respect of entry into the RR Appendix **30B** List (under § 6.17) and notification (under § 8.1), it is important that the Bureau has the required information as specified by RR Appendix **4** for both types of submission.

If an administration requests the submission under § 6.17 to be treated in respect of both provisions § 6.17 and § 8.1:

- For items C.2.a.1 and C.3.a, the same pre-defined standard value used in the submission under § 6.17 can be assumed for the submission under § 8.1.
- For item C.7.a, the pre-defined standard values used in the submission under § 6.17 include only the necessary bandwidth while the values required for submission under § 8.1 are necessary bandwidth and class of emission for each carrier. To allow one submission to be treated in respect of both provisions § 6.17 and § 8.1, administrations need to provide the class of emission (e.g. G7W), it is possible to make a change in RR Appendix **4** such that item C.7.a is also provided for submission under § 6.17.
- For item C.8.a.2, the value in item C.8.b.2 shall be submitted for each carrier for submission under § 8.1.

3/7/3.3.7 Summary and analysis of the results of ITU-R studies for Issue C7

In order to implement the possibility of obtaining agreement from affected administrations for a specified period to considerably facilitate the tasks of those administrations applying Article 4 of RR Appendices **30** and **30A** as well as Article 6 of RR Appendix **30B**, it is proposed to amend RR Appendices **30A** and **30B** to be harmonized among RR Appendices **30**, **30A** and **30B**.

3/7/3.4 Method to satisfy Issue C

3/7/3.4.1 Method to satisfy Issue C1

A single method has been identified to address this issue. The method to address the regulatory inconsistency identified in this issue is to align the text of paragraph 8.13 of Article 8 of RR Appendix **30B** with that of RR No. **11.43A** of RR Article **11**.

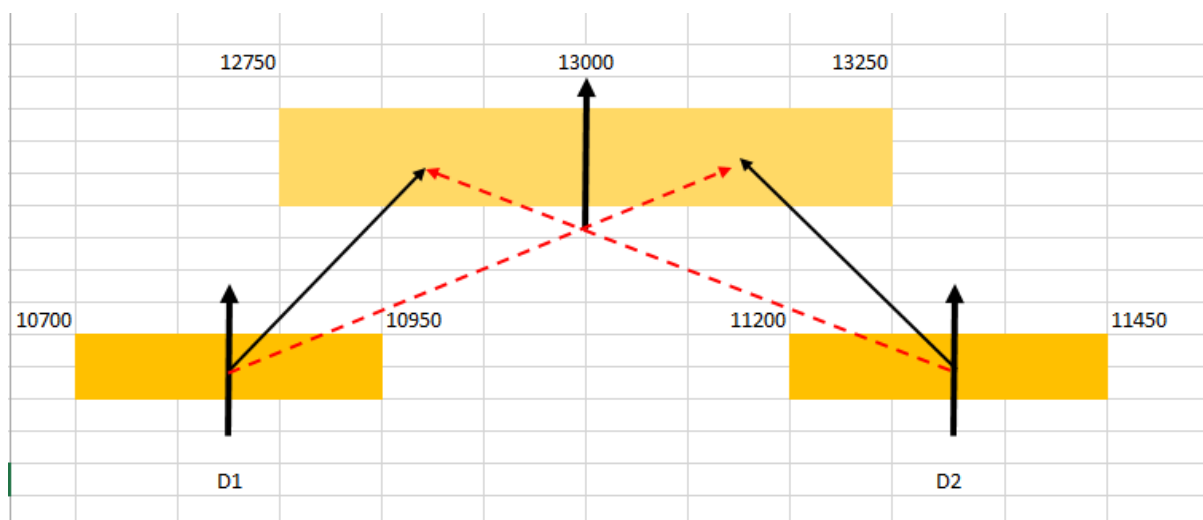
3/7/3.4.2 Method to satisfy Issue C2

A single method has been identified to address this issue. The method is to add another footnote to paragraph 6.1 of Article 6 of RR Appendix **30B** to allow the administration as follows:

- to submit under paragraph 6.1 an additional use for the two blocks/sub-bands in 10-11 GHz but only bring into use one of the blocks/one sub-band or,
- to submit under paragraph 6.1 an application of an additional use for only one of the two blocks/sub-bands in 10-11 GHz and notify and bring into use that block/sub-band only;
- to allow/authorize the Bureau, in applying Article 6, to act according to the nature of submission and further process them accordingly, i.e. to process the two blocks/sub-bands or process one of the two block/sub-bands and further process the submission as received;
- to allow/authorize the Bureau, in applying Article 8, to maintain one of the two blocks/sub-bands as notified even though the entire two blocks/sub-bands were submitted under Article 6 and successfully coordinated under that Article but only one of the block/sub-bands is notified or brought into use.

To continue providing the same level of protection to allotments and assignments with 500 MHz and to reflect the possibility of cross-strapping, the following strapping scheme for the 13/10-11 GHz frequency bands will be used:

(Frequency values are indicated in MHz)



This scheme will be reflected in the following calculated values of reference *C/I*.

CI reference values

| Reference value | Downlink frequency band (GHz) | Uplink frequency band (GHz) |
|-----------------------|-------------------------------|-----------------------------|
| Downlink single entry | 10.70-10.95 | – |
| | 11.20-11.45 | – |
| Uplink single entry | – | 12.75-13.00 |
| | – | 13.00-13.25 |
| Overall aggregate | 10.70-10.95 | 12.75-13.00 |
| | 11.20-11.45 | 13.00-13.25 |
| | 11.20-11.45 | 12.75-13.00 |
| | 10.70-10.95 | 13.00-13.25 |

3/7/3.4.3 Method to satisfy Issue C3

A single method has been identified to address this issue. The method is to add a new provision in Article 6 of RR Appendix **30B** to clearly state that § 6.13 to 6.15 of RR Appendix **30B** do not apply in the context of requirements associated with § 6.6 of RR Appendix **30B**.

3/7/3.4.4 Method to satisfy Issue C4

A single method has been identified to address this issue. The method is to modify § 4.1.12*bis* and § 4.2.16*bis* of RR Appendices **30** and **30A** to allow administrations to request the Bureau to have notices submitted under any of these two provisions also examined with respect to § 5.1.1 of RR Appendix **30** and § 5.1.2 of RR Appendix **30A** for Notification.

3/7/3.4.5 Method to satisfy Issue C5

A single method has been identified to address this issue. It would be considered advantageous to notifying administrations if the Bureau sends a reminder of the option to resubmit returned frequency assignments under RR No. **11.37** or **11.38**. Modification of RR No. **11.46** requiring the Bureau to remind the notifying administration of the six-month deadline would aid administrations who may have had difficulties in receiving the communication of returned frequency assignments.

3/7/3.4.6 Method to satisfy Issue C6

A single method has been identified to address this issue. This method would modify § 6.17 to allow one submission to be treated in respect of both provisions and modify RR Appendix **4** to enable this.

3/7/3.4.7 Method to satisfy Issue C7

A single method has been identified to address this issue. This method would add a new provision 6.15*bis* to Article 6 and a new provision § 8.16*bis* to Article 8 of RR Appendix **30B** in order to recognize the possibility of obtaining agreement from affected administrations for a specified period.

In addition, in order to make harmonization of RR Appendix **30B** and RR Appendices **30** and **30A**, modification to § 5.2.6 to Article 5 of RR Appendix **30A** would be necessary.

3/7/3.5 Regulatory and procedural considerations for Issue C

3/7/3.5.1 Regulatory and procedural considerations for Issue C1

APPENDIX 30B (REV.WRC-15)

**Provisions and associated Plan for the fixed-satellite service
in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz,
10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

ARTICLE 8 (REV.WRC-15)

**Procedure for notification and recording in the Master Register
of assignments in the planned bands for the
fixed-satellite service^{11, 12} (WRC-15)**

MOD

8.13 A notice of a change in the characteristics of an assignment already recorded, as specified in Appendix 4, shall be examined by the Bureau under § 8.8 and § 8.9, as appropriate. Any changes to the characteristics of an assignment that has been ~~notified~~recorded and confirmed as having been brought into use shall be brought into use within eight years from the date of the notification of the modification. Any changes to the characteristics of an assignment that has been ~~notified~~recorded but not yet brought into use shall be brought into use within the period provided for in §§ 6.1, 6.31 or 6.31*bis* of Article 6. (WRC-~~12~~19)

3/7/3.5.2 Regulatory and procedural considerations for Issue C2

APPENDIX 30B (REV.WRC-15)

**Provisions and associated Plan for the fixed-satellite service
in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz,
10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

ARTICLE 6 (REV.WRC-15)

**Procedures for the conversion of an allotment into an assignment, for
the introduction of an additional system or for the modification of
an assignment in the List^{1, 2} (WRC-15)**

ADD

6.1*bis* Administrations, in submitting an additional use under paragraph 6.1 of Appendix **30B**, may submit Appendix 4 for both blocks/sub-bands each with 250 MHz (10.7-10.95 GHz or 11.2-11.45 GHz for downlink and 12.75-13.0 GHz or 13.0-13.25 GHz for uplink) and notify under Article 8 and bring into use only one of the two blocks/sub-bands each with 250 MHz (10.7-

10.95 GHz or 11.2-11.45 GHz for downlink and 12.75-13.0 GHz or 13.0-13.25 GHz for uplink) or submit under paragraph 6.1 either of the two blocks/sub-bands each with 250 MHz (10.7-10.95 GHz or 11.2-11.45 GHz for downlink and 12.75-13.0 GHz or 13.0-13.25 GHz for uplink) and notify and bring into use under Article 8 that block/sub-band. The Bureau shall process that block/sub-band as it has been submitted under Article 6 and shall apply Article 8 for that notified and brought into use block/sub-band and cancel the other block/sub-band from its database. (WRC-19)

ADD

6.17*bis* An administration that has submitted the notice for an additional use under § 6.1 may request the Bureau to enter into the List only one block/sub-band of 250 MHz (10.7-10.95 GHz or 11.2-11.45 GHz for downlink and 12.75-13.0 GHz or 13.0-13.25 GHz for uplink). (WRC-19)

3/7/3.5.3 Regulatory and procedural considerations for Issue C3

APPENDIX 30B (REV.WRC-15)

Provisions and associated Plan for the fixed-satellite service in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz

ARTICLE 6 (REV.WRC-15)

Procedures for the conversion of an allotment into an assignment, for the introduction of an additional system or for the modification of an assignment in the List^{1, 2} (WRC-15)

ADD

6.15*bis* The course of actions described in §§ 6.13 to 6.15 do not apply to the agreement requested under § 6.6. (WRC-19)

3/7/3.5.4 Regulatory and procedural considerations for Issue C4

APPENDIX 30 (REV.WRC-15)*

Provisions for all services and associated Plans and List¹ for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3³

4.1 Provisions applicable to Regions 1 and 3

NOC

4.1.12 If agreement has been reached with the administrations identified in the publication referred to under § 4.1.5 above, the administration proposing the new or modified assignment may continue with the appropriate procedure in Article 5, and shall so inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-15)

MOD

4.1.12*bis* In application of § 4.1.12, an administration may indicate the changes to the information communicated to the Bureau under § 4.1.3 and published under § 4.1.5. In submitting such information, noting the requirements of § 5.1.2, the administration may also request the Bureau to examine the submission in respect of notification under § 5.1.1. (WRC-0319)

4.2 Provisions applicable to Region 2

MOD

4.2.16*bis* In application of § 4.2.16, an administration may indicate the changes to the information communicated to the Bureau under § 4.2.6 and published under § 4.2.8. In submitting such information, noting the requirements of § 5.1.2, the administration may also request the Bureau to examine the submission in respect of notification under § 5.1.1. (WRC-0319)

APPENDIX 30A (REV.WRC-15)*

Provisions and associated Plans and List¹ for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz² and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-03)

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan
or for additional uses in Regions 1 and 3**

4.1 Provisions applicable to Regions 1 and 3

NOC

4.1.12 If agreement has been reached with the administrations identified in the publication referred to under § 4.1.5 above, the administration proposing the new or modified assignment may continue with the appropriate procedure in Article 5 and shall inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-15)

MOD

4.1.12*bis* In application of § 4.1.12, an administration may indicate the changes to the information communicated to the Bureau under § 4.1.3 and published under § 4.1.5. In submitting such information, noting the requirements of § 5.1.6, the administration may also request the Bureau to examine the submission in respect of notification under § 5.1.2. (WRC-03/19)

4.2 Provisions applicable to Region 2

MOD

4.2.16*bis* In application of § 4.2.16, an administration may indicate the changes to the information communicated to the Bureau under § 4.2.6 and published under § 4.2.8. In submitting such information, noting the requirements of § 5.1.6, the administration may also request the Bureau to examine the submission in respect of notification under § 5.1.2. (WRC-03/19)

3/7/3.5.5 Regulatory and procedural considerations for Issue C5

ARTICLE 11

Notification and recording of frequency assignments^{1, 2, 3, 4, 5, 6, 7, 8} (WRC-15)

Section II – Examination of notices and recording of frequency assignments in the Master Register

MOD

11.46 In applying the provisions of this Article, any resubmitted notice which is received by the Bureau more than six months after the date on which the original notice was returned by the Bureau shall be considered to be a new notification with a new date of receipt **ADDx**. For frequency assignments to a space station, should the new date of receipt of such a notice not comply with the period specified in No. **11.44.1** or No. **11.43A**, as appropriate, the notice shall be returned to the notifying administration in the case of No. **11.44.1**, and the notice shall be examined as a new notice of a change in the characteristics of an assignment already recorded with a new date of receipt in the case of No. **11.43A**. The Bureau shall reflect the resubmission within 30 days of receipt on the ITU website, as appropriate. (WRC-0719)

ADD

^x **11.46.1** If the resubmitted notice is not received by the Bureau within four months from the date on which the original notice was returned by the Bureau, the Bureau shall promptly send a reminder to the notifying administration. (WRC-19)

3/7/3.5.6 Regulatory and procedural considerations for Issue C6

APPENDIX 4 (REV.WRC-15)

Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III

ANNEX 2

Characteristics of satellite networks, earth stations or radio astronomy stations² (Rev.WRC-12)

Footnotes to Tables A, B, C and D

MOD

TABLE A
GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,
EARTH STATION OR RADIO ASTRONOMY STATION (Rev.WRC-~~15~~19)

| Items in Appendix | <p style="text-align: center;"><i>A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION</i></p> | ... | <p style="text-align: center;">Notice for a satellite network in the fixed- satellite service under Appendix 30B (Articles 6 and 8)</p> |
|-------------------|---|-----|---|
| A.2 | DATE OF BRINGING INTO USE | | |
| A.2.a | <p>the date (actual or foreseen, as appropriate) of bringing the frequency assignment (new or modified) into use</p> <p>For a frequency assignment to a GSO space station, including frequency assignments in Appendices 30, 30A and 30B, the date of bringing into use is as defined in Nos. 11.44B and 11.44.2</p> <p>Whenever the assignment is changed in any of its basic characteristics (except in the case of a change under A.1.a, the date to be given shall be that of the latest change (actual or foreseen, as appropriate)</p> <p>Required only for notification <u>and, in the case of Appendix 30B, also for simultaneous submissions for entry into the List under § 6.17 and notification under § 8.1</u></p> | | + |
| ... | | | |
| A.3 | OPERATING ADMINISTRATION OR AGENCY | | |
| A.3.a | <p>the symbol for the operating administration or agency (see the Preface) that is in operational control of the space station, earth station or radio astronomy station</p> <p><u>In the case of Appendix 30B, required only for notification under Article 8</u></p> | | + <u>X</u> |
| A.3.b | <p>the symbol for the address of the administration (see the Preface) to which communication should be sent on urgent matters regarding interference, quality of emissions and questions referring to the technical operation of the network or station (see Article 15)</p> <p><u>In the case of Appendix 30B, required only for notification under Article 8</u></p> | | + <u>X</u> |
| ... | | | |

MOD

TABLE C

**CHARACTERISTICS TO BE PROVIDED FOR EACH GROUP OF FREQUENCY ASSIGNMENTS
FOR A SATELLITE ANTENNA BEAM OR AN EARTH STATION OR
RADIO ASTRONOMY ANTENNA** (Rev.WRC-15~~19~~)

| Items in Appendix | <i>C - CHARACTERISTICS TO BE PROVIDED FOR EACH GROUP OF FREQUENCY ASSIGNMENTS FOR A SATELLITE ANTENNA BEAM OR AN EARTH STATION OR RADIO ASTRONOMY ANTENNA</i> | | Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8) |
|-------------------|---|--|---|
| ... | | | |
| C.7 | NECESSARY BANDWIDTH AND CLASS OF EMISSION <i>(in accordance with Article 2 and Appendix 1)</i> For advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9, changes to this information within the limits specified under C.1 shall not affect consideration of notification under Article 11 Not required for active or passive sensors | | |
| C.7.a | the necessary bandwidth and the class of emission: for each carrier In the case of Appendix 30B, required only for notification under Article 8 <u>(including simultaneous submissions for entry into the List under § 6.17 and notification under § 8.1)</u> <u>NOTE – For simultaneous submissions, the Bureau will use predefined values for the necessary bandwidth when examining the notice under § 6.17 of Article 6 of Appendix 30B</u> | | + |
| .. | | | |
| C.8.a.2 | the maximum power density, in dB(W/Hz), supplied to the input of the antenna for each carrier type ² In the case of Appendix 30B, required only for notification under Article 8 <u>or simultaneous submissions for entry into the List under § 6.17 and notification under § 8.1</u> Required if neither C.8.b.2 nor C.8.b.3.b is provided | | + |

APPENDIX 30B (REV.WRC-15)

**Provisions and associated Plan for the fixed-satellite service
in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz,
10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

ARTICLE 6 (REV.WRC-15)

**Procedures for the conversion of an allotment into an assignment, for
the introduction of an additional system or for the modification of
an assignment in the List^{1, 2} (WRC-15)**

MOD

6.17 If agreements have been reached with administrations published in accordance with § 6.7, the administration proposing the new or modified assignment may request the Bureau to have the assignment entered into the List, indicating the final characteristics of the assignment together with the names of the administrations with which agreement has been reached. For this purpose, it shall send to the Bureau the information specified in Appendix 4. In submitting the notice, the administration may request the Bureau to examine ~~this~~^{the} notice under § 6.19, 6.21 and 6.22 (entry into the List) and ~~to automatically generate the notice for examination then the notice submitted separately~~^{to automatically generate the notice for examination} under Article 8 of this Appendix (notification). (WRC-15¹⁹)

3/7/3.5.7 Regulatory and procedural considerations for Issue C7**APPENDIX 30B (REV.WRC-15)**

**Provisions and associated Plan for the fixed-satellite service
in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz,
10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

ARTICLE 6 (REV.WRC-15)

**Procedures for the conversion of an allotment into an assignment, for
the introduction of an additional system or for the modification of
an assignment in the List^{1, 2} (WRC-15)**

ADD

6.15^{bis} The agreement of the administrations affected may also be obtained in accordance with this Article, for a specified period. When this specific period of agreement expires for an assignment in the List, the assignment in question shall be maintained in the List until the end of the period referred to in § 6.1 above. After that date this assignment in the List shall lapse unless the agreement of the administrations affected is renewed. (WRC-19)

MOD

ARTICLE 8 (REV.WRC-15)

**Procedure for notification and recording in the Master Register
of assignments in the planned bands for the
fixed-satellite service**~~MOD~~^{11, 12} (WRC-15~~19~~)

ADD

8.16bis In the event that the Bureau has been informed of agreement to new or modified frequency assignments in the List for a specified period of time in accordance with Article 6, the frequency assignment shall be recorded in the Master Register with a note indicating that the frequency assignment is valid only for the period specified. The notifying administration using the frequency assignment over a specified period shall not subsequently invoke this fact to justify the continued use of the frequency beyond the period specified unless it obtains the agreement of the administration(s) concerned. (WRC-19)

¹¹ If the payments are not received in accordance with the provisions of Council Decision 482, as amended, on the implementation of cost recovery for satellite network filings, the Bureau shall cancel the publication specified in § 8.5 and 8.12 and the corresponding entries in the Master Register under § 8.11 or 8.16bis, as appropriate, after informing the administration concerned. The Bureau shall inform all administrations of such action and that any resubmitted notice shall be considered to be a new notice. The Bureau shall send a reminder to the notifying administration not later than two months prior to the deadline for the payment in accordance with the above-mentioned Council Decision 482, unless the payment has already been received. See also Resolution 905 (WRC-07)*. (WRC-07~~19~~)

^{*} ~~————— Note by the Secretariat: This Resolution was abrogated by WRC-12.~~

APPENDIX 30A (REV.WRC-15)*

Provisions and associated Plans and List¹ for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz² and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-03)

MOD

ARTICLE 5 (REV.WRC-15)

Coordination, notification, examination and recording in the Master International Frequency Register of frequency assignments to feeder-link transmitting earth stations and receiving space stations in the fixed-satellite service²¹, MOD²² (WRC-0719)

5.2 Examination and recording

MOD

5.2.6 If the notifying administration resubmits the notice without modification and insists on its reconsideration, and if the Bureau's finding with respect to § 5.2.1 remains unfavourable, the notice is returned to the notifying administration in accordance with § 5.2.4. In this case, the notifying administration undertakes not to bring into use the frequency assignment until the condition specified in § 5.2.5 is fulfilled. For Regions 1, 2 and 3, in the event that the Bureau has been informed of agreement to new or modified frequency assignments to the Plan for a specified period of time in accordance with Article 4, the frequency assignment shall be recorded in the Master Register with a note indicating that the frequency assignment is valid only for the period specified. The notifying administration using the frequency assignment over a specified period shall not subsequently invoke this fact to justify the continued use of the frequency beyond the period specified unless it obtains the agreement of the administration(s) concerned. (WRC-19)

²² If the payments are not received in accordance with the provisions of Council Decision 482, as amended, on the implementation of cost recovery for satellite network filings, the Bureau shall cancel the publication specified in § 5.1.10 and the corresponding entries in the Master Register under § 5.2.2, 5.2.2.1, ~~or 5.2.2.2~~ or 5.2.6, as appropriate, and the corresponding entries included in the Plan on and after 3 June 2000 or in the List, as appropriate, after informing the administration concerned. The Bureau shall inform all administrations of such action. The Bureau shall send a reminder to the notifying administration not later than two months prior to the deadline for the payment in accordance with the above-mentioned Council Decision 482 unless the payment has already been received. ~~See also Resolution 905 (WRC-07)*.~~ (WRC-0719)

—*—— ~~Note by the Secretariat: This Resolution was abrogated by WRC-12.~~

Agenda item 7(D)

3/7/4 Issue D – Identification of those specific satellite networks and systems with which coordination needs to be effected under RR Nos. 9.12, 9.12A and 9.13

3/7/4.1 Executive summary

Currently, when an administration sends a coordination request (a new one or a modification to an existing one, as appropriate) for frequency assignments subject to RR Nos. **9.12**, **9.12A** and **9.13**, the Bureau publishes in the CR/C Special Section only a list of (potentially) affected administrations in the cases covered by the provisions under RR No. **9.36.1**. This differs from the current course of action of publishing in the same CR/C Special Section a list of specific satellite networks or earth stations in the cases covered by the provisions under RR No. **9.36.2**.

It may be easier for administrations if the two courses of action above were aligned. By doing so, the Bureau would publish a list of potentially affected satellite networks and/or systems following the receipt of a coordination request (a new one or a modification to an existing one, as appropriate) for frequency assignments subject to RR Nos. **9.12**, **9.12A** and **9.13**, rather than a list of affected administrations only.

3/7/4.2 Background

The 2012 World Radiocommunication Conference (WRC-12) decided to modify RR No. **9.36.2**. Following this provision, the Bureau now publishes a “definitive list” of those networks, systems and earth stations with which coordination under RR Nos. **9.7**, **9.7A** and **9.7B** needs to be effected once a coordination request (a new one or a modification to an existing one, as appropriate) for a satellite network or system is processed. Such a list is published in the relevant Special Section annexed to the BR International Frequency Information Circular (BR IFIC).

The above-mentioned provision (RR No. **9.36.2**) is very useful, because, in the cases of coordination under RR Nos. **9.7**, **9.7A** and **9.7B**, it reduces the administrative workload of identifying the names of specific satellite networks, systems and earth stations with which a new satellite network or system needs to effect coordination.

However, in the cases of coordination under RR Nos. **9.12**, **9.12A** and **9.13**, the Bureau does not publish a list of the satellite networks or systems potentially affected to complement the list of administrations potentially affected by incoming satellite networks or systems that it provides.

3/7/4.3 Summary and analysis of the results of ITU-R studies

RR No. **9.36.2** significantly decreased the administrative workload related to the identification of the satellite networks, systems and earth stations, as applicable, with which coordination needs to be effected under RR Nos. **9.7**, **9.7A** and **9.7B**. As noted above, the Bureau compiles, in the relevant Special Sections annexed to the BR IFIC, a list including all the specific networks, systems and earth stations with which coordination is required under the following cases:

- a) for a station in a satellite network using the geostationary-satellite orbit (GSO), in any space radiocommunication service, in a frequency band and in a region where this service is not subject to a plan, in respect of any other satellite network using that orbit, in any space radiocommunication service in a frequency band and in a Region where this service is not subject to a plan, with the exception of coordination between earth stations operating in the opposite direction of transmission (see RR No. **9.7**);

- b) for a specific earth station in a geostationary-satellite network in the fixed-satellite service in certain frequency bands, in respect of a non-geostationary-satellite system in the fixed-satellite service (see RR No. **9.7A**);
- c) for a non-geostationary-satellite system in the fixed-satellite service in certain frequency bands, in respect of a specific earth station in a geostationary-satellite network in the fixed-satellite service (see RR No. **9.7B**).

However, for the cases of coordination under RR Nos. **9.12**, **9.12A** and **9.13**, the CR/C Special Section includes only a list of administrations potentially affected and not a list of potentially affected GSO networks or non-GSO systems, as appropriate, for which those administrations are responsible.

Bearing in mind that, according to RR No. **9.36.1**, the list of administrations referred to above is only for information purposes, each of those potentially affected administrations needs to carry out the following tasks:

- 1) identify, together with each of its operators, those GSO networks and non-GSO systems that may be affected by the new satellite system requesting coordination;
- 2) compile, in case the administration is responsible for more than one operator, a comprehensive list covering all the GSO networks and non-GSO systems with which coordination is required;
- 3) transmit to the administration having filed a CR/C (a new one or a modification to an existing one, as appropriate) and to the Bureau its comments on or disagreement to the request for coordination pursuant to RR No. **9.52**.

It should be noted that the tasks above should be carried out within four months from the date of publication of the BR IFIC, so as to avoid the application of the provisions of RR No. **9.52C**.

In particular, concerning the application of RR Nos. **9.12**, **9.12A** and **9.13**, it is noted that the number of coordination requests for new non-GSO systems has recently increased, and exchanging the relevant correspondence with other administrations and the Bureau for each of them within the time limit specified in RR No. **9.52** is becoming challenging.

The above process could be simplified if a pre-compiled list of satellite networks or systems considered as potentially affected would be available, for information purposes only, in the cases of coordination under RR Nos. **9.12**, **9.12A** and **9.13** as it is currently for the cases of RR Nos. **9.7**, **9.7A** and **9.7B** in the CR/C Special Section.

Furthermore, consideration may also be given to require the potentially affected administrations to identify in their comments under RR Nos. **9.51** or **9.52**, as appropriate, the list of the affected satellite networks or systems on the basis of the lists published in the CR/C Special Section. It should be noted that an affected administration could also submit comments as per the provisions of RR No. 9.52 to include additional networks or systems that may have been omitted in the lists published in the CR/C Special Section. The Bureau would then compile and publish these comments in a CR/D Special Section according to RR No. **9.53A**. The process would therefore be similar to the current one but it would offer two main advantages:

- 1) the comments under RR Nos. **9.51** or **9.52**, as appropriate, would be much simpler to make as they would entail an examination of a pre-compiled list published, for information purposes only, in the CR/C Special Section, and
- 2) the CR/D Special Section would contain a “definitive list” of satellite systems instead of a simple list of administrations that may further ease the work of administrations in trying to assess the status of the coordination under RR Nos. **9.12**, **9.12A** and **9.13** prior to the notification under RR Article **11**.

It should be noted that the identification of the potentially affected satellite networks or systems would not require any additional tools since the coordination trigger for RR Nos. **9.12**, **9.12A** and **9.13** in RR Appendix 5 is based on frequency overlap²⁶.

3/7/4.4 Methods to satisfy Issue D

3/7/4.4.1 Method D1

Under this method, it is proposed to add the requirements to have:

- a) a pre-compiled list of potentially affected satellite networks and/or systems, published for information only, included in the CR/C Special Section for coordination under RR Nos. **9.12**, **9.12A** and **9.13**, by stipulating it in RR No. **9.36.1**;
- b) the definitive list of affected satellite networks or systems to be considered when effecting coordination under RR Nos. **9.12**, **9.12A** and **9.13** to be included in the CR/D Special Section by stipulating it in RR No. **9.53A**.

The list of potentially affected satellite networks/systems provided in the CR/C is for information only, and to also avoid a different status compared to the list of affected administrations. Under the current regulatory regime, the definitive list of administrations is provided in the CR/D. Under this method, it is proposed to also include the definitive list of satellite networks/systems in the CR/D.

3/7/4.4.2 Method D2

Under this method, it is proposed to add the requirements to have the list of satellite networks or systems potentially affected included in the CR/C Special Section for coordination under RR Nos. **9.12**, **9.12A** and **9.13** for information only, by stipulating it in RR No. **9.36.1**. As opposed to Method D1, no further action will be required from the notifying administrations for the list of satellite networks/systems following the publication of the CR/C.

3/7/4.5 Regulatory and procedural considerations for Issue D

3/7/4.5.1 Method D1

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations^{1, 2, 3, 4, 5, 6, 7, 8, 9} (WRC-15)

Section II – Procedure for effecting coordination^{12, 13}

Sub-Section IIA – Requirement and request for coordination

MOD

- 9.36** b) identify in accordance with No. **9.27** any administration with which coordination may need to be effected^{MOD 20, 21}; (WRC-12~~19~~)

²⁶ The only exception is the coordination trigger for RR No. **9.13** in the frequency band 1 668-1 668.4 MHz but developing a tool to address this very specific case should not lead to any major difficulty.

MOD

²⁰ **9.36.1** In the case of coordination under Nos. 9.12, 9.12A and 9.13, the Bureau shall also identify the satellite networks or systems with which coordination may need to be effected. The list of administrations identified by the Bureau under Nos. 9.11 to 9.14 and 9.21, and the list of satellite networks or systems identified by the Bureau under Nos. 9.12, 9.12A and 9.13 ~~is~~are only for information purposes, to help administrations comply with this procedure. (WRC-19)

Sub-Section IIC – Action upon a request for coordination**MOD**

9.52C For coordination requests under Nos. 9.11 to 9.14 and 9.21, an administration not responding under No. 9.52 within the same four-month period shall be regarded as unaffected and, in the cases of Nos. 9.11 to 9.14, the provisions of Nos. 9.48 and 9.49 shall apply. Furthermore, for coordination under Nos. 9.12, 9.12A and 9.13, any satellite networks or systems identified under No. 9.36.1 but not confirmed in the response provided by the administration under No. 9.52 within the same four-month period shall be regarded as unaffected and the provisions of Nos. 9.48 and 9.49 shall also apply. (WRC-19)

MOD

9.53A Upon expiry of the deadline for comments in respect of a coordination request under Nos. 9.11 to 9.14 and 9.21, the Bureau shall, according to its records, publish a Special Section, indicating the list of administrations having submitted their disagreement and the list of satellite networks or systems upon which this disagreement is based, as appropriate, or other comments within the regulatory deadline. (WRC-200019)

3/7/4.5.2 Method D2

Same as Method D1 for RR No. 9.36.1 but NOC for the rest of RR Article 9.

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations^{1, 2, 3, 4, 5, 6, 7, 8, 9} (WRC-15)

Section II – Procedure for effecting coordination^{12, 13}**Sub-Section IIA – Requirement and request for coordination****MOD**

9.36 b) identify in accordance with No. 9.27 any administration with which coordination may need to be effected MOD^{20, 21}; (WRC-1219)

MOD

²⁰ **9.36.1** In the case of coordination under Nos. 9.12, 9.12A and 9.13, the Bureau shall also identify the satellite networks or systems with which coordination may need to be effected. The list of administrations identified by the Bureau under Nos. 9.11 to 9.14 and 9.21, and the list of satellite networks or systems identified by the Bureau under Nos. 9.12, 9.12A and 9.13 ~~is~~ are only for information purposes, to help administrations comply with this procedure. (WRC-19)

Agenda item 7(E)

3/7/5 **Issue E: Resolution related to RR Appendix 30B**

3/7/5.1 **Executive summary**

Considering Resolution **86 (Rev.WRC-07)** which *resolves to invite future world radiocommunication conferences*:

- a) to consider any proposals which deal with deficiencies and improvements in the advance publication, coordination, notification and recording procedures of the Radio Regulations for frequency assignments pertaining to space services which have either been identified by the Board and included in the Rules of Procedure or which have been identified by administrations or by the Radiocommunication Bureau, as appropriate;
- b) to ensure that these procedures, and the related appendices of the Radio Regulations reflect the latest technologies, as far as possible.

An administration wishing to convert its national allotment in RR Appendix **30B** to assignments with characteristics beyond those of the initial allotment or wishing to introduce a new network will be faced with several difficulties. Three of these are:

- there is a large number of networks already in the RR Appendix **30B** List and under coordination;
- due to the conservative criteria used in RR Appendix **30B**, a large number of coordination requirements will be identified;
- networks can be designed with combinations of characteristics, possibly unrealistic, to obtain a high sensitivity to interference from later submissions.

It is, therefore, considered to address the issue as a special one-time applied measure and procedure to be contained in a new WRC Resolution as an enhancement of equitable access to spectrum/orbital resources for developing countries to facilitate the processing of their submission in RR Appendix **30B**.

3/7/5.2 **Background**

ITU-R considered studies relating to the enhancement of regulatory provisions of RR Appendix **30B** to observe the principles based on which it was initially established.

An administration which decides to convert its national allotment into assignments in an economically viable manner very often needs to modify the initial characteristics of its national allotments, taking into account the latest available development and advancement in technology as well as the most economically viable solution.

In so doing, a) when the request for conversion is submitted, the application would be queued at the end of the last submission received before it and b) once its turn to be processed is reached, due to the nature of those additional systems/uses it would be extremely difficult, if not totally impossible, to succeed coordination within the regulatory deadline. In summary, as it could be noted from the above, the probability that an administration could successfully complete coordination for the conversion of its national allotment to assignments with characteristics beyond the initial allotment within that regulatory period is very low.

3/7/5.3 **Summary and analysis of the results of ITU-R studies**

In discussing these issues within ITU-R, a solution that addresses the underlying issue has been identified. This solution would be a possible WRC Resolution along the lines of Resolution **553**

(Rev.WRC-15) which addresses a similar issue for the 21.4-22 GHz BSS frequency band for Regions 1 and 3.

Key elements of Resolution **553 (Rev.WRC-15)** are:

- a) the procedure can be used only once by an administration;
- b) the privilege of using this procedure is limited to submissions with national service and coverage area;
- c) submissions will be examined ahead of regular submissions waiting to be processed (i.e. getting a higher priority date);
- d) relaxed coordination triggers in respect of certain categories of networks will be applied;
- e) coordination triggers are used that avoid certain combinations of technical parameters becoming very sensitive to new submissions thereby removing unnecessary coordination.

In addition to these key elements from Resolution **553 (Rev.WRC-15)**, a reduced coordination arc with the same values as those adopted by WRC-15 for the non-planned bands is included as part of the proposed solution to further alleviate the coordination burden for submissions made under the Resolution.

3/7/5.4 Method to satisfy Issue E

Establish special measures to be applied once with respect to the submission received from an administration having no frequency assignments in the RR Appendix **30B** List the details of which are to be contained in a WRC Resolution to facilitate the tasks of those administrations to provide an economically viable satellite service to its national territory as initially considered when the allotment Plan was established in 1988.

3/7/5.5 Regulatory and procedural considerations for Issue E

The following Resolution along with the related attachment and appendix, containing the criteria to determine whether an allotment or an assignment is considered to be affected by networks submitted to RR Appendix **30B** under this Resolution, are necessary to address the above-mentioned problems.

APPENDIX 30B (REV.WRC-15)

**Provisions and associated Plan for the fixed-satellite service
in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz,
10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

MOD

ARTICLE 6 (REV.WRC-1519)

**Procedures for the conversion of an allotment into an assignment, for
the introduction of an additional system or for the modification of
an assignment in the List^{1, 2, 2bis} (WRC-1519)**

ADD

DRAFT NEW RESOLUTION [A7(E)-AP30B] (WRC-19)

**Additional measures for satellite networks in the fixed-satellite service
in frequency bands subject to Appendix 30B for the enhancement
of equitable access to these frequency bands**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a) that WARC Orb-88 created an allotment Plan for the use of the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz;
- b) that WRC-07 revised the regulatory regime governing the use of the frequency bands mentioned in *considering a)* above,

considering further

- a) the additional regulatory measures for the enhancement of equitable access included in Resolution **553 (WRC-15)**;
- b) that the Rule of Procedure on No. **9.6** of the Radio Regulations states that “the intent of Nos. **9.6 (9.7 to 9.21), 9.27** and Appendix **5** is to identify to which administrations a request for coordination is to be addressed, and not to state an order of priorities for rights to a particular orbital position”,

recognizing

- a) that Article 44 of the ITU Constitution lays down the basic principles for the use of the radio-frequency spectrum and the geostationary-satellite and other satellite orbits, taking into account the needs of developing countries;

2bis

Draft new Resolution [A7(E)-AP30B] (WRC-19) applies.

- b) that the “first-come first-served” concept can restrict and sometimes prevent access to and use of certain frequency bands and orbit positions;
- c) the relative disadvantage for developing countries in coordination negotiations due to various reasons such as a lack of resources and expertise;
- d) that Resolution 2 (**Rev.WRC-03**) resolves that “the registration with the Radiocommunication Bureau of frequency assignments for space radiocommunication services and their use do not provide any permanent priority for any individual country or groups of countries and do not create an obstacle to the establishment of space systems by other countries”,

recognizing further

- a) that information provided by the Bureau into ITU-R studies indicate that significant numbers of Appendix 30B submissions have been received by the Bureau in the time period 1 January 2013 until 30 June 2018 and that the table below summarizes the data provided by the Bureau into those studies and shows the variations for the number of networks at the various stages;

| | Request for conversion without change of initial allotment national service area | Request for conversion with changes within the envelope of initial allotment national service area | Request for conversion with changes outside the envelope of initial allotment national service area | Request for conversion with changes outside the envelope of initial allotment supra national service area | Request for additional use national service area | Request for additional use, with supra national service area and global coverage** |
|--------------|--|--|---|---|--|--|
| 2012 Q1 + Q2 | 0 | 0 | 0 | 0 | 3 | 20 |
| 2012 Q3 + Q4 | 1 | 0 | 2 | 0 | 2 | 23 |
| 2013 Q1 + Q2 | 1 | 0 | 0 | 0 | 4 | 27 |
| 2013 Q3 + Q4 | 1 | 0 | 0 | 0 | 0 | 17 |
| 2014 Q1 + Q2 | 1 | 0 | 0 | 0 | 2 | 30 |
| 2014 Q3 + Q4 | 0 | 0 | 0 | 0 | 7 | 20 |
| 2015 Q1 + Q2 | 0 | 0 | 1 | 0 | 1 | 30 |
| 2015 Q3 + Q4 | 0 | 0 | 0 | 0 | 0 | 26 |
| 2016 Q1 + Q2 | 0 | 1 | 0 | 0 | 0 | 23 |
| 2016 Q3 + Q4 | 0 | 0 | 0 | 0 | 1 | 24 |
| 2017 Q1 + Q2 | 0 | 0 | 0 | 0 | 4 | 34 |
| 2017 Q3 + Q4 | 0 | 1 | 0 | 0 | 0 | 25 |
| 2018 Q1 + Q2 | 0 | 0 | 0 | 0 | 6 | 20 |
| 2018 Q3 + Q4 | 0 | 0 | 0 | 0 | 0 | 10 |

** Notices for additional use with service area and coverage beyond the national territory of notifying administration.

*** The above table needs to be replaced by that to be provided by the Bureau before the start of WRC-19.

- b) that the number of Appendix 30B submissions made by some administrations is large, which may not be realistic;
- c) that the use of certain combinations of technical parameters in submissions (e.g. high-gain receiving space station antennas) can make the systems/submissions overly sensitive to

interference in such a way that subsequent submissions for conversion from allotment into assignments with change would cause interference to those systems,

taking into account

that the majority of Appendix **30B** submissions under § 6.1 have global coverage and service area, which is typically changed limited service area with considerably wider coverage area at the time of § 6.17 submission, notwithstanding the Note to Appendix **4** data item B.3.b.1 which states “Taking due account of applicable technical restrictions and allowing some reasonable degree of flexibility for satellite operations, administrations should, to the extent practicable, align the areas the satellite steerable beams could cover with the service area of their networks with due regard to their service objectives” and this is complicating coordination for administrations attempting to convert their national allotments into assignments or introducing an additional system for national use in a technically and economically viable manner,

resolves

that as of the date (*yet to be decided by WRC-19*), the special procedure described in the Attachment to this Resolution for processing of submissions received by the Bureau under Article 6 of Appendix **30B** for conversion of the allotment of an administration into an assignment with modifications which are outside the envelope of the initial allotment while restricted to provide service to its national territory designated by test points as contained in the corresponding allotment, or submission by an administration of an additional system the service area of which is limited to its national territory designated by test points as contained in the allotment, in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz shall be applied if requested by an administration in respect of its submission as specified in the Attachment below.

ATTACHMENT TO DRAFT NEW RESOLUTION [A7(E)-AP30B] (WRC-19)

Additional measures for satellite networks in the fixed-satellite service in frequency bands subject to Appendix 30B for the enhancement of equitable access to these frequency bands

1 The special procedure described in this Attachment can only be applied once by an administration having no assignment in the List of Appendix **30B** or assignment submitted under § 6.1 of Appendix **30B**.

2 With regard to the latter case, in order to benefit from application of the special procedure, the submitting Administration may either withdraw or modify its submission previously sent to the Bureau under § 6.1 of Appendix **30B**.

3 Administrations seeking to apply this special procedure shall submit their request to the Bureau, with the information specified in § 6.1 of that Appendix. Specifically, this information shall contain:

- a) in the cover letter to the Bureau, the information that the administration requests the use of this special procedure;
- b) a service area limited to the territory as contained in its national allotment or submitted in the case that a new Member State of the Union does not have an allotment in the Plan and has not submitted a request under § 7.2 of Article **7** of Appendix **30B**;

- c) a minimum ellipse determined by the test points which designate the service area. An administration may request the Bureau to create such diagram. See *resolves* section of the Resolution.
- 4 If the information sent under § 3 above is found to be incomplete, the Bureau shall immediately seek from the administration concerned any clarification required and information not provided.
- 5 An administration using this special procedure shall effect coordination with other administrations as required in § 6 below before:
- i) submitting a request under § 6.17 of Appendix **30B** to have the satellite network entered into the Appendix **30B** List, and
 - ii) bringing into use a frequency assignment.
- 6 Following the successful application of §§ 1 to 4 above, the Bureau shall, ahead of submissions not yet processed under § 6.3 of Appendix **30B**, promptly:
- a) examine the information with respect to its conformity with § 6.3 of Appendix **30B**;
 - b) identify, in accordance with Appendix 1 of this Attachment, any administration with which coordination may need to be effected¹;
 - c) include their names in the publication under d) below;
 - d) publish², as appropriate, the complete information in the International Frequency Information Circular (BR IFIC) within the time-limit as specified in Appendix **30B**;
 - e) inform the administrations concerned of its actions and communicate the results of its calculations, drawing attention to the relevant BR IFIC.
- 7 In applying §§ 6.5, 6.12, 6.14, 6.21 and 6.22 of Appendix **30B**, the criteria in Annex 4 of Appendix **30B** shall be replaced by those given in Appendix 1 of this Attachment.
- 8 The provisions in this Attachment are supplementary to the provisions of Article 6 of Appendix **30B**.

¹ The Bureau shall also identify the specific satellite networks with which coordination needs to be effected.

² If the payments are not received in accordance with the provisions of Council Decision 482, as amended, on the implementation of cost recovery for satellite network filings, the Bureau shall cancel the publication, after informing the administration concerned. The Bureau shall inform all administrations of such action and that the network specified in the publication in question no longer has to be taken into consideration by the Bureau and other administrations. The Bureau shall send a reminder to the notifying administration not later than two months prior to the deadline for the payment in accordance with the above-mentioned Council Decision 482 unless the payment has already been received.

APPENDIX 1 TO ATTACHMENT TO DRAFT NEW RESOLUTION [A7(E)-AP30B] (WRC-19)

Criteria for determining whether an assignment is considered to be affected by networks submitted to Appendix 30B under this Resolution

The criteria as contained in Annex 4 of Appendix **30B** continue to apply in order to determine if a proposed new assignment applying the procedures of this Attachment affects:

- a) national allotments in the Plan;
- b) an assignment stemming from the conversion of an allotment into an assignment without modification or with modification inside the envelope of the allotment;
- c) allotment requested under Article 7 of Appendix **30B** by a new Member State of the Union which has received unfavourable findings under Article 7 and has been subsequently treated as a submission under § 6.1 of Appendix **30B**;
- d) assignments stemming from the application of § 6.35 of Appendix **30B**;
- e) assignments for which the procedures of this Resolution have been previously applied.

An assignment which appears in the List or which the Bureau has previously examined after receiving complete information and published under § 6.7 of Appendix **30B**, which does not fall into any of the above categories and which is not applying the procedures of this Attachment is considered as being affected by a proposed new assignment that is applying the procedures of this Attachment:

- 1) if the orbital spacing between its orbital position and the orbital position of the proposed new assignment is equal to or less than:
 - 1.1) 7° in the 4 500-4 800 MHz (space-to-Earth) and 6 725-7 025 MHz (Earth-to-space) frequency bands;
 - 1.2) 6° in the 10.70-10.95 GHz (space-to-Earth), 11.20-11.45 GHz (space-to-Earth) and 12.75-13.25 GHz (Earth-to-space) frequency bands.
- 2) however, an administration is considered as not being affected by a proposed new assignment that is applying the procedures of this Attachment if the conditions listed in 2.1 or 2.2 are satisfied:
 - 2.1) the calculated³ Earth-to-space single-entry carrier-to-interference $(C/I)_u$ value at each test point associated with the assignment under consideration is greater than or equal to a reference value that is 27 dB, or $(C/N)_u + 6$ dB⁴, or any already accepted Earth-to-space single entry (C/I) , whichever is the lowest and the calculated³ space-to-Earth single-entry $(C/I)_d$ value everywhere within the service area of the assignment under consideration is greater than or equal to a reference value⁵ that is 23.65 dB, or $(C/N)_d + 8.65$ dB⁶, or any already accepted value whichever is the lowest, and

³ Including a computational precision of 0.05 dB.

⁴ $(C/N)_u$ is calculated as in Appendix 2 to Annex 4 of Appendix **30B**.

⁵ The reference values within the service area are interpolated from the reference values on the test points.

⁶ $(C/N)_d$ is calculated as in Appendix 2 to Annex 4 of Appendix **30B**.

the calculated³ overall aggregate $(C/I)_{agg}$ value at each test point associated with the assignment under consideration, is greater than or equal to a reference value that is 21 dB, or $(C/N)_t + 7$ dB⁷, or any already accepted overall aggregate $(C/I)_{agg}$ value, whichever is the lowest, with a tolerance of 0.45 dB⁸ in the case of assignments not stemming from the conversion of an allotment into an assignment without modification, or when the modification is within the envelope characteristics of the initial allotment;

- 2.2) in the 4 500-4 800 MHz (space-to-Earth) frequency band the pfd produced under assumed free-space propagation conditions, does not exceed the threshold values shown below, anywhere within the service area of the potentially affected assignment;

| | | |
|------------------------|--------------------------------|--------------------------------------|
| $\theta \leq 0.09$ | -240.5 | $\text{dB(W/(m}^2 \cdot \text{Hz))}$ |
| $0.09 < \theta \leq 3$ | $-240.5 + 20\log(\theta/0.09)$ | $\text{dB(W/(m}^2 \cdot \text{Hz))}$ |
| $3 < \theta \leq 5.5$ | $-216.8 + 0.75 \cdot \theta^2$ | $\text{dB(W/(m}^2 \cdot \text{Hz))}$ |
| $5.5 < \theta \leq 7$ | $-193.8 + 25\log(\theta/5.6)$ | $\text{dB(W/(m}^2 \cdot \text{Hz))}$ |

where θ denotes nominal geocentric separation (degrees) between interfering and interfered with satellite networks;

in the 6 725-7 025 MHz (Earth-to-space) the pfd produced at the location in the geostationary-satellite orbit of the potentially affected assignment under assumed free-space propagation conditions does not exceed $-201.0 \text{ dB(W/(m}^2 \cdot \text{Hz))}$;

in the 10.7-10.95 and 11.2-11.45 GHz (space-to-Earth) frequency bands, the pfd produced under assumed free-space propagation conditions, does not exceed the threshold values shown below, anywhere within the service area of the potentially affected assignment:

| | | |
|------------------------|--------------------------------|--------------------------------------|
| $\theta \leq 0.05$ | -235.0 | $\text{dB(W/(m}^2 \cdot \text{Hz))}$ |
| $0.05 < \theta \leq 3$ | $-235.0 + 20\log(\theta/0.05)$ | $\text{dB(W/(m}^2 \cdot \text{Hz))}$ |
| $3 < \theta \leq 5$ | $-207.9 + 0.95 \cdot \theta^2$ | $\text{dB(W/(m}^2 \cdot \text{Hz))}$ |
| $5 < \theta \leq 6$ | $-184.2 + 25\log(\theta/5)$ | $\text{dB(W/(m}^2 \cdot \text{Hz))}$ |

where θ denotes nominal geocentric separation (degrees) between interfering and interfered with satellite networks;

in the 12.75-13.25 GHz (Earth-to-space) frequency band, the pfd produced at the location in the geostationary-satellite orbit of the potentially affected assignment under assumed free-space propagation conditions does not exceed $-205.0 \text{ dB(W/(m}^2 \cdot \text{Hz))}$.

In addition to the above, and as a consequence of the reduced coordination arc in 1) above as compared to that in Annex 3 to Appendix **30B**, the following limits shall be applied, instead of the limits contained in Annex 3 to Appendix **30B**, for submissions made under this Resolution.

⁷ $(C/N)_t$ is calculated as in Appendix 2 of Annex 4 of Appendix **30B**.

⁸ Inclusive of the 0.05 dB computational precision.

Under assumed free-space propagation conditions, the power flux-density (space-to-Earth) of a proposed new allotment or assignment produced on any portion of the surface of the Earth shall not exceed:

- $-131.4 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ in the 4 500-4 800 MHz frequency band; and
- $-118.4 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ in the 10.70-10.95 GHz and 11.20-11.45 GHz frequency bands.

Under assumed free-space propagation conditions, the power flux-density (Earth-to-space) of a proposed new allotment or assignment shall not exceed:

- $-140.0 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ towards any location in the geostationary-satellite orbit located more than 7° from the proposed orbital position in the 6 725-7 025 MHz frequency band; and
- $-133.0 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ towards any location in the geostationary-satellite orbit located more than 6° from the proposed orbital position in the 12.75-13.25 GHz frequency band.

APPENDIX 2 TO ATTACHMENT TO DRAFT NEW RESOLUTION [A7(E)-AP30B] (WRC-19)

Protection criteria for new incoming network

| Incoming network | Allotments or assignments to be protected | Protection criteria |
|--|---|---------------------|
| Assignment applying the special procedure | Allotment in the Plan | Annex 4 |
| | Assignment converted from allotment without modification | Annex 4 |
| | Assignment converted from allotment with modification within the envelope of the allotment | Annex 4 |
| | Assignment converted from allotment with modification outside the envelope of the allotment and the special procedure applied | Annex 4 |
| | Assignment converted from allotment with modification outside the envelope of the allotment and the special procedure NOT applied | New criteria |
| | Former existing system | New criteria |
| | Additional system for which the special procedure applied | Annex 4 |
| | Additional system for which the special procedure NOT applied | New criteria |
| | Request under Article 7 but transferred to Article 6 | Annex 4 |
| | New allotment through the application of § 6.35 | Annex 4 |
| Conversion of allotment or new additional system for which the special procedure NOT applied | All | Annex 4 |

Agenda item 7(F)

3/7/6 Issue F – Measures to facilitate entering new assignments into the RR Appendix 30B List

3/7/6.1 Executive summary

An administration wishing to convert its national allotment in RR Appendix **30B** to assignments with characteristics beyond those of the initial allotment or wishing to introduce a new network will be faced with several difficulties. Two of these are:

- due to the conservative criteria used in RR Appendix **30B**, a large number of coordination requirements will be identified;
- networks can be designed with combinations of characteristics, possibly unrealistic, to obtain a high sensitivity to interference from later submissions.

In response to this issue, methods as outlined in sections 3/7/6.4 and 3/7/6.5 have been developed.

3/7/6.2 Background

Article 44 of the ITU Constitution stipulates that for countries to have equitable access to spectrum/orbit resources, administrations shall limit their use to the minimum required to provide services in a satisfactory manner and to endeavour to apply the latest technical advances.

An administration which wants to convert its national allotment of RR Appendix **30B** into assignments in an economically viable manner very often needs to modify the initial characteristics of its national allotments, taking into account the latest available development and advancement in technology. For this purpose, the administration will make a submission and follow the procedures of Article 6 of RR Appendix **30B**.

In so doing:

- a) when the submission is examined and published by the Bureau, the submission would need to coordinate with affected networks with higher priority;
- b) due to the conservative criteria used in RR Appendix **30B**, a large number of coordination requirements will be identified;
- c) networks can be designed with combinations of characteristics, possibly unrealistic, to obtain a high sensitivity to interference from later submissions of other administrations.

As a result, it may be difficult for an administration to successfully complete the coordination within the regulatory period.

3/7/6.3 Summary and analysis of the results of ITU-R studies

While the structure of the protection criteria for satellite networks submitted in the unplanned frequency bands as well as in RR Appendices **30** and **30A** has undergone significant modifications to take into account technological advances over the last decades, the structure used in RR Appendix **30B** has remained essentially unchanged.

In addition, with the structure of the protection criteria of RR Appendix **30B**, if e.g. the parameters of submitted satellite networks contain small receiving earth station antennas with low system noise temperatures combined with low e.i.r.p. levels or high gain receiving space station antennas with global coverage combined with low uplink e.i.r.p. levels, these additional systems/uses will become very sensitive to interference and overprotected. This may hinder successful coordination of later submissions.

To benefit from the homogeneity between satellite networks that has developed in C- and Ku-band over the years to facilitate new satellite networks, several WRCs have reduced the size of the coordination arc in the unplanned C- and Ku-band. Due to the planned nature of RR Appendix **30B**, the level of homogeneity in these frequency bands would be greater than that encountered in the unplanned frequency bands. Yet, the size of the coordination arc in RR Appendix **30B** remains unchanged at the levels as when the concept of coordination arc was first introduced by WRC-2000.

To allow new submissions to take advantage of the improvements offered by e.g. non-overlapping coverages, use of larger antennas, lower e.i.r.p. levels etc. between networks located within the coordination arc and also to avoid overprotection of networks, e.g. due to unrealistic combinations of technical parameters in submissions, WRC-2000, in revising RR Appendices **30** and **30A** structured the protection criteria such that unnecessary coordination requirements inside the coordination arc should not hinder introduction of new networks. Provisions to avoid unnecessary coordination in portions of the unplanned frequency bands have similarly been introduced by later WRCs. However, for RR Appendix **30B**, there are no such mechanisms to avoid unnecessary coordination which hinder introduction of new networks.

Use of pfd and reduced coordination arc criteria

Protection criteria based upon coordination arc and pfd thresholds have been used in various parts of the Radio Regulations for several years. WRC-2000 introduced such criteria for RR Appendices **30** and **30A** and WRC-12 did the same for the 21.4-22 GHz BSS frequency band. WRC-2000 also introduced the coordination arc for unplanned FSS and in the revision of RR Appendix **30B** by WRC-07, the coordination arc was introduced also for these frequency bands.

During the 2007-2012 and 2012-2015 study cycles, revisions to the size of the coordination arc and use of pfd criteria were studied for unplanned FSS under WRC-12 agenda item 7, issue 2A, for the 2007-2012 study cycle and under WRC-15 agenda item 9.1, issue 9.1.2, for the 2012-2015 study cycle, respectively.

Pfd criteria

Some effects of the current coordination mechanisms of RR Appendix **30B** are:

- 1) Networks at great orbital separations can request to be included in the coordination process even though these networks may have had to accept much higher interference levels from more closely spaced networks.
- 2) Special sensitive combinations of characteristics (e.g. low e.i.r.p. and very low system noise temperature combined with very small receiving earth station antennas) for submissions may complicate coordination for new networks.

The purpose of introducing a pfd criterion is to alleviate these difficulties to facilitate coordination of new networks while providing full protection of existing networks with reasonable technical parameters.

It can be seen that the relationship between the triggering $\Delta T/T$ and the permissible interfering pfd is determined by the following equations:

$$Pfd_{downlink} = 10 \log \{ (\Delta T/T) \cdot k \cdot T_s \cdot 4 \cdot \pi \cdot f^2 / \Delta G \cdot c^2 \} \text{ dB(W/(m}^2 \cdot \text{Hz))}$$

$$Pfd_{uplink} = 10 \log \{ (\Delta T/T) \cdot k \cdot 4 \cdot \pi \cdot f^2 / (G/T) \cdot c^2 \} \text{ dB(W/(m}^2 \cdot \text{Hz))}$$

where:

$$\Delta T/T = \Delta T/T \text{ in a linear scale, i.e. } \Delta T/T (\%) / 100;$$

$$T_s = \text{receiving earth station system noise temperature (K);}$$

$$f = \text{frequency (Hz);}$$

ΔG = absolute off-axis gain of receiving earth station antenna towards interfering satellite in linear scale, i.e. $10^{\Delta G(\text{dBi})/10}$; taking into account topocentric angle of RX antenna;

G/T = interfered-with satellite figure of merit in linear scale, i.e. $10^{G/T(\text{dB/K})/10}$;

k = Boltzmann's constant in linear scale ($1.38 \cdot 10^{-23}$ J/K);

c = speed of light ($3 \cdot 10^8$ m/s).

It can thus be seen that the relationship between $\Delta T/T$ and pfd is determined by only a few variables:

Downlink:

- Receiving earth station system noise temperature;
- Receiving earth station antenna off-axis absolute gain (determined by:
 - antenna diameter;
 - antenna pattern).

Uplink:

- Interfered-with satellite figure of merit (G/T).

For the downlink, the resulting pfd will be a mask determined by the earth station antenna pattern where the large antennas will determine the critical pfd value at small orbital separations while smaller antennas will determine the critical pfd further out. The antenna patterns taken into account should appropriately protect all antenna diameters of Plan allotments and List assignments. Once the orbital separation is such that the interfering satellite is seen through the sidelobes of the earth station antenna, the critical pfd value will be the same for all antenna sizes (assuming that the antennas follow the same sidelobe template).

For the uplink, the critical pfd will be determined by the maximum satellite G/T within the range and will be one fixed value which will represent the worst G/T case in order to appropriately protect all Plan allotments and standard operational characteristics of List assignments.

During the 2012-2015 study cycle, under WRC-15 agenda item 9.1, issue 9.1.2, studies were conducted on what would constitute reasonable technical parameters for practical operational satellites, for which full protection should be expected and afforded. The agreed assumptions were as shown in Table 3/7/6.3-1. It can also be noted that several of the technical parameters used are taken from Annex 1 of RR Appendix **30B** since these represented the most up-to-date set of parameters available.

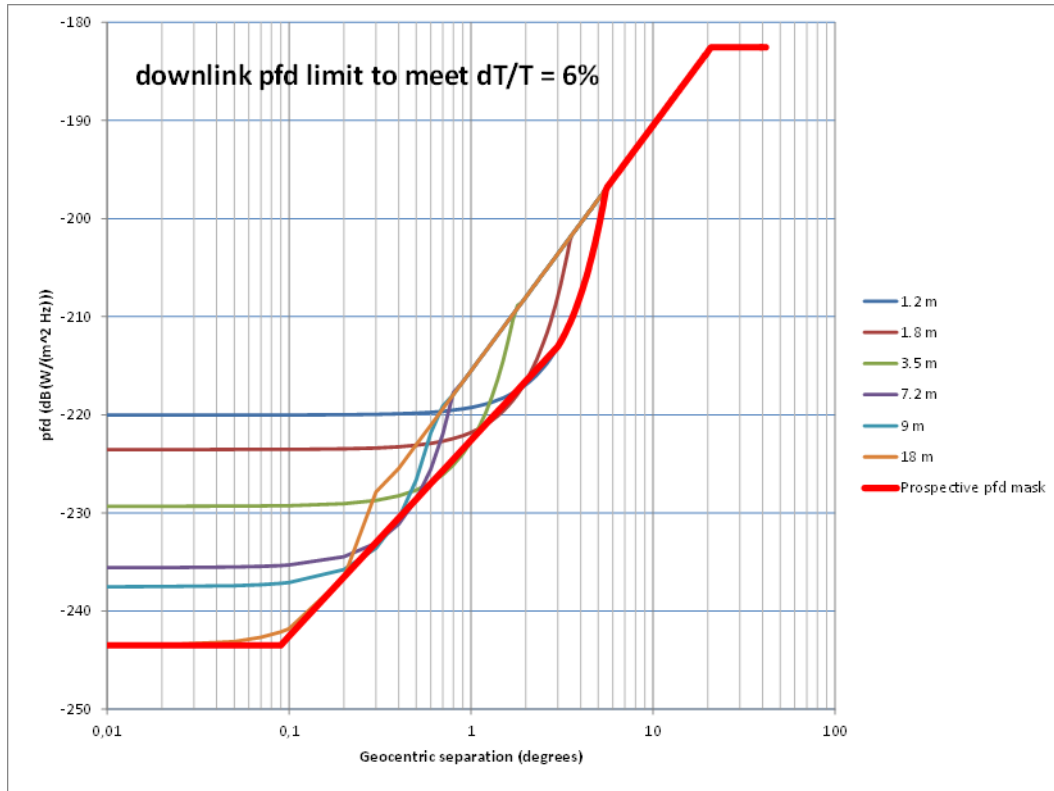
TABLE 3/7/6.3-1

| Downlink | 4 GHz | 10/11/12 GHz |
|----------------------------------|--|--|
| Earth station antenna diameter | 1.2-18 m (5.5 m in RR AP 30B Plan) | 0.45-11 m (2.7 m in RR AP 30B Plan) |
| Earth station antenna diagram | Main lobe: According to RR Appendix 8 , Section III Sidelobes: 29-25 log θ dBi (Recommendation ITU-R BO.1213, which implements these main and sidelobe characteristics, was used for the calculations) | |
| Earth station noise temperature | 95 K (as per RR AP 30B Plan) | 125 K (as per RR AP 30B Plan) |
| Earth station antenna efficiency | 70% (as per RR AP 30B Plan) | 70% (as per RR AP 30B Plan) |
| Equivalent $\Delta T/T$ | 6% | 6% |

| Uplink | 6 GHz | 14 GHz |
|-------------------------|--------|---------|
| Maximum satellite G/T | 0 dB/K | 11 dB/K |
| Equivalent $\Delta T/T$ | 6% | 6% |

With these assumptions, using the above equations, the downlink pfd masks and the uplink pfd levels become as shown in Figures 3/7/6.3-1 and 3/7/6.3-2.

FIGURE 3/7/6.3-1

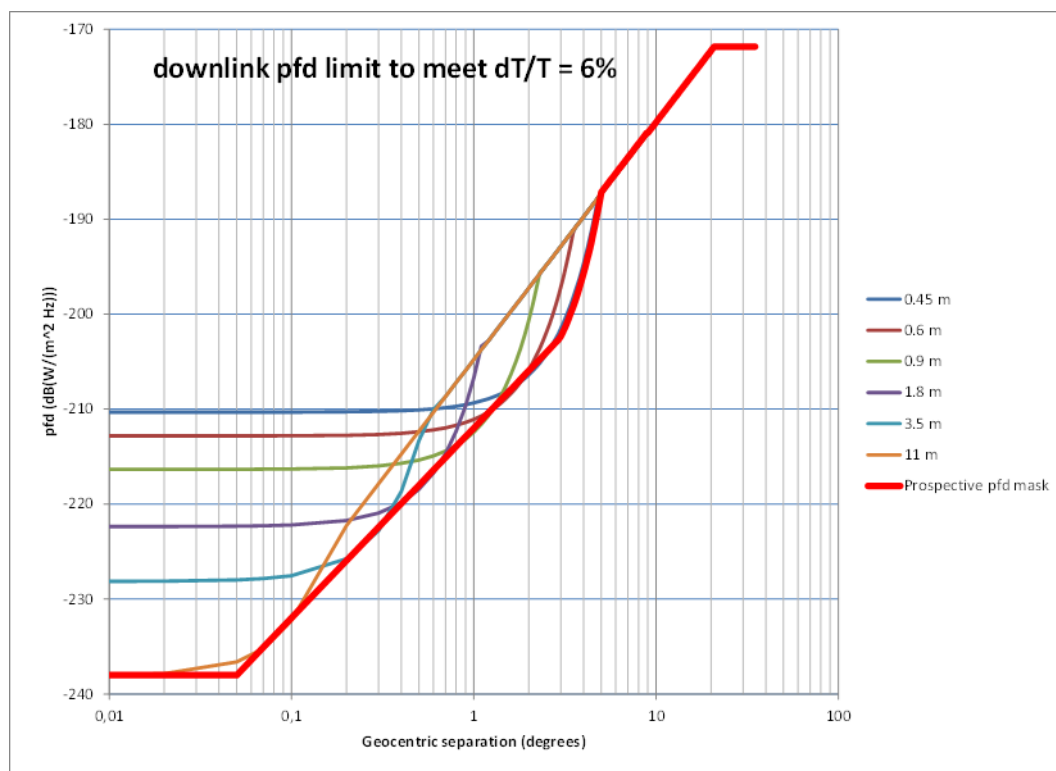


The thick red line in Figure 3/7/6.3-1 denotes the C-band downlink mask to protect the range of antenna diameters to a $\Delta T/T \leq 6\%$ and is described by the mask:

| | | | | | |
|------|----------|----------|--------|--------|---|
| | θ | \leq | 0.09 | -243.5 | dB(W/(m ² · Hz)) |
| 0.09 | $<$ | θ | \leq | 3 | $-243.5 + 20\log(\theta/0.09)$ dB(W/(m ² · Hz)) |
| 3 | $<$ | θ | \leq | 5.5 | $-219.8 + 0.75 \cdot \theta^2$ dB(W/(m ² · Hz)) |
| 5.5 | $<$ | θ | \leq | 20.9 | $-196.8 + 25\log(\theta/5.6)$ dB(W/(m ² · Hz)) |
| 20.9 | $<$ | θ | | -182.6 | dB(W/(m ² · Hz)) |

For the uplink, the pfd level is calculated as -204 dB(W/(m² · Hz)).

FIGURE 3/7/6.3-2



The thick red line in Figure 3/7/6.3-2 denotes the Ku-band downlink mask to protect the range of antenna diameters to a $\Delta T/T \leq 6\%$ and is described by the mask:

| | | | | | |
|------|----------|----------|--------|--------|---|
| | θ | \leq | 0.05 | -238 | dB(W/(m ² · Hz)) |
| 0.05 | $<$ | θ | \leq | 3 | $-238 + 20\log(\theta/0.05)$ dB(W/(m ² · Hz)) |
| 3 | $<$ | θ | \leq | 5 | $-210.9 + 0.95 \cdot \theta^2$ dB(W/(m ² · Hz)) |
| 5 | $<$ | θ | \leq | 20.9 | $-187.15 + 25\log(\theta/5)$ dB(W/(m ² · Hz)) |
| 20.9 | $<$ | θ | | -171.9 | dB(W/(m ² · Hz)) |

For the uplink, the pfd level is calculated as -208 dB(W/(m² · Hz)).

Reduction of the size of the coordination arc

Similar to pfd criteria, the coordination arc concept has the effect of facilitating coordination of new networks while offering good protection of existing networks with reasonable technical parameters. Since the introduction of the coordination arc by WRC-2000, the size of the coordination arc for unplanned C- and Ku-band has been studied and consequently reduced by two later WRCs; under WRC-12 agenda item 7, issue 2A, and WRC-15 agenda item 9.1, issue 9.1.2.

| Size of coordination arc for unplanned | WRC-2000 | WRC-12 | WRC-15 |
|--|----------|--------|--------|
| C-band | 10° | 8° | 7° |
| Ku-band | 9° | 7° | 6° |

When RR Appendix **30B** was revised by WRC-07, similar to what had already been done in the unplanned frequency bands and RR Appendices **30** and **30A**, the coordination arc was introduced also to these frequency bands. In doing so, the same size of the coordination arc was adopted as that

of the other frequency bands at that time, i.e. 10° for C-band and 9° for Ku-band. However, in updating the size of the coordination arc for unplanned frequency bands, WRCs have failed to do the same thing for RR Appendix **30B**.

For C- and Ku-band, ITU-R studies show that with no e.i.r.p. difference between the networks, the coordination arc could be reduced to 4.8° and 3.7° respectively. With increasing e.i.r.p. difference, the required separation distance would increase. The coordination arc as adopted by WRC-15 of 7° and 6° for C- and Ku-band, respectively, would correspond to about 10 dB e.i.r.p. difference between the wanted and the interfering signals.

These studies were conducted with the smallest antenna size assumed in Recommendation ITU-R S.1524 (corresponding to 1.3 m at C-band and 90 cm at Ku-band). Observing that the RR Appendix **30B** Plan is based on 5.5 m and 2.7 m for C- and Ku-band, respectively, and also observing the higher degree of homogeneity of the e.i.r.p. values stemming from the planned nature of the RR Appendix **30B** frequency bands, with the same size of the coordination arc, the RR Appendix **30B** Plan and also submissions with reasonable variations from the parameters of the Plan would have a higher protection than those in the unplanned frequency bands.

Impact on RR Appendix 30B Plan and assignments emanating from the Plan

The basis for the pfd criteria and the associated values is to provide full protection ($\Delta T/T \leq 6\%$) to a reasonable range of parameters while avoiding unnecessary coordination and preventing unrealistic combinations of parameters from unduly blocking coordination or new networks. With the pfd masks suggested, C-band antennas down to 1.2 m in diameter and Ku-band antennas down to 45 cm in diameter will be fully protected.

Antennas smaller than this will encounter lower protection for incoming interfering signals at certain orbital separations (at the edge of the main lobe). However, these antenna sizes are significantly smaller than those of the Plan and also smaller than commonly used antenna sizes in practical satellite networks.

To enable efficient spectrum utilization and to facilitate coordination or new networks for administrations, some degree of homogeneity of technical parameters should be sought. For this reason, combinations of technical parameters which deviate largely from what is deemed a reasonable range should not be entitled to unduly block coordination of networks with reasonable technical parameters, i.e. these networks should expect a reduced protection.

Similar to the pfd criteria, the effect of the coordination arc is to remove unnecessary coordination and reduce the possibility of unrealistic combinations of parameters contained in filings unduly blocking coordination or new networks. As shown in ITU-R studies, networks with antenna diameters down to 1.3 m at C-band and 90 cm at Ku-band are protected for e.i.r.p. differences up to 10 dB between the wanted and the interfering signal with the coordination arcs of 6° and 5° for C- and Ku-band respectively.

Observing the 5.5 m and 2.7 m antenna sizes used in the RR Appendix **30B** Plan, allotments in the Plan can tolerate significantly larger e.i.r.p. differences while being protected with the same size of the coordination arc. Also, considerably smaller antennas can be introduced in conversions of allotments into assignments while being protected by the 6° and 5° coordination arcs for C- and Ku-band respectively.

Also, again, it should be borne in mind that full protection of infinitesimal antennas with very low e.i.r.p. at large orbital separations is what would block new networks from entering and is exactly what should be avoided.

3/7/6.4 Methods to satisfy Issue F

3/7/6.4.1 Method F1

To facilitate coordination of submissions of new networks and ease access of administrations to the frequency bands of RR Appendix **30B**, a possible method has been identified to update the coordination triggers to take into account technological advances and avoid some unnecessary coordination while assuring adequate protection of other satellite networks.

This method will be beneficial to all submissions for new networks, including those of newcomers and those of administrations seeking to convert their national allotments into assignments with changes. Specifically, the proposed changes include:

- Adopting the structure decided by WRC-2000 for RR Appendices **30** and **30A**, i.e. a reduced coordination arc and mechanisms to remove unnecessary coordination requirements inside the coordination arc.
- Bringing the size of the coordination arc in line with that used for the unplanned frequency bands, i.e. 7° for C-band and 6° for Ku-band and consequently align the Annex 3 limits to newly established coordination arcs.
- Introducing pfd masks and levels like in RR Appendices **30** and **30A** as well as in portions of the unplanned frequency bands to remove unnecessary coordination and prevent combinations of technical parameters leading to unrealistic links from hindering introduction of new networks. Proposed values for pfd masks and levels are those developed in preparation for WRC-15, based on a level of protection corresponding to $\Delta T/T = 6\%$ for C-band antennas with a diameter between 1.2 and 18 m and Ku-band antennas with a diameter between 45 cm and 11 m).

3/7/6.4.2 Method F2

This method would be the same as Method F1 except that to allow new submissions of administrations to benefit from already agreed single entry C/I values, the provisions as contained in the current RR Appendix **30B** to this effect would be retained.

3/7/6.4.3 Method F3

This method would be based on either Methods F1 or F2, but in addition, protection of the existing and operational additional systems recorded in the List prior to a specified date will be provided by applying criteria specified in Annex **4 (Rev.WRC-07)** of Appendix **30B** to the Radio Regulations.

3/7/6.4.4 Method F4

This method proposes no changes to the Radio Regulations.

The principle of the RR Appendix **30B** is to provide equitable access to the frequency bands. It is important to ensure protection of the assignments in the List and allotments in the Plan of RR Appendix **30B**. However, facilitation to enter new assignments into the RR Appendix **30B** List through revising the current protection criteria may reduce the protection of assignments in the List and allotments in the Plan of RR Appendix **30B**.

3/7/6.5 Regulatory and procedural considerations for Issue F

3/7/6.5.1 Method F1

APPENDIX 30B (REV.WRC-15)

Provisions and associated Plan for the fixed-satellite service in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz

MOD

ANNEX 3 (REV.WRC-~~07~~19)

Limits applicable to submissions received under Article 6 or Article 7~~MOD~~¹⁵

Under assumed free-space propagation conditions, the power flux-density (space-to-Earth) of a proposed new allotment or assignment produced on any portion of the surface of the Earth shall not exceed:

- ~~−131.4*~~^{−127.5} dB(W/(m² · MHz)) in the 4 500-4 800 MHz frequency band; and
- ~~−118.4*~~^{−114.0} dB(W/(m² · MHz)) in the 10.70-10.95 GHz and 11.20-11.45 GHz frequency bands.

Under assumed free-space propagation conditions, the power flux-density (Earth-to-space) of a proposed new allotment or assignment shall not exceed:

- −140.0 dB(W/(m² · MHz)) towards any location in the geostationary-satellite orbit located more than ~~10~~⁷° from the proposed orbital position in the 6 725-7 025 MHz frequency band, and
- −133.0 dB(W/(m² · MHz)) towards any location in the geostationary-satellite orbit located more than ~~9~~⁶° from the proposed orbital position in the 12.75-13.25 GHz frequency band.

*NOTE – These are consequential changes to the proposed reduction of the coordination arc from 10° to 7° in the 4 GHz frequency band and from 9° to 6° in the 10/11 GHz frequency band. Should other sizes of the coordination arc be considered by WRC-19, the power flux-densities should be amended according to the equation: $pfd_{new} = pfd_{current} - 25 \cdot \log (current\ coordination\ arc / new\ coordination\ arc)$.

¹⁵ These limits shall not apply to assignments submitted in accordance with Article 6 or recorded in the List before ~~17 November 2007~~^{22 November 2019}.

MOD

ANNEX 4 (REV.WRC-0719)

Criteria for determining whether an allotment or an assignment is considered to be affected

An allotment or an assignment is considered as being affected by a proposed new allotment or assignment:

1 if the orbital spacing between its orbital position and the orbital position of the proposed new allotment or assignment is equal to or less than:

1.1 ~~107°~~ in the 4 500-4 800 MHz (space-to-Earth) and 6 725-7 025 MHz (Earth-to-space) ~~frequency~~ bands;

1.2 ~~96°~~ in the 10.70-10.95 GHz (space-to-Earth), 11.20-11.45 GHz (space-to-Earth) and 12.75-13.25 GHz (Earth-to-space) ~~frequency~~ bands;

~~and~~

2 ~~However, an administration is considered as not being affected~~ if at least one of the following ~~three~~ conditions is ~~not~~ satisfied:

2.1 the calculated¹⁶ Earth-to-space single-entry carrier-to-interference $(C/I)_u$ value at each test point associated with the allotment or assignment under consideration is greater than or equal to a reference value that is 30 dB, or $(C/N)_u + 9$ dB¹⁷, ~~or any already accepted Earth-to-space single-entry $(C/I)_u$~~ ¹⁸, whichever is the lowest; ~~and~~

~~2.2~~ the calculated¹⁶ space-to-Earth single-entry $(C/I)_d$ value everywhere within the service area of the allotment or assignment under consideration is greater than or equal to a reference value¹⁹ that is 26.65 dB, or $(C/N)_d + 11.65$ dB²⁰, ~~or any already accepted space-to-Earth single-entry $(C/I)_d$ value~~, whichever is the lowest; ~~and~~

~~2.3~~ the calculated¹⁶ overall aggregate $(C/I)_{agg}$ value at each test point associated with the allotment or assignment under consideration, is greater than or equal to a reference value that is 21 dB, or $(C/N)_t + 7$ dB²¹, or any already accepted overall aggregate $(C/I)_{agg}$ value, whichever is the lowest, with a tolerance of 0.25 dB²² in the case of assignments not stemming from the conversion of an allotment into an assignment without modification, or when the modification is within the envelope characteristics of the initial allotment.

~~2.2~~ in the 4 500-4 800 MHz (space-to-Earth) frequency band, the pfd produced under assumed free-space propagation conditions does not exceed the threshold values shown below, anywhere within the service area of the allotment or assignment under consideration:

| | | | | | |
|-------------|--------------------|------------|---|-----------------------------------|-----------------------------------|
| | θ | \leq | <u>0.09</u> | <u>-243.5</u> | <u>dB(W/(m² · Hz))</u> |
| <u>0.09</u> | $\leq \theta \leq$ | <u>3</u> | <u>-243.5 + 20log($\theta/0.09$)</u> | <u>dB(W/(m² · Hz))</u> | |
| <u>3</u> | $\leq \theta \leq$ | <u>5.5</u> | <u>-219.8 + 0.75 · θ^2</u> | <u>dB(W/(m² · Hz))</u> | |
| <u>5.5</u> | $\leq \theta \leq$ | <u>7</u> | <u>-196.8 + 25log($\theta/5.6$)</u> | <u>dB(W/(m² · Hz))</u> | |

¹⁸ ~~Excluding values accepted in accordance with § 6.15 of Article 6~~ (SUP – WRC-19)

where θ denotes nominal geocentric separation (degrees) between interfering and interfered-with satellite networks;

in the 6 725-7 025 MHz (Earth-to-space) frequency band, the pfd produced at the location in the geostationary-satellite orbit of the allotment or assignment under consideration under assumed free-space propagation conditions does not exceed $-204.0 \text{ dB(W/(m}^2 \cdot \text{Hz))}$;

in the 10.7-10.95 and 11.2-11.45 GHz (space-to-Earth) frequency bands, the pfd produced under assumed free-space propagation conditions does not exceed the threshold values shown below, anywhere within the service area of the allotment or assignment under consideration:

| | | | | | | |
|-------------|----------|----------|-------------|---------------|--------------------------------------|-----------------------------------|
| | θ | \leq | <u>0.05</u> | <u>-238.0</u> | <u>dB(W/(m² · Hz))</u> | |
| <u>0.05</u> | \leq | θ | \leq | <u>3</u> | <u>-238.0 + 20log(θ/0.05)</u> | <u>dB(W/(m² · Hz))</u> |
| <u>3</u> | \leq | θ | \leq | <u>5</u> | <u>-210.9 + 0.95 · θ²</u> | <u>dB(W/(m² · Hz))</u> |
| <u>5</u> | \leq | θ | \leq | <u>6</u> | <u>-187.2 + 25log(θ/5)</u> | <u>dB(W/(m² · Hz))</u> |

where θ denotes nominal geocentric separation (degrees) between interfering and interfered-with satellite networks;

in the 12.75-13.25 GHz (Earth-to-space) frequency band, the pfd produced at the location in the geostationary-satellite orbit of the allotment or assignment under consideration under assumed free-space propagation conditions does not exceed $-208.0 \text{ dB(W/(m}^2 \cdot \text{Hz))}$.

3/7/6.5.2 Method F2

This method would be the same as Method F1, but with the following alternative text for § 2.1 of Annex 4 of RR Appendix **30B**:

APPENDIX 30B (REV.WRC-15)

Provisions and associated Plan for the fixed-satellite service in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz

MOD

ANNEX 4 (REV.WRC-07/19)

Criteria for determining whether an allotment or an assignment is considered to be affected

...

- 2 However, an administration is considered as not being affected if at least one of the following ~~three~~ conditions is ~~not~~ satisfied:
- 2.1 the calculated¹⁶ Earth-to-space single-entry carrier-to-interference $(C/I)_u$ value at each test point associated with the allotment or assignment under consideration is greater than or equal to a reference value that is 30 dB, or $(C/N)_u + 9$ dB¹⁷, or any already accepted Earth-to-space single-entry $(C/I)_u$ ¹⁸, whichever is the lowest; and
- ~~2.2~~ the calculated¹⁶ space-to-Earth single-entry $(C/I)_d$ value everywhere within the service area of the allotment or assignment under consideration is greater than or equal to a reference value¹⁹ that is 26.65 dB, or $(C/N)_d + 11.65$ dB²⁰, or any already accepted space-to-Earth single-entry $(C/I)_d$ value, whichever is the lowest; and
- ~~2.3~~ the calculated¹⁶ overall aggregate $(C/I)_{agg}$ value at each test point associated with the allotment or assignment under consideration, is greater than or equal to a reference value that is 21 dB, or $(C/N)_t + 7$ dB²¹, or any already accepted overall aggregate $(C/I)_{agg}$ value, whichever is the lowest, with a tolerance of 0.25 dB²² in the case of assignments not stemming from the conversion of an allotment into an assignment without modification, or when the modification is within the envelope characteristics of the initial allotment.

...

3/7/6.5.3 Method F3

This method would be based on either Method F1 or F2, but with the following footnote added to the title of Annex 4 of RR Appendix **30B**:

APPENDIX 30B (REV.WRC-15)

Provisions and associated Plan for the fixed-satellite service in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz

MOD

ANNEX 4 (REV.WRC-~~07~~19)

Criteria for determining whether an allotment or an assignment is considered to be affected~~XX~~

...

~~XX~~ For frequency assignments recorded in the List before 22 November 2019, the criteria of Annex 4 (Rev.WRC-07) applies.

¹⁸ ~~Excluding values accepted in accordance with § 6.15 of Article 6.~~(SUP – WRC-19)

3/7/6.5.4 Method F4

No changes to the Radio Regulations.

NOC

APPENDIX 30B (REV.WRC-15)

Agenda item 7(G)

3/7/7 Issue G – Updating the reference situation for Regions 1 and 3 networks under RR Appendices 30 and 30A when provisionally recorded assignments are converted into definitive recorded assignments

3/7/7.1 Executive summary

The protection criteria in the Regions 1 and 3 RR Appendices **30** and **30A** frequency bands are based upon a reference situation which takes into account the aggregation of interference from all other networks in the Plan and the List and prescribes a protection based upon an equivalent protection margin (EPM) (a measure for aggregated interference relative to a predefined acceptable level) which should not fall more than 0.45 dB below 0 dB, or if already negative, should not be degraded by more than 0.45 dB. Studies show that networks would have the best protection against interference when the reference situation is about ± 5 dB around zero and will be lower for both higher and lower EPMs.

§ 4.1.18 of RR Appendices **30** and **30A** prescribes that in the case of recording in the List with outstanding coordination requirements, this recording shall be provisional, but that the entry shall be changed from provisional to definitive recording in the List if the Bureau is informed that the new assignment in the Regions 1 and 3 List has been in use, together with the assignment which was the basis for the disagreement, for at least four months without any complaint of harmful interference being made.

§ 4.1.18*bis* prescribes that when entering assignments of a network provisionally into the List, the reference situation of interfered-with networks with which coordination is not completed is not updated. However, RR Appendices **30** and **30A** currently do not state whether or not the Bureau should update the reference situation of the network with which there is still outstanding disagreement if the provisionally recorded assignments are changed to definitively recorded, and the Bureau has never been faced with such a situation.

Depending on the initial reference situation of the affected network and what would be the reference situation if taking into account the interference from the network for which the agreement has not been given, it can be seen that updating or not updating the reference situation can have different effects on its protection against later submissions.

In response to Issue G, three methods have been identified:

Method G1

The administration with an interfered-with network, depending on the specific situation of its network, will determine whether or not the reference situation shall be updated.

Method G2

Quantification of when § 4.1.18 may be used, requirements for both existing and new network to operate exactly at notified parameters, and a Resolution which involves exchange of measurements and outlines how networks can be recorded under § 4.1.18.

Method G3

No change to the Radio Regulations.

3/7/7.2 Background

§§ 4.1.18 to 4.1.20 were included in the RR based on a WRC-2000 decision, to be used in exceptional cases to overcome continuing disagreement of administrations of the affected networks to enter provisionally into the List and after being four months in use without complaint of harmful interference to give a chance to new or modified Article 4 networks to enter definitively in the Lists of RR Appendices **30** and **30A**.

The issue of updating the reference situation for Regions 1 and 3 networks under RR Appendices **30** and **30A** when provisionally recorded assignments are converted into definitive assignments was first raised during the CPM15-2 meeting. It was therefore too late to have this issue captured in the CPM Report. Subsequently, this issue was brought to the attention of the RRB-70 meeting in October 2015 (Document RRB-70/10), requesting that a Rule of Procedure (RoP) be prepared to outline the desired practice to be followed by the Bureau. RRB-70 however was of the view that such a RoP would consist in a change of the Radio Regulations and therefore was outside the authority of the RRB.

Following this decision, a proposal on this issue was submitted to WRC-15, which has the authority to make changes to the Radio Regulations (Document WRC-15/169). Since this proposal was made directly to the conference with no previous ITU-R studies, WRC-15 decided that:

“....it was felt that further study of this issue is required if this current practice is to be changed. ITU-R is therefore invited to study this issue under the standing agenda item 7 with the aim of finding an appropriate regulatory and technical solution to this issue.”

This Issue G is in response to these activities before and during the last WRC and the decision of WRC-15.

3/7/7.3 Summary and analysis of the results of ITU-R studies

The protection criteria in the Regions 1 and 3 RR Appendices **30** and **30A** frequency bands are based upon a reference situation which takes into account the aggregation of interference from all other networks in the Plan and the List and prescribes a protection based upon an equivalent protection margin (a measure for aggregated interference relative to a predefined acceptable level) which should not fall more than 0.45 dB below 0 dB, or if already negative, should not be degraded by more than 0.45 dB.

If the reference situation of an assignment of a network in the List, as a result of including the interference from the network to which it has not given its agreement, falls below 0 dB, interference from later submissions may be higher before reaching the further 0.45 dB degradation which triggers coordination. The further below 0 dB the reference situation falls, the higher the interference can be before coordination is triggered, making the interfered-with network less and less sensitive to interference from later submissions.

Table 3/7/7.3-1 below shows the allowable interference in terms of C/I (carrier-to-interference ratio, C/I_{new}) and interference power (I_{new}) derived by EPM criteria (RR Appendix **30**). When the carrier level is constant (e.i.r.p. of 59 dBW), the allowable interference is almost constant for high *Ref. EPM* (above 5 dB). However, the allowable interference increases drastically for low *Ref. EPM* (below 0 dB).

TABLE 3/7/7.3-1

Relation between reference (*Ref.*) EPM and the allowable interference derived by EPM criteria (RR Appendix 30)

| | | | | | | | | |
|--|--------|--------|-------|-------|-------|--------|--------|--------|
| C e.i.r.p. (dBW) | 59.0 | 59.0 | 59.0 | 59.0 | 59.0 | 59.0 | 59.0 | 51.0 |
| PR (dB) | 21.0 | 21.0 | 21.0 | 21.0 | 21.0 | 21.0 | 21.0 | 21.0 |
| C/I_{aggr} (dB) | 36.0 | 31.0 | 26.0 | 21.0 | 16.0 | 11.0 | 6.0 | 2.0 |
| I_{aggr} (dBW) | 23.0 | 28.0 | 33.0 | 38.0 | 43.0 | 48.0 | 53.0 | 49.0 |
| <i>Ref. EPM</i> (dB) | 15.0 | 10.0 | 5.0 | -0.0 | -5.0 | -10.0 | -15.0 | -19.0 |
| C/I_{new} (dB) | 20.7 | 21.0 | 22.0 | 30.6 | 25.6 | 20.6 | 15.6 | 11.6 |
| I_{new} (dBW) | 38.3 | 38.0 | 37.0 | 28.4 | 33.4 | 38.4 | 43.4 | 39.4 |
| $C/(I_{aggr}+I_{new})$ (dB) | 20.5 | 20.6 | 20.5 | 20.5 | 15.5 | 10.6 | 5.5 | 1.5 |
| <i>EPM</i> ($I_{aggr}+I_{new}$) (dB) | -0.45 | -0.45 | -0.45 | -0.45 | -5.45 | -10.45 | -15.45 | -19.45 |
| Degradation in EPM (dB) | -15.45 | -10.45 | -5.45 | -0.45 | -0.45 | -0.45 | -0.45 | -0.45 |

PR: Protection ratio. It is 21 dB for co-channel signals adopted in the WRC-2000 Plan (RR Appendix 30 Annex 5 section 3.4).

Table 3/7/7.3-1 shows that networks would have the best protection when the reference situation is about ± 5 dB around zero and will be lower for both higher and lower EPMs.

This means that if the reference situation of a network in the RR Appendix 30 or 30A List is updated to take into account the interference situation of a network which has entered through § 4.1.18 and if this brings the reference situation significantly below 0 dB, the network in the List will encounter a reduced protection from later submissions due to a network to which it has not given its agreement.

On the other hand, if the EPM of a network is high, it could tolerate a relatively high interference before the EPM is brought down to 0.45 dB below zero and triggering coordination. If the reference situation is not updated to take into account the interference from the network which has used § 4.1.18 against it, a later submission can take up this interference tolerance while it is not recognized that this interference allowance is already taken up by the network using § 4.1.18. In this situation, not updating the reference situation will lead to a reduced protection against later submissions.

It can also be noted that for an assignment in the Regions 1 and 3 List which already has a very low reference EPM, the further latecomer could enter into the List without applying the § 4.1.18 procedure. In this situation, the issue of updating of the reference situation when networks are entered into the List applying § 4.1.18 becomes irrelevant.

Note that the last column in Table 3/7/7.3-1 shows a network with low e.i.r.p. of 51 dBW. In this case, compared to a network with nominal e.i.r.p. of 59 dBW, the wanted carrier is 8 dB low and the interference is 8 dB high. As a result, C/I_{aggr} is 16 dB less than the nominal network (e.i.r.p. of 59 dBW). In Table 3/7/7.3-1, another interference from the opposite side satellite is considered, which creates an additional 3 dB degradation and results in the *Ref. EPM* of -19 dB. The allowable interference power is 39.4 dBW, which corresponds to the *Ref. EPM* of -10 dB for the network with nominal e.i.r.p. of 59 dBW.

The EPM criteria contribute to alleviate the problem of “sensitive satellite network”, which has a low transmitting power and permits a very low interference power. A satellite network with a low transmitting power generally has to accept a low EPM to enter into the List. Then such a sensitive satellite network has to allow a high interference power as seen in the last column of Table 3/7/7.3-1, and has no chance to block others. As a result, it becomes easier for a new-comer

to enter the List. However, if a “sensitive network” has managed to get into the List without getting a low EPM, in not updating the reference EPM for such a “sensitive satellite network”, it will continue to enjoy a higher degree of sensitivity against later submissions and in respect of the EPM criterion, triggering more coordination than if the reference EPM was updated.

In consideration of updating of the reference EPM, in combination with the other coordination criteria used in RR Appendices **30** and **30A**, the effect on the network having § 4.1.18 used against it by a later network, as well as the effect of “sensitive parameters” contained in networks in the List, should be taken into account.

§§ 4.1.18-4.1.20 of RR Appendix **30** describes the requirements and conditions for recording in the Regions 1 and 3 List of a network with outstanding coordination requirements.

§ 4.1.18 prescribes that in the case of recording in the List with outstanding coordination requirements, this recording shall be provisional, but that the entry shall be changed from provisional to definitive recording in the List if the Bureau is informed that the new assignment in the Regions 1 and 3 List has been in use, together with the assignment which was the basis for the disagreement, for at least four months without any complaint of harmful interference being made. It was noted during the studies that, while a number of networks have entered the List provisionally through the use of § 4.1.18, the Bureau has never been requested to change a provisional entry to definitive.

§ 4.1.18*bis* prescribes that when entering assignments of a network provisionally into the List, the reference situation of interfered-with networks with which coordination is not completed is not updated. However, RR Appendices 30 and 30A currently do not state whether or not the Bureau should update the reference situation of the network with which there is still outstanding disagreement if the provisionally recorded assignments are changed to definitively recorded.

There may be many reasons why harmful interference does not occur during the first four months of operation, e.g. during this period, the interfered-with network may not operate with its most sensitive characteristics among its assignments in the List (use of larger antennas, modulation/coding that is more robust, e.i.r.p. levels higher than the minimum values, etc.) or the interfering network may not operate with its most interfering characteristics (lower e.i.r.p. levels, transponders with no emissions, steerable beams pointing in another direction, etc.).

However, if at the end of this four-month period, the reference situation of the interfered-with network is updated to incorporate the maximum interference (as contained in the submission to ITU, even if during the four-month period actual operation may have been with parameters causing less interference) from the network to which it has not given its agreement, depending on the situation of the affected network, this could severely affect the reference situation and thereby the protection of the interfered-with network such that later submissions could impose significantly more interference upon the interfered-with network before exceeding the relative degradation which triggers coordination. As a result, the interfered-with network may find itself with reduced protection due to a network which has not completed the required coordination with the interfered-with network and to which it has not given its agreement.

On the other hand, for other affected networks, not updating the reference situation could keep networks at a high reference situation where they would be required to accept higher levels of interference from latecomers than if the reference situation had been updated. For these cases, the interfered-with network may find itself with reduced protection due to a network which has not completed the required coordination with the interfered-with network and to which it has not given its agreement if the reference situation is not updated.

Depending on the initial reference situation of the affected network and what would be the reference situation if taking into account the interference from the network for which the agreement

has not been given, it can be seen that updating or not updating the reference situation can have different effects on its protection against later submissions.

3/7/7.4 Methods to satisfy Issue G

3/7/7.4.1 Method G1

To avoid administrations receiving a reduced protection due to a network to which they have not given their agreement, this method prescribes that when a network has entered into the List using § 4.1.18, and when the recording of the associated assignment transitions from provisional to definitive while there is still disagreement, the reference situation of the interfered-with network should be updated in consultation with, and only with the agreement of, the affected administration. To this effect, this method proposes to modify § 4.1.18*bis* of RR Appendices **30** and **30A**.

3/7/7.4.2 Method G2

Under this method, the core of the current situation would be kept unchanged, however, the application of the provisions in §§ 4.1.18-4.1.20 of RR Appendices **30** and **30A** would be modified to exclude their improper use. This method is based upon the following points:

- 1) With technology evolving, the cases of the findings of the BR for the need of coordination based on unrealistic analyses results will increase.
- 2) This discrepancy can be removed only by revising the reference values of the basic parameters of BSS systems. Meanwhile, it is not acceptable for new networks to have no possibility to be included definitively in the Lists based on unrealistic analyses results.
- 3) Realizing that §§ 4.1.18-4.1.20 are of a particular importance in case the disagreement is not based on a real concern of interference impact, but rather to prevent appearance of new entrant on the market of satellite services, the efforts have to be directed to prevent from unacceptable consequences the networks identified as potentially affected. Such an approach will be more constructive and consistent with the Resolution **2 (Rev.WRC-03)**, Resolution **80 (Rev.WRC-07)**, Article 44 of the Constitution, the main principle of the RR, etc. allowing frequency-orbital resources for Regions 1 and 3 to be used for BSS networks of new operators.
- 4) One of the measures should be that the continuing disagreement has to be proven through providing proper correspondence and/or meetings for coordination.
- 5) Another necessary measure should be the requirement that both the existing and new incoming systems should operate with their notified parameter values.
- 6) The third measure related to the reference situation update would be the restriction of EPM degradation value up to 5 dB allowing the application of the provisions in §§ 4.1.18-4.1.20.

Considerations and calculations were presented about the appropriate value of EPM degradation limit for entering provisionally in the Lists. An analysis regarding the discrepancy between the interference impact calculated by MSPACEg and the protection requirements of a typical BSS network, with example MODCOD QPSK3/4, was submitted. The key assumptions of this analysis were: i) as the interference impact exhibits a long-term effect it should be calculated during the available time of the links, ii) both wanted and interfering signals were assumed to be digital with noise-like equalized spectrum, iii) with error correction coding, less than 1 dB margin above C/N threshold is needed to operate effectively. The analysis concluded that, for the particular case analysed, an EPM degradation of about 5 dB should be tolerable, however, it was also noted that the value of the tolerable EPM degradation has to be arrived at through a trade-off between three

considerations: i) allowance to enter assignments provisionally in the List, ii) the discrepancy between MSPACEg interference results and the real case-by-case interference impact when accounting for a real network protection requirements and iii) the consequences for the interfered-with network after updating the reference situation in case of successful measurements, which is closely related to the previous two points.

3/7/7.4.3 Method G3

The EPM criterion contributes to alleviate the problem of “sensitive satellite network” having very low transmitting power. In not updating the reference EPM for a “sensitive satellite network” with still not having a very low reference EPM, this network would continue to enjoy a higher degree of sensitivity against later submissions and, in respect of the EPM criterion, triggering more coordination than if the reference EPM was updated.

The current provisions of RR Appendices **30** and **30A** contribute to update the reference EPM of satellite networks including “sensitive satellite networks”, therefore, this method prescribes that the current provisions in §§ 4.1.18-4.1.20 of RR Appendices **30** and **30A** should be kept unchanged.

3/7/7.5 Regulatory and procedural considerations for Issue G

3/7/7.5.1 Method G1

APPENDIX 30 (REV.WRC-15)*

Provisions for all services and associated Plans and List¹ for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3³

4.1 Provisions applicable to Regions 1 and 3

MOD

4.1.18*bis* When requesting the application of § 4.1.18, the notifying administration shall undertake to meet the requirements of § 4.1.20 and provide to the administration in respect of which § 4.1.18 is applied, with a copy to the Bureau, a description of the steps by which it undertakes to meet these requirements. Once an assignment is entered in the List provisionally under the provisions of § 4.1.18, the calculation of the equivalent protection margin (EPM)⁹ of an assignment in the Regions 1 and 3 List or for which the procedure of Article 4 has been initiated and which was the basis for the disagreement shall not take into account the interference produced by the assignment for which the provisions of § 4.1.18 have been applied. When the recording of an assignment entered into the List is changed from provisional to definitive in accordance with § 4.1.18, but there is still continuing disagreement between the administrations, the Bureau will consult with the administration responsible for the assignments which were the basis for the disagreement and will only update the EPM to take into account interference produced by the assignment for which the provisions of § 4.1.18 have been

applied with the agreement of the administration responsible for the assignments which were the basis for the disagreement. (WRC-0319)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3³

4.2 Provisions applicable to Region 2

NOC

4.2.21A

APPENDIX 30A (REV.WRC-15)*

Provisions and associated Plans and List¹ for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz² and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-03)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 feeder-link Plan or for additional uses in Regions 1 and 3

4.1 Provisions applicable to Regions 1 and 3

MOD

4.1.18bis When requesting the application of § 4.1.18, the notifying administration shall undertake to meet the requirements of § 4.1.20 and provide to the administration in respect of which § 4.1.18 is applied, with a copy to the Bureau, a description of the steps by which it undertakes to meet these requirements. Once an assignment is entered in the feeder-link List provisionally under the provisions of § 4.1.18, the calculation of the equivalent protection margin (EPM)¹¹ of an assignment in the Regions 1 and 3 feeder-link List or for which the procedure of Article 4 has been initiated and which was the basis for the disagreement shall not take into account interference produced by the assignment for which the provisions of § 4.1.18 have been applied. When the recording of an assignment entered into the List is changed from provisional to definitive in accordance with § 4.1.18, but there is still continuing disagreement between the administrations, the Bureau will consult with the administration responsible for the assignments which were the basis for the disagreement and will only update the EPM to take into account interference produced by the assignment for which the provisions of § 4.1.18 have been applied with the agreement of the

administration responsible for the assignments which were the basis for the disagreement. (WRC-03/19)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 feeder-link Plan or for additional uses in Regions 1 and 3

4.2 Provisions applicable to Region 2

NOC

4.2.21A

3/7/7.5.2 Method G2

APPENDIX 30 (REV.WRC-15)*

Provisions for all services and associated Plans and List¹ for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3³

4.1 Provisions applicable to Regions 1 and 3

MOD

4.1.18 If, in spite of the application of § 4.1.16 and 4.1.17, there is still continuing disagreement proven by correspondence^{ADDXX} and the assignment which was the basis of the disagreement is not an assignment in the Regions 1 and 3 Plan, or in the Region 2 Plan or for which the procedure of § 4.2 has been initiated, and if the notifying administration insists that the proposed assignment be included in the Regions 1 and 3 List if the EPM degradation is less than 5 dB, the Bureau shall provisionally enter the assignment in the Regions 1 and 3 List with an indication of those administrations whose assignments were the basis of the disagreement; however, the entry shall be changed from provisional to definitive recording in the List only if the Bureau is informed that the new assignment in the Regions 1 and 3 List has been in use, together with the assignment which was the basis for the disagreement, and both assignments have been in operation with the

^{XX} Three or more attempts to obtain agreement by correspondence and/or by meetings including the assistance by the Bureau. (WRC-19)

notified parameter values^{ADDYY} for at least four months without any complaint of harmful interference being made. (WRC-03¹⁹)

MOD

4.1.18*bis* When requesting the application of § 4.1.18, the notifying administration shall undertake to meet the requirements of § 4.1.20 and provide to the administration in respect of which § 4.1.18 is applied, with a copy to the Bureau, a description of the steps by which it undertakes to meet these requirements^{ADDZZ}. Once an assignment is entered in the List provisionally under the provisions of § 4.1.18, the calculation of the equivalent protection margin (EPM)⁹ of an assignment in the Regions 1 and 3 List or for which the procedure of Article 4 has been initiated and which was the basis for the disagreement shall not take into account the calculated interference ~~produced by~~ impact due to the assignment for which the provisions of § 4.1.18 have been applied. (WRC-03¹⁹)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3³

4.2 Provisions applicable to Region 2

NOC

4.2.21A

^{YY} This shall be proven by measurement results sent to the Bureau. The procedure is subject to draft new Resolution [A7(G)-YYY] (WRC-19). (WRC-19)

^{ZZ} They shall be proven by measurement results sent to the Bureau. The procedure is subject to draft new Resolution [A7(G)-YYY] (WRC-19). (WRC-19)

APPENDIX 30A (REV.WRC-15)*

Provisions and associated Plans and List¹ for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz² and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-03)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 feeder-link Plan or for additional uses in Regions 1 and 3

4.1 Provisions applicable to Regions 1 and 3

MOD

4.1.18 If, in spite of the application of § 4.1.16 and 4.1.17, there is still continuing disagreement proven by correspondence^{ADDXX1} and the assignment which was the basis of the disagreement is not an assignment in the Regions 1 and 3 Plan, or in the Region 2 Plan or for which the procedure of § 4.2 has been initiated, and if the notifying administration insists that the proposed assignment be included in the Regions 1 and 3 feeder-link List if the EPM degradation is less than 5 dB, the Bureau shall provisionally enter the assignment in the Regions 1 and 3 feeder-link List with an indication of those administrations whose assignments were the basis of the disagreement; however, the entry shall be changed from provisional to definitive recording in the feeder-link List only if the Bureau is informed that the new assignment in the Regions 1 and 3 feeder-link List has been in use, together with the assignment which was the basis for the disagreement, and both assignments have been in operation with the notified parameter values^{ADDYY1} for at least four months without any complaint of harmful interference being made. (WRC-03¹⁹)

MOD

4.1.18bis When requesting the application of § 4.1.18, the notifying administration shall undertake to meet the requirements of § 4.1.20 and provide to the administration in respect of which § 4.1.18 is applied, with a copy to the Bureau, a description of the steps by which it undertakes to meet these requirements^{ADDZZ1}. Once an assignment is entered in the feeder-link List provisionally under the provisions of § 4.1.18, the calculation of the equivalent protection margin (EPM)¹¹ of an assignment in the Regions 1 and 3 feeder-link List or for which the procedure of Article 4 has been initiated and which was the basis for the disagreement shall not take into account calculated

^{XX1} Three or more attempts to obtain agreement by correspondence and/or by meetings including the assistance by the Bureau. (WRC-19)

^{YY1} This shall be proven by measurement results sent to the Bureau. The procedure is subject to draft new Resolution [A7(G)-YYY] (WRC-19). (WRC-19)

^{ZZ1} This shall be proven by measurement results sent to the Bureau. The procedure is subject to draft new Resolution [A7(G)-YYY] (WRC-19). (WRC-19)

interference ~~impact due to produced by~~ the assignment for which the provisions of § 4.1.18 have been applied. (WRC-03~~19~~)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 feeder-link Plan or for additional uses in Regions 1 and 3

4.2 Provisions applicable to Region 2

NOC

4.2.21A

ADD

DRAFT NEW RESOLUTION [A7(G)-YYY] (WRC-19)

Relating to the procedure for application of the provisions in §§ 4.1.18 and 4.1.18*bis*** in Article 4 of Appendices 30 and 30A**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that the provisions in §§ 4.1.18 and 4.1.18***bis*** in Article 4 of Appendices 30 and 30A are giving an opportunity to assignments identified as potentially affected to enter definitively in the Appendices 30 and 30A Lists for Regions 1 and 3 to obtain protection from the new submitted assignments in case of continuing disagreement;
- b)* that the provisions in §§ 4.1.18 and 4.1.18***bis*** in Article 4 of Appendices 30 and 30A are not enough defined in their details and this gives rise to some uncertainty in their application from one side and creates an opportunity for manipulation of the measurement results on the other;
- c)* that there is an increasing need for specifying a clear guidance for the application of the provisions, defined in *considering a)* in order that any suspicion in their improper use be avoided,

considering further

- a)* that it is not realistic that the provisions in §§ 4.1.18 and 4.1.18***bis*** in Article 4 of Appendices 30 and 30A be applied at high levels of identified EPM (equivalent protection margin) degradation;
- b)* that it is not acceptable to apply the provisions in §§ 4.1.18 and 4.1.18***bis*** in Article 4 of Appendices 30 and 30A if there has been no demonstration of continuing disagreement by the administration(s) identified as potentially affected,

noting

- a) that there is an increasing overload of BSS planned frequency bands in some part of the geostationary orbit because of the numerous BSS networks for additional use submitted under the provisions of Article 4 of Appendices 30 and 30A;
- b) that many national assignments in the BSS and FL Plans are blocked by closely situated networks for additional use of the planned frequency bands;
- c) that there are administrations which are not keen to give coordination agreement even for a very low excess of the coordination criteria, in this case of EPM degradation;
- d) that continuously evolving progress in technologies related to the BSS networks leads to increasing remoteness of real system capabilities to deal with interference from the technical parameters of the BSS networks in Appendices 30 and 30A on the basis of which the need for coordination is identified by the Radiocommunication Bureau,

recognizing

- a) that there is in Appendix 10 of the Radio Regulations a description of some parameters of mainly terrestrial stations for measurement purposes and by the view of interference impact;
- b) that there is some guidance in Report ITU-R SM.2181 for presentation of the measurement results of emissions from space stations that can be used for description of measured parameter values for the purpose of §§ 4.1.18 and 4.1.18bis,

resolves

that an administration may submit a request for provisions of § 4.1.18 to be applied to its BSS/FL network in case:

- a) this network is identified as affecting but causing EPM degradation of no more than 5 dB of the reference situation at any test point of other BSS/FL network(s), and
- b) continuing disagreement is available with the notifying administration of the identified as potentially affected BSS/FL network(s) proven by at least three letters/faxes or coordination meetings with a proposal to this administration for coordination agreement sent by the notifying administration of the network identified as potentially affecting.

ANNEX TO DRAFT NEW RESOLUTION [A7(G)-YYY] (WRC-19)

1 An administration which assignment(s) is included provisionally in the Regions 1 and 3 List of Appendix 30 or 30A as a result of a request for application of the provisions of § 4.1.18 wishing to change the recording from provisional to definitive recording in the List has to provide for transmission of this assignment under the following conditions:

- 1.1 informs the notifying administration(s) of the potentially affected network(s), with a copy to the Bureau, for the time period, which has to be at least four months, intended to carry out transmission of assignment(s) identified as potentially affecting, indicating exactly which of them will be the subject of transmission;
- 1.2 both or all involved administrations must provide transmission of the specified assignment(s) during the agreed time period with the notified values of its parameters;

- 1.3 at the end of the agreed time period a report¹ has to be prepared and sent to the Radiocommunication Bureau by the initiating administration comprising information of:
- a) e.i.r.p. value of the transmitted assignment(s) wishing to be definitively recorded in the List, beginning with 10 dB lower than and increasing up to the notified values of e.i.r.p. observing the requirements in § 4.1.20 to avoid harmful interference to any recorded assignment in the Master Register;
 - b) measured carrier levels at the output of the receiving antenna with notified parameters at at least three different points in the service area(s) of the assignments of the network identified as potentially affecting and the network(s) identified as potentially affected, subject to continuing disagreement from its notifying administrations;
 - c) measured values of any other network-related parameters aiming to prove that the assignment subject to the submission under the provisions of § 4.1.18 has no interference impact on the network(s) identified as potentially affected as measured C/N , $C/(N+I)$, BER, etc. for the emission(s) of this network at several levels of e.i.r.p. of the subject assignment;
- 1.4 the Radiocommunication Bureau has to examine the submitted measurement report and if no degradation of the reception of the emission(s) of the network assignment(s) identified as potentially affected is found, the Bureau shall continue as in § 4.1.18 with the updating of the reference situation of the corresponding assignment(s) of this network(s) and to convert the provisional status in the Regions 1 and 3 List(s) of the assignment(s) identified as potentially affecting and which is the subject to the measurement report into definitive recording.

3/7/7.5.3 Method G3

APPENDIX 30 (REV.WRC-15)*

Provisions for all services and associated Plans and List¹ for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3³

4.1 Provisions applicable to Regions 1 and 3

NOC

4.1.18

¹ Refer to Appendix 10 and Report ITU-R SM.2181.

NOC

4.1.18*bis*

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3³

4.2 Provisions applicable to Region 2

NOC

4.2.21A

APPENDIX 30A (REV.WRC-15)*

Provisions and associated Plans and List¹ for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz² and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-03)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 feeder-link Plan or for additional uses in Regions 1 and 3

4.1 Provisions applicable to Regions 1 and 3

NOC

4.1.18

NOC

4.1.18*bis*

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan
or for additional uses in Regions 1 and 3**

4.2 Provisions applicable to Region 2

NOC

4.2.21A

Agenda item 7(H)

3/7/8 Issue H – Modifications to RR Appendix 4 data items to be provided for non-geostationary satellite systems

3/7/8.1 Executive summary

Issue H consolidates three different issues that were developed during the ITU-R preparatory process for WRC-19 agenda item 7. Issue H relates to the need to ensure that enough RR Appendix 4 data items are provided to facilitate modelling non-geostationary (non-GSO) satellite systems in order for:

- the administrations to be able to identify the potential impacts of these systems on their own systems and to formulate their comments to the notifying administration and the Radiocommunication Bureau based on the advance publication information (API) in the case of frequency assignments to non-geostationary satellite systems not subject to coordination under Section II of RR Article 9 (see No. 9.3) or the Coordination Request (CR/C) in the case of frequency assignments to non-GSO satellite systems subject to Section II of RR Article 9 (see No. 9.52), or,
- the Radiocommunication Bureau to be able to perform an examination with respect to the compliance with the RR Article 22 epdf limits based on the latest version of the algorithm contained in Recommendation ITU-R S.1503.

As a result, ITU-R identified a single method to address this Issue. This method proposes:

- to extend the requirement to provide items for frequency assignments of non-GSO systems in frequency bands subject to coordination under Section II of RR Article 9 of RR Appendix 4 parameters (namely the right ascension of the ascending node, the longitude of the ascending node and the associated date and time, the argument of the perigee) to API and notification filings for frequency assignments to non-GSO systems in frequency bands not subject to coordination under Section II of RR Article 9. Those requirements would apply only for non-GSO systems, for which the relative distribution of the orbital planes and satellites is known, identified by additional RR Appendix 4 data items. It is also proposed to add new RR Appendix 4 data items for frequency assignments to non-GSO systems in frequency bands not subject to coordination under Section II of RR Article 9: mandatory items, identifying whether the orbit is sun-synchronous or not, and optional items, providing the local time of the ascending node (LTAN) for sun-synchronous orbits;
- to add new RR Appendix 4 data items: an indicator of whether all of the orbital planes define a single non-GSO system or multiple mutually exclusive configurations and in the case of the latter, another RR Appendix 4 data item for the number of mutually exclusive configurations and another RR Appendix 4 data item for the provision of an exhaustive list of the potential orbital plane configurations;
- changes to RR Appendix 4 data items as a consequence of the revision of Recommendation ITU-R S.1503 to improve the ability to define sub constellations with different sets of parameters per sub constellation (e.g. minimum angle to the GSO arc that varies by orbit plane), the ability to define different sets of system operating parameters by frequency band and provide additional degrees of flexibility in existing fields (e.g. possibility of having the minimum elevation angle varying by latitude and azimuth).

3/7/8.2 Background

The RR Appendix 4 items provided in the various notices published in the BR IFIC are used for multiple purposes. In APIs for frequency assignments to non-GSO networks or systems not subject to coordination under Section II of RR Article 9, this information is typically used by administrations to identify potential interference scenarios to their existing and planned systems and to formulate their comments under RR No. 9.3. In the CR/Cs, for frequency assignments to non-GSO networks or systems subject to coordination under Section II of RR Article 9, this information is used first by the Radiocommunication Bureau to perform the relevant examination including compliance with the RR Article 22 epfd limits and publish its findings in the BR IFIC for administrations to identify/validate potential interference scenarios to their existing and planned systems and to formulate their comments under RR No. 9.52. Recent analysis performed for non-GSO satellite networks or systems based on APIs and CR/Cs as published in the Radiocommunication Bureau International Frequency Information Circular (BR IFIC) have shown that, in some instances, there is a need for additional information in order to properly model the non-GSO satellite systems. Some of these analyses have also led to the revision of Recommendation ITU-R S.1503 with the modifications of input parameters required by the algorithm used by the Radiocommunication Bureau to determine whether a non-GSO FSS system or network meets the equivalent power flux-density (epfd) limits in RR Article 22. To realize the benefits of the revisions to this Recommendation (i.e. increased flexibility for non-GSO system operators to model their non-GSO satellite systems), it is necessary for the input data to be available, and to ensure this can occur this data should be reflected in RR Appendix 4.

3/7/8.3 Summary and analysis of the results of ITU-R studies

3/7/8.3.1 Summary and analysis of the results of ITU-R studies relating to API to frequency assignments to non-GSO satellite systems not subject to formal coordination

Frequency assignments to a non-GSO network or system for which an API is required are not subject to the procedures of Section II in RR Article 9. However, any affected administration shall communicate their concerns with respect to any anticipated interference involving any of its existing or planned systems in accordance with RR No. 9.3. The formulation of these concerns requires modelling the orbit of the non-GSO satellites for the identification of potential interference scenarios.

In general, to model a satellite orbit, a set of parameters typically referred to as the classical orbital elements are required, as follows:

- 1) semimajor axis (a);
- 2) eccentricity (ϵ);
- 3) inclination angle (i);
- 4) right ascension of the ascending node (Ω), the point where the satellite crosses the equatorial plane in the south-to-north direction;
- 5) argument of the perigee (ω), the angle between the ascending node and the perigee, measured in the orbital plane in the direction of the motion;
- 6) epoch time (t), is the time at which the orbital elements are observed, and
- 7) mean anomaly (M), gives the position of the satellite in its orbital path.

The first two parameters relate to the shape of the orbit. The third, fourth and fifth elements relate to the orientation of the orbit with respect to the Earth. The seventh element relates to the actual position of the satellite in the orbit. Furthermore, some of these elements (including Ω , ω and M) are time-dependent and specifically associated with an epoch time.

Under the current RR Appendix 4, each API shall contain information about the following RR Appendix 4 items:

- Item A.4.b.4.a, the angle of inclination of the orbital plane with respect to the Earth's equatorial plane;
- Item A.4.b.4.c, the period;
- Item A.4.b.4.d, the altitude, in kilometres, of the apogee of the space station, and
- Item A.4.b.4.e, the altitude, in kilometres, of the perigee of the space station.

These RR Appendix 4 items provide information on the shape of the orbit but not the complete information on the actual orientation of the orbit with respect to the Earth. In fact, of the four RR Appendix 4 items referred to above, only one of the three parameters required to define the orientation of the satellite orbit with respect to the Earth is provided (i.e. the angle of inclination of orbital planes).

In order to assess the impact of such limited information on the ability to properly model a non-GSO satellite orbit, there is a need to consider the different type of orbits case-by-case.

Case 1: API for non-GSO satellites with a circular orbit

In the case of a circular orbit, characterized by a constant altitude, there is no perigee and, as a result, information about the argument of the perigee is not relevant.

The right ascension of the ascending node (RAAN) appears to be important in the case of a repeating ground track orbit. In this case, the non-GSO satellite passes periodically over the same locations on the globe. For other types of non-GSO circular orbits, the RAAN may not be critical for the identification of potential interference scenarios. However, it may play a more fundamental role in the detailed discussions amongst administrations/operators during the coordination process.

In the case of a constellation of non-GSO satellites with a circular orbit, additional information is required to properly model the constellation. This includes:

- 1) the distribution of the orbital planes around the Earth;
- 2) the distribution of the non-GSO satellites within each plane, and
- 3) the phasing between satellites in adjacent planes.

However, we note that in the current RR Appendix 4, the additional information referred to above, could be derived from the CR/C. To illustrate, the inclusion of the RAAN for each orbital plane (item A.4.b.5.a of RR Appendix 4) in the CR/C provides sufficient information to conclude on the distribution of the orbital planes around the Earth. The same conclusion applies for the initial phase angle for each satellite of the constellation (item A.4.b.5.b of RR Appendix 4) with respect to the distribution of the non-GSO satellites within each plane and the phasing between non-GSO satellites in adjacent planes. As a result, the extension of the requirement to provide items A.4.b.5.a and A.4.b.5.b in APIs appears to be a potential option. However, as indicated earlier, some of these RR Appendix 4 data elements (e.g. the RAAN) are associated to an epoch time and, as such, are not time invariant. In fact, the requirement to provide the RAAN for each plane at an early stage of the system design and prior to their launch appears to be problematic. As an alternative to the RAAN, it may be possible to use the longitudes of the ascending node for all orbital planes given at the same reference time (no need to provide a specific date or a specific time at the location corresponding to the longitudes of the ascending node). It is noted that this item already exists in RR Appendix 4 and is required for the calculations of the epfd in some frequency bands (see item A.4.b.6.g).

It should be noted that provision of the additional information on orbit parameters is only possible for constellation-type non-GSO systems, for which the relative distribution of the orbital planes and

satellites is known. For some cases, when non-GSO systems contain a set of typical orbits implemented on a case-by-case basis, the relative distribution of the orbital planes and satellites could not be described (i.e. TT&C systems for launch vehicles with different trajectories, manned missions, etc.).

Case 2: API for non-GSO satellites with a highly elliptical orbit (HEO)

The HEO type of orbit for a non-GSO system is generally selected to ensure that the satellite system to be launched will have some very specific attributes, such as the ability to cover certain specific land mass or other portions of the Earth. In this context, the orbital characteristics related to the orientation of the orbital planes, including the RAAN and the argument of the perigee, cannot all be randomly selected.

In a relatively recent BR IFIC (# 2833), an API was filed for a HEO system with the following orbital characteristics:

- A.4.b.4.a, the angle of inclination of the orbital plane with respect to the Earth equatorial plane: 63.435 degrees;
- A.4.b.4.c, the period: 17 hours and 47 minutes;
- A.4.b.4.d, the altitude in kilometres of the apogee of the space station: 53 795 km;
- A.4.b.4.e, the altitude in kilometres of the perigee of the space station: 26 313.4 km.

It is important to note that, in theory, there is a limitless number of non-GSO satellite orbits that can be derived from this information resulting from the multiple combinations of RAAN (that can vary from 0 to 360 degrees) and the argument of the perigee (that can vary from 0 to 360 degrees). However, as for the circular orbit, the RAAN would be critical in case of a repeating ground track. For other types of HEO orbits, the RAAN may not be critical for the identification of potential interference scenario. As for Case 1 above, an alternative to the RAAN could be the longitudes of the ascending node for all of the orbital planes at the same reference time, removing the need to provide a specific date or a specific time at the location corresponding to the longitudes of the ascending node.

The argument of the perigee provides administrations with critical information on the positioning of the Earth with respect to the two focuses of the ellipse describing the trajectory of the HEO satellite. To illustrate, in the context of the example referred above, an argument of the perigee of 90 degrees will indicate an intention to provide radiocommunication services in the Southern hemisphere while an argument of the perigee of 270 degrees will be for services in the Northern hemisphere.

Adding the argument of the perigee to the list of RR Appendix 4 items to be provided in APIs will certainly help potentially affected administrations to formulate their comments without creating too much burden for the notifying administration.

It was noted that HEO non-GSO systems are usually used for radiocommunication services providing instantaneous coverage, and therefore also represent a constellation of several satellites.

In order to address this aspect of Issue H and avoid complex modifications to RR Appendix 4, it may be advisable to simply extend the current requirements to provide items A.4.b.5.b (initial phase angle at a reference time), A.4.b.5.c (argument of the perigee) and the longitude of the ascending node for all orbital planes at a reference time (see A.4.b.6.g) to APIs for frequency assignments to non-GSO systems in frequency bands not subject to coordination under Section II of RR Article 9.

3/7/8.3.2 Summary and analysis of the results of ITU-R studies relating to frequency assignments to non-GSO satellites systems with multiple orbital planes²⁷

Under the current RR Appendix 4, frequency assignments can be linked to multiple orbital planes in a single API or CR/C, as appropriate. Therefore, the challenge for potentially affected administrations is to be able to determine if the API or CR/C is:

- describing a single non-GSO system, or
- describing the multiple potential configurations of a single non-GSO system to be implemented.

To illustrate the bullets above, in an API or CR/C filing containing four orbital planes, the goal of the operator may be to implement:

- a non-GSO system consisting of all the orbital planes;
- a non-GSO system consisting of only one of the four orbital planes, or
- a non-GSO system consisting of any grouping of the orbital planes provided in the filing.

Ultimately, the various implementation plans have to be communicated to the Bureau. Under the current practice, the Radiocommunication Bureau is seeking this information from the notifying administration by letters after the receipt of an API or a CR/C filing containing multiple orbital planes.

One potential improvement may consist in providing the relevant information in the initial submission to the Radiocommunication Bureau to avoid unnecessary correspondence amongst the involved parties.

3/7/8.3.3 Summary and analysis of the results of ITU-R studies relating to frequency assignments to non-GSO satellites systems subject to the RR Article 22 epfd limits

Modifications to RR Appendix 4 in consequence of the revision of Recommendation ITU-R S.1503 were studied by the ITU-R and tables showing an agreed set of changes were developed.

3/7/8.4 Method to satisfy Issue H

Under this method it is proposed to:

- extend the requirement to provide the following items in RR Appendix 4 for APIs and notifications for frequency assignments to non-GSO systems in frequency bands not subject to coordination under Section II of RR Article 9:
 - Items A.4.b.5.b (initial phase angle at a reference time) and A.4.b.5.c (argument of the perigee, which can be set to 0 for any circular or equatorial orbits). It should be noted that these items are currently required for CR/Cs for frequency assignments to non-GSO systems in frequency bands subject to coordination under Section II of RR Article 9.
 - Item A.4.b.6.g (longitudes of the ascending node for all orbital planes will be required at the same reference time). It should be noted that this item is currently required for the evaluation of the epfd in some frequency bands. Furthermore, although there is a requirement to provide a date and a time in association with this item (see items A.4.b.6.h and A.4.b.6.i), it does not appear to be critical in

²⁷ This section applies to both frequency assignments to non-GSO satellite systems subject to and not subject to Section II of RR Article 9 as represented in their API and CR/C respectively.

the assessment of the epfd nor the identification of potential scenario of interference. As a result, the longitude of the ascending node does not have to be associated with a specific date and time to be useful for modelling non-GSO systems as long as the same reference time is used when providing this information (i.e.: the longitude of the ascending node at the reference time $t = 0$ without further indication).

The above items would only be mandatory for constellation-type non-GSO systems, as shown by a new RR Appendix 4 item.

- add the following new items in RR Appendix 4 for APIs and notifications for frequency assignments to non-GSO systems in frequency bands not subject to coordination under Section II of RR Article 9:
 - new mandatory item, identifying whether the orbit is sun-synchronous or not;
 - new optional item, providing the local time of the ascending node (LTAN) for sun-synchronous orbits.
- add new items in RR Appendix 4 for the provision of information relating to the multiple orbital planes and their relationship with respect to the non-GSO system:
 - an indicator of whether all of the orbital planes identified under A.4.b.1 describe a single configuration where all frequency assignments to the satellite system will be in use, or multiple mutually exclusive configurations identified at the coordination stage with the expectation to select a single configuration at the notification stage. This new item is required for both APIs and CR/Cs as appropriate, when the filing contains more than one orbital plane, and,
 - in case the number of orbital planes identified under A.4.b.1 describe multiple mutually exclusive configurations, a new item for the number of mutually exclusive configurations, and a new item allowing for the identification of the orbital planes that are associated with each of the mutually exclusive configurations. This new item is required for both APIs and CR/Cs as appropriate, only if the proposed new item A.4.b.1.a is different from 1 and the multiple-planes are meant to define a constellation of non-GSO satellites.
- add new RR Appendix 4 data items or modify existing ones to implement changes associated with the revision of Recommendation ITU-R S.1503.

3/7/8.5 Regulatory and procedural considerations for Issue H

APPENDIX 4 (REV.WRC-15)

Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III

ANNEX 2

Characteristics of satellite networks, earth stations or radio astronomy stations² (Rev.WRC-12)

Footnotes to Tables A, B, C and D

MOD

TABLE A
GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,
EARTH STATION OR RADIO ASTRONOMY STATION (Rev.WRC-~~15~~19)

| Items in Appendix | A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION | Advance publication of a geostationary-satellite network | Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9 | Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9 | Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A) | Notification or coordination of a non-geostationary-satellite network | Notification or coordination of an earth station (including notification under Appendices 30A or 30B) | Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5) | Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5) | Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8) | Items in Appendix | Radio astronomy |
|---------------------------|--|--|--|--|--|---|---|---|--|---|---------------------------|-----------------|
| A.4.b | For space station(s) onboard non-geostationary satellite(s): | | | | | | | | | | A.4.b | |
| A.4.b.1 | the number of orbital planes | | | X | | X | | | | | A.4.b.1 | |
| A.4.b.1.a | <u>Indicator of whether the non-geostationary satellite system represents a “constellation”, where a term “constellation” describes a satellite system, for which the relative distribution of the orbital planes and satellites is defined.</u> <u>Note – Non-geostationary satellite systems in frequency bands subject to the provisions of Nos. 9.12, 9.12A, 22.5C, 22.5D or 22.5F are always considered as “constellations”.</u> | | | X | | X | | | | | A.4.b.1.a | |
| A.4.b.1.b | <u>Indicator of whether all the orbital planes identified under A.4.b.1 describe a) single configuration where all frequency assignments to the satellite system will be in use, or b) multiple configurations are mutually exclusive where a sub-set of the frequency assignments to the satellite system will be in use on one of the sub-sets of orbital parameters to be determined at the notification and recording stage of the satellite system</u> <u>Required only for the:</u> <u>1) advance publication information of a non-geostationary satellite system representing a constellation (A.4.b.1.a), and</u> <u>2) coordination request of non-geostationary-satellite systems</u> | | | + | | + | | | | | A.4.b.1.b | |

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|---------------------------|---|--|--|--|--|---|---|---|--|---|---------------------------|-----------------|
| A.4.b.1.c | <u>In case the orbital planes identified under A.4.b.1 describe multiple mutually exclusive configurations, identification of the number of sub-sets of orbital characteristics that are mutually exclusive</u> <u>Required only for the:</u> <u>1) advance publication information of a non-geostationary satellite system representing a constellation (A.4.b.1.a), and</u> <u>2) coordination request for non-geostationary-satellite systems</u> | | | ± | | ± | | | | | A.4.b.1.c | |
| A.4.b.1.d | <u>In case the orbital planes identified under A.4.b.1.b describe multiple mutually exclusive configurations, identification of the orbital planes id numbers that are associated with each of the mutually exclusive configurations</u> <u>Required only for the:</u> <u>1) advance publication information of a non-geostationary satellite system representing a constellation (A.4.b.1.a), and</u> <u>2) coordination request of non-geostationary satellite systems</u> | | | ± | | ± | | | | | A.4.b.1.d | |
| A.4.b.2 | the reference body code | | X | X | | X | | | | | A.4.b.2 | |
| A.4.b.3 | For space stations of a non-geostationary fixed-satellite service system operating in the <u>frequency</u> band 3 400-4 200 MHz: | | | | | | | | | | A.4.b.3 | |
| A.4.b.3.a | the maximum number of space stations (N_M) in a non-geostationary-satellite system simultaneously transmitting on a co-frequency basis in the fixed-satellite service in the Northern Hemisphere | | | X | | X | | | | | A.4.b.3.a | |
| A.4.b.3.b | the maximum number of space stations (N_S) in a non-geostationary-satellite system simultaneously transmitting on a co-frequency basis in the fixed-satellite service in the Southern Hemisphere | | | X | | X | | | | | A.4.b.3.b | |
| A.4.b.4 | For each orbital plane, where the Earth is the reference body: | | | | | | | | | | A.4.b.4 | |
| A.4.b.4.a | the angle of inclination (i_j) of the orbital plane with respect to the Earth's equatorial plane ($0^\circ \leq i_j < 180^\circ$) | | | X | | X | | | | | A.4.b.4.a | |

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|-------------------|---|--|--|--|--|---|---|---|--|---|-------------------|-----------------|
| A.4.b.4.b | the number of satellites in the orbital plane | | | X | | X | | | | | A.4.b.4.b | |
| A.4.b.4.c | the period | | | X | | X | | | | | A.4.b.4.c | |
| A.4.b.4.d | the altitude, in kilometres, of the apogee of the space station | | | X | | X | | | | | A.4.b.4.d | |
| A.4.b.4.e | the altitude, in kilometres, of the perigee of the space station | | | X | | X | | | | | A.4.b.4.e | |
| A.4.b.4.f | the minimum altitude of the space station above the surface of the Earth at which any satellite transmits | | | X | | X | | | | | A.4.b.4.f | |
| A.4.b.4.g.a | the right ascension of the ascending node (Ω_j) for the j -th orbital plane, measured counter-clockwise in the equatorial plane from the direction of the vernal equinox to the point where the satellite makes its South-to-North crossing of the equatorial plane ($0^\circ \leq \Omega_j < 360^\circ$), <u>determined at the reference time indicated in A.4.b.4.k and A.4.b.4.l.</u> <u>Required only for space stations operating in a frequency band subject to the provisions of Nos. 9.12 or 9.12A</u> <u>Note – All satellites in all orbital planes must use the same reference time. If no reference time is provided in A.4.b.4.k and A.4.b.4.l, it is assumed to be $t = 0$</u> | | | | | ±X | | | | | A.4.b.4.g.a | |
| A.4.b.4.h.b | the initial phase angle (ω_i) of the i -th satellite in its orbital plane at reference time $t = 0$, measured from the point of the ascending node ($0^\circ \leq \omega_i < 360^\circ$) <u>Required only in case of a non-geostationary satellite system representing a “constellation” (A.4.b.1.a), and to be specified in:</u> <u>1) the Advanced Publication (API), for any frequency assignment not subject to the provisions of Section II of Article 9</u> <u>2) the Coordination Request (CR/C), for any frequency assignment subject to the provisions of Nos. 9.12, 9.12A, 22.5C, 22.5D or 22.5F</u> <u>3) the Notification, in all cases</u> <u>Note – The initial phase angle is the argument of perigee plus the true anomaly</u> | | | ± | | ±X | | | | | A.4.b.4.h.b | |

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|--|--|--|--|--|--|---|---|---|--|---|--|-----------------|
| A.4.b.4 <i><u>5</u></i> .i <i><u>e</u></i> | <p>the argument of perigee (ω_p), measured in the orbital plane, in the direction of motion, from the ascending node to the perigee ($0^\circ \leq \omega_p < 360^\circ$)</p> <p><u>Required only for orbits of a “constellation” (A.4.b.1.a) where the altitudes of apogee and perigee (A.4.b.4.d and A.4.b.4.e) are different and to be specified in:</u></p> <ul style="list-style-type: none"> – <u>the Advanced Publication (API), for any frequency assignment not subject to the provisions of Section II of Article 9</u> – <u>the Coordination Request (CR/C), for any frequency assignment subject to the provisions of Nos. 9.12, 9.12A, 22.5C, 22.5D or 22.5F</u> – <u>the Notification, in all cases</u> | | | ± | | ± X | | | | | A.4.b.4 <i><u>5</u></i> .i <i><u>e</u></i> | |
| A.4.b.4.j | <p><u>the longitude of the ascending node (θ_j) for the j-th orbital plane, measured counter-clockwise in the equatorial plane from the Greenwich meridian to the point where the satellite orbit makes its South-to-North crossing of the equatorial plane ($0^\circ \leq \theta_j < 360^\circ$)</u></p> <p><u>Required only for orbits of a “constellation” (A.4.b.1.a) and to be specified in:</u></p> <ul style="list-style-type: none"> – <u>the Advanced Publication (API), for any frequency assignment not subject the provisions of Section II of Article 9</u> – <u>the Coordination Request (CR/C), for any frequency assignment subject to the provisions of Nos. 9.12, 9.12A, 22.5C, 22.5D or 22.5F</u> – <u>the Notification, in all cases</u> <p><u>Note – All satellites in all orbital planes must use the same reference time. If no reference time is provided in A.4.b.4.k and A.4.b.4.l, it is assumed to be $t=0$</u></p> | | | ± | | ± | | | | | A.4.b.4.j | |
| A.4.b.4.k | <u>the date (day:month:year) at which the satellite is at the location defined by the longitude of the ascending node (θ_j), (see Note under A.4.b.4.j)</u> | | | 0 | | 0 | | | | | A.4.b.4.k | |
| A.4.b.4.l | <u>the time (hours:minutes) at which the satellite is at the location defined by the longitude of the ascending node (θ_j), (see Note under A.4.b.4.j)</u> | | | 0 | | 0 | | | | | A.4.b.4.l | |
| A.4.b.4.m | <p><u>indicator of whether the space station uses sun-synchronous orbit or not</u></p> <p><u>Required only in frequency bands not subject to the provisions of Nos 9.12 or 9.12A</u></p> | | | ± | | ± | | | | | A.4.b.4.m | |

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|----------------------------|---|--|--|--|--|---|---|---|--|---|----------------------------|-----------------|
| A.4.b.4.n | <u>if the space station uses sun-synchronous orbit (A.4.b.4.m), indicator if the space station references the local time of the ascending node (solar local time when the space station is crossing the equator plane in the South-North direction in hours:minutes format) or the descending node (solar local time when the space station is crossing the equator plane in the North-South direction in hours:minutes format)</u> | | | <u>Q</u> | | <u>Q</u> | | | | | A.4.b.4.n | |
| A.4.b.4.o | <u>if the space station uses sun-synchronous orbit (A.4.b.4.m), the local time of the ascending (or descending, per A.4.b.4.n) node (solar local time when the space station is crossing the equator plane in the South-North (or North-South) direction in hours:minutes format)</u> | | | <u>Q</u> | | <u>Q</u> | | | | | A.4.b.4.o | |
| A.4.b.5 | Not used | | | | | | | | | | | |
| A.4.b.6 | For space stations operating in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F, <u>additional</u> the data elements to characterize properly the orbital operation of the non-geostationary-satellite system: | | | | | | | | | | A.4.b.6 | |
| A.4.b.6bis | <u>An indicator showing whether the set of operating parameters is provided in A.14.d (extended set of operating parameters) or provided in A.4.b.6.a and A.4.b.7 (limited set of operating parameters)</u> | | | | | <u>X</u> | | | | | A.4.b.6bis | |
| A.4.b.6.a | For each range of latitudes: <u>the limited set of operating parameters</u> | | | | | | | | | | A.4.b.6.a | |
| A.4.b.6.a.1 | the maximum number of non-geostationary satellites transmitting with overlapping frequencies to a given location | | | | | <u>X₊</u> | | | | | A.4.b.6.a.1 | |
| A.4.b.6.a.2 | the associated start of the latitude range | | | | | <u>X₊</u> | | | | | A.4.b.6.a.2 | |
| A.4.b.6.a.3 | the associated end of the latitude range | | | | | <u>X₊</u> | | | | | A.4.b.6.a.3 | |
| A.4.b.6.b | Not used | | | | | | | | | | A.4.b.6.b | |
| A.4.b.6.c | an indicator showing whether the space station uses station-keeping to maintain a repeating ground track | | | | | X | | | | | A.4.b.6.c | |

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|-------------------|---|--|--|--|--|---|---|---|--|---|-------------------|-----------------|
| A.4.b.6.d | if the space station uses station-keeping to maintain a repeating ground track, the time in seconds that it takes for the constellation to return to its starting position, i.e. such that all satellites are in the same location with respect to the Earth and each other | | | | | + | | | | | A.4.b.6.d | |
| A.4.b.6.e | an indicator showing whether the space station should be modelled with a specific precession rate of the ascending node of the orbit instead of the J_2 term | | | | | X | | | | | A.4.b.6.e | |
| A.4.b.6.f | if the space station is to be modelled with a specific precession rate of the ascending node of the orbit instead of the J_2 term, the precession rate in degrees/day, measured counter-clockwise in the equatorial plane | | | | | + | | | | | A.4.b.6.f | |
| A.4.b.6.g | the longitude of the ascending node (θ_j) for the j-th orbital plane, measured counter-clockwise in the equatorial plane from the Greenwich meridian to the point where the satellite orbit makes its South to North crossing of the equatorial plane ($0^\circ \leq \theta_j < 360^\circ$) Note—For the evaluation of epfd a reference to a point on the Earth is used and hence the “longitude of the ascending node” is required. All satellites in the constellation must use the same reference time <u>Not used</u> | | | | | X | | | | | A.4.b.6.g | |
| A.4.b.6.h | the date (day:month:year) at which the satellite is at the location defined by the longitude of the ascending node (θ_j), (see Note under A.4.b.6.g) <u>Not used</u> | | | | | X | | | | | A.4.b.6.h | |
| A.4.b.6.i | the time (hours:minutes) at which the satellite is at the location defined by the longitude of the ascending node (θ_j), (see Note under A.4.b.6.g) <u>Not used</u> | | | | | X | | | | | A.4.b.6.i | |
| A.4.b.6.j | the longitudinal tolerance of the longitude of the ascending node | | | | | X | | | | | A.4.b.6.j | |
| A.4.b.7 | For space stations operating in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F, the data elements to characterize properly the performance of the non-geostationary-satellite system: <u>to be provided, if A.4.b.6bis indicates the limited set of operating parameters</u> | | | | | | | | | | A.4.b.7 | |

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|---------------------|---|--|--|--|--|---|---|---|--|---|---------------------|-----------------|
| A.4.b.7.a | the maximum number of non-geostationary satellites receiving simultaneously with overlapping frequencies from the associated earth stations within a given cell | | | | | X ₊ | | | | | A.4.b.7.a | |
| A.4.b.7.b | the average number of associated earth stations with overlapping frequencies per square kilometre within a cell | | | | | X ₊ | | | | | A.4.b.7.b | |
| A.4.b.7.c | the average distance, in kilometres, between co-frequency cells | | | | | X ₊ | | | | | A.4.b.7.c | |
| <u>A.4.b.7.cbis</u> | <u>the minimum elevation angle at which any associated earth station can transmit to or receive from a non-geostationary satellite</u> | | | | | + | | | | | <u>A.4.b.7.cbis</u> | |
| A.4.b.7.d | For the exclusion zone about the geostationary-satellite orbit: | | | | | | | | | | A.4.b.7.d | |
| A.4.b.7.d.1 | the type of zone (based on topocentric angle, satellite-based angle or other method for establishing the exclusion zone) | | | | | X ₊ | | | | | A.4.b.7.d.1 | |
| A.4.b.7.d.2 | if the zone is based on a topocentric angle or a satellite-based angle, the width of the zone, in degrees | | | | | + | | | | | A.4.b.7.d.2 | |
| A.4.b.7.d.3 | if an alternative method is used for establishing the exclusion zone, a detailed description of the avoidance mechanism Not used | | | | | + | | | | | A.4.b.7.d.3 | |
| ... | ... | | | | | ... | | | | | ... | ... |

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|-------------------|---|--|--|--|---|---|---|---|--|--|-------------------|-----------------|
| A.14 | FOR STATIONS OPERATING IN A FREQUENCY BAND SUBJECT TO Nos. 22.5C, 22.5D OR 22.5F: SPECTRUM MASKS | | | | | | | | | | A.14 | |
| A.14.a | For each e.i.r.p. mask used by the non-geostationary space station: | | | | | | | | | | A.14.a | |
| A.14.a.1 | the mask identification code | | | | | X | | | | | A.14.a.1 | |
| A.14.a.2 | the lowest frequency for which the mask is valid | | | | | X | | | | | A.14.a.2 | |
| A.14.a.3 | the highest frequency for which the mask is valid | | | | | X | | | | | A.14.a.3 | |
| A.14.a.4 | the mask pattern defined in terms of the power in the reference bandwidth for a series of off-axis angles with respect to a specified reference point <u>measured at the non-geostationary space station between the line to the sub-satellite point and the line to a point on the geostationary arc, together with the bandwidth used</u> | | | | | X | | | | | A.14.a.4 | |
| <u>A.14.a.5</u> | <u>the reference bandwidth used for the mask pattern of A.14.a.4</u> | | | | | <u>X</u> | | | | | <u>A.14.a.5</u> | |
| A.14.b | For each associated earth station e.i.r.p. mask: | | | | | | | | | | A.14.b | |
| A.14.b.1 | the mask identification code | | | | | X | | | | | A.14.b.1 | |
| A.14.b.2 | the lowest frequency for which the mask is valid | | | | | X | | | | | A.14.b.2 | |
| A.14.b.3 | the highest frequency for which the mask is valid | | | | | X | | | | | A.14.b.3 | |
| A.14.b.4 | <u>Not used</u> the minimum elevation angle at which any associated earth station can transmit to a non-geostationary satellite | | | | | <u>X</u> | | | | | A.14.b.4 | |
| A.14.b.5 | <u>Not used</u> the minimum separation angle between the geostationary-satellite orbit arc and the associated earth station main beam axis at which the associated earth station can transmit towards a non-geostationary satellite | | | | | <u>X</u> | | | | | A.14.b.5 | |

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|-------------------|--|--|--|--|--|---|---|---|--|---|-------------------|-----------------|
| A.14.b.6 | the mask pattern defined in terms of the power in the reference bandwidth <u>for a series of off-axis angles with respect to a specified reference point as a function of latitude and the off-axis angle between the non-geostationary earth station boresight line and the line from the non-geostationary earth station to a point on the GSO arc</u> | | | | | X | | | | | A.14.b.6 | |
| <u>A.14.b.7</u> | <u>the reference bandwidth used for the mask pattern of A.14.b.6</u> | | | | | <u>X</u> | | | | | <u>A.14.b.7</u> | |
| A.14.c | For each pfd mask used by the non-geostationary space station: <i>Note</i> – The space station pfd mask is defined by the maximum power flux-density generated by any space station in the interfering non-geostationary-satellite system as seen from any point on the surface of the Earth | | | | | | | | | | A.14.c | |
| A.14.c.1 | the mask identification code | | | | | X | | | | | A.14.c.1 | |
| A.14.c.2 | the lowest frequency for which the mask is valid | | | | | X | | | | | A.14.c.2 | |
| A.14.c.3 | the highest frequency for which the mask is valid | | | | | X | | | | | A.14.c.3 | |
| A.14.c.4 | the type of mask, <u>among one of the following types: (Earth-based exclusion zone angle, difference in longitude, latitude), (satellite-based exclusion zone angle, difference in longitude, latitude) or (satellite azimuth, satellite elevation, latitude)</u> | | | | | X | | | | | A.14.c.4 | |
| A.14.c.5 | the mask pattern of the power flux-density defined in three dimensions | | | | | X | | | | | A.14.c.5 | |
| <u>A.14.c.6</u> | <u>the reference bandwidth used for the mask pattern of A.14.c.5</u> | | | | | <u>X</u> | | | | | <u>A.14.c.6</u> | |
| <u>A.14.d</u> | For each set of non-geostationary satellite system operating parameters <u>to be provided, if A.4.b.6bis indicates the use of an extended set of operating parameters</u> <i>Note</i> – <u>There could be different sets of parameters at different frequency bands, but only one set of operating parameters for any frequency band used by the non-geostationary system</u> | | | | | | | | | | <u>A.14.d</u> | |
| <u>A.14.d.1</u> | <u>the parameter set identification code</u> | | | | | ± | | | | | <u>A.14.d.1</u> | |
| <u>A.14.d.2</u> | <u>the lowest frequency for which the mask is valid</u> | | | | | ± | | | | | <u>A.14.d.2</u> | |
| <u>A.14.d.3</u> | <u>the highest frequency for which the mask is valid</u> | | | | | ± | | | | | <u>A.14.d.3</u> | |

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|-------------------|---|--|--|--|--|---|---|---|--|---|-------------------|-----------------|
| A.14.d.4 | <u>minimum limit of the latitude range of non-geostationary earth station locations in degrees North</u> | | | | | + | | | | | <u>A.14.d.4</u> | |
| A.14.d.5 | <u>maximum limit of the latitude range of non-geostationary earth station locations in degrees North</u> | | | | | + | | | | | <u>A.14.d.5</u> | |
| A.14.d.6 | <u>the average number of associated earth stations, per km², active at the same time</u> | | | | | + | | | | | <u>A.14.d.6</u> | |
| A.14.d.7 | <u>the average distance, in kilometres, between co-frequency cell or beam footprint centre</u> | | | | | + | | | | | <u>A.14.d.7</u> | |
| A.14.d.8 | <u>the minimum duration, in seconds, during which an earth station will track a non-geostationary satellite without handover for different ranges of latitude</u> | | | | | + | | | | | <u>A.14.d.8</u> | |
| A.14.d.9 | <u>the maximum number of co-frequency tracked non-geostationary satellites for different ranges of latitude</u> | | | | | + | | | | | <u>A.14.d.9</u> | |
| A.14.d.10 | <u>the exclusion zone angle (degrees), i.e. the minimum angle to the geostationary arc at the non-geostationary earth station at which it will operate defined at the earth station given latitude range</u> <u>Note – The exclusion zone angle could vary between non-geostationary system orbit planes. If identification code of orbital plane is not defined then it applies to all orbital planes</u> | | | | | + | | | | | <u>A.14.d.10</u> | |
| A.14.d.11 | <u>the minimum elevation angle (degrees) of the non-geostationary earth station when it is receiving or transmitting within a given latitude (degrees North) and azimuth (degrees from North) range</u> | | | | | + | | | | | <u>A.14.d.11</u> | |

Agenda item 7(I)

3/7/9 Issue I – Modified regulatory procedure for non-GSO satellite systems with short-duration missions

3/7/9.1 Executive summary

Non-GSO satellites with short-duration missions are treated the same as all other satellites under RR Articles **9** and **11**. Given their short development cycle, short lifetimes, and typical missions, a modified regulatory procedure for the advance publication, notification and MIFR recording of non-GSO satellite systems with short-duration missions may be beneficial for these systems. The successful and timely development and operation of non-GSO satellite systems with short-duration missions may require regulatory procedures that take account of the nature and timing for deployment of these systems.

Many of these non-GSO satellite systems are being developed by academic institutions, amateur satellite organizations, or by developing countries that are using these satellites to build their expertise in space capability. The current regulatory procedures for satellite networks and systems may result in some difficulties for non-GSO satellite systems with short-duration missions (see RoP for RR No. **9.11A**). This can have adverse consequences in the management of interference. Additionally, these short-duration satellite systems are beginning to operate outside the amateur-satellite service. There is no dedicated radiocommunication service associated with short-duration satellite system frequency usage, however non-GSO satellites with short-duration missions shall operate in spectrum allocated to satellite services in accordance with the relevant conditions of the allocation.

A draft new WRC Resolution, together with an associated regulatory procedure for non-GSO satellite systems with short-duration missions, has been developed to modify the regulatory process for short-duration missions.

3/7/9.2 Background

In recent years, an increasing number of academic institutions, amateur satellite organizations and government agencies have been developing non-GSO satellite systems with short duration missions using nano and picosatellites. The use of these types of satellites has presented various regulatory challenges, including difficulties for the notifying administrations to provide accurate RR Appendix **4** orbital characteristics at the beginning of the development cycle and, in some instances, not even prior to the launch of the satellites.

At WRC-15 a proposal for a new agenda item for WRC-19 “to consider modifications to the regulatory procedures for notifying satellite networks to accommodate nanosatellite and picosatellite missions” was submitted. WRC-15 decided not to include this as an item on the WRC-19 agenda, and concluded that this matter could best be dealt with by the ITU-R under the standing WRC agenda item 7.

As a result, the ITU-R developed a method to address this issue that consists of modifications to the existing regulatory procedures for advanced publication and notification of satellite networks and systems that are not subject to Section II of RR Article **9** to facilitate the recording of non-GSO satellite systems with short-duration missions in the MIFR.

3/7/9.3 Summary and analysis of the results of ITU-R studies

Under the current regulatory framework, a certain period of time following the submission of an API for frequency assignments to a non-GSO satellite network or system is required for:

- 1) the Radiocommunication Bureau to publish this API. RR No. **9.2B** provides up to three months from the date of receipt of the complete RR Appendix **4** information for the Bureau to publish the API. It also specifies that this period can be extended;
- 2) the affected administrations to perform their analysis and provide their comments. RR No. **9.3** provides up to four months for these activities;
- 3) the notifying and the affected administrations to resolve any difficulties identified in the comments received. There is no time-limit associated with the resolution of difficulties referred to above noting however that the current regulations provide a minimum period of two-months during which the notifying and affected administrations could attempt to resolve any difficulties identified²⁸.

When considering the various elements mentioned above, nine months (three months for the Bureau to publish the API + the minimum six-month period) could have elapsed before the notification information is receivable by the Bureau. In theory, this could result in having a space station operating on frequency assignments without rights for international recognition nor protection because of the non-completion of their recording process in the MIFR. This may be the case for satellite projects with a very short development and deployment cycle such as non-GSO satellite networks or systems with a short-duration mission. However, it is also worth mentioning that in most cases, activities associated with the resolution of difficulties identified by affected administrations are the limiting factor with respect to how early an administration would submit the notification information. These activities are meant to ensure, to the extent possible, operations in an environment free of harmful interference.

Based on input contributions, ITU-R discussed the possibility of accelerating the timing of the processing of frequency assignments to non-GSO satellite networks and systems with a short-duration mission not subject to Section II of RR Article **9**. This could be achieved, in part, by taking advantage of the recent development relating to the implementation of an online tool for the submission of all the notices. Other possibilities presented involved the reduction of the period provided to affected administrations to submit their comments. In both cases, the impacts of these modifications on the Radiocommunication Bureau or administrations may need to be further considered.

3/7/9.4 Methods to satisfy Issue I

3/7/9.4.1 Method I1

No changes to the Radio Regulations.

3/7/9.4.2 Method I2

Modifications to RR Articles **9** and **11**, including the addition of a new WRC Resolution are proposed.

²⁸ The current regulations specify a minimum period of six months between the date of publication of the API and the earliest possible date of receipt of the notification information and a four-month period from the publication of the API and the deadline for the submission of comments by any affected administrations. This leaves two months between the deadline for submission of the comments and the earliest possible date of receipt for the notification information.

3/7/9.5 Regulatory and procedural considerations for Issue I

3/7/9.5.1 Method I1

NOC

ARTICLES

NOC

APPENDICES

NOC

RESOLUTIONS

NOC

RECOMMENDATIONS

3/7/9.5.2 Method I2

MOD

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations^{1, 2, 3, MOD 4, 5, 6, 7, 8, 9} (WRC-159)

Section I – Advance publication of information on satellite networks or satellite systems

General

MOD

9.1 Before initiating any action under Article **11** in respect of frequency assignments for a satellite network or a satellite system not subject to the coordination procedure described in Section II of Article **9** below, an administration, or one¹⁰ acting on behalf of a group of named administrations, shall send to the Bureau a general description of the network or system for advance publication in the International Frequency Information Circular (BR IFIC) not earlier than seven years and preferably not later than two years before the planned date of bringing into use of the network or system (see also No. **11.44**). The characteristics to be provided for this purpose are listed in Appendix **4**. The notification information may also be communicated to the Bureau at the same

time, but shall be considered as having been received by the Bureau not earlier than ~~six~~ four months after the date of publication of the advance publication information. (WRC-~~15~~19)

MOD

9.2B On receipt of the complete information sent under Nos. **9.1** and **9.2**, the Bureau shall publish¹¹ it in a Special Section of its BR IFIC within ~~three~~ two months. When the Bureau is not in a position to comply with the time limit referred to above, it shall periodically so inform the administrations, giving the reasons therefor. (WRC-~~2000~~19)

MOD

⁴ **A.9.4** Resolution **49 (Rev.WRC-15)**, ~~or~~ Resolution **552 (Rev.WRC-15)**, or draft new Resolution [A7(I)-NGSO SHORT DURATION] (WRC-19) as appropriate, shall also be applied with respect to those satellite networks and satellite systems that are subject to it. (WRC-~~15~~19)

Sub-Section IA – Advance publication of information on satellite networks or satellite systems that are not subject to coordination procedure under Section II

MOD

9.3 If, upon receipt of the BR IFIC containing information published under No. **9.2B**, any administration believes that interference which may be unacceptable may be caused to its existing or planned satellite networks or systems, it shall within four months of the date of publication of the BR IFIC communicate to the publishing administration its comments ADD XX on the particulars of the anticipated interference to its existing or planned systems. A copy of these comments shall also be sent to the Bureau. Thereafter, both administrations shall endeavour to cooperate in joint efforts to resolve any difficulties, with the assistance of the Bureau, if so requested by either of the parties, and shall exchange any additional relevant information that may be available. If no such comments are received from an administration within the aforementioned period, it may be assumed that the administration concerned has no objections to the planned satellite network(s) of the system on which details have been published. (WRC-19)

ADD

^{xx} **9.3.1** Upon receipt of the International Frequency Information Circular (BR IFIC) containing information published under No. **9.2B** for frequency assignments to non-GSO satellite systems subject to Resolution [A7(I)-NGSO SHORT DURATION] (WRC-19), any administration which believes that unacceptable interference may be caused to its existing or planned satellite networks or systems shall, as soon as possible and within a period of four months, communicate with the notifying administration, with copy to the Bureau, these comments on the particulars of the potential interference to its existing or planned systems. The Bureau shall promptly make these comments available “as received”, on the ITU website. (WRC-19)

MOD

ARTICLE 11

Notification and recording of frequency assignments¹, MOD 2, 3, 4, 5, 6, 7, 8 (WRC-~~15~~19)

MOD

² **A.11.2** Resolution 49 (Rev.WRC-15), ~~or~~ Resolution 552 (Rev.WRC-15), or draft new Resolution [A7(I)-NGSO SHORT DURATION] (WRC-19) as appropriate, shall also be applied with respect to those satellite networks and satellite systems that are subject to it. (WRC-~~15~~19)

APPENDIX 4 (REV.WRC-15)

Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III

ANNEX 2

Characteristics of satellite networks, earth stations or radio astronomy stations² (Rev.WRC-12)

Footnotes to Tables A, B, C and D

MOD

TABLE A
**GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,
 EARTH STATION OR RADIO ASTRONOMY STATION** (Rev.WRC-15/19)

| Items in Appendix | A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION | Advance publication of a geostationary-satellite network | Advance publication of a non-geostationary-satellite network subject to coordination under Section II | Advance publication of a non-geostationary-satellite network not subject to coordination under Section II | Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A) | Notification or coordination of a non-geostationary-satellite network | Notification or coordination of an earth station (including notification under Appendices 30A or 30B) | Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5) | Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5) | Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8) | Items in Appendix | Radio astronomy |
|-------------------|--|--|---|---|--|---|---|---|--|---|-------------------|-----------------|
| A.2 | DATE OF BRINGING INTO USE | | | | | | | | | | A.2 | |
| A.2.a | <p>the date (actual or foreseen, as appropriate) of bringing the frequency assignment (new or modified) into use</p> <p>For a frequency assignment to a GSO space station, including frequency assignments in Appendices 30, 30A and 30B, the date of bringing into use is as defined in Nos. 11.44B and 11.44.2</p> <p><u>For a frequency assignment to a non-GSO satellite system with a short-duration mission, the date of bringing into use is as defined in draft new Resolution [A7(I)-NGSO SHORT DURATION] (WRC-19)</u></p> <p>Whenever the assignment is changed in any of its basic characteristics (except in the case of a change under A.1.a, the date to be given shall be that of the latest change (actual or foreseen, as appropriate)</p> <p>Required only for notification</p> | | | | + | + | + | + | + | + | A.2.a | |
| A.2.b | for a space station, the period of validity of the frequency assignments (see Resolution 4 (Rev.WRC-03) and draft new Resolution [A7(I)-NGSO SHORT DURATION] (WRC-19), as appropriate) | | | X | X | X | | | | | A.2.b | |

ADD

DRAFT NEW RESOLUTION [A7(I)-NGSO SHORT DURATION] (WRC-19)

Modified regulatory procedures for the processing of frequency assignments to non-GSO satellite networks or systems identified as short-duration mission¹ under Articles 9 and 11

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a) that some non-GSO satellites with short-duration missions to date have been operating for their entire mission duration without being notified or recorded;
- b) that successful and timely development and operation of non-GSO satellite networks or systems with short-duration missions may require regulatory procedures which take account of the short development cycle, the short lifetimes and the typical missions of such satellites, and therefore the application of certain provisions of Articles 9 and 11 of the Radio Regulations may need to be adapted to take account of the nature of these satellites;
- c) that these satellites typically have a short (one to two years) development time and are low cost, often using off-the-shelf components;
- d) that the operational lifetime of these satellites generally ranges from several weeks up to not more than three years;
- e) that non-GSO satellites with short-duration missions are being used for a wide variety of applications, including remote sensing, space weather research, upper atmosphere research, astronomy, communications, technology demonstration and education, and therefore may operate under various radiocommunication services;
- f) that advances in the field of satellite technology have resulted in non-GSO satellites with short-duration missions becoming a means for developing countries to become involved in space activities,

considering further

- a) that the application of provisions of Articles 9 and 11 to frequency assignments to non-GSO satellite networks or systems identified as short-duration mission as prescribed in this Resolution should not adversely or otherwise affect the regulatory treatment of other systems;
- b) that the application of any modified regulatory procedure should not change the sharing status with respect to networks and systems not applying the modified regulatory procedure, both terrestrial and space, in frequency bands which may be used by non-GSO satellite systems with short-duration missions,

recognizing

- a) that Resolution ITU-R 68 seeks to improve awareness and increase knowledge on existing regulatory procedures for small satellites;

¹ For the purpose of this Resolution, the definition of non-GSO satellite systems identified as short-duration missions is contained in *resolves* 4 and 5 of this Resolution.

- b) that, even though satellite mass and size are not relevant from a frequency management perspective, the small mass and small dimensions of these satellites have been some of the major contributors to their success amongst new space-faring nations;
- c) that all the non-GSO satellite networks or systems operating in bands not subject to Section II of Article 9 are, irrespective of the period of validity of their associated frequency assignments, subject to No. 9.3 and its process for resolution of difficulties;
- d) that non-GSO satellite systems with short-duration missions are not be used for safety-of-life services,

noting

- a) Report ITU-R SA.2312 on “Characteristics, definitions and spectrum requirements of nanosatellites and picosatellites, as well as systems composed of such satellites”;
- b) Report ITU-R SA.2348 which contains descriptions of current regulatory practices relating to space network notification of such satellites,

resolves

- 1 that this Resolution shall apply only to non-GSO networks or systems identified by the notifying administration as short duration mission;
- 2 that non-GSO satellite networks or systems identified as short-duration mission operating under any space radiocommunication service in bands not subject to the application of Section II of Article 9 shall be subject to the provisions of the Radio Regulations with the exceptions stipulated in the Annex to this Resolution;
- 3 that non-GSO satellite networks or systems identified as short-duration mission operating in frequency bands allocated to satellite services shall operate in accordance with the relevant conditions of the allocated satellite service;
- 4 that non-GSO satellite networks or systems identified as short-duration mission using spectrum allocated to the amateur-satellite service shall operate in accordance with the definition of the amateur-satellite service as contained in Article 25 of the Radio Regulations;
- 5 that the total number of satellites in a non-GSO satellite network or system identified as short-duration mission shall not exceed *ten/TBD by WRC-19* satellites;
- 6 that the maximum period of operation and validity of frequency assignments of a non-GSO satellite network or system identified as short-duration mission shall not exceed three years from the date of bringing into use of the frequency assignments (see the Annex to this Resolution for the definition of date of bringing into use for such network or system), without any possibility of extension, after which the recorded assignments shall be cancelled;
- 7 that for the purpose of this Resolution, a non-GSO satellite network or system identified as short-duration mission shall have a single launch date associated with the first launch (in the case of systems with multiple launches) and that launch date shall be defined as the date on which the first satellite of the non-GSO satellite network or system with a short-duration mission is placed into its notified orbital plane,

instructs the Director of the Radiocommunication Bureau

- 1 to establish, as soon as possible, proper means to identify the non-GSO satellite networks or systems with short-duration missions subject to this Resolution;
- 2 to expedite the online publication of notices for such networks or systems, in addition to the normal publication of notices;

3 to provide the necessary assistance to administrations in the implementation of this Resolution,

invites administrations

1 to exchange information associated with non-GSO satellite networks or systems identified as short-duration missions and to make every possible effort to resolve interference that may be unacceptable to existing or planned satellite networks or systems, including those with short-duration missions;

2 to disseminate information on non-GSO satellite networks or systems identified as short-duration missions in accordance with the provisions of Resolution ITU-R 68;

3 to provide their comments on the application of No. **9.3**, upon receipt of the International Frequency Information Circular (BR IFIC) containing information published under No. **9.2B**, as soon as possible within a period of four months from the date of publication of the (BR IFIC) and to communicate with the notifying administration, with copy to the Bureau, these comments on the particulars of the potential interference to its existing or planned systems.

ANNEX TO DRAFT NEW RESOLUTION [A7(I)-NGSO SHORT DURATION] (WRC-19)

Application of the provisions of Articles 9 and 11 for non-GSO satellite networks and systems identified as short-duration missions

1 The general provisions of the Radio Regulations shall apply to non-GSO satellite networks or systems identified as short-duration mission with the following exceptions/additions/amendments.

2 That when submitting advance publication information under No. **9.1**, administrations shall submit the best estimated orbital characteristics (Appendix 4 data item A.4.b.4) known at the early development time of the satellite project.

3 In the application of No. **9.1**, the notification information cannot be communicated to the Bureau at the same time, and can only be submitted after the launch of a satellite in the case of a network or the first satellite in the case of a system with multiple launches.

4 Notices relating to non-GSO satellite networks or systems identified as short-duration mission shall be communicated to the Bureau only after the launch of a satellite in the case of a satellite network or the first satellite in the case of a system requiring multiple launches, and not later than two months after the date of bringing into use. This provision applies instead of No. **11.25** for frequency assignments to non-GSO satellite networks or systems with short-duration mission. Irrespective of the date of receipt of the notified characteristics of the non-GSO satellite network or system with a short-duration mission under this Resolution, the maximum period of validity of frequency assignments of this system shall not exceed the time limit in *resolves* 6 of this Resolution. At the expiry date of period of validity, as described in *resolves* 6 of this Resolution, the Bureau shall publish a suppression of the related Special Section.

*NOTE: In developing the alternative application of RR No. **11.25** above it was recognized that it would be important to include a requirement for administrations to also submit a commitment to the Bureau stating that in case unacceptable interference caused by the short-duration mission system is not resolved, it shall undertake to eliminate the interference or reduce it to an acceptable level. It*

was further recognized that this commitment should be considered part of the complete information for the notice and should therefore be included as a new data item under Appendix 4.

5 In the application of No. **11.28** the Bureau shall make available on its website the complete information received instead of publication in the BR IFIC. Administrations may comment upon this information in accordance with No. **11.28.1**.

6 In addition to the application of No. **11.36** the Bureau shall publish the characteristics of the system together with the findings under No. **11.31** in the BR IFIC and on its website within no more than four months from the date of receipt of complete information under No. **11.28**. When the Bureau is not in a position to comply with the time-limit referred to above, it shall periodically so inform the notifying administration, giving the reasons therefor.

7 In the application of No. **11.44**, the date of bringing into use of a non-GSO satellite network or system identified as short-duration mission shall be considered automatically as the launch date of a satellite in the case of a non-GSO satellite network or the first satellite in the case of a non-GSO satellite system requiring multiple launches (see *resolves 7* of this Resolution).

8 No. **11.49** shall not apply to frequency assignments to non-GSO satellite networks or systems identified as short-duration mission.

Agenda item 7(J)

3/7/10 Issue J – Pfd limit in Section 1, Annex 1 of RR Appendix 30

3/7/10.1 Executive summary

Issue J deals with the possibility of the exceedance of the power flux-density (pfd) limit for the broadcasting-satellite service (BSS) networks in the List.

The pfd limit of $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ was established for additional use in Regions 1 and 3 in order to protect BSS networks outside the coordination arc of ± 9 degrees. In the case that an administration applies the relevant provisions of RR Article 23 to request the exclusion of its territory from the service areas of BSS networks of other administrations, such BSS networks of other administrations are not entitled to be protected within the territory of the objecting administration. According to the idea above, the pfd limit of $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ may be exceeded only within the national territory of the notifying administration providing that, on the border areas and other territory of another country, this pfd limit is not exceeded.

Under WRC-19 agenda item 7 Issue J, two methods are provided. Method J1 proposes modifications to Section 1, Annex 1 of RR Appendix 30 and Method J2 proposes no changes to the Radio Regulations.

3/7/10.2 Background

Although WRC-2000 adopted a revised Plan that generally assigned ten channels per administration in Region 1 and twelve channels per administration in Region 3, this channel capacity may not be enough to meet a national requirement in terms of spectrum for UHDTV or any future generation of HDTV.

In order to provide the advanced BSS applications like UHDTV (see Recommendation [ITU-R BT.2020](#)), a modulation scheme with high spectrum efficiency (e.g. APSK) and high required C/N (carrier-to-noise ratio) is necessary (see Recommendation [ITU-R BO.2098](#) and Report [ITU-R BO.2397](#)). In that situation, a pfd value exceeding the limit of $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ within the service area is required in order to achieve the same service availability as the conventional BSS.

§ 5.2.1 d) of RR Appendix 30, specifies that the limit of $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ could be exceeded under some conditions.

- *in the case of the notification of Plan assignments, use of an e.i.r.p. which produces a pfd that exceeds the limit of $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ given in Section 1 of Annex 1 to Appendix 30 on the territory of the notifying administration under the condition that the calculated pfd at test points of any Plan assignment, List assignment or proposed assignment submitted under Article 4 are equal to or below that of the original Plan assignments in the same channel of the administration applying this section.*

This Issue J is in response to these requirements for providing new BSS applications.

3/7/10.3 Summary and analysis of the results of ITU-R studies

3/7/10.3.1 Current practice in the Bureau's examination

The current practice in the Bureau's examination on the pfd limit is as follows.

In accordance with the first paragraph of Annex 1 to RR Appendix 30, "Under assumed free-space propagation conditions, the power flux-density of a proposed new or modified assignment in the List shall not exceed the value of $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ ", the pfd produced by each

assignment of an incoming Article 4 BSS submission under examination is calculated at any downlink test point located in Regions 1 and 3 and is compared with the value of $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$.

The downlink test points used by the Bureau in this examination are those associated with all BSS assignments:

- in Regions 1 and 3 BSS Plan and List;
- of any previous Regions 1 and 3 Article 4 BSS submissions, which are still at the stage of application of that Article;
- of the incoming Article 4 BSS submission under examination.

Any excess leads to an unfavourable finding, even if the limit is exceeded only at a test point located inside the territory of the notifying administration.

In this connection, it should be noted that, except for some test points associated with assignments in Regions 1 and 3 BSS Plan, which were adopted by WARC-77 and WRC-2000, any other above-mentioned test point has to be located on land inside the associated service area(s) and be visible from the associated satellite. If it is determined through GIMS (Graphical Interference Management System) that a submitted test point is located at sea, irrespective of how close it is to the territory of an administration, that test point is not accepted by the Bureau.

3/7/10.3.2 Results of ITU-R studies on the pfd limit

The Rules of Procedure addresses implementation of the pfd limit referred to in the first paragraph of Section 1 of Annex 1 to RR Appendix **30** as a hard limit that shall not be exceeded in order to protect BSS assignments from interference that may be caused by BSS networks located outside an arc of $\pm 9^\circ$ around a wanted BSS network.

In the case that an administration applies the relevant provisions of RR Article **23** to request the exclusion of its territory from the service areas of BSS networks of other administrations, such BSS networks of other administrations are not entitled to be protected within the territory of the objecting administration (i.e. the notifying administration mentioned above). It should be also noted that coordination among BSS networks belonging to the same notifying administration is an internal matter of that administration.

If that limit is not exceeded outside the territory of the notifying administration, the BSS networks outside the coordination arc of other administrations are protected outside the territory of the notifying administration. For the BSS networks inside the coordination arc of other administrations, the current coordination procedure continues to be applied.

According to the idea above, the pfd limit of $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ may be exceeded only within the national territory of the notifying administration providing that, on the border areas and other territory of another country, this pfd limit is not exceeded. Therefore, this pfd exceedance should not be allowed for networks submitted by an international satellite organization or an administration that acts on behalf of a group of named administrations.

From the viewpoint of spectrum, the frequency assignment should not overlap with the guardbands in order to ensure the protection of services in adjacent frequency bands.

3/7/10.4 Methods to satisfy Issue J

3/7/10.4.1 Method J1

It is proposed that Section 1, Annex 1 of RR Appendix **30** needs to be modified in order to allow List assignments to exceed the pfd limit given in Section 1 of Annex 1 to RR Appendix **30** only

within the national territory of the notifying administration under the condition that the assignment does not overlap with the Regions 1 and 3 guardbands as defined in § 3.9 of Annex 5 to RR Appendix 30 and also under the condition that, on the border areas and other territory of another country, this pfd limit is not exceeded.

3/7/10.4.2 Method J2

Under this method, there is no change to the Radio Regulations since the pfd limit referred to in the first paragraph of Section 1 of Annex 1 to RR Appendix 30 is a hard limit that shall not be exceeded in order to protect BSS assignments from interference that may be caused by BSS networks located outside an arc of $\pm 9^\circ$ around a wanted BSS network.

3/7/10.5 Regulatory and procedural considerations for Issue J

3/7/10.5.1 Method J1

APPENDIX 30 (REV.WRC-15)*

Provisions for all services and associated Plans and List¹ for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)

ANNEX 1 (REV.WRC-15)

Limits for determining whether a service of an administration is affected by a proposed modification to the Region 2 Plan or by a proposed new or modified assignment in the Regions 1 and 3 List or when it is necessary under this Appendix to seek the agreement of any other administration²⁵

MOD

1 Limits for the interference into frequency assignments in conformity with the Regions 1 and 3 Plan or with the Regions 1 and 3 List or into new or modified assignments in the Regions 1 and 3 List

Under assumed free-space propagation conditions, the power flux-density of a proposed new or modified assignment in the List shall not exceed the value of $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ ²⁶.

²⁶ ~~(SUP-WRC-15)~~ The limit of $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ may be exceeded only within the territory under the jurisdiction of the notifying administration, under the condition that the frequency assignment does not overlap with the Regions 1 and 3 guardbands. This power flux-density (pfd) exceedance is limited to assignments submitted by an administration acting on its own behalf.

...

3/7/10.5.2 Method J2**APPENDIX 30 (REV.WRC-15)***

**Provisions for all services and associated Plans and List¹ for
the broadcasting-satellite service in the frequency bands
11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1)
and 12.2-12.7 GHz (in Region 2) (WRC-03)**

ANNEX 1 (REV.WRC-15)

**Limits for determining whether a service of an administration is affected
by a proposed modification to the Region 2 Plan or by a proposed
new or modified assignment in the Regions 1 and 3 List
or when it is necessary under this Appendix to seek
the agreement of any other administration²⁵**

NOC

- 1 Limits for the interference into frequency assignments in conformity
with the Regions 1 and 3 Plan or with the Regions 1 and 3 List or into
new or modified assignments in the Regions 1 and 3 List**

The limit of $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ on the border areas and other territory under jurisdiction of any other administration shall not be exceeded. In the case that any administration reports that this limit is exceeded over the territory under its jurisdiction, the administration which operates assignments with exceedance of pfd upon receipt of the report of exceedance of the pfd shall immediately reduce the exceedance to an acceptable level over the territory of the administration which reported the exceedance of pfd. (WRC-19)

Agenda item 7(K)

3/7/11 Issue K – Difficulties for Part B examinations under § 4.1.12 or 4.2.16 of RR Appendices 30 and 30A and § 6.21 c) of RR Appendix 30B

3/7/11.1 Executive summary

To address the difficulties encountered by the notifying administration in the Part B examination of its junior network (herein after referred to as “Network JR”) under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.21 c) of RR Appendix **30B**, it is proposed to add one more examination under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** and § 6.21 c) of RR Appendix **30B** such that should any remaining affected networks whose assignments have been entered in the List or Plan, as appropriate, before the submission under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.17 of RR Appendix **30B**, the Bureau shall further examine if the remaining corresponding assignments in the List or Plan are still considered as being affected.

In this way, like the current practice today, if examination under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.21 c) of RR Appendix **30B** of Part B of a junior network (herein after referred to as “Network JR-Part B”) in respect of Part A of a senior network (herein after referred to as “Network SR-Part A”) is favourable, the senior network (herein after referred to as “Network SR”) is considered as not being affected like today and no further examination will be conducted.

Meanwhile, it addresses the difficulties experienced by the notifying administration and allows its notice submitted under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.17 of RR Appendix **30B** (Network JR-Part B) to receive favourable findings in respect of Network SR if Network SR-Part B is considered as not affected in the further examination based on the method of Annex 1 (RR Appendix **30**), Annex 1 (RR Appendix **30A**) or Annex 4 (RR Appendix **30B**). This avoids overprotection of Network SR based on the characteristics which are outdated and no longer valid while ensuring Network SR is adequately protected.

Only one method is proposed to satisfy Issue K.

3/7/11.2 Background

Examination under § 6.21 c) of RR Appendix **30B** is based on the assignments for which the Bureau has previously received complete information in accordance with § 6.1 (i.e. Network SR-Part A) even though the Network SR-Part B has already been published under § 6.23 or § 6.25 with much reduced characteristics (e.g. reduced service area and coverage area) and from that Part B publication, Network SR-Part A no longer exists in the Appendix **30B** databases.

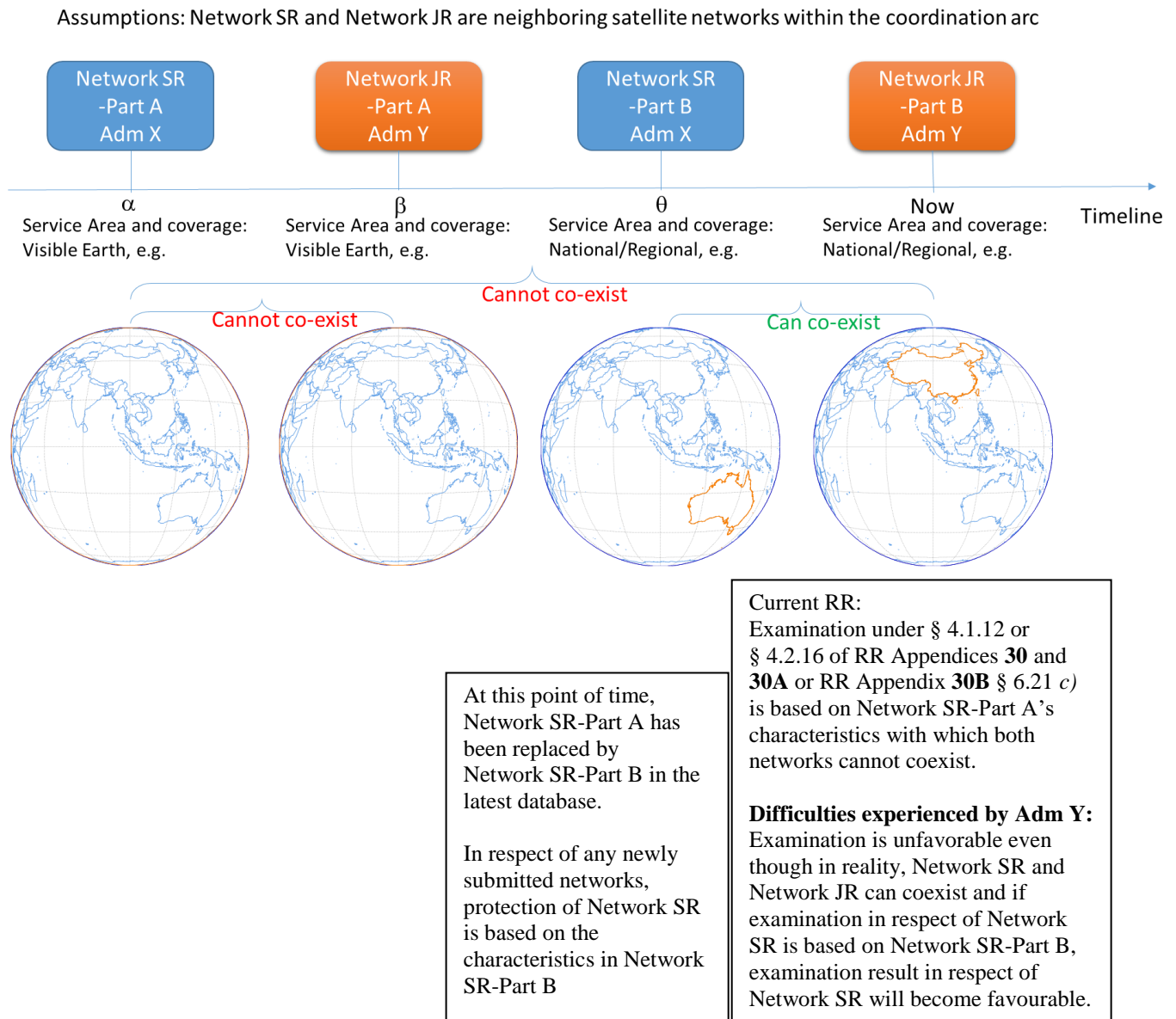
Examination under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** in respect of Network SR is based on the assignments for which the Bureau has previously received complete information in accordance with § 4.1.3 or § 4.2.6 (i.e. Network SR-Part A) even though the Network SR-Part B has already been published under § 4.1.15 or § 4.2.19 with much reduced characteristics (e.g. reduced service area and coverage area) and from that Part B publication, Network SR-Part A no longer exists in the RR Appendices **30** and **30A** databases.

This creates difficulties to the notifying administration and may prevent its notice submitted under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.17 of RR Appendix **30B** (Network JR-Part B) from entering into the List or Plan with favourable findings as the examination of its submission in respect of the senior network (Network SR-Part A) is unfavourable even though in reality, its network (Network JR-Part B) can coexist with the senior network in the List or Plan (Network SR-Part B) and if examination in respect of Network SR is based on its Part B, the examination result will become favourable.

3/7/11.3 Summary and analysis of the results of ITU-R studies

The diagram in Figure 3/7/11.3-1 illustrates the difficulties encountered by the notifying administration in its Part B examination under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.21 c) of RR Appendix **30B**.

FIGURE 3/7/11.3-1



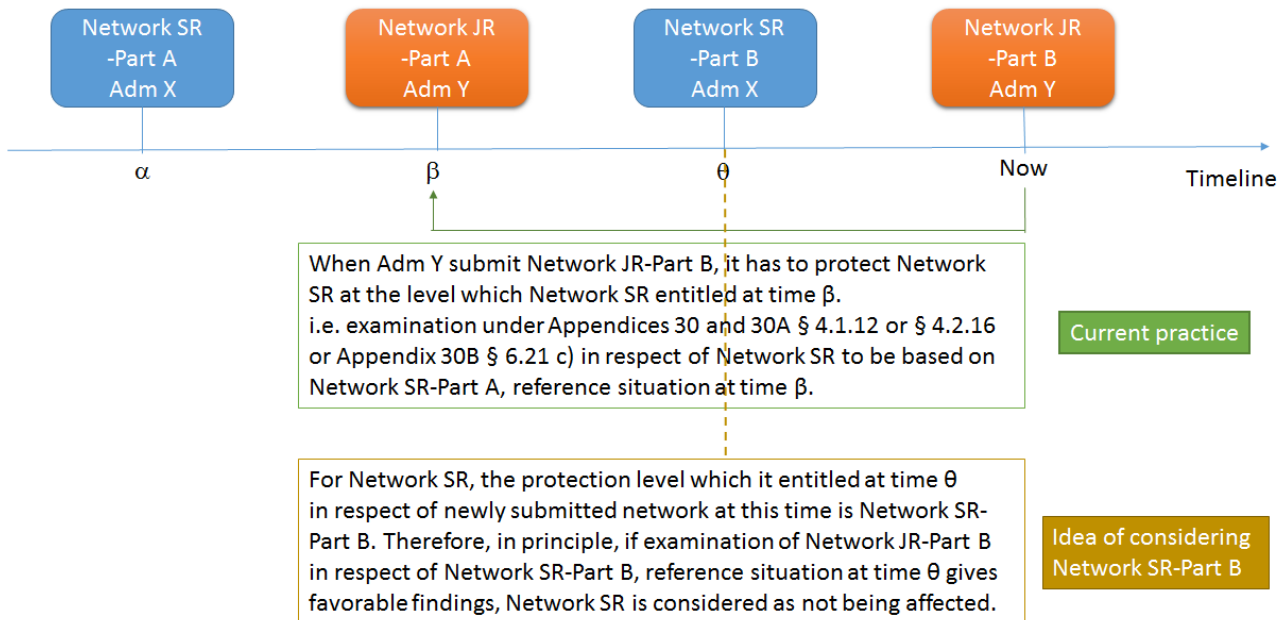
Once an RR Appendices **30** and **30A** or RR Appendix **30B** network (Network SR) is entered into the List or Plan and published under § 4.1.15 or § 4.2.19 or § 6.23 or § 6.25, respectively (Network SR-Part B), the Network SR-Part A no longer exists in the Appendices **30** and **30A** or Appendix **30B** databases, respectively, from that Network SR-Part B publication. The protection level to which Network SR is entitled in respect of a newly submitted network (Network NEW) submitted after this point of time is based on Network SR-Part B.

Therefore, in principle, Network SR is considered as not being affected by Network JR-Part B if examination of Network JR-Part B in respect of Network SR-Part B using the method of Annex 1

(RR Appendix **30**), Annex 1 (RR Appendix **30A**) or Annex 4 (RR Appendix **30B**), as appropriate, gives favourable findings.

However, according to the current practice, the examination of Network JR-Part B is in respect of Network SR-Part A, which may lead to overprotection based on characteristics which are outdated and no longer valid.

FIGURE 3/7/11.3-2



Impacts are considered if the current practice should be changed such that Network JR-Part B shall be examined with respect to Network SR-Part B instead of Network SR-Part A, if submitted (see Figure 3/7/11.3-2).

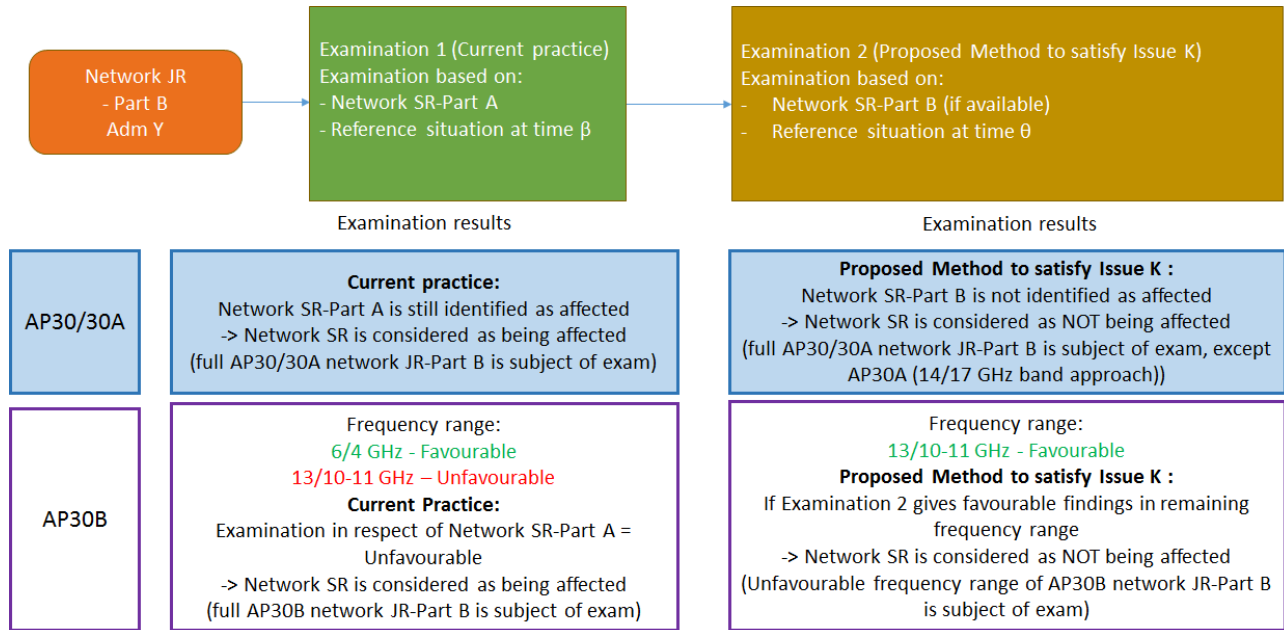
However, Network SR-Part B could potentially be more sensitive than Network SR-Part A in some area(s), in this case, the required protection level of Network SR-Part B could be higher than that of Network SR-Part A.

If the rule is changed in a way such that Network JR-Part B shall be examined with respect to Network SR-Part B instead of Network SR-Part A, if submitted, it is possible that Network JR-Part B is designed in a way which can coexist with Network SR-Part A and it can receive favourable findings in the examination under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.21 c) of RR Appendix **30B** in respect of Network SR according to current practice. However, all of a sudden, the rule is changed and now Network SR requires more protection in some area(s) which caused the examination of Network JR-Part B to become unfavourable. This would lead to unintended consequences to the notifying administration (Adm Y), at the time the notifying administration is preparing its submission of Network JR-Part B, Network SR-Part B may not even be published and thus unknown to Adm Y, it is impossible for Adm Y to take into account and protect Network SR-Part B which is unknown to them.

To avoid the above-mentioned potential unintended consequences, one possible solution is to add one more examination under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.21 c) of RR Appendix **30B** such that should any remaining affected networks (Network SR) whose assignments have been entered in the List or Plan before the submission of Network JR-Part B, the Bureau will

further examine to see if Network SR-Part B remains affected. If further examination in respect of Network SR-Part B gives favourable findings, Network SR is considered as not being affected in examination under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.21 c) of RR Appendix **30B** respectively. The diagram in Figure 3/7/11.3-3 illustrates the two-step examination approach proposed under the method for Issue K.

FIGURE 3/7/11.3-3



In this way, like the current practice today, if examination of Network JR-Part B in respect of Network SR-Part A is favourable, Network SR is considered as not being affected like today and no further examination will be conducted based on Network SR-Part B.

Meanwhile, it addresses the difficulties experienced by the notifying administration and allows its notice submitted under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.17 of RR Appendix **30B** (Network JR-Part B) to receive favourable findings in respect of Network SR if Network SR-Part B is considered as not being affected in the further examination based on the method of Annex 1 (RR Appendix **30**), Annex 1 (RR Appendix **30A**) or Annex 4 (RR Appendix **30B**), as appropriate. This avoids overprotection of Network SR based on the characteristics which are outdated and no longer valid while ensuring Network SR is adequately protected.

3/7/11.4 Method to satisfy Issue K

This method adds one more examination under § 4.1.12 and § 4.2.16 of RR Appendices **30** and **30A** and § 6.21 c) of RR Appendix **30B** such that should any remaining affected networks whose assignments have been entered in the List or Plan before the submission under § 4.1.12 and § 4.2.16 of RR Appendices **30** and **30A** or § 6.17 of RR Appendix **30B**, the Bureau shall further examine if the remaining corresponding assignments in the List or Plan are still considered as being affected.

In this way, like the current practice today, if examination under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.21 c) of RR Appendix **30B** of Network JR-Part B in respect of Network SR-Part A is favourable, Network SR is considered as not being affected like today and no further examination will be conducted.

Meanwhile, it addresses the difficulties experienced by the notifying administration and allows its notice submitted under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.17 of RR Appendix **30B** (Network JR-Part B) to receive favourable findings in respect of Network SR if Network SR-Part B is considered as not being affected in the further examination based on the method of Annex 1 (RR Appendix **30**), Annex 1 (RR Appendix **30A**) or Annex 4 (RR Appendix **30B**). This avoids overprotection of Network SR based on the characteristics which are outdated and no longer valid while ensuring Network SR is adequately protected.

3/7/11.5 Regulatory and procedural considerations for Issue K

APPENDIX 30 (Rev.WRC-15)*

Provisions for all services and associated Plans and List¹ for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)

ARTICLE 4 (REV.WRC-15)

Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3³

4.1 Provisions applicable to Regions 1 and 3

MOD

4.1.12~~XX~~ If agreement has been reached with the administrations identified in the publication referred to under § 4.1.5 above, the administration proposing the new or modified assignment may continue with the appropriate procedure in Article 5, and shall so inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-15~~19~~)

XX Should any remaining affected networks whose assignments have been entered in the List before the notice received under § 4.1.12, the Bureau shall use the method of Annex 1 to further examine if the remaining corresponding assignments in the List are still considered as being affected. The examination in respect of those remaining affected networks is conducted independently using the Appendices **30** and **30A** master database corresponding to the Part B Special Section that was published under § 4.1.15. Resolution **548 (Rev.WRC-12)** applies. (WRC-19)

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 Plan or
for additional uses in Regions 1 and 3³**

4.2 Provisions applicable to Region 2

MOD

4.2.16~~XX1~~ If no comments have been received on the expiry of the periods specified in § 4.2.14, or if agreement has been reached with the administrations which have made comments and with which agreement is necessary, the administration proposing the modification may continue with the appropriate procedure in Article 5, and shall so inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-19)

XX1 Should any remaining affected networks whose assignments have been entered in the Plan before the notice received under § 4.2.16, the Bureau shall use the method of Annex 1 to further examine if the remaining corresponding assignments in the Plan are still considered as being affected. The examination in respect of those remaining affected networks is conducted independently using the Appendices 30 and 30A master database corresponding to the Part B Special Section that was published under § 4.2.19. (WRC-19)

APPENDIX 30A (Rev.WRC-15)*

Provisions and associated Plans and List¹ for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz² and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-03)

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan
or for additional uses in Regions 1 and 3**

4.1 Provisions applicable to Regions 1 and 3

MOD

4.1.12~~XX~~ If agreement has been reached with the administrations identified in the publication referred to under § 4.1.5 above, the administration proposing the new or modified assignment may continue with the appropriate procedure in Article 5 and shall inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-~~15~~¹⁹)

^{XX} Should any remaining affected networks whose assignments have been entered in the List before the notice received under § 4.1.12, the Bureau shall use the method of Annex 1 to further examine if the remaining corresponding assignments in the List are still considered as being affected. The examination in respect of those remaining affected networks is conducted independently using the Appendices 30 and 30A master database corresponding to the Part B Special Section that was published under § 4.1.15. Resolution 548 (Rev.WRC-12) applies. (WRC-19)

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan
or for additional uses in Regions 1 and 3**

4.2 Provisions applicable to Region 2

MOD

4.2.16^{XXI} If no comments have been received on the expiry of the periods specified in § 4.2.14, or if agreement has been reached with the administrations which have made comments and with which agreement is necessary, the administration proposing the modification may continue with the appropriate procedure in Article 5, and shall so inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-19)

APPENDIX 30B (Rev.WRC-15)

**Provisions and associated Plan for the fixed-satellite service
in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz,
10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

ARTICLE 6 (REV.WRC-15)

**Procedures for the conversion of an allotment into an assignment, for
the introduction of an additional system or for the modification of
an assignment in the List^{1,2} (WRC-15)**

MOD

6.21 When the examination with respect to § 6.19 of an assignment received under § 6.17 leads to a favourable finding, the Bureau shall use the method of Annex 4 to examine if the affected administrations and the corresponding:

- a) allotments in the Plan;
- b) assignments which appear in the List at the date of receipt of the examined notice submitted under § 6.1;

^{XXI} Should any remaining affected networks whose assignments have been entered in the Plan before the notice received under § 4.2.16, the Bureau shall use the method of Annex 1 to further examine if the remaining corresponding assignments in the Plan are still considered as being affected. The examination in respect of those remaining affected networks is conducted independently using the Appendices 30 and 30A master database corresponding to the Part B Special Section that was published under § 4.2.19. (WRC-19)

- c) assignments for which the Bureau has previously received complete information in accordance with § 6.1 and has conducted the examination under § 6.5 of this Article at the date of receipt of the examined notice submitted under § 6.1^{YY};

indicated in the Special Section published under § 6.7 and whose agreement has not been provided under § 6.17 are still considered as being affected by that assignment. (WRC-19)

^{YY} Should any remaining affected networks whose assignments have been entered in the List before the notice received under § 6.17, the Bureau shall use the method of Annex 4 to further examine if the remaining corresponding assignments in the List are still considered as being affected. The examination in respect of those remaining affected networks is conducted independently using the Appendix **30B** master database corresponding to the A6B Special Section that was published under § 6.23 or § 6.25. (WRC-19)

Agenda item 9.1

9 *to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:*

9.1 *on the activities of the Radiocommunication Sector since WRC-15;*

NOTE: Nine issues have been identified by CPM19-1 under this agenda item.

Agenda item 9.1(9.1.2)

3/9.1.2 Resolution 761 (WRC-15)

Compatibility of International Mobile Telecommunications and broadcasting-satellite service (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3

3/9.1.2/1 Executive summary

Pursuant to Resolution **761 (WRC-15)**, the regulatory and technical studies between International Mobile Telecommunications (IMT) and the broadcasting-satellite service (sound) (BSS (sound)) in the frequency band 1 452-1 492 MHz in Regions 1 and 3 were conducted by ITU-R, taking into account IMT and BSS (sound) operational requirements.

The purpose of the studies is to respond to the *resolves to invite ITU-R* as contained in Resolution **761 (WRC-15)** in order to enable WRC-19 to decide on the matter, as appropriate.

Currently, RR No. **9.19**, *inter alia*, applies with respect to the coordination for potential interference from IMT systems into the BSS (sound) receivers across the border between different countries within the satellite network service area. At the same time, RR No. **9.11** applies currently with respect to the coordination for potential interference from a BSS (sound) space station into IMT receivers. In addition, associated Resolutions **33 (Rev.WRC-15)**, **507 (Rev.WRC-15)** and **528 (Rev.WRC-15)** apply. On this basis, the coordination and power flux-density limit solutions are currently in consideration, noting that maintaining the status quo (i.e. no changes to the Radio Regulations) is also a solution.

3/9.1.2/2 Background

The frequency band 1 452-1 492 MHz is allocated to the fixed service (FS), mobile service (MS), broadcasting service (BS) and broadcasting-satellite service (BSS). Based on the outcome of WRC-15, the frequency band 1 452-1 492 MHz is identified for use by Regions 1 and 3 administrations wishing to implement IMT in accordance with Resolution **223 (Rev.WRC-15)** and Resolution **761 (WRC-15)** (see RR Nos. **5.346** and **5.346A**). Pursuant to Resolution **528 (Rev.WRC-15)**, in the interim period, broadcasting-satellite systems may only be introduced within the upper 25 MHz of this frequency band in accordance with the procedures contained in Sections A to C of Resolution **33 (Rev.WRC-15)**, or in RR Articles **9** to **14**, as appropriate (see *resolves* 1 and 2 of Resolution **33 (Rev.WRC-15)**). The complementary terrestrial service may be introduced during this interim period subject to coordination with administrations whose services may be affected.

Based on the ITU BR database, there are many satellite network filings submitted for coordination in the frequency band 1 467-1 492 MHz in which the orbital positions of the space stations are distributed globally in the GSO. Some of these satellite networks are operational and their frequency assignments are already recorded in the Master International Frequency Register (MIFR). To this effect, in order to avoid retroactive impact on the BSS (sound), necessary transitional measures are required to be decided by the conference, e.g. for networks in operation or for

networks for which complete coordination information has been received by the Radiocommunication Bureau under RR Article 9 before the last day of WRC-19 or for networks which will be brought into use before the last day of WRC-19. When deciding on the appropriate date to be applied regarding the avoidance of a retroactive impact on the BSS (sound) and to properly manage avoidance of excessive and multiple submissions (warehousing of spectrum/orbital resources) before the date of application, WRC-19 could consider the timeline/process relating to satellite networks design stage for which complete RR Appendix 4 information for coordination has been received. Besides operational satellite systems, some other additional or succeeding BSS (sound) satellite systems are also planned to be deployed in the GSO. Currently, the coordination procedures in RR Nos. 9.11 and 9.19 are applied in order to reach the required sharing and compatibility conditions between the BSS and terrestrial services.

3/9.1.2/3 Summary and analysis of the results of ITU-R studies

3/9.1.2/3.1 Applicable ITU-R Recommendations and Reports

Recommendations: [ITU-R BO.789](#), [ITU-R BO.1130](#), [ITU-R P.452](#), [ITU-R P.1546](#), [ITU-R P.2001](#), [ITU-R M.2101](#)

Reports: [ITU-R M.2292](#)

PDN Report ITU-R M.[IMT&BSS COMPATIBILITY]

ITU-R Handbook: [DSB Handbook – Terrestrial and satellite digital sound broadcasting to vehicular, portable and fixed receivers in the VHF/UHF bands](#)

Recommendation [ITU-R P.452](#) is a path specific interference prediction method which requires a terrain profile. Recommendation [ITU-R P.1546](#) is a path general terrestrial model derived from measurements over gently rolling terrain.

3/9.1.2/3.2 BSS (sound) applications

3/9.1.2/3.2.1 Overview of BSS (sound) system characteristics

BSS systems operating in the frequency band 1 452-1 492 MHz provide an essential capability that cannot efficiently or effectively be replicated by two-way terrestrial systems. They can provide seamless coverage over an entire nation, region or continent reaching billions of people with multiple channels of programming, using a fraction of the bandwidth required by two-way terrestrial systems for equivalent services. The programming, including educational content, emergency notifications, news and entertainment, can be provided in sound, data and video format to fixed-site and mobile terminals. In the event of a natural disaster or emergency situation, where terrestrial infrastructure might be damaged or destroyed, the broadcast satellite capability would not be affected.

While the broadcasting-satellite systems currently deployed in the frequency band 1 452-1 492 MHz provide mobile services to cars, new, higher-powered satellites will leverage the propagation characteristics of the frequency mostly band to reach small handheld terminals, computer tablets and other mobile devices. This capability is important to support government and general population requirements in rural and remote areas that would otherwise not be serviced by the broadcasting service, as well as in more densely populated areas where terrestrial mobile services are well developed. The ability of BSS applications to reach many customers is very important for the public service.

3/9.1.2/3.2.2 BSS (sound) high power requirement

Satellites have proven themselves to be an important and effective broadcast technology, especially when covering very large regions. New BSS (sound) applications are planned for provision to smart

phones and tablets (without an external antenna), which could be complementary to IMT services. However, reaching small terminals while supporting high quality of service and providing high capacity, requires very high satellite power²⁹.

In particular, BSS handheld terminal receivers require the satellite signal to overcome body losses, multipath, shadowing and ill-defined antenna patterns, and therefore limiting power levels would preclude such services (see the details for this high power requirements in the relevant parts of the PDN Report ITU-R M.[IMT & BSS COMPATIBILITY]).

3/9.1.2/3.2.3 BSS (sound) terrestrial augmentations requirement

Existing BSS systems that have been widely adopted rely on terrestrial augmentations to reach places unreachable by satellites, such as urban canyons or along highways with low-elevation look-angles to the satellite. In such systems, transmission from BSS and terrestrial augmentations are compatible, as they broadcast the same programmes and are operated by the same entity. Enabling technologies include: 1) buffering programming to enable seamless switching between the satellite and terrestrial augmentations and 2) combining satellite and terrestrial signals to improve the overall signal-to-noise ratio (SNR).

However, since these terrestrial augmentations are used in particular applications for which no typical characteristics are available, and because in general satellite reception is deemed to be more sensible to interference than augmentation systems, it has been agreed that terrestrial augmentations would not be taken into account in the compatibility studies.

3/9.1.2/3.2.4 BSS (sound) protection requirement

From the viewpoint of avoiding interference, an exclusive use for the BSS (sound) may be preferred, in which complementary terrestrial sound broadcasting deployment is practical.

During the ITU-R studies, it was agreed that the *I/N* ratio of –12.2 dB be used as the protection criteria for BSS (sound) receiver, and can be treated as the BSS (sound) receiver protection requirement from IMT single-entry interference across national borders.

3/9.1.2/3.3 IMT applications

3/9.1.2/3.3.1 IMT system characteristics

IMT systems operating in the frequency band 1 452-1 492 MHz would be able to deliver mobile broadband applications due to a good balance of capacity and coverage over relatively large areas including inside buildings. Therefore, various types of IMT deployments are expected in this frequency band in rural, urban and indoor environments using macro and small cells.

Furthermore, ITU-R is developing frequency arrangements in a revision of Recommendation [ITU-R M.1036](#). The frequency arrangements are based on i) frequency division duplex (FDD) with IMT base-station transmission only, ii) FDD using a paired arrangement with IMT base-station and mobile-station transmission and iii) time-division duplex (TDD) using an un-paired arrangement with IMT base-station and mobile-station transmission. Therefore, it was essential to consider protection of both IMT base stations and mobile stations from BSS (sound) systems in the sharing and compatibility studies.

²⁹ See BSS (sound) satellite characteristics in Table 3-A of the PDN Report ITU-R M.[IMT & BSS COMPATIBILITY] Compatibility studies between IMT systems and BSS (sound) systems in the band 1 452-1 492 MHz in different countries in Regions 1 and 3.

3/9.1.2/3.3.2 IMT protection requirement

With respect to the characteristics of IMT systems to be used for sharing and compatibility studies, the parameters of IMT base stations and mobile stations are defined in the Report [ITU-R M.2292](#) in which the *I/N* of the protection criterion for IMT base stations and mobile stations is -6 dB, respectively. In the sharing and compatibility studies, Recommendation [ITU-R M.2101](#) – *Modelling and simulation of IMT networks for use in sharing and compatibility studies* may be used.

3/9.1.2/3.4 Possible actions with respect to issue 9.1.2

The following possible actions have been prepared with respect to WRC-19 agenda item 9.1, issue 9.1.2.

3/9.1.2/3.4.1 Possible action 1: Maintain status quo (i.e. no changes to the Radio Regulations)

This action is to maintain the status quo (i.e. no changes to the Radio Regulations) since the current regulations and technical conditions to ensure compatibility of IMT and BSS (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3 are sufficient and their change is not required.

3/9.1.2/3.4.2 Possible action 2: Maintain status quo (i.e. no changes to the Radio Regulations) for those countries for which the frequency band is not identified for IMT

This action is to maintain the status quo (i.e. no changes to the Radio Regulations) with respect to the countries for which the frequency band is not identified for IMT.

NOTE: With respect to the countries for which the frequency band is identified for IMT, other possible action may need to be applied.

3/9.1.2/3.4.3 Possible action 3: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of BSS (sound) and stipulate pfd limits for the protection of IMT in Regions 1 and 3

Under this action, maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of the BSS (sound). The protection of the BSS (sound) is achieved by the application of RR No. **9.19** currently in force.

On the other hand, for the protection of IMT, as indicated in *recognizing c*) in Resolution **761 (WRC-15)**, the application of RR No. **9.11** does not provide long-term stability for the operation of IMT due to the fact that only the IMT systems that would come into operation within the next three years would be protected if their coordination is agreed, and only for those three years. This situation implies that IMT systems may not be protected appropriately in those countries planning to deploy them in future, if the territory of those countries were covered by a satellite network service area provided by another country's BSS (sound) system(s). Therefore, this action is to specify pfd limit(s) at the Earth's surface produced by a space station in the BSS (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3. Then, RR No. **9.11** does not apply under this action. Three alternatives are available in this action. Alternatives 1 and 2 below stipulate the pfd limit(s) for Regions 1 and 3 in RR Table **21-4** under RR No. **21.16** taking into account the protection of IMT stations, and alternative 3 below stipulates the pfd limit(s) in a new footnote for Regions 1 and 3 taking into account the operational requirement of the BSS (sound) system pursuant to Resolution **761 (WRC-15)**. Alternative 1 is prepared for the downlink only frequency arrangement and alternative 2 is prepared for the FDD and TDD frequency arrangements.

Alternative 1:

-112.0 dB(W/m²) in 1 MHz for all angles of arrival above the horizontal plane,

where this pfd limit is derived from the results of sharing and compatibility studies regarding protection of IMT mobile stations assuming 1 dB body loss.

Alternative 2:

–131.3 dB(W/m²) in 1 MHz for angles of arrival ($0^\circ \leq \delta \leq 5^\circ$) above the horizontal plane,

–131.3 + 16/20($\delta - 5$) dB(W/m²) in 1 MHz for angles of arrival ($5^\circ \leq \delta \leq 25^\circ$) above the horizontal plane,

–115.3 dB(W/m²) in 1 MHz for angles of arrival ($25^\circ \leq \delta \leq 90^\circ$) above the horizontal plane,

where these pfd limits are derived from the results of sharing and compatibility studies regarding protection of both IMT base and mobile stations.

Alternative 3:

This alternative specifies pfd limitation by addition of the footnote RR No. **5.A912**, in which the operational requirement is appropriately considered as requested by Resolution **761 (WRC-15)**,

–91.5 dB(W/m²) in 4 MHz,

where this pfd limit is calculated from the e.i.r.p. value 70.8 dBW in this frequency band of a space station of BSS (sound); however, this pfd limit is not sufficient to protect IMT stations according to the results of sharing and compatibility studies.

Examples of new footnotes are as follows.

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

1 300-1 525 MHz

| Allocation to services | | |
|--|---|----------|
| Region 1 | Region 2 | Region 3 |
| 1 452-1 492 FIXED MOBILE except aeronautical mobile 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B <u>ADD 5.A912</u> 5.341 5.342 5.345 | 1 452-1 492 FIXED MOBILE 5.341B 5.343 5.346A BROADCASTING BROADCASTING-SATELLITE 5.208B <u>ADD 5.A912</u> 5.341 5.344 5.345 | |

Alternatives 1 and 2:**ADD**

5.A912 Use of the frequency band 1 452-1 492 MHz in Regions 1 and 3 by the broadcasting-satellite service, and by the broadcasting service, is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (Rev.WRC-15)**. The power flux-density (pfd) at the Earth's surface given in Table **21-4** of Article **21** for the broadcasting-satellite service, shall apply on the territory of the countries in Regions 1 and 3. (WRC-19)

ARTICLE 21**Terrestrial and space services sharing frequency bands above 1 GHz****Section V – Limits of power flux-density from space stations****Alternative 1:****MOD****TABLE 21-4** (REV.WRC-~~15~~19)

| Frequency band | Service* | Limit in dB(W/m ²) for angles of arrival (δ) above the horizontal plane | | | Reference bandwidth |
|--|--|--|--------|---------|------------------------|
| | | 0°-5° | 5°-25° | 25°-90° | |
| ... | ... | ... | ... | ... | ... |
| <u>1 452-1 492 MHz</u> <u>(Applicable to the</u> <u>territory of the</u> <u>administrations in</u> <u>Regions 1 and 3)</u> | <u>Broadcasting-</u> <u>satellite</u> | <u>-112</u> | | | <u>1 MHz</u> |
| ... | ... | ... | ... | ... | ... |

Alternative 2:**MOD**

TABLE 21-4 (REV.WRC-1519)

| Frequency band | Service* | Limit in dB(W/m ²) for angles of arrival (δ) above the horizontal plane | | | Reference bandwidth |
|---|-------------------------------|--|--|----------------|---------------------|
| | | 0°-5° | 5°-25° | 25°-90° | |
| ... | ... | ... | ... | ... | ... |
| <u>1 452-1 492 MHz</u> (Applicable to the territory of the administrations in Regions 1 and 3) | <u>Broadcasting-satellite</u> | <u>0°-5°</u> | <u>5°-25°</u> | <u>25°-90°</u> | <u>1 MHz</u> |
| | | <u>-131.3</u> | <u>$-131.3 + 16/20(\delta - 5)$</u> | <u>-115.3</u> | |
| ... | ... | ... | ... | ... | ... |

Alternative 3:**ADD**

5.A912 Use of the frequency band 1 452-1 492 MHz in Regions 1 and 3 by the broadcasting-satellite service, and by the broadcasting service, is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (Rev.WRC-15)**. Before an administration brings into use a BSS (sound) satellite network in the frequency band 1 452-1 492 MHz, it shall ensure that the power flux-density (pfd) at the Earth's surface produced by the space station does not exceed -91.5 dB(W/m²) in 4 MHz, unless otherwise agreed between the administrations concerned.

No. **9.11** does not apply. (WRC-19)

3/9.1.2/3.4.4 Possible action 4: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of BSS (sound) and stipulate pfd limits for the protection of IMT in some countries of Regions 1 and 3

Under this action, maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of the BSS (sound). The protection of the BSS (sound) is achieved by the application of RR No. **9.19** currently in force.

On the other hand, for the protection of IMT, as indicated in *recognizing c)* in Resolution **761 (WRC-15)**, the application of RR No. **9.11** does not provide long-term stability for the operation of IMT due to the fact that only the IMT systems that would come into operation within the next three years would be protected if their coordination is agreed, and only for those three years. This situation implies that IMT systems may not be protected appropriately in those countries planning to deploy them in future, if the territory of those countries were covered by a satellite network service area provided by another country's BSS (sound) system(s). Therefore, this action is to specify pfd limit(s) at the Earth's surface produced by a space station in the BSS (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3 with respect to the territory of administrations for which this frequency band is identified for usage by International Mobile Telecommunications (IMT) in accordance with RR Nos. **5.346** and **5.346A**. Then, coordination does not require for RR No. **9.11** under this action with the administrations specified in RR Nos. **5.346** and **5.346A**. Three

alternatives are available in this action. Alternatives 1 and 2 below stipulate the pfd limit(s) for Regions 1 and 3 in RR Table **21-4** under RR No. **21.16** on the territory of administrations specified in RR Nos. **5.346** and **5.346A** taking into account the protection of IMT stations, and alternative 3 below stipulates the pfd limit(s) in a new footnote for Regions 1 and 3 on the territory of administrations specified in RR Nos. **5.346** and **5.346A** taking into account the operational requirement of the BSS (sound) system pursuant to Resolution **761 (WRC-15)**. Alternative 1 is prepared for the downlink only frequency arrangement and alternative 2 is prepared for the FDD and TDD frequency arrangements.

Alternative 1:

−112.0 dB(W/m²) in 1 MHz for all angles of arrival above the horizontal plane, where this pfd limit is derived from the results of sharing and compatibility studies regarding protection of IMT mobile stations assuming 1 dB body loss. An example is presented below:

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

1 300-1 525 MHz

| Allocation to services | | |
|--|---|----------|
| Region 1 | Region 2 | Region 3 |
| 1 452-1 492 FIXED MOBILE except aeronautical mobile 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B <u>ADD 5.A912</u> 5.341 5.342 5.345 | 1 452-1 492 FIXED MOBILE 5.341B 5.343 5.346A BROADCASTING BROADCASTING-SATELLITE 5.208B <u>ADD 5.A912</u> 5.341 5.344 5.345 | |

ADD

5.A912 Use of the frequency band 1 452-1 492 MHz in Regions 1 and 3 by the broadcasting-satellite service, and by the broadcasting service, is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (Rev.WRC-15)**. The pfd limit from Table **21-4** No. **21.16** is applicable only to the territories of the administrations for which this frequency band is identified for usage by International Mobile Telecommunications (IMT) in accordance with Nos. **5.346** and **5.346A**. Coordination for the space stations of the broadcasting-satellite service in the considered frequency band in accordance with No. **9.11** is not required with respect to the administrations specified in Nos. **5.346** and **5.346A**. (WRC-19)

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz**Section V – Limits of power flux-density from space stations****MOD**

TABLE 21-4 (Rev.WRC-1519)

| Frequency band | Service* | Limit in dB(W/m ²) for angles of arrival (δ) above the horizontal plane | | | | Reference bandwidth |
|---|---|---|---------------------|---------------------|---------------|---------------------|
| | | 0°-5° | 5°-25° | | 25°-90° | |
| 1 670-1 700 MHz | Earth exploration-satellite Meteorological-satellite | -133 (value based on sharing with meteorological aids service) | | | | 1.5 MHz |
| 1 518-1 525 MHz (Applicable to the territory of the United States in Region 2 between the longitudes 71° W and 125° W) | Mobile-satellite (space-to-Earth) | 0° ≤ δ ≤ 4° | 4° < δ ≤ 20° | 20° < δ ≤ 60° | 60° < δ ≤ 90° | 4 kHz |
| | | -181.0 | -193.0 + 20 log δ | -213.3 + 35.6 log δ | -150.0 | |
| 1 518-1 525 MHz (Applicable to all other territory of the United States in Region 2) | Mobile-satellite (space-to-Earth) | 0° ≤ δ ≤ 43.4° | 43.4° < δ ≤ 60° | | 60° < δ ≤ 90° | 4 kHz |
| | | -155.0 | -213.3 + 35.6 log δ | | -150.0 | |
| <u>1 452-1 492 MHz</u> <u>(Applicable to the territory of the administrations specified in Nos. 5.346 and 5.346A)</u> | <u>Broadcasting-satellite</u> | <u>-112</u> | | | | <u>1 MHz</u> |
| ... | ... | ... | | | | ... |

APPENDIX 5 (REV.WRC-15)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MODTABLE 5-1 (Rev.WRC-~~15~~19)

Technical conditions for coordination
(see Article 9)

| Reference of Article 9 | Case | Frequency bands (and Region) of the service for which coordination is sought | Threshold/condition | Calculation method | Remarks |
|--|--|--|--|--|---------|
| ... | ... | ... | ... | ... | ... |
| No. 9.11 GSO, non-GSO/ terrestrial | A space station in the BSS in any band shared on an equal primary basis with terrestrial services and where the BSS is not subject to a Plan, in respect of terrestrial services | 620-790 MHz (see Resolution 549 (WRC-07)) 1 452-1 492 MHz 2 310-2 360 MHz (No. 5.393) 2 535-2 655 MHz (Nos. 5.417A and 5.418) 17.7-17.8 GHz (Region 2) 74-76 GHz | Bandwidths overlap: The detailed conditions for the application of No. 9.11 in the bands 2 630-2 655 MHz and 2 605-2 630 MHz are provided in Resolution 539 (Rev.WRC-03) for non-GSO BSS (sound) systems pursuant to Nos. 5.417A and 5.418 , and in Nos. 5.417A and 5.418 for GSO BSS (sound) networks pursuant to those provisions. <u>Detailed information regarding conditions of application for No. 9.11 in the frequency band 1 452-1 492 MHz for BSS (sound) systems are provided in No. 5.A912.</u> | Check by using the assigned frequencies and bandwidths | |
| ... | ... | ... | ... | ... | ... |

Alternative 2:

–131.3 dB(W/m²) in 1 MHz for angles of arrival ($0^\circ \leq \delta \leq 5^\circ$) above the horizontal plane,

–131.3 + 16/20($\delta - 5$) dB(W/m²) in 1 MHz for angles of arrival ($5^\circ \leq \delta \leq 25^\circ$) above the horizontal plane,

–115.3 dB(W/m²) in 1 MHz for angles of arrival ($25^\circ \leq \delta \leq 90^\circ$) above the horizontal plane,

where these pfd limits are derived from the results of sharing and compatibility studies regarding protection of both IMT base and mobile stations. An example is presented below:

ARTICLE 5**Frequency allocations****Section IV – Table of Frequency Allocations**

(See No. 2.1)

MOD**1 300-1 525 MHz**

| Allocation to services | | |
|--|---|----------|
| Region 1 | Region 2 | Region 3 |
| 1 452-1 492 FIXED MOBILE except aeronautical mobile 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B <u>ADD 5.A912</u> 5.341 5.342 5.345 | 1 452-1 492 FIXED MOBILE 5.341B 5.343 5.346A BROADCASTING BROADCASTING-SATELLITE 5.208B <u>ADD 5.A912</u> 5.341 5.344 5.345 | |

ADD

5.A912 Use of the frequency band 1 452-1 492 MHz in Regions 1 and 3 by the broadcasting-satellite service, and by the broadcasting service, is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (Rev.WRC-15)**. The pfd limit from Table **21-4** No. **21.16** is applicable only to the territories of the administrations for which this frequency band is identified for usage by International Mobile Telecommunications (IMT) in accordance with Nos. **5.346** and **5.346A**. Coordination for the space stations of the broadcasting satellite service in the considered frequency band in accordance with No. **9.11** is not required with respect to the administrations specified in Nos. **5.346** and **5.346A**. (WRC-19)

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz**Section V – Limits of power flux-density from space stations****MOD**

TABLE 21-4 (Rev.WRC-15.19)

| Frequency band | Service* | Limit in dB(W/m ²) for angles of arrival (δ) above the horizontal plane | | | | Reference bandwidth |
|---|---|---|------------------------------|---------------------|----------------|---------------------|
| | | 0°-5° | 5°-25° | | 25°-90° | |
| 1 670-1 700 MHz | Earth exploration-satellite Meteorological-satellite | -133 (value based on sharing with meteorological aids service) | | | | 1.5 MHz |
| 1 518-1 525 MHz (Applicable to the territory of the United States in Region 2 between the longitudes 71° W and 125° W) | Mobile-satellite (space-to-Earth) | 0° ≤ δ ≤ 4° | 4° < δ ≤ 20° | 20° < δ ≤ 60° | 60° < δ ≤ 90° | 4 kHz |
| | | -181.0 | -193.0 + 20 log δ | -213.3 + 35.6 log δ | -150.0 | |
| 1 518-1 525 MHz (Applicable to all other territory of the United States in Region 2) | Mobile-satellite (space-to-Earth) | 0° ≤ δ ≤ 43.4° | 43.4° < δ ≤ 60° | | 60° < δ ≤ 90° | 4 kHz |
| | | -155.0 | -213.3 + 35.6 log δ | | -150.0 | |
| <u>1 452-1 492 MHz</u> <u>(Applicable to the territory of the administrations specified in Nos. 5.346 and 5.346A)</u> | <u>Broadcasting-satellite</u> | <u>0°-5°</u> | <u>5°-25°</u> | | <u>25°-90°</u> | <u>1 MHz</u> |
| | | <u>-131.3</u> | <u>-131.3 + 16/20(δ - 5)</u> | | <u>-115.3</u> | |
| --- | --- | --- | --- | | --- | --- |

APPENDIX 5 (REV.WRC-15)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MODTABLE 5-1 (Rev.WRC-~~15~~19)**Technical conditions for coordination**
(see Article 9)

| Reference of Article 9 | Case | Frequency bands (and Region) of the service for which coordination is sought | Threshold/condition | Calculation method | Remarks |
|--|--|--|--|--|---------|
| ... | ... | ... | ... | ... | ... |
| No. 9.11 GSO, non-GSO/ terrestrial | A space station in the BSS in any band shared on an equal primary basis with terrestrial services and where the BSS is not subject to a Plan, in respect of terrestrial services | 620-790 MHz (see Resolution 549 (WRC-07)) 1 452-1 492 MHz 2 310-2 360 MHz (No. 5.393) 2 535-2 655 MHz (Nos. 5.417A and 5.418) 17.7-17.8 GHz (Region 2) 74-76 GHz | Bandwidths overlap: The detailed conditions for the application of No. 9.11 in the bands 2 630-2 655 MHz and 2 605-2 630 MHz are provided in Resolution 539 (Rev.WRC-03) for non-GSO BSS (sound) systems pursuant to Nos. 5.417A and 5.418 , and in Nos. 5.417A and 5.418 for GSO BSS (sound) networks pursuant to those provisions. <u>Detailed information regarding conditions of application for No. 9.11 in the frequency band 1 452-1 492 MHz for BSS (sound) systems are provided in No. 5.A912.</u> | Check by using the assigned frequencies and bandwidths | |
| ... | ... | ... | ... | ... | ... |

Alternative 3:

This alternative specifies pfd limitation by addition of the footnote RR No. **5.A912**, in which the operational requirement of BSS (sound) is appropriately considered as requested by Resolution **761 (WRC-15)**,

−91.5 dB(W/m²) in 4 MHz,

where this pfd limit is calculated from the e.i.r.p. value 70.8 dBW in this frequency band of a space station of BSS (sound); however, this pfd limit is not sufficient to protect IMT stations according to the results of sharing and compatibility studies. An example of a new footnote is as follows.

ARTICLE 5**Frequency allocations****Section IV – Table of Frequency Allocations**

(See No. 2.1)

MOD**1 300-1 525 MHz**

| Allocation to services | | |
|--|---|----------|
| Region 1 | Region 2 | Region 3 |
| 1 452-1 492 FIXED MOBILE except aeronautical mobile 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B <u>ADD 5.A912</u> 5.341 5.342 5.345 | 1 452-1 492 FIXED MOBILE 5.341B 5.343 5.346A BROADCASTING BROADCASTING-SATELLITE 5.208B <u>ADD 5.A912</u> 5.341 5.344 5.345 | |

ADD

5.A912 Use of the frequency band 1 452-1 492 MHz in Regions 1 and 3 by the broadcasting-satellite service, and by the broadcasting service, is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (Rev.WRC-15)**. Before an administration brings into use a BSS (sound) satellite network in the frequency band 1 452-1 492 MHz, it shall ensure that the power flux-density (pfd) at the Earth's surface produced by the space station with respect to the administrations for which this frequency band is identified for usage by International Mobile Telecommunications (IMT) in accordance with Nos. **5.346** and **5.346A** does not exceed −91.5 dB(W/m²) in 4 MHz, unless otherwise agreed between the administrations concerned. No. **9.11** does not apply with respect to the administrations for which this frequency band is identified for usage by International Mobile Telecommunications (IMT) in accordance with Nos. **5.346** and **5.346A**. (WRC-19)

APPENDIX 5 (REV.WRC-15)

**Identification of administrations with which coordination is to be effected or
agreement sought under the provisions of Article 9**

MOD

TABLE 5-1 (Rev.WRC-15)

Technical conditions for coordination
(see Article 9)

| Reference of Article 9 | Case | Frequency bands (and Region) of the service for which coordination is sought | Threshold/condition | Calculation method | Remarks |
|---|---|---|--|--|---------|
| ... | ... | ... | ... | ... | ... |
| No. 9.11 GSO, non-GSO/ terrestrial | A space station in the BSS in any band shared on an equal primary basis with terrestrial services and where the BSS is not subject to a Plan, in respect of terrestrial services | 620-790 MHz (see Resolution 549 (WRC-07)) 1 452-1 492 MHz 2 310-2 360 MHz (No. 5.393) 2 535-2 655 MHz (Nos. 5.417A and 5.418) 17.7-17.8 GHz (Region 2) 74-76 GHz | Bandwidths overlap: The detailed conditions for the application of No. 9.11 in the bands 2 630-2 655 MHz and 2 605- 2 630 MHz are provided in Resolution 539 (Rev.WRC-03) for non-GSO BSS (sound) systems pursuant to Nos. 5.417A and 5.418, and in Nos. 5.417A and 5.418 for GSO BSS (sound) networks pursuant to those provisions. <u>Detailed information regarding conditions of application for No. 9.11 in the frequency band 1 452-1 492 MHz for BSS (sound) systems are provided in No. 5.A912.</u> | Check by using the assigned frequencies and bandwidths | |
| ... | ... | ... | ... | ... | ... |

3/9.1.2/3.4.5 Possible action 5: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of IMT and stipulate pfd limits for the protection of BSS (sound) in Regions 1 and 3

Under this action, maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of the IMT stations. The protection of IMT stations is therefore achieved by the application of RR No. **9.11** currently in force.

On the other hand, in order to ease the coordination under RR No. **9.19**, the mandatory action for the protection of BSS (sound) receivers shall be applied in which RR No. **21.2.1** shall also be considered. Then, RR No. **9.19** does not apply under this action. By modification of RR Nos. **5.346** and **5.346A**, this action stipulates the pfd limit across the borders between relevant countries, as follows.

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

1 300-1 525 MHz

| Allocation to services | | |
|---|--|----------|
| Region 1 | Region 2 | Region 3 |
| 1 452-1 492 FIXED MOBILE except aeronautical mobile MOD 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B 5.341 5.342 5.345 | 1 452-1 492 FIXED MOBILE 5.341B 5.343 MOD 5.346A BROADCASTING BROADCASTING-SATELLITE 5.208B 5.341 5.344 5.345 | |

MOD

5.346 In Algeria, Angola, Saudi Arabia, Bahrain, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo (Rep. of the), Côte d'Ivoire, Djibouti, Egypt, United Arab Emirates, Gabon, Gambia, Ghana, Guinea, Iraq, Jordan, Kenya, Kuwait, Lesotho, Lebanon, Liberia, Madagascar, Malawi, Mali, Morocco, Mauritius, Mauritania, Mozambique, Namibia, Niger, Nigeria, Oman, Uganda, Palestine**, Qatar, Dem. Rep. of the Congo, Rwanda, Senegal, Seychelles, Sudan, South Sudan, South Africa, Swaziland, Tanzania, Chad, Togo, Tunisia, Zambia, and Zimbabwe, the frequency band 1 452-1 492 MHz is identified for use by administrations listed above wishing to implement International Mobile Telecommunications (IMT) in accordance with Resolution **223 (Rev.WRC-15)**. This identification does not preclude the use of this frequency band by any other application of the services to which it is allocated and does not establish priority in the Radio Regulations. The use of this frequency band for the implementation of IMT is subject to

agreement obtained under No. **9.21** with respect to the aeronautical mobile service used for aeronautical telemetry in accordance with No. **5.342**. See also Resolution **761 (WRC-15)**. Before an administration brings into use an IMT system in the frequency band 1 452-1 492 MHz, it shall ensure that the power flux-density (pfd) produced by any IMT transmitting station at 3 m above the ground of any point of the territory of any other administration which is within the service area of a satellite network in the broadcasting-satellite service in this frequency band does not exceed $-159.4 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz))}$, unless otherwise agreed between the administrations concerned. (WRC-15~~19~~)

MOD

5.346A The frequency band 1 452-1 492 MHz is identified for use by administrations in Region 3 wishing to implement International Mobile Telecommunications (IMT) in accordance with Resolution **223 (Rev.WRC-15)** and Resolution **761 (WRC-15)**. The use of this frequency band by the above administrations for the implementation of IMT is subject to agreement obtained under No. **9.21** from countries using stations of the aeronautical mobile service. This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Before an administration brings into use an IMT system in the frequency band 1 452-1 492 MHz, it shall ensure that the power flux-density (pfd) produced by any IMT transmitting station at 3 m above the ground of any point of the territory of any other administration which is within the service area of a satellite network in the broadcasting-satellite service in this frequency band does not exceed $-159.4 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz))}$, unless otherwise agreed between the administrations concerned. (WRC-15~~19~~)

3/9.1.2/3.4.6 Possible action 6: Stipulate pfd limits for the protection of both IMT and BSS (sound) in Regions 1 and 3

Under this action, stipulate pfd limits for the protection of both IMT and BSS (sound) in Regions 1 and 3.

The protection of IMT stations is the same as that in section 3/9.1.2/3.4.3. The protection of BSS (sound) receivers is the same as that in section 3/9.1.2/3.4.5.

3/9.1.2/3.4.7 Possible action 7: Stipulate pfd limits for the protection of both IMT and BSS (sound) in some countries of Regions 1 and 3

Under this action, stipulate pfd limits for the protection of both IMT and BSS (sound) in some countries of Regions 1 and 3, specified in RR Nos. **5.346** and **5.346A**.

The protection of IMT stations is the same as that in section 3/9.1.2/3.4.4. The protection of BSS (sound) receivers is the same as that in section 3/9.1.2/3.4.5.

3/9.1.2/3.4.8 Possible action 8: Stipulate a new coordination threshold for the protection of both IMT and BSS (sound) in Regions 1 and 3

Under this action, stipulate a new coordination threshold for the protection of both IMT and BSS (sound) in Regions 1 and 3.

Coordination under RR No. **9.19** is applied to address the interference from an IMT system into a BSS (sound) earth station where the pfd threshold is exceeded. The BSS (sound) earth station receiver may receive aggregate interference from IMT transmissions which needs further studies.

Meanwhile, coordination under RR No. **9.11** is applied to address the interference from BSS (sound) into an IMT station where the pfd threshold is exceeded. Therefore, no pfd mandatory limitation is imposed under RR Article **21** to the BSS (sound) space station and no pfd mandatory limitation is set up across the borders in the 1 452-1 492 MHz frequency band. In addition, RR No. **21.2.1** should also be considered. Addition of relevant RR provisions is proposed accordingly.

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

(See No. **2.1**)

MOD

1 300-1 525 MHz

| Allocation to services | | |
|---|--|----------|
| Region 1 | Region 2 | Region 3 |
| 1 452-1 492 FIXED MOBILE except aeronautical mobile MOD 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B ADD 5.B912 5.341 5.342 5.345 | 1 452-1 492 FIXED MOBILE 5.341B 5.343 MOD 5.346A BROADCASTING BROADCASTING-SATELLITE 5.208B ADD 5.B912 5.341 5.344 5.345 | |

MOD

5.346 In Algeria, Angola, Saudi Arabia, Bahrain, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo (Rep. of the), Côte d'Ivoire, Djibouti, Egypt, United Arab Emirates, Gabon, Gambia, Ghana, Guinea, Iraq, Jordan, Kenya, Kuwait, Lesotho, Lebanon, Liberia, Madagascar, Malawi, Mali, Morocco, Mauritius, Mauritania, Mozambique, Namibia, Niger, Nigeria, Oman, Uganda, Palestine**, Qatar, Dem. Rep. of the Congo, Rwanda, Senegal, Seychelles, Sudan, South Sudan, South Africa, Swaziland, Tanzania, Chad, Togo, Tunisia, Zambia, and Zimbabwe, the frequency band 1 452-1 492 MHz is identified for use by administrations listed above wishing to implement International Mobile Telecommunications (IMT) in accordance with Resolution **223 (Rev.WRC-15)**. This identification does not preclude the use of this frequency band by any other application of the services to which it is allocated and does not establish priority in the Radio Regulations. The use of this frequency band for the implementation of IMT is subject to agreement obtained under No. **9.21** with respect to the aeronautical mobile service used for aeronautical telemetry in accordance with No. **5.342**. See also Resolution **761 (WRC-15)**. Before an administration brings into use an IMT system in the frequency band 1 452-1 492 MHz, it should ensure that the power flux-density (pfd) produced by any IMT transmitting station at 3 m above the ground of any point of the territory of any other administration which is within the service area of a satellite network in the broadcasting-satellite service in this frequency band does not exceed

–159.4 dB(W/(m² · 4 kHz)), unless otherwise agreed between the administrations concerned. (WRC-15~~19~~)

MOD

5.346A The frequency band 1 452-1 492 MHz is identified for use by administrations in Region 3 wishing to implement International Mobile Telecommunications (IMT) in accordance with Resolution **223 (Rev.WRC-15)** and Resolution **761 (WRC-15)**. The use of this frequency band by the above administrations for the implementation of IMT is subject to agreement obtained under No. **9.21** from countries using stations of the aeronautical mobile service. This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Before an administration brings into use an IMT system in the frequency band 1 452-1 492 MHz, it should ensure that the power flux-density (pfd) produced by any IMT transmitting station at 3 m above the ground of any point of the territory of any other administration which is within the service area of a satellite network in the broadcasting-satellite service in this frequency band does not exceed –159.4 dB(W/(m² · 4 kHz)), unless otherwise agreed between the administrations concerned. (WRC-15~~19~~)

Note: Under this action, it is also proposed to keep the current application of RR Nos. **9.11** and **9.19**, and no mandatory pfd limitation set up under RR Article **21** to the BSS (sound) space station or across national borders in the 1 452-1 492 MHz frequency band. In addition, RR No. **21.2.1** should be considered.

ADD

5.B912 Use of the frequency band 1 452-1 492 MHz in Regions 1 and 3 by the broadcasting-satellite service, and by the broadcasting service, is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (Rev.WRC-15)**. Before an administration brings into use a BSS (sound) satellite network in the frequency band 1 452-1 492 MHz, it should ensure that the power flux-density (pfd) at the Earth's surface produced by the space station does not exceed –106 dB(W/(m² · MHz)), unless otherwise agreed between the administrations concerned. Nos. **9.11** and **9.52C** still apply. (WRC-19)

NOTE: The pfd value –106 dB(W/(m² · MHz)) is calculated from the e.i.r.p. value 70.8 dBW in 25 MHz of the space station of BSS (sound).

3/9.1.2/3.4.9 Possible action 9: Stipulate a new coordination threshold for the protection of both IMT and BSS (sound) in some countries of Regions 1 and 3

Under this action, stipulate a new coordination threshold for the protection of both IMT and BSS (sound) in some countries of Regions 1 and 3, specified in RR Nos. **5.346** and **5.346A**.

Coordination under RR No. **9.19** is applied to address the interference from an IMT system into a BSS (sound) earth station where the pfd threshold is exceeded. The BSS (sound) earth station receiver may receive aggregate interference from IMT transmissions which needs further studies.

Meanwhile, coordination under RR No. **9.11** is applied to address the interference from BSS (sound) into an IMT station where the pfd threshold is exceeded. Therefore, no pfd mandatory limitation is imposed under RR Article **21** to the BSS (sound) space station and no pfd mandatory limitation is set up across the borders in the 1 452-1 492 MHz frequency band. In addition, RR No. **21.2.1** should also be considered. Addition of relevant RR provisions is proposed accordingly.

ARTICLE 5

Frequency allocations**Section IV – Table of Frequency Allocations**

(See No. 2.1)

MOD**1 300-1 525 MHz**

| Allocation to services | | |
|---|--|----------|
| Region 1 | Region 2 | Region 3 |
| 1 452-1 492 FIXED MOBILE except aeronautical mobile MOD 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B ADD 5.B912 5.341 5.342 5.345 | 1 452-1 492 FIXED MOBILE 5.341B 5.343 MOD 5.346A BROADCASTING BROADCASTING-SATELLITE 5.208B ADD 5.B912 5.341 5.344 5.345 | |

MOD

5.346 In Algeria, Angola, Saudi Arabia, Bahrain, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo (Rep. of the), Côte d'Ivoire, Djibouti, Egypt, United Arab Emirates, Gabon, Gambia, Ghana, Guinea, Iraq, Jordan, Kenya, Kuwait, Lesotho, Lebanon, Liberia, Madagascar, Malawi, Mali, Morocco, Mauritius, Mauritania, Mozambique, Namibia, Niger, Nigeria, Oman, Uganda, Palestine**, Qatar, Dem. Rep. of the Congo, Rwanda, Senegal, Seychelles, Sudan, South Sudan, South Africa, Swaziland, Tanzania, Chad, Togo, Tunisia, Zambia, and Zimbabwe, the frequency band 1 452-1 492 MHz is identified for use by administrations listed above wishing to implement International Mobile Telecommunications (IMT) in accordance with Resolution **223 (Rev.WRC-15)**. This identification does not preclude the use of this frequency band by any other application of the services to which it is allocated and does not establish priority in the Radio Regulations. The use of this frequency band for the implementation of IMT is subject to agreement obtained under No. **9.21** with respect to the aeronautical mobile service used for aeronautical telemetry in accordance with No. **5.342**. See also Resolution **761 (WRC-15)**. Before an administration brings into use an IMT system in the frequency band 1 452-1 492 MHz, it should ensure that the power flux-density (pfd) produced by any IMT transmitting station at 3 m above the ground of any point of the territory of any other administration which is within the service area of a satellite network in the broadcasting-satellite service in this frequency band does not exceed $-159.4 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz))}$, unless otherwise agreed between the administrations concerned. (WRC-15¹⁹)

MOD

5.346A The frequency band 1 452-1 492 MHz is identified for use by administrations in Region 3 wishing to implement International Mobile Telecommunications (IMT) in accordance

with Resolution **223 (Rev.WRC-15)** and Resolution **761 (WRC-15)**. The use of this frequency band by the above administrations for the implementation of IMT is subject to agreement obtained under No. **9.21** from countries using stations of the aeronautical mobile service. This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Before an administration brings into use an IMT system in the frequency band 1 452-1 492 MHz, it should ensure that the power flux-density (pfd) produced by any IMT transmitting station at 3 m above the ground of any point of the territory of any other administration which is within the service area of a satellite network in the broadcasting-satellite service in this frequency band does not exceed $-159.4 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz))}$, unless otherwise agreed between the administrations concerned. (WRC-15~~19~~)

Note: Under this action, it is also proposed to keep the current application of RR Nos. **9.11** and **9.19**, and no mandatory pfd limitation set up under RR Article 21 to the BSS (sound) space station or across national borders in the 1 452-1 492 MHz frequency band. In addition, RR No. **21.2.1** should be considered.

ADD

5.B912 Use of the frequency band 1 452-1 492 MHz in Regions 1 and 3 by the broadcasting-satellite service, and by the broadcasting service, is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (Rev.WRC-15)**. Before an administration brings into use a BSS (sound) satellite network in the frequency band 1 452-1 492 MHz, it should ensure that the power flux-density (pfd) at the Earth's surface produced by the space station on the territory of the administrations for which this frequency band is identified for usage by International Mobile Telecommunications (IMT) in accordance with Nos. **5.346** and **5.346A** does not exceed $-106 \text{ dB(W/(m}^2 \cdot \text{MHz))}$, unless otherwise agreed between the administrations concerned. Nos. **9.11** and **9.52C** still apply. (WRC-19)

NOTE: The pfd value $-106 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ is calculated from the e.i.r.p. value 70.8 dBW in 25 MHz of the space station of BSS (sound).

3/9.1.2/4 Conclusions

Based on the results of ITU-R studies as detailed in section 3/9.1.2/3.4 above, the following possible actions below were prepared in order to facilitate the long-term stability of IMT and BSS (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3.

Possible action 1: Maintain status quo (i.e. no changes to the Radio Regulations)

This action proposes to maintain the status quo (i.e. no changes to the Radio Regulations) since the current regulations and technical conditions to ensure compatibility of IMT and BSS (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3 are sufficient and their change is not required.

Possible action 2: Maintain status quo (i.e. no changes to the Radio Regulations) for those countries for which the frequency band is not identified for IMT

This action proposes to maintain the status quo (i.e. no changes to the Radio Regulations) with respect to the countries for which the frequency band is not identified for IMT. With respect to the countries where IMT is identified the modifications to current provisions can be applied in the Radio Regulations appropriately.

Possible action 3: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of BSS (sound) and stipulate pfd limits for the protection of IMT in Regions 1 and 3

This action proposes to maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of the BSS (sound) receivers and to stipulate pfd limitation to BSS (sound) space stations for the protection of IMT in Regions 1 and 3. Alternatives 1 and 2 stipulate the pfd limit(s) in RR Table 21-4 under RR No. 21.16, taking into account protection of IMT, pursuant to Resolution 761 (WRC-15).

In addition, alternative 3 stipulates the pfd limit(s) in a new footnote, taking into account the operational requirement of BSS (sound) system pursuant to Resolution 761 (WRC-15).

Possible action 4: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of BSS (sound) and stipulate pfd limits for the protection of IMT in some countries of Regions 1 and 3

This action proposes to maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of the BSS (sound) receivers and to stipulate pfd limitation to BSS (sound) space stations for the protection of IMT in some countries of Regions 1 and 3, specified in RR Nos. 5.346 and 5.346A. Alternatives 1 and 2 stipulate the pfd limit(s) in RR Table 21-4 under RR No. 21.16, taking into account protection of IMT, pursuant to Resolution 761 (WRC-15).

In addition, alternative 3 stipulates the pfd limit(s) in a new footnote, taking into account the operational requirement of BSS (sound) system pursuant to Resolution 761 (WRC-15).

Possible action 5: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of IMT and stipulate pfd limits for the protection of BSS (sound) in Regions 1 and 3

This action proposes to maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of IMT stations and to stipulate pfd limitation to IMT for the protection of the BSS (sound) receivers by modification of RR Nos. 5.346 and 5.346A.

Possible action 6: Stipulate pfd limits for the protection of both IMT and BSS (sound) in Regions 1 and 3

The protection of IMT stations is the same as that in possible action 3. The protection of BSS (sound) receivers is the same as that in possible action 5.

Possible action 7: Stipulate pfd limits for the protection of both IMT and BSS (sound) in some countries of Regions 1 and 3

The protection of IMT stations is the same as that in possible action 4. The protection of BSS (sound) receivers is the same as that in possible action 5.

Possible action 8: Stipulate a new coordination threshold for the protection of both IMT and BSS (sound) in Regions 1 and 3

This action proposes to stipulate a coordination threshold for RR Nos. 9.11 and 9.19 based on new pfd values to reach coexistence for protection of BSS (sound) and IMT in Regions 1 and 3.

Possible action 9: Stipulate a new coordination threshold for the protection of both IMT and BSS (sound) in some countries of Regions 1 and 3

This action proposes to stipulate a coordination threshold for RR Nos. 9.11 and 9.19 based on new pfd values to reach coexistence for protection of BSS (sound) and IMT in some countries of Regions 1 and 3, specified in RR Nos. 5.346 and 5.346A.

The following Table 1 summarizes the possible actions as mentioned above with respect to WRC-19 agenda item 9.1, issue 9.1.2, in Regions 1 and 3.

TABLE 1
Possible actions with respect to WRC-19 agenda item 9.1, issue 9.1.2, in Regions 1 and 3, pursuant to Resolution 761 (WRC-15)

| Possible action | Protection of IMT stations | Protection of BSS (sound) receivers |
|-----------------|---|--|
| 1 | Maintain status quo (i.e. no changes to the Radio Regulations). | Maintain status quo (i.e. no changes to the Radio Regulations). |
| 2 | Maintain status quo (i.e. no changes to the Radio Regulations) for those countries for which the frequency band is not identified for IMT. | Maintain status quo (i.e. no changes to the Radio Regulations) for those countries for which the frequency band is not identified for IMT. |
| 3 | <p>Stipulate pfd limit(s) for BSS (sound) space stations in Regions 1 and 3. Three alternatives are available in this action.</p> <p><u>Alternative 1</u>: The pfd limit is stipulated in RR Table 21-4 under RR No. 21.16 taking into account protection of IMT mobile stations.</p> <p><u>Alternative 2</u>: The pfd limit is stipulated in RR Table 21-4 under RR No. 21.16 taking into account protection of IMT base and mobile stations.</p> <p><u>Alternative 3</u>: The pfd limit is stipulated in a new footnote taking into account the operational requirement of BSS (sound) system.</p> | Maintain status quo (i.e. no changes to the Radio Regulations). |
| 4 | <p>Stipulate pfd limit(s) for BSS (sound) space stations in some countries of Regions 1 and 3, specified in RR Nos. 5.346 and 5.346A. Three alternatives are available in this action.</p> <p><u>Alternative 1</u>: The pfd limit is stipulated in RR Table 21-4 under RR No. 21.16 taking into account protection of IMT mobile stations.</p> <p><u>Alternative 2</u>: The pfd limit is stipulated in RR Table 21-4 under RR No. 21.16 taking into account protection of IMT base and mobile stations.</p> <p><u>Alternative 3</u>: The pfd limit is stipulated in a new footnote taking into account the operational requirement of BSS (sound) system.</p> | Maintain status quo (i.e. no changes to the Radio Regulations). |
| 5 | Maintain status quo (i.e. no changes to the Radio Regulations). | Stipulate pfd limit for IMT stations by modification of RR Nos. 5.346 and 5.346A . |
| 6 | <p>Stipulate pfd limit(s) for BSS (sound) space stations in Regions 1 and 3. Three alternatives are available in this action.</p> <p><u>Alternative 1</u>: The pfd limit is stipulated in RR Table 21-4 under RR No. 21.16 taking into account protection of IMT mobile stations.</p> <p><u>Alternative 2</u>: The pfd limit is stipulated in RR Table 21-4 under RR No. 21.16 taking into account protection of IMT base and mobile stations.</p> <p><u>Alternative 3</u>: The pfd limit is stipulated in a new footnote taking into account the operational requirement of BSS (sound) system.</p> | Stipulate pfd limit for IMT stations by modification of RR Nos. 5.346 and 5.346A . |

| Possible action | Protection of IMT stations | Protection of BSS (sound) receivers |
|-----------------|--|--|
| 7 | <p>Stipulate pfd limit(s) for BSS (sound) space stations. In some countries of Regions 1 and 3, specified in RR Nos. 5.346 and 5.346A. Three alternatives are available in this action.</p> <p><u>Alternative 1</u>: The pfd limit is stipulated in RR Table 21-4 under RR No. 21.16 taking into account protection of IMT mobile stations.</p> <p><u>Alternative 2</u>: The pfd limit is stipulated in RR Table 21-4 under RR No. 21.16 taking into account protection of IMT base and mobile stations.</p> <p><u>Alternative 3</u>: The pfd limit is stipulated in a new footnote taking into account the operational requirement of BSS (sound) system.</p> | Stipulate pfd limit for IMT stations by modification of RR Nos. 5.346 and 5.346A . |
| 8 | <p>Stipulate a new coordination threshold for RR No. 9.11 based on pfd value in Regions 1 and 3. The pfd value is stipulated in a new footnote taking into account the e.i.r.p. value of 70.8 dBW for a space station of BSS (sound).</p> | Stipulate a new coordination threshold for RR No. 9.19 based on pfd value to reach coexistence for protection of BSS (sound) receivers. |
| 9 | <p>Stipulate a new coordination threshold for RR No. 9.11 based on pfd value in some countries of Regions 1 and 3, specified in RR Nos. 5.346 and 5.346A.</p> <p>The pfd value is stipulated in a new footnote taking into account the e.i.r.p. value of 70.8 dBW for a space station of BSS (sound).</p> | Stipulate a new coordination threshold for RR No. 9.19 based on pfd value to reach coexistence for protection of BSS (sound) receivers. |

Some of the possible actions described above could be included in a new WRC Resolution and Resolution **761 (WRC-15)** could then be suppressed. Alternatively, Resolution **761 (WRC-15)** could be revised.

Agenda item 9.1(9.1.3)

3/9.1.3 Resolution 157 (WRC-15)

Study of technical and operational issues and regulatory provisions for new non-geostationary-satellite orbit systems in the 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz and 6 725-7 025 MHz frequency bands allocated to the fixed-satellite service.

3/9.1.3/1 Executive summary

Resolution **157 (WRC-15)** invites the ITU-R to study technical and operational issues and regulatory provisions for new non-geostationary-satellite orbit (non-GSO) systems in a number of frequency bands between 3 700 MHz and 7 025 MHz allocated to the fixed-satellite service, while ensuring that existing services are protected.

Specifically, in the frequency band 6 725-7 025 MHz, *resolves to invite the ITU Radiocommunication Sector d)* requests that the studies address the protection of feeder links for mobile-satellite service (MSS) systems operating in the space-to-Earth direction from unacceptable interference, pursuant to existing criteria, from co-frequency, non-GSO fixed-satellite service (FSS) system earth stations operating in the Earth-to-space direction.

In response to Resolution **157 (WRC-15)**, options have been developed to address issue 9.1.3 under WRC-19 agenda item 9.1.

3/9.1.3/2 Background

RR Article **21** contains provisions to ensure compatibility of non-GSO FSS operations with the fixed and mobile services. These provisions are in the form of pfd limits for non-GSO FSS systems. Similar to the sharing situations that led to the RR Article **22** epfd limits to protect GSO systems, the existing RR Article **21** pfd limits for 3 700-4 200 MHz were established based solely on sharing studies between highly-elliptical orbits (HEO) non-GSO systems and the fixed and mobile services. New non-GSO systems that seek to operate in these frequency bands may utilize different types of orbits.

Article **22** of the Radio Regulations contains provisions to ensure compatibility of non-GSO FSS operations with GSO networks. Among these provisions are uplink and downlink equivalent power flux-density (epfd \uparrow and epfd \downarrow) limits to protect GSO networks from unacceptable interference. Regulatory provisions in RR Article **22** for sharing between non-GSO FSS systems and GSO FSS networks operating in the 6/4 GHz frequency bands were based on a particular type of HEO non-GSO system. The epfd \downarrow limits in the 3 700-4 200 MHz (space-to-Earth) and epfd \uparrow limits in the 5 925-6 725 MHz (Earth-to-space) frequency bands did not take into account circular orbit non-GSO systems and therefore are more stringent than in other FSS frequency bands that did consider circular orbit non-GSO systems.

RR Article **22** does not contain epfd \downarrow and epfd \uparrow limits for non-GSO systems in the frequency bands 4 500-4 800 MHz (space-to-Earth) and 6 725-7 025 MHz (Earth-to-space) allocated to the FSS, the use of which is subject to the provisions of RR Appendix **30B**.

At WRC-15, an issue was identified under WRC-19 agenda item 9.1 that called for the study of technical and operational issues and regulatory provisions for new non-GSO systems in frequency bands that included 6 725-7 025 MHz.

WRC-95 allocated the frequency band 6 700-7 075 MHz to FSS space-to-Earth feeder downlinks of non-GSO MSS systems on a primary basis. One worldwide, non-GSO MSS system, referred to as LEO-D in various ITU-R Recommendations has been in continuous operation in this frequency

band since 1998. The potential for interference exists for co-frequency use for both of these applications between spacecraft and between earth stations if the earth stations are located in the same area. The frequency band 6 725-7 075 MHz is also used as uplink for RR Appendix **30B**. Article **22** of the Radio Regulations provides that the maximum aggregate power flux-density produced at the GSO and within $\pm 5^\circ$ of inclination around the GSO by a non-GSO satellite system in the FSS shall not exceed -168 dB (W/m²) in any 4 kHz band (see RR No. **22.5A**).

RR Nos. **5.16** to **5.20** and **5.21** define the term tropical zone. In the tropical zone, the reliability of GSO systems in the 3 700-4 200 MHz and 5 925-6 425 MHz frequency bands is decisively undoubted. The characteristics of these frequency bands accommodate the rain attenuation issue that exists in the tropical zone. The existence of GSO satellites using the 3 700-4 200 MHz and 5 925-6 425 MHz frequency bands in developing countries especially located in the tropical zone is very important to support the economic growth of the countries through equitable distribution of ICT infrastructure, financial services, and government sector.

There is no calculation method on how to measure and/or calculate the amount of maximum aggregate power flux-density produced at the GSO and within $\pm 5^\circ$ of inclination around the GSO by a non-GSO satellite system in the FSS. In fact, adding another category of service to those currently allocated to non-GSO systems would increase the doubt on how the receiving space station of the FSS in RR Appendix **30B** would be protected. In addition, at this stage there is no information on the new non-GSO satellite systems as referred to in the WRC-19 agenda item/issue. Therefore, there would be total uncertainty on how to measure and/or calculate the above-mentioned maximum aggregate power flux-density produced at the GSO and within $\pm 5^\circ$ of inclination around the GSO by a non-GSO satellite system in the FSS.

Footnotes are contained in RR Article **5** to address protection of certain passive services as well as the radio astronomy service (see RR Nos. **5.458**, **5.458A** and **5.458B**).

3/9.1.3/3 Summary and analysis of the results of ITU-R studies

3/9.1.3/3.1 List of relevant ITU-R Recommendations, Reports and other relevant ITU-R publications

In preparation for WRC-19, WDPDN Reports ITU-R S.[NGSO FSS 6/4 GHZ SHARING] and ITU-R S.[NGSO_6/4-GHz] were developed, which provide studies and discussions related to WRC-19 agenda item 9.1, issue 9.1.3.

In addition, below is a non-exhaustive list of ITU-R publications whose latest version is relevant in respect of this issue:

Recommendations ITU-R S.465, ITU-R S.580, ITU-R S.672, ITU-R S.737, ITU-R S.738, ITU-R S.739, ITU-R S.740, ITU-R S.741, ITU-R S.1323, ITU-R S.1325, ITU-R S.1328, ITU-R S.1529 and ITU-R S.1781.

3/9.1.3/3.2 Summary of the results of ITU-R studies

According to Resolution **157 (WRC-15)**, sharing studies related to new non-GSO systems have been conducted.

a) Sharing with GSO FSS in the frequency bands 3 700-4 200 MHz and 5 925-6 425 MHz

Studies were carried out regarding sharing between circular orbit non-GSO systems and GSO networks under WRC-19 agenda item 9.1, issue 9.1.3. In the 6/4 GHz frequency band, there is minimal degradation due to propagation losses and thus the margin for protection is almost entirely dominated by the interference statistics. These studies considered the operation of a representative

circular orbit non-GSO system intended to provide global broadband services. Epfd↓ profiles were generated based on the collected statistics of this non-GSO system operation and compared against the protection criteria given in Recommendation ITU-R S.1323. The study shows that the operation of the circular orbit non-GSO system considered in the 6/4 GHz frequency bands results that FSS GSO systems are not protected (the exceedance of the protection criteria being as much as 40 dB). The application of mitigation techniques considered in the study does little to prevent the exceedance of the protection criteria.

b) Sharing with GSO FSS in the frequency bands 4 500-4 800 MHz and 6 725-7 025 MHz

It should be noted that according to RR No. **5.441**, the use of the frequency bands 4 500-4 800 MHz (space-to-Earth) and 6 725-7 025 MHz (Earth-to-space) by the FSS shall be in accordance with the provisions of RR Appendix **30B**, which is limited to GSO FSS networks.

Currently, sharing studies between non-GSO FSS systems and GSO FSS networks have not been conducted in these frequency bands.

c) Sharing with HEO FSS in the frequency bands 3 700-4 200 MHz and 5 925-6 425 MHz

One study was conducted to evaluate the probability of interference from circular orbit non-GSO FSS systems to a HEO FSS system operating in the bands frequency 3 700-3 900 MHz and 5 925-6 225 MHz. Under the relevant assumption for the characteristics and interference criteria, it shows that in the downlink scenario the *I/N* ratio could be exceeded during 0.015%-1.25% of time depending on the type of the affected earth station, configurations and parameters of the interfering LEO FSS constellation, and in the uplink scenario the LEO constellations with high inclinations may potentially exceed the long-term interference criteria and may cause interference to the HEO system, operating with earth station in the high latitudes. Considering that there are no coordination criteria and protection mitigation techniques between non-GSO FSS systems with highly elliptical and circular orbits, it is suggested to develop the regulatory approaches to ensure cooperation of non-GSO FSS HEO and LEO systems.

d) Sharing with FSS (space-to-Earth) in the frequency band 6 700-7 025 MHz

Two interference situations exist for bidirectional operation, i.e. spacecraft-to-spacecraft interference and earth station-to-earth station interference.

As included in the WDPDN Report ITU-R S.[NGSO FSS 6/4 GHz SHARING], spacecraft-to-spacecraft coordination may be possible, depending on specific spacecraft characteristics, such as antenna patterns, using existing coordination procedures. Earth station-to-earth station coordination will be possible using existing procedures for stations already established and filed with ITU-R, but the case of new feeder-link stations for MSS systems could become problematic if the new non-GSO FSS earth stations are deployed on a ubiquitous or near-ubiquitous basis since large geographic areas could be blocked for the establishment of future feeder-link earth stations due to the strong likelihood of interference being caused to receiving feeder-link stations sharing frequencies with transmitting non-GSO FSS earth stations in the same geographic area.

e) Sharing with FS and MS in the frequency bands 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz and 6 725-7 025 MHz

Sharing studies between new non-GSO FSS systems and the existing and planned systems in the fixed service and the mobile service have not been conducted at this stage.

3/9.1.3/4 Conclusions

One study indicates that circular orbit non-GSO FSS operations in the 6/4 GHz frequency band could result in large exceedances (up to 40 dB) of the GSO protection criteria and concludes that it

would be very difficult to operate a non-GSO circular orbit system for the purposes of a global broadband network in the 6/4 GHz frequency bands. Therefore, there is no need to review the values of the existing limits presented in RR Article **22** (epfd) and RR Article **21** (pfd) for the 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz, and 6 725-7 025 MHz frequency bands.

Another study suggested to establish a coordination procedure in the frequency bands 3 700-4 200 MHz and 5 925-6 425 MHz between non-GSO FSS systems under RR No. **9.12**. This study finds that there is no need to review the values of the existing limits presented in RR Article **22** (epfd) and RR Article **21** (pfd) for the 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz, and 6 725-7 025 MHz frequency bands.

Agenda item 9.1(9.1.9)

3/9.1.9 Resolution 162 (WRC-15)

Studies relating to spectrum needs and possible allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space)

3/9.1.9/1 Executive summary

Resolution **162 (WRC-15)** resolves to invite ITU-R to conduct studies considering additional spectrum needs for development of the fixed-satellite service (FSS) and conduct sharing and compatibility studies with existing services to determine the suitability of new primary allocations to the FSS in the frequency band 51.4-52.4 GHz (Earth-to-space) limited to FSS gateway links for geostationary orbit use, and the possible associated regulatory actions.

ITU-R has conducted studies required by Resolution **162 (WRC-15)**. The results of analysis of additional spectrum needs are contained in DN Report ITU-R S.[SPECTRUM_NEEDS]. The results of sharing and compatibility studies with incumbent services including the fixed service (FS), mobile service (MS), Earth exploration-satellite service (EESS) (passive), radio astronomy service (RAS), and sharing with potential IMT-2020 applications are contained in PDN Report ITU-R S.[SPECTRUM_SHARING].

The spectrum needs were analysed and it was concluded that the additional allocation to the FSS being considered is beneficial to make broadband connections accessible to communities as achieved by high throughput satellite (HTS) systems.

The conducted studies between FSS (Earth-to-space) and incumbent services in the 51.4-52.4 GHz frequency band and in adjacent frequency bands have demonstrated the possibility of sharing and compatibility by the means of separation distances between the stations as well as by limiting the unwanted emissions falling in the passive frequency band 52.6-54.25 GHz. It was concluded that the coexistence between the FSS and FS can be achieved through separation distances between FSS earth stations and FS stations. Regarding the MS, ITU-R has confirmed that there are no ITU-R Recommendations or Reports that include system characteristics and/or protection requirements for systems in MS operating at the frequency band 51.4-52.4 GHz. However, this statement does not preclude any existing or future use of the frequency band by the MS. In addition, the frequency band 51.4-52.4 GHz is being considered for IMT-2020 identification; therefore, sharing studies with this application have been conducted. Sharing through separation distances between FSS earth stations and IMT-2020 stations is feasible.

Based on the results of studies and in order to ensure protection of the currently allocated EESS (passive) and space research service (SRS) (passive) systems in the 52.6-54.25 GHz frequency band, it is proposed to apply unwanted emission power limits on FSS earth stations, depending on the elevation angle of the FSS earth station antenna. To address the possible allocation to FSS limited to gateway links, a minimum earth station antenna size is also being considered. Regarding the protection of future GSO EESS (passive) sensors, a minimum orbital separation in the GSO arc between the FSS and EESS space stations would be required.

Radio astronomy observations may be carried out in the frequency band 51.4-54.25 GHz under national arrangements under RR No. **5.556**. Compatibility studies concluded that separation distances in the range 10-100 km would be necessary to protect radio astronomy observations according to a static worst case analysis and it may be feasible for GSO FSS operators to protect radio astronomy stations in their own and neighbouring countries by choosing appropriate sites when planning the deployment of FSS earth stations.

3/9.1.9/2 Background

Satellite systems are increasingly being used to deliver broadband services with high data rates to accommodate user demand and service expectations worldwide. Next-generation satellite networks are expected to provide data rate services from 100 Mbit/s to greater than 1 Gbit/s on a single channel to all users regardless of location. Satellite systems enable the immediate connection of many subscribers, irrespective of their location, to broadband and Internet backbone networks with just one launch, compared to a point-by-point roll-out. By implementing advanced technologies such as spot-beam antennas and high frequency reuse factors, HTS reach many times the throughput of traditional satellites using the same amount of allocated spectrum, which leads to the reduction of Gigabits per second (Gbit/s) costs.

The limiting factor of HTS satellite networks is the amount of spectrum allocated to the forward link in the Earth-to-space segment (gateway-to-satellite link).

Current HTS systems are mainly operated in Ka-band and use the Earth-to-space allocations for both user links and gateway links, which leads to the scarcity of spectral resources in this frequency band. In order to achieve higher data rates and improve the services provided to end-users, it is proposed to use the allocation to FSS (Earth-to-space) in the 50/40 GHz frequency bands for the gateway uplink (from gateway to space station) and Ka-band allocations to FSS (Earth-to-space) for the user uplink (from user terminals to space station). Therefore, the consideration of new primary allocations to the FSS in the frequency band 51.4-52.4 GHz (Earth-to-space) limited to FSS gateway links is required.

The current frequency range of primary allocations to FSS (Earth-to-space) in the frequency bands 40/50 GHz in Regions 1, 2 and 3 is 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz. The two FSS Earth-to-space allocations in the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz are almost contiguous, making these 4 GHz allocations suitable for operation of wideband carriers. The additional allocation of FSS (Earth-to-space) in the 51.4-52.4 GHz frequency band will allow access to 5 GHz of almost contiguous spectrum for the uplink communications; in addition, the 42.5-43.5 GHz allocation would enable a total of 6 GHz of spectrum for Earth-to-space communications. This situation will make it more suitable for the operation of FSS systems providing high data rate services worldwide with satisfactory availabilities.

3/9.1.9/3 Summary and analysis of the results of ITU-R studies

3/9.1.9/3.1 Studies on spectrum needs

Next-generation FSS satellite systems can leverage innovative technologies to provide a wide range of broadband services for residential, commercial, institutional, and professional users worldwide irrespective of their location. This can be achieved through frequency reuse by covering a given geographical area with a number of spot beams instead of using traditional wide beams. In order to meet the requirements for frequency bands used for uplink gateways, it is proposed to migrate the gateway uplinks to higher frequency bands in particular the 50/40 GHz frequency bands.

In DN Report ITU-R S.[SPECTRUM_NEEDS], spectrum needs for development of the FSS and justification of the additional 1 GHz FSS allocation (Earth-to-space) in the 51.4-52.4 GHz frequency band are analysed. Those studies have been conducted taking into account several aspects including:

- a) the need to contribute to providing connectivity to the world's population that currently does not have access to the Internet;

- b) advances in satellite technology such as spot-beam antennas and high frequency reuse factors that are crucial to deliver broadband services everywhere, including rural and isolated areas;
- c) current allocations to the FSS in the 50/40 GHz frequency bands and the technical simplifications of satellite payloads in these frequency bands if the new allocation is granted to the FSS;
- d) improvement of the availability levels that can be reached by FSS networks operating in these frequency bands that are subject to significant propagation impairments.

The consideration of all these aspects indicate that the additional allocation to the FSS being considered would be beneficial to make reliable broadband connections more accessible to communities through satellite communication regardless of their geographical location, as achieved by HTS.

3/9.1.9/3.2 Relevant ITU-R Recommendations and Reports

ITU-R Recommendations, relevant for sharing and compatibility studies under WRC-19 agenda item 9.1, issue 9.1.9, are:

- ITU-R S.1328, ITU-R S.1557, ITU-R S.465, ITU-R F.758, ITU-R F.1495, ITU-R F.1496, ITU-R F.1565, ITU-R F.1606, ITU-R F.2086, ITU-R P.452, ITU-R P.525, ITU-R P.676, ITU-R P.840, ITU-R RA.517, ITU-R RA.611, ITU-R RA.769, ITU-R RA.1031, ITU-R SM.1542, ITU-R SM.1633, ITU-R RS.1861, ITU-R M.2101, ITU-R RS.2017

ITU-R Reports, relevant for the studies under WRC-19 agenda item 9.1, issue 9.1.9, are:

- ITU-R S.2361, ITU-R RA.2131, ITU-R RA.2126, ITU-R RA.2188, ITU-R SM.2091

New ITU-R Reports developed for this issue are:

- DN Report ITU-R S.[SPECTRUM_NEEDS], PDN Report ITU-R S.[SPECTRUM_SHARING]

3/9.1.9/3.3 Compatibility and sharing studies

In PDN Report ITU-R S.[SPECTRUM_SHARING], sharing and compatibility studies between the potential new FSS and the FS, MS (including the potential IMT-2020 applications), RAS and the EESS (passive) were addressed to the extent that up-to-date information permitted.

Sharing studies between the FSS (Earth-to-space) and FS were conducted. To protect FS stations, separation distances up to 33 km are required when assuming FSS earth station transmission e.i.r.p. spectral density level of -47 dBW/MHz and minimum antenna diameter of 4.5 m. The calculation was based on flat terrain, which means that the distance can be reduced when real terrain is taken into consideration. Studies also concluded that FSS space stations will not receive harmful interference from FS stations.

Regarding sharing with the MS, the relevant ITU-R expert group has confirmed that there are no ITU-R Recommendations or Reports that include such characteristics of land mobile service in the 51.4-52.4 GHz frequency band; the relevant ITU-R expert group has also confirmed that currently there are no maritime or aeronautical mobile systems identified in the frequency band 51.4-52.4 GHz, and therefore no ITU-R operational requirements nor technical characteristics are available. However, such confirmation does not exclude the operation of the MS nor does it exclude the future use of the frequency band by the MS.

Sharing studies between the FSS and the possible IMT-2020 applications of the MS have indicated that the required separation distances between FSS earth stations and IMT base station and IMT

user equipment are 260 and 330 metres, respectively. These values may be further reduced by consideration of propagation losses other than free space, the pointing of the IMT-2020 antennas in directions other than that of the FSS earth station, and the high likelihood that the antenna pattern of the FSS earth station is more directive than the 29-25 log θ pattern assumed in the analysis.

Regarding the RAS, RR No. **5.556** indicates that radio astronomy observations may be carried out in the frequency band 51.4-54.25 GHz under national arrangements. According to worst case static analysis, separation distances of 10-100 km would be necessary to protect radio astronomy observation. However, it could be feasible, under certain circumstances, for GSO FSS operators to protect the radio astronomy stations operating in this frequency band in their own and neighbouring countries by choosing appropriate sites for earth stations while planning the deployments of FSS earth stations.

Several compatibility studies were conducted to determine unwanted emission power limits for the protection of EESS (passive) in the frequency band 52.6-54.25 GHz.

Study 1 was an interference analysis examining the four EESS (passive) sensors contained in Recommendation ITU-R RS.1861-0 over nine different measurement areas across the world. This study determined that the worst-case interference received in this analysis was in measurement area I (Equatorial South America), and exceeded the protection criteria by 49.12 dB using an unwanted emission power from FSS ES of 0 dBW/100 MHz falling in the passive frequency band. However, an unwanted emission power limit of -34.35 dBW/100 MHz could be considered for earth stations with elevation angles below 75 degrees, without considering apportionment of the EESS protection criterion.

Study 2 indicated that the EESS (passive) protection criterion when apportionment among services is considered, can be satisfied when the unwanted emissions from each FSS ES falling in the passive frequency band are limited to -39 dBW/100 MHz for FSS earth stations with elevation angles equal or lower than 78°. For FSS ES with higher elevation angles, the unwanted emissions in the passive frequency band should be limited to -52 dBW/100 MHz. In addition, the protection of a GSO EESS sensor identified as sensor A³⁰ would require a minimum angular separation in the GSO arc between the FSS satellite and the EESS satellite; such orbital separation varies between 0.5° and 2°, depending on the unwanted emission limits considered for the FSS ES.

Study 3 indicated that the EESS (passive) protection criteria when apportionment among services is considered, can be satisfied when the unwanted emissions from each FSS ES falling in the passive frequency band are limited to -37 dBW/100 MHz for FSS earth stations with elevation angles equal or lower than 74°. For FSS ES with higher elevation angles, the unwanted emissions in the passive frequency band should be limited to -52 dBW/100 MHz.

Study 4 indicates that for non-GSO conical scan sensors, different orbital altitudes may cause different interference level from FSS earth stations. In order to protect EESS (passive) sensor J2 (Recommendation ITU-R RS.1861-0), the unwanted emissions from each FSS ES should be limited to -64.6 dBW/100 MHz. In order to protect EESS (passive) JX sensor³¹, the unwanted emissions from each FSS ES should be limited to

³⁰ Information for sensor A is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J10).

³¹ Information for JX sensor is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J8).

–61.8 dBW/100 MHz. The orbit separation between GSO FSS satellite and GSO EESS (passive) satellite should be not less than 0.9° to protect GSO EESS (passive) systems when the unwanted emissions from each FSS ES are limited to –45 dBW/100 MHz.

Study 5 analysed the protection of EESS (passive) sensor Meteor-M³² assuming an apportionment factor of 3 dB for the EESS protection criterion and an unwanted emission power of –19.7 dBW/100 MHz of the FSS ES. The static analysis indicated that for the worst-case single-entry main-to-main beam scenario, the threshold of interference will be exceeded by 72.1 dB. A static analysis determined that there will also be a deficit of 7.4 dB when Meteor-M satellite falls within the main lobe of the transmitting FSS ES located outside the passive sensor Instantaneous Field of View (IFOV).

According to results of dynamic interference analysis the threshold interference level of –172 dBW/100 MHz (apportionment of 3 dB is applied) is exceeded by 17 dB for more than 10% of the time (corresponding to Meteor-M passive sensor data unavailability per pixel) for a single FSS earth station with 13.5 m antenna diameter (unwanted emission power in the passive frequency band of –19.7 dBW/100 MHz) and by 22 dB for 4.5 m antenna (unwanted emission power in the passive frequency band of –10.2 dBW/100 MHz). Limitations on unwanted emissions of –36.7 dBW/100 MHz within 52.6-54.25 GHz frequency band will be required for transmitting FSS ES, operating in the frequency band below 52.4 GHz to protect the Meteor-M passive sensor.

The following table summarizes the results from the five compatibility studies conducted between FSS and EESS (passive):

| Study | EESS protection criteria apportionment | Protection of non-GSO EESS (passive) in Rec. ITU-R RS.1861-0: FSS ES unwanted emission limit and elevation angle | Protection of other non-GSO EESS (passive) sensors: FSS ES unwanted emission limit | Protection of GSO EESS (passive) sensor A ¹ : FSS ES unwanted emission limit, separation angle between FSS and EESS satellites |
|---|--|--|--|---|
| 1 | No | –34 dBW/100 MHz, <75° –49 dBW/100 MHz, ≥75° | | |
| 2 | 3 dB | –39 dBW/100 MHz, <78° –52 dBW/100 MHz, ≥78° | Sensor JX ² : –25 dBW/100 MHz | –39 dBW/100 MHz, 1.8° –52 dBW/100 MHz, 0.5° |
| 3 | 3 dB | –37 dBW/100 MHz, <74° –52 dBW/100 MHz, ≥74° | | |
| 4 | No | –64.6 dBW/100 MHz | Sensor JX ² : –61.8 dBW/100 MHz | –45 dBW/100 MHz, 0.9° |
| 5 | 3 dB | | Sensor Meteor-M ³ : –36.7 dBW/ 100 MHz | |
| ¹ Information for sensor A is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J10). ² Information for JX sensor is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J8). ³ Information for Meteor-M sensor is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J4 (Updated)). | | | | |

³² Information for Meteor-M sensor is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J4 (Updated)).

3/9.1.9/4 Conclusions

In response to Resolution **162 (WRC-15)**, ITU-R developed two Reports; one on spectrum needs for development of the FSS and the second one on sharing and compatibility between FSS and existing services.

It is considered to make an allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space), limited to FSS gateway links for geostationary orbit use while protecting currently allocated services in the same frequency band and in adjacent frequency bands as follows:

To protect FS stations, separation distances up to 33 km are required when assuming flat terrain, which means that the distance can be reduced when real terrain is taken into consideration. Regarding the possible IMT-2020 applications of the MS in the same frequency band, the required separation distances between FSS earth stations and IMT base station and IMT user equipment are 260 and 330 metres, respectively. It is recognized that under RR No. **5.556**, radio astronomy observations can be carried out under national arrangements and in such cases, separation distances in the range of 10-100 km would be necessary.

The protection of non-GSO EESS (passive) sensors operating in the frequency band 52.6-54.25 GHz can be achieved by limiting the FSS earth station unwanted emissions falling in the passive frequency band as follows:

a power level between -39 to -34 dBW in any 100 MHz of the EESS (passive) frequency band for FSS ES with antenna elevation angles lower than a value between 74° to 78° ;

a power level between -52 to -49 dBW in any 100 MHz of the EESS (passive) frequency band for FSS ES with antenna elevation angles equal or higher than a value between 74° to 78° .

Regarding the protection of future GSO EESS (passive) sensors, it was found that angular separations between GSO FSS and GSO EESS (passive) satellites in the order of 0.0-3.2 degrees would be necessary for unwanted emission levels of the FSS earth stations falling in the passive frequency bands of -84 dBW/100 MHz and -34 dBW/100 MHz respectively. One of the following procedures (or alternatives to them) could be implemented to address this issue.

Option 1:

Ensuring a minimum angular separation in the GSO arc between the FSS and the EESS (passive) space stations. The orbital separation would vary between 0.0 and 3.2 degrees, depending on the FSS ES unwanted emission levels falling in the passive frequency band. The regulatory implementation of this procedure could be that the BR identifies the GSO EESS (passive) satellites operating within 3.2 degrees from the nominal orbital position of the FSS space station and includes them among the coordination requirements of the FSS network.

Option 2:

Giving priority to a limited number of orbital positions in the GSO arc for the operation of GSO EESS (passive) sensors. The GSO FSS networks with space stations located at less than 3.2 degrees separation of such positions should adjust the unwanted emission levels from earth stations to protect the EESS (passive) sensors on board the GSO satellite. Protection is needed for the following orbital positions of EESS (passive) sensors on board GSO satellites: 0° , 3.5°E , 9.5°E , 41.5°E , 76°E , 79°E , 86.5°E , 99.5°E , 105°E , 112°E , 123.5°E , 133°E , 165.8°E , 3.2°W , 14.5°W , 75°W , and 137°W .

In line with *resolves* 2 of Resolution **162 (WRC-15)** involving “*the possible associated regulatory actions*”, relevant regulatory considerations are put forward as follows, including modifications to Article **5**, Article **21**, Appendix **7**, and Resolution 750 (Rev.WRC-15) of the Radio Regulations.

An example of a possible regulatory solution is shown below.

Example:

For this example, a new primary allocation would be made to the FSS in the frequency band 51.4-52.4 GHz (Earth-to-space) in RR limited to FSS gateway links for geostationary orbit use.

Regarding the protection of passive GSO EESS sensors, this example implements only option 2.

An example of implementation for option 1 has not been developed.

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

(See No. 2.1)

MOD

51.4-55.78 GHz

| Allocation to services | | |
|-----------------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 51.4-52.6 <u>52.4</u> | FIXED 5.338A <u>FIXED-SATELLITE (Earth-to-space) ADD 5.A919</u> MOBILE 5.547 5.556 <u>MOD 5.338A</u> | |
| 51.4 <u>52.4</u> -52.6 | FIXED <u>MOD</u> 5.338A MOBILE 5.547 5.556 | |

Reasons: Allocation to the FSS (Earth-to-space).

MOD

5.338A In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 30-31.3 GHz, 49.7-50.2 GHz, 50.4-50.9 GHz, 51.4-52.4 GHz, 52.4-52.6 GHz, 81-86 GHz and 92-94 GHz, Resolution **750 (Rev.WRC-~~15~~19)** applies. (WRC-~~15~~19)

Reasons: Application of the limits for FSS ES unwanted emissions as contained in the proposed revision to Resolution **750 (Rev.WRC-15)**.

ADD

5.A919 The use of the frequency band 51.4-52.4 GHz by the fixed-satellite service (Earth-to-space) is limited to geostationary satellite networks and the fixed-satellite service earth stations shall have a minimum antenna diameter of 4.5 metres. (WRC-19)

Reasons: To limit the new allocation to gateways operating in FSS GSO networks.

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section II – Power limits for terrestrial stations

MOD

TABLE 21-2 (Rev.WRC-~~45~~19)

| Frequency band | Service | Limit as specified in Nos. |
|---|-----------------|----------------------------|
| ... | ... | ... |
| 10.7-11.7 GHz ⁵ (Region 1) 12.5-12.75 GHz ⁵ (Nos. 5.494 and 5.496) 12.7-12.75 GHz ⁵ (Region 2) 12.75-13.25 GHz 13.75-14 GHz (Nos. 5.499 and 5.500) 14.0-14.25 GHz (No. 5.505) 14.25-14.3 GHz (Nos. 5.505 and 5.508) 14.3-14.4 GHz ⁵ (Regions 1 and 3) 14.4-14.5 GHz 14.5-14.8 GHz <u>51.4-52.4 GHz</u> | Fixed-satellite | 21.2, 21.3 and 21.5 |
| ... | ... | ... |

Reasons: Inclusion of the frequency band proposed for the new allocation to FSS (Earth-to-space) for applicability of the limits in RR Nos. **21.2, 21.3 and 21.5**.

Section III – Power limits for earth stations

MOD

TABLE 21-3 (Rev.WRC-~~15~~19)

| Frequency band | | Services |
|----------------------------|--|-----------------------------|
| ... | ... | ... |
| 14.3-14.4 GHz ⁶ | (for Regions 1 and 3) | |
| 14.4-14.8 GHz | | |
| 17.7-18.1 GHz | | Fixed-satellite |
| 22.55-23.15 GHz | | Earth exploration-satellite |
| 27.0-27.5 GHz ⁶ | (for Regions 2 and 3) | Mobile-satellite |
| 27.5-29.5 GHz | | Space research |
| 31.0-31.3 GHz | (for the countries listed in No. 5.545) | |
| 34.2-35.2 GHz | (for the countries listed in No. 5.550 with respect to the countries listed in No. 5.549) | |
| <u>51.4-52.4 GHz</u> | | <u>Fixed-satellite</u> |

Reasons: Inclusion of the frequency band proposed for the new allocation to FSS (Earth-to-space) for applicability of the limits in RR No. **21.8**.

APPENDIX 4 (REV.WRC-15)

Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III

ANNEX 2

Characteristics of satellite networks, earth stations or radio astronomy stations² (Rev.WRC-12)

Footnotes to Tables A, B, C and D

MOD

TABLE C
CHARACTERISTICS TO BE PROVIDED FOR EACH GROUP OF FREQUENCY ASSIGNMENTS
FOR A SATELLITE ANTENNA BEAM OR AN EARTH STATION OR
RADIO ASTRONOMY ANTENNA (Rev.WRC-1519)

| Items in Appendix | C - CHARACTERISTICS TO BE PROVIDED FOR EACH GROUP OF FREQUENCY ASSIGNMENTS FOR A SATELLITE ANTENNA BEAM OR AN EARTH STATION OR RADIO ASTRONOMY ANTENNA | Advance publication of a geostationary-satellite network | Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9 | Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9 | Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A) | Notification or coordination of a non-geostationary-satellite network | Notification or coordination of an earth station (including notification under Appendices 30A or 30B) | Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5) | Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5) | Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8) | Items in Appendix | Radio astronomy |
|-------------------|---|--|--|--|--|---|---|---|--|---|-------------------|-----------------|
| ... | ... | | | | | | | | | | | |
| C.10.d.7 | the antenna diameter, in metres In cases other than Appendix 30A, required for fixed-satellite service networks operating in the frequency bands 13.75-14 GHz, 14.5-14.75 GHz (in countries listed in Resolution 163 (WRC-15) not for feeder links for the broadcasting-satellite service), 14.5-14.8 GHz (in countries listed in Resolution 164 (WRC-15) not for feeder links for the broadcasting-satellite service), 24.65-25.25 GHz (Region 1) and 24.65-24.75 GHz (Region 3) and 51.4-52.4 GHz and for maritime mobile-satellite service networks operating in the frequency band 14-14.5 GHz | | | | + | + | | | X | | C.10.d.7 | |
| ... | ... | | | | | | | | | | | |

Reasons: Limitations for antenna diameter for the frequency band 51.4-52.4 GHz is proposed in footnote RR No. 5.A919.

APPENDIX 7 (REV.WRC-15)

Methods for the determination of the coordination area around an earth station in frequency bands between 100 MHz and 105 GHz

ANNEX 7

System parameters and predetermined coordination distances for determination of the coordination area around an earth station

MOD

TABLE 7c (Rev.WRC-12.19)

Parameters required for the determination of coordination distance for a transmitting earth station

| Transmitting space radiocommunication service designation | | Fixed-satellite | Fixed-satellite ² | Fixed-satellite ³ | Space research | Earth exploration-satellite, space research | Fixed-satellite, mobile-satellite, radionavigation-satellite | <u>Fixed-satellite</u> | Fixed-satellite ² |
|---|--------------------------|--------------------------|------------------------------|------------------------------|------------------------------|---|--|--------------------------|------------------------------|
| Frequency bands (GHz) | | 24.65-25.25 27.0-29.5 | 28.6-29.1 | 29.1-29.5 | 34.2-34.7 | 40.0-40.5 | 42.5-47 47.2-50.2 50.4-51.4 | <u>51.4-52.4</u> | 47.2-50.2 |
| Receiving terrestrial service designations | | Fixed, mobile | Fixed, mobile | Fixed, mobile | Fixed, mobile, radiolocation | Fixed, mobile | Fixed, mobile, radionavigation | <u>Fixed, mobile</u> | Fixed, mobile |
| Method to be used | | § 2.1 | § 2.2 | § 2.2 | | § 2.1, § 2.2 | § 2.1, § 2.2 | <u>§ 2.1</u> | § 2.2 |
| Modulation at terrestrial station ¹ | | N | N | N | | N | N | <u>N</u> | N |
| Terrestrial station interference parameters and criteria | p_0 (%) | 0.005 | 0.005 | 0.005 | | 0.005 | 0.005 | <u>0.005</u> | 0.001 |
| | n | 1 | 2 | 1 | | 1 | 1 | <u>1</u> | 1 |
| | p (%) | 0.005 | 0.0025 | 0.005 | | 0.005 | 0.005 | <u>0.005</u> | 0.001 |
| | N_L (dB) | 0 | 0 | 0 | | 0 | 0 | <u>0</u> | 0 |
| | M_s (dB) | 25 | 25 | 25 | | 25 | 25 | <u>25</u> | 25 |
| | W (dB) | 0 | 0 | 0 | | 0 | 0 | <u>0</u> | 0 |
| Terrestrial station parameters | G_x (dBi) ⁴ | 50 | 50 | 50 | | 42 | 42 | <u>42</u> | 46 |
| | T_e (K) | 2 000 | 2 000 | 2 000 | | 2 600 | 2 600 | <u>2 600</u> | 2 000 |
| Reference bandwidth | B (Hz) | 10^6 | 10^6 | 10^6 | | 10^6 | 10^6 | <u>10^6</u> | 10^6 |
| Permissible interference power | $P_r(p)$ (dBW) in B | -111 | -111 | -111 | | -110 | -110 | <u>-110</u> | -111 |

¹ A: analogue modulation; N: digital modulation.² Non-geostationary satellites in the fixed-satellite service.³ Feeder links to non-geostationary-satellite systems in the mobile-satellite service.⁴ Feeder losses are not included.

MOD**RESOLUTION 750 (REV.WRC-~~15~~19)****Compatibility between the Earth exploration-satellite service (passive) and relevant active services**

The World Radiocommunication Conference (~~Geneva, 2015~~[Sharm el-Sheikh, 2019](#)),

...

noting

- a)* that the compatibility studies between relevant active and passive services operating in adjacent and nearby frequency bands are documented in Report ITU-R SM.2092 [and in PDN Report ITU-R S.\[SPECTRUM_SHARING\]](#);
- b)* that the compatibility studies between IMT systems in the frequency bands 1 375-1 400 MHz and 1 427-1 452 MHz and EESS (passive) systems in the frequency band 1 400-1 427 MHz are documented in Report ITU-R RS.2336;
- c)* that Report ITU-R F.2239 provides the results of studies covering various scenarios between the fixed service, operating in the frequency band 81-86 GHz and/or 92-94 GHz, and the Earth exploration-satellite service (passive), operating in the frequency band 86-92 GHz;
- d)* that Recommendation ~~ITU-R RS.1029~~[ITU-R RS.2017](#) provides the interference criteria for satellite passive remote sensing,

...

TABLE 1-1

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band¹ |
|----------------------------|----------------------------|-----------------------|--|
| ... | ... | ... | ... |
| 52.6-54.25 GHz | 51.4-52.6 GHz | Fixed | For stations brought into use after the date of entry into force of the Final Acts of WRC-07: –33 dBW in any 100 MHz of the EESS (passive) band |

| EESS (passive) band | Active service band | Active service | Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band ¹ |
|-----------------------|----------------------|---------------------------------|---|
| <u>52.6-54.25 GHz</u> | <u>51.4-52.4 GHz</u> | <u>Fixed-satellite (E-to-s)</u> | <p><u>For stations brought into use after the date of entry into force of the Final Acts of WRC-19:</u></p> <p><u>a power level between –39 to –34 dBW in any 100 MHz of the EESS (passive) band for earth stations with antenna elevation angles lower than a value between 74° to 78°;</u></p> <p><u>a power level between –52 to –49 dBW in any 100 MHz of the EESS (passive) band for earth stations with antenna elevation angles equal or higher than a value between 74° to 78°.</u></p> <p><u>For earth stations operating with an FSS space station whose orbital separation Δ is equal or smaller than 3.2° from the GSO EESS (passive) space stations with nominal orbital positions: 0°, 3.5° E, 9.5° E, 41.5° E, 76° E, 79° E, 86.5° E, 99.5° E, 105° E, 112° E, 123.5° E, 133° E, 165.8° E, 3.2° W, 14.5° W, 75° W and 137° W:</u></p> <p><u>–84 + 200 Δ (dBW/100 MHz) for $0^\circ \leq \Delta < 0.1^\circ$</u></p> <p><u>–67 + 22.8 Δ (dBW/100 MHz) for $0.1^\circ < \Delta < 0.5^\circ$</u></p> <p><u>–61 + 11.3 Δ (dBW/100 MHz) for $0.5^\circ \leq \Delta < 1.9^\circ$</u></p> <p><u>–47 + 4 Δ (dBW/100MHz) for $1.9^\circ \leq \Delta \leq 3.2^\circ$</u></p> |

Reasons: To limit the unwanted emissions from the FSS Earth stations falling in the frequency band 52.6-54.25 GHz to protect the EESS (passive) according to their elevation angle.

CHAPTER 4

Science services

(Agenda items 1.2, 1.3, 1.7)

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Agenda item 1.2

1.2 to consider in-band power limits for earth stations operating in the mobile-satellite service, meteorological-satellite service and Earth exploration-satellite service in the frequency bands 401-403 MHz and 399.9-400.05 MHz, in accordance with Resolution 765 (WRC-15);

Resolution 765 (WRC-15) – *Establishment of in-band power limits for earth stations operating in mobile-satellite service, the meteorological-satellite service and the Earth exploration-satellite service in the frequency bands 401-403 MHz and 399.9-400.05 MHz.*

4/1.2/1 Executive summary

Taking into account the results of ITU-R studies, the objective of WRC-19 agenda item 1.2 is to consider establishing, within the Radio Regulation, in-band power limits applicable to earth stations transmissions in the frequency bands 399.9-400.05 MHz and 401-403 MHz in order to ensure the operation of existing and future systems that usually implement low or moderate output powers for mobile-satellite service (MSS), Earth exploration-satellite service (EESS) and meteorological satellite service (MetSat) systems.

Report ITU-R SA.2430-0 compiles elements related to background on WRC-19 agenda item 1.2 as well as technical considerations on MSS, EESS and MetSat and associated space operation functions according to RR No. **1.23** in the frequency ranges of 399.9-400.05 MHz and 401-403 MHz bands. This Report includes an analysis section providing guidance to derive the possible e.i.r.p. (equivalent isotropically radiated power) and e.i.r.p. density limits under this agenda item while recognizing that some current and planned systems using space operation functions, according to RR No. **1.23** in these bands will not be able to comply with a given set of limits.

For the band 399.9-400.05 MHz, four different methods are proposed.

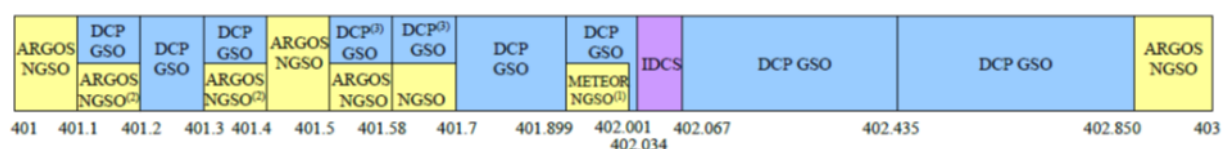
For the band 401-403 MHz, three different methods are proposed.

4/1.2/2 Background

Two frequency bands: 399.9-400.05 MHz for MSS (Earth-to-space), 401-403 MHz for EESS (Earth-to-space) and MetSat (Earth-to-space) are under the scope of this agenda item. These bands are used mainly for data collection systems (DCS) and data collection platform systems (DCP), and may be used for associated space operation functions in accordance with RR No. **1.23**. EESS, MetSat, and MSS systems in these frequency bands are currently used or planned for use by DCS that implement moderate/low power levels. In these bands, earth stations, also called platforms, are deployed and send specific information to dedicated satellites which collect the corresponding data when the platforms are in the satellite footprint. Most of these platforms are active all the time. It is to be noted that very often, customers tend to use very low power to ensure extended lifetime of the platforms.

The basic general partitioning of the band 401-403 MHz for the use of DCS is described in Recommendation ITU-R SA.2045. The partitioning lists the use of specific channels by geostationary and non-geostationary DCPs.

Basic general partitioning of the band 401-403 MHz for future long-term coordinated use of DCS systems on geostationary and non-geostationary MetSat and EESS systems



In addition, the bands are used for associated space operation functions as described in the Report ITU-R SA.2430 which provides characteristics of some links in each of these bands. This agenda item was created as a result of the significant recent increase in use of the frequency bands 401-403 MHz and 399.9-400.05 MHz for telecommand purposes. This increase is largely attributable to increased interest by educational institutions and some commercial entities seeking to operate large fleets and constellations of satellites. A large number of these satellite networks are already filed in both bands and, as can be seen from filed parameters in the ITU-R database (i.e. large uplink transmit gains for example), plan to use the frequency bands 401-403 MHz and 399.9-400.05 MHz for telecommand (see RR No. **1.135**) (Earth-to-space) purposes under the EESS, MetSat, or MSS allocations for associated space operation functions in accordance with RR No. **1.23**.

The proliferation of such telecommand usage could impact usage by the large number of existing lower power DCS stations communicating to sensitive receivers on GSO and non-GSO satellites. The output power levels of some of the earth stations referred to these telecommand links (Earth-to-space) transmitting higher data rates can be much higher than the power levels used for the operation of DCS in these frequency bands. In view of such differences in the power levels, mitigation measures would be necessary to ensure protection of the DCS platforms on a long-term basis. Mitigation measures (use of high gain antenna and GSO arc avoidance) have been studied in Report ITU-R SA.2430.

It should also be noted that the number of such deployed telecommand earth stations is limited and telecommand earth stations will in general operate with directive transmitting antennas affording isolation when pointing in directions separated in space from DCS satellite systems.

In the 401-403 MHz band, currently tens of thousands of DCS stations communicating with GSO and non-GSO are deployed worldwide for the purpose of collecting essential weather and climate data. The DCP gather information activity related to the Earth, the environment and scientific application, weather, environment observation: meteorological and oceanographic, seismic observation, volcanology, geodesy and geodynamics, fishing vessel monitoring, wildlife tracking, homeland security, law enforcement, test/evaluation, monitoring shipments of dangerous goods, humanitarian applications, managing water resources or tsunami warning system, etc. The data, which are collected by DCP, are sent and received by satellites in visibility of these platforms that retransmit the retrieved information to dedicated earth stations.

In the 399.9-400.05 MHz band, several large constellations under development are planning to operate under the MSS allocation which in some cases may also include operation of associated space operation functions according to RR No. **1.23**.

4/1.2/3 Summary and analysis of the results of ITU-R studies

4/1.2/3.1 Relevant ITU-R Recommendations and Reports

Relevant ITU-R Recommendations: ITU-R SA.2044-0, ITU-R SA. 1163-3, ITU-R SA.1164-3, ITU-R SA.1627-0, ITU-R SA.1159-4, ITU-R SA.2045-0 ITU-R M.2046-0 and ITU-R Report: ITU-R SA.2430-0.

4/1.2/3.2 Studies regarding the power limits

In the frequency band 401-403 MHz, according to ITU-R studies, for non-GSO satellite networks, the values of output power range from -3 dBW (bandwidth of 800 Hz) up to 7 dBW (bandwidth of 6 400 Hz). In some applications, the power may decrease down to -25 dBW using specific techniques such as spread spectrum multiple access. For specific bands within 401-403 MHz satellite uplink e.i.r.p. for DCS low-Earth orbiting (LEO) systems could reach 12 dBW for existing non-GSO MetSat system (i.e. Meteor-3M). The maximum value of the corresponding antenna gain

is below 3 dBi, and in practice the antenna gain does not exceed 0 dBi. The antennas are most of time omnidirectional and whip antennas are used. Any additional use, other than for DCS, of this limited and unique spectrum resource for DCS systems would have to blend in with appropriate power levels such that the reception of signals from data collection platforms at the satellite receivers is not interfered.

For GSO networks, there are various types of DCP transmitters in operation generally ranging from 5 W, 10 W, and 20 W output power with a directional antenna, or 40 W or higher output power with an omnidirectional antenna. The resulting uplink e.i.r.p. is between 6 to 22 dBW. Highly elliptical orbit (HEO) DCS systems are based on the orbits with apogee of 40 000 km, which makes their characteristics similar to characteristic of the GSO DCP. For DCPs operating with HEO satellites (ARCTICA-M), uplink e.i.r.p. would not exceed 16-18 dBW.

Given the significant difference in the power level ranges of non-GSO data collection platforms compared to platforms communicating to GSO MetSat and EESS satellites, as outlined above, the establishment of e.i.r.p. limits will have to differentiate between non-GSO (LEO and medium-Earth orbit (MEO)) and GSO/HEO DCS in the 401-403 MHz frequency band.

In this respect, the establishment of an appropriate set of in-band e.i.r.p. limits in the 401-403 MHz frequency band will have to take into account the framework set forth by the general partitioning in Recommendation ITU-R SA.2045-0 to ensure the protection of existing and future use of meteorological operations (MetSat and EESS (Earth-to-space)) in the 401-403 MHz frequency band for both non-GSO (LEO and MEO) and GSO/HEO DCS systems.

Report ITU-R SA.2430 contains the technical characteristics and results of current ITU-R studies for in-band power limits applicable to the earth stations in the MSS in the frequency band 399.9-400.05 MHz and the MetSat service and the EESS in the frequency band 401-403 MHz. The Report shows that the power limits for the earth stations operating in the EESS and MetSat service in the frequency band 401-403 MHz are based on two categories: GSO/HEO and non-GSO (LEO and MEO). Regarding the MSS in the frequency band 399.9-400.05 MHz, since this band is limited to non-GSO, only one set of limits for DCS is necessary, noting that these limits will not support associated space operation functions.

The conclusion of Report ITU-R SA.2430 (see Tables 4/1.2/3-1 and 4/1.2/3-2 below) are that the earth station maximum e.i.r.p. for non-GSO DCS systems in the MSS in the frequency band 399.9-400.05 MHz, and both GSO/HEO and non-GSO DCS systems in the MetSat service and the EESS in the frequency band 401-403 MHz, shall comply with the following conditions:

TABLE 4/1.2/3-1

| Frequency band | Maximum e.i.r.p. of the earth stations |
|------------------|--|
| 399.9-400.05 MHz | 5 dBW |

TABLE 4/1.2/3-2

| Frequency band | Maximum e.i.r.p. of the earth stations | |
|----------------|--|----------------------|
| 401-403 MHz | GSO/HEO | 22 dBW |
| | non-GSO (MEO and LEO) | 7 dBW ⁽¹⁾ |

⁽¹⁾ The maximum e.i.r.p. for existing non-GSO MetSat system in the 401.898-402.522 MHz can be increased up to 12 dBW.

The telecommand earth station maximum e.i.r.p. for associated space operation functions in the frequency band 399.9-400.05 MHz is 18 dBW under normal mode of operation, but this value may be exceeded by up to 14 dB, for short periods only, during emergency situations.

4/1.2/3.3 Studies regarding the e.i.r.p. density limits

Report ITU-R SA.2430-0 contains the technical characteristics and results of current ITU-R studies for in-band power limits applicable to the MetSat service and the EESS in the frequency band 401-403 MHz and associated telecommand links in these bands.

One study indicated that the associated e.i.r.p. density for the GSO systems deployed in 401-403 MHz frequency band could be used, however, it is important to take into account the requirement for coexistence of different types of carriers operating within these frequencies, including telecommand operations, while ensuring protection of DCS systems through use of various methods including mitigation measures. Mitigation methods could be further developed and captured in ITU-R Recommendations, as appropriate. Table 4/1.2/3-3 provides the limits that may be imposed on different types of operations in the band of interest to ensure efficient and proper use of this band and that fall within the range of e.i.r.p. density used by current systems. It has to be noted that these values are only consistent with the telecommand links.

TABLE 4/1.2/3-3

| Frequency band | Maximum e.i.r.p. density of the earth stations | |
|----------------|--|---------------------------|
| 401-403 MHz | GSO/HEO DCS | 2 dBW/Hz |
| | non-GSO (MEO and LEO) DCS | -27 dBW/Hz ⁽¹⁾ |

⁽¹⁾ The maximum e.i.r.p. density for existing non-GSO MetSat system in the 401.898-402.522 MHz can be increased up to -20 dBW/Hz.

Regarding the non-GSO space operation service (SOS), the maximum e.i.r.p. density of the earth stations is -5 dBW/Hz.

Report ITU-R SA.2430-0 indicated that the associated e.i.r.p. density for the GSO systems deployed in the 401-403 MHz frequency band could be between -25.8 to 2 dBW/Hz, suggesting a range of 28 dB (e.i.r.p. range of 5 to 22 dBW). This wide range is indicative of the earth stations deployed in this band use of links based on wide range of e.i.r.p. and/or bandwidth parameters. Furthermore, for non-GSO satellite DCS systems in this band, the values of typical earth stations e.i.r.p. densities range between -35 to -20 dBW/Hz or an e.i.r.p. range of -3 to 13 dBW (excluding ICARUS system). For the telecommand links described in Report ITU-R SA.2430-0, the peak e.i.r.p. density ranges from -17.8 to -6.4 dBW/Hz or an e.i.r.p. range of 27 to 39 dBW. Given the larger range in the e.i.r.p. density level for non-GSO data collection platforms compared to platforms communicating to GSO MetSat and EESS satellites, as outline above, the establishment of e.i.r.p. density limits will have to differentiate between non-GSO (LEO/MEO) and GSO/HEO DCS in the 401-403 MHz frequency band.

It should be noted that these e.i.r.p. density figures were derived assuming a uniform spectrum shape of carriers.

Some mitigation techniques have been proposed considering the use of the GSO arc avoidance technique and high-gain antenna but need further studies.

4/1.2/3.4 Compatibility studies between DCS and SOS

4/1.2/3.4.1 399.9-400.05 MHz frequency band

Two studies were performed to assess the effect of telecommand operations from a non-GSO MSS earth station (Earth-to-space) into the non-GSO DCS satellite receiver. The analyses show that the levels of interference from non-GSO MSS earth station uplink telecommand signals into the non-GSO DCS satellite receiver could significantly exceed the protection criteria in Recommendation ITU-R M.2046. Consequently co-frequency usage is not possible.

4/1.2/3.4.2 401-403 MHz frequency band

Three studies were performed in Report ITU-R SA.2430-0 to assess the effect of telecommand signals from a non-GSO satellite earth station (E-s) into the GSO DCS and non-GSO DCS satellite receivers. All analyses show that the levels of interference from the telecommand signals of non-GSO earth stations (Earth-to-space) into the GSO DCS and/or non-GSO DCS satellite receivers could significantly exceed the relevant ITU-R interference criteria. The use of mitigation techniques may reduce the interference to GSO DCS and non-GSO DCS satellite receiver uplink operations. One study, using a certain type of highly directional antenna that are not covered by Recommendation ITU-R F.699-8, shows that the telecommand signals non-GSO earth station may comply with the up-to-date GSO DCS interference criteria by introducing the avoidance angle measured from TT&C non-GSO earth station antenna pointing direction towards GSO DCS satellites.

4/1.2/3.4.3 Summary of all compatibility studies

The results of the studies show that the non-GSO telecommand operations are not compatible with the low power operations of MSS in the band 399.9-400.05 MHz, and low-power operation of the non-GSO EESS and MetSat in the band 401-403 MHz.

Apart from a possible band segmentation in the band 399.9-400.05 MHz, no other measure has been found to solve the compatibility issue between DCS and telecommand operations.

In addition, in the band 401-403 MHz the non-GSO telecommand operations are not compatible with the low power operations of GSO EESS and MetSat systems unless feasible mitigation measures are applied.

The proliferation of telecommand usage may have a significant impact upon the large number of existing lower power DCP stations communicating to sensitive receivers on GSO and non-GSO satellites.

In addition, necessary measures are required in both bands to permit the continued operation of frequency assignments to networks and systems for which the confirmed date of bringing into use is prior to WRC-19 and whose operations exceed the proposed e.i.r.p. or e.i.r.p. density limits, as appropriate (see section 4/1.2/3).

4/1.2/4 Methods to satisfy the agenda item

4/1.2/4.1 For the band 399.9-400.05 MHz

4/1.2/4.1.1 Method A NOC

4/1.2/4.1.2 Method B

To include in RR the relevant e.i.r.p. limits given in section 4/1.2/3.2 by adding a new footnote in the bands 399.9-400.03 MHz in the Table of Frequency Allocations in RR Article 5, leaving the

band 400.03-400.05 MHz without e.i.r.p. limits. This method proposes a transition period up to 22 November 2024 for some systems operating in the MSS.

Advantages:

- Would ensure the operation of existing systems that usually implement low or moderate output powers for MSS systems.
- The accommodation of MSS systems using high telecommand powers is possible.
- Accommodate a transitional phase for existing high power telecommand systems.
- Provide the global network of the data collection system operating in the MSS long-term availability and assurance of the quality of meteorological and environmental data.

Disadvantages:

- Part of the MSS band (20 kHz) may be used by high power telecommand links and this part of the band may not be usable by data collection systems.
- Future MSS systems using low power transmitters could not use the entire 150 kHz available bandwidth, that would imply a reduced capacity and performance for data collection purposes.
- Does not fulfil the objectives of Resolution **765 (WRC-15)** to ensure the operations of existing and future DCS systems on a long term in the entire band.

4/1.2/4.1.3 Method C

The proposed method is to include in RR the relevant e.i.r.p. limits within reference bandwidth of 4 kHz and within 399.9-400.05 MHz, based on figures given in section 4/1.2/3.1 by adding a new footnote in the band 399.9-400.05 MHz in the Table of Frequency Allocations in RR Article 5. This method introduces limits for the whole 399.9-400.05 MHz band without breaking it into sub-bands and also proposes a transition period until 22 November 2024 for some systems operating in the MSS.

Advantages:

- Would ensure the operation of existing and future systems that usually implement low or moderate output powers for MSS systems.
- Accommodate a transitional phase for existing high power telecommand systems for MSS.
- Provide the global network of the data collection system operating in the MSS long-term availability and assurance of the quality of meteorological and environmental data.

Disadvantages:

- May not allow high power telecommand operations for non-GSO MSS satellite systems to close communication links.
- High power telecommand operation for MSS would be prevented after 22 November 2024.

4/1.2/4.1.4 Method D

The proposed method is to include in RR the relevant e.i.r.p. limits given in section 4/1.2/3.2 by adding a new footnote in the bands 399.9-400.02 MHz in the Table of Frequency Allocations in RR Article 5, leaving the band 400.02-400.05 MHz without e.i.r.p. limits. This method proposes a transition period up to 22 November 2029 for some systems operating in the MSS.

Some administrations are of the view that a frequency range of 30 kHz without e.i.r.p. limits would accommodate a larger telecommand bandwidth taking account of Doppler shift effects (e.g. typical link bandwidth of 9.6 kHz + Doppler shift of ± 8 kHz).

Advantages:

- Would ensure the operation of existing systems that usually implement low or moderate output powers for MSS systems.
- The accommodation of MSS systems using high telecommand powers is possible.
- Accommodate a transitional phase for existing high power telecommand systems.
- Provide the global network of the data collection system operating in the MSS long-term availability and assurance of the quality of meteorological and environmental data.

Disadvantages:

- Part of the MSS band (30 kHz) may be used by high power telecommand links and this part of the band may not be usable by data collection systems.
- Future MSS systems using low power transmitters could not use the entire 150 kHz available bandwidth that would imply a reduced capacity and performance for data collection purposes.
- May not fulfil the objectives of Resolution **765 (WRC-15)** to ensure the operations of existing and future DCS systems on a long term in the entire band.

4/1.2/4.2 For the bands 401-403 MHz

4/1.2/4.2.1 Method E

The proposed method is to include in RR the relevant e.i.r.p. limits within reference bandwidth of 4 kHz and within 401-403 MHz, based on figures given in section 4/1.2/3.2 by adding a new footnote in the band 401-403 MHz in the Table of Frequency Allocations in RR Article 5. This method introduces e.i.r.p. limits for the whole frequency band and the end of transition period, after which new regulations would apply is proposed to be set on 22 November 2024 or 2029 (date to be decided by WRC-19), depending on WRC-19 decision.

Advantages:

- The in-band power limits applicable to earth stations would ensure the operation of existing and future systems that usually implement low or moderate output powers for EESS, and MetSat systems.
- Accommodate a transitional phase for existing high power telecommand systems.
- Provide the global network of the data collection system operating in the EESS and MetSat services long-term availability and assurance of the quality of meteorological and environmental data.

Disadvantages:

- Most telecommand operations for EESS and MetSat would be prevented after 22 November 2024 or 2029 (date to be decided by WRC-19).

4/1.2/4.2.2 Method F

The proposed method is to include in RR the relevant e.i.r.p. limits and e.i.r.p. densities given in section 4/1.2/3.2 and 4/1.2/3.3 in different bands by adding a new footnote in the bands 401-403 MHz in the Table of Frequency Allocations in RR Article 5. This method proposes specific measures for Telecommand to ensure protection of EESS and MetSat.

Advantages:

- Some administrations are of the view that this method allows continuation of existing and future high power telecommand operations in the EESS and MetSat frequency bands.
- Some other administrations are of the view that this Method could satisfy the objectives of Resolution **765 (WRC-15)**, protecting data collection services, with deployment of proper mitigation techniques.
- Accommodate a transitional phase for existing high power telecommand systems.

Disadvantages:

- The in-band power limits applicable to earth stations would prevent the operation of existing and future systems that usually implement low or moderate output powers for EESS, and MetSat systems.
- May not provide the global network of the data collection system operating in the EESS and MetSat services long-term availability and assurance of the quality of meteorological and environmental data.
- May not protect data collection systems in the EESS and MetSat frequency bands.
- Some administrations are of the view that this Method contradicts the objectives of Resolution **765 (WRC-15)**, since proposed e.i.r.p. density limits, which are not justified by technical studies, would not ensure protection and future operation of DCS systems.

4/1.2/4.2.3 Method G

The proposed method is to include in the RR the relevant e.i.r.p. limits given in section 4/1.2/3.2 by adding a new footnote in the band 401-403 MHz in the Table of Frequency Allocations in RR Article 5.

This method contains WRC-19 Resolution (still to be developed) which provides provisions for continuation of some telecommand operations while ensuring the protection of the EESS and MetSat in these frequency bands after 1 January 2029. According to proponents of this methods the following advantages may be expected:

- The in-band power limits applicable to earth stations would ensure the operation of existing and future systems that usually implement low or moderate output powers for EESS, and MetSat systems, whilst also accommodating the higher power systems for MSS and telecommand.
- Accommodate a transitional phase for high power telecommand systems.
- Provide the global network of the data collection system operating in the EESS and MetSat services long-term availability and assurance of the quality of meteorological and environmental data
- Allows continuation of some telecommand operations in the EESS and MetSat frequency bands, with protection to all DCP operations, after 1 January 2029.

4/1.2/5 Regulatory and procedural considerations

4/1.2/5.1 For the band 399.9-400.05 MHz

4/1.2/5.1.1 Method A

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

NOC

335.4-410 MHz

4/1.2/5.1.2 Method B

MOD

335.4-410 MHz

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 399.9-400.05 | MOBILE-SATELLITE (Earth-to-space) 5.209 5.220 <u>ADD 5.A12</u> | |

ADD

5.A12 In the frequency band 399.9-400.03 MHz, the maximum e.i.r.p. of earth stations in the mobile-satellite service shall not exceed 5 dBW. Until 22 November 2024, this limit shall not apply to satellite systems for which complete notification information has been received by the Radiocommunication Bureau by 22 November 2019 and that have been brought into use by that date. Administrations are encouraged to make all practicable efforts to comply with the limits in the frequency band 399.9-400.03 MHz prior to 22 November 2024. (WRC-19)

4/1.2/5.1.3 Method C

MOD

335.4-410 MHz

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 399.9-400.05 | MOBILE-SATELLITE (Earth-to-space) 5.209 5.220 <u>ADD 5.B12</u> | |

ADD

5.B12 In the frequency band 399.9-400.05 MHz, the maximum e.i.r.p of any emission of the earth stations in the mobile-satellite service shall not exceed 5 dBW in any 4 kHz and maximum e.i.r.p. of each earth station in the mobile-satellite service shall not exceed 5 dBW in the whole 399.9-400.05 MHz frequency band. Until 22 November 2024, this limit shall not apply to satellite systems for which complete notification information has been received by the Radiocommunication Bureau by 22 November 2019 and that have been brought into use by that date. After 22 November 2024 these limits shall apply to all systems within mobile-satellite service operating in this frequency band. (WRC-19)

4/1.2/5.1.4 Method D**MOD****335.4-410 MHz**

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 399.9-400.05 | MOBILE-SATELLITE (Earth-to-space) 5.209 5.220 <u>ADD 5.C12</u> | |

ADD

5.C12 In the frequency band 399.9-400.02 MHz, the maximum e.i.r.p. of earth stations in the mobile-satellite service shall not exceed 5 dBW. Until 22 November 2029, this limit shall not apply to satellite systems for which complete notification information has been received by the Radiocommunication Bureau by 22 November 2019 and that have been brought into use by that date. Administrations are encouraged to make all practicable efforts to comply with the limits in the frequency band 399.9-400.02 MHz prior to 22 November 2029. (WRC-19)

4/1.2/5.2 For the band 401-403 MHz**4/1.2/5.2.1 Method E****MOD****335.4-410 MHz**

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 401-402 | METEOROLOGICAL AIDS SPACE OPERATION (space-to-Earth) EARTH EXPLORATION-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Fixed Mobile except aeronautical mobile <u>ADD 5.D12</u> | |

| | |
|----------------|---|
| 402-403 | METEOROLOGICAL AIDS EARTH EXPLORATION-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Fixed Mobile except aeronautical mobile ADD 5.D12 |
|----------------|---|

ADD

5.D12 In the frequency band 401-403 MHz, the maximum e.i.r.p. of any emission of the earth stations in the meteorological-satellite service and the Earth exploration-satellite service shall not exceed 22 dBW in any 4 kHz for geostationary systems and non-geostationary systems with an orbit of apogee equal or greater than 35 786 km and 7 dBW in any 4 kHz for non-geostationary systems with an orbit of apogee lower than 35 786 km and maximum e.i.r.p. of each earth station in the meteorological-satellite service and the Earth exploration-satellite service shall not exceed 22 dBW for geostationary systems and non-geostationary systems with an orbit of apogee equal or greater than 35 786 km and 7 dBW for non-geostationary systems with an orbit of apogee lower than 35 786 km in the whole 401-403 MHz frequency band.

These provisions shall not apply to all systems in the meteorological-satellite service and the Earth exploration-satellite service in this frequency band for which complete notification information has been received by the Radiocommunication Bureau before 22 November 2019 and brought into use before 22 November 2019.

After 22 November 2024 or 2029 (date to be decided by WRC-19), these limits shall apply to all systems in the meteorological-satellite service and the Earth exploration-satellite service operating in this frequency band excluding non-geostationary satellite systems for which complete notification information has been received by the Radiocommunication Bureau before 28 April 2007, for which maximum e.i.r.p. of earth stations within the 401.898-402.522 MHz frequency band can be increased to 12 dBW. (WRC-19)

4/1.2/5.2.2 Method F

MOD

335.4-410 MHz

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 401-402 | METEOROLOGICAL AIDS SPACE OPERATION (space-to-Earth) EARTH EXPLORATION-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Fixed Mobile except aeronautical mobile ADD 5.E12 ADD 5.E12bis | |

| | |
|----------------|--|
| 402-403 | METEOROLOGICAL AIDS EARTH EXPLORATION-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Fixed Mobile except aeronautical mobile ADD 5.E12 ADD 5.E12bis |
|----------------|--|

ADD

5.E12 In the frequency band 401.7-402.850 MHz, the maximum e.i.r.p. of earth stations in the meteorological-satellite service and the Earth exploration-satellite service shall not exceed 22 dBW for geostationary systems and non-geostationary systems with an orbit of apogee equal to or greater than 35 786 km. The maximum e.i.r.p. density of earth stations in the meteorological-satellite service and the Earth exploration-satellite service shall not exceed –17.8 dBW/Hz for non-geostationary systems with an orbit of apogee lower than 35 786 km. Until 22 November 2029, this limit shall not apply to satellite systems for which complete notification information has been received by the Radiocommunication Bureau by 22 November 2019 and that have been brought into use by that date. (WRC-19)

ADD

5.E12bis In the frequency band 401-401.7 MHz and 402.850-403 MHz, the maximum e.i.r.p. of earth stations in the meteorological-satellite service and the Earth exploration-satellite service shall not exceed 22 dBW for geostationary systems and non-geostationary systems with an orbit of apogee equal or greater than 35 786 km and 7 dBW for non-geostationary systems with an orbit of apogee lower than 35 786 km. Until 22 November 2029, these limits shall not apply to satellite systems for which complete notification information has been received by the Radiocommunication Bureau by 22 November 2019 and that have been brought into use by that date. (WRC-19)

4/1.2/5.2.3 Method G**MOD****335.4-410 MHz**

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 401-402 | METEOROLOGICAL AIDS SPACE OPERATION (space-to-Earth) EARTH EXPLORATION-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Fixed Mobile except aeronautical mobile ADD 5.F12 ADD 5.G12 | |

| | |
|----------------|---|
| 402-403 | METEOROLOGICAL AIDS EARTH EXPLORATION-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Fixed Mobile except aeronautical mobile ADD 5.F12 ADD 5.G12 |
|----------------|---|

ADD

5.F12 In the frequency band 401-403 MHz, the maximum e.i.r.p. of earth stations in the meteorological-satellite service and the Earth exploration-satellite service shall not exceed 22 dBW for geostationary systems and non-geostationary systems with an orbit of apogee equal or greater than 35 786 km and 7 dBW for non-geostationary systems with an orbit of apogee lower than 35 786 km.

These provisions shall not apply to all systems in the meteorological-satellite service and the Earth exploration-satellite service in this frequency band for which complete notification information has been received by the Radiocommunication Bureau before 22 November 2019 and brought into use before 22 November 2019.

After 1 January 2029, these limits shall apply to all systems, except telecommand systems for which complete notification information has been received by the Radiocommunication Bureau before 22 November 2019 and brought into use before 22 November 2019, in the meteorological-satellite service and the Earth exploration-satellite service operating in this frequency band.

In the frequency band 401.898-402.522 MHz, the maximum e.i.r.p. of earth stations for the METEOR-3M satellite system for which complete notification information was received by the Radiocommunication Bureau by 28 April 2007 can be increased to 12 dBW. (WRC-19)

ADD

5.G12 Operations for telecommand of the space stations in the band 401-403 MHz (under No. **1.23**) after 1 January 2029 shall comply with Draft New Resolution **[TBD]** (WRC-19). (WRC-19)

ADD

DRAFT NEW RESOLUTION [TBD] (WRC-19)

TBD

4/1.2/5.3 For all Methods A, B, C, D, E, F and G

SUP

RESOLUTION 765 (WRC-15)

**Establishment of in-band power limits for earth stations operating
in mobile-satellite service, the meteorological-satellite service and
the Earth exploration-satellite service in the frequency bands
401-403 MHz and 399.9-400.05 MHz**

Agenda item 1.3

1.3 to consider possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a possible primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz, in accordance with Resolution 766 (WRC-15);

Resolution 766 (WRC-15) – *Consideration of possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz*

4/1.3/1 Executive summary

This agenda item aims at determining the possibility of upgrading the secondary meteorological-satellite service (MetSat) (space-to-Earth) allocation to primary status and adding a primary Earth exploration satellite-service (EESS) (space-to-Earth) allocation in the frequency band 460-470 MHz.

This has to be performed while providing protection and not imposing any additional constraints on existing primary services to which the frequency band is already allocated and to services in the adjacent frequency bands, and maintaining the conditions contained in RR No. **5.289**. In addition, the resultant power flux-density (pfd) mask will be no less restrictive than -152 dBW/m²/4 kHz.

Report ITU-R SA.2429-0 provides the studies and compiles elements related to background on WRC-19 agenda item 1.3. This Report also includes initial technical considerations on EECS and MetSat in the 460-470 MHz band and other services allocated in this band and adjacent bands, namely the mobile, maritime mobile, mobile-satellite, fixed and broadcasting services.

The studies resulted in the development of pfd limits for non-GSO satellites and separate pfd limits for GSO satellites that would protect the incumbent in-band and adjacent channel service operations.

Three methods are proposed. Method A proposes no change, Method B, and Method C propose Radio Regulations (RR) changes to upgrade the MetSat and EECS allocations to primary and to add an appropriate provisions to protect existing services in the frequency band 460-470 MHz.

4/1.3/2 Background

The use of the frequency band 460-470 MHz is already established due to the existence of a secondary allocation to MetSat. Meteorological satellites already transmit in this band to control and configure data collection platforms.

Data collection systems (DCS) operate on geostationary and non-geostationary orbits in the MetSat and the EECS (Earth-to-space) systems in the frequency band 401-403 MHz (uplink) and 460-470 MHz (downlink). DCS are essential for monitoring and predicting climate change, monitoring ocean and water resources, weather forecasting and assisting in protecting biodiversity, as well as improving maritime security.

DCS have been operating globally under a secondary allocation and on a primary basis in some countries under RR No. **5.290**, but this use is constrained by coordination under RR No. **9.21**. This has led to differing limitations and protection criteria and has posed a barrier to implementation of essential DCS components on a global basis.

According to RR No. **5.289**, “Earth exploration-satellite service applications, other than the meteorological-satellite service, may also be used in the bands 460-470 MHz and 1 690-1 710 MHz

for space-to-Earth transmissions subject to not causing harmful interference to stations operating in accordance with the Table”.

One of the EESS/MetSat usages comprises the data collection platforms gathering information activity related to the Earth, the environment and scientific application, weather and environment observation. The data, which are collected by ground platforms, are sent to the corresponding satellites that retransmit the retrieved information to dedicated earth stations. DCS are particularly useful for the collection of data from remote and inhospitable locations where it may provide the only possibility for data relay. DCS also have very many uses in areas with a highly developed infrastructure. The installations required for relay of the data tend to be inexpensive, unobtrusive, and normally blend easily into the local environment.

Amongst others, this band is currently used by the advanced data collection system also called ARGOS which is a unique worldwide location and DCS dedicated to studying oceans and atmospheric conditions, preserving and monitoring wildlife, volcanoes, fishing fleets, shipments of dangerous goods, humanitarian applications, and managing water resources.

DCS help the scientific community to better monitor and understand our environment but also help industry to comply with environmental protection regulations implemented by various governments. This positioning capability also permits applications such as monitoring drifting ocean buoys and studying wildlife migration paths.

A primary allocation to the MetSat and EESS (space-to-Earth) in the frequency band 460-470 MHz would provide confidence to space and meteorological agencies deeply involved in satellite data collection programmes and the public sectors funding the development and operation of such systems. These space programmes have involved a long-term effort and investment for decades between the time when the programme is officially decided, the development, the launch phase; and the time when the various satellites are in operation, keeping in mind that usually many satellites are deployed in order to provide a continuous service. Space and meteorological agencies are also investing in the continuity of these programmes providing subsequent satellites and payloads, and an allocation upgrade in the frequency band 460-470 MHz would provide the necessary long-term continuity for these programmes of public interest. In addition, the power flux-density (pfd) limits will provide reliable protection to incumbent terrestrial services without imposing constraints.

The frequency band 460-470 MHz is currently allocated to the fixed and mobile services on a primary basis and is widely used by these services. Resolution **766 (WRC-15)** states that there is a need to protect the fixed and mobile services in the frequency band 460-470 MHz and not to constrain their future development. Furthermore, RR No. **5.286AA** identifies the frequency band 450-470 MHz for use by administrations wishing to implement International Mobile Telecommunications (IMT).

4/1.3/3 Summary and analysis of the results of ITU-R studies

Report ITU-R SA.2429 provides the studies related to WRC-19 agenda item 1.3. This Report is based on the most restrictive study results for the pfd levels required to protect mobile service (MS) and fixed service (FS) systems from MetSat/EESS satellite downlinks.

The results of the static analyses presented four cases where the pfd limit was more stringent than $-152 \text{ dBW/m}^2/4 \text{ kHz}$. Dynamic analysis was performed where the static analysis resulted in a pfd limit more restrictive than $-152 \text{ dBW/m}^2/\text{MHz}$ and time constraints for the radio frequency interference (RFI) were known. This was the case for the FS point-to-point (P-P), point-to-multipoint (P-MP), and Radio Frequency mesh network Central Station Alarm (RF CSA) systems as well as all applications under the mobile service. Static analysis was also done to address the protection of BS and radio astronomy in adjacent bands.

The studies determined that the pfd limits for the downlink emission of non-GSO and GSO satellites as a function of the angle of arrival (α) are:

For non-GSO satellites:

$$\text{pfd} \left(\text{dBW} / \left(\text{m}^2 \cdot 4 \text{ kHz} \right) \right) = \begin{cases} -157 & 0^\circ \leq \alpha < 5^\circ \\ -157 + 0.5(\alpha - 5) & 5^\circ \leq \alpha < 15^\circ \\ -152 & 15^\circ \leq \alpha \leq 90^\circ \end{cases}$$

For GSO satellites:

Option 1:

$$\text{pfd} \left(\text{dBW} / \left(\text{m}^2 \cdot 4 \text{ kHz} \right) \right) = \begin{cases} -162 & 0^\circ \leq \alpha \leq 15^\circ \\ -162 + 0.5(\alpha - 15) & 15^\circ < \alpha < 35^\circ \\ -152 & 35^\circ \leq \alpha \leq 90^\circ \end{cases}$$

Option 2:

$$\text{pfd} \left(\text{dBW} / \left(\text{m}^2 \cdot 4 \text{ kHz} \right) \right) = -156 + 0.033 \times \alpha \quad 0^\circ \leq \alpha \leq 90^\circ$$

Since the adoption of Report ITU-R SA.2429, further discussions and consideration of the above masks for GSO satellites resulted in agreement that the Option 2 mask will not ensure protection of fixed and mobile services.

Some administrations are of the view that further studies are needed to address the pfd limits for GSO satellites and conclude on a single mask and also that further studies are required to take into account systems in the mobile service requiring higher protection, such as PPDR, from GSO and non-GSO satellites as provided in Recommendation ITU-R M.1808-0.

Some other administrations are of the view that the non-GSO pfd mask and GSO pfd mask provided in Option 1 will ensure protection of fixed and mobile services.

The frequency band 460-470 MHz has been utilized by several satellite systems, some of which do not meet the above pfd limit masks. An appropriate arrangement is necessary to ensure that the existing satellite systems, including those for which complete notification information or coordination request or advance publication information was received by the Radiocommunication Bureau prior to the end of WRC-19 can continue their operation in compliance with the provisions adopted at WRC-19.

4/1.3/4 Methods to satisfy the agenda item

4/1.3/4.1 Method A NOC

No changes are proposed to the RR. A consequential suppression of Resolution **766 (WRC-15)**.

4/1.3/4.2 Method B

An upgrade of the MetSat (space-to-Earth) allocation from secondary to primary status and a primary EESS (space-to-Earth) allocation could be added in the frequency band 460-470 MHz provided that the priority of MetSat over EESS, as currently contained in the Radio Regulations, is retained and that the protection of primary services in the frequency band and in adjacent frequency bands is ensured.

In order to protect terrestrial services, pfd limits are proposed for both non-GSO and GSO MetSat/EESS satellites.

In addition, RR No. **5.290** is proposed to be suppressed since MetSat and EESS are primary services in the frequency band.

Finally, a new Resolution is proposed to provide the transitional measures for the existing MetSat/EESS frequency assignments.

Advantage:

- Provide a primary status to MetSat/EESS service while improving the protection of the existing terrestrial services by implementing pfd masks.

Disadvantage:

- There is a potential for harmful interference into stations of terrestrial services in case more than two non-GSO and GSO MetSat/EESS satellites operate simultaneously in the same frequency band within the same service area.

4/1.3/4.3 Method C

An upgrade of the MetSat (space-to-Earth) allocation from secondary to primary status and a primary EESS (space-to-Earth) allocation could be added in the frequency band 460-470 MHz provided that the priority of MetSat over EESS, as currently contained in the Radio Regulations, is retained and that the protection of primary services in the frequency band and in adjacent frequency bands is ensured.

A new Resolution is proposed to protect existing terrestrial services in the band 460-470 MHz by introducing regulatory provisions, including pfd limits for both non-GSO and GSO MetSat/EESS satellites and also grandfathering the existing MetSat/EESS frequency assignments.

In addition, RR No. **5.290** is proposed to be suppressed since MetSat and EESS are primary services in the frequency band.

Advantage:

- Provide a primary status to MetSat/EESS service while improving the protection of the existing terrestrial services by implementing pfd masks.

Disadvantage:

- There is a potential for harmful interference into stations of terrestrial services in case more than two non-GSO and GSO MetSat/EESS satellites operate simultaneously in the same frequency band within the same service area.

4/1.3/5 Regulatory and procedural considerations

4/1.3/5.1 Method A

NOC

ARTICLES

SUP

RESOLUTION 766 (WRC-15)

Consideration of possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz

4/1.3/5.2 Method B

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. 2.1)

MOD

460-890 MHz

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 460-470 | <u>EARTH EXPLORATION-SATELLITE (space-to-Earth)</u> FIXED <u>METEOROLOGICAL-SATELLITE (space-to-Earth)</u> MOBILE 5.286AA Meteorological satellite (space-to-Earth) 5.287 5.288 5.289 5.290 <u>ADD 5.A13</u> | |

MOD

5.289 Earth exploration-satellite service applications, other than the meteorological-satellite service, may also be used in the bands ~~s 460-470 MHz and~~ 1 690-1 710 MHz for space-to-Earth transmissions subject to not causing harmful interference to stations operating in accordance with the Table. (WRC-19)

Reasons: Inclusion in the Table, a primary EESS (space-to-Earth) allocation in the frequency band 460-470 MHz.

SUP

5.290

Reasons: Consequential change.

Method B Option 1

ADD

5.A13 In the frequency band 460-470 MHz, earth stations in the meteorological-satellite service (space-to-Earth) and Earth exploration-satellite service (space-to-Earth) shall not cause harmful interference to nor claim protection from stations of the fixed and mobile services, and shall not claim protection from broadcasting service in the adjacent bands. (WRC-19)

Method B Option 2

ADD

5.A13 In the frequency band 460-470 MHz, earth stations in the meteorological-satellite service (space-to-Earth) and Earth exploration-satellite service (space-to-Earth) shall not claim protection from stations of the fixed and mobile services, and shall not claim protection from broadcasting service in the adjacent bands. (WRC-19)

Reasons: The frequency band 470-694 MHz is allocated to the broadcasting service in all three regions on a primary basis and is widely used by this service. Given the fact that, based on *resolves* to invite the 2019 World Radiocommunication Conference (WRC-19), Resolution **766 (WRC-15)**, the MetSat and EESS would not claim protection from services in adjacent frequency band, the compatibility of MetSat and EESS and more importantly not claiming protection from broadcasting service in adjacent frequency band, should be ensured.

Method B (continued)

ADD

5.B13 In the frequency band 460-470 MHz, space stations in the meteorological-satellite (space-to-Earth) and Earth exploration-satellite (space-to-Earth) shall comply with the following power flux-density limits.

For non-GSO space stations:

$$\text{pfd} \left(\text{dBW} / (\text{m}^2 \cdot 4 \text{ kHz}) \right) = \begin{cases} -157 & 0^\circ \leq \alpha < 5^\circ \\ -157 + 0.5(\alpha - 5) & 5^\circ \leq \alpha < 15^\circ \\ -152 & 15^\circ \leq \alpha \leq 90^\circ \end{cases}$$

and for GSO space stations:

Option 1:

$$\text{pfd} \left(\text{dBW} / (\text{m}^2 \cdot 4 \text{ kHz}) \right) = \begin{cases} -162 & 0^\circ \leq \alpha \leq 15^\circ \\ -162 + 0.5(\alpha - 15) & 15^\circ < \alpha < 35^\circ \\ -152 & 35^\circ \leq \alpha \leq 90^\circ \end{cases}$$

Option 2:

$$\text{pfd} \left(\text{dBW} / (\text{m}^2 \cdot 4 \text{ kHz}) \right) = -156 + 0.033 \times \alpha \quad 0^\circ \leq \alpha \leq 90^\circ$$

where α is the angle of arrival above the horizontal plane, in degrees.

These limits apply to all space stations in the meteorological-satellite service and Earth exploration-satellite service in this frequency band for which a complete notification information or

coordination request was received by the Radiocommunication Bureau after the end of WRC-19. Resolution [A13] (WRC-19) shall apply. (WRC-19)

ADD

5.C13 In the frequency band 460-470 MHz stations in the Earth exploration-satellite service (space-to-Earth) shall not cause harmful interference to nor claim protection from stations in the meteorological-satellite service (space-to-Earth). (WRC-19)

APPENDIX 7 (REV.WRC-15)

Methods for the determination of the coordination area around an earth station in frequency bands between 100 MHz and 105 GHz

ANNEX 7

System parameters and predetermined coordination distances for determination of the coordination area around an earth station

3 Horizon antenna gain for a receiving earth station with respect to a transmitting earth station

MOD

TABLE 8a (Rev.WRC-12/19)

Parameters required for the determination of coordination distance for a receiving earth station

| Receiving space radiocommunication service designation | | Space operation, space research | Meteorological-satellite, mobile-satellite | Space research | Space research, space operation | Space operation | Mobile-satellite | Meteorological-satellite | Mobile-satellite | Space research | Space operation | Meteorological-satellite | Broad-casting-satellite | Mobile-satellite | Broadcasting-satellite (DAB) | Mobile-satellite, land-mobile satellite, maritime mobile-satellite |
|--|-------------------------------|---------------------------------|--|-------------------------------|---------------------------------|------------------------------|------------------|--------------------------|---------------------|---------------------|------------------------------------|--------------------------|------------------------------|------------------------------|------------------------------|--|
| Frequency bands (MHz) | | 137-138 | 137-138 | 143.6-143.65 | 174-184 | 163-167 272-273 ⁵ | 335.4-399.9 | 400.15-401 | 400.15-401 | 400.15-401 | 401-402 | 460-470 | 620-790 | 856-890 | 1 452-1 492 | 1 518-1 530 1 555-1 559 2 160-2 200 ¹ |
| Transmitting terrestrial service designations | | Fixed, mobile | Fixed, mobile | Fixed, mobile, radio-location | Fixed, mobile, broad-casting | Fixed, mobile | Fixed, mobile | Meteorological aids | Meteorological aids | Meteorological aids | Meteorological aids, fixed, mobile | Fixed, mobile | Fixed, mobile, broad-casting | Fixed, mobile, broad-casting | Fixed, mobile, broadcasting | Fixed, mobile |
| Method to be used | | § 2.1 | § 2.1 | § 2.1 | § 2.1 | § 2.1 | § 1.4.6 | § 1.4.6 | § 1.4.6 | – | § 2.1 | § 2.1 | § 1.4.5 | § 1.4.6 | § 1.4.5 | § 1.4.6 |
| Modulation at earth station ² | | N | | N | | N | | | | N | N | | | | N | N |
| Earth station interference parameters and criteria | p_0 (%) | 0.1 | | 0.1 | | 1.0 | | 0.012 | | 0.1 | 0.1 | 0.012 | | | | 10 |
| | n | 2 | | 2 | | 1 | | 1 | | 2 | 2 | 1 | | | | 1 |
| | p (%) | 0.05 | | 0.05 | | 1.0 | | 0.012 | | 0.05 | 0.05 | 0.012 | | | | 10 |
| | N_L (dB) | 0 | | 0 | | 0 | | 0 | | 0 | 0 | | | | | 0 |
| | M_s (dB) | 1 | | 1 | | 1 | | 4.3 | | 1 | 1 | | | | | 1 |
| | W (dB) | 0 | | 0 | | 0 | | 0 | | 0 | 0 | | | | | 0 |
| Terrestrial station parameters | E (dBW) in B ³ | A | – | – | | 15 | | | | – | – | 5 | | | 38 | 37 ⁴ |
| | | N | – | – | | 15 | | | | – | – | 5 | | | 38 | 37 |
| | P_t (dBW) in B | A | – | – | | –1 | | | | – | – | –11 | | | 3 | 0 |
| | | N | – | – | | –1 | | | | – | – | –11 | | | 3 | 0 |
| | G_x (dBi) | – | | – | | 16 | | | | – | – | 16 | | | 35 | 37 |
| Reference bandwidth | B (Hz) | 1 | | 1 | | 10^3 | | 177.5×10^3 | | 1 | 1 | 85 | | | 25×10^3 | 4×10^3 |
| Permissible interference power | $P_r(p)$ (dBW) in B | –199 | | –199 | | –173 | | –148 | | –208 | –208 | –178 | | | | –176 |

¹ In the band 2 160-2 200 MHz, the terrestrial station parameters of line-of-sight radio-relay systems have been used. If an administration believes that, in this band transhorizon systems need to be considered, the parameters associated with the frequency band 2 500-2 690 MHz may be used to determine the coordination area.

² A: analogue modulation; N: digital modulation.

³ E is defined as the equivalent isotropically radiated power of the interfering terrestrial station in the reference bandwidth.

⁴ This value is reduced from the nominal value of 50 dBW for the purposes of determination of coordination area, recognizing the low probability of high power emissions falling fully within the relatively narrow bandwidth of the earth station.

⁵ The fixed-service parameters provided in the column for 163-167 MHz and 272-273 MHz are only applicable to the band 163-167 MHz.

SUP

RESOLUTION 766 (WRC-15)

Consideration of possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz

(Note to CPM/19-2: Due to the time constraint it was not possible to carefully review the text of this Resolution in particular areas containing the status of assignment which normally should be included in the Table of Allocations and associated Footnotes, there is a need to carefully review this Resolution and transfer the status of assignment to corresponding Footnotes and alignment of the text to be clearly understood by the readers.)

(Note to CPM/19-2: The intention of this resolution is to guarantee that 1) current networks notified under RR No. **5.290** on a primary basis or coordinated under RR No. **9.21** will continue to have the same rights, including those obtained under RR No. **9.21** agreements and 2) that current networks notified under the secondary EESS allocations (see RR No. **5.289**) that are not compliant with the pfd limits could have similar rights vis-à-vis EESS networks under the new primary EESS allocation (similar issue for MetSat systems). Views from the Bureau would be needed to ensure that the proposed provisions (“*resolves*” and “*instructs the Director of the Bureau*”) below duly reach those goals.)

ADD

DRAFT NEW RESOLUTION [A13] (WRC-19)

Transitional measures for existing satellite networks and systems of the meteorological-satellite service (space-to-Earth) and the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that data collection systems (DCS) operate on geostationary and non-geostationary orbits in the meteorological-satellite service (MetSat) and the Earth exploration-satellite service (EESS) (Earth-to-space) systems in the frequency band 401-403 MHz;
- b)* that DCS are essential for monitoring and predicting climate change, monitoring oceans, and water resources, weather forecasting and assisting in protecting biodiversity and improving maritime security;
- c)* that most of these DCS have implemented satellite downlinks (space-to-Earth) in the frequency band 460-470 MHz which bring significant improvements to the operation of satellite

DCS, such as the transmission of information to optimize the usage of the terrestrial data collection platforms;

- d) that the frequency band 460-470 MHz is also used for the downlink of mission and telemetry data for meteorological and Earth exploration purposes;
- e) that the frequency band 460-470 MHz is allocated to the fixed and mobile services on a primary basis and is widely used by these services;
- f) that the World Radiocommunication Conference 2019 (WRC-19) has upgraded the secondary allocation of the MetSat (space-to-Earth) to primary status and added a primary allocation to the EESS (space-to-Earth) in the frequency band 460-470 MHz, and established the power flux-density (pfd) masks in the provision of No. **5.B13** to provide protection of existing terrestrial services to which the frequency band is already allocated and in the adjacent frequency bands;
- g) that WRC-19 has deleted No. **5.290** and the relevant parameters in Table 8a of Appendix **7**, which identified some administrations that already had a primary allocation to the MetSat (space-to-Earth), subject to agreement obtained under No. **9.21**, in the light of the upgrade mentioned in *considering f)* above, and that it is necessary to provide some measures for the satellite systems which was in accordance with No. **5.290** to retain their regulatory status as of the end of WRC-19,

noting

- a) that several EESS and MetSat satellite networks and systems in the frequency band 460-470 MHz were notified and brought into use;
- b) that some of these EESS and MetSat satellite networks and systems above may not meet the pfd masks in *considering f)*, but there is a need to authorize them to continue their operation,

resolves

- 1 that the satellite networks and systems in the meteorological-satellite (space-to-Earth) and Earth exploration-satellite (space-to-Earth) services in the frequency band 460-470 MHz for which a complete coordination request or notification information has been received by the Radiocommunication Bureau prior to the end of WRC-19 are allowed to continue to operate with the same parameters under Appendix **4** submitted for coordination or notification;
- 2 that the frequency assignment of MetSat (space-to-Earth) and EESS (space-to-Earth) satellite network in the frequency band 460-470 MHz for which complete notification information or coordination request was received by the Radiocommunication Bureau prior to the end of WRC-19 and which space stations do not meet the pfd limits given in No. **5.B13** shall be used on a secondary basis with respect to the fixed and mobile service stations;
- 3 that the satellite systems in the meteorological-satellite service (space-to-Earth) referred to in *considering g)* for which complete coordination information related to No. **9.21** has been received by the Radiocommunication Bureau prior to the end of WRC-19 can operate on a primary basis, and that, for those systems, the relevant provisions of Articles **9** and **11** continue to apply, and the relevant agreements obtained under No. **9.21** remain in force after the end of WRC-19,

instructs the Director of the Radiocommunication Bureau

for the frequency assignment of MetSat (space-to-Earth) and EESS (space-to-Earth) satellite network for which complete notification information or coordination request was received by the Radiocommunication Bureau prior to the end of WRC-19, the Bureau shall review the finding under No. **11.50** without proposal to the administration that it submit a new assignment to replace

the previous one. The date of such assignment original recording in the Master International Frequency Register (MIFR) shall be kept.

4/1.3/5.3 Method C

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

(See No. 2.1)

MOD

460-890 MHz

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 460-470 | FIXED <u>EARTH EXPLORATION-SATELLITE (space-to-Earth)</u> <u>FIXED</u> <u>METEOROLOGICAL-SATELLITE (space-to-Earth)</u> MOBILE 5.286AA Meteorological-satellite (space-to-Earth) 5.287 5.288 5.289 5.290 <u>ADD 5.D13</u> | |

MOD

1 660-1 710 MHz

| Allocation to services | | |
|--|--|---|
| Region 1 | Region 2 | Region 3 |
| 1 690-1 700 METEOROLOGICAL AIDS METEOROLOGICAL-SATELLITE (space-to-Earth) Fixed Mobile except aeronautical mobile <u>MOD</u> 5.289 5.341 5.382 | 1 690-1 700 METEOROLOGICAL AIDS METEOROLOGICAL-SATELLITE (space-to-Earth) <u>MOD</u> 5.289 5.341 5.381 | |
| 1 700-1 710 FIXED METEOROLOGICAL-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile <u>MOD</u> 5.289 5.341 | | 1 700-1 710 FIXED METEOROLOGICAL-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile <u>MOD</u> 5.289 5.341 5.384 |

MOD

5.289 Earth exploration-satellite service applications, other than the meteorological-satellite service, may also be used in the bands ~~s 460-470 MHz and~~ 1 690-1 710 MHz for space-to-Earth transmissions subject to not causing harmful interference to stations operating in accordance with the Table. (WRC-19)

SUP

5.290

ADD

5.D13 In the frequency band 460-470 MHz, Resolution [E13] (WRC-19) shall apply. (WRC-19)

APPENDIX 7 (REV.WRC-15)

Methods for the determination of the coordination area around an earth station in frequency bands between 100 MHz and 105 GHz

ANNEX 7

System parameters and predetermined coordination distances for determination of the coordination area around an earth station

3 Horizon antenna gain for a receiving earth station with respect to a transmitting earth station

MOD

TABLE 8a (Rev.WRC-~~12~~19)

Parameters required for the determination of coordination distance for a receiving earth station

| Receiving space radiocommunication service designation | | Space operation, space research | Meteoro-logical-satellite, mobile-satellite | Space research | Space research, space operation | Space operation | Mobile-satellite | Meteoro-logical-satellite | Mobile-satellite | Space research | Space operation | Meteoro-logical-satellite | Broad-casting-satellite | Mobile-satellite | Broadcasting-satellite (DAB) | Mobile-satellite, land-mobile satellite, maritime mobile-satellite |
|--|-------------------------------|---------------------------------|---|-------------------------------|---------------------------------|------------------------------|------------------|---------------------------|----------------------|----------------------|-------------------------------------|---------------------------|------------------------------|------------------------------|------------------------------|--|
| Frequency bands (MHz) | | 137-138 | 137-138 | 143.6-143.65 | 174-184 | 163-167 272-273 ⁵ | 335.4-399.9 | 400.15-401 | 400.15-401 | 400.15-401 | 401-402 | 460-470 | 620-790 | 856-890 | 1 452-1 492 | 1 518-1 530 1 555-1 559 2 160-2 200 ¹ |
| Transmitting terrestrial service designations | | Fixed, mobile | Fixed, mobile | Fixed, mobile, radio-location | Fixed, mobile, broad-casting | Fixed, mobile | Fixed, mobile | Meteoro-logical aids | Meteoro-logical aids | Meteoro-logical aids | Meteoro-logical aids, fixed, mobile | Fixed, mobile | Fixed, mobile, broad-casting | Fixed, mobile, broad-casting | Fixed, mobile, broadcasting | Fixed, mobile |
| Method to be used | | § 2.1 | § 2.1 | § 2.1 | § 2.1 | § 2.1 | § 1.4.6 | § 1.4.6 | § 1.4.6 | – | § 2.1 | § 2.1 | § 1.4.5 | § 1.4.6 | § 1.4.5 | § 1.4.6 |
| Modulation at earth station ² | | N | | N | | N | | | | N | N | | | | N | N |
| Earth station interference parameters and criteria | p_0 (%) | 0.1 | | 0.1 | | 1.0 | | 0.012 | | 0.1 | 0.1 | 0.012 | | | | 10 |
| | n | 2 | | 2 | | 1 | | 1 | | 2 | 2 | 1 | | | | 1 |
| | p (%) | 0.05 | | 0.05 | | 1.0 | | 0.012 | | 0.05 | 0.05 | 0.012 | | | | 10 |
| | N_L (dB) | 0 | | 0 | | 0 | | 0 | | 0 | 0 | | | | | 0 |
| | M_s (dB) | 1 | | 1 | | 1 | | 4.3 | | 1 | 1 | | | | | 1 |
| | W (dB) | 0 | | 0 | | 0 | | 0 | | 0 | 0 | | | | | 0 |
| Terrestrial station parameters | E (dBW) in B ³ | A | – | – | | 15 | | | | – | – | 5 | | | 38 | 37 ⁴ |
| | | N | – | – | | 15 | | | | – | – | 5 | | | 38 | 37 |
| | P_t (dBW) in B | A | – | – | | –1 | | | | – | – | –11 | | | 3 | 0 |
| | | N | – | – | | –1 | | | | – | – | –11 | | | 3 | 0 |
| | G_x (dBi) | – | | – | | 16 | | | | – | – | 16 | | | 35 | 37 |
| Reference bandwidth | B (Hz) | 1 | | 1 | | 10^3 | | 177.5×10^3 | | 1 | 1 | 85 | | | 25×10^3 | 4×10^3 |
| Permissible interference power | $P_r(p)$ (dBW) in B | –199 | | –199 | | –173 | | –148 | | –208 | –208 | –178 | | | | –176 |

¹ In the band 2 160-2 200 MHz, the terrestrial station parameters of line-of-sight radio-relay systems have been used. If an administration believes that, in this band transhorizon systems need to be considered, the parameters associated with the frequency band 2 500-2 690 MHz may be used to determine the coordination area.

² A: analogue modulation; N: digital modulation.

³ E is defined as the equivalent isotropically radiated power of the interfering terrestrial station in the reference bandwidth.

⁴ This value is reduced from the nominal value of 50 dBW for the purposes of determination of coordination area, recognizing the low probability of high power emissions falling fully within the relatively narrow bandwidth of the earth station.

⁵ The fixed-service parameters provided in the column for 163-167 MHz and 272-273 MHz are only applicable to the band 163-167 MHz.

SUP

RESOLUTION 766 (WRC-15)

Consideration of possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz

ADD

DRAFT NEW RESOLUTION [B13] (WRC-19)

Implementation of satellite networks and systems of the meteorological-satellite service (space-to-Earth) and the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that data collection systems (DCS) operate on geostationary and non-geostationary orbits in the meteorological-satellite service (MetSat) and the Earth exploration-satellite service (EESS) (Earth-to-space) in the frequency band 401-403 MHz;
- b)* that DCS are essential for monitoring and predicting climate change, monitoring oceans, and water resources, weather forecasting and assisting in protecting biodiversity, improving maritime security;
- c)* that most of these DCS have implemented satellite downlinks (space-to-Earth) in the frequency band 460-470 MHz which bring significant improvements to the operation of satellite DCS, such as the transmission of information to optimize the usage of the terrestrial data collection platforms;
- d)* that the frequency band 460-470 MHz is also used for the downlink of mission and telemetry data for meteorological and Earth-exploration purposes;
- e)* that the frequency band 460-470 MHz is allocated to the fixed and mobile services on a primary basis and is widely used by these services and is also identified for IMT on a global basis;
- f)* that World Radiocommunication Conference 2019 (WRC-19) has upgraded the secondary allocation of the MetSat (space-to-Earth) to primary status and added a primary allocation to the EESS (space-to-Earth) in the frequency band 460-470 MHz, and established power flux-density (pfd) limits, providing protection and not imposing any additional constraints on existing primary services to which the frequency band is already allocated and in the adjacent frequency bands;

g) that the priority of MetSat systems over EESS systems in the frequency band 460-470 MHz is provided to ensure protection of MetSat systems from interference from the increasing number of small satellite systems operating in the EESS;

h) that WRC-19 suppressed No. **5.290** and the relevant parameters in Table **8a** of Appendix **7**, which identified some administrations that already have a primary allocation to the MetSat (space-to-Earth), subject to agreement obtained under No. **9.21**, in the light of the upgrade mentioned in *considering f*) above, and that it is necessary to provide some regulatory measures for satellite systems which operate in accordance with No. **5.290** to retain their regulatory status after the end of WRC-19,

noting

a) that frequency assignments for several EESS and MetSat satellite networks and systems in the frequency band 460-470 MHz were notified and brought into use before 22 November 2019;

b) that some of these EESS and MetSat satellite networks and systems above may not meet the pfd limit in *considering f*), but there is a need to continue to authorize them for operations in order to continue their operations,

resolves

1 that in the frequency band 460-470 MHz the power flux-density at the Earth's surface produced by stations in the meteorological-satellite (space-to-Earth) and Earth exploration-satellite (space-to-Earth) services shall comply with the limits listed below under assumed free-space propagation conditions for all methods of modulation:

For non-GSO space stations:

$$pfd \left(\text{dBW} / \left(\text{m}^2 \cdot 4 \text{ kHz} \right) \right) = \begin{cases} -157 & 0^\circ \leq \alpha < 5^\circ \\ -157 + 0.5(\alpha - 5) & 5^\circ \leq \alpha < 15^\circ \\ -152 & 15^\circ \leq \alpha < 90^\circ \end{cases}$$

And for GSO space stations:

$$pfd \left(\text{dBW} / \left(\text{m}^2 \cdot 4 \text{ kHz} \right) \right) = \begin{cases} -162 & 0^\circ \leq \alpha < 15^\circ \\ -162 + 0.5(\alpha - 15) & 15^\circ \leq \alpha < 35^\circ \\ -152 & 35^\circ \leq \alpha < 90^\circ \end{cases}$$

where

α is the angle of arrival above the horizontal plane, in degrees.

These limits apply to all space stations in the meteorological-satellite service and Earth exploration-satellite service in this frequency band for which complete notification information for non-geostationary satellite networks or coordination request or advance publication information for geostationary satellite networks is received by the Radiocommunication Bureau after the end of WRC-19;

2 that the satellite networks and systems in the meteorological-satellite (space-to-Earth) and Earth exploration-satellite (space-to-Earth) services in the frequency band 460-470 MHz for which a complete coordination request or advance publication information for geostationary satellite networks or notification information for non-geostationary satellite networks has been received by the Radiocommunication Bureau prior to the end of WRC-19, and those space stations which meet the pfd limits given in *resolves 1*, may to continue to operate with the same parameters under Appendix **4** submitted for coordination or notification;

3 that the frequency assignment of MetSat (space-to-Earth) and EESS (space-to-Earth) satellite network and systems in the frequency band 460-470 MHz for which complete notification information for non-geostationary satellite networks or coordination request or advance publication information for geostationary satellite networks was received by the Radiocommunication Bureau prior to the end of WRC-19 and whose space stations do not meet the pfd limits given in *resolves* 1 shall be used on a primary basis subject to not causing harmful interference to the fixed and mobile service stations;

4 that the satellite systems in the meteorological-satellite service (space-to-Earth) referred to in *considering h*) for which complete coordination information related to No. **9.21** has been received by the Radiocommunication Bureau prior to the end of WRC-19 shall operate on a primary basis, and that, for those systems, the relevant provisions of Articles **9** and **11** continue to apply, and the relevant agreements obtained under No. **9.21** remain in force after the end of WRC-19;

5 that the MetSat and EESS in the 460-470 MHz band shall not limit the development or the deployment of the fixed, mobile and broadcast services allocated in the 460-470 MHz and adjacent bands;

6 that in the frequency band 460-470 MHz, earth stations in the meteorological-satellite service (space-to-Earth) and Earth exploration-satellite service (space-to-Earth) shall not claim protection from stations of the fixed and mobile services in the frequency band 460-470 MHz and shall not claim protection from stations of the broadcasting service operating in the adjacent band unless other agreements were obtained under No. **9.21** prior to the end of WRC-19. No. **5.43A** does not apply;

7 that in the frequency band 460-470 MHz, stations in the Earth exploration-satellite service (space-to-Earth) shall not cause harmful interference to nor claim protection from stations in the meteorological-satellite service (space-to-Earth),

instructs the Director of the Radiocommunication Bureau

for the frequency assignment of MetSat (space-to-Earth) and EESS (space-to-Earth) satellite network for which complete notification information or coordination request was received by the Radiocommunication Bureau prior to the end of WRC-19, the Bureau shall review the finding under No. **11.50** without requiring the administration to submit a new assignment. The date of such assignment's original recording in the Master International Frequency Register (MIFR) shall remain unchanged. For satellite systems of MetSat (space-to-Earth) and EESS (space-to-Earth), which space stations do not meet the pfd limits given in *resolves* 1, the Bureau shall propose the notifying administration to provide commitment that harmful interference would not be caused to the fixed and mobile service stations. In case of receiving such a commitment, relevant frequency assignments shall have primary status and be published by the Bureau in relevant parts of the BR IFIC with note that the relevant administration has provided commitment not to cause harmful interference to the fixed and mobile service stations. If the notifying administration does not provide this commitment and requests to retain the assignment and states that it will be operated under No. **4.4**, the assignment shall be kept in MIFR for information purposes under the conditions of No. **8.5**. If no reply is received within 30 days after the date of the Bureau communication, the Bureau shall send a reminder. If no reply is received from the relevant administration within 30 days after the date of reminder, the Bureau shall suppress the concerned recorded assignment from the MIFR.

Agenda item 1.7

1.7 to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution 659 (WRC-15);

Resolution 659 (WRC-15) – *Studies to accommodate requirements in the space operation service for non-geostationary satellites with short duration missions.*

4/1.7/1 Executive summary

In accordance with Resolution 659 (WRC-15), ITU-R has performed studies on spectrum needs for telemetry, tracking and command (TT&C) in the space operation service (SOS) for non-GSO satellites with short duration (non-GSO SD) missions, to assess the suitability of existing allocations to the SOS and, if necessary, to consider possible new allocations.

Typical non-GSO SD TT&C technical parameters were developed for use in the studies.

The studies show that the amount of spectrum required for non-GSO SD systems is 0.682 MHz to 0.938 MHz for non-GSO SD earth station uplink (depends on scenario) and 0.625 MHz to 2.5 MHz for non-GSO SD satellite downlink (depends on scenario).

Furthermore, technical and regulatory studies including compatibility and sharing studies were carried out.

Four methods and associated regulatory texts were developed to satisfy this agenda item. Methods B1 and B2 propose a new allocation (see Resolution 659 (WRC-15) *invites* 3) and Method C proposes to use existing allocations (see Resolution 659 (WRC-15) *invites* 2):

- Method A proposes no change to the Radio Regulations;
- Method B1 proposes a new SOS (Earth-to-space) allocation for non-GSO SD systems in the frequency range 403-404 MHz;
- Method B2 proposes a new SOS (Earth-to-space) allocation for non-GSO SD systems in the frequency range 404-405 MHz;
- Method C proposes to use the SOS allocation in the frequency band 137-138 MHz for downlink and the band 148-149.9 MHz for uplink and to provide appropriate associated regulatory provisions in the Radio Regulations for telecommand links of non-GSO SD missions.

4/1.7/2 Background

WRC-19 agenda item 1.7 invites studies to accommodate spectrum requirements for TT&C in the SOS for non-GSO SD missions. These types of missions provide an affordable means to access orbital resources (spectrum and orbit) for new entrants into the use of space-based applications. The mass and dimensions of these satellites have significantly contributed to their successful adoption among newly spacefaring nations. Thus, the demand for suitable allocations (in particular to the SOS) will likely increase. However, it is important to ensure that any satellite radio-frequency operation avoids harmful interference to incumbent and authorized systems and services. The two frequency bands below 1 GHz under consideration for new or upgraded allocation (150.05-174 MHz and 400.15-420 MHz) are used for a wide variety of terrestrial and space applications, and some are heavily used on a consistent basis. Nevertheless, new allocations to the SOS in these frequency bands should not put undue constraints on any incumbent services.

The term “short duration mission” used in Resolution **659 (WRC-15)** refers to a mission having a limited period of validity of “not more than typically three years”. Therefore, the term “short duration mission” is directly tied to the lifetime of the spacecraft. For example, a single spacecraft with a lifetime of less than typically three years, where the operator does not launch replenishment or replacement spacecraft, is a short duration mission. However the case of one (or multiple) spacecraft with a lifetime of less than typically three years, where the operator launches a (or multiple) replenishment or replacement spacecraft such that the operator has persistent frequency assignments longer than typically three years, is not a short duration mission.

4/1.7/2.1 The mobile satellite service in the frequency band 406-406.1 MHz

The frequency band 406-406.1 MHz, allocated exclusively to the MSS, is within the studied frequency range of 400.15-420 MHz in *invites ITU-R 3* of Resolution **659 (WRC-15)**. Resolution **659 (WRC-15)** recognizes the regulatory provisions contained in RR No. **5.266**, RR No. **5.267** and Resolution **205 (Rev.WRC-15)**. This band is used by the COSPAS-SARSAT system for safety of life purposes, and therefore the 406-406.1 MHz band should not be considered for an allocation to the SOS. Protection of safety-of-life systems operating in this frequency band is further described in Article **31** and Appendix **15** of the Radio Regulations. Since the frequency bands 400.15-406 MHz and 406.1-420 MHz are under consideration for an SOS allocation, adjacent band interference to COSPAS-SARSAT has been studied and is addressed in section 4/1.7/3.3.3.1.

4/1.7/3 Summary and analysis of the results of ITU-R studies

4/1.7/3.1 Relevant ITU-R Recommendations and Reports

Relevant ITU-R Recommendations: [SA.363-5](#), [P.452-16](#), [SA.514-3](#), [SA.609-2](#), [F.699-8](#), [F.758-6](#), [RA.769-2](#), [SA.1163-3](#), [SA.1164-3](#), [RS.1165-3](#), [RS.1263-2](#), [F.1336-4](#), [M.1478-3](#), [M.1808-0](#), [SA.2044-0](#), [M.2046-0](#), [SA.2045-0](#), [P.2108-0](#), [M.1184-3](#), [M.1230-0](#), [M.1231-0](#) and [M.1232-0](#).

Relevant ITU-R Reports: Report [SA.2425-0](#), Report [SA.2426-0](#), and Report [SA.2427-0](#).

Adjacent band compatibility studies between AM(R)S systems below 137 MHz and SOS non-GSO SD satellite systems proposed in the 137-138 MHz (s-E) and 148-149.9 MHz (E-s) frequency bands are being considered including identification of appropriate AM(R)S protection criteria.

4/1.7/3.2 Results of the study of spectrum needs

Report ITU-R SA.2425-0 contains studies to determine the amount of TT&C spectrum required for non-GSO SD missions, based on the protection criteria as outlined in Recommendation ITU-R SA.363-5.

The studies in Report ITU-R SA.2425-0 show that the protection criteria could be exceeded for many of the various satellite-earth station pair scenarios considered, but not always. Therefore, in practice, some inter-operator coordination may be necessary. Furthermore, such coordination may be necessary to account for changes in the satellite population. Lastly, it is expected that some of the 300 satellite-earth station combinations will be in centrally-controlled multi-satellite (and earth station) systems, in which spectrum use is coordinated and thus efficiencies may be gained. This Report indicates that the spectrum needs for non-GSO SD systems are in the range from 0.625 MHz to 2.5 MHz in the space-to-Earth direction and in the range from 0.682 MHz to 0.938 MHz in the Earth-to-space direction, depending on the operational scenario.

4/1.7/3.3 Results of sharing or compatibility studies

Report ITU-R SA.2426-0 which studies typical non-GSO SD TT&C parameters was developed to perform sharing/compatibility studies with incumbent services; the results of these sharing/compatibility studies are contained in Report ITU-R SA.2427-0.

4/1.7/3.3.1 Suitability of existing allocations to the space operation service in the frequency range below 1 GHz

In the Earth-to-space direction there is currently no spectrum allocated to the SOS below 1 GHz which is not subject to RR No. **9.21**. As indicated in *recognizing a)* of Resolution **659 (WRC-15)**, SOS allocations where RR No. **9.21** applies are not suitable for non-GSO SD missions. If the application of RR No. **9.21** is removed in the frequency band 148-149.9 MHz, this band would become a candidate to accommodate short duration mission requirements. The impact of removing RR No. **9.21** is still to be investigated.

An examination of the telemetry downlink (space-to-Earth) summary shows that currently there are three frequency bands below 1 GHz that are allocated to the SOS on a primary basis: 137-138 MHz, 272-273 MHz and 401-402 MHz. However, the frequency bands 272-273 MHz and 401-402 MHz are heavily used by existing systems. The 137-138 MHz SOS (space-to-Earth) allocation could accommodate the spectrum needs for short duration missions, however consideration of this band for short duration missions needs further regulatory and technical studies. It is noted that the current Rule of Procedure for RR No. **9.11A** applies to the SOS in the frequency bands 137-137.025 MHz and 137.175-137.825 MHz.

4/1.7/3.3.2 Results of sharing and compatibility studies within the frequency range 150.05-174 MHz

All studies conducted in the frequency range 150.05-174 MHz show that sharing between non-GSO SD systems (Earth-to-space and space-to-Earth) and the existing incumbent services in this frequency band is not feasible as indicated below.

4/1.7/3.3.2.1 150.05-153 MHz band – radio astronomy service (RAS)

A study performed on the in-band sharing scenario between the RAS and non-GSO SD satellites in both Earth-to-space and space-to-Earth directions show that co-channel, co-existence is not feasible in this band. For the Earth-to-space direction a separation distance of 697 km is required between a RAS station and an earth station operating to the non-GSO SD satellites. For the space-to-Earth direction the interference thresholds for the RAS bands are exceeded with a margin of up to 72 dB.

Compatibility studies on the impact of unwanted emissions of this non-GSO system on the RAS for both the space-to-Earth and Earth-to-space directions show that guardbands or other mitigation techniques are required to ensure the protection of the RAS.

4/1.7/3.3.2.2 150.05-174 MHz band (land mobile service)

Sharing studies with land-mobile systems in the frequency band 150.05-174 MHz show:

- 1 sharing between non-GSO SD satellites and land-mobile stations is not feasible;
- 2 sharing between non-GSO SD earth stations and land-mobile stations is not feasible.

4/1.7/3.3.2.3 154-156 MHz band (space surveillance radars)

Space surveillance radars operating in the frequency band 154-156 MHz can cause unacceptable interference to SOS systems in the Earth-to-space direction for command of non-GSO SD satellites. Unacceptable interference could result in satellite control loss. It was also shown that the space surveillance radars operating in this frequency band can suffer unacceptable interference from such

systems in the space-to-Earth direction. Therefore, sharing of SOS systems (Earth-to-space and space-to-Earth) with the radiolocation systems in this frequency band is not feasible.

4/1.7/3.3.2.4 156-162.0375 MHz band (GMDSS)

SOS non-GSO SD space and earth stations can cause interference to GMDSS receiving stations in the following scenarios:

- 1 interference to ship stations is caused by SOS non-GSO SD space and earth stations on the frequencies 156.3 MHz, 156.525 MHz, 156.650 MHz, 156.8 MHz, 161.975 MHz and 162.025 MHz;
- 2 interference to coast stations is caused by SOS non-GSO SD space and earth stations on the frequencies 156.3 MHz, 156.525 MHz, 156.650 MHz, 156.8 MHz, 161.975 MHz and 162.025 MHz;
- 3 interference to space stations is caused by SOS non-GSO SD space and earth stations on the frequencies 161.975 MHz and 162.025 MHz;
- 4 interference to aircraft stations is caused by SOS non-GSO SD space and earth stations on the frequencies 156.3 MHz, 156.525 MHz, 156.8 MHz, 161.975 MHz and 162.025 MHz;
- 5 it is noted that for each frequency given above, the channel bandwidth is the centre frequency ± 12.5 kHz.

4/1.7/3.3.3 Results of sharing and compatibility studies within the frequency range 400.15-420 MHz

4/1.7/3.3.3.1 Results of sharing and compatibility studies within the frequency range 400.15-403 MHz

All studies conducted in the frequency range 400.15-403 MHz show that sharing is not feasible between non-GSO SD systems and the existing incumbent services as indicated below.

4/1.7/3.3.3.1.1 400.15-401 MHz band (SRS/MetSat)

The simulation studies indicate that the levels of mutual interference between SRS (space-to-Earth) transmissions and SOS (space-to-Earth) transmissions in the frequency band 400.15-401 MHz would exceed the relevant ITU-R protection criteria thresholds by large amounts for single-entry cases. Aggregate interference would increase the exceedance. Therefore, co-frequency sharing between non-GSO SD and incumbent systems in the SOS and SRS in this band is not feasible.

Sharing studies between MetSat (space-to-Earth) transmissions and SOS (space-to-Earth) non-GSO SD satellite transmissions in the 400.15-401 MHz frequency band show that relevant ITU-R interference criteria thresholds are exceeded when considering co-frequency operation. Therefore, the results of the studies show that an upgrade of the SOS (space-to-Earth) allocation from secondary to primary as per *invites* 3 of Resolution **659 (WRC-15)** is not feasible.

4/1.7/3.3.3.1.2 401-402 MHz band (MetSat/EESS)

4/1.7/3.3.3.1.2.1 401-402 MHz band – MetSat/EESS (non-GSO SD satellite space-to-Earth direction)

Studies show that non-GSO SD satellite operations in the space-to-Earth direction would cause harmful interference to the GSO and non-GSO data collection systems (DCS) spacecraft receivers. Therefore, the non-GSO SD satellites (space-to-Earth) systems are not compatible with GSO DCS

and non-GSO DCS spacecraft receivers in the 401-402 MHz frequency band when considering co-frequency operation.

4/1.7/3.3.3.1.2.2 401-402 MHz band – MetSat/EESS (non-GSO SD satellite Earth-to-space direction)

Studies show that the levels of interference from non-GSO SD Earth-to-space transmissions into the GSO DCS and non-GSO DCS receivers would exceed the interference protection criteria thresholds; therefore the non-GSO SD (Earth-to-space) systems are not compatible with GSO DCS and non-GSO DCS spacecraft receivers when considering co-frequency operation.

4/1.7/3.3.3.1.2.3 402-403 MHz (MetSat/EESS)

Based on the studies conducted in the 401-402 MHz frequency band on the compatibility between non-GSO SD satellites and MetSat/EESS systems, the same conclusions should be applied to the 402-403 MHz frequency band due to the similar operations. Therefore, co-frequency sharing between non-GSO short duration satellites and MetSat/EESS systems in this frequency band is not compatible in both directions.

4/1.7/3.3.3.1.2.4 400.15-403 MHz band – MetAids (non-GSO SD satellite space-to-Earth and Earth-to-space directions)

Sharing and compatibility studies between non-GSO SD satellite space-to-Earth and Earth-to-space operations and meteorological aids service (MetAids) systems (radiosondes, dropsondes and rocketsondes) were performed.

Study results show that when non-GSO-SD satellite and MetAids systems are operated co-channel within the 400.15-403 MHz frequency band that both the long-term and the short-term protection criteria for MetAids (radiosondes, dropsondes and rocketsondes) are exceeded.

Therefore, co-channel sharing between non-GSO SD satellite and MetAids systems operating in the 400.15-403 MHz frequency band is not feasible.

4/1.7/3.3.3.1.2.5 402-403 MHz (MetSat/EESS) – Out-of-Band transmissions from non-GSO SD operations in 403-404 MHz

Results of a study show that there is interference to non-GSO DCS receivers in 402.85-403 MHz from potential SOS non-GSO SD satellite operations in the 403-404 MHz frequency band. Therefore, use of 403-404 MHz by non-GSO SD systems will not be compatible if a guardband is not applied.

4/1.7/3.3.3.2 Results of sharing and compatibility studies within the frequency range 403-406 MHz

Sharing and compatibility studies between non-GSO SD satellite space-to-Earth and Earth-to-space operations and MetAids systems (radiosondes, dropsondes and rocketsondes) were performed.

The studies show varying conclusions regarding the feasibility of sharing between potential new SOS allocations for the non-GSO SD systems and the existing services in the 403-406 MHz range as indicated below.

A) Three studies show that when non-GSO-SD satellite and MetAids systems are operated co-channel within the 400.15-406 MHz frequency band that both the long-term and the short-term protection criteria for MetAids (radiosondes, dropsondes and rocketsondes) are exceeded. Therefore these three studies concluded that co-channel sharing between non-GSO SD satellite and MetAids systems operating in the 400.15-406 MHz frequency band is not feasible. These studies therefore suggest that any new allocation to SOS in any portion of the 403-406 MHz band

(e.g. 403-404 MHz) would *de facto* lead to the frequency band being unusable for radiosondes, by excluding MetAids operations within any SOS allocation in this band, as well as from adjacent bands. As stipulated in the ITU/WMO Handbook on Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction the entire 400.15-406 MHz band is required for MetAids operation for the foreseeable future.

B) One study indicated that coexistence between the SOS (Earth-to-space) and MetAids in the 403-406 MHz band may be feasible under certain deployment conditions that are not necessarily applicable to large portions of the world and therefore a new allocation may be made to the SOS within the band 403-405 MHz in support of non-GSO SD missions. This study did not consider any sharing and compatibility analysis to address the protection of dropsondes or rocketsondes. This study used a specific situation (e.g. number of radiosonde stations, detailed terrain and land use data, 6 kHz receiver bandwidth, earth station antenna height) instead of a more generic situation that would ensure protection of radiosonde receivers from non-GSO SD on a global basis.

C) One other study also indicated that coexistence between the SOS (Earth-to-space) and MetAids in the 403-406 MHz band may be feasible and therefore a new allocation may be made to the SOS within the band 403-405 MHz in support of non-GSO SD missions. This study considered a scenario with a single earth station and a single non-GSO SD satellite; furthermore, various examples of potential mitigation techniques (e.g. reduced e.i.r.p., pointing avoidance) were considered. Further studies should consider additional simulations and measurements to demonstrate the feasibility of these mitigation techniques. It also should be noted that sharing with dropsondes may not be feasible unless effective mitigation techniques are applied. This study did not apply the recommended 20% value, but instead assumed a 50% value. The separation distance results using the 50% value may be less than those distance values which would be derived from using the recommended 20% value.

A comparative analysis of the use of different ITU-R Recommendations dealing with propagation models showed that this did not account for the difference in results between the studies in A) above and the studies in B) and C) above and this could be explained by the use of different terrain databases and the use of a land use database (clutter).

A study was performed to determine interference from radiosondes to non-GSO satellite SD receivers in the Earth-to-space direction concludes that co-frequency sharing with radiosondes is feasible. One study performed static single entry and aggregate analysis and it showed that co-frequency sharing with radiosondes into non-GSO SD satellite receivers in the Earth-to-space direction is not feasible.

The frequency band 405-406 MHz should not be considered for new SOS allocations for use by non-GSO SD systems in order to protect the COSPAS-SARSAT system in the 406-406.1 MHz frequency band.

Compatibility studies on the impact of unwanted emissions of this non-GSO system on the RAS for both the space-to-Earth and Earth-to-space directions show that guardbands or other mitigation techniques are required to ensure the protection of the RAS.

4/1.7/3.3.3.3 Results of sharing and compatibility studies within the frequency range 406-420 MHz

All studies conducted in the frequency range 406-420 MHz show that sharing is not feasible between non-GSO SD systems and the existing services as indicated below.

4/1.7/3.3.3.3.1 406-406.1 MHz band (mobile satellite service - COSPAS-SARSAT)

As noted in section 4/1.7/2.1 the frequency band 406-406.1 MHz should not be considered for an allocation to the SOS. The protection provided by RR No. **5.267** (any emission capable of causing harmful interference to the authorized uses of the band 406-406.1 MHz is prohibited) also includes protection from out-of-band emissions from services which might operate in frequencies adjacent to 406-406.1 MHz.

Analysis of proposed non-GSO SD satellite systems operating in frequencies adjacent to 406-406.1 MHz concluded that transmissions would exceed the emergency position indicating radio beacon (EPIRB) maximum permissible level of interference. However, the implementation of 100 kHz guardbands above 406.1 MHz and below 406 MHz would protect the spaceborne COSPAS-SARSAT receivers operating in the 406-406.1 MHz frequency band from non-GSO SD space-to-Earth transmissions. Additionally, the implementation of a 1 MHz guardband below 406 MHz and 900 kHz above 406.1 MHz applied to the non-GSO SD satellite earth stations would protect the spaceborne COSPAS-SARSAT receivers.

4/1.7/3.3.3.3.2 406.1-410 MHz band (LMS, FS, RAS)

Analysis of sharing between non-GSO SD satellites and land-mobile and fixed stations in the 406.1-410 MHz frequency band showed that sharing is not feasible. The analysis also showed that sharing between non-GSO SD earth stations and land-mobile and fixed stations in the 406.1-410 MHz frequency band is not feasible when considering co-frequency operation.

A study performed on the in-band sharing scenario between the RAS and non-GSO SD missions in both Earth-to-space and space-to-Earth directions showed that co-channel co-existence is not feasible in this band. For the Earth-to-space direction a separation distance of 560 km is required between a RAS station and an earth station operating to the non-GSO satellites. For the space-to-Earth direction the interference thresholds for the RAS bands are exceeded with a margin of up to 68 dB.

The results show that a guardband of 1.5 MHz from each edge of the 406.1-410 MHz frequency range is required for both uplink and downlink directions with an associated separation distance of up to four km for transmitting earth stations. However, if the separation distance is more than four km the guardband will be less than 1.5 MHz.

4/1.7/3.3.3.3.3 410-420 MHz band (SRS, LMS, FS)

Eight scenarios were studied for the compatibility of SOS non-GSO SD satellites and the Space-to-Space Communication System (SSCS) in the SRS from the International Space Station in the frequencies 414.2 MHz (primary frequency) and 417.1 MHz (backup frequency). The results from the eight different scenarios indicate that sharing is not feasible when considering co-frequency operation.

Analysis of sharing between non-GSO SD satellites and land-mobile and fixed stations in the 410-420 MHz frequency band showed that sharing is not feasible when considering co-frequency operation. The analysis also showed that sharing between non-GSO SD earth stations and land-mobile and fixed stations in the 410-420 MHz frequency band is not feasible when considering co-frequency operation.

4/1.7/3.3.4 Summary of studies

Study results are summarized below; more details of all the studies can be found in Report ITU-R SA.2425-0 and Report ITU-R SA.2427-0.

Summary of the study on the spectrum needs for non-GSO SD systems

The requirements report indicates that the spectrum needs for non-GSO SD systems are in the range from 0.625 MHz to 2.5 MHz in the space-to-Earth direction and in the range from 0.682 MHz to 0.938 MHz in the Earth-to-space direction, depending on the operational scenario.

Summary of studies on the suitability of existing SOS allocations below 1 GHz

Studies show that in the Earth-to-space direction all frequency allocations to the SOS below 1 GHz are subject to RR No. **9.21**.

Some studies proposed that if the application of RR No. **9.21** is removed in the frequency band 148-149.9 MHz in the Earth-to-space direction, this band could accommodate short duration mission requirements. The impact of removing RR No. **9.21** is still to be investigated and should consider any requisite regulatory and technical provisions in this regard.

The existing 137-138 MHz SOS (space-to-Earth) allocation could accommodate the spectrum needs of short-duration missions, however some administrations are of the view that consideration of this band needs further regulatory and technical studies.

Summary of studies on the potential upgrade of existing SOS allocations below 1 GHz

A study in the frequency band 400.15-401 MHz concluded that an upgrade to the SOS (space-to-Earth) allocation for non-GSO SD missions is not feasible because MetSat and SRS protection criteria would be exceeded.

Summary of studies of potential new SOS allocations in the frequency range 150.05-174 MHz

All studies conducted in the frequency range show that sharing between non-GSO SD systems (Earth-to-space and space-to-Earth) and the existing incumbent services in this frequency band is not feasible.

Summary of studies of potential new SOS allocations in the frequency range 400.15-420 MHz

All studies conducted in the frequency range 400.15-403 MHz show that sharing between non-GSO SD systems (Earth-to-space and space-to-Earth) and the existing incumbent services in this frequency band is not feasible.

Studies conducted in the frequency range 403-406 MHz show varying conclusions regarding the feasibility of sharing between new allocations for non-GSO SD systems and the MetAids as indicated in section 4/1.7/3.3.3.2.

All studies conducted in the frequency range 406-420 MHz show that sharing between non-GSO SD systems (Earth-to-space and space-to-Earth) and the existing incumbent services in this frequency band is not feasible.

Summary of studies regarding the protection of systems operating in the MSS in the band 406-406.1 MHz

A study has shown that because of the impact of interference that no new allocation should be established in the 406-406.1 MHz band. In the frequency bands 405-406 MHz and 406.1-407 MHz, a study has shown that a possible new SOS allocation for non-GSO SD missions in both directions, (space-to-Earth) and (Earth-to-space) should not be made because out-of-band emissions would exceed COSPAS-SARSAT protection criteria in the adjacent 406-406.1 MHz band.

4/1.7/4 Methods to satisfy the agenda item

4/1.7/4.1 Method A NOC

4/1.7/4.2 Method B

An allocation of 1 MHz to the SOS in the Earth-space direction, limited to non-GSO SD satellite systems, in either 403-404 MHz (see method B1) or 404-405 MHz (see method B2) as indicated in section 4/1.7/3.3.3.2 and below, which is not subject to coordination under Section II of Article 9 of the Radio Regulations.

Advantage:

- An allocation to the SOS in the Earth-to-space direction would provide a regulatory compliant alternative to the current and foreseen use of the bands under consideration under WRC-19 agenda item 1.2 for telemetry, tracking and command in the Earth-to-space direction, for which WRC-19 agenda item 1.2 is trying to establish e.i.r.p. limits.

Disadvantages:

- Several studies show that co-channel sharing with MetAids is not feasible in the 403-406 MHz band and hence that current and future usage of the 403-406 MHz frequency band for MetAids will not be fulfilled.
- This method is not proposing a downlink band associated with this uplink band.

Note 1: The proponents of this method also advocate the use of the band 137-138 MHz as associated downlink spectrum and will provide detailed proposal at WRC-19, together with the regulatory provisions.

Note 2: Some administrations are of the view that studies on compatibility between the AM(R)S systems below 137 MHz and non-GSO SD systems proposed in the frequency band (137-138 MHz (s-E)) have not yet been completed within ITU-R.

4/1.7/4.3 Method C

This method (refer section 4/1.7/3.3.1) proposes to use the existing SOS allocation in the frequency bands 137-138 MHz for downlink and 148-149.9 MHz for uplink and to provide appropriate associated regulatory provisions in the Radio Regulations for telecommand links of non-GSO SD satellites.

In the frequency band 148-149.9 MHz, in order to comply with the requirement of non-GSO SD missions for an allocation which is not subject to coordination under section II of Article 9 of the Radio Regulations, it is proposed to remove the reference to RR No. 9.21 in RR No. 5.218 and to not apply RR No. 9.11A.

In the frequency band 137-138 MHz, in order to comply with the requirement of non-GSO SD missions for an allocation which is not subject to coordination under section II of Article 9 of the Radio Regulations by ensuring the protection of terrestrial services, Method C would apply to stations of the SOS (space-to-Earth) the same coordination threshold with terrestrial services as those for space stations of the MSS (space-to-Earth) (see sections 1.1.1 and 1.1.2 of Annex 1 of Appendix 5 of the RR) and would not apply RR No. 9.11A. Some administrations are of the view that studies have not yet been completed within the ITU-R to demonstrate the applicability of that threshold for the non-GSO SD application, nor whether it would be sufficient to ensure protection of in-band and adjacent-band incumbent systems from the short-duration SOS application.

Advantages:

- To use efficiently the existing allocation to the SOS in this band and to recognize the specificity of non-GSO SD systems.
- The definition of a pfd limit for coordination in 137-138 MHz will ensure more protection to terrestrial services than the current situation.
- The design of associated equipment will be improved as the same antenna will be used for both transmission and reception.

Disadvantages:

- The impact of removal of RR No. **9.21** in the frequency band 148-149.9 MHz (in particular for non-GSO SD missions) is still to be investigated.
- Consideration of the 137-138 MHz frequency band for non-GSO SD may need further regulatory and technical studies.
- Studies on compatibility between the AM(R)S systems below 137 MHz and non-GSO SD systems proposed in the frequency bands (137-138 MHz (s-E) and 148-149.9 MHz (E-s)) have not yet been completed within ITU-R.

4/1.7/5 Regulatory and procedural considerations**4/1.7/5.1 Method A****ARTICLE 5****Frequency allocations****NOC**

Section IV – Table of Frequency Allocations
(See No. 2.1)

SUP**RESOLUTION 659 (WRC-15)**

**Studies to accommodate requirements in the space operation service for
non-geostationary satellites with short duration missions**

4/1.7/5.2 Method B1**ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**
(See No. 2.1)**MOD****335.4-410 MHz**

| Allocation to services | | |
|--------------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 403-406 <u>404</u> | METEOROLOGICAL AIDS <u>SPACE OPERATION (Earth-to-space) ADD 5.A17</u> Fixed Mobile except aeronautical mobile 5.265 | |
| 403 <u>404</u> -406 | METEOROLOGICAL AIDS Fixed Mobile except aeronautical mobile 5.265 | |

ADD

5.A17 The use of the band 403-404 MHz by the space operation service (Earth-to-space) is limited to non-GSO satellites with short duration missions having a limited period of validity of not more than three years (refer to Resolution 4 (Rev.WRC-03)). (WRC-19)

Note: Studies carried out in support of this Method include elements such as separation distances and guardbands which need to be respected. Consequently, such missing information should be duly included in the regulatory parts.

4/1.7/5.3 Method B2**ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**
(See No. 2.1)

MOD**335.4-410 MHz**

| Allocation to services | | |
|--|---|-----------------|
| Region 1 | Region 2 | Region 3 |
| 403-406 <u>404</u> | METEOROLOGICAL AIDS Fixed Mobile except aeronautical mobile 5.265 | |
| 403 <u>404-406</u> 405 | METEOROLOGICAL AIDS <u>SPACE OPERATION (Earth-to-space) ADD 5.B17</u> Fixed Mobile except aeronautical mobile 5.265 | |
| 403 <u>405-406</u> | METEOROLOGICAL AIDS Fixed Mobile except aeronautical mobile 5.265 | |

ADD

5.B17 The use of the band 404-405 MHz by the space operation service (Earth-to-space) is limited to non-GSO satellites with short duration missions having a limited period of validity of not more than three years (refer to Resolution **4 (Rev.WRC-03)**). (WRC-19)

Note: Studies carried out in support of this Method include elements such as separation distances and guardbands which need to be respected. Consequently, such missing information should be duly included in the regulatory parts.

SUP**RESOLUTION 659 (WRC-15)**

**Studies to accommodate requirements in the space operation service for
non-geostationary satellites with short duration missions**

4/1.7/5.4 Method C**ARTICLE 5****Frequency allocations****Section IV – Table of Frequency Allocations**
(See No. 2.1)**MOD****75.2-137.175 MHz**

| Allocation to services | | |
|-------------------------------|---|-----------------|
| Region 1 | Region 2 | Region 3 |
| 137-137.025 | SPACE OPERATION (space-to-Earth) <u>ADD 5.C17</u> METEOROLOGICAL-SATELLITE (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) 5.208A 5.208B 5.209 SPACE RESEARCH (space-to-Earth) Fixed Mobile except aeronautical mobile (R) 5.204 5.205 5.206 5.207 5.208 | |
| 137.025-137.175 | SPACE OPERATION (space-to-Earth) <u>ADD 5.C17</u> METEOROLOGICAL-SATELLITE (space-to-Earth) SPACE RESEARCH (space-to-Earth) Fixed Mobile except aeronautical mobile (R) Mobile-satellite (space-to-Earth) 5.208A 5.208B 5.209 5.204 5.205 5.206 5.207 5.208 | |

ADD

5.C17 The use of the frequency bands 137-138 MHz and 148-149.9 MHz in the SOS for telemetry, tracking and command links of non-GSO satellites with short duration missions is subject to Resolution [A17-METHOD-C] (WRC-19). (WRC-19)

MOD**137.175-148 MHz**

| Allocation to services | | |
|------------------------|---|----------|
| Region 1 | Region 2 | Region 3 |
| 137.175-137.825 | SPACE OPERATION (space-to-Earth) <u>ADD 5.C17</u> METEOROLOGICAL-SATELLITE (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) 5.208A 5.208B 5.209 SPACE RESEARCH (space-to-Earth) Fixed Mobile except aeronautical mobile (R) 5.204 5.205 5.206 5.207 5.208 | |
| 137.825-138 | SPACE OPERATION (space-to-Earth) <u>ADD 5.C17</u> METEOROLOGICAL-SATELLITE (space-to-Earth) SPACE RESEARCH (space-to-Earth) Fixed Mobile except aeronautical mobile (R) Mobile-satellite (space-to-Earth) 5.208A 5.208B 5.209 5.204 5.205 5.206 5.207 5.208 | |

MOD**148-161.9375 MHz**

| Allocation to services | | |
|--|---|----------|
| Region 1 | Region 2 | Region 3 |
| 148-149.9 FIXED MOBILE except aeronautical mobile (R) MOBILE-SATELLITE (Earth-to-space) 5.209 <u>SPACE OPERATION (Earth-to-space) MOD 5.218 ADD 5.C17</u> <u>5.218-5.219 5.221</u> | 148-149.9 FIXED MOBILE MOBILE-SATELLITE (Earth-to-space) 5.209 <u>SPACE OPERATION (Earth-to-space) MOD 5.218 ADD 5.C17</u> <u>5.218-5.219 5.221</u> | |

MOD

5.218 *Additional allocation:* ~~the band 148-149.9 MHz is also allocated to the space operation service (Earth-to-space) on a primary basis, subject to agreement obtained under No. 9.21.~~ The bandwidth of any individual transmission by stations of the space operation service in the band 148-149.9 MHz shall not exceed ± 25 kHz. (WRC-19)

ADD

DRAFT NEW RESOLUTION [A17-METHOD-C] (WRC-19)

Frequency bands used for telemetry, tracking and command of non-GSO satellites with short duration missions

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that the term “short duration mission” used in this Resolution refers to a mission having a limited period of validity of not more than three years;
- b)* that telemetry, tracking and command links for non-GSO satellites with short duration missions fall under the space operation service;
- c)* that these satellites are constrained in terms of low on-board power and low antenna gain;
- d)* that No. **5.C17** identifies the bands 137-138 MHz (space-to-Earth) and 148-149.9 MHz (Earth-to-space) for such applications;
- e)* that ITU-R studies have indicated that frequency bands other than those mentioned in *considering d)* allocated to the space operation service below 1 GHz are not suitable for such applications,

invites administrations

- 1 to use the BR software in order to check the SOS pfd values mentioned in *resolves 2*,
resolves

- 1 that administrations wishing to implement telemetry, tracking and command of non-GSO satellites with short duration missions use the bands referred to in *considering d)* above;

- 2 that in the band 137-138 MHz (space-to-Earth), space stations of space operation service shall not exceed pfd value $-140 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz))}$, except in cases when another value was coordinated. If this level is exceeded, No. **9.11A** applies for networks or systems within the SOS in this band;

- 3 that in the frequency band 148-149.9 MHz (Earth-to-space), No. **9.11A** does not apply to space operation service (SOS) (Earth-to-space) networks,

further resolves

- 1 that the use of the bands in *considering d)* for non-GSO satellites in the space operation service with short duration missions does not establish priority in the Radio Regulations and does not preclude the use of the band for any application of the services to which they are allocated;

- 2 that the SOS shall not constrain the development and use of the fixed and mobile services in the frequency band 148-149.9 MHz,

instructs the BR

in applying *resolves 2* at the notification stage, to check conformity with the pfd value contained herein during its examination under No. **11.31**: if the value is met, the finding shall be favourable; if

the value is exceeded, the Bureau shall check whether a coordination request has previously been sent for this satellite or otherwise issue an unfavourable finding under No. **11.32**.

Notes:

- 1 *resolves* 1 would need to be included in the relevant footnotes.
- 2 Appropriate mechanisms to be used for application of *resolves* 2 and 3 are required.
- 3 Appropriate mechanisms to be used for application of *instructs the BR* are required.

APPENDIX 5 (REV.WRC-15)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

TABLE 5-1 (continued) (REV.WRC-1519)

| Reference of Article 9 | Case | Frequency bands (and Region) of the service for which coordination is sought | Threshold/condition | Calculation method | Remarks |
|---|--|---|---|--|---------|
| No. 9.13 GSO/ non-GSO | A station in a GSO satellite network in the frequency bands for which a footnote refers to No. 9.11A or No. 9.13, in respect of any other non-GSO satellite network, with the exception of coordination between earth stations operating in the opposite direction of transmission | Frequency bands for which a footnote refers to No. 9.11A or No. 9.13 | 1) Bandwidths overlap 2) For the band 1 668-1 668.4 MHz with respect to MSS network coordination with SRS (passive) networks, in addition to bandwidth overlap, the e.i.r.p. spectral density of mobile earth stations in a GSO network of the mobile-satellite service operating in this band exceeds -2.5 dB(W/4 kHz) or the power spectral density delivered to the mobile earth station antenna exceeds -10 dB(W/4 kHz) | 1) Check by using the assigned frequencies and bandwidths 2) Check by using MSS network Appendix 4 data | |
| No. 9.14 Non-GSO/ terrestrial, GSO/ terrestrial | A space station in a satellite network in the frequency bands for which a footnote refers to No. 9.11A or to No. 9.14, in respect of stations of terrestrial services where threshold(s) is (are) exceeded | 1) Frequency bands for which a footnote refers to No. 9.11A; or 2) 11.7-12.2 GHz (Region 2 GSO FSS) 3) 5 030-5 091 MHz 4) <u>137-138 MHz (SOS)</u> | 1) See § 1 of Annex 1 to this Appendix; In the bands specified in No. 5.414A, the detailed conditions for the application of No. 9.14 are provided in No. 5.414A for MSS networks or 2) In the band 11.7-12.2 GHz (Region 2 GSO FSS): $-124 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for $0^\circ \leq \theta \leq 5^\circ$ $-124 + 0.5 (\theta - 5) \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for $5^\circ < \theta \leq 25^\circ$ $-114 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for $\theta > 25^\circ$ where θ is the angle of arrival of the incident wave above the horizontal plane (degrees) 3) Bandwidth overlap 4) <u>In the band 137-138 MHz (SOS):</u> <u>$-140 \text{ dB (W/(m}^2 \cdot 4 \text{ kHz))}$</u> | 1) See § 1 of Annex 1 to this Appendix | |

SUP

RESOLUTION 659 (WRC-15)

**Studies to accommodate requirements in the space operation service for
non-geostationary satellites with short duration missions**

CHAPTER 5

Maritime, aeronautical and amateur services (Agenda items 1.1, 1.8, 1.9.1, 1.9.2, 1.10, 9.1 (issue 9.1.4))

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Agenda item 1.1

1.1 to consider an allocation of the frequency band 50-54 MHz to the amateur service in Region 1, in accordance with Resolution 658 (WRC-15);

Resolution 658 (WRC-15) – *Allocation of the frequency band 50-54 MHz to the amateur service in Region 1*

5/1.1/1 Executive summary

This agenda item addresses a possible new Region 1 allocation to the amateur service in the frequency band 50-54 MHz by full or partial worldwide harmonization with the existing 4 MHz primary allocations in Regions 2 and 3.

The spectrum needs for the amateur service has been quantified in two studies using an application-based approach. One of them indicates that 4 MHz of spectrum is required while the other indicates that 1.75 MHz is required.

Administrations in parts of Region 1 are party to the ST61³³ and GE89³⁴ Regional Agreements which remain in force in the band 50-54 MHz.

Studies have been undertaken to assess the possibility of sharing with the incumbent broadcasting, land mobile and radiolocation services. The studies have demonstrated that large separation distances are required for sharing with incumbent services. Furthermore, regulatory provisions will need to be implemented. Depending upon the incumbent service to be protected, the different protection distances and some measures can be found in Report ITU-R M.[AMATEUR_50_MHz].

Four methods are provided to satisfy the agenda item including the No Change method:

- **Method A:** An allocation to the amateur service on a primary basis in Region 1 in the band 50-54 MHz, or part thereof;
- **Method B:** An allocation to the amateur service on a secondary basis in Region 1 in the band 50.080-50.280 MHz, (**Method B1**), or in the band 50-52 MHz (**Method B2**);
- **Method C:** An allocation to the amateur service in Region 1 on a partly primary and partly secondary basis in all or part of the frequency band 50-54 MHz;
- **Method D:** No changes in the frequency band 50-54 MHz.

Regulatory text is also provided for implementation of the proposed methods.

5/1.1/2 Background

In ITU Region 1, the frequency band 50-54 MHz is allocated to the broadcasting service on a primary basis, with additional or alternative allocations to the amateur, fixed, mobile, and/or radiolocation limited to wind profiler radars (WPR) services in some countries.

The frequency band 47-68 MHz in most of Region 1 is governed by the ST61 and GE89 Regional Agreements, which remain in force, noting that several countries in Region 1 were not party to the original agreements.

³³ Final Acts of the European Broadcasting Conference (Stockholm, 1961 as revised in Geneva, 2006) (“ST61”) in the European Broadcasting Area.

³⁴ Final Acts of the African Broadcasting Conference (Geneva, 1989 as revised in Geneva, 2006) (“GE89”) in the African Broadcasting Area and neighbouring countries.

It is also noted that the frequency band 50-54 MHz is allocated to the amateur service on a primary basis in ITU Regions 2 and 3, full or partial worldwide harmonization of the allocation to the amateur service in the frequency band 50-54 MHz would enhance radio amateurs' global efforts to fulfil the purposes of the amateur service, which include self-training, technical investigations and intercommunication for a variety of purposes including communication in support of disaster relief.

Further noting that the frequency bands 47-50 MHz and 54-68 MHz are allocated to broadcasting services on a primary basis in Region 3. Furthermore, the frequency band 50-54 MHz is allocated to fixed, mobile and broadcasting services on a primary basis in some countries in Region 3 based on RR footnote No. **5.167**.

5/1.1/3 Summary and analysis of the results of ITU-R studies

5/1.1/3.1 Spectrum needs

In considering the need for spectrum harmonization across the three regions, the required amount of spectrum for existing and future amateur applications needs to be calculated, taking into account the principles contained in Recommendation **34 (Rev.WRC-12)**.

An application-based approach, based on current usage of the 50-54 MHz frequency band in Regions 2 and 3, has been developed and agreed for calculating the spectrum needs for current and envisaged amateur applications in the 50-54 MHz frequency band. The results given by this application-based approach are strongly dependent upon the input parameters used. The parameters obtained through the spectrum occupancy analysis and contest log data are used in one study, while the parameters for another study are based on estimations.

Both studies considered the following applications: point-to-point single sideband (SSB) and frequency modulated (FM) voice transmission, FM voice repeater systems, wideband digital modes and infrastructure applications using a variety of transmission protocols.

In one study, the spectrum needs have been calculated for two different spectrum use situations: an average spectrum use occurring in about 98% of time (average day) and an exceptional intensive spectrum use (e.g. contest) occurring in about 2% of time.

Different parameters used for the spectrum needs calculations for each use case are derived through spectrum monitoring data analysis (only eight days in April 2018) as well as through the amateur contest data analysis (during June 2017 50 MHz contest of International Amateur Radio Union – IARU). The obtained results are representative for European countries with the average amateur population density of 0.117 stations/km². Table 5/1.1-1 summarizes the spectrum needs calculation results of that study.

TABLE 5/1.1-1

Spectrum needs for different combination of amateur applications and use cases based on spectrum occupancy measurements and log-data analysis

| Required spectrum (kHz) | | |
|--|--|---------------------------------------|
| Applications | Average use + 300% margin (98% of time) | Intensive use (2% of time) |
| SSB, FM, wideband | 540 | 765 |
| SSB, FM, wideband, repeaters | 740 | 1 865** |
| SSB, FM, wideband, repeaters, infrastructure | 1 240 | 4 865** 1 465* |
| <p>* Infrastructure and repeaters are only considered in average cases.</p> <p>** The spectrum needs calculation regarding infrastructure and repeaters in the intensive use case assumes the same value for the fraction of active amateur stations using SSB; however, such a situation is unlikely to occur in practice and may need to be ignored.</p> | | |

Another study uses the same applications-based approach, but using only estimated parameters based on long-term band usage patterns for SSB, FM, repeater and propagation beacon applications and extrapolated for future wideband applications (++) gives the spectrum needs shown in Table 5/1.1-2.

Using the parameters typical for the countries of European Conference of Postal and Telecommunications (CEPT), with an average population density of amateur licensees (0.07 stations/km²), the required spectrum is calculated to be slightly in excess of 4 MHz. Table 5/1.1-2 shows the estimated spectrum required for each of the applications.

TABLE 5/1.1-2

Spectrum needs for different amateur applications based on parameter estimation

| Required spectrum (kHz) | |
|-----------------------------------|-----------------------------------|
| Applications | Average use (100% of time) |
| SSB | 87 |
| FM | 25 |
| Wideband modes++ | 500 |
| Repeaters (FM) | 950 |
| Infrastructure++ | 2 500 |
| Propagation beacons | 100 |
| Total for all applications | 4 162 |

5/1.1/3.2 Sharing with the broadcasting service in Region 1

The transition to digital television broadcasting has significantly reduced the occupancy of the 50-54 MHz frequency band by the broadcasting service in ITU Region 1. However, the regional plans ST61 and GE89 still contain many frequency assignments in the frequency band 50-54 MHz and the Master International Frequency Register (MIFR) contains hundreds of records for broadcasting service transmitters in ITU Region 1.

Studies have shown that for protection of the broadcasting service from harmful interference, a field strength from an amateur station at the edge of the service area of a broadcasting transmitter shall not exceed 6 dB(μ V/m) for 10% of the time at a height of 10 m above ground. Typical separation distances between amateur service systems and broadcasting service stations would range from 70 to 175 km.

5/1.1/3.3 Sharing between the amateur service and the land mobile service in Region 1

For an interference protection ratio of $I/N = -6$ dB, studies have indicated that for protection of the land mobile service, a separation distance in the range of 170 km to more than 500 km in average terrain is needed. In mountainous regions, the separation distances are in about the same range. Dependent on the amateur service application, interference from a single amateur station may simultaneously interfere with more than 25 mobile channels in a range of up to 170 km. Given the mobile nature of governmental communication systems, new and existing amateur service applications (fixed, mobile or portable) using the frequency band of 50-54 MHz, make sharing difficult.

One study has shown that some amateur service applications, such as repeaters (in high activity situations) and new infrastructure may generate harmful interference into the mobile service if operated in the frequency band 50-54 MHz. However, some other amateur service applications, such as SSB, FM, wideband modes and repeaters (in low activity situations), could share the band 50-54 MHz with the mobile service under specific operational conditions. It was further calculated that the spectrum needs for SSB, FM, wideband modes and repeaters in the band 50-54 MHz could be satisfied within 1.75 MHz. Therefore, in view of *invites* 1 and 2 of Resolution **658 (WRC-15)**, this study concludes that any spectrum allocation within the band 50-54 MHz for the amateur service should be limited to 1.75 MHz.

Monte-Carlo simulations conducted with no mitigation techniques have shown that the probability of interference is highly dependent on the usage density of the band by amateurs. For the SSB mode, it has been shown that the probability of harmful interference (based on the exceedance of a protection criterion of $I/N = -6$ dB) ranges between 8 and 86% given the number of active amateur channels considered in the simulation radius. For the FM mode, it is about 28%. For the wideband digital mode, the probability of interference is around 93% for the in-band case (affecting up to 20 land mobile channels) and decreases for the out-of-band emissions.

Interference mitigation measures such as coordination between services in adjacent countries, operational limitation on amateur stations; listen-before-talk operation and technical means such as spread spectrum techniques have not been studied as part of this agenda item.

5/1.1/3.4 Sharing between the amateur service and the radiolocation service (wind profiler radars)

Radio Regulations (RR) No. **5.162A** provides an additional allocation to the radiolocation service on a secondary basis in a number of countries, limited to the operation of wind profiler radars (WPR).

Studies show that typical separation distances between amateur service systems and wind profiler radars would range from 29 km to distances above 300 km, confirming the need for specific protection measures.

Taking into account the limited numbers of systems in or immediately adjacent to the frequency band 50-54 MHz range (and probably the expected low number of amateur systems in the vicinity of WPR installations), sharing could probably be considered on a case-by-case basis e.g. coordination zones established in affected geographical areas.

It has to be noted that this approach, currently, could only be possible and efficient if appropriate regulatory measures in the Radio Regulations ensure that amateur and radiolocation services are of equal status within the 50-54 MHz band.

5/1.1/3.5 Relevant ITU-R Recommendations

Recommendations ITU-R [M.1634-0](#), [M.1651-0](#), [M.1732-2](#), [M.1825-0](#), [P.526-14](#), [P.1546-5](#), [P.2001-2](#), [SM.851-1](#), [SM.1055-0](#), [BT.1368-13](#), [BT.2033-1](#), [Report ITU-R M.2013-0](#).

5/1.1/3.6 Relevant ITU-R Reports

PDN Report ITU-R M.[AMATEUR_50_MHz], Report ITU-R [BT.2387-0](#).

5/1.1/4 Methods to satisfy the agenda item

Four methods are proposed to satisfy the agenda item and all of them involve suppression of Resolution **658 (WRC-15)**.

5/1.1/4.1 Method A

An allocation to the amateur service on a primary basis in the entire band 50-54 MHz, or part thereof, with appropriate footnotes to provide protection to services which already have an allocation in the band.

Advantages:

- The requirement of the amateur service to have an allocation in the frequency band 50-54 MHz in Region 1 would be partly or fully satisfied.
- Partial or full harmonization of spectrum throughout the three ITU regions would be achieved for the amateur service, thus the principles outlined in Recommendation **34 (Rev.WRC-12)** would be respected.

Disadvantages:

- Administrations may need to adopt specific measures or develop multilateral agreements to ensure harmful interference is not caused to stations of incumbent services operated within their territory or in neighbouring territories.
- The amateur service could cause harmful interference to incumbent services, in Region 1 and its neighbouring countries in Region 3, which may be difficult to resolve.
- Regarding the radiolocation service, the sharing approach proposed may not be fulfilled.
- May affect current and future usage of the band in Region 1 and its neighbouring countries in Region 3.

5/1.1/4.2 Method B1

An allocation to the amateur service on a secondary basis in the 50.080-50.280 MHz frequency band, with appropriate footnotes or appropriate regulatory text to provide protection to services which already have an allocation in the band.

Advantages:

- The requirement of the amateur service to have an allocation in the frequency band 50-54 MHz in Region 1 would be partly satisfied.
- Partial harmonization of spectrum throughout the three RR Regions would be achieved, thus the principles outlined in Recommendation **34 (Rev.WRC-12)** would be respected.

- Incumbent services with a primary allocation remain protected and does not place constraints on the secondary incumbent services.

Disadvantages:

- Full harmonization of spectrum for the amateur service throughout the three RR Regions would not be achieved in terms of service status.
- If the amateur service has secondary status, future introduction of new primary services into the band or modification to RR Article 5 covering all or part of the 50-54 MHz frequency band may adversely impact the amateur service.
- The spectrum needs of the amateur service in the frequency band 50-54 MHz in Region 1 would not be satisfied.

5/1.1/4.3 Method B2

An allocation to the amateur service on a secondary basis in the frequency band 50-52 MHz, with appropriate footnotes to provide protection to services which already have an allocation in the band.

Advantages:

- The spectrum needs of the amateur service in the frequency band 50-54 MHz in Region 1 would be satisfied according to one study.
- Partial harmonization of spectrum throughout the three RR Regions would be achieved, thus the principles outlined in Recommendation 34 (Rev.WRC-12) would be respected.
- Incumbent services with a primary allocation remain protected and does not place constraints on the secondary incumbent services.

Disadvantages:

- The spectrum needs of the amateur service in the frequency band 50-54 MHz in Region 1 would be only partly satisfied according to another study.
- Full harmonization of spectrum for the amateur service throughout the three RR Regions would not be achieved in terms of service status.
- If the amateur service has secondary status, future introduction of new primary services into the band or modification to RR Article 5 covering all or part of the 50-54 MHz frequency band may adversely impact the amateur service.

5/1.1/4.4 Method C

An allocation to the amateur service on a partly primary and partly secondary basis in all or part of the frequency band 50-54 MHz, with appropriate footnotes to provide protection to services which already have an allocation in the band.

Advantages:

- The requirement of the amateur service to have an allocation in the frequency band 50-54 MHz in Region 1 would be fully or partially satisfied.
- Partial harmonization of spectrum throughout the three ITU regions would be achieved, thus the principles outlined in Recommendation 34 (Rev.WRC-12) would be fully or partially respected.
- The use of RR No. 4.4 for implementing spectrum allocations on a national or multinational basis may be avoided.

Disadvantages:

- The needs of the amateur service in the frequency band 50-54 MHz in Region 1 for spectrum and spectrum harmonization may only be partly satisfied.
- Administrations in Region 1 and its neighbouring countries in Region 3 may need to adopt specific measures, or develop multilateral agreements to ensure harmful interference is not caused to stations of incumbent services (which may be difficult to resolve) operating within their territory or in neighbouring territories.
- Regarding the radiolocation service, the sharing approach proposed may not be fulfilled.
- May affect current and future usage of the band in Region 1 and its neighbouring countries in Region 3.

5/1.1/4.5 Method D

Method D is to not make any changes (No Change) in the frequency band 50-54 MHz.

Advantage:

- Avoid additional restrictions on the operations of broadcasting, radiolocation, land mobile and fixed services stations and avoid possible interference from the amateur service.

Disadvantage:

- Does not satisfy the requirements of the amateur service.

5/1.1/5 Regulatory and procedural considerations**5/1.1/5.1 For all Methods A, B1, B2, C, and D, suppression of Resolution 658 (WRC-15)**

SUP

RESOLUTION 658 (WRC-15)**Allocation of the frequency band 50-54 MHz to the amateur service in Region 1****5/1.1/5.2 For Method A****ARTICLE 5****Frequency allocations**

Section IV – Table of Frequency Allocations
(See No. 2.1)

MOD**47-75.2 MHz**

| Allocation to services | | |
|--|--|---|
| Region 1 | Region 2 | Region 3 |
| 47-6850 BROADCASTING 5.162A 5.163 5.164 5.165 5.169-5.171 | 47-50 FIXED MOBILE | 47-50 FIXED MOBILE BROADCASTING 5.162A |
| 4750-685[x] AMATEUR BROADCASTING 5.162A- 5.163 5.164 5.165 5.169- 5.171 <u>ADD 5.A11</u> <u>ADD 5.B11</u> | 50-54 AMATEUR 5.162A 5.167 5.167A 5.168 5.170 | |
| 475[x]-68 BROADCASTING 5.162A 5.163 5.164 5.165 5.169 5.171 | 54-68 BROADCASTING Fixed Mobile 5.172 | 54-68 FIXED MOBILE BROADCASTING 5.162A |

ADD

5.A11 In Region 1 in the frequency band 50-5[x] MHz, with the exception of those countries listed in No. **5.169**, stations of the amateur service shall not cause harmful interference to, or claim protection from, stations of the broadcasting service. The administrations in Region 1 shall ensure that the field strength emitted by an amateur station does not exceed a calculated value of +6 dB(μV/m) at a height of 10 m above ground at the service area boundary of operational broadcasting stations of countries in Region 1 and the neighbouring countries in Region 3 for more than 10% of time, unless otherwise agreed between affected administrations. (WRC-19)

ADD

5.B11 In Region 1 in the frequency band 50-5[x] MHz with the exception of those countries listed in No. **5.169**, stations of the amateur service shall not cause harmful interference to, or claim protection from, stations of the fixed and mobile services and wind profiler radars operating in the radiolocation service in Region 1 and its neighbouring countries in Region 3. (See Resolution [A11-WPR] (WRC-19).) (WRC-19)

ADD

RESOLUTION [A11-WPR] (WRC-19)

Coexistence between the amateur service and Wind Profiler Radars (WPR) in the frequency band 50-54 MHz in Region 1

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that fully or partially harmonized worldwide frequency bands for radiocommunication services are desirable in order to achieve international operability;
- b)* that weather forecasting requires high quality wind data from near the Earth's surface and from high in the atmosphere;
- c)* that spectrum in the vicinity of 50 MHz enables measurements at altitudes greater than 20 km;
- d)* that WPRs play an important role in experimental atmospheric research;
- e)* that Report ITU-R M.2013 provides the characteristics of WPRs and analyses of various spectrum-sharing scenarios with other radiocommunication services including the amateur service at 50 MHz and concludes that 40-80 MHz is generally suitable from a sharing standpoint provided that wind profiler density is low and broadcasting density is low;
- f)* that WPR antennas at 50 MHz are normally highly directional pointing skywards with low horizontal gain;
- g)* that although a primary allocation to the amateur service in Region 1 has been introduced in the 50.0-[54.0] MHz frequency band, this Conference agreed that WPR stations in existence on 22 November 2019 should be afforded the necessary protection to continue their operations in this frequency band, see *invites ITU-R* below;
- h)* that there is a need to establish sharing conditions when considering frequency bands for possible additional allocations to any service,

noting

- a)* that No. **5.162A** of the Radio Regulations provides for an additional allocation in the 46-68 MHz frequency band to the radiolocation service on a secondary basis in a number of countries, limited to the operation of wind profiler radars in accordance with Resolution **217 (WRC-97)**;
- b)* that Report ITU-R M.2013 indicates that the weak-signal segments of amateur allocations are used for experimentation with non-line-of-sight and anomalous propagation modes and should be avoided by WPRs;
- c)* that the global weak signal segments of the amateur service are located in the 50.0-50.5 MHz frequency band;
- d)* that available documentation indicates that there are nine WPRs currently operational in Europe within the range 45-66 MHz. Of these only three are operating in the 50-54 MHz frequency band;

e) that with the small number of affected WPRs in Region 1, often in remote locations, it will be possible for administrations to implement coordination zones around WPR sites where the spectrum used by these WPRs would be subject to appropriate limits, in order to facilitate coexistence between the amateur service and WPRs,

resolves

TBD

invites ITU-R

TBD

5/1.1/5.3 For Method B1

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

47-75.2 MHz

| Allocation to services | | |
|--|--|---|
| Region 1 | Region 2 | Region 3 |
| <p>47-68<u>50.080</u> BROADCASTING</p> <p>5.162A 5.163 5.164 5.165 5.169–5.171</p> | <p>47-50 FIXED MOBILE</p> | <p>47-50 FIXED MOBILE BROADCASTING</p> <p>5.162A</p> |
| <p>47<u>50.080-68</u><u>50.280</u> BROADCASTING <u>Amateur</u> 5.162A–5.163 5.164 5.165 5.169–5.171 <u>ADD 5.C11</u> <u>ADD 5.D11</u></p> | <p>50-54 AMATEUR</p> <p>5.162A 5.167 5.167A 5.168 5.170</p> | |
| <p>47<u>50.280-68</u> BROADCASTING</p> <p>5.162A 5.163 5.164 5.165 5.169 5.171</p> | <p>54-68 BROADCASTING Fixed Mobile</p> <p>5.172</p> | <p>54-68 FIXED MOBILE BROADCASTING</p> <p>5.162A</p> |

ADD

5.C11 Amateur stations in the band 50.080-50.280 MHz, with the exception of those countries listed in No. **5.169**, shall not cause harmful interference to, or claim protection from wind profiler radars operating in the radiolocation service. (WRC-19)

ADD

5.D11 The use of frequencies within the frequency band 50.080-50.280 MHz by amateur stations with the exception of those countries listed in No. **5.169**, is subject to getting prior special authorization by the administration concerned, together with the agreement of other administrations, whose broadcasting service may be affected. To identify potentially affected administrations in Region 1 the field-strength value shall not exceed 6 dB(μV/m) at a height of 10 m above the ground for 10% of the time at the border of the territory of this administration. (WRC-19)

5/1.1/5.4 For Method B2**ARTICLE 5****Frequency allocations**

Section IV – Table of Frequency Allocations
(See No. 2.1)

MOD**47-75.2 MHz**

| Allocation to services | | |
|---|--|---|
| Region 1 | Region 2 | Region 3 |
| 47-6850 BROADCASTING 5.162A 5.163 5.164 5.165 5.169-5.171 | 47-50 FIXED MOBILE | 47-50 FIXED MOBILE BROADCASTING 5.162A |
| 4750-6852 BROADCASTING <u>Amateur</u> 5.162A 5.163 -5.164 5.165 5.169- 5.171 <u>ADD 5.C11</u> <u>ADD 5.D11</u> | 50-54 AMATEUR 5.162A 5.167 5.167A 5.168 5.170 | |
| 4752-6854 BROADCASTING 5.162A 5.163 -5.164 5.165 5.169- 5.171 | | |

| | | |
|--|--|---|
| 47 54 -68 BROADCASTING 5.162A 5.163 5.164 5.165 5.169 -5.171 | 54-68 BROADCASTING Fixed Mobile 5.172 | 54-68 FIXED MOBILE BROADCASTING 5.162A |
|--|--|---|

ADD

5.C11 Amateur stations in the band 50-52 MHz, with the exception of those countries listed in No. **5.169**, shall not cause harmful interference to, or claim protection from wind profiler radars operating in the radiolocation service. (WRC-19)

ADD

5.D11 The use of frequencies within the frequency band 50-52 MHz by amateur stations with the exception of those countries listed in No. **5.169**, is subject to getting prior special authorization by the administration concerned, together with the agreement of other administrations, whose broadcasting service may be affected. To identify potentially affected administrations in Region 1 the field-strength value shall not exceed 6 dB(μV/m) at a height of 10 m above the ground for 10% of the time at the border of the territory of this administration. (WRC-19)

5/1.1/5.5 For Method C**ARTICLE 5****Frequency allocations**

Section IV – Table of Frequency Allocations
(See No. 2.1)

MOD**47-75.2 MHz**

| Allocation to services | | |
|---|---------------------------------|---|
| Region 1 | Region 2 | Region 3 |
| 47-68 50 BROADCASTING 5.162A 5.163 5.164 5.165 5.169 - 5.171 | 47-50 FIXED MOBILE | 47-50 FIXED MOBILE BROADCASTING 5.162A |

5.F11 In Region 1, in the frequency band 50-[xx] MHz, with the exception of those countries listed in No. **5.169**, stations in the amateur service shall not cause harmful interference to, or claim protection from, stations in the broadcasting service. The administrations in Region 1 shall ensure that the field strength emitted by an amateur station does not exceed a calculated value of +6 dB(μ V/m) at a height of 10 m above ground at the service area boundary of operational broadcasting stations of countries in Regions 1 and the neighbouring countries in Region 3 for more than 10% of time, unless otherwise agreed between affected administrations. (WRC-19)

5.G11 In Region 1, in the frequency band 50-[xx] MHz, with the exception of those countries listed in No. **5.169**, stations in the amateur service shall not cause harmful interference to, or claim protection from, stations in the fixed and mobile services and wind profiler radars operating in the radiolocation service in Region 1 and its neighbouring countries in Region 3. (See Resolution **[B11-WPR] (WRC-19)**.) (WRC-19)

5.H11 The use of frequencies within the frequency band [xx-< 54] MHz by amateur stations with the exception of those countries listed in No. **5.169**, is subject to getting prior special authorization from the administration concerned, together with the agreement of other administrations, whose broadcasting service may be affected. To identify potentially affected administrations in Region 1 the field-strength value must be set to 6 dB(μ V/m) at a height of 10 m above the ground for 10% of the time at the border of the territory of this administration. (WRC-19)

ADD

5.I11 Amateur stations in the band [xx]-[< 54] MHz, with the exception of those countries listed in No. **5.169**, shall not cause harmful interference to, or claim protection from wind profiler radars operating in the radiolocation service. (WRC-19)

ADD**RESOLUTION [B11-WPR] (WRC-19)**

Coexistence between the amateur service and Wind Profiler Radars (WPR) in the frequency band 50-54 MHz in Region 1

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a) that fully or partially harmonized worldwide frequency bands for radiocommunication services are desirable in order to achieve international operability;
- b) that weather forecasting requires high quality wind data from near the Earth's surface and from high in the atmosphere;
- c) that spectrum in the vicinity of 50 MHz enables measurements at altitudes greater than 20 km;
- d) that WPRs play an important role in experimental atmospheric research;
- e) that Report ITU-R M.2013 provides the characteristics of WPRs and analyses of various spectrum-sharing scenarios with other radiocommunication services including the amateur service at 50 MHz and concludes that 40-80 MHz is generally suitable from a sharing standpoint provided that wind profiler density is low and broadcasting density is low;
- f) that WPR antennas at 50 MHz are normally highly directional pointing skywards with low horizontal gain;
- g) that although a primary allocation to the amateur service in Region 1 has been introduced in the 50.0-[54.0] MHz frequency band, this Conference agreed that WPR stations in existence on 22 November 2019 should be afforded the necessary protection to continue their operations in this frequency band, see *invites ITU-R* below;
- h) that there is a need to establish sharing conditions when considering frequency bands for possible additional allocations to any service,

noting

- a) that No. **5.162A** of the Radio Regulations provides for an additional allocation in the 46-68 MHz frequency band to the radiolocation service on a secondary basis in a number of countries, limited to the operation of wind profiler radars in accordance with Resolution **217 (WRC-97)**;
- b) that Report ITU-R M.2013 indicates that the weak-signal segments of amateur allocations are used for experimentation with non-line-of-sight and anomalous propagation modes and should be avoided by WPRs;

- c) that the global weak-signal segments of the amateur service are located in the 50.0-50.5 MHz frequency band;
- d) that available documentation indicates that there are nine WPRs currently operational in Europe within the range 45-66 MHz. Of these only three are operating in the 50-54 MHz frequency band;
- e) that with the small number of affected WPRs in Region 1, often in remote locations, it will be possible for administrations to implement coordination zones around WPR sites where the spectrum used by these WPRs would be subject to appropriate limits, in order to facilitate coexistence between the amateur service and WPRs,

resolves

TBD

invites ITU-R

TBD

5/1.1/5.6 For Method D

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

NOC

47-75.2 MHz

Agenda item 1.8

1.8 to consider possible regulatory actions to support Global Maritime Distress Safety System (GMDSS) modernization and to support the introduction of additional satellite systems into the GMDSS, in accordance with Resolution 359 (Rev.WRC-15);

Resolution 359 (Rev.WRC-15) – *Consideration of regulatory provisions for updating and modernization of the Global Maritime Distress and Safety System*

5/1.8/1 Executive summary

WRC-19 agenda item 1.8 encompasses two separate items. The first is global maritime distress and safety system (GMDSS) modernization addressed under *resolves to invite ITU-R 1* of Resolution 359 (Rev.WRC-15). In this chapter GMDSS modernization is referred to as “Issue A.” The second is the introduction of an additional satellite system into the GMDSS. This is covered under *resolves to invite ITU-R 2* of Resolution 359 (Rev.WRC-15). The introduction of additional satellite systems into the GMDSS is referred to as “Issue B.”

5/1.8/1.1 Resolution 359 (Rev.WRC-15), invites the 2019 World Radiocommunication Conference 1

To satisfy Issue A under WRC-19 agenda item 1.8, three methods are presented below to be reflected in the Radio Regulations.

- The first method is no change.
- The second method includes frequencies to be used for medium frequency (MF) and high frequency (HF) navigational data (NAVDAT) systems, in support of GMDSS modernization.
- The third method is similar to the second one with the following conditions:
 - NAVDAT transmits only from coastal stations
 - Their usage is subject to agreement to be obtained with affected administrations.

5/1.8/1.2 Resolution 359 (Rev.WRC-15), invites the 2019 World Radiocommunication Conference 2

To satisfy Issue B under WRC-19 agenda item 1.8, several methods are presented below to reflect in the Radio Regulations the frequencies used by a non-GSO MSS GMDSS satellite system, noting that WRC-19 is invited to take into consideration the activities of International Maritime Organization (IMO) which has recognized a non-GSO MSS satellite system as an additional provider of GMDSS communications.

5/1.8/2 Background

Agenda item 1.8 (Resolution 359 (Rev.WRC-15)), concerns GMDSS. *Resolves 1* addresses the modernization of the GMDSS while *resolves 2* addresses the introduction of additional satellite providers into the GMDSS.

5/1.8/2.1 Issue A: Global maritime distress and safety system modernization

The GMDSS was adopted as part of the 1988 amendments to the International Convention for the Safety of Life at Sea, 1974 (SOLAS). It was fully implemented in 1999. It has served the mariner and the maritime industry well since its inception, but some of the GMDSS technologies used have not reached their full potential, and some GMDSS functions could be performed by more modern technologies.

IMO has adopted a modernization plan for the GMDSS containing a high-level review and a detailed review. The detailed review and the plan show that the use of some existing services is declining. Meanwhile, some new technologies are considered to be possibly introduced in the modernized GMDSS, such as VHF data exchange system (VDES) and the NAVDAT system. The VDES has been already covered by WRC-15 for the terrestrial component and agenda item 1.9.2 covers the satellite component, therefore no action is requested for the VDES under agenda item 1.8.

Navigational text (NAVTEX) was incorporated into the regulations for the GMDSS for disseminating maritime safety information, which was introduced in a transitional phase from 1992 to 1999, after which it became mandatory under Chapter V of the SOLAS regulations.

In March 2012, ITU-R approved Recommendation ITU-R M.2010 “*Characteristics of a digital system, named Navigational Data for broadcasting maritime safety and security related information from shore-to-ship in the 500 kHz band*”. In April 2014, the other Recommendation ITU-R M.2058 “*Characteristics of a digital system, named navigational data for broadcasting maritime safety and security related information from shore-to-ship in the maritime HF frequency band*” was also approved. NAVDAT is counted as an enhancement of existing NAVTEX and could be considered as a potential entity in the next generation of GMDSS.

WRC-12 addressed the allocation of the 495-505 kHz frequency band for the maritime mobile service. This band is regarded as the most suitable for MF NAVDAT application. However, regulatory provisions are still needed for both MF and HF NAVDAT applications.

5/1.8/2.2 Issue B: Introduction of additional satellite systems into the Global Maritime Distress and Safety System (*resolves to invite ITU-R 2*)

To date, only one satellite system has been incorporated by the IMO in the GMDSS “system of systems”.

IMO recognized a non-GSO MSS system³⁵, operating in the frequency band 1 616-1 626.5 MHz which expected to come into GMDSS operation in early 2020.

A compilation of related ITU-R Recommendations and Reports is given below.

5/1.8/3 Summary and analysis of the results of ITU-R studies

Existing relevant Recommendations and Report for Issue A:

Recommendations [ITU-R M.2010](#), [ITU-R M.2058](#), [ITU-R M.1798](#), [ITU-R P.368](#), Report [ITU-R M.2201](#).

Existing relevant Recommendations and Reports for Issue B:

Recommendations [ITU-R M.1184-2](#), [ITU-R M.1188-1](#), [ITU-R RA.769](#), [ITU-R RA.1513](#), [ITU-R M.1583-1](#), [ITU-R RA.1631-0](#), Report [ITU-R M.2369-0](#), WDPDN Report ITU-R M.[GMDSS-SATREG], WDPDN Report ITU-R M.[RAS-COMPAT].

5/1.8/3.1 Issue A: Global maritime distress and safety system modernization (*resolves to invite ITU-R 1*)

IMO will approve the revision of SOLAS Chapters III and IV in 2022. For this reason, it will be important to keep on the agenda for WRC-23 the modernization of the GMDSS. However, some

³⁵ See IMO Resolution MSC.451(99), “*Statement Of Recognition Of Maritime Mobile Satellite Services Provided By Iridium Satellite LLC*” (May 2018).

actions could be considered and taken for the WRC-19. The regulatory recognition of the frequencies for the MF and HF NAVDAT could facilitate the work during WRC-23. It will also help the administrations, given sufficient time, to make available those frequencies for the MF and HF NAVDAT.

NAVDAT is a digital system for broadcasting maritime safety and security-related information from shore-to-ship. NAVDAT uses a time-slot allocation similar to the NAVTEX system which could be coordinated by IMO in the same manner. NAVDAT could operate in both MF and HF frequency bands. A 10 kHz channel is the necessary bandwidth for each system. The system uses orthogonal frequency division multiplexing (OFDM) which is a modulation technology for digital transmissions, and every subcarrier is modulated using Quadrature amplitude modulation (QAM), as 64-QAM, 16-QAM or 4-QAM.

As the 500 kHz frequency band provides good coverage as shown in Recommendation ITU-R P.368-9, the frequency band 415-526.5 kHz of the maritime mobile service would be used for MF NAVDAT as described in Recommendation ITU-R M.2010.

The detailed review of GMDSS shows that the uses of HF narrowband direct printing (NBDP) for follow-up communications is declining greatly, and HF MSI could also be accomplished by means other than NBDP, such as HF NAVDAT. Six channels respectively in 4 MHz, 6 MHz, 8 MHz, 12 MHz, 16 MHz and 22 MHz frequency bands listed in RR Appendix 17 would be used for HF NAVDAT, as described in Recommendation ITU-R M.2058.

NAVDAT has the function of broadcasting messages relating to of safety of navigation, security, piracy, search and rescue, meteorological messages and piloting or harbour messages, etc. There is a need to establish international harmonized standards, including detailed technical and operational characteristics in detail, such as priority identification, protocol, message classification and data structure, necessary coordination schemes by IMO, and harmonized frequency band explicitly identified by the Radio Regulations. This will ensure the global implementation of global NAVDAT. This is very similar to the implementation of the international NAVTEX service transmitting English language messages and operating on 518 kHz.

On the other hand, the NAVDAT system could also be used by national authorities for transmitting safety and security-related information in national languages or for some specific functions. This kind of national NAVDAT application might not operate according to globally harmonized standards, for example, in different data structures, or in different frequency bands. The national NAVDAT systems may need to meet the coordination schemes by IMO, depending on the frequency bands they use. This is very similar to NAVTEX transmitting local language messages operating on 490 kHz or other frequency bands specified by national authorities in accordance with the NAVTEX Manual.

Analyses on medium-frequency band

So far, NAVDAT is one of the most important potential elements involved both in GMDSS modernization and e-navigation. However, there is not any frequency band identified for the application in the Radio Regulations. With respect to the frequency band 415-526.5 kHz, only the 495-505 kHz band is exclusively allocated in the maritime mobile service globally. Thus, this band would be the best choice for the international NAVDAT broadcasting.

Technically, other parts of the frequency band 415-526.5 kHz are also suitable for the NAVDAT application. However, the use of these bands by the maritime mobile service is restricted to radiotelegraphy according to RR No. 5.79. Practically, except the NAVTEX services, use of radiotelegraphy has greatly declined to disuse in many countries. Allowing national NAVDAT systems to use these bands for the maritime mobile service might be feasible. Some appropriate

regulatory approaches would give administrations an opportunity to promote the development and deployment of this kind of new advanced technology.

The further protection approaches will be considered during the implementation of GMDSS modernization as NAVDAT recognized in GMDSS, and the coordination scheme developed. This is planned to be done in the study cycle of WRC-23, according to the progress of activities of IMO.

Analyses on high-frequency band

WRC-12 designated some frequency bands in RR Appendix 17 for digitally modulated emissions in the maritime mobile service (e.g. as described in the most recent version of Recommendation ITU-R M.1798) from 1 January 2017 by footnote *p*). ITU-R issued Recommendation ITU-R M.2058-0 in February 2014. Six channels respectively within 4 MHz, 6 MHz, 8 MHz, 12 MHz, 16 MHz and 22 MHz frequency bands with footnote *p*) are recommended to be used for HF NAVDAT. It is feasible technically. However, actions is required to give NAVDAT application regulatory status to operate in these bands. Furthermore, just as with MF NAVDAT, the further protection approaches on HF bands need to be considered during the implementation of GMDSS modernization depending on the situation related to NAVDAT recognized in GMDSS, and the related coordination scheme developed. This is also planned to be done in the study cycle for WRC-23, according to the progress of activities of IMO.

Analysis of the Master International Frequency Register (MIFR) showed that the frequency bands suggested for implementation of the HF NAVDAT system were used by a large number of transmitting coastal stations in the maritime mobile service subject to existing spectrum allocations. Those stations could cause harmful interference to the operation of HF NAVDAT ship receivers on a significant portion of the World Ocean. Therefore, effective implementation of HF NAVDAT systems would require appropriate development of regulatory and technical measures providing its compatibility with currently existing maritime mobile stations. Currently the NAVDAT does not refer to internationally coordinated systems, adopted by IMO. Therefore, incorporation of HF NAVDAT system frequency bands into RR Appendix 15 seems inappropriate.

5.1.8/3.2 Issue B: Introduction of additional satellite systems into the Global Maritime Distress and Safety System (*resolves to invite ITU-R 2*)

There is currently one operating non-GSO MSS system which could provide worldwide operation of GMDSS, including in Arctic and Antarctic areas, within MSS allocations in the frequency range 1 616-1 626.5 MHz.

This system was first published under special section RES46/C/40, BR IFIC 2081, and notified in BR IFIC 2418. The allocation used by this system is also used by other non-GSO and GSO MSS systems.

MSS satellite systems in the band 1 610-1 626.5 MHz are subject to frequency coordination under RR Article 9 as indicated in RR No. 5.364. Specifically, RR No. 9.11A, together with the associated Rules of Procedure (RoP), calls for coordination between geostationary and non-geostationary satellite networks alike, and with other services having equal rights. The above-mentioned system's service links within this band (both uplink and downlink) having been coordinated under RR No. 9.11A with those services with equal status, notified and recorded under RR Article 11 in the MIFR. It is emphasized that today, apart from frequency overlap check, there is no established criteria to trigger coordination with other satellite networks. However, many coordinations have taken place and are taking place on the basis of frequency overlap. Consequently, successful application of RR No. 9.11A should not be construed as successful coordination similar to those foreseen under RR No. 9.7. It is also to be noted that the MSS downlinks are recorded as having secondary status.

Within the band 1 616-1 626.5 MHz the satellite system under consideration by IMO operates using the same frequency for both uplink and downlink, to each mobile earth station. A full description of this operation can be found in Report ITU-R M.2369.

Under the authorization issued by the notifying administration, the space stations of the satellite system are authorized to operate in the 1 618.725-1 626.5 MHz band, and on a shared basis with another non-GSO network under the responsibility of the same notifying administration in the 1 617.775-1 618.725 MHz band.

On this subject, two views were expressed:

- View 1: expressed that, because these assignments are operated using time division duplex (TDD), in which the subscriber units and satellites transmit and receive in the same frequency band, the secondary downlinks are effectively protected by the primary uplink communication links and in practice enjoy the same rights in the 1 618.725-1 626.5 MHz band. There is no other operational MSS system which is co-frequency with the non-GSO MSS system. From the practical perspective of the assignments and their protection, the unique operation of the non-GSO MSS satellite uplink and downlink in the same frequency band (“time division duplex”), the date priority enjoyed by the non-GSO MSS filing, and the primary allocation status of the uplink provide suitable protection for use of the frequencies in both directions.
- View 2: expressed that since synchronization and the channel assignments mentioned above are managed by the satellite, it is vital for the function of this system that the downlink can be received without interruption, something that cannot be ensured with a secondary allocation. Moreover, the operation of this satellite system downlink has a status of “non-interference, non-protection” vis-à-vis any primary service within the same band and in adjacent bands, and since there is currently no reliable coordination criteria, apart from frequency overlap which is one among other interference criteria, to accomplish coordination, the allocation should not be a candidate to provide a safety-of-life aspect as required by the GMDSS.

5/1.8/3.2.1 Allocations and other regulatory provisions to be taken into account

Various portions of the band 1 610.0-1 626.5 MHz are also allocated to the following services:

- aeronautical mobile-satellite (route) service (AMS(R)S),
- aeronautical radionavigation service (ARNS),
- fixed service (FS),
- radio astronomy service (RAS), and
- radiodetermination-satellite service (RDSS).

5/1.8/3.2.1.1 Allocations and associated matters

The services listed in section 5/1.8/3.2.1 and their current operational status are further discussed here.

- Pursuant to RR No. **5.367**, AMS(R)S is allocated on a primary basis in the band 1 610-1 626.5 MHz in both uplink and downlink directions, subject to agreement to be obtained under RR No. **9.21**.

Two views were expressed:

- View 1: It should be noted that, based on this allocation, the International Civil Aviation Organization (ICAO) has adopted Standards and Recommended Practices (SARPs) in relation to communications of different categories of

AMS(R)S safety messages over the satellite system being considered by the IMO for provision of GMDSS.

- View 2: There is no need to talk about SARPs and ICAO Standards, for inclusion in CPM text. Irrespective of actions taken under this agenda item, ICAO continues to apply the standards with respect to AMS(R)S. Moreover, it is not within the mandate nor the competence of ITU-R Study Groups to confirm or otherwise the compliance of operation of any system with ICAO standards.
- ARNS is allocated in the band 1 610-1 626.5 MHz. There are no known planned or operational ARNS systems in this band.
- The radio astronomy service (RAS) operates in the 1 610.6-1 613.8 MHz frequency band on a primary basis. Resolution **359 (Rev.WRC-15)** invites WRC-19 to consider the impact on the protection of the RAS, in accordance with RR No. **5.372**. In this connection some administrations operating RAS in the frequency band above have reported that, since 1998, harmful interference has been experienced from the downlink operations of this MSS system. This was reported to the ITU³⁶ and to the responsible administration for the satellite system³⁷. The responsible administration described measures³⁸ it is taking that will, in its view, resolve the interference. (See also working document towards a PDN Report ITU-R M.[RAS.COMPAT].)
- Pursuant to RR No. **5.359**, FS is allocated in the band 1 610-1 626.5 MHz. It is noted that RR No. **5.359** (adopted before WARC-92) states: “*Administrations are urged to make all practicable efforts to avoid the implementation of new fixed-service stations in these frequency bands*”.
- The RDSS is allocated in the band 1 610-1 626.5 MHz on a primary basis in Region 2, and on a secondary basis in Regions 1 and 3 and under RR No. **5.364** is subject to coordination under RR No. **9.11A**. In addition, RR No. **5.369** provides for the RDSS (Earth-to-space) in the 1 610-1 626.5 MHz band on a primary basis for some countries in Regions 1 and 3 identified in the footnote, subject to agreement under RR No. **9.21** from countries not listed in this provision.

Two views were expressed:

- View 1: In the 1 613.8-1 626.5 MHz band, a downlink using a MSS secondary allocation (space-to-Earth) cannot claim protection from harmful interference from the uplink of satellite networks using the primary allocation (Earth-to-space), operating in accordance with the Radio Regulations.
- View 2: In the 1 613.8-1 626.5 MHz band, stations using the secondary MSS (space-to-Earth) allocation cannot claim protection from harmful interference from stations using the primary RDSS (Earth-to-space) allocation. However, in Regions 1 and 3, outside of the twenty administrations listed in RR No **5.369**, the RDSS (Earth-to-space) allocation is secondary in the remaining 138 Region 1 and Region 3 administrations. Consequently, both the RDSS (Earth-to-space) allocation and the MSS (space-to-Earth) allocation are of secondary allocation status. Regardless of the situation described above, before

³⁶ See ITU-R RRB 17.1 Document [2].

³⁷ See Attachments 4, 6, 7, 8, 9, 10 and 11 of RRB 17.1 Document [2].

³⁸ See ITU-R RRB 17.1 Document [5].

consideration of the secondary MSS (space-to-Earth) allocation vis-à-vis the primary RDSS (Earth-to-space) allocation, the operator of the primary RDSS (Earth-to-space) allocation must first effect successful coordination with the operator of the primary MSS (Earth-to-space) allocation. In the case of the MSS system that is under consideration by the IMO, and is at the basis of *resolves 2*, that MSS system would have date priority over any RDSS system filed subsequently. In this situation, successful coordination of MSS and RDSS uplinks on the basis of frequency overlap in the same geographical area may prove difficult. Furthermore, coordination with the primary MSS (Earth-to-space) allocation on the same satellite system would be also required by any primary RDSS (Earth-to-space) system notified subsequently. The above requirements in practice ensure protection of MSS secondary (space-to-Earth) assignments on the MSS system being considered by the IMO.

- The adjacent frequency band 1 626.5-1 660.5 MHz is allocated to the MSS (Earth-to-space).

Two views were expressed about the compatibility of the newly recognized MSS system for GMDSS and the systems operating in the adjacent band 1 626.5-1 660.5 MHz:

- View 1: Several MSS networks and systems use bands adjacent to, both above and below, those proposed for GMDSS operation for uplinks from mobile earth stations (MESs). There is potential for interference from transmitting MESs in the band 1 626.5-1 660.5 MHz to non-GSO MESs that may be used in the new GMDSS system. It is important that non-GSO MESs planned to be used for GMDSS services be designed and installed in such a manner as to mitigate the effect of, and be resilient to, the potential interference from existing non-GSO and GSO terminals which operate in the adjacent bands, including those terminals used for the GMDSS and Global Mobile Personal Communications by Satellite (GMPCS). It is important for administrations to take this issue into account when deciding on possible revisions to the RR, to ensure that the new GMDSS system operates within the existing interference environment.
- View 2: MSS MESs to be used for GMDSS services within the frequency band 1 616-1 626.5 MHz should be designed and installed on ships in such a manner as to mitigate the effect of, and be resilient to, potential interference from other existing MSS terminals operating in the adjacent band. In this regard, the expert UN agency for maritime safety communications, the International Maritime Organization (IMO) provides performance standards for ship earth stations for use in the GMDSS³⁹. Furthermore, it is important to note that management of communication devices that may operate on board ships is an ongoing exercise carried out by the national licensing authorities.

5/1.8/3.2.1.2 Other regulatory provisions

- RR No. **1.59**, which defines a safety service.
- RR No. **5.368**, which references RR No. **4.10** and its applicability (if any) to the MSS and RDSS.
- RR No. **9.52C** including reference to RR No. **9.47** and RR No. **9.48** which describes the nature of coordination.

³⁹ See, IMO Resolution MSC.434(98), “*Performance Standards for a Ship Earth Station for use in the GMDSS*” (June 2017).

- RR Appendix **15** contains all frequencies and frequency bands used by the GMDSS.
- Paragraph 2.3 of RoP relating to RR No. **9.11A** which describes the need to coordinate.
- Paragraph 5 of RoP relating to RR No. **11.50** which explains the role of the BR resulting from the upgrade of an existing service.

5/1.8/4 Methods to satisfy the agenda item

Three methods are proposed to satisfy Issue A, while 4 methods are proposed to satisfy Issue B.

5/1.8/4.1 Issue A: Modernization of the global maritime distress and safety system (*resolves to invite ITU-R 1*)

5/1.8/4.1.1 Method A1

No change to the Radio Regulations.

5/1.8/4.1.2 Method A2

MF NAVDAT

The frequency band 495-505 kHz is intended to be used for international MF NAVDAT.

The limitation on the use of the bands 415-495 kHz and 505-526.5 kHz (505-510 kHz in Region 2) in the maritime mobile service only by radiotelegraphy should be modified. And the possibility of using these bands by national MF NAVDAT could be given.

HF NAVDAT

Modification of RR Appendix **17** is required to allow the frequency bands described in the most recent version of Recommendation ITU-R M.2058 to be used for the HF NAVDAT system.

Therewith, proper regulatory provisions should be developed to ensure compatibility of HF NAVDAT systems with digital maritime mobile systems operating the frequency bands concerned subject to relevant existing allocations.

WRC-23 will consider the modernization of the GMDSS after IMO has concluded its work on this topic. Therefore, at that time it will be possible to consider a possible revision of RR Appendix **15**.

5/1.8/4.1.3 Method A3

MF NAVDAT

The frequency band 495-505 kHz is intended to be used for international MF NAVDAT.

The limitation on the use of the bands 415-495 kHz and 505-526.5 kHz (505-510 kHz in Region 2) in the maritime mobile service only by radiotelegraphy should be removed. And the possibility of using these bands and the band 495-505 kHz by MF NAVDAT could be given subject to limiting the transmitting stations of MF NAVDAT system to coastal stations with their usage being subject to agreement to be obtained with affected administration using aeronautical radionavigation service.

HF NAVDAT

Modification of RR Appendix **17** is required to allow the frequency bands described in the most recent version of Recommendation ITU-R M.2058 to be used for the HF NAVDAT system.

Therewith, proper regulatory provisions should be developed to ensure compatibility of HF NAVDAT systems with digital maritime mobile systems operating the frequency bands concerned subject to relevant existing allocations. Such provisions might include limiting the NAVDAT HF system transmitting stations to coastal stations only with their usage being subject to agreement to be obtained with affected administration.

Reasons: Transmitting stations in the MF NAVDAT and HF NADAT systems are limited to coastal stations and their transmitting power is much higher as compared with that of existing systems in maritime mobile service in the frequency bands considered. Therefore, the above proposed provisions are suggested to provide for compatibility of NAVDAT systems with existing systems and services.

WRC-23 will consider the modernization of the GMDSS after IMO has concluded its work on this topic. Therefore, at that time it will be possible to consider a possible revision of RR Appendix 15.

5/1.8/4.2 Issue B: Introduction of additional satellite systems into global maritime distress and safety systems (*resolves to invite ITU-R 2*)

5/1.8/4.2.1 Method B1

Due to limited antenna discrimination provided by MSS earth stations, MSS frequency band segmentation is a well-established coordination approach amongst coordinating MSS satellite systems. In the case of MSS frequencies used in both uplink and downlink directions by the same user terminal of the satellite system, upon coordinating such frequency use in one direction, other satellite networks are in effect prevented access to those frequencies in the same geographical area. The absence of emissions from other satellite systems in the same band within the coordinated geographical area ensures protection of using the same frequencies in the other direction of transmission by the satellite system operating bidirectionally on the same frequencies.

The IMO recognized non-GSO MSS system which has been operating for over twenty years. The recognition of the system to provide GMDSS by the IMO did not require technical or operational changes to the system. No new allocations or associated studies are required. However, from a regulatory perspective, in order to implement the “recognition” by IMO of the system under consideration as a satellite provider for the GMDSS in the frequency band 1 616-1 626.5 MHz, regulatory modifications would be necessary to the Radio Regulations including:

- a) A footnote in the MSS allocations to identify their use in the GMDSS;
- b) Modification of provisions RR Nos. **5.364** and **5.368** in order to avoid any inconsistency and ambiguity about the regulatory status of the maritime mobile-satellite service in the band 1 616-1 626.5 MHz when used for GMDSS.
- c) The addition of the band 1 616-1 626.5 MHz to Table 15-2 of RR Appendix 15, as well as provisions RR No. **33.50** and RR No. **33.53** of RR Article 33.

Further, although Radio Regulations provisions regarding safety services are not linked to a particular allocation status, in introducing this frequency band in RR Appendix 15, to avoid that the secondary allocation for the downlink could be seen as a precedent and due to the unique nature of the non-GSO MSS system where MSS frequencies are used in both the uplink and downlink directions within the same frequency band, a note could be associated with this band, which reads:

“In addition to its availability for routine non-safety purposes, the band 1 616-1 626.5 MHz is used for distress and safety purposes in the Earth-to-space and space-to-Earth directions in the maritime mobile-satellite service solely by satellite networks using the same channel in both directions.”

5/1.8/4.2.2 Method B2

This method supports the addition of the new satellite system to GMDSS, while ensuring compatibility between the new system and the current services. The method addresses in particular the regulatory status of the band 1 616-1 626.5 MHz with respect to MSS operations in the adjacent frequency band 1 626.5-1 660.5 MHz. The adjacent band is used by transmitting MESs in GSO MSS networks, including ship earth stations used in the GMDSS.

The current allocation to the MSS (space-to-Earth) in the band 1 616-1 626.5 MHz is secondary, while the MSS (Earth-to-space) allocation in the band 1 626.5-1 660.5 MHz is primary.

Some methods (B1 and B4) would change the regulatory status of the allocation to the MSS (space-to-Earth) in the band 1 616-1 626.5 MHz, effectively or directly raising that MSS allocation status to primary when used for GMDSS. This could lead to new constraints being placed on GSO MSS operations in the adjacent frequency band (potentially constraining MES emissions in the band 1 626.5-1 660.5 MHz) and may restrict its capability to provide the different maritime communications.

This Method is divided into two sub-methods: Method B2(a) and Method B2(b), in order to supplement methods B1 and B4 respectively, with additional regulatory text that would maintain the current regulatory status with respect to GSO MSS operations in the adjacent band.

The method would apply an additional regulatory provision in a footnote in Article 5 of the Radio Regulations, stating that mobile earth stations receiving in the band 1 616-1 626.5 MHz shall not claim protection from mobile earth stations transmitting in the adjacent band 1 626.5-1 660.5 MHz.

Furthermore, this method proposes a variation to Method B1 such that RR No. **5.364** would not be changed. The changes RR No. **5.364** proposed in Method B1 would degrade the status of the aeronautical radionavigation service, including airborne electronic aids to air navigation and the fixed service, and would change the status of the AMS(R)S with respect to the same services, which is outside the scope of WRC-19 agenda item 1.8. To avoid such changes, under Method B2(a), no change is proposed to RR No. **5.364**.

The method is divided into two sub-methods as follows:

5/1.8/4.2.2.1 Method B2(a)

Same method as B1 (i.e. retain the secondary status of the allocation to the MSS (space-to-Earth) in the band 1 613.8-1 626.5 MHz) except with no change to RR No. **5.364**, and add a footnote to prevent constraints on the MSS services on adjacent band.

5/1.8/4.2.2.2 Method B2(b)

Same method as B4 (i.e. upgrade the status of the allocation to the MSS (space-to-Earth) in the band 1 621.35-1 626.5 MHz to primary) and add a footnote to prevent constraints on the MSS services on adjacent band.

5/1.8/4.2.3 Method B3

With Method B3 NOC is proposed due to the fact that a number of issues, including the regulatory status of the non-GSO MSS system, and any potential adverse impact of any change to the regulatory status of in-band and adjacent systems or the apparent inconsistency and potential constraint of RR No. **5.368** have not been studied. Further, the compatibility issues related to the protection of RAS have not been solved.

From a regulatory perspective, in order to implement the “recognition” by IMO of the system under consideration as a satellite provider for the GMDSS, regulatory modifications would be necessary to the Radio Regulations, while ensuring no additional impact on the incumbent services to which the frequency band is allocated within the frequency band and the adjacent bands.

In Method B1, the secondary MSS (space-to-Earth) allocation in the band 1 616-1 626.5 MHz is directly to be used for GMDSS. But some issues, including the inconsistency between the secondary allocation with the status of “no interference, no protection” and the safety-of-life aspect as required by the GMDSS, the potential harmful interference from the mobile earth stations with the primary MSS (Earth-to-space) allocation in the band 1 610-1 626.5 MHz into the mobile earth

station with the secondary MSS (space-to-Earth) allocation in the band 1 616-1 626.5 MHz, the potential impact of possible modification to the provisions of the Radio Regulations on the incumbent services and systems in both directions in the frequency band and adjacent frequency bands, have not been studied and/or reach consensus.

In Method B4, the secondary MSS (space-to-Earth) allocation is upgraded to primary or adding a new primary allocations in both directions in the band 1 621.35-1 626.5 MHz. The following studies are needed to be carried out:

- Pursuant to paragraph 5, 11.50 of Rules of Procedure, the Bureau shall draw the notifying administration's attention to the recorded assignment concerned, which previously had a secondary status, and propose to this administration that it submit a new assignment to replace the previous one. The relevant coordination procedures shall apply to the newly submitted assignment and no priority shall be given to it in this process. The status of the assignment should be upgraded only if all relevant provisions of the Radio Regulations have been applied. But the coordination procedure between the mobile earth stations with the same status operating in the opposite direction of transmission in the same frequency band is missing.
- The potential impact of possible modification to the provisions of the Radio Regulations on the incumbent services and systems in both directions in the frequency band and adjacent frequency bands.

In view of the above, WRC-19 is invited to consider the matter and take necessary action, as appropriate.

5/1.8/4.2.4 Method B4

In order that a satellite network or satellite system be used for GMDSS, the frequency band of that satellite network /system, must be of primary status and be contained into RR Appendix 15. Regarding the frequency band 1 616-1 626.5 MHz, the secondary MSS allocation in the space-to-Earth direction cannot be considered for use by GMDSS due to the fact that *non-GSO MSS* has a status of “non-interference, non-protection” vis-à-vis any primary service within the same band and in the adjacent bands.

Moreover according to paragraph 2.3 of the Rules of Procedure relating to application of RR No. 9.11A (“While recognizing the difficulties of harmonizing the text of the footnotes to RR Article 5 introduced by WARC-92, WRC-95 and WRC-97 on the one hand and the text of the provision of RR No. 9.11A (including RR Nos. 9.12 to 9.16) and RR No. 9.17A, as appropriate with respect to the services to which this provision is applicable, on the other hand, the Board concluded that the procedure is applicable to all other space and terrestrial services with respect to those satellite services having allocations with equal rights and mentioned in the specific footnotes to which this provision applies. The frequency bands are those to which, in a footnote, reference is made to this provision in the Table of Frequency Allocations (see Tables 9.11A-1 and 9.11A-2 below). In these Tables, there is an indication of those other space services (in addition to the MSS and radiodetermination-satellite service as well as non-GSO MSS feeder links and non-GSO FSS included in the footnotes) to which this coordination procedure shall also apply”).

The space-to-Earth operation of the non-GSO MSS system under consideration using the band 1 616-1 626.5 MHz was not required to be coordinated with any space or terrestrial service of primary allocation/status. Since a secondary allocation is not compatible with a safety service like the GMDSS; therefore it is proposed to upgrade the status from secondary to primary but solely for the frequency band 1 621.35-1 626.5 MHz. The reason is that in this frequency band the considered satellite network is the only one to operate and is not sharing with other satellite networks. This 5.15 MHz is fully sufficient to operate the GMDSS.

Consequently, should a primary status be granted directly or implicitly to this allocation, it is fundamental for the downlink assignments of that system to carry out the required coordination with all space and terrestrial services as appropriate. Finally, the regulatory consequences of such action must be carefully analysed and be included in the RR.

It is also suggested that the discussed modifications would refer only to MMSS (space-to-Earth) because modifications in MSS (space-to-Earth) would be beyond the scope of WRC-19 AI 1.8 and would result in significant changes of sharing conditions with other existing systems and services.

In view of the above, in order to respect the requirement of safety of life aspects by the GMDSS and implement applicable provision of RR, Method B4 as described below is proposed:

The upgrading of the allocation of the frequency band 1 621.35-1 626.5 MHz for MMSS (space-to-Earth) shall not be interpreted as a relaxation of the obligation for MMSS systems to protect the radio astronomy. In this respect, it is noted that the remaining secondary status of MSS in the frequency band 1 613.8-1 621.35 MHz did not prevent interference to radio astronomy due to the fact that there are no regulatory limits protecting effectively the radio astronomy services. Therefore, it is proposed to define in the Radio Regulations the unwanted emission limits ensuring the protection of radio astronomy. A regulatory limit is considered as much more protective than the existing secondary status of the MSS downlink in this frequency band.

This method will both satisfy the maritime community and improve the protection of radio astronomy.

The regulatory proposal for this method is as follows:

- Upgrade the status of the band 1 621.35-1 626.5 MHz from a secondary to a primary allocation to the MMSS (space-to-Earth). The status of all other allocations in the frequency band 1 613.8-1 626.5 MHz will remain unchanged.
- Identify this band 1 621.35-1 626.5 MHz in RR Appendix **15** for GMDSS purpose with a note like “In addition to its availability for routine non-safety purposes, the band 1 621.35-1 626.5 MHz is used for distress and safety purposes in the Earth-to-space and space-to-Earth directions in the maritime mobile-satellite service. GMDSS distress, urgency and safety communications have priority in this band.”
- Modification of RR Nos. **5.364** and **5.368**, in relevant methods, in order to remove any ambiguity due to the upgrade of the status for the downlink segment.
- A modification of RR No. **5.372** is proposed introducing the maximum value of *epfd* and *pfd* defined in Resolution **739 (Rev.WRC-15)**, in order to make mandatory and quantify the protection of the radio astronomy.
- Adjustment of RR No. **5.208B** and of Resolution **739 (Rev.WRC-15)** in order not to refer any more to the band 1 613.8-1 626.5 MHz. The Resolution gives just a threshold of “best effort” which is less effective than a regulatory limit. In any case the RR No. **5.208B** could be suppressed for the band 1 613.8-1 626.5 MHz due to the modification of RR No. **5.372**.
- Consequential modifications in RR Article **33** are proposed.
- Suppression of Resolution **359 (Rev.WRC-15)** with regard to *resolves 2*.

5/1.8/5 Regulatory and procedural considerations

5/1.8/5.1 For Issue A

5/1.8/5.1.1 For Method A1

NOC

ARTICLES

NOC

APPENDICES

NOC

RESOLUTIONS

NOC

RECOMMENDATIONS

5/1.8/5.1.2 For Method A2

MF NAVDAT

The possible modifications to the provisions of RR are considered as following:

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

5.79 ~~The use of the~~ In the maritime mobile service, the frequency bands 415-495 kHz and 505-526.5 kHz ~~(505-510 kHz in Region 2) by the maritime mobile service is~~ are limited to be used for radiotelegraphy and the NAVDAT system. Such use of the NAVDAT system should be in accordance with the most recent version of Recommendation ITU-R M.2010, subject to special arrangements between interested and affected administrations. (WRC-19)

Reasons: These two bands are used currently by the NAVTEX system. They could be used in the future by the NAVDAT system and will need time-slot allocation between interested administrations.

MOD

495-1 800 kHz

| Allocation to services | | |
|------------------------|----------------------------------|----------|
| Region 1 | Region 2 | Region 3 |
| 495-505 | MARITIME MOBILE <u>ADD 5.A18</u> | |

ADD

5.A18 The band 495-505 kHz used for the international NAVDAT system as described in the most recent version of Recommendation ITU-R M.2010. (WRC-19)

Reasons: This new footnote secures the usage of this frequency bands for the NAVDAT system.

HF NAVDAT

The possible modifications to the provisions of RR are considered as follows:

MODAPPENDIX 17 (REV.WRC-~~15~~19)

**Frequencies and channelling arrangements in the
high-frequency bands for the maritime mobile service**

(See Article **52**)

...

ANNEX 2 (WRC-~~15~~19)

**Frequency and channelling arrangements in the high-frequency
bands for the maritime mobile service, which
enter into force on 1 January 2017** (WRC-~~12~~19)

MOD**PART A – Table of subdivided bands** (WRC-19)

**Table of frequencies (kHz) to be used in the band between 4 000 kHz and 27 500 kHz
allocated exclusively to the maritime mobile service (end)**

| Band (MHz) | 4 | 6 | 8 | 12 | 16 | 18/19 | 22 | 25/26 |
|---|----------|----------|----------|-----------|-----------|--------------|-----------|--------------|
| Limits (kHz) | 4 221 | 6 332.5 | 8 438 | 12 658.5 | 16 904.5 | 19 705 | 22 445.5 | 26 122.5 |
| Frequencies assignable for wide-band systems, facsimile, special and data transmission systems and direct-printing telegraphy systems <i>m) p) s) <u>pp)</u></i> | | | | | | | | |
| Limits (kHz) | 4 351 | 6 501 | 8 707 | 13 077 | 17 242 | 19 755 | 22 696 | 26 145 |
| ... | | | | | | | | |

...

pp) These sub-bands are also designated for the NAVDAT system as described in the most recent version of Recommendation ITU-R M.2058.

SUP**RESOLUTION 359 (REV.WRC-15)**

**Consideration of regulatory provisions for updating and modernization of the
Global Maritime Distress and Safety System**

5/1.8/5.1.3 For Method A3**MOD****495-1 800 kHz**

| Allocation to services | | |
|-------------------------------|---------------------------------|-----------------|
| Region 1 | Region 2 | Region 3 |
| 495-505 | MARITIME MOBILE <u>MOD 5.79</u> | |

MOD

5.79 The use of the allocations to the maritime mobile service in the frequency bands 415-495 kHz and 505-526.5 kHz (505-510 kHz in Region 2) by the maritime mobile service is limited to radiotelegraphy. In addition, these bands as well as 495-505 kHz may also be used for the NAVDAT system as described in the most recent version of Recommendation ITU-R M.2010, provided that MF NAVDAT system transmitting stations are limited to coastal stations and their

usage is possibly subject to agreement to be obtained with affected administrations using the aeronautical radionavigation service. (WRC-19)

HF NAVDAT

The possible modifications to the provisions of RR are considered as follows:

MOD

APPENDIX 17 (REV.WRC-1519)

Frequencies and channelling arrangements in the high-frequency bands for the maritime mobile service

(See Article 52)

ANNEX 2 (WRC-1519)

Frequency and channelling arrangements in the high-frequency bands for the maritime mobile service, which enter into force on 1 January 2017 (WRC-1219)

MOD

PART A – Table of subdivided bands (WRC-1219)

Table of frequencies (kHz) to be used in the band between 4 000 kHz and 27 500 kHz allocated exclusively to the maritime mobile service (*end*)

| Band (MHz) | 4 | 6 | 8 | 12 | 16 | 18/19 | 22 | 25/26 |
|--|-------|---------|-------|----------|----------|--------|----------|----------|
| Limits (kHz) | 4 221 | 6 332.5 | 8 438 | 12 658.5 | 16 904.5 | 19 705 | 22 445.5 | 26 122.5 |
| Frequencies assignable for wide-band systems, facsimile, special and data transmission systems and direct-printing telegraphy systems <i>m) p) s) pp)</i> | | | | | | | | |
| Limits (kHz) | 4 351 | 6 501 | 8 707 | 13 077 | 17 242 | 19 755 | 22 696 | 26 145 |
| ... | | | | | | | | |

...

pp) These sub-bands are also designated for the NAVDAT system as described in the most recent version of Recommendation ITU-R M.2058 provided that the HF NAVDAT transmitting stations are limited to coastal stations and their usage is possibly subject to agreement to be obtained with affected administrations.

SUP

RESOLUTION 359 (REV.WRC-15)

Consideration of regulatory provisions for updating and modernization of the Global Maritime Distress and Safety System

5/1.8/5.2 For Issue B

5/1.8/5.2.1 For Method B1

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

5.364 The use of the band 1 610-1 626.5 MHz by the mobile-satellite service (Earth-to-space) and by the radiodetermination-satellite service (Earth-to-space) is subject to coordination under No. **9.11A**. A mobile earth station operating in either of the services in this band shall not produce a peak e.i.r.p. density in excess of -15 dB(W/4 kHz) in the part of the band used by systems operating in accordance with the provisions of No. **5.366** (to which No. **4.10** applies), unless otherwise agreed by the affected administrations. In the part of the band where such systems are not operating, the mean e.i.r.p. density of a mobile earth station shall not exceed -3 dB(W/4 kHz).

Except when used for distress and safety purposes in the band 1 616-1 626.5 MHz by the mobile-satellite service (Earth-to-space), Stations of the mobile-satellite service shall not claim protection from stations in the aeronautical radionavigation service, stations operating in accordance with the provisions of No. **5.366** and stations in the fixed service operating in accordance with the provisions of No. **5.359**. Administrations responsible for the coordination of mobile-satellite networks shall make all practicable efforts to ensure protection of stations operating in accordance with the provisions of No. **5.366**. (WRC-19)

Reasons: To provide allocation status parity in the band 1 616-1 626.5 MHz among maritime and aeronautical communications for distress and safety purpose and to recognize the safety service aspects of GMDSS operations within the band 1 616-1 626.5 MHz.

MOD

5.368 With respect to the radiodetermination-satellite and mobile-satellite services the provisions of No. **4.10** do not apply in the band 1 610-~~1 626.5~~ 1 616 MHz, with the exception of the aeronautical radionavigation-satellite service. (WRC-19)

Reasons: To recognize that the band 1 616-1 626.5 MHz is used for safety services. Consequently, RR No. **4.10** applies.

The following addition of RR No. **5.GMDSS-B1** to RR Article **5** could be either a standalone footnote or combined with another footnote:

ADD

5.GMDSS-B1 The band 1 616-1 626.5 MHz may also be used in the Earth-to-space and space-to-Earth directions for the provision of distress, urgency, and safety communications of the Global Maritime Distress and Safety System (GMDSS). See Appendix **15**, Table 15-2, No. **33.50** and No. **33.53**. (WRC-19)

Reasons: To identify the band 1 616-1 626.5 MHz as being available for the provision of GMDSS by mobile-satellite service systems.

MOD

APPENDIX 15 (REV.WRC-~~15~~19)

Frequencies for distress and safety communications for the Global Maritime Distress and Safety System (GMDSS)

(See Article **31**)

The frequencies for distress and safety communications for the GMDSS are given in Tables 15-1 and 15-2 for frequencies below and above 30 MHz, respectively.

NOC

TABLE 15-1 (WRC-07)

Frequencies below 30 MHz

MOD

TABLE 15-2 (WRC-~~15~~19)

Frequencies above 30 MHz (VHF/UHF)

| Frequency (MHz) | Description of usage | Notes |
|-----------------|----------------------|---|
| ... | ... | ... |
| *1 544-1 545 | D&S-OPS | Use of the band 1 544-1 545 MHz (space-to-Earth) is limited to distress and safety operations (see No. 5.356), including feeder links of satellites needed to relay the emissions of satellite emergency position-indicating radio beacons to earth stations and narrow-band (space-to-Earth) links from space stations to mobile stations. |

| Frequency (MHz) | Description of usage | Notes |
|----------------------|----------------------|---|
| <u>1 616-1 626.5</u> | <u>SAT-COM</u> | <u>In addition to its availability for routine non-safety purposes, the band 1 616-1 626.5 MHz is used for distress and safety purposes in the Earth-to-space and space-to-Earth directions in the maritime mobile-satellite service solely by satellite networks using the same channel in both directions. GMDSS distress, urgency and safety communications have priority in this band over non-safety communications within the same satellite system. (WRC-19)</u> |
| 1 626.5-1 645.5 | SAT-COM | In addition to its availability for routine non-safety purposes, the band 1 626.5-1 645.5 MHz is used for distress and safety purposes in the Earth-to-space direction in the maritime mobile-satellite service. GMDSS distress, urgency and safety communications have priority in this band (see No. 5.353A). |
| ... | ... | ... |

Legend:

...

Reasons: To add the band 1 616-1 626.5 MHz as being available for distress and safety communications for the Global Maritime Distress and Safety System (GMDSS).

ARTICLE 33

Operational procedures for urgency and safety communications in the global maritime distress and safety system (GMDSS)

Section V – Transmission of maritime safety information²

33.49 *E – Maritime safety information via satellite*

MOD

33.50 § 26 Maritime safety information may be transmitted via satellite in the maritime mobile-satellite service using the bands 1 530-1 545 MHz and 1 616-1 626.5 MHz (see Appendix 15). (WRC-19)

Reasons: To include the 1 616-1 626.5 MHz band as being available for transmitting maritime safety information via satellite.

Section VII – Use of other frequencies for safety (WRC-07)

MOD

33.53 § 28 Radiocommunications for safety purposes concerning ship reporting communications, communications relating to the navigation, movements and needs of ships and weather observation messages may be conducted on any appropriate communications frequency, including those used for public correspondence. In terrestrial systems, the bands 415-535 kHz (see Article 52), 1 606.5-4 000 kHz (see Article 52), 4 000-27 500 kHz (see Appendix 17), and 156-174 MHz (see Appendix 18) are used for this function. In the maritime mobile-satellite service, frequencies in the bands 1 530-1 544 MHz, 1 616-1 626.5 MHz and 1 626.5-1 645.5 MHz are used for this function as well as for distress alerting purposes (see No. **32.2**). (WRC-07/19)

Reasons: To apply RR No. **33.53** to the 1 610-1 626.5 MHz band for use by mobile-satellite service systems approved by the International Maritime Organization to participate in the Global Maritime Safety and Distress System.

5/1.8/5.2.2 For Method B2

5/1.8/5.2.2.1 For Method B2(a)

As Method B1 (maintain the allocation secondary), but with the addition of a footnote to RR Article **5** to apply the additional condition related to not adding constraints for MESs which transmit in the band 1 626.5-1 660.5 MHz as follows:

ADD

5.GMDSS-B2a The band 1 616-1 626.5 MHz may also be used in the Earth-to-space and space-to-Earth directions for the provision of distress, urgency, and safety communications of the Global Maritime Distress and Safety System (GMDSS). See Appendix **15**, Table 15-2, No. **33.50** and No. **33.53**. No. **31.2** does not apply to the emissions from the band 1 626.5-1 660.5 MHz with respect to the GMDSS receiver in 1 616-1 626.5 MHz. In order not to constrain the operation of MSS terminals on ships in the band 1 626.5-1 660.5 MHz, maritime mobile earth stations receiving in the band 1 616-1 626.5 MHz shall not claim protection from emissions of maritime mobile earth stations transmitting in the band 1 626.5-1 660.5 MHz. (WRC-19)

Reasons: To maintain the current regulatory status with respect to MSS operations without adding constraints to MSS operations in the band 1 626.5-1 660.5 MHz.

NOC

5.364

Reasons: To avoid changing the status of AMS(R)S and the land mobile satellite service with respect to other services, and to avoid changing the status of stations in the aeronautical radionavigation service, stations operating in accordance with the provisions of RR No. **5.366** and stations in the fixed service with respect to maritime mobile earth stations.

5/1.8/5.2.2.2 For Method B2(b)

Same as For Method B4 (i.e. upgrade allocation to the MSS in the band 1 621.35-1 626.5 MHz to primary), with addition of a new footnote to RR Article **5** as a separate footnote, as follows:

ADD

5.GMDSS-B2b No. **31.2** does not apply to the emissions from the band 1 626.5-1 660.5 MHz with respect to the GMDSS receiver in the band 1 621.35-1 626.5 MHz. In order not to constrain the operation of MSS terminals on ships in the band 1 626.5-1 660.5 MHz, maritime mobile earth stations receiving in the band 1 621.35-1 626.5 MHz shall not claim protection from emissions of maritime mobile earth stations transmitting in the band 1 626.5-1 660.5 MHz. (WRC-19)

Reasons: To maintain the current regulatory status without adding constraints with respect to MSS operations in the band 1 626.5-1 660.5 MHz.

5/1.8/5.2.3 For Method B3

NOC

ARTICLES

NOC

APPENDICES

NOC

RESOLUTIONS

NOC

RECOMMENDATIONS

Reasons: In order to introduce an additional satellite system into the GMDSS, the frequency band to be used by this system must be entered into RR Appendix 15. Regarding the frequency band 1 613.8-1 626.5 MHz, the secondary MSS allocation in the space-to-Earth direction cannot be considered for GMDSS.

A satellite system, the downlink of which:

- 1) has a status of “non-interference, non-protection” vis-à-vis any primary service within the same band and in adjacent bands; and
- 2) has currently no reliable coordination criteria, apart from frequency overlap which is one among other interference criteria to accomplish coordination, should not be a candidate to provide safety-of-life aspects as required by the GMDSS.

Moreover according to paragraph 2.3 of the Rules of Procedure relating to application of RR No. 9.11A (*“While recognizing the difficulties of harmonizing the text of the footnotes to Article 5 introduced by WARC-92, WRC-95 and WRC-97 on the one hand and the text of the provision of No. 9.11A (including Nos. 9.12 to 9.16) and 9.17A, as appropriate with respect to the services to which this provision is applicable, on the other hand, the Board concluded that the procedure is applicable to all other space and terrestrial services with respect to those satellite services having allocations with equal rights and mentioned in the specific footnotes to which this provision applies. The frequency bands are those to which, in a footnote, reference is made to this provision in the Table of Frequency Allocations (see Tables 9.11A-1 and 9.11A-2 below). In these Tables, there is an indication of those other space services (in addition to the MSS and radiodetermination-satellite service as well as non-GSO MSS feeder links and non-GSO FSS included in the footnotes) to which this coordination procedure shall also apply”*).

The downlink of the non-GSO MSS system using the band 1 613.8-1 626.5 MHz was not required to coordinate with any space or terrestrial service of primary status. Consequently, should a primary status (on a provisional basis) be granted to this allocation, it is fundamental for the downlink assignments of non-GSO MSS system to carry out the required coordination with all space and terrestrial services submitted to the Bureau until a decision can be made to identify it for GMDSS. Finally the consequences of such action must be analysed.

In addition to the lack of reliable criteria for application of RR No. 9.11A, pursuant to RR No. 9.52C (*“For coordination requests under Nos. 9.11 to 9.14 and 9.21, an administration not responding under No. 9.52 within the same four-month period shall be regarded as unaffected and, in the cases of Nos. 9.11 to 9.14, the provisions of Nos. 9.48 and 9.49 shall apply.”*) unlike RR No. 9.7 the coordination procedure is of an implicit type, i.e., those administrations which failed to reply to request for coordination were considered as not affected even though in reality they were affected.

On account of any attempt to upgrade the status of this allocation from secondary to primary to fulfil this agenda item, the following studies are needed to be carried out:

- the amount of bandwidth required for GMDSS while the allocated MSS band is also used for routine non-safety purposes;
- the sharing and compatibility of the MSS system in the considered frequency band with incumbent services in the same and in adjacent bands;
- the potential impact of possible modifications to the provisions of the Radio Regulations on sharing and compatibility with other services and systems in the frequency band and adjacent frequency bands.

The issues listed above have not been studied or resolved. The inconsistency and potential constraint of RR Nos. **5.364** and **5.368** have not been studied. The harmful interference from the MSS space-to-Earth operations continues to exist in the radio astronomy frequency band 1 610.6-1 613.8 MHz and several administrations are having ongoing communications with the ITU-R RRB on this interference issue. The frequency band 1 613.8-1 626.5 MHz, or any part thereof, is therefore to be considered not suitable for use in GMDSS as long as these studies have not been carried out.

5/1.8/5.2.4 For Method B4

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

1 610-1 660 MHz

| Allocation to services | | |
|--|--|--|
| Region 1 | Region 2 | Region 3 |
| 1 613.8-1 626.5 1 621.35 MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION Mobile-satellite (space-to-Earth) 5.208B | 1 613.8-1 626.5 1 621.35 MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION RADIODETERMINATION- SATELLITE (Earth-to-space) Mobile-satellite (space-to-Earth) 5.208B | 1 613.8-1 626.5 1 621.35 MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION Mobile-satellite (space-to-Earth) 5.208B Radiodetermination-satellite (Earth-to-space) |
| 5.341 5.355 5.359 <u>MOD</u> 5.364 5.365 5.366 5.367 <u>MOD</u> 5.368 5.369 5.371 <u>MOD</u> 5.372 | 5.341 <u>MOD</u> 5.364 5.365 5.366 5.367 <u>MOD</u> 5.368 5.370 <u>MOD</u> 5.372 | 5.341 5.355 5.359 <u>MOD</u> 5.364 5.365 5.366 5.367 <u>MOD</u> 5.368 5.369 <u>MOD</u> 5.372 |

| | | |
|--|--|--|
| 1 613.81 621.35-1 626.5 MARITIME MOBILE- SATELLITE (space-to-Earth) ADD 5.GMDSS-B4 MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION Mobile-satellite (space-to-Earth) except maritime mobile-satellite (space-to-Earth) 5.208B 5.341 5.355 5.359 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.369 5.371 MOD 5.372 | 1 613.81 621.35-1 626.5 MARITIME MOBILE- SATELLITE (space-to-Earth) ADD 5.GMDSS-B4 MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION RADIODETERMINATION- SATELLITE (Earth-to-space) Mobile-satellite (space-to-Earth) except maritime mobile-satellite (space-to-Earth) 5.208B 5.341 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.370 MOD 5.372 | 1 613.81 621.35-1 626.5 MARITIME MOBILE- SATELLITE (space-to-Earth) ADD 5.GMDSS-B4 MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION Mobile-satellite (space-to-Earth) except maritime mobile-satellite (space-to-Earth) 5.208B Radiodetermination-satellite (Earth-to-space) 5.341 5.355 5.359 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.369 MOD 5.372 |
| 1 626.5-1 660 MOBILE-SATELLITE (Earth-to-space) 5.351A 5.341 5.351 5.353A 5.354 5.355 5.357A 5.359 5.362A 5.374 5.375 5.376 | | |

MOD

5.208B* In the frequency bands:

137-138 MHz,
387-390 MHz,
400.15-401 MHz,
1 452-1 492 MHz,
1 525-1 610 MHz,
~~1 613.8-1 626.5 MHz,~~
2 655-2 690 MHz,
21.4-22 GHz,

Resolution **739 (Rev.WRC-15)** applies. (WRC-~~15~~19)

ADD

5.GMDSS-B4 The use of the band 1 621.35-1 626.5 MHz by the maritime mobile-satellite to support GMDSS is subject application of No. **9.11A** and its associated Rules of Procedure requiring, *inter alia*, to coordinate with all space and terrestrial services in this band and the adjacent bands, having allocation with primary status. (WRC-19)

Reasons: The downlink of the non-GSO MSS system using the band 1 613.8-1 626.5 MHz or part thereof is currently on secondary basis. Consequently, according to the footnote to Annex 1 of Appendix **5** of the Radio Regulations, coordination was not required with any space or terrestrial service of primary status. However, should a primary status (on a provisional or permanent basis) be granted to this allocation, it is fundamental that the notifying administration of the non-GSO MSS system, if used as Maritime Mobile Satellite Service to support GDMSS would have to effect the required coordination with all space and terrestrial services submitted to the Bureau at the date of coming into force the new primary allocation to Maritime Mobile Satellite Service.

For the regulatory example of RR No. **5.364** under Method B4, 2 options are proposed:

Option 1:

MOD

5.364 The use of the band 1 610-1 626.5 MHz by the mobile-satellite service (Earth-to-space) and by the radiodetermination-satellite service (Earth-to-space) is subject to coordination under No. **9.11A**. A mobile earth station operating in either of the services in this band shall not produce a peak e.i.r.p. density in excess of -15 dB(W/4 kHz) in the part of the band used by systems operating in accordance with the provisions of No. **5.366** (to which No. **4.10** applies), unless otherwise agreed by the affected administrations. In the part of the band where such systems are not operating, the mean e.i.r.p. density of a mobile earth station shall not exceed -3 dB(W/4 kHz). Except when used for maritime distress and safety purposes in the band 1 621.35-1 626.5 MHz by satellite networks in the maritime mobile-satellite service (see Appendix 15), sStations of the mobile-satellite service shall not claim protection from stations in the aeronautical radionavigation service, stations operating in accordance with the provisions of No. **5.366** and stations in the fixed service operating in accordance with the provisions of No. **5.359**. Administrations responsible for the coordination of mobile-satellite networks shall make all practicable efforts to ensure protection of stations operating in accordance with the provisions of No. **5.366**. (WRC-19)

Option 2:

NOC

5.364

Reasons: Under section 5, Regulatory and procedural considerations, a point was raised regarding apparent inconsistency between RR No. **5.364** (adopted several years ago) and RR No. **5.367** (adopted at WRC-12).

To address this apparent inconsistency, proponent of Method B1 proposed certain modification to RR No. **5.364**.

It was emphasized that no such inconsistency was reported to the Director of the Radiocommunication Bureau. Moreover to address such an apparent inconsistency, there were two agenda item which could have been used to that effect, namely agenda items 3 and 7 of WRC-19, noting that such inconsistency was not raised under these agenda items, neither to WRC-15 nor to ITU-R Study Groups dealing with these agenda items.

It should be beared in mind that current agenda items of WRC-19, namely agenda items 3, 7 and 9.1 still could be used to report the matter to WRC-19.

It is further emphasized that the proposed modification to RR No. **5.364** would result in an implicit super primary to up-link of non-GSO MSS under consideration to support GMDSS if used as maritime mobile satellite service which adversely affect the primary station of AMRS which is a safety of life service at sea, land and air. Such implicit super primary status is also in contradiction to the objectives of No. **4.10** of the Radio Regulations accorded to all safety services including AMRS.

In view of the above, in order to avoid such negative consequence, it is proposed NOC for RR No. **5.364** as an option for Method B4.

For Method B4 (continued)**MOD**

5.368 With respect to the radiodetermination-satellite and mobile-satellite services the provisions of No. **4.10** do not apply in the band 1 610-1 626.5 MHz, with the exception of the aeronautical radionavigation-satellite service and of the maritime mobile-satellite service in the band 1 621.35-1 626.5 MHz when used for GMDSS. (WRC-19)

MOD

5.372 Harmful interference shall not be caused to stations of the radio astronomy service using the band 1 610.6-1 613.8 MHz by stations of the radiodetermination-satellite and mobile-satellite services (including land, aeronautical and maritime mobile-satellite services) (No. **29.13** applies). For the mentioned services non-GSO satellite systems operating in the band 1 613.8-1 626.5 MHz shall not exceed an epfd of $-258 \text{ dB(W/(m}^2 \cdot 20 \text{ kHz))}$ in the band 1 610.6-1 613.8 MHz unless the data loss resulting from exceeding this limit is less than 2%, and GSO satellite networks operating in the band 1 613.8-1 626.5 MHz shall not exceed a pfd of $-194 \text{ dB(W/(m}^2 \cdot 20 \text{ kHz))}$ in the band 1 610.6-1 613.8 MHz, at any radio astronomy station performing observations in this band. The verification of the compliance with the epfd threshold for non-GSO systems shall be done using Recommendation ITU-R M.1583-1 and the antenna pattern and the maximum antenna gain given in Recommendation ITU-R RA.1631-0. (WRC-19)

ARTICLE 33**Operational procedures for urgency and safety communications in the global maritime distress and safety system (GMDSS)****Section V – Transmission of maritime safety information²**

33.49 *E – Maritime safety information via satellite*

MOD

33.50 § 26 Maritime safety information may be transmitted via satellite in the maritime mobile-satellite service using the bands 1 530-1 545 MHz and 1 621.35-1 626.5 MHz (see Appendix **15**). (WRC-19)

MOD**Section VII – Use of other frequencies for safety** (Rev. WRC-07/19)

MOD

33.53 § 28 Radiocommunications for safety purposes concerning ship reporting communications, communications relating to the navigation, movements and needs of ships and weather observation messages may be conducted on any appropriate communications frequency, including those used for public correspondence. In terrestrial systems, the bands 415-535 kHz (see Article **52**), 1 606.5-4 000 kHz (see Article **52**), 4 000-27 500 kHz (see Appendix **17**), and 156-174 MHz (see Appendix **18**) are used for this function. In the maritime mobile-satellite service, frequencies in the bands 1 530-1 544 MHz, 1 621.35-1 626.5 MHz and 1 626.5-1 645.5 MHz are used for this function as well as for distress alerting purposes (see No. **32.2**). (WRC-0719)

MODAPPENDIX 15 (REV.WRC-~~15~~19)

**Frequencies for distress and safety communications for the Global
Maritime Distress and Safety System (GMDSS)**

(See Article **31**)

The frequencies for distress and safety communications for the GMDSS are given in Tables 15-1 and 15-2 for frequencies below and above 30 MHz, respectively.

MODTABLE 15-2 (*end*) (WRC-~~15~~19)

| Frequency (MHz) | Description of usage | Notes |
|-------------------------|-------------------------|---|
| ... | ... | ... |
| <u>1 621.35-1 626.5</u> | <u>SAT-COM</u> | <u>In addition to its availability for routine non-safety purposes, the band 1 621.35-1 626.5 MHz is used for distress and safety purposes in the Earth-to-space and space-to-Earth directions in the maritime mobile-satellite service. GMDSS distress, urgency and safety communications have priority in this band. (WRC-19)</u> |
| ... | ... | ... |

MOD

RESOLUTION 739 (REV.WRC-~~15~~19)

**Compatibility between the radio astronomy service and the active
space services in certain adjacent and nearby frequency bands**

The World Radiocommunication Conference (~~Geneva, 2015~~Sharm el-Sheikh, 2019),

...

ANNEX 1 TO RESOLUTION 739 (REV.WRC-~~15~~19)

...

TABLE 1-1
pfd thresholds for unwanted emissions from any geostationary space station
at a radio astronomy station

| Space service | Space service frequency band | Radio astronomy frequency band | Single dish, continuum observations | | Single dish, spectral line observations | | VLBI | | Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of: |
|---|---|-------------------------------------|-------------------------------------|---------------------|---|---------------------|-------------------------|---------------------|--|
| | | | pfd ⁽¹⁾ | Reference bandwidth | pfd ⁽¹⁾ | Reference bandwidth | pfd ⁽¹⁾ | Reference bandwidth | |
| | | | (dB(W/m ²)) | (MHz) | (dB(W/m ²)) | (kHz) | (dB(W/m ²)) | (kHz) | |
| MSS (space-to-Earth) | 387-390 | 322-328.6 | −189 | 6.6 | −204 | 10 | −177 | 10 | WRC-07 |
| BSS MSS (space-to-Earth) | 1 452-1 492 1 525-1 559 | 1 400-1 427 | −180 | 27 | −196 | 20 | −166 | 20 | WRC-03 |
| MSS (space-to-Earth) MSS (space-to-Earth) | 1 525-1 559 1 613.8-1 626.5 | 1 610.6-1 613.8 | NA | NA | −194 | 20 | −166 | 20 | WRC-03 |
| RNSS (space-to-Earth) | 1 559-1 610 | 1 610.6-1 613.8 | NA | NA | −194 | 20 | −166 | 20 | WRC-07 |
| BSS FSS (space-to-Earth) | 2 655-2 670 | 2 690-2 700 | −177 | 10 | NA | NA | −161 | 20 | WRC-03 |
| FSS (space-to-Earth) | 2 670-2 690 | 2 690-2 700 (in Regions 1 and 3) | −177 | 10 | NA | NA | −161 | 20 | WRC-03 |
| | (GHz) | (GHz) | — | — | — | — | — | — | |
| BSS | 21.4-22.0 | 22.21-22.5 | −146 | 290 | −162 | 250 | −128 | 250 | WRC-03 for VLBI, and WRC-07 for other types of observation |

NA: Not applicable, measurements of this type are not made in this frequency band.

⁽¹⁾ Integrated over the reference bandwidth with an integration time of 2 000 s.

TABLE 1-2

**epfd thresholds⁽¹⁾ for unwanted emissions from all space stations of a non-GSO satellite system
at a radio astronomy station**

| Space service | Space service frequency band | Radio astronomy frequency band | Single dish, continuum observations | | Single dish, spectral line observations | | VLBI | | Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of: |
|--------------------------------------|---------------------------------|---|--|------------------------|--|------------------------|-------------------------|------------------------|---|
| | | | epfd ⁽²⁾ | Reference bandwidth | epfd ⁽²⁾ | Reference bandwidth | epfd ⁽²⁾ | Reference bandwidth | |
| | | | (dB(W/m ²)) | (MHz) | (dB(W/m ²)) | (kHz) | (dB(W/m ²)) | (kHz) | |
| MSS (space-to-Earth) | 137-138 | 150.05-153 | −238 | 2.95 | NA | NA | NA | NA | WRC-07 |
| MSS (space-to-Earth) | 387-390 | 322-328.6 | −240 | 6.6 | −255 | 10 | −228 | 10 | WRC-07 |
| MSS (space-to-Earth) | 400.15-401 | 406.1-410 | −242 | 3.9 | NA | NA | NA | NA | WRC-07 |
| MSS (space-to-Earth) | 1 525-1 559 | 1 400-1 427 | −243 | 27 | −259 | 20 | −229 | 20 | WRC-07 |
| RNSS (space-to-Earth) ⁽³⁾ | 1 559-1 610 | 1 610.6-1 613.8 | NA | NA | −258 | 20 | −230 | 20 | WRC-07 |
| MSS (space-to-Earth) | 1 525-1 559 | 1 610.6-1 613.8 | NA | NA | −258 | 20 | −230 | 20 | WRC-07 |
| MSS (space-to-Earth) | 1 613.8-1 626.5 | 1 610.6-1 613.8 | NA | NA | −258 | 20 | −230 | 20 | WRC-03 |

NA: Not applicable, measurements of this type are not made in this frequency band.

⁽¹⁾ These epfd thresholds should not be exceeded for more than 2% of time.

⁽²⁾ Integrated over the reference bandwidth with an integration time of 2 000 s.

⁽³⁾ This Resolution does not apply to current and future assignments of the radionavigation-satellite system GLONASS/GLONASS-M in the frequency band 1 559-1 610 MHz, irrespective of the date of reception of the related coordination or notification information, as appropriate. The protection of the radio astronomy service in the frequency band 1 610.6-1 613.8 MHz is ensured and will continue to be in accordance with the bilateral agreement between the Russian Federation, the notifying administration of the GLONASS/GLONASS-M system, and IUCAF, and subsequent bilateral agreements with other administrations.

SUP

RESOLUTION 359 (REV.WRC-15)

**Consideration of regulatory provisions for updating and modernization of the
Global Maritime Distress and Safety System**

Agenda item 1.9.1

1.9 *to consider, based on the results of ITU-R studies:*

1.9.1 *regulatory actions within the frequency band 156-162.05 MHz for autonomous maritime radio devices to protect the GMDSS and automatic identifications system (AIS), in accordance with Resolution 362 (WRC-15);*

Resolution **362 (WRC-15)** – *Autonomous maritime radio devices operating in the frequency band 156-162.05 MHz*

5/1.9.1/1 Executive summary

The aim of this agenda item is to prevent unregulated operation of autonomous maritime radio devices (AMRD) in order to enhance safety of navigation and to ensure the integrity of the global maritime distress and safety system (GMDSS) which is the only system for distress, urgency, safety and routine communication for general shipping. Furthermore, the integrity of the collision avoidance system, automatic identification system (AIS), including the AIS VHF data link needs to be ensured.

The AMRD are grouped and identified as AMRD Group A that enhance the safety of navigation and AMRD Group B that do not enhance the safety of navigation. Four methods to satisfy this agenda item were developed. It is noted that according to Resolution ITU-R 2-7 Annex 2 Section 4 “methods of no change is always a possible method and normally should not be included amongst the methods”.

Method A considers amendments to the footnote *f*) in RR Appendix **18** to allow AMRD Group A to operate on certain channels.

Under Method B, there are three approaches to consider the harmonization of the spectrum use for AMRD Group B.

Method B1 proposes the use of channel 2006 as listed in RR Appendix **18** for AIS technology.

Method B2 proposes the use of channel 2006 in RR Appendix **18** for AIS technology and channels 2078, 2019 and 2079 in RR Appendix **18** for non-AIS technology.

Method B3 proposes the use of channel 2006 in RR Appendix **18** for AIS technology and channels 2078, 2019 and 2079 in RR Appendix **18**, for non-AIS technology, with an e.i.r.p. limitation inserted in the RR.

5/1.9.1/2 Background

Studies on this WRC-19 agenda item are based on the following definition of AMRD:

An AMRD is a *mobile station*; operating at sea and transmitting independently of a *ship station* or a *coast station*. Two groups of AMRD are identified:

- Group A: AMRD that enhance the safety of navigation;
- Group B: AMRD that do not enhance the safety of navigation (AMRD which deliver signals or information which do not concern the vessel can distract or mislead the navigator and degrade the safety of navigation).

Considering a) of Resolution **362 (WRC-15)** introduces the need to “enhance safety of navigation”. The relevant term is derived from the International Convention for the Safety of Life at Sea (SOLAS), as amended. Within SOLAS, Chapter V is titled “Safety of navigation” and contains all relevant regulations. Consequently, the criterion for distinguishing the two categories of AMRD is

the influence on the safety of navigation. Any signal or information originated by an AMRD, which reaches the navigator, may influence the safety of navigation. This includes AIS (symbols to be shown on radar and on the electronic chart display and information system (ECDIS), if equipped) and VHF (working channels, Ch. 16 and Ch. 70). In any case, the navigator has to decide how to proceed. In a positive case, the safety of navigation will be enhanced. However, in other cases, AMRD which deliver signals or information which do not concern the vessel can distract or mislead the navigator and degrade the safety of navigation.

WDPDN Report ITU-R M.[AMRD] explains how “safety of navigation” is relevant and necessary to evaluate the categories of AMRD.

Consequently, in distinguishing the two groups of AMRD, the following question has to be answered: is safety of navigation enhanced or rather degraded?

AMRD Group A devices that enhance the safety of navigation may be subject to IMO SOLAS regulations for the presentation of information to the navigators on board vessels. Other AMRD may be considered as Group B devices depending on certain characteristics and parameters. The Group A and Group B parameters are contained in Recommendation ITU-R M.[AMRD].

Sharing and compatibility studies between AMRD in the mobile service and other existing services, including land mobile service, would be required to ensure compatibility with incumbent services if AMRD were to use frequencies not listed in RR Appendix 18.

5/1.9.1/3 Summary and analysis of the results of ITU-R studies

5/1.9.1/3.1 Applications with autonomous maritime radio devices

To distinguish the two categories of AMRD, a two-step approach was used.

The first step was a compilation of the existing applications of AMRD which could be found on the market worldwide. To get a clear overview on these devices, to compile and to categorize the existing AMRD in the different countries, Circular Letter 5/LCCE/64 was sent to ITU Member States with a questionnaire to request information of such devices. Responses were received from 16 member administrations and one non-governmental organization member.

The responses are summarized in the WDPDN Report ITU-R M.[AMRD].

The information was consolidated to give a general description of the applications. Applications described in the responses to the questionnaire included diver emergency and Danbuoy/lifebuoy uses and these have been included in a man overboard (MOB) category as the function appears the same: A separate category for routine diver functions has been created.

The result shows that some devices are using AIS channels in the maritime mobile service frequency bands. Different transmitting power and intervals, message formats and unregulated maritime mobile service identities (MMSIs) are used by these AMRD.

Fishnet indicators have been divided into two categories; one to identify and locate a hazard; one for net recovery only.

General categories of “Tracking an object which is not a hazard to navigation” and possible future “Mobile aid to navigation (mobile AtoN) for an object which is a hazard to navigation” have been created. A racing mark and an oceanographic meteorological buoy could be in either category.

Emergency position-indicating radiobeacon (EPIRB) and AIS-search and rescue transmitter (SART) are components in the GMDSS and therefore not considered to be AMRD.

Two respondents indicated that future mobile AtoN might include virtual and physical types.

One respondent also reported devices operating on industrial, scientific and medical (ISM) frequencies.

The second step was listing the technical details of the various AMRD and its applications. Various technologies, such as AIS, digital selective calling, synthetic voice, or the combination of the technologies have been observed. In addition to channels 6/16/70, AIS 1, AIS 2 and other frequency bands outside the maritime mobile service, some AMRD are wrongly using 121.5 MHz and/or 406 MHz. Other AMRD use identities in the maritime mobile service such as MMSI.

The operation of AMRD is also various. Some AMRD are deployed at sea, others are carried by divers and used in the vessel and the vicinity. So, AMRD could be used at sea including the coastal areas, and AMRD may be brought into land or may be washed ashore by accident.

It could be concluded from the studies that the application of AMRD lacks harmonized technical standards and frequency bands. The operation of AMRD is also varied, and AMRD could be used in areas where they cause interferences to the land mobile service if AMRD and the land mobile service use the same frequency bands. The technical standards on AMRD are necessary in order to conduct sharing and compatibility studies, and these standards should cover the transmitting power and intervals, technologies used, message formats and so on. Meanwhile, it is necessary to find proper frequency bands for the application of AMRD, whether within or without the maritime mobile service frequency bands, without causing any interference to the existing services. It is also required to specify limitations for AMRD transmitter e.i.r.p. which ensure their compatibility with systems of other radio services operating in frequency bands affected by AMRD.

5/1.9.1/3.2 Existing relevant Recommendations and Reports are listed as follows:

Recommendations [ITU-R M.493-14](#), [ITU-R M.585-7](#), [ITU-R M.1371-5](#), WDPDN Report ITU-R M.[AMRD], WDPDN Report ITU-R M.[NEW_MARNUM] and WDPDN Recommendation ITU-R M.[AMRD].

5/1.9.1/3.3 Analyses on spectrum requirements

AMRD specified as Group A intended to be operated on frequencies of the current Radio Regulations (RR) Appendix 18. So, no additional spectrum requirement for this category of devices has been identified. However, this group will be restricted by the list of applications in new Recommendation ITU-R M.[AMRD].

For AMRD specified as Group B, the following spectrum requirements have been considered:

- Only one AIS channel is required to support AMRD applications. There is a low antenna height and the transmission power will be restricted to 1 W. A huge amount of AMRD in a certain area cannot be expected. It is unlikely to overload this 25 kHz channel;
- AMRD applications using other technologies require three 25 kHz channels. There is a low antenna height and the transmission power will be restricted to 1 W. If needed, channel sharing is necessary.

5/1.9.1/3.4 Appropriate frequency bands

Group A, AMRD that enhance the safety of navigation, are intended to use the frequencies of the current RR Appendix 18. These frequencies have been allocated for the operation of vessels.

Group B, AMRD that do not enhance the safety of navigation, but do operate in the maritime environment, should not be permitted to use the frequencies which cause any constraints on the existing mobile services. The signals or information originated by this group of AMRD do not concern the operation of vessels.

The part of the frequency range 156-162.05 MHz which is not channelized by RR Appendix **18** is already allocated to the fixed and mobile services, and these sub-bands are widely used by land mobile service in many countries worldwide. It should be noted that these sub-bands are used in some countries by public protection and disaster relief. Therefore these sub-bands are not suitable for AMRD.

Only the frequency bands 156.4875-156.5625 MHz and 156.7875-156.8125 MHz are allocated to maritime mobile service (MMS) exclusively for transmitting distress signals and calling. All other frequency bands are allocated to MMS on a co-primary basis. In this regard it is necessary to develop measures to ensure compatibility of suggested AMRD with systems of radio services operating in affected frequency bands. One of the measures could be the limitation of the AMRD transmitter e.i.r.p.

In RR Appendix **18**, the frequency 160.900 MHz (Ch. 2006) is already reserved for experimental use for future applications (see footnote *r*). This frequency is intended to be used solely by AIS-technology for AMRD Group B.

AMRD Group B using other technologies may be operated on the frequencies 161.525 MHz (Channel 2078), 161.550 MHz (Channel 2019) and 161.575 MHz (Channel 2079).

5/1.9.1/3.5 Analyses on device identification requirements

AMRD that are noted as Group A should use the numbering scheme given in Recommendation [ITU-R M.585-7](#) and the symbols given in Recommendation [ITU-R M.1371-5](#). Revisions of the recommendations might be necessary to display special AMRD on the ECDIS.

AMRD noted as Group B should use a new numbering system which is under development (WDPDN Report ITU-R M.[NEW_MARNUM]).

5/1.9.1/4 Methods to satisfy the agenda item

5/1.9.1/4.1 Autonomous maritime radio devices Group A

5/1.9.1/4.1.1 Method A

For the operation of AMRD Group A, it is proposed to amend footnote *f*) of RR Appendix **18** to allow AMRD Group A to operate on frequency channels 156.525 MHz (channel 70), 161.975 MHz (AIS 1) and 162.025 MHz (AIS 2).

5/1.9.1/4.2 Autonomous maritime radio devices Group B

In order to accommodate all varieties of AMRD Group B technologies, the following three methods are proposed:

5/1.9.1/4.2.1 Method B1

For operation of AMRD using AIS-technology, the frequency 160.900 MHz (Ch. 2006) (new AMRD AIS) is suggested to be used. This requires amendment to RR Appendix **18** footnote *r*) as appropriate. Such use should be in accordance with the latest version of Recommendation ITU-R M.[AMRD].

5/1.9.1/4.2.2 Method B2

AMRD group B using AIS technology should be operated on the frequency 160.900 MHz (Ch. 2006). In addition, AMRD Group B using other technologies than AIS technology may be operated on the frequencies 161.525 MHz (Channel 2078), 161.550 MHz (Channel 2019) and 161.575MHz (Channel 2079). This requires an amendment to RR Appendix **18** footnote *mm*) as

appropriate. Such use should be in accordance with the latest version of Recommendation ITU-R M.[AMRD].

5/1.9.1/4.2.3 Method B3

For operation of AMRD using AIS-technology, the frequency 160.900 MHz (Ch. 2006) (new AMRD AIS) is suggested to be used. This requires an amendment to RR Appendix **18** footnote *r*) as appropriate. Such use should be in accordance with the latest version of Recommendation ITU-R M.[AMRD] and AMRD e.i.r.p. shall be limited by [TBD] dBW.

AMRD Group B using other technologies than AIS technology may be operated on the frequencies 161.525 MHz (Channel 2078), 161.550 MHz (Channel 2019) and 161.575 MHz (Channel 2079). This requires an amendment to RR Appendix **18** footnote *mm*) as appropriate. Such use should be in accordance with the latest version of Recommendation ITU-R M.[AMRD] and AMRD e.i.r.p. should be limited by [TBD] dBW.

5/1.9.1/5 Regulatory and procedural considerations

5/1.9.1/5.1 For Method A

MOD

APPENDIX 18 (REV.WRC-~~15~~19)

Table of transmitting frequencies in the VHF maritime mobile band

(See Article 52)

...

Notes referring to the Table

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Specific notes

...

- f) The frequencies 156.300 MHz (channel 06), 156.525 MHz (channel 70), 156.800 MHz (channel 16), 161.975 MHz (AIS 1) and 162.025 MHz (AIS 2) may also be used by aircraft stations for the purpose of search and rescue operations and other safety-related communication. The frequencies 156.525 MHz (channel 70), 161.975 MHz (AIS 1) and 162.025 MHz (AIS 2) may also be used by autonomous maritime radio devices Group A for digital selective calling respectively AIS-technology. Such use should be in accordance with the most recent version of Recommendation ITU-R M.[AMRD]. (WRC-~~07~~19)

5/1.9.1/5.2 For Method B1**MOD**APPENDIX 18 (REV.WRC-~~15~~19)**Table of transmitting frequencies in the
VHF maritime mobile band**

(See Article 52)

...

Notes referring to the Table

...

Specific notes

...

- r) In the maritime mobile service, 160.900 MHz (channel 2006) ~~this frequency~~ is reserved for ~~experimental use for future applications or systems (e.g. new AIS applications, man over board systems, etc.)~~ usage of Group B autonomous maritime radio devices using AIS-technology as described in the most recent version of Recommendation ITU-R M.[AMRD]. This frequency also may be used for future AIS-technology applications or systems on an experimental basis. If authorized by administrations for AIS-technology based Group B autonomous maritime radio devices or experimental AIS-technology applications, their use, ~~the~~ operation shall not cause harmful interference to, or claim protection from, stations operating in the fixed and mobile services. (WRC-~~12~~19)

SUP

RESOLUTION 362 (WRC-15)

**Autonomous maritime radio devices operating in the frequency band
156-162.05 MHz****5/1.9.1/5.3 For Method B2****MOD**APPENDIX 18 (REV.WRC-~~15~~19)**Table of transmitting frequencies in the
VHF maritime mobile band**

(See Article 52)

...

Notes referring to the Table

...

Specific notes

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mm) Transmission on these channels is limited to coast stations. If permitted by administrations and specified by national regulations, these channels may be used by ship stations for transmission. All precautions should be taken to avoid harmful interference to channels AIS 1, AIS 2, 2027* and 2028*.

In addition, channels 2078, 2019 and 2079 may also be used for autonomous maritime radio devices Group B for non-AIS technologies as described in the most recent version of Recommendation ITU-R M.[AMRD], subject to coordination with affected administrations. (WRC-1519)

* From 1 January 2019, channel 2027 will be designated ASM 1 and channel 2028 will be designated ASM 2.

r) In the maritime mobile service, 160.900 MHz (channel 2006) this frequency is reserved for usage of Group B autonomous maritime radio devices using AIS-technology as described in the most recent version of Recommendation ITU-R M.[AMRD]. This frequency also may be used for future AIS-technology applications or systems on an experimental basis. If authorized by administrations for AIS-technology based Group B autonomous maritime radio devices or experimental AIS-technology applications, their use, the operation shall not cause harmful interference to, or claim protection from, stations operating in the fixed and mobile services. (WRC-1219)

5/1.9.1/5.4 For Method B3

MOD

APPENDIX 18 (REV.WRC-1519)

Table of transmitting frequencies in the VHF maritime mobile band

(See Article 52)

...

Notes referring to the Table

...

Specific notes

...

r) In the maritime mobile service, this frequency is reserved for usage of autonomous maritime radio devices Group B using AIS technology. ~~experimental use for future applications or systems (e.g. new AIS applications, man-over-board systems, etc.).~~ If authorized by administrations for experimental use, the operation shall not cause harmful interference to, or claim protection from, stations operating in the fixed and mobile services. Such use should be in accordance with the most recent version of Recommendation ITU-R M.[AMRD]. The e.i.r.p. of AMRD Group B shall be limited to [TBD] dBW. (WRC-1219)

MOD

APPENDIX 18 (REV.WRC-~~15~~19)**Table of transmitting frequencies in the
VHF maritime mobile band**

(See Article 52)

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Notes referring to the Table

...

Specific notes

...

mm) Transmission on these channels is limited to coast stations. If permitted by administrations and specified by national regulations, these channels may be used by ship stations for transmission. All precautions should be taken to avoid harmful interference to channels AIS 1, AIS 2, 2027* and 2028*.

In addition, channels 2078, 2019 and 2079 may also be used for autonomous maritime radio devices Group B for non-AIS technologies as described in the most recent version of Recommendation ITU-R M.[AMRD]. The e.i.r.p. of AMRD Group B shall be limited to [TBD] dBW. (WRC-~~15~~19)

* From 1 January 2019, channel 2027 will be designated ASM 1 and channel 2028 will be designated ASM 2.

Agenda item 1.9.2

1.9 to consider, based on the results of ITU-R studies:

1.9.2 modifications of the Radio Regulations, including new spectrum allocations to the maritime mobile-satellite service (Earth-to-space and space-to-Earth), preferably within the frequency bands 156.0125-157.4375 MHz and 160.6125-162.0375 MHz of Appendix 18, to enable a new VHF data exchange system (VDES) satellite component, while ensuring that this component will not degrade the current terrestrial VDES components, applications specific messages (ASM) and AIS operations and not impose any additional constraints on existing services in these and adjacent frequency bands as stated in recognizing d) and e) of Resolution 360 (Rev.WRC-15);

Resolution 360 (Rev.WRC-15) – *Consideration of regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication*

5/1.9.2/1 Executive summary

In accordance with Resolution **360 (Rev.WRC-15)**, the ITU-R has undertaken studies for possible new allocations to the maritime mobile-satellite service (MMSS) (Earth-to-space) and (space-to-Earth), preferably within the frequency bands 156.0125-157.4375 MHz and 160.6125-162.0375 MHz of RR Appendix **18**, to support the digital evolution of maritime radio communications.

The results of the sharing and compatibility studies are contained in Recommendation ITU-R M.2092-0 which was developed in the WRC-15 study cycle, and Report ITU-R M.2435-0, which has been developed in this study cycle.

Based on the results of these studies, six methods have been developed to satisfy WRC-19 agenda item 1.9.2. The main differences between the methods are the frequency plan and pfd-mask to be imposed on the MMSS (space-to-Earth) emissions, which are further described in Report ITU-R M.2435-0.

Method A

NOC to the Radio Regulations except suppression of Resolution **360 (Rev.WRC-15)**. As a result there will be no frequency allocations to the satellite component of VDES (VDE-SAT).

Method B

This method proposes new primary allocations to the maritime mobile-satellite service (MMSS) (Earth-to-space) and (space-to-Earth) using frequency plan alternative 2 as described in section 5/1.9.2/3.2.2. The coordination mechanism with respect to terrestrial services under RR No. **9.14** is introduced with two options for the pfd-mask, as detailed in section 5/1.9.2/5.2.

Method C

This method uses the same frequency plan as Method B but with new secondary allocations for the MMSS (Earth-to-space) and (space-to-Earth).

Due to the proposed secondary status of the allocation to the MMSS, there is no coordination required between the MMSS and terrestrial services and therefore there is no need to make any modifications to Appendix **5** of the RR.

Method D

This method is the same as Method C except with the addition of a pfd limit in RR Article 5 in order to protect the terrestrial services. This method includes two options, and the description of the pfd masks, as detailed in section 5/1.9.2/5.3.

Method E

This method proposes new secondary allocations for the MMSS (Earth-to-space) and (space-to-Earth) subject to agreement in accordance with No. 9.21 of the RR to be limited to the use of the VDES satellite component to ensure compatibility with existing services.

Method F

This method proposes new primary allocations to the MMSS (Earth-to-space) and (space-to-Earth) using frequency plan based on alternative 3 as described in section 5/1.9.2/3.2.3. Details on the pfd mask for coordination of MMSS (space-to-Earth) with respect to terrestrial services are provided in the section 5/1.9.2/5.5.

5/1.9.2/2 Background

The studies associated with WRC-15 agenda item 1.16 resulted in elaboration of a concept for the VDES which is reflected in Recommendation ITU-R M.2092-0. The system combines the current automatic identification system (AIS), applications specific messages (ASM) as well as VHF data exchange (VDE), which has a terrestrial component (VDE-TER) and a satellite component (VDE-SAT).

WRC-15 allocated frequencies for the terrestrial component of VDES, including ASM satellite uplink, but requested further compatibility and sharing studies between VDE-SAT and other services in the same and in the adjacent frequency bands.

5/1.9.2/3 Summary and analysis of the results of ITU-R studies

5/1.9.2/3.1 Discussion on compatibility with incumbent services

Compatibility studies between VDE-SAT and incumbent services have been performed. These studies are contained in Report ITU-R M.2435-0, together with a summary of why allocations for VDE-SAT is required, identification of the spectrum requirements and a technical description of VDE-SAT.

The compatibility between the downlink of VDE-SAT and mobile, as well as fixed, services has been evaluated by two study methodologies.

One methodology uses carrier-to-interference analysis to evaluate if the pfd-mask contained in Recommendation ITU-R M.2092-0 provides protection for incumbent services. The interference analysis for fixed services uses bit-error ratio performance as specified in Recommendation ITU-R F.758 and $C/(N+I)$ threshold for that bit-error ratio performance provided in Recommendation ITU-R F.1101. The interference analysis for mobile services uses signal-to-noise and distortion ratio (SINAD) threshold and bit-error ratio performance as specified in Recommendation ITU-R M.1808.

The other methodology uses interference-to-noise analysis based on a protection criteria of $I/N = -6$ dB, as specified in Recommendation ITU-R M.1808 and Recommendation ITU-R F.758.

The two study methodologies lead to four different pfd-masks, as they are based on different assumptions as mentioned above, that provide compatibility with incumbent fixed and mobile services.

One study on the compatibility between the VDE-SAT uplink and the land mobile service indicates that the VDE-SAT receiver can suffer interference caused by stations in the terrestrial services. Another study, which is supported by measurements, indicate compatibility between the VDE-SAT uplink and the land mobile service when using the most robust waveform.

5/1.9.2/3.2 Frequency plans

The following three frequency plans have been studied in Report ITU-R M.2435-0. Note that only frequency plan alternatives 2 and 3 are used in the methods.

5/1.9.2/3.2.1 Frequency plan alternative 1

Frequency plan alternative 1 allows for the utilization of the channels 24, 84, 25, 85, 26 and 86 of RR Appendix 18 in a shared manner between VDE-TER and VDE-SAT.

- The four channels 1024, 1084, 1025 and 1085 are shared between ship-to-shore and ship-to-satellite (VDE-SAT uplink) communications.
- The two channels 1026 and 1086 are identified for ship-to-satellite (VDE-SAT uplink) communications and are not used for VDE-TER.
- The four channels 2024, 2084, 2025 and 2085 are shared among shore-to-ship, ship-to-ship and satellite-to-ship (VDE-SAT downlink) communications.
- The two channels 2026 and 2086 are identified for satellite-to-ship (VDE-SAT downlink) communications and are not used for VDE-TER.

5/1.9.2/3.2.2 Frequency plan alternative 2

Frequency plan alternative 2 identifies channels 24, 84, 25 and 85 for VDE-TER, while channels 26 and 86 are identified for VDE-SAT uplink, and are not used for VDE-TER. VDE-SAT uplink is also possible in channels 24, 84, 25 and 85, but the VDE-SAT uplink on these channels should not impose constraints on VDE-TER. Frequencies are identified for VDE-SAT downlink within the frequency range 160.9625 MHz to 161.4875 MHz, which is not channelized in RR Appendix 18.

- The four channels 1024, 1084, 1025 and 1085 are identified for ship-to-shore communications, but ship-to-satellite (VDE-SAT uplink) may be possible without imposing constraints on ship-to-shore communications.
- The four channels 2024, 2084, 2025 and 2085 are identified for shore-to-ship and ship-to-ship communications, but ship-to-satellite (VDE-SAT uplink) may be possible without imposing constraints on shore-to-ship and ship-to-ship communications.
- The four channels 1026, 1086, 2026 and 2086 are identified for ship-to-satellite (VDE-SAT uplink) communications and are not used for VDE-TER.
- Frequencies are identified for satellite-to-ship (VDE-SAT downlink) communications within the frequency range 160.9625 MHz to 161.4875 MHz, which is not channelized in RR Appendix 18.

5/1.9.2/3.2.3 Frequency plan alternative 3

Frequency plan alternative 3 allows for the utilization of the channels 24, 84, 25 and 85 in a shared manner between VDE-TER and VDE-SAT, while channels 26 and 86 are identified for VDE-SAT and are not used for VDE-TER communications.

- The four channels 1024, 1084, 1025 and 1085 are shared between ship-to-shore, ship-to-ship, shore-to-ship and ship-to-satellite (VDE-SAT uplink) communications.
- The two channels 1026 and 1086 are identified for ship-to-satellite (VDE-SAT uplink) communications and are not used for VDE-TER.

- The four channels 2024, 2084, 2025 and 2085 are identified for satellite-to-ship (VDE-SAT downlink) communications, while shore-to-ship communications may be possible without imposing constraints on satellite-to-ship communications.
- The two channels 2026 and 2086 are identified for satellite-to-ship (VDE-SAT downlink) communications, and are not used for VDE-TER communications.

5/1.9.2/3.3 Existing relevant Recommendations and Reports are listed as follows:

Recommendations [ITU-R F.758](#), [ITU-R F.1101](#), [ITU-R M.1808](#), [ITU-R M.2092](#), Report [ITU-R M.2435](#).

5/1.9.2/4 Methods to satisfy the agenda item

5/1.9.2/4.1 Method A

Due to the sharing difficulties of the VDE-SAT uplink and downlink with the systems in the land mobile service, it is proposed to make no changes in the RR except suppression of Resolution **360 (Rev.WRC-15)**.

5/1.9.2/4.2 Method B

This method proposes changes to the RR in order to introduce VDE-SAT to support the digital evolution of maritime communications.

This method is based on frequency plan alternative 2 and proposes new primary allocations to the MMSS (Earth-to-space) in the frequency bands 157.1875-157.3375 MHz and 161.7875-161.9375 MHz. These two frequency bands correspond to channels 24, 84, 25, 85, 26 and 86 of RR Appendix **18**. The channels 26 and 86 are identified for ship-to-satellite (VDE-SAT uplink) communications. The channels 24, 84, 25 and 85 are identified for VDE-TER, but ship-to-satellite (VDE-SAT uplink) communications may be possible without imposing constraints on ship-to-shore communications.

The method also proposes a new primary allocation for the MMSS (space-to-Earth) in the frequency band 160.9625-161.4875 MHz, which is identified for satellite-to-ship (VDE-SAT downlink).

Coordination of MMSS (space-to-Earth) assignments in the frequency band 160.9625-161.4875 MHz with respect to terrestrial services is captured under RR No. **9.14** which is introduced by the new footnote RR No. **5.A192**. Two options for the pfd mask are proposed to be included in Appendix **5** of the RR:

Option 1: pfd mask provided in Recommendation ITU-R M.2092-0;

Option 2: pfd mask provided in Annex 2 of Report ITU-R M.2435-0.

The method proposes to modify RR Nos. **5.208A** and **5.208B** and Annex 1 to Resolution **739 (Rev.WRC-15)** in order to ensure the protection of the RAS in the frequency bands 150.05-153 MHz and 322-328.6 MHz.

5/1.9.2/4.3 Method C

This method is based on frequency plan alternative 2 and proposes new secondary allocations for the MMSS (Earth-to-space), for frequency band 157.1875-157.3375 MHz (channels 1024, 1084, 1025, 1085, 1026 and 1086) and frequency band 161.7875-161.9375 MHz (channels 2024, 2084, 2025, 2085 2026 and 2086). The channels 1026, 1086, 2026 and 2086 are identified for ship-to-satellite (VDE-SAT uplink) communications. The channels 1024, 1084, 1025 and 1085 are

identified for ship-to-shore communications, but ship-to-satellite (VDE-SAT uplink) communications are possible without imposing constraints on ship-to-shore communications.

The method proposes a new secondary allocation for the MMSS (space-to-Earth) in the frequency band 160.9625-161.4875 MHz, for improved VDE communication capacity and coverage.

The method proposes to modify RR Nos. **5.208A** and **5.208B** and Annex 1 to Resolution **739 (Rev.WRC-15)** in order to ensure the protection of the RAS in the frequency bands 150.05-153 MHz and 322-328.6 MHz.

Due to the proposed secondary status of the allocations to the MMSS for the VDE-SAT there is no coordination requirement between the MMSS and the terrestrial services and therefore there is no need to make any modification to Appendix **5** of the RR.

5/1.9.2/4.4 Method D

This method is based on frequency plan alternative 2 and proposes, in addition to regulatory changes in Method C, to introduce pfd limits for VDE-SAT downlink.

There are two options for a pfd-mask proposed. The pfd-mask of option 1 is defined in section 6.1.2.2.3.2 of Report ITU-R M.2435-0. The pfd mask of option 2 is defined in section 6.1.2.2.2 of Report ITU-R M.2435-0.

5/1.9.2/4.5 Method E

This method is based on frequency plan alternative 2 and proposes new secondary allocations for the MMSS (Earth-to-space) in the frequency bands 157.1875-157.3375 MHz (channels 1024, 1084, 1025, 1085, 1026 and 1086) and 161.7875-161.9375 MHz (channels 2024, 2084, 2025, 2085 2026 and 2086). The channels 1026, 1086, 2026 and 2086 are identified for ship-to-satellite (VDE-SAT uplink) communications. The channels 1024, 1084, 1025 and 1085 are identified for ship-to-shore communications, but ship-to-satellite (VDE-SAT uplink) communications are possible without imposing constraints on ship-to-shore communications.

The method proposes a new secondary allocation to the MMSS (space-to-Earth) in the frequency band 160.9625-161.4875 MHz, for improved VDE communication capacity and coverage.

To ensure compatibility with existing services, new allocations to the MMSS (space-to-Earth) and the MMSS (Earth-to-space) in the frequency range 156-162 MHz are proposed to be limited to the use of the VDES satellite component, subject to agreement obtained under No. **9.21** of the RR.

The method proposes to modify RR Nos. **5.208A** and **5.208B** and Annex 1 to Resolution **739 (Rev.WRC-15)** in order to ensure the protection of the RAS in the frequency bands 150.05-153 MHz and 322-328.6 MHz.

5/1.9.2/4.6 Method F

This method is based on frequency plan alternative 3 and proposes a new primary allocation for the MMSS (Earth-to-space) for the frequency band 157.1875-157.3375 MHz (channels 1024, 1084, 1025, 1085, 1026 and 1086 of RR Appendix **18**).

The method proposes a new primary allocation for the MMSS (space-to-Earth) for the frequency band 161.7875-161.9375 MHz (channels 2024, 2084, 2025, 2085, 2026 and 2086 of RR Appendix **18**), for improved VDE communication capacity and coverage.

To avoid complexity in sharing between VDE-SAT downlink and VDE-TER the method proposes to modify the frequency plan of VDE-TER as follows.

- RR Appendix **18** lower legs (channels 1024, 1084, 1025, 1085) are for ship-to-shore, shore-to-ship and ship-to-ship VDE.

- RR Appendix **18** upper legs (channels 2024, 2084, 2025, 2085) are for shore-to-ship and ship-to-ship VDE when satellite downlink is not available.

The method proposes to modify RR Nos. **5.208A** and **5.208B** and Annex 1 to Resolution **739 (Rev.WRC-15)** in order to ensure the protection of the RAS in the frequency bands 150.05-153 MHz and 322-328.6 MHz.

The method proposes to add provision RR No. **5.B192** in order to ensure the coordination of terrestrial services in the same frequency band. Coordination of VDE space stations of the MMSS (space-to-Earth) with respect to terrestrial services is described in modification of RR Appendix **5**, proposing a pfd mask.

5/1.9.2/5 Regulatory and procedural considerations

5/1.9.2/5.1 For Method A

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. **2.1**)

NOC

148-161.9375 MHz

| Allocation to services | | |
|---|--|-----------------|
| Region 1 | Region 2 | Region 3 |
| 156.8375-161.9375 FIXED MOBILE except aeronautical mobile 5.226 | 156.8375-161.9375 FIXED MOBILE 5.226 | |

SUP

RESOLUTION 360 (REV.WRC-15)

Consideration of regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication

Reasons: It is proposed to suppress Resolution **360 (Rev.WRC-15)** since it will become superfluous after the studies are completed.

5/1.9.2/5.2 For Method B

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. 2.1)

MOD

148-161.9375 MHz

| Allocation to services | | |
|---|--|----------|
| Region 1 | Region 2 | Region 3 |
| 156.8375-161.9375 <u>157.1875</u> FIXED MOBILE except aeronautical mobile 5.226 | 156.8375-161.9375 <u>157.1875</u> FIXED MOBILE 5.226 | |
| 156.8375 <u>157.1875-161.9375</u> <u>157.3375</u> FIXED MOBILE except aeronautical mobile <u>MARITIME MOBILE-SATELLITE (Earth-to-space)</u> <u>MOD 5.228AA</u> 5.226 | 156.8375 <u>157.1875-161.9375</u> <u>157.3375</u> FIXED MOBILE <u>MARITIME MOBILE-SATELLITE (Earth-to-space)</u> <u>MOD 5.228AA</u> 5.226 | |
| 156.8375 <u>157.3375-161.9375</u> <u>160.9625</u> FIXED MOBILE except aeronautical mobile 5.226 | 156.8375 <u>157.3375-161.9375</u> <u>160.9625</u> FIXED MOBILE 5.226 | |
| 156.8375 <u>160.9625-161.9375</u> <u>161.4875</u> FIXED MOBILE except aeronautical mobile <u>MARITIME MOBILE-SATELLITE (space-to-Earth)</u> <u>MOD 5.208A MOD 5.208B</u> <u>ADD 5.A192</u> 5.226 | 156.8375 <u>160.9625-161.9375</u> <u>161.4875</u> FIXED MOBILE <u>MARITIME MOBILE-SATELLITE (space-to-Earth)</u> <u>MOD 5.208A MOD 5.208B</u> <u>ADD 5.A192</u> 5.226 | |
| 156.8375 <u>161.4875-161.9375</u> <u>161.7875</u> FIXED MOBILE except aeronautical mobile 5.226 | 156.8375 <u>161.4875-161.9375</u> <u>161.7875</u> FIXED MOBILE 5.226 | |

| | |
|--|--|
| 156.8375 161.7875-161.9375 FIXED MOBILE except aeronautical mobile <u>MARITIME MOBILE-</u> <u>SATELLITE (Earth-to-space)</u> <u>MOD 5.228AA</u> 5.226 | 156.8375 161.7875-161.9375 FIXED MOBILE <u>MARITIME MOBILE-</u> <u>SATELLITE (Earth-to-space)</u> <u>MOD 5.228AA</u> 5.226 |
|--|--|

MOD

5.228AA The use of the frequency bands 157.1875-157.3375 MHz, 161.7875-161.9375 MHz, 161.9375-161.9625 MHz and 161.9875-162.0125 MHz by the maritime mobile-satellite (Earth-to-space) service is limited to the systems which operate in accordance with Appendix **18**. (WRC-~~15~~19)

ADD

5.A192 The use of the frequency band 160.9625-161.4875 MHz by the maritime mobile-satellite (space-to-Earth) service is limited to non-GSO satellite systems operating in accordance with the most recent version of Recommendation ITU-R M.2092. Such use is subject to the application of the provisions of No. **9.14**. (WRC-19)

MOD

5.208A In making assignments to space stations in the mobile-satellite service in the bands 137-138 MHz, 387-390 MHz, ~~and 400.15-401 MHz~~ and in the maritime-mobile satellite service (space-to-Earth) in the band 160.9625-161.4875 MHz, administrations shall take all practicable steps to protect the radio astronomy service in the bands 150.05-153 MHz, 322-328.6 MHz, 406.1-410 MHz and 608-614 MHz from harmful interference from unwanted emissions. ~~The threshold levels of interference detrimental to the radio astronomy service are~~ as shown in the relevant ITU-R Recommendation. (WRC-~~07~~19)

MOD

5.208B* In the frequency bands:
137-138 MHz,
160.9625-161.4875 MHz,
387-390 MHz,
400.15-401 MHz,
1 452-1 492 MHz,
1 525-1 610 MHz,
1 613.8-1 626.5 MHz,
2 655-2 690 MHz,
21.4-22 GHz,

* This provision was previously numbered as No. **5.347A**. It was renumbered to preserve the sequential order.

Resolution 739 (Rev.WRC-~~15~~19) applies. (WRC-~~15~~19)

MOD

APPENDIX 18 (REV.WRC-~~15~~19)

Table of transmitting frequencies in the VHF maritime mobile band

(See Article 52)

...

| Channel designator | Notes | Transmitting frequencies (MHz) | | Inter-ship | Port operations and ship movement | | Public correspondence |
|--------------------|------------------------------|--------------------------------|---------------------|---------------------|-----------------------------------|---------------|-----------------------|
| | | From ship stations | From coast stations | | Single frequency | Two frequency | |
| .../... | .../... | .../... | .../... | .../... | .../... | .../... | .../... |
| 24 | w), ww), x), xx) | 157.200 | 161.800 | | x | x | x |
| 1024 | w), ww), x), xx), <u>AAA</u> | 157.200 | | | | | |
| 2024 | w), ww), x), xx), <u>AAA</u> | 161.800 | 161.800 | x (digital only) | | | |
| 84 | w), ww), x), xx) | 157.225 | 161.825 | | x | x | x |
| 1084 | w), ww), x), xx), <u>AAA</u> | 157.225 | | | | | |
| 2084 | w), ww), x), xx), <u>AAA</u> | 161.825 | 161.825 | x (digital only) | | | |
| 25 | w), ww), x), xx) | 157.250 | 161.850 | | x | x | x |
| 1025 | w), ww), x), xx), <u>AAA</u> | 157.250 | | | | | |
| 2025 | w), ww), x), xx), <u>AAA</u> | 161.850 | 161.850 | x (digital only) | | | |
| 85 | w), ww), x), xx) | 157.275 | 161.875 | | x | x | x |
| 1085 | w), ww), x), xx), <u>AAA</u> | 157.275 | | | | | |
| 2085 | w), ww), x), xx), <u>AAA</u> | 161.875 | 161.875 | x (digital only) | | | |
| 26 | w), ww), x) | 157.300 | 161.900 | | x | x | x |
| 1026 | w), ww), x), <u>AAA</u> | 157.300 | | | | | |
| 2026 | w), ww), x), <u>AAA</u> | | 161.900 | | | | |
| 86 | w), ww), x) | 157.325 | 161.925 | | x | x | x |
| 1086 | w), ww), x), <u>AAA</u> | 157.325 | | | | | |

| Channel designator | Notes | Transmitting frequencies (MHz) | | Inter-ship | Port operations and ship movement | | Public correspondence |
|--------------------|------------------------------|--------------------------------|---------------------|------------|-----------------------------------|---------------|-----------------------|
| | | From ship stations | From coast stations | | Single frequency | Two frequency | |
| 2086 | w), ww), x), AAA) | | 161.925 | | | | |
| 27 | z), zx) | 157.350 | 161.950 | | | x | x |
| 1027 | z) , zz) | 157.350 | 157.350 | | x | | |
| 2027* | z) | 161.950 | 161.950 | | | | |
| 87 | z) , zz) | 157.375 | 157.375 | | x | | |
| 28 | z), zx) | 157.400 | 162.000 | | | x | x |
| 1028 | z) , zz) | 157.400 | 157.400 | | x | | |
| 2028* | z) | 162.000 | 162.000 | | | | |
| 88 | z) , zz) | 157.425 | 157.425 | | x | | |
| AIS 1 | f), l), p) | 161.975 | 161.975 | | | | |
| AIS 2 | f), l), p) | 162.025 | 162.025 | | | | |

* From 1 January 2019, channel 2027 will be designated ASM 1 and channel 2028 will be designated ASM 2.

Notes referring to the Table

...

Specific notes

...

w) In Regions 1 and 3:

~~Until 1 January 2017, the frequency bands 157.200–157.325 MHz and 161.800–161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) may be used for digitally modulated emissions, subject to coordination with affected administrations. Stations using these channels or frequency bands for digitally modulated emissions shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article 5.~~

~~From 1 January 2017, the~~The frequency bands ~~157.1875–157.3375~~157.200–157.325 MHz and ~~161.7875–161.9375~~161.800–161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are identified for the utilization of the VHF Data Exchange System (VDES) described in the most recent version of Recommendation ITU-R M.2092. These frequency bands may also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not causing harmful interference to, or claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-15~~19~~)

wa) In Regions 1 and 3:

~~Until 1 January 2017, the frequency bands 157.025–157.175 MHz and 161.625–161.775 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23 and 83) may be used for digitally modulated emissions, subject to coordination with affected administrations. Stations using these channels or frequency bands for digitally modulated emissions shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article 5.~~

~~From 1 January 2017, the~~The frequency bands ~~157.0125–157.1125~~157.025–157.100 MHz and ~~161.6125–161.7125~~161.625–161.700 MHz (corresponding to channels: 80, 21, 81 and 22) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using multiple 25 kHz contiguous channels.

~~From 1 January 2017, the~~The frequency bands ~~157.1375–157.1875~~157.150–157.175 MHz and ~~161.7375–161.7875~~161.750–161.775 MHz (corresponding to channels: 23 and 83) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using two 25 kHz contiguous channels. ~~From 1 January 2017, the~~The frequencies 157.125 MHz and 161.725 MHz (corresponding to channel: 82) are identified for the utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842.

The frequency bands ~~157.0125-157.1875 MHz and 161.6125-161.7875~~~~157.025-157.175 MHz and 161.625-161.775 MHz~~ (corresponding to channels: 80, 21, 81, 22, 82, 23 and 83) can also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-~~15~~19)

- ww) In Region 2, the frequency bands ~~157.1875-157.3375~~~~157.200-157.325~~ and ~~161.7875-161.9375~~~~161.800-161.925~~ MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions in accordance with the most recent version of Recommendation ITU-R M.1842.

In Canada and Barbados, ~~from 1 January 2019~~ the frequency bands ~~157.1875-157.2875~~~~157.200-157.275~~ and ~~161.7875-161.8875~~~~161.800-161.875~~ MHz (corresponding to channels: 24, 84, 25 and 85) may be used for digitally modulated emissions, such as those described in the most recent version of Recommendation ITU-R M.2092, subject to coordination with affected administrations. (WRC-~~15~~19)

- x) ~~From 1 January 2017, in~~ In Angola, Botswana, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Democratic Republic of the Congo, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, the frequency bands ~~157.1125-157.3375~~~~157.125-157.325~~ and ~~161.7125-161.9375~~~~161.725-161.925~~ MHz (corresponding to channels: 82, 23, 83, 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions.

~~From 1 January 2017, in~~ In China, the frequency bands ~~157.1375-157.3375~~~~157.150-157.325~~ and ~~161.7375-161.9375~~~~161.750-161.925~~ MHz (corresponding to channels: 23, 83, 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions. (WRC-~~12~~19)

- xx) ~~From 1 January 2019, the~~ The channels 24, 84, 25 and 85 may be merged in order to form a unique duplex channel~~s~~ with a bandwidth of 100 kHz in order to operate the VDES terrestrial component described in the most recent version of Recommendation ITU-R M.2092. (WRC-~~15~~19)

...

- z) ~~Until 1 January 2019, these channels may be used for possible testing of future AIS applications without causing harmful interference to, or claiming protection from, existing applications and stations operating in the fixed and mobile services.~~

~~From 1 January 2019, these~~ The channels 27 and 28 are each split into two simplex channels. The channels ~~2027 and 2028 designated as~~ ASM 1 and ASM 2 are used for application specific messages (ASM) as described in the most recent version of Recommendation ITU-R M.2092. (WRC-~~15~~19)

...

- zz) ~~From 1 January 2019, The~~ channels 1027, 1028, 87 and 88 are used as single-frequency analogue channels for port operation and ship movement. (WRC-~~15~~19)

AAA) These channels may be used for the maritime mobile-satellite service (Earth-to-space) by the VDES satellite component (VDE-SAT) as described in the most recent version of Recommendation ITU-R M.2092 in the following way:

- The channels 1024, 1084, 1025 and 1085 are identified for ship-to-shore communications, but ship-to-satellite (VDE-SAT uplink) communications may be possible without imposing constraints on ship-to-shore communications.
- The channels 2024, 2084, 2025 and 2085 are identified for shore-to-ship and ship-to-ship communications, but ship-to-satellite (VDE-SAT uplink) communications may be possible without imposing constraints on shore-to-ship and ship-to-ship communications.
- The channels 1026, 1086, 2026 and 2086 are identified for ship-to-satellite (VDE-SAT uplink) communications and are not used by the terrestrial component of VDES. (WRC-19)

Reasons: Notes a) to l), n) to v) and y): No change as the notes are not relevant to this agenda item.

Notes w), wa), ww), x), xx), z) and zz): Changes are to update the Radio Regulations and correction on the frequency bands.

Notes zx): No changes proposed.

Note AAA): Introduces the satellite component of VDES (VDE-SAT) into Appendix **18** on both lower leg and upper leg of channels 24, 84, 25, 85, 26 and 86 for ship-to-satellite (VDE-SAT uplink) according to the most recent version of the Recommendation ITU-R M.2092.

MOD

RESOLUTION 739 (REV.WRC-~~15~~19)

Compatibility between the radio astronomy service and the active space services in certain adjacent and nearby frequency bands

The World Radiocommunication Conference (~~Geneva, 2007~~[Sharm el-Sheikh, 2019](#)),

...

ANNEX 1 TO RESOLUTION 739 (REV.WRC-~~15~~19)

Unwanted emission threshold levels

TABLE 1-2

epfd thresholds⁽¹⁾ for unwanted emissions from all space stations of a non-GSO satellite system at a radio astronomy station

| Space service | Space service band | Radio astronomy band | Single dish, continuum observations | | Single dish, spectral line observations | | VLBI | | Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of: |
|---------------------------------------|-----------------------------------|----------------------------|-------------------------------------|----------------------|---|---------------------|-------------------------|---------------------|--|
| | | | epfd ⁽²⁾ | Reference bandwidth | epfd ⁽²⁾ | Reference bandwidth | epfd ⁽²⁾ | Reference bandwidth | |
| | (MHz) | (MHz) | (dB(W/m ²)) | (MHz) | (dB(W/m ²)) | (kHz) | (dB(W/m ²)) | (kHz) | |
| MSS (space-to-Earth) | 137-138 | 150.05-153 | -238 | 2.95 | NA | NA | NA | NA | WRC-07 |
| MMSS (space-to-Earth) | 160.9625-161.4875 | 150.05-153 | -238 | 2.95 | NA | NA | NA | NA | WRC-19 |
| MMSS (space-to-Earth) | 160.9625-161.4875 | 322-328.6 | -240 | 6.6 | -255 | 10 | -228 | 10 | WRC-19 |
| MSS (space-to-Earth) | 387-390 | 322-328.6 | -240 | 6.6 | -255 | 10 | -228 | 10 | WRC-07 |
| MSS (space-to-Earth) | 400.15-401 | 406.1-410 | -242 | 3.9 | NA | NA | NA | NA | WRC-07 |
| MSS (space-to-Earth) | 1 525-1 559 | 1 400-1 427 | -243 | 27 | -259 | 20 | -229 | 20 | WRC-07 |
| RNSS (space-to-Earth) ⁽³⁾ | 1 559-1 610 | 1 610.6-1 613.8 | NA | NA | -258 | 20 | -230 | 20 | WRC-07 |
| MSS (space-to-Earth) | 1 525-1 559 | 1 610.6-1 613.8 | NA | NA | -258 | 20 | -230 | 20 | WRC-07 |
| MSS (space-to-Earth) | 1 613.8-1 626.5 | 1 610.6-1 613.8 | NA | NA | -258 | 20 | -230 | 20 | WRC-03 |

SUP

RESOLUTION 360 (REV.WRC-15)

Consideration of regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication

Reasons: Resolution **360 (WRC-15)** is proposed to be suppressed as it will not be needed when the regulatory provisions and spectrum allocations to the maritime mobile-satellite service required to enable the VDES satellite component (VDE-SAT) have been approved by WRC-19.

5/1.9.2/5.2.1 For Option 1

MOD

APPENDIX 5 (REV.WRC-~~15~~19)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

TABLE 5-1 (continued) (Rev.WRC-1519)

| Reference of Article 9 | Case | Frequency bands (and Region) of the service for which coordination is sought | Threshold/condition | Calculation method | Remarks |
|---|--|---|---|--|---------|
| No. 9.14 Non-GSO/ terrestrial, GSO/ terrestrial | A space station in a satellite network in the frequency bands for which a footnote refers to No. 9.11A or to No. 9.14, in respect of stations of terrestrial services where threshold(s) is (are) exceeded | 1) Frequency bands for which a footnote refers to No. 9.11A; or 2) 11.7-12.2 GHz (Region 2 GSO FSS) 3) 5 030-5 091 MHz 4) <u>160.9625-161.4875 MHz (non-GSO maritime mobile-satellite service)</u> | 1) See § 1 of Annex 1 to this Appendix; In the bands specified in No. 5.414A, the detailed conditions for the application of No. 9.14 are provided in No. 5.414A for MSS networks or 2) In the band 11.7-12.2 GHz (Region 2 GSO FSS): $-124 \text{ dB(W/(m}^2 \cdot \text{MHz)) for } 0^\circ \leq \theta \leq 5^\circ$ $-124 + 0.5 (\theta - 5) \text{ dB(W/(m}^2 \cdot \text{MHz)) for } 5^\circ < \theta \leq 25^\circ$ $-114 \text{ dB(W/(m}^2 \cdot \text{MHz)) for } \theta > 25^\circ$ where θ is the angle of arrival of the incident wave above the horizontal plane (degrees) 3) Bandwidth overlap 4) <u>In the band 160.9625-161.4875 MHz (non-GSO maritime mobile-satellite service):</u> $-149 + 0.16 \cdot \theta^\circ \text{ dB(W/(m}^2 \cdot 4 \text{ kHz)) for } 0^\circ \leq \theta < 45^\circ$ $-142 + 0.53 \cdot (\theta^\circ - 45^\circ) \text{ dB(W/(m}^2 \cdot 4 \text{ kHz)) for } 45^\circ \leq \theta < 60^\circ$ $-134 + 0.1 \cdot (\theta^\circ - 60^\circ) \text{ dB(W/(m}^2 \cdot 4 \text{ kHz)) for } 60^\circ \leq \theta \leq 90^\circ$ <u>where θ is the angle of arrival of the incident wave above the horizontal plane (degrees)</u> | 1) See § 1 of Annex 1 to this Appendix | |

Reasons: The above modification defines a coordination threshold in Table 5-1 for references of RR No. **9.14** for the VDE-SAT downlink to ensure compatibility with terrestrial services. The coordination threshold mask is defined in Recommendation ITU-R M.2092-0 and in line with studies provided in Report ITU-R M.2435.

5/1.9.2/5.2.2 For Option 2

MOD

APPENDIX 5 (REV.WRC-~~15~~19)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

TABLE 5-1 (continued) (Rev.WRC-1519)

| Reference of Article 9 | Case | Frequency bands (and Region) of the service for which coordination is sought | Threshold/condition | Calculation method | Remarks |
|---|--|---|---|--|---------|
| No. 9.14 Non-GSO/ terrestrial, GSO/ terrestrial | A space station in a satellite network in the frequency bands for which a footnote refers to No. 9.11A or to No. 9.14, in respect of stations of terrestrial services where threshold(s) is (are) exceeded | 1) Frequency bands for which a footnote refers to No. 9.11A; or 2) 11.7-12.2 GHz (Region 2 GSO FSS) 3) 5 030-5 091 MHz 4) <u>160.9625-161.4875 MHz (non-GSO maritime mobile-satellite service)</u> | 1) See § 1 of Annex 1 to this Appendix; In the bands specified in No. 5.414A, the detailed conditions for the application of No. 9.14 are provided in No. 5.414A for MSS networks or 2) In the band 11.7-12.2 GHz (Region 2 GSO FSS): $-124 \text{ dB(W/(m}^2 \cdot \text{MHz)) for } 0^\circ \leq \theta \leq 5^\circ$ $-124 + 0.5 (\theta - 5) \text{ dB(W/(m}^2 \cdot \text{MHz)) for } 5^\circ < \theta \leq 25^\circ$ $-114 \text{ dB(W/(m}^2 \cdot \text{MHz)) for } \theta > 25^\circ$ where θ is the angle of arrival of the incident wave above the horizontal plane (degrees) 3) Bandwidth overlap 4) <u>In the band 160.9625-161.4875 MHz (non-GSO maritime mobile-satellite service):</u> $-141.72 - 8.15 + 12 \cdot (\theta/16.47)^2 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz)) for } 0^\circ \leq \theta < 8.5^\circ$ $-149 + 0.16 \cdot \theta^\circ \text{ dB(W/(m}^2 \cdot 4 \text{ kHz)) for } 8.5^\circ \leq \theta < 45^\circ$ $-142 + 0.53 \cdot (\theta^\circ - 45^\circ) \text{ dB(W/(m}^2 \cdot 4 \text{ kHz)) for } 45^\circ \leq \theta < 58.5^\circ$ $-141.72 + 6.85 - 10 \log_{10}((\theta^\circ/16.47)^{-1.5} + 0.7) \text{ dB(W/(m}^2 \cdot 4 \text{ kHz)) for } 58.5^\circ \leq \theta < 90^\circ$ <u>where θ is the angle of arrival of the incident wave above the horizontal plane (degrees)</u> | 1) See § 1 of Annex 1 to this Appendix | |

Reasons: The above modification defines a coordination threshold in Table 5-1 for references of RR No. 9.14 for the VDE-SAT downlink to ensure compatibility with terrestrial services. The coordination threshold mask is defined in Annex 2 of Report ITU-R M.2435-0.

5/1.9.2/5.3 For Methods C and D

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. 2.1)

MOD

148-161.9375 MHz

| Allocation to services | | |
|--|--|----------|
| Region 1 | Region 2 | Region 3 |
| 156.8375-161.9375 <u>157.1875</u> FIXED MOBILE except aeronautical mobile 5.226 | 156.8375-161.9375 <u>157.1875</u> FIXED MOBILE 5.226 | |
| 156.8375 <u>157.1875-</u> 161.9375 <u>157.3375</u> FIXED MOBILE except aeronautical mobile <u>Maritime mobile-satellite (Earth-to-space) ADD 5.A192</u> 5.226 | 156.8375 <u>157.1875-161.9375</u> <u>157.3375</u> FIXED MOBILE <u>Maritime mobile-satellite (Earth-to-space) ADD 5.A192</u> 5.226 | |
| 156.8375 <u>157.3375-</u> 161.9375 <u>160.9625</u> FIXED MOBILE except aeronautical mobile 5.226 | 156.8375 <u>157.3375-161.9375</u> <u>160.9625</u> FIXED MOBILE 5.226 | |
| 156.8375 <u>160.9625-</u> 161.9375 <u>161.4875</u> FIXED MOBILE except aeronautical mobile <u>Maritime mobile-satellite (space-to-Earth) MOD 5.208A MOD 5.208B ADD 5.B192</u> 5.226 | 156.8375 <u>160.9625-161.9375</u> <u>161.4875</u> FIXED MOBILE <u>Maritime mobile-satellite (space-to-Earth) MOD 5.208A MOD 5.208B ADD 5.B192</u> 5.226 | |
| 156.8375 <u>161.4875-</u> 161.9375 <u>161.7875</u> FIXED MOBILE except aeronautical mobile 5.226 | 156.8375 <u>161.4875-161.9375</u> <u>161.7875</u> FIXED MOBILE 5.226 | |

| | |
|---|---|
| 156.8375 <u>161.7875</u> -161.9375 FIXED MOBILE except aeronautical mobile <u>Maritime mobile-satellite (Earth-to-space) ADD 5.A192</u> 5.226 | 156.8375 <u>161.7875</u> -161.9375 FIXED MOBILE <u>Maritime mobile-satellite (Earth-to-space) ADD 5.A192</u> 5.226 |
|---|---|

ADD

5.A192 The use of the frequency bands 157.1875-157.3375 MHz and 161.7875-161.9375 MHz by the maritime mobile-satellite (Earth-to-space) service is limited to non-GSO satellite systems which operate in accordance with Appendix 18. (WRC-19)

Reasons: The above modification of RR Article 5 specify that the MMSS allocation (Earth-to-space) for the VDES satellite component as described in the Report ITU-R M.2435 should operate in accordance with RR Appendix 18.

MOD

5.208A In making assignments to space stations in the mobile-satellite service in the bands 137-138 MHz, 387-390 MHz ~~and~~, 400.15-401 MHz and in the maritime mobile-satellite service (space-to-Earth) in the band 160.9625-161.4875 MHz, administrations shall take all practicable steps to protect the radio astronomy service in the bands 150.05-153 MHz, 322-328.6 MHz, 406.1-410 MHz and 608-614 MHz from harmful interference from unwanted emissions. ~~The threshold levels of interference detrimental to the radio astronomy service are~~ as shown in the relevant ITU-R Recommendation. (WRC-~~07~~19)

Reasons: The above modification is proposed to ensure the protection of the radio astronomy service (RAS).

MOD

5.208B* In the frequency bands:
 137-138 MHz,
160.9625-161.4875 MHz,
 387-390 MHz,
 400.15-401 MHz,
 1 452-1 492 MHz,
 1 525-1 610 MHz,
 1 613.8-1 626.5 MHz,
 2 655-2 690 MHz,
 21.4-22 GHz,

Resolution 739 (Rev.WRC-~~15~~19) applies. (WRC-~~15~~19)

Reasons: The above modification is proposed to ensure the protection of the radio astronomy service (RAS).

* This provision was previously numbered as No. 5.347A. It was renumbered to preserve the sequential order.

MOD

APPENDIX 18 (REV.WRC-~~15~~19)Table of transmitting frequencies in the
VHF maritime mobile band

(See Article 52)

...

| Channel designator | Notes | Transmitting frequencies (MHz) | | Inter-ship | Port operations and ship movement | | Public correspondence |
|--------------------|----------------------------------|--------------------------------|---------------------|---------------------|-----------------------------------|---------------|-----------------------|
| | | From ship stations | From coast stations | | Single frequency | Two frequency | |
| <u>...</u> | <u>...</u> | <u>...</u> | <u>...</u> | <u>...</u> | <u>...</u> | <u>...</u> | <u>...</u> |
| 24 | w), ww), x), xx) | 157.200 | 161.800 | | x | x | x |
| 1024 | w), ww), x), xx), <u>AAA)</u> | 157.200 | | | | | |
| 2024 | w), ww), x), xx), <u>AAA)</u> | 161.800 | 161.800 | x (digital only) | | | |
| 84 | w), ww), x), xx) | 157.225 | 161.825 | | x | x | x |
| 1084 | w), ww), x), xx), <u>AAA)</u> | 157.225 | | | | | |
| 2084 | w), ww), x), xx), <u>AAA)</u> | 161.825 | 161.825 | x (digital only) | | | |
| 25 | w), ww), x), xx) | 157.250 | 161.850 | | x | x | x |
| 1025 | w), ww), x), xx), <u>AAA)</u> | 157.250 | | | | | |
| 2025 | w), ww), x), xx), <u>AAA)</u> | 161.850 | 161.850 | x (digital only) | | | |
| 85 | w), ww), x), xx) | 157.275 | 161.875 | | x | x | x |
| 1085 | w), ww), x), xx), <u>AAA)</u> | 157.275 | | | | | |
| 2085 | w), ww), x), xx), <u>AAA)</u> | 161.875 | 161.875 | x (digital only) | | | |
| 26 | w), ww), x) | 157.300 | 161.900 | | x | x | x |
| 1026 | w), ww), x), <u>AAA)</u> | 157.300 | | | | | |
| 2026 | w), ww), x), <u>AAA)</u> | | 161.900 | | | | |
| 86 | w), ww), x) | 157.325 | 161.925 | | x | x | x |
| 1086 | w), ww), x), <u>AAA)</u> | 157.325 | | | | | |
| 2086 | w), ww), x), <u>AAA)</u> | | 161.925 | | | | |

| Channel designator | Notes | Transmitting frequencies (MHz) | | Inter-ship | Port operations and ship movement | | Public correspondence |
|--------------------|--------------------|--------------------------------|---------------------|------------|-----------------------------------|---------------|-----------------------|
| | | From ship stations | From coast stations | | Single frequency | Two frequency | |
| 27 | z), zx) | 157.350 | 161.950 | | | x | x |
| 1027 | z), zx) | 157.350 | 157.350 | | x | | |
| 2027* | z) | 161.950 | 161.950 | | | | |
| 87 | z), zx) | 157.375 | 157.375 | | x | | |
| 28 | z), zx) | 157.400 | 162.000 | | | x | x |
| 1028 | z), zx) | 157.400 | 157.400 | | x | | |
| 2028* | z) | 162.000 | 162.000 | | | | |
| 88 | z), zx) | 157.425 | 157.425 | | x | | |
| AIS 1 | f), l), p) | 161.975 | 161.975 | | | | |
| AIS 2 | f), l), p) | 162.025 | 162.025 | | | | |

* From 1 January 2019, channel 2027 will be designated ASM 1 and channel 2028 will be designated ASM 2.

Notes referring to the Table

...

Specific notes

...

w) In Regions 1 and 3:

— Until 1 January 2017, the frequency bands 157.200–157.325 MHz and 161.800–161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) may be used for digitally modulated emissions, subject to coordination with affected administrations. Stations using these channels or frequency bands for digitally modulated emissions shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article 5.

From 1 January 2017, the frequency bands ~~157.200–157.325~~ 157.1875–157.3375 MHz and ~~161.800–161.925~~ 161.7875–161.9375 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are identified for the utilization of the VHF Data Exchange System (VDES) described in the most recent version of Recommendation ITU-R M.2092. These frequency bands may also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not causing harmful interference to, or claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-15~~19~~)

wa) In Regions 1 and 3:

— Until 1 January 2017, the frequency bands 157.025–157.175 MHz and 161.625–161.775 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23 and 83) may be used for digitally modulated emissions, subject to coordination with affected administrations. Stations using these channels or frequency bands for digitally modulated emissions shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article 5.

From 1 January 2017, the frequency bands ~~157.025–157.100~~ 157.0125–157.1125 MHz and ~~161.625–161.700~~ 161.6125–161.7125 MHz (corresponding to channels: 80, 21, 81 and 22) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using multiple 25 kHz contiguous channels.

From 1 January 2017, the frequency bands ~~157.150–157.175~~ 157.1375–157.1875 MHz and ~~161.750–161.775~~ 161.7375–161.7875 MHz (corresponding to channels: 23 and 83) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using two 25 kHz contiguous channels. From 1 January 2017, the frequencies 157.125 MHz and 161.725 MHz (corresponding to channel: 82) are identified for the utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842.

The frequency bands ~~157.025-157.175~~ 157.0125-157.1875 MHz and ~~161.625-161.775~~ 161.6125-161.7875 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23 and 83) can also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-~~15~~19)

- ww) In Region 2, the frequency bands ~~157.1875-157.3375~~ 157.200-157.325 and ~~161.7875-161.9375~~ 161.800-161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions in accordance with the most recent version of Recommendation ITU-R M.1842.

In Canada and Barbados, ~~from 1 January 2019~~ the frequency bands ~~157.1875-157.2875~~ 157.200-157.275 and ~~161.7875-161.8875~~ 161.800-161.875 MHz (corresponding to channels: 24, 84, 25 and 85) may be used for digitally modulated emissions, such as those described in the most recent version of Recommendation ITU-R M.2092, subject to coordination with affected administrations. (WRC-~~15~~19)

- x) ~~From 1 January 2017, in~~ In Angola, Botswana, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Democratic Republic of the Congo, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, the frequency bands ~~157.1125-157.3375~~ 157.125-157.325 and ~~161.7125-161.9375~~ 161.725-161.925 MHz (corresponding to channels: 82, 23, 83, 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions.

~~From 1 January 2017, in~~ In China, the frequency bands ~~157.1375-157.3375~~ 157.150-157.325 and ~~161.7375-161.9375~~ 161.750-161.925 MHz (corresponding to channels: 23, 83, 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions. (WRC-~~12~~19)

- xx) ~~From 1 January 2019, the~~ The channels 24, 84, 25 and 85 may be merged in order to form ~~a~~ a unique ~~duplex~~ channels with a bandwidth of 100 kHz in order to operate the VDES terrestrial component described in the most recent version of Recommendation ITU-R M.2092. (WRC-~~15~~19)

...

- z) ~~Until 1 January 2019, these channels may be used for possible testing of future AIS applications without causing harmful interference to, or claiming protection from, existing applications and stations operating in the fixed and mobile services.~~

~~From 1 January 2019, these~~ The channels 27 and 28 are each split into two simplex channels. The channels ~~2027 and 2028 designated as~~ ASM 1 and ASM 2 are used for application specific messages (ASM) as described in the most recent version of Recommendation ITU-R M.2092. (WRC-~~15~~19)

...

- zz) ~~From 1 January 2019, The~~ channels 1027, 1028, 87 and 88 are used as single-frequency analogue channels for port operation and ship movement. (WRC-~~15~~19)

AAA) These channels may be used for the maritime mobile-satellite service (Earth-to-space) by the VDES satellite component (VDE-SAT) as described in the most recent version of Recommendation ITU-R M.2092 in the following way:

- The channels 1024, 1084, 1025 and 1085 are identified for ship-to-shore communications, but ship-to-satellite (VDE-SAT uplink) communications may be possible without imposing constraints on ship-to-shore communications.
- The channels 2024, 2084, 2025 and 2085 are identified for shore-to-ship and ship-to-ship communications, but ship-to-satellite (VDE-SAT uplink) communications may be possible without imposing constraints on shore-to-ship and ship-to-ship communications.
- The channels 1026, 1086, 2026 and 2086 are identified for ship-to-satellite (VDE-SAT uplink) communications and are not used by the terrestrial component of VDES. (WRC-19)

Reasons: To update the Radio Regulations.

MOD

RESOLUTION 739 (REV.WRC-~~15~~19)

Compatibility between the radio astronomy service and the active space services in certain adjacent and nearby frequency bands

The World Radiocommunication Conference (~~Geneva, 2015~~[Sharm el-Sheikh, 2019](#)),

ANNEX 1 TO RESOLUTION 739 (REV.WRC-~~15~~19)

Unwanted emission threshold levels

TABLE 1-2

epfd thresholds⁽¹⁾ for unwanted emissions from all space stations of a non-GSO satellite system at a radio astronomy station

| Space service | Space service band | Radio astronomy band | Single dish, continuum observations | | Single dish, spectral line observations | | VLBI | | Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of: |
|---------------------------------------|-----------------------------------|----------------------------|-------------------------------------|----------------------|---|---------------------|-------------------------|---------------------|--|
| | | | epfd ⁽²⁾ | Reference bandwidth | epfd ⁽²⁾ | Reference bandwidth | epfd ⁽²⁾ | Reference bandwidth | |
| | (MHz) | (MHz) | (dB(W/m ²)) | (MHz) | (dB(W/m ²)) | (kHz) | (dB(W/m ²)) | (kHz) | |
| MSS (space-to-Earth) | 137-138 | 150.05-153 | -238 | 2.95 | NA | NA | NA | NA | WRC-07 |
| MMSS (space-to-Earth) | 160.9625-161.4875 | 150.05-153 | -238 | 2.95 | NA | NA | NA | NA | WRC-19 |
| MMSS (space-to-Earth) | 160.9625-161.4875 | 322-328.6 | -240 | 6.6 | -255 | 10 | -228 | 10 | WRC-19 |
| MSS (space-to-Earth) | 387-390 | 322-328.6 | -240 | 6.6 | -255 | 10 | -228 | 10 | WRC-07 |
| MSS (space-to-Earth) | 400.15-401 | 406.1-410 | -242 | 3.9 | NA | NA | NA | NA | WRC-07 |
| MSS (space-to-Earth) | 1 525-1 559 | 1 400-1 427 | -243 | 27 | -259 | 20 | -229 | 20 | WRC-07 |
| RNSS (space-to-Earth) ⁽³⁾ | 1 559-1 610 | 1 610.6-1 613.8 | NA | NA | -258 | 20 | -230 | 20 | WRC-07 |
| MSS (space-to-Earth) | 1 525-1 559 | 1 610.6-1 613.8 | NA | NA | -258 | 20 | -230 | 20 | WRC-07 |
| MSS (space-to-Earth) | 1 613.8-1 626.5 | 1 610.6-1 613.8 | NA | NA | -258 | 20 | -230 | 20 | WRC-03 |

SUP

RESOLUTION 360 (REV.WRC-15)

Consideration of regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication

Reasons: It is proposed to suppress Resolution **360 (Rev.WRC-15)** since it will become superfluous after the studies are completed and the identification of frequencies in order to enhance maritime radiocommunications has been made by WRC-19.

5/1.9.2/5.3.1 For Method C

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

ADD

5.B192 The use of the frequency band 160.9625-161.4875 MHz by the maritime mobile-satellite (space-to-Earth) service is limited to non-GSO satellite systems which should operate in accordance with the most recent version of Recommendation ITU-R M.2092. (WRC-19)

Reasons: The above modification of RR Article 5 specifies that the MMSS allocation (space-to-Earth) for the VDES satellite component as described in the Report ITU-R M.2435 should be limited to non-GSO satellite systems.

5/1.9.2/5.3.2 For Method D (Option 1)

ADD

5.B192 The use of the frequency band 160.9625-161.4875 MHz by the maritime mobile-satellite (space-to-Earth) service is limited to the non-GSO satellite systems which should operate in accordance with the most recent version of Recommendation ITU-R M.2092. In the band, the power flux-density at the surface of the Earth produced by emissions from transmitting stations of the maritime mobile-satellite (space-to-Earth) service shall not exceed $-172.3 \text{ dB(W/m}^2\text{)}$ for $0^\circ \leq \theta < 5^\circ$, $-172.3 + 0.45 (\theta - 5) \text{ dB(W/m}^2\text{)}$ for $5^\circ \leq \theta < 25^\circ$ and $-163.3 \text{ dB(W/m}^2\text{)}$ for $25^\circ \leq \theta \leq 90^\circ$, where θ is the angle of arrival of the radio-frequency wave and the reference bandwidth is 4 kHz. (WRC-19)

5/1.9.2/5.3.3 For Method D (Option 2)

ADD

5.B192 The use of the frequency band 160.9625-161.4875 MHz by the maritime mobile-satellite (space-to-Earth) service is limited to the non-GSO satellite systems which should operate in accordance with the most recent version of Recommendation ITU-R M.2092. In the band, the power flux-density at the surface of the Earth produced by emissions from transmitting stations of the maritime mobile-satellite (space-to-Earth) service shall not exceed $-158.5 + 12(\theta/16.47)^2$ dB(W/m²) for $0^\circ \leq \theta < 16.47^\circ$, $-143.5 - 10\log_{10}(1.7)$ dB(W/m²) for $16.47^\circ \leq \theta < 16.95^\circ$ and $-143.5 - 10\log_{10}((|\theta|/16.47)^{-1.5} + 0.7)$ dB(W/m²) for $16.95^\circ \leq \theta \leq 90^\circ$, where θ is the angle of arrival of the radio-frequency wave and the reference bandwidth is 4 kHz. (WRC-19)

5/1.9.2/5.4 For Method E

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

148-161.9375 MHz

| Allocation to services | | |
|--|--|----------|
| Region 1 | Region 2 | Region 3 |
| 156.8375-161.9375 <u>157.1875</u> FIXED MOBILE except aeronautical mobile 5.226 | 156.8375-161.9375 <u>157.1875</u> FIXED MOBILE 5.226 | |
| 156.8375 <u>157.1875-</u> 161.9375 <u>157.3375</u> FIXED MOBILE except aeronautical mobile <u>Maritime mobile-satellite (Earth-to-space) ADD 5.A192</u> 5.226 | 156.8375 <u>157.1875-161.9375</u> <u>157.3375</u> FIXED MOBILE <u>Maritime mobile-satellite (Earth-to-space) ADD 5.A192</u> 5.226 | |
| 156.8375 <u>157.3375-</u> 161.9375 <u>160.9625</u> FIXED MOBILE except aeronautical mobile 5.226 | 156.8375 <u>157.3375-161.9375</u> <u>160.9625</u> FIXED MOBILE 5.226 | |

| | |
|---|--|
| 156.8375 160.9625- 161.9375 <u>161.4875</u> FIXED MOBILE except aeronautical mobile <u>Maritime mobile-satellite (space-to-Earth) MOD 5.208A</u> <u>MOD 5.208B ADD 5.B192</u> 5.226 | 156.8375 160.9625- 161.9375 <u>161.4875</u> FIXED MOBILE <u>Maritime mobile-satellite (space-to-Earth) MOD 5.208A</u> <u>MOD 5.208B ADD 5.B192</u> 5.226 |
| 156.8375 <u>161.4875-</u> 161.9375 <u>161.7875</u> FIXED MOBILE except aeronautical mobile 5.226 | 156.8375 <u>161.4875-</u> 161.9375 <u>161.7875</u> FIXED MOBILE 5.226 |
| 156.8375 <u>161.7875-</u> 161.9375 FIXED MOBILE except aeronautical mobile <u>Maritime mobile-satellite (Earth-to-space) ADD 5.A192</u> 5.226 | 156.8375 <u>161.7875-</u> 161.9375 FIXED MOBILE <u>Maritime mobile-satellite (Earth-to-space) ADD 5.A192</u> 5.226 |

ADD

5.A192 The use of the frequency bands 157.1875-157.3375 MHz and 161.7875-161.9375 MHz by the maritime mobile-satellite (Earth-to-space) service is subject to agreement obtained under No. **9.21** and is limited to non-GSO satellite systems which operate in accordance with Appendix **18**. (WRC-19)

Reasons: The above modification of RR Article **5** specify that the MMSS allocation (Earth-to-space) for the VDES satellite component as described in the Report ITU-R M.2435 should operate in accordance with RR Appendix **18**.

ADD

5.B192 The use of the frequency band 160.9625-161.4875 MHz by the maritime mobile-satellite (space-to-Earth) service is subject to agreement obtained under No. **9.21** and is limited to non-GSO satellite systems which should operate in accordance with most recent version of Recommendation ITU-R M.2092. (WRC-19)

Reasons: The above modification of RR Article **5** specifies conditions for the usage of the frequency band 160.9625-161.4875 MHz by VDES satellite component in accordance with the Method.

MOD

5.208A In making assignments to space stations in the mobile-satellite service in the bands 137-138 MHz, 387-390 MHz ~~and~~, 400.15-401 MHz and in the maritime mobile-satellite service (space-to-Earth) in the band 160.9625-161.4875 MHz, administrations shall take all practicable steps to protect the radio astronomy service in the bands 150.05-153 MHz, 322-328.6 MHz, 406.1-410 MHz and 608-614 MHz from harmful interference from unwanted emissions. ~~The~~

~~threshold levels of interference detrimental to the radio astronomy service are~~ as shown in the relevant ITU-R Recommendation. (WRC-~~07~~19)

Reasons: The above modification is proposed to ensure the protection of the radio astronomy service (RAS).

MOD

5.208B* In the frequency bands:
 137-138 MHz,
160.9625-161.4875 MHz,
 387-390 MHz,
 400.15-401 MHz,
 1 452-1 492 MHz,
 1 525-1 610 MHz,
 1 613.8-1 626.5 MHz,
 2 655-2 690 MHz,
 21.4-22 GHz,

Resolution **739 (Rev.WRC-~~15~~19)** applies. (WRC-~~15~~19)

Reasons: The above modification is proposed to ensure the protection of the radio astronomy service (RAS).

MOD

APPENDIX 18 (REV.WRC-~~15~~19)

Table of transmitting frequencies in the VHF maritime mobile band

(See Article 52)

...

| Channel designator | Notes | Transmitting frequencies (MHz) | | Inter-ship | Port operations and ship movement | | Public correspondence |
|--------------------|--------------------------------|--------------------------------|---------------------|---------------------|-----------------------------------|---------------|-----------------------|
| | | From ship stations | From coast stations | | Single frequency | Two frequency | |
| .../... | .../... | .../... | .../... | .../... | .../... | .../... | .../... |
| 24 | w), ww), x), xx) | 157.200 | 161.800 | | x | x | x |
| 1024 | w), ww), x), xx), <u>AAA</u>) | 157.200 | | | | | |
| 2024 | w), ww), x), xx), <u>AAA</u>) | 161.800 | 161.800 | x (digital only) | | | |

* This provision was previously numbered as No. **5.347A**. It was renumbered to preserve the sequential order.

| Channel designator | Notes | Transmitting frequencies (MHz) | | Inter-ship | Port operations and ship movement | | Public correspondence |
|--------------------|-------------------------------|--------------------------------|---------------------|---------------------|-----------------------------------|---------------|-----------------------|
| | | From ship stations | From coast stations | | Single frequency | Two frequency | |
| 84 | w), ww), x), xx) | 157.225 | 161.825 | | x | x | x |
| 1084 | w), ww), x), xx), <u>AAA)</u> | 157.225 | | | | | |
| 2084 | w), ww), x), xx), <u>AAA)</u> | 161.825 | 161.825 | x (digital only) | | | |
| 25 | w), ww), x), xx) | 157.250 | 161.850 | | x | x | x |
| 1025 | w), ww), x), xx), <u>AAA)</u> | 157.250 | | | | | |
| 2025 | w), ww), x), xx), <u>AAA)</u> | 161.850 | 161.850 | x (digital only) | | | |
| 85 | w), ww), x), xx) | 157.275 | 161.875 | | x | x | x |
| 1085 | w), ww), x), xx), <u>AAA)</u> | 157.275 | | | | | |
| 2085 | w), ww), x), xx), <u>AAA)</u> | 161.875 | 161.875 | x (digital only) | | | |
| 26 | w), ww), x) | 157.300 | 161.900 | | x | x | x |
| 1026 | w), ww), x), <u>AAA)</u> | 157.300 | | | | | |
| 2026 | w), ww), x), <u>AAA)</u> | | 161.900 | | | | |
| 86 | w), ww), x) | 157.325 | 161.925 | | x | x | x |
| 1086 | w), ww), x), <u>AAA)</u> | 157.325 | | | | | |
| 2086 | w), ww), x), <u>AAA)</u> | | 161.925 | | | | |
| 27 | z), zx) | 157.350 | 161.950 | | | x | x |
| 1027 | z) , zz) | 157.350 | 157.350 | | x | | |
| 2027* | z) | 161.950 | 161.950 | | | | |
| 87 | z) , zz) | 157.375 | 157.375 | | x | | |
| 28 | z), zx) | 157.400 | 162.000 | | | x | x |
| 1028 | z) , zz) | 157.400 | 157.400 | | x | | |
| 2028* | z) | 162.000 | 162.000 | | | | |
| 88 | z) , zz) | 157.425 | 157.425 | | x | | |
| AIS 1 | f), l), p) | 161.975 | 161.975 | | | | |
| AIS 2 | f), l), p) | 162.025 | 162.025 | | | | |

* From 1 January 2019, channel 2027 will be designated ASM 1 and channel 2028 will be designated ASM 2.

Notes referring to the Table

...

Specific notes

...

w) In Regions 1 and 3:

~~Until 1 January 2017, the frequency bands 157.200-157.325 MHz and 161.800-161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) may be used for digitally modulated emissions, subject to coordination with affected administrations. Stations using these channels or frequency bands for digitally modulated emissions shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article 5.~~

~~From 1 January 2017, the~~The frequency bands 157.1875-157.3375 ~~157.200-157.325~~ MHz and 161.7875-161.9375 ~~161.800-161.925~~ MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are identified for the utilization of the VHF Data Exchange System (VDES) described in the most recent version of Recommendation ITU-R M.2092. These frequency bands may also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not causing harmful interference to, or claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-~~15~~19)

wa) In Regions 1 and 3:

~~Until 1 January 2017, the frequency bands 157.025-157.175 MHz and 161.625-161.775 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23 and 83) may be used for digitally modulated emissions, subject to coordination with affected administrations. Stations using these channels or frequency bands for digitally modulated emissions shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article 5.~~

~~From 1 January 2017, the~~The frequency bands 157.0125-157.1125 ~~157.025-157.100~~ MHz and 161.6125-161.7125 ~~161.625-161.700~~ MHz (corresponding to channels: 80, 21, 81 and 22) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using multiple 25 kHz contiguous channels.

~~From 1 January 2017, the~~The frequency bands 157.1375-157.1875 ~~157.150-157.175~~ MHz and 161.7375-161.7875 ~~161.750-161.775~~ MHz (corresponding to channels: 23 and 83) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using two 25 kHz contiguous channels. ~~From 1 January 2017, the~~The frequencies 157.125 MHz and 161.725 MHz (corresponding to channel: 82) are identified for the utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842.

The frequency bands 157.0125-157.1875 ~~157.025-157.175~~ MHz and 161.6125-161.7875 ~~161.625-161.775~~ MHz (corresponding to channels: 80, 21, 81, 22, 82, 23 and 83) can also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-~~15~~19)

ww) In Region 2, the frequency bands 157.1875-157.3375 ~~157.200-157.325~~ and 161.7875-161.9375 ~~161.800-161.925~~ MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions in accordance with the most recent version of Recommendation ITU-R M.1842.

In Canada and Barbados, ~~from 1 January 2019~~ the frequency bands 157.1875-157.2875 ~~157.200-157.275~~ and 161.7875-161.8875 ~~161.800-161.875~~ MHz (corresponding to channels: 24, 84, 25 and 85) may be used for digitally modulated emissions, such as those described in the most recent version of Recommendation ITU-R M.2092, subject to coordination with affected administrations. (WRC-~~15~~19)

x) ~~From 1 January 2017, in~~In Angola, Botswana, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Democratic Republic of the Congo, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, the frequency bands 157.1125-157.3375 ~~157.125-157.325~~ and 161.7125-161.9375 ~~161.725-161.925~~ MHz (corresponding to channels: 82, 23, 83, 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions.

~~From 1 January 2017, in~~In China, the frequency bands 157.1375-157.3375 ~~157.150-157.325~~ and 161.7375-161.9375 ~~161.750-161.925~~ MHz (corresponding to channels: 23, 83, 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions. (WRC-~~12~~19)

xx) ~~From 1 January 2019, the~~The channels 24, 84, 25 and 85 may be merged in order to form ~~a~~ unique ~~duplex~~ channels with a bandwidth of 100 kHz in order to operate the VDES terrestrial component described in the most recent version of Recommendation ITU-R M.2092. (WRC-~~15~~19)

...

- z) ~~Until 1 January 2019, these channels may be used for possible testing of future AIS applications without causing harmful interference to, or claiming protection from, existing applications and stations operating in the fixed and mobile services.~~

~~From 1 January 2019, these~~ The channels 27 and 28 are each split into two simplex channels. The channels ~~2027 and 2028 designated as~~ ASM 1 and ASM 2 are used for application specific messages (ASM) as described in the most recent version of Recommendation ITU-R M.2092. (WRC-~~15~~19)

...

- zz) ~~From 1 January 2019,~~ The channels 1027, 1028, 87 and 88 are used as single-frequency analogue channels for port operation and ship movement. (WRC-~~15~~19)

AAA) These channels may be used for the maritime mobile-satellite service (Earth-to-space) by the VDES satellite component (VDE-SAT) as described in the most recent version of Recommendation ITU-R M.2092 in the following way:

- The channels 1024, 1084, 1025 and 1085 are identified for ship-to-shore communications, but ship-to-satellite (VDE-SAT uplink) communications may be possible without imposing constraints on ship-to-shore communications.
- The channels 2024, 2084, 2025 and 2085 are identified for shore-to-ship and ship-to-ship communications, but ship-to-satellite (VDE-SAT uplink) communications may be possible without imposing constraints on shore-to-ship and ship-to-ship communications.
- The channels 1026, 1086, 2026 and 2086 are identified for ship-to-satellite (VDE-SAT uplink) communications and are not used by the terrestrial component of VDES. (WRC-19)

Reasons: To update the Radio Regulations.

MOD

RESOLUTION 739 (REV.WRC-~~15~~19)

Compatibility between the radio astronomy service and the active space services in certain adjacent and nearby frequency bands

The World Radiocommunication Conference (~~Geneva, 2015~~[Sharm el-Sheikh, 2019](#)),

...

ANNEX 1 TO RESOLUTION 739 (REV.WRC-~~15~~19)

Unwanted emission threshold levels

TABLE 1-2

epfd thresholds⁽¹⁾ for unwanted emissions from all space stations of a non-GSO satellite system at a radio astronomy station

| Space service | Space service frequency band | Radio astronomy frequency band | Single dish, continuum observations | | Single dish, spectral line observations | | VLBI | | Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of: |
|---------------------------------------|-----------------------------------|--------------------------------|-------------------------------------|----------------------|---|---------------------|-------------------------|---------------------|--|
| | | | epfd ⁽²⁾ | Reference bandwidth | epfd ⁽²⁾ | Reference bandwidth | epfd ⁽²⁾ | Reference bandwidth | |
| | (MHz) | (MHz) | (dB(W/m ²)) | (MHz) | (dB(W/m ²)) | (kHz) | (dB(W/m ²)) | (kHz) | |
| MSS (space-to-Earth) | 137-138 | 150.05-153 | -238 | 2.95 | NA | NA | NA | NA | WRC-07 |
| MMSS (space-to-Earth) | 160.9625-161.4875 | 150.05-153 | -238 | 2.95 | NA | NA | NA | NA | WRC-19 |
| MMSS (space-to-Earth) | 160.9625-161.4875 | 322-328.6 | -240 | 6.6 | -255 | 10 | -228 | 10 | WRC-19 |
| MSS (space-to-Earth) | 387-390 | 322-328.6 | -240 | 6.6 | -255 | 10 | -228 | 10 | WRC-07 |

| | | | | | | | | | |
|--------------------------------------|-----------------|-----------------|------|-----|------|----|------|----|--------|
| MSS (space-to-Earth) | 400.15-401 | 406.1-410 | −242 | 3.9 | NA | NA | NA | NA | WRC-07 |
| MSS (space-to-Earth) | 1 525-1 559 | 1 400-1 427 | −243 | 27 | −259 | 20 | −229 | 20 | WRC-07 |
| RNSS (space-to-Earth) ⁽³⁾ | 1 559-1 610 | 1 610.6-1 613.8 | NA | NA | −258 | 20 | −230 | 20 | WRC-07 |
| MSS (space-to-Earth) | 1 525-1 559 | 1 610.6-1 613.8 | NA | NA | −258 | 20 | −230 | 20 | WRC-07 |
| MSS (space-to-Earth) | 1 613.8-1 626.5 | 1 610.6-1 613.8 | NA | NA | −258 | 20 | −230 | 20 | WRC-03 |

...

SUP

RESOLUTION 360 (REV.WRC-15)

Consideration of regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication

Reasons: It is proposed to suppress Resolution **360 (Rev.WRC-15)** since it will become superfluous after the studies are completed and the identification of frequencies in order to enhance maritime radiocommunications has been made by WRC-19.

5/1.9.2/5.5 For Method F

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. 2.1)

MOD

148-161.9375 MHz

| Allocation to services | | |
|---|---|----------|
| Region 1 | Region 2 | Region 3 |
| 156.8375-161.9375 <u>157.1875</u> FIXED MOBILE except aeronautical mobile 5.226 | 156.8375-161.9375 <u>157.1875</u> FIXED MOBILE 5.226 | |
| 156.8375 <u>157.1875-</u> 161.9375 <u>157.3375</u> FIXED MOBILE except aeronautical mobile <u>MARITIME MOBILE-</u> <u>SATELLITE (Earth-to-space)</u> <u>ADD 5.A192</u> 5.226 | 156.8375 <u>157.1875-161.9375</u> <u>157.3375</u> FIXED MOBILE <u>MARITIME MOBILE-</u> <u>SATELLITE (Earth-to-space)</u> <u>ADD 5.A192</u> 5.226 | |
| 156.8375 <u>157.3375-</u> 161.9375 <u>161.7875</u> FIXED MOBILE except aeronautical mobile 5.226 | 156.8375 <u>157.3375-161.9375</u> <u>161.7875</u> FIXED MOBILE 5.226 | |

| | |
|---|---|
| 156.8375 161.7875-161.9375 FIXED MOBILE except aeronautical mobile <u>MARITIME MOBILE-</u> <u>SATELLITE (space-to-Earth)</u> <u>MOD 5.208A MOD 5.208B</u> <u>ADD 5.B192</u> 5.226 | 156.8375 161.7875-161.9375 FIXED MOBILE <u>MARITIME MOBILE-</u> <u>SATELLITE (space-to-Earth)</u> <u>MOD 5.208A MOD 5.208B</u> <u>ADD 5.B192</u> 5.226 |
|---|---|

Reasons: The above modifications of RR Article 5 identify a MMSS allocation uplink and downlink for the VHF Data Exchange System which is described in Recommendation ITU-R M.2092-0.

MOD

5.208A In making assignments to space stations in the mobile-satellite service in the bands 137-138 MHz, 387-390 MHz, ~~and~~ 400.15-401 MHz and in the maritime mobile-satellite service (space-to-Earth) in the band 161.7875-161.9375 MHz, administrations shall take all practicable steps to protect the radio astronomy service in the bands 150.05-153 MHz, 322-328.6 MHz, 406.1-410 MHz and 608-614 MHz from harmful interference from unwanted emissions. ~~The threshold levels of interference detrimental to the radio astronomy service are~~ as shown in the relevant ITU-R Recommendation. (WRC-07~~19~~)

Reasons: The frequency range 161.7875-161.9375 MHz is a new allocation to the maritime mobile-satellite service (space-to-Earth). To ensure protection of the RAS this frequency range has to be added to RR No. **5.208A**.

MOD

5.208B* In the frequency bands:

- 137-138 MHz,
- 161.7875-161.9375 MHz,
- 387-390 MHz,
- 400.15-401 MHz,
- 1 452-1 492 MHz,
- 1 525-1 610 MHz,
- 1 613.8-1 626.5 MHz,
- 2 655-2 690 MHz,
- 21.4-22 GHz,

Resolution **739 (Rev.WRC-15~~19~~)** applies. (WRC-15~~19~~)

Reasons: The frequency range 161.7875-161.9375 MHz is a new allocation to the maritime mobile-satellite service (space-to-Earth). To ensure protection of the RAS this frequency range has to be added to RR No. **5.208B**.

ADD

5.A192 The use of the frequency band 157.1875-157.3375 MHz by the maritime mobile-satellite service (Earth-to-space) is limited to the systems which operate in accordance with Appendix **18**. (WRC-19)

* This provision was previously numbered as No. **5.347A**. It was renumbered to preserve the sequential order.

Reasons: Identify a MMSS allocation uplink for the VDES which is described in Recommendation ITU-R M.2092-0.

ADD

5.B192 The use of the frequency band 161.7875-161.9375 MHz by the maritime mobile-satellite service (space-to-Earth) is limited to the systems which operate in accordance with Appendix 18. Such use is subject to the application of the provisions of No. 9.14 for coordination with stations of terrestrial services. (WRC-19)

Reasons: Identify a MMSS allocation downlink for the VDES which is described in Recommendation ITU-R M.2092-0. It is also clarified, in the footnote RR No. 5.B192, that the coordination between the MMSS and the terrestrial services is subject to the application of the provision of RR No. 9.14.

MOD

APPENDIX 5 (REV.WRC-1519)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

ANNEX 1

MOD

- 1 Coordination thresholds for sharing between MSS (space-to-Earth) and terrestrial services in the same frequency bands and between non-GSO MSS feeder links (space-to-Earth) and terrestrial services in the same frequency bands and between RDSS (space-to-Earth) and terrestrial services in the same frequency bands** (WRC-1219)

MOD

1.1 Below 1 GHz*

...

1.1.4 In the band 161.7875-161.9375 MHz, coordination of a space station of the maritime mobile-satellite service (space-to-Earth) with respect to terrestrial services is required only if the power spectral and flux-density produced by this space station exceeds the following mask in dB(W/(m² · 4 kHz)) at the Earth's surface:

* These provisions apply only to the MSS.

$$PFD(\theta^{\circ})_{((\text{dBW/m}^2 \cdot 4 \text{ kHz}))} = \begin{cases} -149 + 0.16 * \theta^{\circ} & 0^{\circ} \leq \theta < 45^{\circ}; \\ -142 + 0.53 * (\theta^{\circ} - 45^{\circ}) & 45^{\circ} \leq \theta < 60^{\circ}; \\ -134 + 0.1 * (\theta^{\circ} - 60^{\circ}) & 60^{\circ} \leq \theta \leq 90^{\circ}. \end{cases}$$

where θ is the angle of arrival of the incident wave above the horizontal plane (degrees).

Reasons: It is proposed to extend the coordination threshold defined in Annex 1 of RR Appendix 5 for the VDES using the frequency band 161.7875-161.9375 MHz by using the pfd mask defined in Recommendation ITU-R M.2092-0.

MOD

APPENDIX 18 (REV.WRC-~~15~~19)

Table of transmitting frequencies in the VHF maritime mobile band

(See Article 52)

...

| Channel designator | Notes | Transmitting frequencies (MHz) | | Inter-ship | Port operations and ship movement | | Public correspondence |
|--------------------|---|--------------------------------|---------------------|--------------------------------|-----------------------------------|----------------|-----------------------|
| | | From ship stations | From coast stations | | Single frequency | Two frequency | |
| ... | ... | ... | ... | ... | ... | ... | ... |
| 24 | w), ww), x), xx) | 157.200 | 161.800 | | x | x | x |
| 1024 | w), ww), x), xx), AAA | 157.200 | 157.200 | x (digital only) | | | |
| 2024 | w), ww), x), xxx BBB | 161.800 | 161.800 | x (digital only) | | | |
| 84 | w), ww), x), xx) | 157.225 | 161.825 | | x | x | x |
| 1084 | w), ww), x), xx), AAA | 157.225 | 157.225 | x (digital only) | | | |
| 2084 | w), ww), x), xxx BBB | 161.825 | 161.825 | x (digital only) | | | |
| 25 | w), ww), x), xx) | 157.250 | 161.850 | | x | x | x |
| 1025 | w), ww), x), xx), AAA | 157.250 | 157.250 | x (digital only) | | | |
| 2025 | w), ww), x), xxx BBB | 161.850 | 161.850 | x (digital only) | | | |
| 85 | w), ww), x), xx) | 157.275 | 161.875 | | x | x | x |
| 1085 | w), ww), x), xx), AAA | 157.275 | 157.275 | x (digital only) | | | |
| 2085 | w), ww), x), xxx BBB | 161.875 | 161.875 | x (digital only) | | | |

| Channel designator | Notes | Transmitting frequencies (MHz) | | Inter-ship | Port operations and ship movement | | Public correspondence |
|--------------------|-----------------------------|--------------------------------|---------------------|------------|-----------------------------------|---------------|-----------------------|
| | | From ship stations | From coast stations | | Single frequency | Two frequency | |
| 26 | w), ww), x) | 157.300 | 161.900 | | x | x | x |
| 1026 | w), ww), x), AAA | 157.300 | | | | | |
| 2026 | w), ww), x), BBB | | 161.900 | | | | |
| 86 | w), ww), x) | 157.325 | 161.925 | | x | x | x |
| 1086 | w), ww), x), AAA | 157.325 | | | | | |
| 2086 | w), ww), x), BBB | | 161.925 | | | | |
| 27 | z), zx) | 157.350 | 161.950 | | | x | x |
| 1027 | z), zz) | 157.350 | 157.350 | | x | | |
| 2027* | z) | 161.950 | 161.950 | | | | |
| 87 | z), zz) | 157.375 | 157.375 | | x | | |
| 28 | z), zx) | 157.400 | 162.000 | | | x | x |
| 1028 | z), zz) | 157.400 | 157.400 | | x | | |
| 2028* | z) | 162.000 | 162.000 | | | | |
| 88 | z), zz) | 157.425 | 157.425 | | x | | |
| AIS 1 | f), l), p) | 161.975 | 161.975 | | | | |
| AIS 2 | f), l), p) | 162.025 | 162.025 | | | | |

* From 1 January 2019, channel 2027 will be designated ASM 1 and channel 2028 will be designated ASM 2.

Notes referring to the Table

...

Specific notes

...

w) In Regions 1 and 3:

~~Until 1 January 2017, the frequency bands 157.200–157.325 MHz and 161.800–161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) may be used for digitally modulated emissions, subject to coordination with affected administrations. Stations using these channels or frequency bands for digitally modulated emissions shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article 5.~~

~~From 1 January 2017, the~~The frequency bands ~~157.200–157.325~~157.1875–157.3375 MHz and ~~161.800–161.925~~161.7875–161.9375 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are identified for the utilization of the VHF Data Exchange System (VDES) described in the most recent version of Recommendation ITU-R M.2092. These frequency bands may also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not causing harmful interference to, or claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-15~~19~~)

wa) In Regions 1 and 3:

~~Until 1 January 2017, the frequency bands 157.025–157.175 MHz and 161.625–161.775 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23 and 83) may be used for digitally modulated emissions, subject to coordination with affected administrations. Stations using these channels or frequency bands for digitally modulated emissions shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article 5.~~

~~From 1 January 2017, the~~The frequency bands ~~157.025–157.100~~157.0125–157.1125 MHz and ~~161.625–161.700~~161.6125–161.7125 MHz (corresponding to channels: 80, 21, 81 and 22) are identified for utilization of

the digital systems described in the most recent version of Recommendation ITU-R M.1842 using multiple 25 kHz contiguous channels.

~~From 1 January 2017, the~~The frequency bands ~~457.150-457.175~~157.1375-157.1875 MHz and ~~161.750-161.775~~161.7375-161.7875 MHz (corresponding to channels: 23 and 83) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using two 25 kHz contiguous channels. ~~From 1 January 2017, the~~The frequencies 157.125 MHz and 161.725 MHz (corresponding to channel: 82) are identified for the utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842.

The frequency bands ~~157.025-157.175~~157.0125-157.1875 MHz and ~~161.625-161.775~~161.6125-161.7875 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23 and 83) can also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-~~15~~19)

- ww) In Region 2, the frequency bands ~~157.200-157.325~~157.1875-157.3375 MHz and ~~161.800-161.925~~161.7875-161.9375 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions in accordance with the most recent version of Recommendation ITU-R M.1842.

In Canada and Barbados, ~~from 1 January 2019~~ the frequency bands ~~157.200-157.275~~157.1875-157.2825 MHz and ~~161.800-161.875~~161.7875-161.8875 MHz (corresponding to channels: 24, 84, 25 and 85) may be used for digitally modulated emissions, such as those described in the most recent version of Recommendation ITU-R M.2092, subject to coordination with affected administrations. (WRC-~~15~~19)

- x) ~~From 1 January 2017, in~~In Angola, Botswana, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Democratic Republic of the Congo, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, the frequency bands ~~157.1125-157.3375~~157.125-157.325 and ~~161.7125-161.9375~~161.725-161.925 MHz (corresponding to channels: 82, 23, 83, 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions.
- ~~From 1 January 2017, in~~In China, the frequency bands ~~157.1375-157.3375~~157.150-157.325 and ~~161.7375-161.9375~~161.750-161.925 MHz (corresponding to channels: 23, 83, 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions. (WRC-~~12~~19)

Reasons: Correction on the frequency bands.

- xx) ~~From 1 January 2019, the~~The channels 24, 84, 25 and 85 may be merged in order to form a unique duplex channel with a bandwidth of 100 kHz in order to operate the VDES terrestrial component described in the most recent version of Recommendation ITU-R M.2092.

The channels 1024, 1084, 1025 and 1085 may be merged in order to form a unique channel with a bandwidth of 100 kHz in order to operate the VDES terrestrial component for ship-to-ship, ship-to-shore and shore-to-ship communications as described in the most recent version of Recommendation ITU-R M.2092. (WRC-~~15~~19)

Reasons: The above modifications of the RR Appendix 18 identify both the simplex and duplex operation of the terrestrial component of VDES.

...

- z) ~~Until 1 January 2019, these channels may be used for possible testing of future AIS applications without causing harmful interference to, or claiming protection from, existing applications and stations operating in the fixed and mobile services.~~

~~From 1 January 2019, these~~The channels 27 and 28 are each split into two simplex channels. The channels ~~2027 and 2028~~ designated as ASM 1 and ASM 2 are used for application specific messages (ASM) as described in the most recent version of Recommendation ITU-R M.2092. (WRC-~~15~~19)

...

- zz) ~~From 1 January 2019,~~The channels 1027, 1028, 87 and 88 are used as single-frequency analogue channels for port operation and ship movement. (WRC-~~15~~19)

AAA) From 1 January 2024, the combination of the channels 1024, 1084, 1025, 1085, 1026 and 1086, which are also allocated to the maritime mobile-satellite service (Earth-to-space), shall be used for the reception of VDES messages from ships as described in the most recent version of Recommendation ITU-R M.2092. (WRC-19)

BBB) From 1 January 2024, the combination of the channels 2024, 2084, 2025, 2085, 2026 and 2086, which are also allocated to the maritime mobile-satellite service (space-to-Earth), shall be used for the reception of VDES messages from satellites as described in the most recent version of Recommendation ITU-R M.2092. (WRC-19)

Reasons: The above modifications of RR Appendix 18 identify a MMSS allocation uplink and downlink for the VDES which is described in Recommendation ITU-R M.2092-0. The channels are identified for the satellite downlink of the VDES.

MOD

RESOLUTION 739 (REV.WRC-~~15~~19)**Compatibility between the radio astronomy service and the active space services in certain adjacent and nearby frequency bands**The World Radiocommunication Conference (~~Geneva, 2015~~[Sharm el-Sheikh, 2019](#)),ANNEX 1 TO RESOLUTION 739 (REV.WRC-~~15~~19)**Unwanted emission threshold levels**

TABLE 1-2

epfd thresholds⁽¹⁾ for unwanted emissions from all space stations of a non-GSO satellite system at a radio astronomy station

| Space service | Space service frequency band | Radio astronomy frequency band | Single dish, continuum observations | | Single dish, spectral line observations | | VLBI | | Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of: |
|---------------------------------------|-----------------------------------|--------------------------------|-------------------------------------|----------------------|---|---------------------|-------------------------|---------------------|--|
| | | | epfd ⁽²⁾ | Reference bandwidth | epfd ⁽²⁾ | Reference bandwidth | epfd ⁽²⁾ | Reference bandwidth | |
| | (MHz) | (MHz) | (dB(W/m ²)) | (MHz) | (dB(W/m ²)) | (kHz) | (dB(W/m ²)) | (kHz) | |
| MSS (space-to-Earth) | 137-138 | 150.05-153 | -238 | 2.95 | NA | NA | NA | NA | WRC-07 |
| MMSS (space-to-Earth) | 161.7875-161.9375 | 150.05-153 | -238 | 2.95 | NA | NA | NA | NA | WRC-19 |
| MMSS (space-to-Earth) | 161.7875-161.9375 | 322-328.6 | -240 | 6.6 | -255 | 10 | -228 | 10 | WRC-19 |
| MSS (space-to-Earth) | 387-390 | 322-328.6 | -240 | 6.6 | -255 | 10 | -228 | 10 | WRC-07 |
| MSS (space-to-Earth) | 400.15-401 | 406.1-410 | -242 | 3.9 | NA | NA | NA | NA | WRC-07 |
| MSS (space-to-Earth) | 1 525-1 559 | 1 400-1 427 | -243 | 27 | -259 | 20 | -229 | 20 | WRC-07 |

| | | | | | | | | | |
|--------------------------------------|-----------------|-----------------|----|----|------|----|------|----|--------|
| RNSS (space-to-Earth) ⁽³⁾ | 1 559-1 610 | 1 610.6-1 613.8 | NA | NA | −258 | 20 | −230 | 20 | WRC-07 |
| MSS (space-to-Earth) | 1 525-1 559 | 1 610.6-1 613.8 | NA | NA | −258 | 20 | −230 | 20 | WRC-07 |
| MSS (space-to-Earth) | 1 613.8-1 626.5 | 1 610.6-1 613.8 | NA | NA | −258 | 20 | −230 | 20 | WRC-03 |

NA: Not applicable, measurements of this type are not made in this frequency band.

⁽¹⁾ These epfd thresholds should not be exceeded for more than 2% of time.

⁽²⁾ Integrated over the reference bandwidth with an integration time of 2 000 s.

⁽³⁾ This Resolution does not apply to current and future assignments of the radionavigation-satellite system GLONASS/GLONASS-M in the frequency band 1 559-1 610 MHz, irrespective of the date of reception of the related coordination or notification information, as appropriate. The protection of the radio astronomy service in the frequency band 1 610.6-1 613.8 MHz is ensured and will continue to be in accordance with the bilateral agreement between the Russian Federation, the notifying administration of the GLONASS/GLONASS-M system, and IUCAF, and subsequent bilateral agreements with other administrations.

Reasons: The frequency range 161.7875-161.9375 MHz is a new allocation to the maritime mobile-satellite service (space-to-Earth). To ensure protection of the RAS this frequency range has to be added to Annex 1 to Resolution **739 (Rev.WRC-15)**.

SUP

RESOLUTION 360 (REV.WRC-15)

Consideration of regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication

Reasons: It is proposed to suppress Resolution **360 (Rev.WRC-15)** since it will become superfluous after the studies are completed and the identification of frequencies in order to enhance maritime radiocommunication has been made by WRC-19.

Agenda item 1.10

1.10 to consider spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System (GADSS), in accordance with Resolution 426 (WRC-15);

Resolution **426 (WRC-15)**: *Studies on spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System*

5/1.10/1 Executive summary

In accordance with Resolution **426 (WRC-15)**, ITU-R considered spectrum needs and regulatory provisions for the introduction and the use of the global aeronautical distress and safety system (GADSS).

Three methods were developed. Each method states that no changes to Article **5** of the Radio Regulations (RR) are required in addition to suppression of Resolution **426 (WRC-15)**.

In Method A, modification to RR Article **30** and a new RR Article **34A** to recognize GADSS in the RR are suggested.

In Method B, by comparison to Method A, different modifications to RR Article **30**, and RR Article **34A** are proposed, as is a Resolution requiring the development of ITU-R Recommendations to list the frequency bands of the systems contributing to GADSS, their technical characteristics and protection criteria are suggested. Method B also states that systems composing the GADSS shall only operate in primary allocations when used for safety purposes.

Method C proposes no changes to the RR.

5/1.10/2 Background

The International Civil Aviation Organization (ICAO) has developed a concept of operations (ConOps) to support the future development of GADSS.

The ConOps⁴⁰ describes in particular the following functions:

- Aircraft tracking
 - Typically uses existing technologies to assist in the timely identification and location of aircraft.
 - Provides an automated reporting function every 15 mins or less.
 - Aircraft tracking may be accomplished by multiple different systems over the duration of a flight.
- Autonomous distress tracking
 - An automated method of position reporting at intervals of one minute or less to support search and rescue (SAR), triggered by indications that an aircraft is in distress which may result in an accident.
 - Distress tracking aims to establish the location of a potential accident site within a six nautical mile (11.11 km) radius.

⁴⁰ Version 6.0. In 2017 the ICAO Air Navigation Commission agreed to use Version 6.0 to guide the further development of ICAO performance-based standards in order to support the implementation of the ConOps.

- Post-flight localization and recovery
 - A combination of both the immediate need to locate and rescue possible survivors after an air accident using emergency location beacons and other methods to an accuracy of < 1 nautical mile (< 1.85 km), and the timely collection of aircraft components and data that will assist in the accident investigation.
- Procedures and information management
 - The method of data collection and notification of flight tracking data to the relevant SAR, and rescue coordination centres.

The ConOps provides the guidelines for the development of ICAO performance-based standards, outlining specific technical and operational requirements that an aircraft shall meet. It does not identify specific systems proposed to contribute to GADSS. ICAO intends to use systems operating under existing allocations in accordance with the provisions of the RR, including the use of emergency position-indicating radio beacons (termed as emergency locator transmitters in ICAO) operating in the 406-406.1 MHz frequency band⁴¹.

In addition, ICAO is of the view that:

- 1) systems being utilized to meet GADSS requirements should not receive any additional priority beyond that accorded by the RR to the radiocommunication service(s) under which those systems operate, and
- 2) ICAO does not support regulatory modifications that would require future WRC action in order to update or modify GADSS requirements and/or systems available for satisfying GADSS requirements.

5/1.10/3 Summary and analysis of the results of ITU-R studies

Section 3 “Spectrum Needs for the Introduction and Use of the GADSS”, of Report ITU-R M.2436-0 concludes that “studies within ICAO have determined that the GADSS requirements can be satisfied using existing systems operating within existing aeronautical frequency allocations and distress spectrum (e.g. 406.1 MHz).” Therefore, no changes are required to RR Article 5.

Depending on the method considered, possible changes to other portions of RR have been identified to facilitate GADSS implementation⁴².

5/1.10/3.1 Relevant ITU-R Recommendations and Reports

Report ITU-R M.2436.

5/1.10/4 Methods to satisfy the agenda item

Three methods are proposed to satisfy the agenda item, providing, *inter alia*, the suppression of Resolution 426 (WRC-15).

⁴¹ The 406-406.1 MHz frequency band is already identified for the use of emergency position-indicating radiobeacons in the provisions of RR No. 5.266.

⁴² It was noted that some RR provisions outside the scope of WRC-19 agenda item 1.10 may not reflect the current/future plans for aeronautical use. No related WRC-19 action is proposed regarding those provisions.

5/1.10/4.1 Method A

Regarding *invites ITU-R 2 of Resolution 426 (WRC-15)*, in order to facilitate its introduction, modification of the RR are proposed to include GADSS as a distress and safety communications system in RR Chapter VII – Distress and safety communications.

The modifications of RR proposed under Method A specify:

- that the details of the GADSS elements are contained in Annexes to the ICAO Convention;
- that the type of radiocommunication service used depends on the requirements of the specific GADSS function;
- that radiocommunication systems contributing to the GADSS are operated in conformity with the RR;
- that operation of GADSS elements under RR No. 4.4 is precluded.

5/1.10/4.2 Method B

Regarding *invites ITU-R 2 of Resolution 426 (WRC-15)*, in order to facilitate its introduction, modification of the RR are proposed to include GADSS as a distress and safety communications system in RR Chapter VII – Distress and safety communications. In addition, the frequency bands used for GADSS, its systems, their technical characteristics and protection criteria shall be reflected in the relevant ITU-R Recommendations. Therefore, a new Resolution [A110-GADSS] (WRC-19) calling ICAO to provide to ITU-R the information in relation to the frequency bands and systems included in GADSS and also the information about the technical characteristics of such systems and inviting ITU-R to develop appropriate Recommendations shall be developed.

The modifications of the RR proposed under Method B specify:

- that the details of the GADSS elements are contained in Annexes to the ICAO Convention;
- that radiocommunication systems contributing to the GADSS are operated in conformity with the RR;
- that the use of frequency bands for GADSS shall be limited to systems that operate in accordance with recognized international aviation standards;
- that the use of GADSS shall also not prevent the use of these frequency bands by any applications of services to which these bands are allocated on a primary basis, and shall not establish a priority for GADSS in the RR;
- that the GADSS must operate in accordance with the terms of new Resolution [A110-GADSS] (WRC-19), resolving:
 - that systems composing the GADSS shall only operate in primary allocations when used for safety purposes;
 - that ITU-R shall develop ITU-R Recommendations detailing the system elements of the GADSS including their operating frequency bands and technical characteristics;
 - that if constituent elements of GADSS are changed, those changes should be reflected in the relevant ITU-R Recommendation.

5/1.10/4.3 Method C

Regarding Resolution 426 (WRC-15), the introduction of GADSS can be ensured by ICAO without any modifications of RR recognizing that studies within ICAO have determined that the GADSS

requirements can be satisfied using existing systems operating within existing aeronautical frequency allocations and distress spectrum (e.g. 406.1 MHz).

Method A introduces only a high level description of GADSS which is not sufficient for ITU-R to determine any necessary system protections or help in compatibility studies. In addition, by not specifying specific systems and/or specific operating frequency bands, the proposed provisions do not offer any regulatory benefits, but may result in trying to operate distress and safety systems, with consequential protection requirement, outside distress and safety bands defined in the RR, which may impact other uses.

Method B does not meet the desire by ICAO to avoid future ITU-R actions in order to update or modify GADSS requirements and/or systems available for satisfying GADSS requirements.

As noted ICAO is able to implement the GADSS under the current RR.

As a result, NOC is proposed.

5/1.10/5 Regulatory and procedural considerations

5/1.10/5.1 Method A

NOC

ARTICLE 5

Frequency allocations

CHAPTER VII

Distress and safety communications¹

ARTICLE 30

General provisions

Section I – Introduction

MOD

30.1 § 1 Nos. 30.4-30.13, and Articles 31, 32, 33 and 34 of ~~This~~ Chapter contains the provisions for the operational use of the global maritime distress and safety system (GMDSS), whose functional requirements, system elements and equipment carriage requirements are set forth in the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended. ~~This Chapter~~ These Nos. and Articles also contains provisions for initiating distress, urgency and safety communications by means of radiotelephony on the frequency 156.8 MHz (VHF channel 16). (WRC-07~~19~~)

ADD

30.1A Article **34A** of this Chapter contains the provisions for the global aeronautical distress and safety system (GADSS), whose functional requirements are set forth in the Annexes to the Convention on International Civil Aviation, as amended. (WRC-19)

ADD

ARTICLE 34A

Global aeronautical distress and safety system

ADD

34A.1 The global aeronautical distress and safety system (GADSS) determines performance requirements for the radiocommunication systems utilized for conducting functions such as aircraft tracking, autonomous distress tracking, and post-flight localization and recovery. (WRC-19)

ADD

34A.2 The type of radiocommunication service(s) to be used by systems contributing to the GADSS depend(s) on the requirements of the specific GADSS function. Radiocommunication systems contributing to the GADSS have to be operated in conformity with the Radio Regulations but these systems shall not be operated under the provisions of No. **4.4**. (WRC-19)

SUP

RESOLUTION 426 (WRC-15)

Studies on spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System

5/1.10/5.2 Method B

NOC

ARTICLE 5

Frequency allocations

CHAPTER VII

Distress and safety communications¹

ARTICLE 30

General provisions

Section I – Introduction

MOD

30.1 § 1 Nos. 30.4-30.13, and Articles 31, 32, 33 and 34 of ~~This~~ Chapter contains the provisions for the operational use of the global maritime distress and safety system (GMDSS), whose functional requirements, system elements and equipment carriage requirements are set forth in the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended. ~~This Chapter~~ These Nos. and Articles also contains provisions for initiating distress, urgency and safety communications by means of radiotelephony on the frequency 156.8 MHz (VHF channel 16). Article 34A of this Chapter contains provisions for the global aeronautical distress and safety system (GADSS), whose functional requirements, system elements and equipment carriage requirements are set forth in the Annexes to the Convention on International Civil Aviation, as amended. (WRC-07/19)

ADD

ARTICLE 34A

Global aeronautical distress and safety system

ADD

34A.1 The GADSS determines performance requirements for the radiocommunication systems utilized for conducting several functions, such as aircraft tracking, autonomous distress tracking, and post-flight localization and recovery.

Resolution [A110-GADSS] (WRC-19) is applied for operation of GADSS. (WRC-19)

ADD

34A.2 The performance requirements, system elements and equipment carriage requirements of GADSS are set forth in ICAO standards and recommended practices, guidance material and manuals. (WRC-19)

ADD

34A.3 The radiocommunication systems meeting the GADSS performance requirements shall operate in the radiocommunication services having an appropriate allocation in Article 5 and shall operate in conformity with the Radio Regulations. The choice of a type of radiocommunication service to be used depends on the requirements of the specific GADSS function in accordance with Resolution [A110-GADSS] (WRC-19). This use of GADSS frequency bands shall not prevent the use of these bands by any application of the services to which these bands are allocated, nor shall establish a priority for GADSS. (WRC-19)

ADD

DRAFT NEW RESOLUTION [A110-GADSS] (WRC-19)

Implementation and operation of global aeronautical distress and safety system

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a) that the International Civil Aviation Organization (ICAO) has developed the concept of operations for the global aeronautical distress and safety system (GADSS);
- b) that GADSS is intended to provide for the timely identification and location of an aircraft during all phases of flight including distress and emergency situations, which will also support search and rescue (SAR) and flight data recorder recovery;
- c) that the GADSS at its current development phase can be introduced within existing primary aeronautical frequency allocations, and may not need any new systems or applications for such introduction;
- d) that the full GADSS concept can be realized in an evolutionary manner, and some applications may be developed after 2019,

recognizing

- a) that SAR operations of aircraft passengers and crew survived in an aircraft accident have the highest priority;
- b) that retrieval of flight recorder data is required to prevent aircraft accidents in future;
- c) that interference-free operation of systems included in GADSS and protection of the GADSS frequencies included in the Radio Regulations should be ensured;
- d) that there are provisions in the Radio Regulations, including frequency band allocations, related to aeronautical services that support distress and safety systems;
- e) that Annex 10 to the Convention on International Civil Aviation is a part of international standards and recommended practices for aeronautical telecommunication systems used by international civil aviation,

resolves

- 1 that GADSS elements shall use frequency bands which have already been allocated on a primary basis when used for safety purposes;

2 that the use of frequency bands for GADSS shall be limited to systems that operate in accordance with recognized international aviation standards;

3 that the frequency bands used by GADSS, its system elements and their technical characteristics to be contained in ITU-R Recommendation(s) as appropriate;

4 that in case of changes of the frequency bands, system elements included in GADSS or their technical and operational characteristics, these changes be contained in ITU-R Recommendation(s) as appropriate,

invites ITU-R

based on the information to be provided by ICAO, to develop the relevant ITU-R Recommendation(s) and to ensure their timely update,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of ICAO,

invites the International Civil Aviation Organization

to provide to ITU-R the information in relation to GADSS elements, their technical and operational characteristics and operational frequency bands for development of the relevant ITU-R Recommendations and timely update this information in case of change of GADSS elements, their technical characteristics and operational frequency bands.

SUP

RESOLUTION 426 (WRC-15)

Studies on spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System

5/1.10/5.3 Method C

NOC

ARTICLES

NOC

APPENDICES

NOC

RESOLUTIONS

NOC

RECOMMENDATIONS

SUP

RESOLUTION 426 (WRC-15)

Studies on spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System

Agenda item 9.1

9 *to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:*

9.1 *on the activities of the Radiocommunication Sector since WRC-15;*

NOTE: Nine issues have been identified by CPM19-1 under this agenda item.

Agenda item 9.1(9.1.4)

5/9.1.4 Resolution 763 (WRC-15)

Stations on board sub-orbital vehicles.

5/9.1.4/1 Executive summary

ITU-R is studying the impact of the future deployments of sub-orbital vehicles on radiocommunication regulations and some aspects would require further consideration. Thus, there is no requirement for any change to the Radio Regulations at WRC-19.

5/9.1.4/2 Background

WRC-15 adopted Resolution **763 (WRC-15)** to consider stations on board sub-orbital vehicles. It has been resolved to conduct studies during the WRC-19 study cycle:

- to identify any required technical and operational measures, in relation to stations on board sub-orbital vehicles, that could assist in avoiding harmful interference between radiocommunication services;
- to determine spectrum requirements and, based on the outcome of those studies, to consider a possible future agenda item for WRC-23.

It is also noted that ITU-R in 2015 formulated Question [ITU-R 259/5](#).

Sub-orbital vehicles, including space planes, have been developed to reach altitudes much higher than conventional aircraft. Some of them may be capable of reaching space. Sub-orbital vehicles may perform various missions (e.g. deploying a space vehicle, conducting scientific research, or providing transportation) and then return to the Earth's surface without completing a full orbit around the Earth.

Sub-orbital vehicles must safely share airspace used by conventional aircraft during their transition to and from high altitude, including those from space. There is a need to track and to be able to communicate and send commands to the sub-orbital vehicles for the entire duration of the flight. It is expected to use existing allocations, in particular, for systems and applications related to aviation safety and standardized by ICAO for harmonization and interoperability.

ICAO has begun efforts to change some existing aviation equipment standards to support possible use of that equipment by craft flying at altitudes and speeds greater than those reached by conventional aircraft.

5/9.1.4/3 Summary and analysis of the results of ITU-R studies

The ITU-R initiated regulatory, technical and operational studies on sub-orbital vehicles.

5/9.1.4/3.1 Regulatory issues

The definitions of sub-orbital vehicle and sub-orbital flight still need to be agreed taking into account that other international organizations are also dealing with this topic. However, the definitions used in preliminary draft new Report ITU-R M.[SUBORBITAL VEHICLES] for sub-orbital vehicles and sub-orbital flight preclude a sub-orbital vehicle from being considered a satellite. Indeed, there is no internationally agreed boundary between the Earth's atmosphere and the space domain⁴³. Consequently, there is not a defined delimitation between terrestrial services and space services as described in Article 1 of the Radio Regulations.

Considering a variety of operational uses needed in part or in all phases of sub-orbital flight, several frequency allocations currently defined in the Radio Regulations may be applicable. As such, stations used for sub-orbital flights could be operated within the framework of existing radiocommunication services provided that regulatory, technical and procedural provisions accommodate sub-orbital vehicle operational requirements and would not impact incumbent services.

5/9.1.4/3.2 Operations in the Earth's atmosphere

Sub-orbital vehicles operating in the Earth's atmosphere would be expected to use the existing allocations in accordance with the Radio Regulations.

5/9.1.4/3.3 Operations in space

Some sub-orbital vehicles are intended to reach such altitudes that define them as a spacecraft within the Radio Regulations. However, some radiocommunication equipment on board sub-orbital vehicles may expect to be interoperable with ICAO standardized systems and use frequency bands that are not included in the space radiocommunication service allocation, such as the ones operated under terrestrial allocations. Based on the Radio Regulations definitions, the radiocommunication services under which applications for sub-orbital vehicles operate need to be analysed. It is envisaged that for the purpose of flight under aeronautical regulation in the upper atmosphere, the station on board sub-orbital vehicle may also be considered as a terrestrial station or an earth station even if a part of the flight occurs in space. Should the intent of an application be to support communications including the one for safety of aircraft or vehicle, this application has to operate in both the Earth's atmosphere and space. Appropriate technical and operational mitigations may be necessary to eliminate potential interference to terrestrial and space services in these missions.

5/9.1.4/3.4 Technical studies including link analyses, Doppler shift, and frequency planning

Preliminary draft new Report ITU-R M.[SUBORBITAL VEHICLES] contains the three studies utilized for this agenda item in Annexes 1, 5 and 6.

Study 1 contained in Annex 1 analyses the impact of sub-orbital vehicle's space access on air transportation, an individual launch and re-entry for one sub-orbital vehicle is discussed.

Study 2 contained in Annex 5 contains the link budget analyses for sub-orbital vehicles using avionics systems for communications, navigation, and surveillance have been studied and shows that the performance required for radiocommunications may be fulfilled when there is no radiocommunications blackout. Study 2 also provides the Doppler shift analyses for sub-orbital vehicles using avionics systems for communications, navigation, and surveillance and show that the performance required for radiocommunications may be fulfilled. The same study shows there may

⁴³ *Considering b)* of WRC-15 Resolution **763 (WRC-15)** states that the boundary between the Earth's atmosphere and space is usually assumed to be 100 kilometres above the Earth's surface.

be impact on terrestrial frequency planning. However, the study does not take into account such impact on other services.

Study 3 contained in Annex 6 indicates that to avoid a communications blackout, additional communications system(s) may be required to provide continuous coverage throughout the entire mission. Indeed, during some types of re-entry, there may be a loss of radiocommunications, and certain frequencies may be more susceptible to the loss of link, while frequency bands higher than 23 GHz may help mitigate or eliminate this problem. Also, in Study 3, Doppler shift and its rate of change were analysed for an example mission of a sub-orbital vehicle. The Doppler shift and its rate of change due to the speed and acceleration of sub-orbital vehicles during some flight phases may have to be further analysed including the avoidance of impact on other services.

5/9.1.4/3.5 Further regulatory analysis and technical studies

Regulatory analyses are required on the radiocommunication services under which applications for sub-orbital vehicle operates, and how applications commonly operated under terrestrial services, in particular aeronautical mobile services, or under space services could also be used.

Consideration is needed for definitions to support radiocommunications of sub-orbital vehicles.

The variations in Doppler shift and its rate of change due to the speed, communications blackout, link budgets and antenna footprints, taking into account altitude, require technical studies to assess the suitability of currently available aviation systems. Further studies to assess the potential for interference between services may also have to be considered in the case of a sub-orbital vehicle operated with:

- terrestrial stations;
- space stations.

Existing relevant Recommendations and Reports are listed as follows:

- i) Preliminary draft new Report ITU-R M.[SUBORBITAL VEHICLES] –
Radiocommunications for sub-orbital vehicles

5/9.1.4/4 Conclusions

There is no requirement for any change to the Radio Regulations at WRC-19. Further operational, technical and regulatory issues may need to be addressed, which require continuing studies, on the status of the station aboard sub-orbital vehicles and type of applications, through the appropriate mechanism and on the potential interference to be considered with regards to radiocommunication systems operating on sub-orbital vehicles. Resolution **763 (WRC-15)** could be revised, or a new resolution could be developed to support these further studies by considering a future agenda item.

CHAPTER 6

General issues

(Agenda items 2, 4, 9.1 (issues 9.1.6, 9.1.7), 10)

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Agenda item 2

2 *to examine the revised ITU-R Recommendations incorporated by reference in the Radio Regulations communicated by the Radiocommunication Assembly, in accordance with Resolution 28 (Rev.WRC-15), and to decide whether or not to update the corresponding references in the Radio Regulations, in accordance with the principles contained in Annex 1 to Resolution 27 (Rev.WRC-12);*

Resolution 28 (Rev.WRC-15): *Revision of references to the text of ITU-R Recommendations incorporated by reference in the Radio Regulations*

Resolution 27 (Rev.WRC-12): *Use of incorporation by reference in the Radio Regulations*

6/2/1 ITU-R Recommendations incorporated by reference in the Radio Regulations which have been revised and approved since WRC-15

According to Resolution 28 (Rev.WRC-15), the CPM Report shall include a list of those ITU-R Recommendations incorporated by reference in the Radio Regulations (RR) (see Resolution 27 (Rev. WRC-12)), which have been revised and approved during the elapsed study period. Since WRC-15 the following ITU-R Recommendations fall in this category:

- Rec. ITU-R P.525-2 “Calculation of free-space attenuation”;
- Rec. ITU-R P.526-13 “Propagation by diffraction”;
- Rec. ITU-R RS.1260-1 “Feasibility of sharing between active spaceborne sensors and other services in the range 420-470 MHz”.

Administrations are invited to examine the most recent versions of the above ITU-R Recommendations, namely ITU-R P.525-3, ITU-R P.526-14, and ITU-R RS.1260-2, with a view to considering the possible updating of the relevant references in the RR.

It should be noted that future possible draft revisions of some other ITU-R Recommendations, also incorporated by reference in the RR, may be in the course of the ITU-R approval process to be ended before WRC-19. Further information about the approval or otherwise of these Recommendations will be provided later on.

It should also be noted that some ITU-R Recommendations are incorporated by reference in RR provisions or WRC Resolutions that are being considered under specific WRC-19 agenda items or issues (e.g. Rec. ITU-R M.1652-1 (Annex 1) under WRC-19 agenda item 1.16; Rec. ITU-R RS.1632-0 and Rec. ITU-R M.1638-0 in response to Resolution 764 (WRC-15) that is being considered in Chapter 2 of the draft CPM Report under issue 9.1.5 of WRC-19 agenda item 9.1).

The cross-reference list of the regulatory provisions, including footnotes and Resolutions, incorporating ITU-R Recommendations is contained in the 2016 Edition of RR Volume 4 together with the text of the ITU-R Recommendations incorporated by reference.

6/2/2 Lists of RR provisions and footnotes containing references to ITU-R Recommendations or to WRC Resolutions containing references to ITU-R Recommendations

According to Resolution 27 (Rev.WRC-12), the Director of the Radiocommunication Bureau is instructed:

“to identify the provisions and footnotes of the Radio Regulations containing references to ITU-R Recommendations and make suggestions on any further action to the second

session of the Conference Preparatory Meeting (CPM) for its consideration, as well as for inclusion in the Director's Report to the next WRC".

The list of the RR provisions and footnotes containing references to ITU-R Recommendations is provided in Table 6/2-1.

"to identify the provisions and footnotes of the Radio Regulations containing references to WRC Resolutions that contain references to ITU-R Recommendations, and make suggestions on any further action to the second session of the Conference Preparatory Meeting (CPM) for its consideration, as well as for inclusion in the Director's Report to the next WRC".

The list of the RR provisions and footnotes containing references to WRC Resolutions that contain references to ITU-R Recommendations is provided in Table 6/2-2.

Administrations are invited to submit proposals to the Conference, taking into account the CPM Report.

TABLE 6/2-1
List of RR provisions and footnotes
containing references to ITU-R Recommendations

| RR provisions or footnotes | Recommendation ITU-R * | Included in RR Volume 4 |
|-------------------------------------|---|-------------------------|
| No. 5.54A | RS.1881 (most recent version of) | NO |
| No. 5.228 | M.1371 (most recent version of) | NO |
| No. 5.279A | RS.1260-1 *** | YES |
| Nos. 5.287,5.288 | M.1174-3 | YES |
| No. 5.391 | SA.1154-0 | YES |
| No. 5.447E | F.1613-0 | YES |
| No. 5.447F | RS.1632-0, M.1638-0 *** | YES (both) |
| No. 5.450A | M.1638-0 *** | YES |
| No. 5.474B | RS.2066-0 | YES |
| No. 5.474C | RS.2065-0 | YES |
| Nos. 5.504B, 5.504C, 5.508A, 5.509A | M.1643-0 | YES |
| No. 5.511C | S.1340-0 | YES |
| No. 5.530A | P.452 (most recent version of), BO.1898 (most recent version of) | NO (both) |
| No. 5.536A | SA.1862 (most recent version of) | NO |
| No. 5.543A | RA.769(most recent version of) | NO |
| No. 5.551H | S.1586-1, RA.1631-0 | YES (both) |
| No. 5.559B | M.2057(most recent version of) | NO |
| Nos. 16.2, 16.6 | SM.1139(most recent version of) | NO |
| No. 19.48 | M.1172-0 | YES |
| No. 19.83 | M.476-5, M.625-4 | YES (both) |
| No. 19.96A | M.476-5 | YES |
| Nos. 19.99, 19.102 | M.585-7 | YES |
| No. 19.108A | M.585(most recent version of) | - |
| No. 19.111 | M.585-7 Annex 1 | YES |

| RR provisions or footnotes | Recommendation ITU-R * | Included in RR Volume 4 |
|---|---|----------------------------|
| Nos. 21.2.2, 21.4.1 | SF.765(most recent version of) **** | NO |
| No. 22.5A | S.1256-0 | YES |
| TABLE 22-1A , TABLE 22-1B , TABLE 22-1C (and No. 22.5C.6) | S.1428-1 | YES |
| TABLE 22-1D (and No. 22.5C.11) | BO.1443-3 Annex 1 | YES |
| TABLE 22-2 (and No. 22.5D.3), TABLE 22-3 (and No. 22.5F.3) | S.672-4 | YES |
| No. 22.36 | S.732 (most recent version of) | NO |
| No. 25.6 | M.1544(most recent version of) | NO |
| No. 29.12 | RA.769 (most recent version of) | NO |
| No. 32.5 | M.493(most recent version of) M.541(most recent version of) | NO - |
| No. 32.7 | M.1172(most recent version of) | - |
| No. 32.13E | M.541 (most recent version of) | - |
| Nos. 32.19B, 32.21A | M.493 (most recent version of) M.541 (most recent version of) | NO - |
| No. 32.53C | M.493 (most recent version of) | NO |
| Nos. 33.8, 33.20A | M.493 (most recent version of) M.541 (most recent version of) | NO - |
| No. 34.1 | M.633-4 | YES |
| Nos. 34.2, 51.25 | M.493 (most recent version of) | NO |
| No. 51.35 | M.541-10 | YES |
| No. 51.41 | M.476-5, M.625-4 M.627(most recent version of) | YES (both) NO |
| No. 51.71 | M.1171(most recent version of) M.1170 (most recent version of) | - NO |
| No. 51.77 | M.489-2 | YES |
| No. 52.112 | M.541-10 M.493 (most recent version of) | YES NO |
| Nos. 52.149, 52.153 | M.541-10 | YES |
| No. 52.181 | M.1173-1 | YES |
| Nos. 52.192, 52.195, 52.213, 52.224 | M.1171-0 | YES |
| No. 52.229 | M.1173-1 | YES |
| No. 52.231 | M.489-2 | YES |
| Nos. 52.234, 52.240 | M.1171-0 | YES |
| No. 52.264 | M.1798 (most recent version of) | NO |
| No. 54.2 | M.493 (most recent version of) M.541-10 | NO YES |
| No. 55.1 | M.1170 (most recent version of) | NO |
| No. 56.2 | M.492-6 | YES |
| No. 57.1 | M.1171-0 | YES |
| Appendix 1 (§ 1 and § 2) | SM.1138-2 | YES |

| RR provisions or footnotes | Recommendation ITU-R * | Included in RR Volume 4 |
|---|--|-------------------------|
| Appendix 3: | | |
| § 4 | SM.329 (most recent version of) | NO |
| § 9 | M.1177 (most recent version of) | NO |
| § 10 | SM.329 (most recent version of), M.1177 (most recent version of) | NO (both) |
| § 13 (Note 14 to Table I) | M.1177 (most recent version of) | NO |
| Annex 1 (§ 1 and § 3) | SM.1541 (most recent version of) | NO |
| Appendix 4: | | |
| Annex 1, Footnotes to Tables 1 and 2 (§ 1) | SF.675 (most recent version of) | NO |
| Annex 1, Table 2, items 3.5.c.a, 3.5.d, 3.5.e, 3.5.f | F.1500 (most recent version of) | NO |
| Annex 2, Information related to the data listed in the following tables | S.1503 (most recent version of), SM.1413 (most recent version of) | NO (both) |
| Annex 2, Footnotes to Tables A, B, C, D (§ 2) | SF.675 (most recent version of) | NO |
| Annex 2, items B.4.a.3.a.1, B.4.a.3.a.2 | SM.1413 (most recent version of) | NO |
| Annex 2, items B.5.d, C.10.d.9 | SM.1855 (most recent version of) | NO |
| Annex 2, item C.11.b | M.1187-1 | YES |
| Appendix 5, Annex 1: | | |
| § 1.2.1 | M.1143 (most recent version of) | NO |
| § 1.2.3.1, Note 6 | SF.357 (most recent version of) | NO |
| § 1.2.3.2 | M.1143 (most recent version of) | NO |
| Appendix 7, § 1.4, footnote 4 | SM.1448 | NO |
| Appendix 7, Annex 4, § 1, Annex5, § 2.1 and Annex6, § 4 | SM.1448 (most recent version of) | NO |
| Appendix 10, footnote 3 | M.1172(most recent version of) | - |
| Appendix 15: | | |
| Table 15-2 | M.690-3 | YES |
| Legend: AIS | M.1371 (most recent version of) | NO |
| Appendix 17 | | |
| Annex 1, Part B, Section I (§ 2; § 6 a) and b)) | M.1173-1 | YES |
| Annex 2, Part A (notes <i>p</i>), <i>t</i>) and <i>v</i>)) | M.1798 (most recent version of) | NO |
| Annex 2, Part B, Section I (§ 2; § 6 a) and b)) | M.1173-1 | YES |
| Annex 2, Part B, Section IV (Note 1 to the table) | M.1798 (most recent version of) | NO |
| Appendix 18: | | |
| Note B | M.1084-5 Annex 4, Tables 1 and 3 M.1842 (most recent version of) | YES NO |
| <i>General notes, e)</i> | M.1084 (most recent version of) M.489-2 | NO YES |
| <i>General notes, l), s)</i> | M.1371 (most recent version of) | NO |
| <i>General notes, w)</i> | M.1084 (most recent version of), M.2092 (most recent version of) | NO (both) |
| <i>General notes, wa)</i> | M.1084 (most recent version of), M.1842(most recent version of) | NO (both) |

| RR provisions or footnotes | Recommendation ITU-R * | Included in RR Volume 4 |
|--------------------------------------|---|-------------------------|
| <i>General notes, ww)</i> | M.1842 (most recent version of), M.2092 (most recent version of) | NO (both) |
| <i>General notes, xx), z)</i> | M.2092 (most recent version of) | NO |
| Appendix 30 : | | |
| Article 11, Col. 6 | BO.1445 | NO |
| Article 11, Col. 9; Annex 3, § 2.4.1 | BO.1213 ** | NO |
| Annex 5, § 2.1 | P.837-1 **, P.618-5 ** | NO (both) |
| Annex 5, § 3.1.1 | F.405-1 (suppressed by RA-03) | NO |
| Annex 5, § 3.2.4 | BO.1212 | NO |
| Annex 5, § 3.4 | BO.1293-2 BO.1297 | YES NO |
| Annex 5, § 3.7.2 | BO.1213 ** | NO |
| Annex 5, § 3.13.3 | BO.1445 | NO |
| Annex 6, Part A, § 1.1 | BO.1213 **, S.580-5 ** | NO (both) |
| Annex 6, Part B, § 1.5 | S.483-3 | NO |
| Annex 6, Part B, § 1.6 | BT.500-7 ** | NO |
| Annex 6, Part B, § 2.1 | S.465-5 ** | NO |
| Appendix 30A : | | |
| Article 9A, Col. 6 | BO.1296 | NO |
| Article 9A, Col. 9 | BO.1295 | NO |
| Annex 3, § 2.1 | P.837-1 ** | NO |
| Annex 3, § 2.2 | P.618-5 **, P.841 ** P.838-3 | NO (both) YES |
| Annex 3, § 2.4 | P.618-5 ** | NO |
| Annex 3, § 3.3 | BO.1293-2 BO.1297 | YES NO |
| Annex 3, § 3.5.3 | BO.1295 | NO |
| Annex 3, § 3.7.3 | BO.1296 | NO |
| Annex 3, § 3.9 | BO.1212 | NO |
| Appendix 30B : | | |
| Annex 1, § 1.2 | P.676-7 **, P.618-9 ** | NO (both) |
| Annex 1, § 1.3 | P.837-5 ** | NO |

* Numbers in bold indicate that these versions of the Recommendations are incorporated by reference and included in RR Volume 4.

** This is not the most recent version of this Recommendation.

*** This Recommendation incorporated by reference has been revised and approved since WRC-15.

**** In these RR provisions, the reference to “(see Resolution 27 (Rev.WRC-03))” may be considered as redundant and deleted.

TABLE 6/2-2

List of RR provisions and footnotes containing references to WRC Resolutions that contain references to ITU-R Recommendations

| RR provisions or footnotes | WRC Resolution | Recommendation ITU-R* | Included in RR Volume 4 |
|--|----------------------------|--|--------------------------------|
| No. 5.547 | 75 (WRC-2000) ** | SA.1157 **, SA.1396 | NO (both) |
| - | 75 (Rev.WRC-12) | SA.1157 **, SA.1396, F.1760, F.1765 | NO (all) |
| No. 22.5K | 76 (WRC-2000) ** | S.1428 **, BO.1443 ** | - |
| - | 76 (Rev.WRC-15) | S.1588 S.1428**, BO.1443 ** | NO - |
| Nos. 5.444, 5.444A | 114 (Rev.WRC-15) | S.1342 | NO |
| Nos. 5.552A ; Appendix 4, Annex 1, Table 2, items 1.14.e, 1.14.f, 1.14.g, 1.14.h | 122 (Rev.WRC-07) | F.1500, SF.1481-1, SF.1843, F.1820 | NO (all) |
| No. 22.5CA | 140 (WRC-03) ** | - | - |
| | 140 (Rev.WRC-15) | S.1715 | NO |
| No. 5.516B | 143 (WRC-03) ** | S.524-7 **, S.1594 | NO |
| - | 143 (Rev.WRC-07) ** | S.524-9, S.1594, S.1783 | NO |
| Appendix 4, Annex 1, Table 2, item 1.14.d | 145 (Rev.WRC-07) ** | F.1570 **, F.1609 **, SF.1601 **, F.1612 | NO (all) |
| Nos. 5.537A, 5.543A | 145 (Rev.WRC-12) | F.1570 **, F.1609 **, SF.1601 **, F.1612 | NO (all) |
| No. 5.457 | 150 (WRC-12) | F.1891, F.2011 | NO (all) |
| No. 5.484B | 155 (WRC-15) | RA.769 (most recent version of), RA.1513 (most recent version of) | NO (both) |
| No. 5.265 | 205 (Rev.WRC-15) | M.1478 ** | NO |
| Nos. 5.162A, 5.291A | 217 (WRC-97) | M.1226, M.1085-1, M.1227 ** | NO (all) |
| No. 5.388A ; Appendix 4, Annex 1, Table 2, items 1.14.b, 1.14.c | 221 (Rev.WRC-07) | M.1456, M.1457 ** | NO (both) |
| Nos. 5.341A, 5.341B, 5.341C, 5.346, 5.346A, 5.384A, 5.388, 5.429B, 5.429D, 5.429F, 5.441A, 5.441B | 223 (Rev.WRC-15) | M.819 **, M.1308, M.1457 **, M.1645, M.2012 ** | NO (all) |
| Nos. 5.286AA, 5.295, 5.296A, 5.308A, 5.312A, 5.316B, 5.317A | 224 (Rev.WRC-15) | M.819 **, M.1036 **, M.1645 | NO (all) |
| Nos. 5.446A, 5.447, 5.453 | 229 (Rev.WRC-12) | RS.1166 **, S.1426, M.1450 (most recent version of), M.1454, M.1653 M.1652 ** | NO (all) - |
| | | RS.1632, M.1652-1 Annex 1 | YES (both) |

| RR provisions or footnotes | WRC Resolution | Recommendation ITU-R* | Included in RR Volume 4 |
|---|-----------------------|--|-------------------------|
| No. 32.10A | 349 (WRC-97) ** | - | - |
| | 349 (Rev. WRC-12) | M.493 (most recent version of) | NO |
| Nos. 52.101, 52.189 | 354 (WRC-07) | M.1171, M.1172 | - |
| No. 5.197A | 413 (Rev.WRC-07) ** | SM.1009 (most recent version of), BS.1114 ** | NO (both) |
| - | 413 (Rev.WRC-12) | SM.1009 (most recent version of), BS.1114 ** | NO (both) |
| No. 5.327A | 417 (Rev.WRC-15) | M.2013-0 Annex 1 | YES |
| No. 5.446C | 418 (Rev.WRC-12) ** | M.1828, M.1829 | NO (both) |
| No. 5.444B | 418 (Rev.WRC-15) | M.1828, M.1829 | NO (both) |
| No. 5.436 | 424 (WRC-15) | M.2067, M.2085 | NO (both) |
| Appendix 11, Part B, § 1.1 | 517 (Rev.WRC-03) ** | BS.1514 ** | NO |
| No. 5.134 | 517 (Rev.WRC-07) ** | BS.1514 ** | NO |
| - | 517 (Rev.WRC-15) ** | BS.1514 ** | NO |
| Appendix 11, Part C, § 1.1, § 2.5 | 543 (WRC-03) | BS.1514 **, BS.1615 ** | NO (both) |
| No. A.9.8; Appendix 5, Table 5-1, No. 9.7, 6bis) | 553 (WRC-12) ** | BO.1900 | NO |
| - | 553 (Rev.WRC-15) | BO.1900 | NO |
| No. 5.329 | 608 (WRC-03) ** | - | - |
| | 608 (Rev.WRC-15) | M.1902 | NO |
| No. 5.328A | 609 (Rev.WRC-07) | M.1642-2 | YES |
| No. 21.18 | 609 (Rev.WRC-03) ** | M.1642 ** | - |
| Nos. 5.132A, 5.145A, 5.161A; Appendix 4, Annex 1, Table 1, items 3A1, 3A2 | 612 (Rev.WRC-12) | P.368-9, P.372-10 ** | NO (both) |
| No. 1.14 | 655 (WRC-15) | TF.460-6 | YES |
| No. 29A.1 | 673 (Rev.WRC-12) | RS.1859, RS.1883 | NO (both) |
| Nos. 5.389A, 5.389C | 716 (Rev.WRC-2000) ** | F.1098 ** | NO |
| - | 716 (Rev.WRC-12) | F.1098 **, F.1335 | NO (both) |
| No. 5.208B | 739 (Rev.WRC-15) | RA.1513 ** | NO |
| | | M.1583 **, S.1586 **, RA.1631 RA.1631-0 | - YES |
| No. 5.443B; Appendix , Annex 2, items A.17.b.1, A.17.b.3 | 741 (Rev.WRC-15) | RA.769 **, RA.1513 ** M.1583 **, RA.1631 M.1583-1, RA.1631-0 | NO (both) - YES |
| No. 5.379D | 744 (Rev.WRC-07) | M.1799 | NO |
| No. 5.444B | 748 (Rev.WRC-15) | P.525-2 ***, P.526-13 ***, M.1827-1 | YES (all) |

| RR provisions or footnotes | WRC Resolution | Recommendation ITU-R* | Included in RR Volume 4 |
|---|----------------------------|---|-------------------------|
| Nos. 5.316B , 5.317A | 749 (Rev.WRC-15) | BT.1368 **, BT.1368 (most recent version of), BT.1895 (most recent version of), BT.2033 **, BT.2033 (most recent version of) | NO (all) |
| No. 5.338A | 750 (Rev.WRC-15) | RS.1029 **** | NO |
| Nos. 5.312A , 5.317A | 760 (WRC-15) | M.1036 **, BT.1368 **, BT.1368 (most recent version of), BT.1895 (most recent version of), BT.2033 **, BT.2033 (most recent version of), M.2090, M.2090 (most recent version of) | NO (all) |
| Nos. 5.346 , 5.346A | 761 (WRC-15) | M.1459 | NO |
| No. 11.32A.2 | 762 (WRC-15) | BO.1213 ** | NO |
| Appendix 5, Table 5-1, No. 9.7, 7) and 8) | 901 (Rev.WRC-07) ** | - | - |
| | 901 (Rev.WRC-15) | S.1780 | NO |
| Nos. 5.457A , 5.457B , 5.506A , 5.506B | 902 (WRC-03) | SF.1650 ** | NO |

* Numbers in bold indicate that this version of the Recommendations are incorporated by reference and included in RR Volume 4.

** This is not the most recent version of this Recommendation or Resolution.

*** This Recommendation incorporated by reference has been revised and approved since WRC-15.

**** This Recommendation was suppressed following the approval of Recommendation ITU-R RS.2017 (see CACE/583 of 22 August 2012).

6/2/3 Possible merger of Resolutions 27 (Rev.WRC-12) and 28 (Rev.WRC-15)

Some administrations proposed consideration of possible merger of Resolutions 27 (Rev.WRC-12) and 28 (Rev.WRC-15), taking into account the following points:

- There are cross-references in both Resolutions;
- The paragraphs for “*instructs the Director of the Radiocommunication Bureau*” or “*urges/invites administrations*” are provided in two separate Resolutions;
- Some texts in the current Resolutions may require more clarification;
- If a single Resolution could be developed and approved, without losing the necessary elements in the current two Resolutions, the preparatory work of Member States and/or the Secretariat may become more efficient.

For further consideration by administrations for their preparation for the WRC-19, the points below may be noted to improve or simplify the text:

- whether it is needed to have separate two paragraphs, i.e. “*resolves*” and “*further resolves*”;
- whether the entire items are properly arranged in their order;
- whether there are any overlapped elements or redundancy between the texts.

Administrations are invited to examine this during preparation for WRC-19.

MOD

RESOLUTION 27 (REV.WRC-~~12~~19)

Use of incorporation by reference in the Radio Regulations

The World Radiocommunication Conference (~~Geneva~~Sharm el-Sheikh, 20122019),

considering

a) that the Voluntary Group of Experts (VGE) on simplification of the Radio Regulations proposed the transfer of certain texts of the Radio Regulations to other documents, especially to ITU-R Recommendations, using the incorporation by reference procedure;

~~a~~b) that the principles of incorporation by reference were adopted by WRC-95 and revised by subsequent conferences ~~(see Annexes 1 and 2 to this Resolution);~~

~~b~~c) that, in some cases, there are provisions in the Radio Regulations containing references which fail to distinguish adequately whether the status of the referenced text is mandatory or non-mandatory;

d) that all texts of ITU-R Recommendations incorporated by reference are published in a volume of the Radio Regulations;

e) that, taking into account the rapid evolution of technology, ITU-R may revise the ITU-R Recommendations containing text incorporated by reference at short intervals;

f) that, following revision of an ITU-R Recommendation containing text incorporated by reference, the reference in the Radio Regulations shall continue to apply to the earlier version until such time as a competent world radiocommunication conference (WRC) agrees to incorporate the new version;

g) that it would be desirable that texts incorporated by reference reflect the most recent technical developments,

noting

a) that references to Resolutions or Recommendations of a world radiocommunication conference (WRC) require no special procedures, and are acceptable for consideration, since such texts will have been agreed by a WRC;

b) that administrations need sufficient time to examine the potential consequences of changes to ITU-R Recommendations containing text incorporated by reference and would therefore benefit greatly from being advised, as early as possible, of which ITU-R Recommendations have been revised and approved during the elapsed study period or at the Radiocommunication Assembly preceding the WRC,

resolves

1 that for the purposes of the Radio Regulations, the term “incorporation by reference” shall only apply to those references intended to be mandatory;

2 that the text incorporated by reference shall have the same treaty status as the Radio Regulations themselves;

3 that the reference must be explicit, specifying the specific part of the text (if appropriate) and the version or issue number;

4 that, where a mandatory reference to an ITU-R Recommendation, or parts thereof, is included in the *resolves* of a WRC Resolution, which is itself cited in a provision or footnote of the Radio Regulations using mandatory language (i.e. “shall”), ITU-R Recommendation or parts thereof shall also be considered as incorporated by reference;

5 that texts which are of a non-mandatory nature or which refer to other texts of a non-mandatory nature shall not be considered for incorporation by reference;

26 that when considering the introduction of new cases of incorporation by reference, such incorporation shall be kept to a minimum and made by applying the following criteria:

–6.1 only texts which are relevant to a specific WRC agenda item may be considered;

~~the correct method of reference shall be determined on the basis of the principles set out in Annex 1 to this Resolution;~~

6.2 where the relevant texts are brief, the referenced material should be placed in the body of the Radio Regulations rather than using incorporation by reference;

–6.3 the guidance contained in Annex 21 to this Resolution shall be applied in order to ensure that the correct method of reference for the intended purpose is employed;

37 that the text of the incorporation by reference must be submitted for adoption by a competent WRC and the procedure described in Annex 32 to this Resolution shall be applied for approving the incorporation by reference of ITU-R Recommendations or parts thereof;

48 that existing references to ITU-R Recommendations shall be reviewed to clarify whether the reference is mandatory or non-mandatory in accordance with Annex 21 to this Resolution;

59 that ITU-R Recommendations, or parts thereof, incorporated by reference at the conclusion of each WRC, and a cross-reference list of the regulatory provisions, including footnotes and Resolutions, incorporating such ITU-R Recommendations by reference, shall be collated and published in a volume of the Radio Regulations (see Annex 32 to this Resolution);

10 that if, between WRCs, a text incorporated by reference (e.g. an ITU-R Recommendation) is updated, the reference in the Radio Regulations shall continue to apply to the earlier version incorporated by reference until such time as a competent WRC agrees to incorporate the new version; the mechanism for considering such a step is given in *further resolves* part of this Resolution.

further resolves

1 that each radiocommunication assembly shall communicate to the following WRC a list of the ITU-R Recommendations containing text incorporated by reference in the Radio Regulations which have been revised and approved during the elapsed study period;

2 that, on this basis, WRC should examine those revised ITU-R Recommendations, and decide whether or not to update the corresponding references in the Radio Regulations;

3 that, if the WRC decides not to update the corresponding references, the currently referenced version shall be maintained in the Radio Regulations;

4 to invite future world radiocommunication conferences to include a standing agenda item which examine revised ITU-R Recommendations in accordance with *further resolves 1 and 2* of this Resolution.

instructs the Director of the Radiocommunication Bureau

- 1 to bring this Resolution to the attention of the Radiocommunication Assembly and the ITU-R Study Groups;
- 2 to identify the provisions and footnotes of the Radio Regulations containing references to ITU-R Recommendations and make suggestions on any further action to the second session of the Conference Preparatory Meeting (CPM) for its consideration and inclusion in the CPM Report, as well as for inclusion in the Director's Report to the next WRC;
- 3 to identify the provisions and footnotes of the Radio Regulations containing references to WRC Resolutions that contain references to ITU-R Recommendations, and make suggestions on any further action to the second session of the Conference Preparatory Meeting (CPM) for its consideration and inclusion in the CPM Report, as well as for inclusion in the Director's Report to the next WRC;
- 4 to provide the second session of the CPM with a list, for inclusion in the CPM Report, of those ITU-R Recommendations containing texts incorporated by reference that have been revised or approved since the previous WRC, or that may be revised in time for the following WRC,

invites administrations

- 1 to submit proposals to future conferences, taking into account the CPM Report, in order to clarify the status of references, where ambiguities remain regarding the mandatory or non-mandatory status of the references in question, with a view to amending those references:
 - i) that appear to be of a mandatory nature, identifying such references as being incorporated by reference by using clear linking language in accordance with Annex 21;
 - ii) that are of a non-mandatory character, so as to refer to “the most recent version” of the Recommendations;
- 2 to participate actively in the work of the radiocommunication study groups and the radiocommunication assembly on revision of those Recommendations to which mandatory references are made in the Radio Regulations;
- 3 to examine any indicated revisions of ITU-R Recommendations containing text incorporated by reference and to prepare proposals on possible updating of relevant references in the Radio Regulations.

ANNEX 1 TO RESOLUTION 27 (Rev.WRC-12)

Principles of incorporation by reference

- 1 ~~For the purposes of the Radio Regulations, the term “incorporation by reference” shall apply only to those references intended to be mandatory.~~
- 2 ~~Where the relevant texts are brief, the referenced material should be placed in the body of the Radio Regulations rather than using incorporation by reference.~~
- 3 ~~Where a mandatory reference to an ITU-R Recommendation, or parts thereof, is included in the resolves of a WRC Resolution, which is itself cited in a provision or footnote of the Radio Regulations using mandatory language (i.e. “shall”), that ITU-R Recommendation or parts thereof shall also be considered as incorporated by reference.~~
- 4 ~~Texts which are of a non-mandatory nature or which refer to other texts of a non-mandatory nature shall not be considered for incorporation by reference.~~

~~5 ————— If, on a case-by-case basis, it is decided to incorporate material by reference on a mandatory basis, then the following provisions shall apply:~~

~~5.1 ————— the text incorporated by reference shall have the same treaty status as the Radio Regulations themselves;~~

~~5.2 ————— the reference must be explicit, specifying the specific part of the text (if appropriate) and the version or issue number;~~

~~5.3 ————— the text incorporated by reference must be submitted for adoption by a competent WRC in accordance with *resolves 3*;~~

~~5.4 ————— all texts incorporated by reference shall be published following a WRC, in accordance with *resolves 5*.~~

~~6 ————— If, between WRCs, a text incorporated by reference (e.g. an ITU-R Recommendation) is updated, the reference in the Radio Regulations shall continue to apply to the earlier version incorporated by reference until such time as a competent WRC agrees to incorporate the new version. The mechanism for considering such a step is given in Resolution **28 (Rev.WRC-03)**^{*}.~~

ANNEX ~~2~~1 TO RESOLUTION 27 (REV.WRC-~~12~~19)

Application of incorporation by reference

When introducing new cases of incorporation by reference in the provisions of the Radio Regulations or reviewing existing cases of incorporation by reference, administrations and ITU-R should address the following factors in order to ensure that the correct method of reference is employed for the intended purpose, according to whether each reference is mandatory (i.e. incorporated by reference), or non-mandatory:

Mandatory references

1 mandatory references shall use clear linking language, i.e. “shall”;

2 mandatory references shall be explicitly and specifically identified, e.g. “Recommendation ITU-R M.541-8”;

3 if the intended reference material is, as a whole, unsuitable as treaty-status text, the reference shall be limited to just those portions of the material in question which are of a suitable nature, e.g. “Annex A to Recommendation ITU-R Z.123-4”.

Non-mandatory references

4 Non-mandatory references or ambiguous references that are determined to be of a non-mandatory character (i.e. not incorporated by reference) shall use appropriate language, such as “should” or “may”. This appropriate language may refer to “the most recent version” of a Recommendation. Any appropriate language may be changed at any future WRC.

^{*} ~~Note by the Secretariat: This Resolution was revised by WRC-15.~~

ANNEX ~~32~~ TO RESOLUTION 27 (REV.WRC-~~12~~19)

**Procedures applicable by WRC for approving the incorporation
by reference of ITU-R Recommendations or parts thereof**

~~The referenced texts shall be made available to delegations in sufficient time for all administrations to consult them in the ITU languages. A single copy of the texts shall be made available to each administration as a conference document.~~

During the course of each WRC, a list of the ~~texts~~ ITU-R Recommendations incorporated by reference, and a cross-reference list of the regulatory provisions, including footnotes and Resolutions, incorporating such ITU-R Recommendations by reference, shall be developed and maintained by the committees. These lists shall be published as a conference document in line with developments during the conference.

Following the end of each WRC, the Bureau and General Secretariat will update the volume of the Radio Regulations which serves as the repository of ~~texts~~ ITU-R Recommendations incorporated by reference in line with developments at the conference as recorded in the above-mentioned document.

SUP

RESOLUTION 28 (REV.WRC-15)

**Revision of references to the text of ITU-R Recommendations
incorporated by reference in the Radio Regulations**

The following Table is provided for better understanding of the above proposed text for the merger of Resolution 27 (Rev.WRC-12) and 28 (Rev.WRC-15).

Structure comparison of the elements contained in Resolutions 27 and 28

| Current Resolution 27 | Current Resolution 28 | New proposed text |
|-----------------------|-----------------------|---|
| | <i>considering a)</i> | <i>considering a)</i> |
| <i>considering a)</i> | | <i>considering b)</i> |
| <i>considering b)</i> | <i>considering b)</i> | <i>considering c)</i> combined with edits |
| | <i>considering c)</i> | delete |
| | <i>considering d)</i> | <i>considering d)</i> |
| | <i>considering e)</i> | <i>considering e)</i> |
| | <i>considering f)</i> | <i>considering f)</i> |
| | <i>considering g)</i> | <i>considering g)</i> |
| <i>noting</i> | | <i>noting a)</i> |
| | <i>noting</i> | <i>noting b)</i> |
| <i>resolves 1</i> | | <i>resolves 1</i> |
| 5.1 of Annex 1 | | <i>resolves 2</i> |
| 5.2 of Annex 1 | | <i>resolves 3</i> |

| Current Resolution 27 | Current Resolution 28 | New proposed text |
|---------------------------------|--------------------------------|----------------------------------|
| 3 of Annex 1 | | <i>resolves 4</i> |
| 4 of Annex 1 | | <i>resolves 5</i> |
| <i>resolves 2</i> | | <i>resolves 6</i> |
| item 1 | | 6.1 |
| item 2 of Annex 1 | | 6.2 |
| <i>resolves 2</i> item 2 | | <i>(deletion)</i> |
| item 3 | | 6.3 |
| <i>resolves 3</i> | | <i>resolves 7</i> |
| <i>5.3 of Annex 1</i> | | |
| <i>resolves 4</i> | | <i>resolves 8</i> |
| <i>resolves 5</i> | | <i>resolves 9</i> |
| <i>6 of Annex 1</i> | | <i>resolves 10</i> |
| | <i>resolves 1</i> | <i>further resolves 1</i> |
| | <i>resolves 2</i> | <i>further resolves 2</i> |
| | <i>resolves 3</i> | <i>further resolves 3</i> |
| | <i>resolves 4</i> | <i>further resolves 4</i> |
| <i>instructs the Director 1</i> | | <i>instructs the Director 1</i> |
| <i>instructs the Director 2</i> | | <i>instructs the Director 2</i> |
| <i>instructs the Director 3</i> | | <i>instructs the Director 3</i> |
| | <i>instructs the Director</i> | <i>instructs the Director 4</i> |
| <i>invites administrations</i> | | <i>invites administrations 1</i> |
| | <i>urges administrations 1</i> | <i>invites administrations 2</i> |
| | <i>urges administrations 2</i> | <i>invites administrations 3</i> |
| 1 of Annex 1 | | <i>(deletion)</i> |
| 5.4 of Annex 1 | | <i>(deletion)</i> |
| Annex 2 | | Annex 1 (with no change) |
| Annex 3 | | Annex 2 (modified) |

Agenda item 4

4 *in accordance with Resolution 95 (Rev.WRC-07), to review the Resolutions and Recommendations of previous conferences with a view to their possible revision, replacement or abrogation;*

Resolution 95 (Rev.WRC-07): *General review of the Resolutions and Recommendations of world administrative radio conferences and world radiocommunication conferences*

Resolution **95 (Rev.WRC-07)** instructs the Director of the Radiocommunication Bureau:

“1 to conduct a general review of the Resolutions and Recommendations of previous conferences and, after consultation with the Radiocommunication Advisory Group and the Chairmen and Vice-Chairmen of the Radiocommunication Study Groups, submit a report to the second session of the Conference Preparatory Meeting in respect of resolves 1 and resolves 2, including an indication of any associated agenda items;

2 to include in the above report, with the cooperation of the chairmen of the Radiocommunication Study Groups, the progress reports of ITU-R studies on the issues which have been requested by the Resolutions and Recommendations of previous conferences, but which are not placed on the agendas of the forthcoming two conferences.”

6/4/1 Modification to Resolution 95 (Rev.WRC-07)

Some administrations proposed consideration of possible modification of Resolution **95 (Rev.WRC-07)**. Administrations are invited to examine this during preparation for WRC-19.

MOD

RESOLUTION 95 (REV.WRC-~~07~~19)

General review of the Resolutions and Recommendations of world administrative radio conferences and world radiocommunication conferences

The World Radiocommunication Conference (~~Geneva~~Sharm el-Sheikh, 20072019),

considering

a) that it is important to keep the Resolutions and Recommendations of past world administrative radio conferences and world radiocommunication conferences under constant review, in order to keep them up to date;

b) that the reports of the Director of the Radiocommunication Bureau submitted to previous conferences provided a useful basis for a general review of the Resolutions and Recommendations of past conferences;

c) that the Conference reviews the Resolutions and Recommendations of previous conferences that are related to its agenda with a view to their possible revision, replacement or abrogation and to take appropriate action;

~~e~~d) that some principles and guidelines are necessary for future conferences to treat the Resolutions and Recommendations of previous conferences which are not explicitly related to the agenda of the Conference,

resolves to invite future competent world radiocommunication conferences

~~1 ——— to review the Resolutions and Recommendations of previous conferences that are related to the agenda of the Conference with a view to their possible revision, replacement or abrogation and to take appropriate action;~~

21 to review the Resolutions and Recommendations of previous conferences that are not related to any agenda item of the Conference with a view to:

- abrogating those Resolutions and Recommendations that have served their purpose or have become no longer necessary;
- reviewing the need for those Resolutions and Recommendations, or parts thereof, requesting ITU-R studies on which no progress has been made during the last two periods between conferences;
- updating and modifying Resolutions and Recommendations, or parts thereof that have become out of date, and to correct obvious omissions, inconsistencies, ambiguities or editorial errors and effect any necessary alignment;

2 to include a standing agenda item which would consider the examination of Resolutions and Recommendations referred to in resolves 1 of this Resolution;

3 at the beginning of the ~~e~~CConference, to determine which committee within the ~~e~~CConference has the primary responsibility to review each of the Resolutions and Recommendations of previous conferences referred to in resolves 1 and 2 above,

instructs the Director of the Radiocommunication Bureau

1 to conduct a general review of the Resolutions and Recommendations of previous conferences and, after consultation with the Radiocommunication Advisory Group and the Chairmen and Vice-Chairmen of the Radiocommunication Study Groups, submit a report to the second session of the Conference Preparatory Meeting (CPM) ~~in respect of resolves 1 and resolves 2,~~ including an indication of any associated agenda items;

2 to include in the above report, with the cooperation of the chairmen of the Radiocommunication Study Groups, the progress reports of ITU-R studies on the issues which have been requested by the Resolutions and Recommendations of previous conferences, but which are not placed on the agendas of the forthcoming two conferences,

invites administrations

to submit contributions on the implementation of this Resolution to the second session of the CPM,

invites the Conference Preparatory Meeting

to include, in its Report, the results of the general review of the Resolutions and Recommendations of previous conferences, based on the contributions by administrations to the second session of the CPM and taking into account the above-mentioned report of the Director, in order to facilitate the follow-up by ~~future WRCs~~ the Conference.

6/4/2 Review of WARC/WRC Resolutions and Recommendations

In response to Resolution **95 (Rev.WRC-07)**, the Bureau performed an initial study in this respect with consultation as appropriate with the Chairmen and Vice-Chairmen of Study Groups. The study was presented to CPM19-2, for consideration (Document CPM19-2/9). The CPM19-2 received additional contributions from membership. Annex 6/4-1 contains the result of the consideration during the CPM19-2 taking into account the comments provided in these contributions. Regional organizations and administrations are still in the process of preparing for AI 4 of WRC-19. Additional information on views and proposals may be available on websites of ITU and regional organizations.

The CPM wishes to emphasize that the indications in the column “Possible follow-up” should not be considered as proposals for the work of the conference, but merely as suggestions concerning the possible course of action to be taken in respect of the concerned Resolution/Recommendation.

The CPM refrained from indicating any possible course of action in respect to those Resolutions/Recommendations that are explicitly on the agenda of WRC-19 (see Resolution **809 (WRC-15)**) or on the preliminary agenda of WRC-23 (see Resolution **810 (WRC-15)**), or for which modifications are foreseen in the draft CPM Report.

Furthermore, there are possibilities that some Resolutions/Recommendations may be considered under specific agenda items as mentioned in the relevant parts of the CPM Report. For these Resolutions/Recommendations, a reference is made in their “Remark” column.

Annex: 1

ANNEX 6/4-1

**Review of WARC/WRC Resolutions and Recommendations in response to
Resolution 95 (Rev.WRC-07)**

PART I – WARC/WRC RESOLUTIONS

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|-----------------|---|--|--|
| 1 | Notification of frequency assignments | (Rev.WRC-97) Still relevant. This Resolution is referred to in No. 26/5.2 of RR Appendix 26 . | NOC |
| 2 | Equitable use of GSO and other satellite orbits and frequency bands for space services | (Rev.WRC-03) Still relevant. This Resolution is referred to in Resolution 4 (Rev.WRC-03) . | NOC |
| 4 | Period of validity of frequency assignments to GSO and other satellite orbits space systems | (Rev.WRC-03) Still relevant. This Resolution is referred to in Item A.2.b of Table A, Annex 2 of RR Appendix 4 . | NOC |
| 5 | Technical cooperation – Propagation in tropical areas | (Rev.WRC-15) Still relevant. | NOC |
| 7 | National radio-frequency management | (Rev.WRC-03) Still relevant; supported by BR and studies in SG 1 with respect to spectrum management systems for developing countries; also supported by BR world and regional seminars. | NOC |
| 10 | Wireless communications by the International Red Cross and Red Crescent Movement | (Rev.WRC-2000) Still relevant. This Resolution relates to Resolution 646 (Rev.WRC-15) . | NOC |
| 12 | Assistance and support to Palestine | (Rev.WRC-15) Still relevant; in “ <i>further instructs the Director of the Radiocommunication Bureau</i> ”, updating item 2 “to report to WRC-19 on the progress achieved in the implementation of this Resolution.” by referring to “WRC-23” could be considered. | MOD |
| 13 | Formation of call signs | (Rev.WRC-97) Still relevant. This Resolution is referred to in RR No. 19.32 . | NOC |
| 15 | International cooperation in space radiocommunications | (Rev.WRC-03) Still relevant; implemented through liaison with ITU-D Study Groups and BR/BDT seminars/workshops. | NOC |
| 18 | Identification/non-parties in an armed conflict | (Rev.WRC-15) Still relevant. | NOC |
| | | Modification may be considered to reflect current aeronautical practice. | MOD |
| 20 | Technical cooperation – Aeronautical service | (Rev.WRC-03) Still relevant. This Resolution is referred to in Recommendations 72 (Rev.WRC-07) . | NOC |
| 25 | Operation of Global Satellite Systems for personal communications | (Rev.WRC-03) Still relevant. This Resolution is referred to in Resolution 156 (WRC-15) . | NOC |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|--|---|---|
| 26 | Review of footnotes | (Rev.WRC-07) Still relevant (permanent agenda item at each WRC (see WRC-19 agenda item 8)). | — |
| 27 | Use of incorporation by reference in the Radio Regulations (principles) | (Rev.WRC-12) Permanent agenda item at each WRC (see WRC-19 agenda item 2). There is a proposal to merge Res. 27 and 28 . (See section number 6/2/3) | — |
| 28 | Revision of references to ITU-R Recommendations incorporated by reference in the Radio Regulations | (Rev.WRC-15) Permanent agenda item at each WRC (see WRC-19 agenda item 2); linked with Resolution 27 (Rev.WRC-12) . There is a proposal to merge Res. 27 and 28 . (See section number 6/2/3) | — |
| 31 | Transitional measures for the elimination of advance publication filings by administrations for frequency assignments to satellite networks and systems subject to Section II of Article 9 | (WRC-15) This Resolution is referred to in No. 59.14 . The transitional period elapsed. May be deleted since the necessary actions to implement <i>resolves</i> 1 and 2 have been completed by the BR. | SUP |
| 33 | Procedure for BSS prior to the entry into force of agreements and plans for the BSS | (Rev.WRC-15) Could be deleted as the processing of filings under this Resolution was completed prior to WRC-07; deletion would require consideration of references to this Resolution in the RR: in Nos. 5.396 , A.9.7 and A.11.5 ; in Appendix 30 § 4.2.3 f) footnote 12 and § 7.1 footnote 23; in Appendix 30A § 7.1 footnote 29; in Resolution 34 (Rev.WRC-15) <i>resolves</i> 1; in the Annex to Resolution 42 (Rev.WRC-15) Section 5.1 f); in Annex 1 to Resolution 49 (Rev.WRC-15) Section 1; in Resolution 507 (Rev.WRC-15) <i>resolves</i> 2; in Resolution 528 (Rev.WRC-15) <i>resolves</i> 3. | SUP |
| 34 | BSS in the band 12.5-12.75 GHz in R3 | (Rev.WRC-15) Still relevant. | NOC |
| | | Text may need to be updated in view of WRC-19 decision on Resolution 33 . | MOD |
| 40 | Use of one space station to bring frequency assignments to geostationary-satellite networks at different orbital locations into use within a short period of time | (WRC-15) Still relevant; may need updating of <i>resolves</i> 5 which refers to "... as of 1 January 2018 ...". | MOD |
| 42 | Interim systems in R2 (BSS and FSS) in AP30/30A bands | (Rev.WRC-15) Still relevant. | NOC |
| | | Could be updated in view of WRC-19 decision on Resolution 33 . | MOD |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|--|---|---|
| 49 | Administrative due diligence | (Rev.WRC-15) Content still relevant. The text was updated at WRC-15. This Resolution is referred to in Nos. 11.44.1 and 11.48 , Articles 9 and 11 , Resolutions 55 (Rev.WRC-15) and 81 (Rev.WRC-15) and Appendices 30, 30A and 30B . This Resolution was considered in the previous WP 4A meetings (see Document 4A/675) and may be treated in relation to the BR Director's Report to WRC-19 with a view to possible modification. It may require updates to remove obsolete provisions and inconsistency with current practice. | MOD |
| 55 | Electronic submission of notice forms for satellite networks | (Rev.WRC-15) Content is still relevant. | NOC |
| | | Content may be transferred into relevant parts of Articles 9 and 11 as well as of Appendices 30, 30A and 30B to make it perennial. | SUP |
| 63 | Protection from ISM equipment | (Rev.WRC-12) Still relevant. | NOC |
| | | <i>invites ITU-R</i> 1 and 2 may need to be updated in view of the recent developments between ITU-R Study Group 1 and CISPR. | MOD |
| 72 | Regional preparations | (Rev.WRC-07) Still relevant. The version number of ITU-R Resolution referred to in this Resolution may be reviewed with the associated text. | MOD |
| 74 | Continuing updating of technical bases of Appendix 7 | (Rev.WRC-03) Still relevant. | NOC |
| 75 | Development of the technical basis for determining the coordination area for coordination of a receiving ES in the SRS (deep space) with transmitting stations of HD applications in the FS in bands 31.8-32.3 and 37-38 GHz | (Rev.WRC-12) Still relevant; closely related to Resolution 74 . | NOC |
| 76 | Development of calculation methodologies concerning aggregate epfd produced by non-GSO in the bands 10.7-30 GHz | (Rev.WRC-15) Still relevant. The text was partly updated at the WRC-15. This Resolution is referred to in No. 22.5K and Resolutions 140 (Rev.WRC-15) and 159 (WRC-15) . Recommendation ITU-R S.1503 has been revised and the new version has been approved. On this basis, <i>invites ITU-R</i> may need to be updated taking account of Recommendations ITU-R S.1588 and ITU-R S.1503 in force; Annex 1 may also need to be updated taking into account the incorporation by reference of Recommendations ITU-R S.1428 and ITU-R BO.1443 and their versions in force. | MOD |
| 80 | Due diligence in applying the principles embodied in the Constitution | (Rev.WRC-07) For consideration under WRC-19 agenda item 9.3. | — |
| 81 | Evaluation of administrative due diligence | (Rev.WRC-15) Still relevant. | NOC |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|---|--|---|
| 85 | Protection of GSO systems (FSS and BSS) from non-GSO FSS systems | (WRC-03) Still relevant; may need to be updated in view of future developments related to the updated version of the validation software and/or modifications to Recommendation ITU-R S.1503. | MOD |
| 86 | Criteria for implementation of Resolution 86 (Rev.PP-02) | (Rev.WRC-07) Still relevant (permanent agenda item at each WRC (see WRC-19 agenda item 7)). | – |
| 95 | Review of WARC and WRC Resolutions /Recommendations | (Rev.WRC-07) Still relevant (permanent agenda item at each WRC (see WRC-19 agenda item 4)). | – |
| | | (Rev.WRC-07) For consideration by WRC-19 (agenda item 4) revision is proposed. | MOD |
| 99 | Provisional application of certain provisions of RR as revised by WRC-15 and abrogation of certain Res./Rec. | (WRC-15) Should be revised to serve a similar purpose for after WRC-19. | MOD |
| 111 | Planning of the FSS in 18/20/30 GHz | (Orb-88) Still relevant. | NOC |
| 114 | FSS (feeder links for MSS) in 5 GHz | (Rev.WRC-15) Still relevant. This Resolution is referred to in Nos. 5.444 and 5.444A and Resolution 748 (Rev.WRC-15) . | NOC |
| 122 | HAPS in 47/48 GHz | (Rev.WRC-07) Still relevant; actions on this Resolution might be taken under WRC-19 agenda item 1.14. | – |
| 125 | Frequency sharing in the bands 1 610.6-1 613.8 MHz and 1 660-1 660.5 MHz between the mobile-satellite service and the radio astronomy service | (Rev.WRC-12) Still relevant. Text was slightly updated at WRC-12. Future competent WRC to review the ongoing sharing studies between the MSS and RAS, but currently no progress is made in the ITU-R studies invited in this Resolution. | NOC |
| 140 | epfd limits in 19.7-20.2 GHz | (Rev.WRC-15) Still relevant. | NOC |
| 143 | Guidelines for implementation of high-density applications in the FSS in identified frequency bands | (Rev.WRC-07) Still relevant; this Resolution is referred to in No. 5.516B . Recommendations ITU-R S.524-9, ITU-R S.1594-0 and ITU-R S.1783-0 in force. | NOC |
| 144 | Special requirements for small or narrow countries operating earth stations in the FSS in the band 13.75-14 GHz | (Rev.WRC-15) Still relevant. The text was reviewed at the WRC-15. If Recommendation ITU-R S.1712 is revised, this Resolution will be reviewed. | NOC |
| 145 | Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by HAPS in the fixed service | (Rev.WRC-12) Still relevant; actions on this Resolution might be taken under WRC-19 agenda item 1.14. | – |
| 147 | Pfd limits for FSS using highly-inclined orbits in the band 17.7-19.7 GHz | (WRC-07) Still relevant. This Resolution is referred to in Nos. 21.16.6B and 21.16.6C . | NOC |
| 148 | Satellite systems formerly listed in Part B of Appendix 30B (WARC Orb-88) | (Rev.WRC-15) Still relevant, depending on BR record for Part B. This Resolution is referred to in Appendix 30B . | NOC |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|--|---|---|
| 149 | Submissions from new Member States of the Union relating to Appendix 30B of the Radio Regulations | (Rev.WRC-12) Still relevant. The text was recently updated at WRC-12. | NOC |
| 150 | Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links for high-altitude platform stations in the fixed service | (WRC-12) Still relevant; actions on this Resolution might be taken under WRC-19 agenda item 1.14. | — |
| 154 | Consideration of technical and regulatory actions in order to support existing and future operation of fixed-satellite service earth stations within the band 3 400-4 200 MHz, as an aid to the safe operation of aircraft and reliable distribution of meteorological information in some countries in Region 1 | (Rev.WRC-15) Still relevant. | NOC |
| 155 | Regulatory provisions related to earth stations on board unmanned aircraft which operate with geostationary-satellite networks in the fixed-satellite service in certain frequency bands not subject to a Plan of Appendices 30 , 30A and 30B for the control and non-payload communications of unmanned aircraft systems in non-segregated airspaces | (WRC-15) Still relevant; actions on this Resolution should be taken based on the Director's Report to WRC-19 under agenda item 9, taking into account <i>resolves</i> 16. | — |
| 156 | Use of the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz by earth stations in motion communicating with geostationary space stations in the fixed-satellite service | (WRC-15) Still relevant; may be modified to update <i>recognizing e</i>) about class of station codes UC and UF. | MOD |
| 157 | Study of technical and operational issues and regulatory provisions for new non-geostationary-satellite orbit systems in the 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz and 6 725-7 025 MHz frequency bands allocated to the fixed-satellite service | (WRC-15) For consideration by CPM19-2 as issue 9.1.3 under WRC-19 agenda item 9.1. | — |
| 158 | Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service | (WRC-15) For consideration under WRC-19 agenda item 1.5. | — |
| 159 | Studies of technical, operational issues and regulatory provisions for non-geostationary fixed-satellite services satellite systems in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) | (WRC-15) For consideration under WRC-19 agenda item 1.6. | — |
| 160 | Facilitating access to broadband applications delivered by high-altitude platform stations | (WRC-15) For consideration under WRC-19 agenda item 1.14. | — |
| 161 | Studies relating to spectrum needs and possible allocation of the frequency band 37.5-39.5 GHz to the fixed-satellite service | (WRC-15) Under study; included in item 2.4 of the preliminary agenda for WRC-23 (see Res. 810 (WRC-15)). | — |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|---|--|---|
| 162 | Studies relating to spectrum needs and possible allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space) | (WRC-15) For consideration by CPM19-2 as issue 9.1.9 under WRC-19 agenda item 9.1. | — |
| 163 | Deployment of earth stations in some Regions 1 and 2 countries in the frequency band 14.5-14.75 GHz in the fixed-satellite service (Earth-to-space) not for feeder links for the broadcasting-satellite service | (WRC-15) Still relevant. This Resolution is referred to in Nos. 5.509B , 5.509C , 5.509D , 5.509E , 5.509F , 5.510 and 22.40 and Appendices 4 and 30A . | NOC |
| 164 | Deployment of earth stations in some Region 3 countries in the frequency band 14.5-14.8 GHz in the fixed-satellite service (Earth-to-space) not for feeder links for the broadcasting-satellite service | (WRC-15) Still relevant. This Resolution is referred to in Nos. 5.509B , 5.509C , 5.509D , 5.509E , 5.509F , 5.510 and 22.40 and Appendices 4 and 30A . A new Recommendation ITU-R S.2112-0 for guidelines to conduct bilateral coordination for explicit agreements in this band has been developed. | NOC |
| 205 | Protection of MSS in 406-406.1 MHz | (Rev.WRC-15) Still relevant. This Resolution is referred to in No. 5.265 and Resolutions 646 (Rev.WRC-15) and 659 (WRC-15) . | NOC |
| 207 | Monitor MMS/AM(R)S | (Rev.WRC-15) Still relevant. The text was updated at the WRC-15. | NOC |
| 212 | Implementation of IMT | (Rev.WRC-15) For consideration by CPM19-2 as issue 9.1.1 under WRC-19 agenda item 9.1. | — |
| 215 | Coordination among MSS systems | (Rev.WRC-12) Still relevant. Text was updated at WRC-12. Currently no progress is made in the ITU-R studies invited in this Resolution. | NOC |
| 217 | Wind profiler radars | (WRC-97) Still relevant. This Resolution is referred to in Nos. 5.162A and 5.291A and Resolution 658 (WRC-15) . The text was editorially corrected by the Secretariat. | NOC |
| 221 | HAPS for IMT in the bands around 2 GHz | (Rev.WRC-07) Still relevant. This Resolution is referred to in No. 5.388A . The ITU-R studies invited in this Resolution has made no progress due to lack of contributions. | NOC |
| 222 | Use of the bands 1 525-1 559 MHz and 1 626.5-1 660.5 MHz by the MSS and studies for long-term availability for AMS(R)S | (Rev.WRC-12) Still relevant. Text was updated at WRC-12. This Resolution is referred to in Nos. 5.353A and 5.357A . It is required to examine whether there is any progress in the ITU-R studies invited in this Resolution. | NOC |
| 223 | Additional bands identified for IMT | (Rev.WRC-15) Still relevant; the invited ITU-R studies are ongoing, e.g. sharing MSS/IMT, channelling arrangements in L-band, etc.; Working Party 5D has sent a note for inclusion into the BR Director's Report to WRC-19 (agenda item 9). | — |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|---|---|---|
| 224 | Frequency bands for the terrestrial component of IMT below 1 GHz. | (Rev.WRC-15) Still relevant. | NOC |
| 225 | Use of additional bands for the satellite component of IMT | (Rev.WRC-12) Still relevant. This Resolution is referred to in No. 5.351A . It is required to examine whether there is any progress in the ITU-R studies invited in this Resolution. | NOC |
| 229 | Use of bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz for WAS including RLAN | (Rev.WRC-12) Still relevant (see RR No. 5.446A); actions on this Resolution might be taken under WRC-19 agenda item 1.16. | — |
| 235 | Review of the spectrum use of the frequency band 470-960 MHz in Region 1 | (WRC-15) Under study; included in item 2.5 of the preliminary agenda for WRC-23 (see Res. 810 (WRC-15)). | — |
| 236 | Railway radiocommunication systems between train and trackside | (WRC-15) For consideration under WRC-19 agenda item 1.11. | — |
| 237 | Intelligent Transport Systems applications | (WRC-15) For consideration under WRC-19 agenda item 1.12. | — |
| 238 | Studies on frequency-related matters for International Mobile Telecommunications identification including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency range between 24.25 and 86 GHz for the future development of International Mobile Telecommunications for 2020 and beyond | (WRC-15) For consideration under WRC-19 agenda item 1.13. | — |
| 239 | Studies concerning Wireless Access Systems including radio local area networks in the frequency bands between 5 150 MHz and 5 925 MHz | (WRC-15) For consideration under WRC-19 agenda item 1.16. | — |
| 331 | Operation of the Global Maritime Distress and Safety System (GMDSS) | (Rev.WRC-12) Still relevant; the requested ITU-R studies have not been conducted so far. Text was updated at WRC-12. | NOC |
| 339 | Coordination of NAVTEX services | (Rev.WRC-07) Still relevant. This Resolution is referred to in No. 5.79A and Appendix 15 (Rev.WRC-15) . | NOC |
| 343 | Certificates (vessels using GMDSS equipment on a non-compulsory basis) | (Rev.WRC-12) Still relevant (to ensure inter-communication between SOLAS and non-SOLAS vessels). Text was updated at WRC-12. This Resolution is referred to in Nos. 47.27A and 48.7 . | NOC |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|--|--|---|
| 344 | Exhaustion of MMSI | (Rev.WRC-12) Still relevant. Text was updated at WRC-12. | NOC |
| | | “Inmarsat B and M” referenced in <i>noting</i> part finished their service in the end of 2016 and 2017 respectively. Furthermore, it is under consideration in IMO to take into account GMDSS satellites other than Inmarsat. Modification in this regard may be needed. It may need to be updated in view of the revisions in Recommendation ITU-R M.585-7 with respect to Inmarsat and the references to the MSS systems/equipment referred to in this Resolution. | MOD |
| 349 | False alerts in GMDSS | (Rev.WRC-12) Still relevant; the new version of Recommendation ITU-R M.493-14 has been approved in January 2019. | NOC |
| 352 | Use of carrier frequencies 12 290 kHz and 16 420 kHz for safety related calling to and from rescue coordination centres | (WRC-03) Still relevant. This Resolution is referred to in No. 52.221A and Appendix 17. | NOC |
| 354 | Distress and safety radiotelephony procedures for 2 182 kHz | (WRC-07) Still relevant. This Resolution is referred to in Nos. 52.101 and 52.189 . | NOC |
| 356 | ITU maritime service information registration | (WRC-07) Still relevant. | NOC |
| | | ITU-R consultation invited in this Resolution is a constant process at WP 5B and in IMO based on new maritime system requirements; perhaps to change <i>invites ITU-R</i> to “to consult <u>on a regular basis</u> ...” | MOD |
| 359 | Consideration of regulatory provisions for modernization of the Global Maritime Distress and Safety System and studies related to e-navigation | (Rev.WRC-15) For consideration under WRC-19 agenda item 1.8. | — |
| 360 | Consideration of regulatory provisions and spectrum allocations to the MMSS to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication | (Rev.WRC-15) For consideration under WRC-19 agenda item 1.9.2. | — |
| 361 | Consideration of regulatory provisions for modernization of the GMDSS and related to the implementation of e-navigation | (WRC-15) Under study; included in item 2.1 of the preliminary agenda for WRC-23 (see Res. 810 (WRC-15)). | — |
| 362 | Autonomous maritime radio devices operating in the frequency band 156-162.05 MHz | (WRC-15) For consideration under WRC-19 agenda item 1.9.1. | — |
| 405 | Frequencies for AM(R)S | (WARC-79) Still relevant; ongoing activities in ICAO. | NOC |
| 413 | Use of the band 108-117.975 MHz by the aeronautical mobile (R) service (AM(R)S) | (Rev.WRC-12) Still relevant. Text was updated at WRC-12. This Resolution is referred to in No. 5.197A . It is required to examine whether there is any progress in the ITU-R studies invited in this Resolution. | NOC |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|--|---|---|
| 416 | Use of the bands 4 400-4 940 MHz and 5 925-6 700 MHz by an aeronautical mobile telemetry application | (WRC-07) Still relevant. This Resolution is referred to in Nos. 5.440A , 5.442 and 5.457C . | NOC |
| 417 | Use of the band 960-1 164 MHz by the AM(R)S | (Rev.WRC-15) Still relevant. Text was updated at WRC-15. This Resolution is referred to in No. 5.327A . | NOC |
| 418 | Use of the band 5 091-5 250 MHz by AMS for telemetry applications | (Rev.WRC-15) Still relevant. | NOC |
| | | The new Recommendation ITU-R M.2122-0 for the band 5 150-5 250 MHz has been approved in January 2019, so deletion of <i>invites ITU-R Sector</i> could be considered. | MOD |
| 422 | Development of methodology to calculate aeronautical mobile-satellite (R) service spectrum requirements within the frequency bands 1 545-1 555 MHz (space-to-Earth) and 1 646.5-1 656.5 MHz (Earth-to-space) | (WRC-12) Implemented following the approval of Recommendation ITU-R M.2091. | SUP |
| 424 | Use of WAIC in the frequency band 4 200-4 400 MHz | (WRC-15) Still relevant. This Resolution is referred to in No. 5.436 . | NOC |
| 425 | Use of the frequency band 1 087.7-1 092.3 MHz by the aeronautical mobile-satellite (R) service (Earth-to-space) to facilitate global flight tracking for civil aviation | (WRC-15) Still relevant; <i>invites ITU-R</i> could be modified taking into account the results of the studies contained in Report ITU-R M.2396-0 in October 2016. | MOD |
| 426 | Studies on spectrum needs and regulatory provisions for the introduction and use of the GADSS | (WRC-15) For consideration under WRC-19 agenda item 1.10. | — |
| 506 | GSO only, in BSS 12 GHz bands | (Rev.WRC-97) Still relevant. | NOC |
| 507 | Agreements/Plans for BSS | (Rev.WRC-15) Still relevant. | NOC |
| | | May need to be updated if Resolution 33 is suppressed. | MOD |
| 517 | Introduction of digitally modulated emissions in the HFBC | (Rev.WRC-15) Still relevant, noting that the introduction of digital modulation in HFBC has not yet been widespread. This Resolution is referred to in No. 5.134 , Appendix 11 , Resolutions 543 (WRC-03) and 550 (WRC-07) and Recommendation 503 (Rev.WRC-2000) . The text was updated at WRC-15. | NOC |
| 526 | Additional provisions for HDTV | (Rev.WRC-12) Still relevant. | NOC |
| 528 | BSS (sound) in 1.5 GHz | (Rev.WRC-15) Still relevant. | NOC |
| | | For consideration by a future WRC; may need update since <i>resolves 1</i> is outdated and Resolution 33 could be suppressed. | MOD |
| 535 | Application of Article 12 | (Rev.WRC-15) Still relevant; may need to suppress <i>instructs the Director 1</i> , since the Annex was already implemented, and there is no need for a Rule of Procedure after administrations were informed about this through circular letters and BR webpage. | MOD |
| 536 | BSS satellites serving other countries | (WRC-97) Still relevant. | NOC |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|--|--|---|
| 539 | Use of the band 2 630-2 655 MHz for non-GSO BSS | (Rev.WRC-15) Still relevant. This Resolution is referred to in No. 5.418 , Appendix 5 and Resolution 903 (Rev.WRC-15) . | NOC |
| 543 | Provisional RF protection ratios for analogue and digital emissions in HFBC | (WRC-03) Still relevant; noting that the introduction of digital modulation in HFBC has not yet been widespread. This Resolution is referred to in 1.1 and 2.5 of Part C of Appendix 11 and Resolutions 517 (Rev.WRC-15) and 535 (Rev.WRC-15) . Following the Note by the Secretariat, the reference to Resolution 517 (Rev.WRC-03) may editorially be updated. Suppression of the <i>invite ITU-R 2</i> , since the phrase is outdated (see Director's Report to WRC-07 on the implementation of this Resolution). | MOD |
| 548 | Application of the grouping concept in AP30/30A in Regions 1 and 3 | (Rev.WRC-12) Still relevant. Text was updated at WRC-12. | NOC |
| 549 | Use of the band 620-790 MHz for existing assignments to BSS | (WRC-07) Still relevant. Status of the operation of two specific BSS referred to in this Resolution needs to be confirmed. This Resolution is referred to in No. 5.311A and Appendix 5 . [Possibility of suppression of this Resolution needs to be considered.] | NOC |
| 550 | Information relating to HF broadcasting service | (WRC-07) Still relevant. | NOC |
| 552 | Long-term access to and development in the band 21.4-22 GHz in Regions 1 and 3 | (Rev.WRC-15) Still relevant. This Resolution is referred to in Nos. 11.44.1 and 11.48 and Articles 9 and 11 . Annex 3 (transitional measures) may need to be suppressed, <i>resolves</i> 2 and 3 may need to be updated. | MOD |
| 553 | Additional regulatory measures for broadcasting-satellite networks in the band 21.4-22 GHz in Regions 1 and 3 for the enhancement of equitable access to this band | (Rev.WRC-15) Still relevant. The text was updated at the WRC-15. §§ 8 and 9 of the Attachment to this resolution need to be updated because the submission of advance publication information is no longer required. | MOD |
| 554 | Application of pfd masks to coordination under No. 9.7 for broadcasting-satellite service networks in the band 21.4-22 GHz in Regions 1 and 3 | (WRC-12) Content is still relevant. | NOC |
| | | Content may be moved to RR Appendix 5 . | SUP |
| 555 | Additional regulatory provisions for broadcasting-satellite service networks in the band 21.4-22 GHz in Regions 1 and 3 for the enhancement of equitable access to this band | (Rev.WRC-15) <i>Resolves</i> 2 will be time-expired by WRC-19. | MOD/SUP |
| 556 | Conversion of all analogue assignments in the Appendices 30 and 30A Regions 1 and 3 Plan and List into digital assignments | (WRC-15) Implemented. | SUP |
| 557 | Consideration of possible revision of Annex 7 to Appendix 30 of the Radio Regulations | (WRC-15) For consideration under WRC-19 agenda item 1.4. | — |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|---|---|---|
| 608 | Use of 1 215-1 300 MHz band by systems in the RNSS (space-to-Earth) | (Rev.WRC-15) Still relevant. This Resolution is referred to in No. 5.329 . The text was updated at WRC-15. | NOC |
| 609 | Protection of ARNS from the equivalent epfd produced by RNSS networks and systems in the 1 164-1 215 MHz band | (Rev.WRC-07) Still relevant. This Resolution is referred to in Nos. 5.328A and 21.18 and Recommendation 608 (Rev.WRC-07) . | NOC |
| 610 | Coordination of RNSS networks and systems in the bands 1 164-1 300 MHz, 1 559-1 610 MHz and 5 010-5 030 MHz | (WRC-03) Still relevant. | NOC |
| | | <i>resolves</i> 6 may require some clarification (criteria of the Annex are logically met if the satellite system is declared as brought into use). | MOD |
| 612 | Use of the radiolocation service between 3 and 50 MHz to support oceanographic radar operations | (Rev.WRC-12) Still relevant. Text was updated at WRC-12. This Resolution is referred to in Nos. 5.132A , 5.145A and 5.161A and Appendix 4 . | NOC |
| 641 | Use of the band 7 000-7 100 kHz | The purpose of the Resolution was achieved and there is no recorded HFBC assignment in 7 000-7 100 kHz. | SUP |
| 642 | Earth stations in the amateur satellite service | (WARC-79) May be suppressed since no submissions have ever been received under this Resolution and RR No. 11.14 indicates that frequency assignments to earth stations in the amateur-satellite service shall not be notified under RR Article 11 . | SUP |
| 646 | Public protection and disaster relief | (Rev.WRC-15) Still relevant; This Resolution is referred to in Resolutions 224 (Rev.WRC-15) and 647 (Rev.WRC-15) and Recommendation 206 (Rev.WRC-15) . The ITU-R studies invited in this Resolution is making certain progress including revision of Recommendation ITU-R M.2015. Recommendation ITU-R BS.2107 may also be referred to in the recognizing part. Need to be updated taking into account the above situation, so to modify <i>invites ITU-R 2</i> : “to review and revise relevant ITU-R ...”. | MOD |
| 647 | Radiocommunication aspects, including spectrum management guideline for early warning, disaster prediction, detection, mitigation and relief operations relating to emergencies and disasters | (Rev.WRC-15) Still relevant; The relation between this Resolution and Resolution 646 (Rev.WRC-15) needs to be reviewed. Similarly to current footnote 3, a new footnote, indicating relevant ITU-R text webpage, e.g. (http://www.itu.int/en/ITU-R/information/Pages/res647.aspx), may be added also to <i>recognizing further a</i>). | MOD |
| 655 | Definition of time scale and dissemination of time signals via radiocommunication systems | (WRC-15) Still relevant; is referred to in No. 1.14 . | NOC |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|---|---|---|
| 656 | Possible allocation to the Earth exploration-satellite service (active) for spaceborne radar sounders in the range of frequencies around 45 MHz | (WRC-15) Referred to in <i>resolves to give the view</i> 2.2 of Resolution 810 (WRC-15) ; for consideration under WRC-19 agenda item 10. | – |
| 657 | Spectrum needs and protection of space weather sensors | (WRC-15) Referred to in <i>resolves to give the view</i> 2.3 of Resolution 810 (WRC-15) ; for consideration under WRC-19 agenda item 10. | – |
| 658 | Allocation of the frequency band 50-54 MHz to the amateur service in Region 1 | (WRC-15) For consideration under WRC-19 agenda item 1.1. | – |
| 659 | Studies to accommodate requirements in the space operation service for non-geostationary satellites with short duration missions | (WRC-15) For consideration under WRC-19 agenda item 1.7. | – |
| 673 | Earth observation applications | (Rev.WRC-12) Still relevant. Text was updated at WRC-12. This Resolution is referred to in No. 29A.1 . | NOC |
| 703 | Interference criteria for the shared bands | (Rev.WRC-07) Still relevant. This Resolution is referred to in Resolutions 33 (Rev.WRC-15) , 34 (Rev.WRC-15) and 528 (Rev.WRC-15) . | NOC |
| 705 | Protection of services in 70-130 kHz | (Rev.WRC-15) Still relevant. The text was updated at WRC-15. | NOC |
| 716 | Use of bands around 2 GHz | (Rev.WRC-12) Still relevant. This Resolution is referred to in Nos. 5.389A and 5.389C . It is required to examine whether there is any progress in the ITU-R studies invited in this Resolution in relation to the MSS. | NOC |
| 729 | Adaptive systems at MF/HF | (Rev.WRC-07) Still relevant. This Resolution is referred to in Appendix 4 . | NOC |
| 731 | Sharing and adjacent-band compatibility between passive and active services above 71 GHz | (Rev.WRC-12) Still relevant. Text was updated at WRC-12. The reference to Recommendation ITU-R RS.1029 already suppressed may be replaced with RS.2017. It is required to examine whether there is any progress in the ITU-R studies invited in this Resolution. | MOD |
| 732 | Sharing between active services above 71 GHz | (Rev.WRC-12) Still relevant. Text was updated at WRC-12. It is required to examine whether there is any progress in the ITU-R studies invited in this Resolution. | NOC |
| 739 | Compatibility between RA and active space services | (Rev.WRC-15) Still relevant. | NOC |
| | | May be updated to add editorially the full name of IUCAF (Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science) in Table 1-2 of Annex 1. | MOD |
| 741 | Protection of RA in the bands 4 990-5 000 MHz | (Rev.WRC-15) Still relevant. This Resolution is referred to in No. 5.443B and Appendices 4 and 30 . The text was slightly updated at WRC-15. | NOC |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|--|--|---|
| 743 | Protection of single-dish RA stations in the band 42.5-43.5 GHz | (WRC-03) Still relevant. | NOC |
| 744 | Sharing between MSS (Earth-to-space) and other services in the band 1 668.4-1 675 MHz | (Rev.WRC-07) Still relevant. This Resolution is referred to in No. 5.379D . | NOC |
| 748 | Compatibility between AM(R)S and FSS (Earth-to- Space) in the band 5 091-5 150 MHz | (Rev.WRC-15) Still relevant. | NOC |
| | | This Resolution is referred to in No. 5.444B and Resolution 418 (Rev.WRC-15) . Since Recommendations ITU-R P.525-2 and ITU-R P.526-13 have been revised, the updating in this respect may be needed under agenda item 2. | MOD |
| 749 | Use of the frequency band 790-862 MHz in countries of Region 1 and the Islamic Republic of Iran by mobile applications and other services | (Rev.WRC-15) Still relevant. This Resolution is referred to in Nos. 5.316B and 5.317A . | NOC |
| 750 | Compatibility between EESS (passive) and relevant active services | (Rev.WRC-15) Still relevant (see RR No. 5.338A); actions on this Resolution might be taken under WRC-19 agenda item 1.6, 1.13 and/or 9.1 (issue 9.1.9). | — |
| 751 | Use of the band 10.6-10.68 GHz | (WRC-07) Still relevant. This Resolution is referred to in No. 5.482A . | NOC |
| 752 | Use of the band 36-37 GHz | (WRC-07) Still relevant. This Resolution is referred to in No. 5.550A . | NOC |
| 759 | Technical studies on the coexistence of the radiolocation service and the amateur, amateur-satellite and radio astronomy services in the frequency band 76-81 GHz | (WRC-15) Still relevant. It is required to examine whether there is any progress in the ITU-R studies invited in this Resolution. | NOC |
| 760 | Provisions relating to the use of the frequency band 694-790 MHz in Region 1 by the mobile, except aeronautical mobile, service and by other services | (WRC-15) Still relevant. | NOC |
| 761 | Compatibility of International Mobile Telecommunications and broadcasting-satellite service (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3 | (WRC-15) For consideration by CPM19-2 as issue 9.1.2 under WRC-19 agenda item 9.1. | — |
| 762 | Application of power flux-density criteria to assess the potential for harmful interference under No. 11.32A for fixed-satellite and broadcasting-satellite service networks in the 6 GHz and 10/11/12/14 GHz frequency bands not subject to a Plan | (WRC-15) Still relevant. This Resolution is referred to in No. 11.32A.2 . The <i>C/I</i> calculation methodology stipulated in Rules of Procedure for RR No. 11.32A are being reviewed. | NOC |
| 763 | Stations on board sub-orbital vehicles | (WRC-15) For consideration by CPM19-2 as issue 9.1.4 under WRC-19 agenda item 9.1. | — |
| 764 | Consideration of the technical and regulatory impacts of referencing Recommendations ITU-R M.1638-1 and ITU-R M.1849-1 in Nos. 5.447F and 5.450A of the Radio Regulations | (WRC-15) For consideration by CPM19-2 as issue 9.1.5 under WRC-19 agenda item 9.1. | — |

| Res. No. | Subject / Title | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|--|---|---|
| 765 | Establishment of in-band power limits for earth stations operating in MSS, MetSat and EESS in the frequency bands 401-403 MHz and 399.9-400.05 MHz | (WRC-15) For consideration under WRC-19 agenda item 1.2. | — |
| 766 | Consideration of possible upgrading of the secondary allocation to the MetSat (space-to-Earth) to primary status and a primary allocation to the EESS (space-to-Earth) in the frequency band 460-470 MHz | (WRC-15) For consideration under WRC-19 agenda item 1.3. | — |
| 767 | Studies towards an identification for use by administrations for LMS and FS applications operating in the frequency range 275-450 GHz | (WRC-15) For consideration under WRC-19 agenda item 1.15. | — |
| 804 | Principles for establishing agendas for WRC | (Rev.WRC-12) Still relevant. This Resolution may also be considered under agenda item 10. | — |
| 809 | Agenda for WRC-19 | (WRC-15) Obsolete in view of the action taken by the Council (see C-16 Resolution 1380 (modified C-17)). | SUP |
| 810 | Preliminary agenda for WRC-23 | (WRC-15) For consideration under WRC-19 agenda item 10. | — |
| 901 | Determination of the orbital arc separation | (Rev.WRC-15) Still relevant. | NOC |
| 902 | Provisions related to earth stations located on board vessels, in FSS networks in 5 925-6 425 MHz and 14-14.5 GHz | (WRC-03) Still relevant. This Resolution is referred to in Nos. 5.457A , 5.457B , 5.506A and 5.506B and Recommendation 37 (WRC-03) . | NOC |
| 903 | Transitional measures for BSS/FSS in the band 2 500-2 690 MHz | (Rev.WRC-15) Still relevant. This Resolution is referred to in No. 21.16.3A . The text was updated at WRC-15. | NOC |
| 904 | Transitional measures for coordination between MSS (Earth-to-Space) and SRS (passive) in the band 1 668-1 668.4 MHz | (WRC-07) The concerned space station was notified and recorded in the MIFR. | SUP |
| 906 | Submission of notice for terrestrial services to BR | (Rev.WRC-15) Still relevant. The text was updated at WRC-15. | NOC |
| 907 | Use of modern electronic means of communication for administrative correspondence related to satellite networks and earth stations | (Rev.WRC-15) Still relevant; actions on this Resolution should be taken based on the Director's Report to WRC-19 under agenda item 9. | — |
| 908 | Electronic submission and publication of advance publication information | (Rev.WRC-15) Still relevant; actions on this Resolution should be taken based on the Director's Report to WRC-19 under agenda item 9. | — |
| 958 | Urgent studies required in preparation for WRC-19 | (WRC-15) For consideration by CPM19-2 as issues 9.1.6, 9.1.7 and 9.1.8 under WRC-19 agenda item 9.1. | — |

PART II – WARC/WRC RECOMMENDATIONS

| Rec. No. | Subject | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|---|---|---|
| 7 | Standard forms for licences | (Rev.WRC-97) Still relevant. | NOC |
| 8 | Automatic identification of stations | (WARC-79) Still relevant. | NOC |
| 9 | Measures to be taken to prevent the operation of broadcasting stations on board ships/aircraft outside national territories | (WARC-79) Still relevant. | NOC |
| 16 | Interference management for stations that may operate under more than one terrestrial radiocommunication service | (WRC-12) Still relevant | NOC |
| | | Since Question ITU-R 224/1 referred to in this Recommendation was already suppressed, updating in this regard may be needed. | MOD |
| 34 | Principles for allocation of frequency bands | (Rev.WRC-12) Still relevant. Text was revised at WRC-12. This Recommendation is referred to in Resolution 160 (WRC-15) , and also in some other places in the draft CPM Report as a basis for consideration. | NOC |
| 36 | International monitoring of emissions from space stations | (WRC-97) Still relevant; studies are ongoing within SG 1. | NOC |
| 37 | Operational procedures for ESV | (WRC-03) Still relevant. This Recommendation is referred to in Resolution 902 (WRC-03) . Recommendations ITU-R S.1587-3 (updated 09/2015), ITU-R SF.1649-1 (updated 08/2008) and ITU-R SF.1650-1 (updated 02/2005) in force. | NOC |
| 63 | Calculation of necessary bandwidth | (WARC-79) Still relevant; the issue of “calculation of necessary bandwidth” has been addressed in Recommendation ITU-R SM.1138, which is incorporated by reference in Appendix 1 (Section 1); ongoing studies; Recommendation ITU-R SM.1138-2 (updated 10/2008) and ITU-R SM.328-11 (updated 05/2006) in force. | NOC |
| 71 | Type approval | (WARC-79) Still relevant. | NOC |
| 75 | Study of boundary between out-of-band and spurious domains of primary radars using magnetrons | (Rev.WRC-15) Still relevant. Text was revised at WRC-15. | NOC |
| 76 | Deployment and use of cognitive radio systems | (WRC-12) Still relevant in view of the ongoing studies within several ITU-R study groups. | NOC |
| | | May need a modification to consider results of studies already completed and/or RA-19 decisions on Resolution ITU-R 58. | MOD |
| 100 | Bands for troposcatter | (Rev.WRC-03) Still relevant. | NOC |
| 206 | Integrated MSS | (Rev.WRC-12) Still relevant. ITU-R studies are ongoing. SG 4 is carrying out studies towards the development of relevant draft new Recommendations/Reports. It is required to examine whether there is any progress in the ITU-R studies recommended in this Recommendation. | NOC |

| Rec. No. | Subject | Remark | Possible follow-up under WRC-19 agenda item 4 |
|----------|---|--|---|
| 207 | Future IMT systems | (Rev.WRC-15) Still relevant. Text was revised at WRC-15. | NOC |
| 316 | Use of ship earth stations within harbours | (Rev.Mob-87) Still relevant. Possible modification/suppression needs to be consulted with IMO. | MOD/SUP |
| 401 | Use of worldwide frequencies in AP27 | (WARC-79) Still relevant. | NOC |
| 503 | HFBC | (Rev.WRC-2000) Still relevant. Obsolete descriptions should be updated to reflect the result of WRC-03 on the introduction of digitally modulated emissions. It may need updating of some parts, e.g. <i>considering f) and g)</i> . | MOD |
| 506 | Harmonics in BSS | (WARC-79) Still relevant. | NOC |
| 520 | Elimination of out-of-band HFBC emissions | (WARC-92) Still relevant. | NOC |
| 522 | Coordination of HFBC schedules | (WRC-97) Still relevant. | NOC |
| 608 | Guidelines for consultation meetings established by Res. 609 | (Rev.WRC-07) Still relevant; This Recommendation is referred to in Resolution 609 (Rev.WRC-07) ; Recommendations ITU-R M.1642-2 (updated 10/2007) and ITU-R M.1787-2 (updated 03/2018) in force. | NOC |
| 622 | Sharing of bands 2 025-2 110 MHz and 2 200-2 290 MHz | (WRC-97) Still relevant; relevant ITU-R Recommendations have been adequately updated along with this Recommendation. | NOC |
| 707 | Sharing in 32-33 GHz | (WARC-79) Still relevant; This Recommendation is referred to in No. 5.548 ; Recommendation ITU-R S.1151-0 in force. | NOC |
| 724 | Use by civil aviation of allocations to FSS | (WRC-07) Still relevant. | NOC |

Agenda item 9.1

9 *to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:*

9.1 *on the activities of the Radiocommunication Sector since WRC-15;*

NOTE: Nine issues have been identified by CPM19-1 under this agenda item.

RR No. 5.441B

RR No. **5.441B**, approved by WRC-15, states that the criterion of the power flux-density produced by the IMT station in the mobile service in three countries of Region 3 in the frequency band 4 800-4 990 MHz is subject to review at WRC-19. CPM19-1 did not identify this topic as an issue under AI 9.1 for study in preparation for WRC-19.

As requested by WRC-15, ITU-R has carried out some studies on the technical and regulatory conditions for the use of IMT in the frequency band 4 800-4 990 MHz in order to protect the aeronautical mobile service, in accordance with Resolution **223 (Rev.WRC-15)**.

No consensus has been reached in ITU-R on the matters above, and as a result there is no ITU-R Report or Recommendation. (See also Doc. CPM19-2/[17](#), Section 3.1.2.2).

A contribution was submitted to CPM19-2 (Doc. CPM19-2/[89](#)) regarding the scope of application of RR No. **5.441B**. The contribution provided a rationale for deletion of the reference to pfd criteria/limit in that footnote as, in the view of the contributor, protection for AMS is provided by another regulatory provision (RR No. **9.21**) also included in RR No. **5.441B**.

After discussions, CPM19-2 recognized that “this criterion is subject to review at WRC-19”, as per RR No. **5.441B**. CPM19-2 did not draw any conclusions on the matter. The Director of the Bureau may wish to consider this topic for the preparation of his Report to WRC-19, as appropriate. As requested by WRC-15, WRC-19 was invited to review the matter and take appropriate action. Administrations are encouraged to consider the matter, if they deem appropriate, when preparing for WRC-19.

Agenda item 9.1(9.1.6)

6/9.1.6 Issue 1) in the Annex to Resolution 958 (WRC-15)

Urgent studies required in preparation for the 2019 World Radiocommunication Conference:

- 1) Studies concerning Wireless Power Transmission (WPT) for electric vehicles:*
 - a) to assess the impact of WPT for electric vehicles on radiocommunication services;*
 - b) to study suitable harmonized frequency ranges which would minimize the impact on radiocommunication services from WPT for electrical vehicles.*

These studies should take into account that the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO) and the Society of Automotive Engineers (SAE) are in the process of approving standards intended for global and regional harmonization of WPT technologies for electric vehicles.

6/9.1.6/1 Executive summary

WRC-19 agenda item 9.1, issue 9.1.6, Resolution **958 (WRC-15)**, requested the ITU-R to study the impact of Wireless Power Transmission (WPT) for electric vehicles (WPT-EV) on radiocommunications and suitable harmonized frequency ranges.

The results of the studies conducted within the ITU-R identified two frequency ranges for high-power WPT-EV and one frequency range for medium-power WPT-EV, as shown in Table 6/9.1.6-2.

Based on these studies, further work will continue within the ITU-R and no change to the RR is required.

6/9.1.6/2 Background

WPT technologies are being developed to support the easy and fast transfer of power wirelessly. WPT-EV is becoming an important charging technology, which aims to reduce the size of vehicle batteries and consequently improve their practical driving distance. Recommendation ITU-R SM.2110 addresses WPT technologies in general. Due to the necessary power and capacities of the batteries, low-power WPT will not be relevant for WPT-EV charging purposes.

Throughout all Regions, some administrations have already implemented national approaches to allow for WPT-EV charging. Notably, the power level required to charge the battery of an electric vehicle depends on the vehicle's use case. For example, passenger vehicles being charged in a home garage may require around 3.3 kW equivalent charging power over a certain number of hours. However, faster charging requires higher power levels: around 22 kW or more.

Heavy-duty vehicles, such as buses and trucks, may also require higher power levels that range from 75 kW equivalent charging power. This category encompasses examples such as 120 kW (achieved by 4×30 kW transducers) used for charging the batteries of passenger busses and other heavy-duty vehicles. The power categories and frequency ranges studied for WPT-EV are summarized in Table 6/9.1.6-1.

TABLE 6/9.1.6-1

Frequency bands and power levels studied for WPT-EV

| Categories | Power level | Frequency band | Applications |
|------------------|----------------|----------------|---|
| High power WPT | 22 kW – 120 kW | 19-25 kHz | Specific heavy-duty electric vehicles (e.g. bus, tram, truck) |
| High power WPT | 22 kW – 120 kW | 55-65 kHz | Specific heavy-duty electric vehicles (e.g. bus, tram, truck) |
| Medium power WPT | 3.3 kW – 22 kW | 79-90 kHz | Generic light-duty electric vehicles |

These frequency bands are allocated to the following services: fixed, maritime mobile, standard frequency and time signal (SFTS), radionavigation, maritime radionavigation, and radiolocation. Other services may also be affected by unwanted emissions, including harmonics, and receiver blocking from WPT-EV.

The frequency bands and related power levels were taken into account as a baseline by the studies.

The impacts of WPT-EV charging applications were not sufficiently known, and in particular, the use of high transmission power was thought to potentially create disturbances that would affect existing radio systems or services. In order to examine any possible impact of WPT-EV charging on radiocommunication services, WRC-15 decided, via its Resolution **958 (WRC-15)** Annex item 1 a) and b), that ITU-R should study this impact and suitable harmonized frequency ranges to minimize it. This was deemed one of the urgent studies required in preparation for the World Radiocommunication Conference 2019 (WRC-19). As such, CPM19-1 identified this item as issue 9.1.6, to be considered under WRC-19 agenda item 9.1.

In this CPM text, the term “unwanted emissions” is used to refer to unwanted radio frequency energy, including harmonics, from WPT-EV into what is considered the out-of-band or spurious domain for radiocommunication services.

6/9.1.6/3 Summary and analysis of the results of ITU-R studies

A number of studies were undertaken to assess the possible impact of WPT-EV transmissions on various applications of incumbent services. The details of these studies are included in WDPDN Report ITU-R SM.[WPT_EV_IMPACT].

The following studies dealt with frequencies ranges for the operation of WPT-EV in the bands 19-25 kHz, 55-5X kHz, 6Y-65 kHz, and 79-90 kHz (see Table 6/9.1.6-2), which were found to be compatible with the existing radiocommunication services, subject to the conditions contained in the conclusions section.

6/9.1.6/3.1 Impact studies for WPT-EV operating in the 19-25 kHz frequency range

In some of the studies, measurements were taken with a 10 m distance between the loop antenna and the charger; the measurement environments are detailed in Report ITU-R SM.2303-2. The measurement results are compared to two limits that are being developed in standards developing organizations (SDOs) (CISPR/B and ETSI EN 303 417). These limits do not necessarily ensure protection of radio services.

6/9.1.6/3.1.1 Impact studies on standard frequency and time signal service

The study on SFTS was conducted by both simulation and field measurements.

The standard frequencies and time signals considered in the study are systems operating at 20 kHz globally; 40 kHz in Japan; 60 kHz in the United Kingdom, the United States, and Japan; 68.5 kHz in China; 77.5 kHz in Germany; 100 kHz in China; and 162 kHz in France.

The measurement results are compared to two limits that are being developed in SDOs (CISPR/B and ETSI EN 303 417). These limits do not necessarily ensure protection of radio services.

6/9.1.6/3.1.2 Impact studies on ripple control

The study on 129.1 kHz and 139 kHz of ripple control was conducted by both simulation and field measurements. The measurement results are compared to the limits of CISPR/B/687/CDV⁴⁴ and ETSI EN 303 417. The measurement results meet limits of CISPR/B/687/CDV. These limits do not necessarily ensure protection of radio services.

6/9.1.6/3.1.3 Impact studies on train protection automatic warning systems

This study concludes that a 5 m separation distance is necessary to protect Automatic Train Stop Systems (ATS).

6/9.1.6/3.1.4 Impact studies on maritime radio

Only Loran-C systems have been studied, and in this study of such systems the emission and field strength of 19-25 kHz, including the harmonics of WPT-EV charging applications, refer to CISPR proposed limits. The Loran-C system protection criterion refers to Recommendations ITU-R M.589-3 and ITU-R P.372-13. According to the impact study, there would be no risk of WPT-EV charging interfering with Loran receivers at sea under marine coverage.

6/9.1.6/3.1.5 Impact studies on AM broadcasting

These studies entailed conducting analyses based on the protection criteria for AM broadcast reception and on possible separation distances in the case of WPT-EV chargers used for specific heavy-duty electric vehicles (e.g. bus, tram, truck). The studies considered that it is likely that WPT-EV for heavy-duty electric vehicles would be located at a minimum separation distance of 10 m from an AM broadcast receiver. The studies also found that mitigation would be required to protect AM broadcasting in cases where the unwanted emissions would need to be reduced and/or WPT-EV would need to operate, with enhanced stability and purity, on specific frequencies such that the corresponding harmonics fall in frequencies that reduce the impact on AM broadcast reception, taking into account the AM channel rasters.

6/9.1.6/3.1.6 Impact studies on amateur radio

Among amateur radio bands, the field measurements were conducted for 135.7 kHz-137.8 kHz and 472 kHz-479 kHz. The measurement results are compared to and meet the limits of CISPR/B/687/CDV. These limits do not necessarily ensure protection of radio services.

6/9.1.6/3.1.7 Study on the impact of WPT-EV to aeronautical service

Among aeronautical service bands, the field measurements were conducted for 190 kHz-535 kHz (Recommendation ITU-R SM.1535) and 2 800 kHz-22 000 kHz (Recommendation ITU-R M.1458). The measurements results meet the limits of CISPR/B/687/CDV and ETSI EN 303 417. These limits do not necessarily ensure protection of radio services.

⁴⁴ It failed in voting, however it was used in the studies that the CPM Report refers to.

6/9.1.6/3.1.8 Study on the impact of WPT-EV to lightning detection system

Field measurements were taken for lightning detection systems that operate at 5-200 kHz. The results of the measurements meet the limits of CISPR/B/687/CDV and ETSI EN 303 417. These limits do not necessarily ensure protection of radio services.

6/9.1.6/3.2 Impact studies for WPT-EV operating in the 55-65 kHz frequency range

6/9.1.6/3.2.1 Impact studies on the standard frequency and time signal service

One study found that WPT-EV operating in the 55-65 kHz frequency range will cause harmful interference to SFTS operating at 60 kHz. 60 kHz SFTS stations are operated in Japan, the United States of America, and the United Kingdom with millions using the service. The results of measurements of a WPT-EV system were compared with the minimum usable field strength. It was found that the measured emissions of WPT-EV at 10 m exceeded the minimum usable field strength by 45.7 dB. WPT-EV operating at 55-65 kHz will have an impact, causing harmful interference to SFTS.

One study on SFTS conducted measurements and considered SFTS stations operating at 20 kHz globally; 40 kHz in Japan; 60 kHz in the United Kingdom, the United States, and Japan; 68.5 kHz in China; 77.5 kHz in Germany; 100 kHz in China; and 162 kHz in France. The measurement results were compared to two limits that are being developed in SDOs (CISPR/B and ETSI EN 303 417). These limits do not necessarily ensure protection of radio services.

6/9.1.6/3.2.2 Impact studies on ripple control

The study on 129.1 kHz and 139 kHz of ripple control was conducted by both simulation and field measurements. The measurement results are compared to the limits of CISPR/B/687/CDV and ETSI EN 303 417, and they meet the former. These limits do not necessarily ensure protection of radio services.

6/9.1.6/3.2.3 Impact studies on train protection automatic warning systems

In the study, a 5 m separation distance is needed to protect ATS.

6/9.1.6/3.2.4 Impact studies on maritime radio including navigation system

Only Loran-C systems have been studied, and in this study of such systems the emission and field strength of 55-65 kHz, including the harmonics of WPT-EV charging applications, refers to CISPR proposed limits. The Loran-C system protection criterion refers to Recommendations ITU-R M.589-3 and ITU-R P.372-13. According to the impact study, there would be no risk of WPT-EV charging interfering with Loran receivers at sea under marine coverage.

6/9.1.6/3.2.5 Impact studies on AM broadcasting

These studies entailed conducting analyses based on the protection criteria for AM broadcast reception and on possible separation distances in the case of WPT-EV chargers used for specific heavy-duty electric vehicles (e.g. bus, tram, truck). The studies considered that it is likely that WPT-EV for heavy-duty electric vehicles would be located at a minimum separation distance of 10 m from an AM broadcast receiver. The studies also found that mitigation would be required to protect AM broadcasting in cases where the unwanted emissions would need to be reduced and/or WPT-EV would need to operate, with enhanced stability and purity, on specific frequencies such that the corresponding harmonics fall in frequencies that reduce the impact on AM broadcast reception, taking into account the AM channel rasters.

6/9.1.6/3.2.6 Impact studies on amateur radio

Among amateur radio bands, the field measurements were conducted for 135.7 kHz-137.8 kHz and 472 kHz-479 kHz. The measurement results are compared to and meet the limits of CISPR/B/687/CDV. These limits do not necessarily ensure protection of radio services.

6/9.1.6/3.3 Impact studies for WPT-EV operating in the 79-90 kHz frequency range

6/9.1.6/3.3.1 Impact studies to standard frequency and time signal service

6/9.1.6/3.3.1.1 Impact studies to standard frequency and time signal service using 40 and 60 kHz

The study on interference between SFTS and WPT-EV at 40-60 kHz was completed. Based on a 10 m separation distance, the study establishes that operation time does not overlap with WPT-EV operation, the variation of propagation direction of SFTS services, and the possible performance improvement of those devices.

This study confirmed the impact of WPT-EV systems on radio-controlled clocks/watches (parts of SFTS) operating at 40-60 kHz to be small enough.

6/9.1.6/3.3.1.2 Impact studies to standard frequency and time signal service using 77.5 kHz

One study, taking into account a WPT field strength of 68.5 dB μ A/m at 10 m, shows that a maximum of 50% blocking of the considered standard clock radio receivers using 77.5 kHz (DCF77) will only occur within a distance of 18 m of a WPT-EV charging installation. In order to account for the possible field strength increase to a maximum of 82 dB μ A/m at 10 m, this distance would be extended to 31 m. This impact can be reduced by restricting the transmission power of the WPT-EV charging installation and carefully selecting its centre frequency within 79-90 kHz and potentially by other mitigation techniques (e.g. periodically interrupting the charging process).

6/9.1.6/3.3.2 Impact studies on ripple control

Not studied.

6/9.1.6/3.3.3 Impact to specific railway radiocommunication system

These studies considered and discussed harmful interference to railway communication systems in actual operational use cases through simulations and measurements. Specifically, the ATS system, which is used globally, was studied operating at 10-250 kHz. The results of the study establish that a minimum 5 m separation distance is required to not produce harmful interference.

6/9.1.6/3.3.4 Impact studies to maritime radio including navigation system

6/9.1.6/3.3.4.1 Loran-C systems in 79-90 kHz

In the study between Loran-C systems and WPT-EV, the emission and field strength of the proposed frequency range 79-90 kHz, including the 2nd harmonics of WPT-EV charging applications, refer to the CISPR proposed limits. The Loran-C system protection criterion refers to Recommendations ITU-R M.589-3 and ITU-R P.372-13.

According to the coexistence study, for single and multiple WPT-EV applications, there would be no risk of interference with Loran receivers under marine coverage by the charging emissions of WPT-EV. The results of the study indicate that the coexistence between WPT-EVs and Loran-C systems is feasible, provided the frequency range 79-90 kHz is identified for medium-power WPT-EV.

6/9.1.6/3.3.5 Impact studies to sound broadcasting

These studies entailed conducting analyses based on the protection criteria for AM broadcast reception and on possible separation distances in the case of WPT-EV chargers used for generic light-duty electric vehicles. The studies considered that it is likely that WPT-EV would be located at minimum separation distances of 1 and 3 metres from an AM broadcast receiver. The studies also found that mitigation would be required to protect AM broadcasting in cases where the unwanted emissions would need to be reduced and/or WPT-EV would need to operate, with enhanced stability and purity, on specific frequencies such that the corresponding harmonics fall in frequencies that reduce the impact on AM broadcast reception, taking into account the AM channel rasters.

Other studies – including a field interference test, a theoretical analysis, and Monte Carlo simulations – were performed in some urban areas with high levels of both wanted broadcast signal and environment noise floor. They showed that higher levels of WPT-EV emissions may be tolerated by AM receivers in such environments. For other scenarios, such as suburban and rural areas, mitigating the interference would require increased separation distances between the WPT-EV equipment and the AM broadcast receiver.

More precisely, 2nd to 21st order harmonics of WPT-EV systems may fall in the frequency range of LF and MF sound broadcasting services. Two approaches for compatibility between WPT-EV systems and sound broadcasting systems are described in Report ITU-R SM.2303-2. The first approach is based on existing ITU-R – protection criteria for AM broadcasting signal. The second approach is based on the criteria that WPT-EV harmonic emissions falling in the LF or MF broadcasting bands should be kept below the environmental noise levels.

Based on the provisions of Recommendations ITU-R BS.703 and ITU-R BS.560, the first approach derives tolerable interference levels of $-44 \text{ dB}\mu\text{A/m}$ in the LF broadcasting band (148.5-283.5 kHz) and $-51 \text{ dB}\mu\text{A/m}$ in the MF broadcasting band (526.5-1 606.5 kHz) at the location of the receiver. If the interferer (including harmonic emissions) is a plain, unmodulated sinusoid with good spectral purity and is accurately co-incident in frequency (within $\pm 50 \text{ Hz}$) with the victim radio service, these levels can be relaxed by 38 dB.

Based on the environmental noise levels derived from Recommendation ITU-R P.372-13, the second approach derives tolerable interference levels of $-25.5 \text{ dB}\mu\text{A/m}$ in cities, $-30.5 \text{ dB}\mu\text{A/m}$ in residential areas, $-34.5 \text{ dB}\mu\text{A/m}$ in rural areas, and $-48.5 \text{ dB}\mu\text{A/m}$ in quiet rural areas, at 500 kHz, at the location of receiver. The results of some measurements show that environmental noise levels in some cities and residential areas are significantly higher than the above levels.

ITU-R is developing recommendations on limits required for the protection of radiocommunication services from WPT, including WPT-EV.

6/9.1.6/3.3.6 Impact studies to the amateur service

The frequency range for WPT-EV, 79-90 kHz, does not overlap with, and has enough separation from, frequency bands for amateur radio services using 135.7-137.8 kHz. Therefore, receiver sensitivity suppression (out-of-band) by interference is not taken into consideration. Radiated emission levels of harmonics (spurious emission) from WPT-EV will need to be considered where they fall into the amateur radio services bands.

Report ITU-R SM.2303-2 states that interference to amateur services was not studied. Subsequent papers submitted to ITU-R show that the current emission limits in the spurious domain, as defined by ITU-R and/or CISPR documents, fall well short of providing adequate protection from harmful interference to amateur services from WPT-EV, given that antennas used in this service are generally located in urban/suburban residential areas.

The high duty cycle of WPT-EV systems, their planned location close to or inside dwellings, and their anticipated deployment density show that the current CISPR or ITU limits are inadequate for such a technology deployed in this way. Harmful interference to the amateur service seems likely if WPT-EV systems operate at or near the existing limits. The necessary limits for harmonic emissions from WPT-EV systems can be less stringent (although still stricter than current limits) if:

- a) WPT-EV systems adopt a harmonized, tightly toleranced frequency of operation; and
- b) the phase noise and noise sidebands from WPT-EV are at least 40 dB below the equivalent of the current emission limits.

6/9.1.6/3.4 ITU-R collaboration with standards developing organizations

Throughout the studies, it was found that close collaboration between SDOs and the ITU-R is important to achieve harmonized outcomes and ensure that WPT-EV does not cause harmful interference/disturbance. Work is ongoing between the ITU-R and SDOs such as IEC-CISPR to define appropriate frequency ranges and technical limits in standards to protect radiocommunication services.

6/9.1.6/4 Conclusions

The studies show that WPT-EV operating at 55-65 kHz will cause harmful interference to SFTS operating at 60 kHz. It may be possible to define two separate frequency ranges below and above 60 kHz to create an exclusion within the 55-65 kHz frequency range to mitigate the impact. The appropriate frequency separation from SFTS still needs to be studied but is likely to be several kHz.

The magnetic resonance frequencies and power levels for WPT-EV operation should be chosen in a way that avoids interference to existing radio services around these frequencies and mitigates the potential for harmful interference to radiocommunication services from WPT-EV unwanted emissions.

Additionally, the studies indicate that the operation of WPT-EV in the 19-25 kHz, 55-5X kHz, 6Y-65 kHz, and 79-90 kHz bands (see Table 6/9.1.6-2) is compatible with existing radiocommunication services operating at other frequencies, provided that the WPT-EV unwanted emissions are tightly controlled. The exact limits and mitigation techniques, as well as potential other matters, still need to be defined through further studies.

Methodology and guidance to administrations are/will be included in several ITU-R documents:

- appropriate bands are specified in preliminary draft revision of Recommendation ITU-R SM.2110-0;
- limits on unwanted emissions, including harmonics, are expected to be specified in a new ITU-R Recommendation; and
- results of related studies and examples of existing national implementations throughout the Regions are provided in Report ITU-R SM.2303-2 and WDPDN Report ITU-R SM.[WPT_EV_IMPACT] and are expected to be provided in one or more ITU-R Reports on WPT-EV.

Consequently, there is no need for activity related to WRC-19 to amend the RR.

The ITU-R will need to continue to closely collaborate with SDOs. This is to ensure that appropriate frequency ranges and technical limits are incorporated into standards to protect radiocommunication services.

TABLE 6/9.1.6-2

Frequency bands and power levels for WPT-EV

| Categories | Power level | Frequency band | WPT applications |
|---------------------|--------------------|-----------------------|---|
| High power WPT-EV | More than 22 kW | 19-25 kHz | Specific heavy-duty electric vehicles (e.g. bus, tram, truck) |
| | More than 22 kW | 55-5X kHz | Specific heavy-duty electric vehicles (e.g. bus, tram, truck) |
| | More than 22 kW | 6Y-65 kHz | Specific heavy-duty electric vehicles (e.g. bus, tram, truck) |
| Medium power WPT-EV | Up to 22 kW | 79-90 kHz | Generic light-duty electric vehicles |

NOTE: Regarding the 55-5X kHz and 6Y-65 kHz bands, frequency separation below and above 60 kHz (exclusion band) is needed to protect SFTS. The appropriate frequency separation still needs to be studied to define values for X and Y.

Agenda item 9.1(9.1.7)

6/9.1.7 Issue 2) in the Annex to Resolution 958 (WRC-15)

Urgent studies required in preparation for the 2019 World Radiocommunication Conference

2) *Studies to examine:*

- a) *whether there is a need for possible additional measures in order to limit uplink transmissions of terminals to those authorized terminals in accordance with No. 18.1;*
- b) *the possible methods that will assist administrations in managing the unauthorized operation of earth station terminals deployed within its territory, as a tool to guide their national spectrum management programme, in accordance with Resolution ITU-R 64 (RA-15).*

{Editorial note: In the rest of the text, wherever possible, the term “earth station” has been used rather than “earth station terminal”}

6/9.1.7/1 Executive summary

Studies under WRC-19 agenda item 9.1, issue 9.1.7 examined the need for additional measures to limit uplink transmissions of earth stations to authorized ones and possible methods to assist administrations in managing unauthorized operation of earth stations.

With respect to *Issue 2a*) in the Annex of Resolution **958 (WRC-15)**, two options have been identified:

- Option 1: no change to the Radio Regulations as current measures are sufficient. The Radio Regulations, specifically the provisions of Article **18**, contain a clear and unambiguous requirement to operate an earth station only if duly authorized. New provisions in the Radio Regulations will not help address unlawfully operated earth stations.
- Option 2: to develop a new WRC Resolution to assist administrations with the application of RR No. **18.1**.

With respect to *Issue 2b*) in the Annex of Resolution **958 (WRC-15)**, one option has been identified:

- to provide necessary guidelines on satellite monitoring capabilities, along with possible revision and/or further development of ITU-R Reports or Handbooks to assist administrations with managing unauthorized operation of earth stations deployed within their territory, as a tool to guide their national spectrum management.

6/9.1.7/2 Background

Fixed-satellite services designed to meet the demand for global communication services are characterized by flexible, rapid and ubiquitous deployment of large numbers of cost-optimized earth stations employing small antennas and having common technical characteristics.

The issue under study is uplink transmissions from such earth stations not adhering to certain international regulations or national service rules: i.e. an earth station operating in the territory of a country without any authorization obtained from that country.

Unauthorized uplink earth station transmissions may also cause interference to legitimate users as well as raise other difficulties for administration spectrum managers.

For these reasons, the Radiocommunication Assembly 2015 (RA-15) approved Resolution ITU-R 64, titled “Guidelines for the management of unauthorized operation of earth station terminals”. The *resolves* of this Resolution invited ITU-R study groups concerned:

- 1) to conduct studies to examine whether there is a need for possible additional measures in order to limit uplink transmissions of terminals to those terminals authorized in accordance with No. **18.1**;
- 2) to study the possible methods that will assist administrations in managing the unauthorized operation of earth station terminals deployed within their territory, as a tool to guide their national spectrum management programme.

In addition, WRC-15 also considered this subject and approved Issue 2) in the Annex to Resolution **958 (WRC-15)** recognizing the urgency of these studies in preparation for, and to be reported to, WRC-19.

6/9.1.7/2.1 Issues arising from the use of unauthorized earth station uplinks

The difficulties facing administrations from the use of unauthorized earth station uplinks are listed below:

- a) Administrations may not have the capability to monitor if there is an unauthorized uplink transmission from an earth station in their territory.
- b) If an unauthorized uplink transmission is discovered in their territory, administrations may not have the capability to geolocate the earth station.
- c) If the location of the unauthorized earth station is identified, administrations may need assistance to resolve the issue with satellite networks notified by other administrations.
- d) Administrations may discover earth stations operating without proper licence, violating RR No. **18.1**.

6/9.1.7/3 Summary and analysis of the results of ITU-R studies

ITU-R studies focused on addressing *Issue 2a*) and *2b*) in the Annex of Resolution **958 (WRC-15)** in sections 6/9.1.7/3.3.1 and 6/9.1.7/3.3.2 respectively.

To this effect, the ITU-R conducted work in the following three areas:

1) ITU questionnaire to administrations

A questionnaire for all administrations was prepared and sent out by ITU-R relating to the operation of ubiquitously deployed earth stations. Responses from administrations were sought about their experience regarding the management of any unauthorized operation of earth stations deployed within their territory.

Twenty-eight responses were received from the ITU Member States and are provided in input Document 1B/153.

A summary of the responses is reported below.

- a) Twenty-seven of the responding Member States reported that they license satellite uplink transmission to ubiquitously deployed earth stations and 26 of these 27 include a revocation clause(s) (i.e. withdrawal of the authorization/licence).
- b) Fifteen of the responding Member States authorizing the uplink transmission of earth stations reported that they require that the assignment of the satellite networks, to which the authorized earth stations are associated, be recorded in the MIFR.

- c) Eight of the responding Member States indicated issues with unauthorized earth stations and have problems in relation to the operation of unauthorized uplink transmission. Not all administrations encountered the same difficulties. Some of the difficulties could be presented as follows:
- i) There is a difficulty in monitoring and locating unauthorized deployed earth stations, especially with irregular and short-term operation.
 - ii) There is no clear framework in the Radio Regulations (RR) for administrations to apply their complaints regarding RR No. **18.1**.
 - iii) There is no clear provision in the RR to address unauthorized transmission of earth stations operating within a given satellite network, taking into account difficulties outlined in the two points above.
 - iv) There is no obligation in the RR identified for a notifying administration to deal with unauthorized earth stations operating in the territory of another administration.
 - v) Three out of the eight administrations experienced issues with unauthorized earth stations that were not resolved.
- d) Twelve out of the 28 Member States that responded have the capability of monitoring and identifying the location of potential unauthorized uplink transmissions. Five of these 12 do not share monitoring information with other administrations.

2) Enquiry to the BR on the application of No. 18.1 of the Radio Regulations

With respect to the application of No. **18.1** of the Radio Regulations in relation with any unauthorized uplink transmission from earth stations, the Bureau replied that it has reviewed all correspondences from administrations between November 2007 and April 2017 and has not found any administration request for assistance with the application of the provision No. **18.1** of the Radio Regulations concerning unauthorized uplink earth stations.

3) Uplink monitoring capabilities

For unreported cases of unauthorized uplink transmission, there are currently no spectrum monitoring techniques and/or methods to identify the emission and location of unauthorized earth stations in FSS frequency bands.

However, for reported cases of unauthorized uplink transmission, geolocation methods are available, noting that only few administrations currently have the necessary geolocation capabilities. Additional information is included in Report ITU-R SM.2424.

6/9.1.7/3.1 Application of Article 18 in the Radio Regulations

RR No. **18.1** provides that:

“No transmitting station may be established or operated by a private person or by any enterprise without a licence issued in an appropriate form and in conformity with the provisions of these Regulations by or on behalf of the government of the country to which the station in question is subject”.

The phrase “to which the station in question is subject” covers many different situations, including those of transmitters moving over or in the territories of different countries.

The requirement of RR No. **18.1** for stations to be licensed applies to all transmitting earth stations. In practice, RR No. **18.1** could be implemented by administrations in various ways – individual licensing, simplified licensing, voluntary registration of earth stations, etc. RR No. **18.1** implies that any transmitting earth stations communicating with fixed satellite networks, not in compliance with

the licence regime of the country where it is deployed, is not in compliance with the Radio Regulations.

In some cases, additional provisions are included in the RR to assist in avoiding unauthorized use for specific cases of earth station deployment and usage.

For example, for Global Mobile Personal Communications by Satellite (GMPCS) using fixed, mobile or transportable earth stations, in addition to RR No. **18.1**, Resolution **25 (Rev.WRC-03)** “Operation of global satellite systems for personal communications” states in *resolves*:

“that administrations licensing global satellite systems and stations intended to provide public personal communications by means of fixed, mobile or transportable terminals shall ensure, when licensing these systems and stations, that they can be operated only from the territory or territories of administrations having authorized such service and stations in compliance with Articles **17** and **18**, in particular No. **18.1**. ”

Also, Resolution **156 (WRC-15)** “Use of the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz by earth stations in motion communicating with geostationary space stations in the fixed-satellite service” states in *resolves* 3:

“that the notifying administration for the satellite network within which the earth stations in motion operate by means of fixed, mobile or transportable terminals shall ensure that they have the capability to limit operations of such earth stations to the territory or territories of administrations having authorized those earth stations and to comply with Article **18** ”

Resolution **156 (WRC-15)** contains additional measures to RR Article **18** to limit uplink transmissions of earth stations in motion operating in frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz to only authorized earth stations.

6/9.1.7/3.2 Licensing responsibilities of satellite operators and administrations

The licensing of earth stations under RR No. **18.1** is a process under the purview of the administration on whose territory the earth stations will be located and operated. This course of action is carried out between the administration on the territory of which the earth station is located and operated and the notifying administration of the subject satellite network, usually through a satellite operator.

Successful satellite network coordination, notification and registration do not imply in any way authorization of earth stations within the territory of any Member State.

It is understood that a notifying administration of a satellite network, through a satellite operator, is responsible for:

- obtaining permission/authorization from administrations on the territory of which the earth stations would be located to communicate with the satellite network in question. However, in some cases this permission/authorization, based on national legislation, is not required.
- obtaining the required licences for the gateway earth stations associated with the satellite for feeder links or for telecommand and user earth stations from the administration on whose territory the gateways and earth stations will be located and operate, noting that the operator of the gateway station(s) may be a separate entity.

The satellite operator is generally responsible for making sure that the approvals/licences/permissions necessary to deploy earth stations in a given country and provide service accordingly are duly obtained. However,

- a) in certain cases, satellite operators provide services indirectly via national or international/regional service providers;
- b) in certain countries, the domestic licensing framework does not allow the satellite operator (especially when foreign) to hold licences/permissions for use of spectrum and/or service provision. Such licences/permissions can be assigned only to local service providers.

As such, in most cases, it is the satellite service provider that interacts with the licensing administration to meet the precise regulatory and licensing requirements to offer satellite services.

The administration which authorizes earth stations located on its territory is responsible for:

- a) protection of its national frequency assignments to space and terrestrial services from possible harmful interference caused by such earth stations; and
- b) ensuring that such earth stations do not cause harmful interference to services of its neighbouring countries.

6/9.1.7/3.3 Analysis of studies

6/9.1.7/3.3.1 Issue 2a in Annex to Resolution 958 (WRC-15)

6/9.1.7/3.3.1.1 Situational status and potential additional measures in order to limit unauthorized uplink transmissions of earth stations

From Section 6/9.1.7/3 there were four issues identified with the use of unauthorized earth stations and each issue is addressed in this section:

6/9.1.7/3.3.1.2 Administrations' monitoring capabilities

The main obstacle for some administrations in resolving the issue of unauthorized earth stations is the inability to know when there are unauthorized uplink transmissions from an earth station in their territory. This is normally because of a lack of monitoring equipment and expertise to actively monitor the uplink of earth stations, especially with short time of transmission and/or movement of the earth stations. This capability can be cost-prohibitive and only few administrations have it. Additionally, the potential ability of the unauthorized earth station (e.g. a VSAT) to be transported to another location in a short period of time and transmit further complicates detection of the uplink signal.

Administrations without the monitoring capabilities could request the BR for help. The BR can help the administration by pointing to other resources such as commercial entities that provide monitoring services or to other administrations or agencies willing to assist.

These measures could be included in a new WRC Resolution (see example for Option 2 below).

6/9.1.7/3.3.1.2.1 Geolocation capabilities

Geolocation of an active transmitter is not an easy or straightforward task and most administrations do not have the capability to geolocate an unauthorized transmitting earth station. Geolocation capabilities are costly and only few administrations have them. Additionally, like in the case for monitoring, the fact that small VSAT are easy to move, further complicates this issue.

Administrations without the capability to geolocate unauthorized earth station uplink transmissions can request assistance from the BR or other administrations with the ability to geolocate. The BR

can help in obtaining assistance from other administrations. For such requests to be effective, information on the suspected unauthorized uplink earth station should be provided from the administration to the BR. Such information, if available, may include:

- 1) the country on the territory of which an unauthorized uplink transmission is detected;
- 2) the starting date;
- 3) the duration and periodicity of such transmission;
- 4) frequency bands and other available information on the suspected satellites networks;
- 5) where possible, motivation and objective of the unauthorized transmission;
- 6) actions, if any, being taken by the reporting administration.

Without some of the above information, it may not be possible to geolocate the unauthorized earth station. Upon receipt of notice accompanied by the available information from an administration detecting an unauthorized uplink transmission to an identified or unidentified FSS satellite network, the Bureau should immediately inform relevant Member States and satellite operating agencies of the matter by a circular telegram. All notifying administrations and satellite operating agencies of FSS networks whose service area covers the country reporting the unauthorized uplink transmission as well as international space monitoring stations are encouraged to jointly collaborate with the administration detecting such transmission in an effort to identify the satellite network and locate the earth station.

Should the above joint action result in clear identification of the source of unauthorized transmission, the BR, together with the administration responsible for the identified FSS satellite network with which such unauthorized transmission occurs, should immediately take necessary action to resolve the matter in a satisfactory manner.

These measures could be included in a new WRC Resolution (see example for Option 2 below).

6/9.1.7/3.3.1.3 Assistance from ITU, notifying administrations and/or satellite operators

Once an administration discovers an unauthorized earth station operating on its territory, there may be a need to work with the notifying administration of the satellite network to request assistance. Should the notifying administration fail or refuse to cooperate, ITU assistance may be necessary.

Along similar lines as in the sections above, all administrations, space operating agencies and satellite network operators should respond to requests for assistance for locating and identifying unauthorized uplink transmission from earth stations, to the maximum extent practicable. The BR can help by notifying the concerned administrations and agencies of a problem.

Cooperation is key to jointly resolving the issue.

Once a satellite network operator has been identified in relation to unauthorized transmission from earth stations, the satellite network operator, along with the notifying administration should take all actions to cease the transmission as quickly as possible. The BR can further facilitate communications and cooperation between the administrations involved.

These measures could be included in a new WRC Resolution (see example for Option 2 below).

6/9.1.7/3.3.1.4 Operating in contravention of RR No. 18.1

Some administrations may experience difficulties in ensuring that the requirement of RR Article 18 for authorization of earth station transmissions are fully complied with in the framework of their national regulations. There could be several reasons for this, for example, but not limited to:

- satellite service providers not familiar with the authorization process within an administration;

- lack of awareness that authorization is required;
- intentional non-observance of an administration's rules and procedures relating to earth station authorization.

An example of an earth station operating in contravention of RR No. **18.1** occurs when an earth station registers for satellite service in Administration A and then the earth station is moved to Administration B, without informing the satellite operator (or service provider) and the Administration B's regulatory authority. The earth station operating in Administration B is not licensed or authorized to operate in Administration B's territory, thereby not respecting RR No. **18.1**.

For the connection of any earth station to operate within a FSS network from any administration, the notifying administration for the satellite network needs to ensure that the earth stations have obtained the required authorization as referred to in RR No. **18.1**, from the administrations on whose territory the earth stations intend to operate.

Administrations are encouraged to make publicly and readily available the relevant procedures for licensing or authorizing the operation of earth stations on their territories.

These measures could be included in a new WRC Resolution (see example for Option 2 below).

6/9.1.7/3.3.1.5 Unauthorized earth stations operating while in motion

An issue of unauthorized uplink earth station transmission can occur with respect to earth stations that operate while moving. An earth station on a boat, plane, or train could cross into the territory of an administration that has not authorized the use of the earth station.

One of the possible options to address the issue is that, similarly to *resolves* 3 of Resolution **156 (WRC-15)**, the notifying administration for the FSS satellite network within which the earth station operates while in motion shall ensure that they have the capability to limit operations of such earth stations to the territory or territories of administrations having authorized those earth stations and to comply with RR Article **18**.

It is emphasized that decisions taken under agenda item 9.1, issue 9.1.7, should not contradict the outcome of WRC-19 agenda item 1.5 and the provisions of Resolution **156 (WRC-15)**.

These measures could be included in a new WRC Resolution (see example for Option 2 below).

6/9.1.7/3.3.2 Issue 2b in Annex to Resolution 958 (WRC-15)

6/9.1.7/3.3.2.1 Possible methods/courses of action for managing the unauthorized operation of earth stations, as a tool to guide national spectrum management programme

In cases where administrations and/or network operators can identify unauthorized use of their satellites and report to the relevant radio monitoring service, geolocation methods are available to determine the location of the transmitter. However, not all administrations have the necessary geolocation capabilities.

Spectrum management training and domestic spectrum monitoring to identify unauthorized uplink transmissions are useful tools to enable administrations to regulate and enforce regulations associated with transmissions originating in their territory. The development of ITU-R Reports or Handbooks may assist administrations in the management of their satellite spectrum resources to prevent or limit the unauthorized use of uplink earth stations and enable the administration to locate and terminate the unauthorized transmissions.

In this context, the regulatory regimes of those administrations experiencing difficulties can also be reviewed and compared with those of administrations authorizing ubiquitous uplink earth stations and not experiencing any issues with unauthorized uplink transmissions. On the basis of such a comparison, taking into consideration that administrations may not manage their national spectrum in the same way, the administration experiencing difficulties can determine rules or procedures that will work best for their administration.

6/9.1.7/4 Conclusions

6/9.1.7/4.1 Issue 2a in the Annex to Resolution 958 (WRC-15)

Issue 2a Option 1: No changes to the Radio Regulations

NOC

ARTICLES

NOC

APPENDICES

NOC

RESOLUTIONS

Issue 2a Option 2: Develop a new WRC Resolution to introduce additional measures in order to address the issue of unauthorized uplink transmissions of earth stations (see example of new WRC Resolution below)

ADD

DRAFT NEW RESOLUTION [A917] (WRC-19)

Measures to limit unauthorized uplink transmissions from earth stations

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

a) that in accordance with Resolution **958 (WRC-15)** and Resolution ITU-R 64 (RA-15) the following issues were studied:

- whether there is a need for possible additional measures in order to limit uplink transmissions of terminals to those authorized terminals in accordance with No. **18.1**;
- the possible methods that will assist administrations in managing the unauthorized operation of earth station terminals deployed within its territory, as a tool to guide their national spectrum management programme;

b) that demand has been increasing for global satellite broadband communication services throughout the world,

recognizing

a) that the notifying administration of an FSS satellite network has the responsibility to ensure that the earth stations associated with the FSS network have obtained the required authorization as referred to in No. **18.1** of the RR, from the administrations on whose territory the earth stations intend to operate;

b) that successful coordination of a satellite network or system does not imply licensing authorization to provide a service within the territory of a Member State,

noting

a) that the ITU Constitution recognizes the sovereign right of each Member State to regulate its telecommunications;

b) that Article **18** specifies the authorities for licensing the operation of stations within any given territory,

resolves

1 that notifying administrations for a satellite network shall take appropriate actions to ensure the operation of earth stations to only those licensed or authorized by the administrations on the territory of which they are located and operated;

2 that the notifying administration, for the satellite network within which earth stations that can operate while in motion are associated, shall ensure that they have the capability to limit operations of such earth stations to the territory or territories of administrations having authorized those earth stations and to comply with Article **18**;

3 that, when the source of unauthorized earth station transmission is identified and reported to the notifying administration responsible for the identified FSS satellite network, that notifying administration shall cooperate with the reporting administration to take appropriate action to resolve the matter in a satisfactory and timely manner,

invites administrations

1 to take all appropriate actions to make publicly and readily available the procedures for licensing/authorizing the operation of earth stations in their territories;

2 that have identified unauthorized operation of earth stations within their territories to provide relevant information to BR to report such cases;

3 when requested by BR or another administration, to cooperate to the maximum extent practicable with assistance in identifying unauthorized earth stations with monitoring or geolocation services,

instructs the Director of the Radiocommunication Bureau

1 upon receipt of notice accompanied by the available information from an administration detecting an unauthorized uplink transmission from its territory, to immediately inform Member States and satellite operating agencies of the matter by appropriate means and work with the administrations involved to resolve the matter;

2 to inform the administrations on the type of assistance ITU can provide on this issue,

instructs the Secretary-General

to stress the importance and ensure the circulation of this Resolution to all Member States.

6/9.1.7/4.2 Issue 2b in Annex to Resolution 958 (WRC-15)

To further assist administrations in managing (identifying and geolocating) the unauthorized operation of earth stations deployed within their territory, the ITU-R needs to provide necessary guidelines on satellite monitoring capabilities, along with possible revision and further development of ITU-R Reports or Handbooks in this regard. These may provide guidance and support for administrations in managing the unauthorized operation of earth stations deployed within their territory and tools to guide their national spectrum management.

Agenda item 10

10 to recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, in accordance with Article 7 of the Convention,

Resolution 810 (WRC-15): Preliminary agenda for the 2023 World Radiocommunication Conference

2 on the basis of proposals from administrations and the Report of the Conference Preparatory Meeting, and taking account of the results of WRC-19, to consider and take appropriate action in respect of the following items:

2.1 to consider possible spectrum needs and regulatory actions to support Global Maritime Distress and Safety System (GMDSS) modernization and the implementation of e-navigation, in accordance with Resolution 361 (WRC-15);

Resolution 361 (WRC-15): Consideration of regulatory provisions for modernization of the Global Maritime Distress and Safety System and related to the implementation of e-navigation

2.2 to conduct, and complete in time for WRC-23, studies for a possible new allocation to the Earth exploration-satellite (active) service for spaceborne radar sounders within the range of frequencies around 45 MHz, taking into account the protection of incumbent services, in accordance with Resolution 656 (WRC-15);

Resolution 656 (WRC-15): Possible allocation to the Earth exploration-satellite service (active) for spaceborne radar sounders in the range of frequencies around 45 MHz

2.3 in accordance with Resolution 657 (WRC-15), to review the results of studies relating to the technical and operational characteristics, spectrum requirements and appropriate radio service designations for space weather sensors, with a view to providing appropriate recognition and protection in the Radio Regulations without placing additional constraints on incumbent services;

Resolution 657 (WRC-15): Spectrum needs and protection of space weather sensors

2.4 study of spectrum needs and possible new allocations to the fixed-satellite service in the frequency band 37.5-39.5 GHz (Earth-to-space), in accordance with Resolution 161 (WRC-15);

Resolution 161 (WRC-15): Studies relating to spectrum needs and possible allocation of the frequency band 37.5-39.5 GHz to the fixed-satellite service

2.5 to review the spectrum use and spectrum needs of existing services in the frequency band 470-960 MHz in Region 1 and consider possible regulatory actions in the frequency band 470-694 MHz in Region 1 on the basis of the review in accordance with Resolution 235 (WRC-15);

Resolution 235 (WRC-15): Review of the spectrum use of the frequency band 470-960 MHz in Region 1

6/10/1 WRC-23 preliminary agenda item 2.1 – Resolution 361 (WRC-15)

The issue of GMDSS modernization was included in the provisional agenda of WRC-19 at WRC-12 (Item 2.1 of Resolution 808 (WRC-12) “Provisional agenda for the World Radiocommunication Conference 2018”). At WRC-15, when considering the issues of modernization of GMDSS and e-navigation implementation the International Maritime Organization noted that issues related to the introduction of e-navigation will not be finalized by 2019. Therefore, it was proposed to consider the issues of GMDSS modernization in two stages. In

the first stage, at WRC-19 (within WRC-19 agenda item 1.8) it was decided to determine the regulatory provisions to support GMDSS modernization and select additional satellite systems for use in the GMDSS and at the second stage, at WRC-23, to continue studying the modernization of GMDSS, including aspects of introducing e-navigation.

Resolution **361 (WRC-15)** “Consideration of regulatory provisions for modernization of the Global Maritime Distress and Safety System and related to the implementation of e-navigation” invites ITU-R to conduct studies, taking into consideration the activities of IMO, in order to determine spectrum needs and regulatory actions to support GMDSS modernization and the implementation of e-navigation, and at WRC-23 consider possible regulatory actions, including spectrum allocations, for supporting e-navigation.

At WRC-19, within agenda item 1.8 (Issue A) it is planned to take some measures in relation to the NAVDAT MF and HF systems and to continue consideration of this issue in the future. It should be noted, that this requires finalization by IMO of all related studies on modernization of GMDSS, in particular, a revision of SOLAS Chapters III and IV.

Agenda item 1.8 (Issue B) WRC-19 considers inclusion of new satellite provider to GMDSS and administrations may plan to continue to conduct technical and regulatory studies based on additional proposals related to a new agenda item for WRC-23.

See also Section 5/1.8 in Chapter 5 of this CPM Report to WRC-19.

6/10/2 WRC-23 preliminary agenda item 2.2 – Resolution 656 (WRC-15)

Resolution **656 (WRC-15)** was adopted to explore a possible allocation to the Earth exploration-satellite service (active) for spaceborne radar sounders operating in the range of frequencies around 45 MHz. The Resolution invites ITU-R to conduct studies on spectrum needs and sharing studies between the Earth exploration-satellite (active) service and the radiolocation, fixed, mobile, broadcasting and space research services in the 40-50 MHz frequency range in order to support an allocation for the EESS (active) service for this operation.

The mission scientific objectives of a spaceborne radar sounder operating in the 40-50 MHz frequency band are 1) to understand the global thickness, inner structure, and the thermal stability of the Earth’s ice sheets and 2) to understand the occurrence, distribution and dynamics of the Earth fossil aquifers in desertic environments.

Preliminary studies, provided in Report ITU-R RS.[VHF_SOUNDER], were performed to assess sharing and compatibility with existing services allocated to, and adjacent to, the 40-50 MHz band, which include fixed, mobile, space research, broadcasting and radiolocation services. The sounding radar’s operating parameters and geographical limitations, coupled with the preliminary study results, show that further studies need to be conducted to determine if the sounding radar can operate to collect important subsurface data without causing harmful interference to incumbent services.

6/10/3 WRC-23 preliminary agenda item 2.3 – Resolution 657 (WRC-15)

Space weather refers to the physical processes occurring in the space environment. It is influenced by the solar wind and the interplanetary magnetic field (IMF) carried by the solar wind plasma. The solar wind and solar disturbances interact with the Earth’s magnetic field and outer atmosphere in complex ways, causing strongly variable energetic particles and electric currents in the Earth’s magnetosphere, ionosphere and surface.

The effects of space weather can impact a number of activities, services and global infrastructure (for communication, transport, energy supplies, etc.) at the Earth’s surface, airborne, or in space.

Resolution **657 (WRC-15)** calls for the ITU-R to document the technical and operational characteristics of space weather sensors, and determine their appropriate radio service designations, in time for WRC-19 so that the Conference may decide on the matter of recommending to Council that this matter be included in the agenda for WRC-23.

To address the requirements established in Resolution **657 (WRC-15)**, the ITU-R has developed Report ITU-R RS.[Space_Weather_Sensors] – *Technical and operational characteristics of RF-based space weather sensors*. This ITU-R Report documents the information called for by Resolution **657 (WRC-15)** to support studies to be performed under a possible agenda item on space weather at WRC-23. This Report also includes an assessment of potentially applicable radio services to the space weather sensor applications.

6/10/4 WRC-23 preliminary agenda item 2.4 – Resolution 161 (WRC-15)

Resolution **161 (WRC-15)** – *Studies relating to spectrum needs and possible allocation of the frequency band 37.5-39.5 GHz to the fixed-satellite service* resolves to invite ITU-R to conduct, and complete in time for WRC-23:

- 1 studies considering additional spectrum needs for development of the fixed-satellite service, taking into account the frequency bands currently allocated to FSS, the technical conditions of their use and the possibility of optimizing the use of these frequency bands with a view to increasing spectrum efficiency;
- 2 sharing and compatibility studies with existing services, on primary and secondary basis, including in adjacent bands as appropriate, to determine the suitability of new primary allocations to the FSS in the frequency band 37.5-39.5 GHz (Earth-to-space, limited to FSS feeder links only) for both GSO and non-GSO orbit use;
- 3 studies towards possible revision of Resolution **750 (Rev.WRC-15)** so that systems operating in the passive frequency band 36-37 GHz are protected.

Currently, under WRC-19 agenda item 9.1, issue 9.1.9, similar studies have been conducted for the frequency band 51.4-52.4 GHz (see Resolution **162 (WRC-15)** – *Studies relating to spectrum needs and possible allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space)*). These studies have shown the possibility of a primary allocation of the 51.4-52.4 GHz frequency band for GSO FSS systems (Earth-to-space) in order to ensure the availability of broadband connections via high-capacity satellites (HTS).

With a positive decision by WRC-19 on issue 9.1.9 and allocation of the frequency band 51.4-52.4 GHz for the FSS (Earth-space, limited to FSS feeder links for geostationary orbit use) the current spectrum requirements of the GSO FSS feeder links (Earth-to-space) can be fully satisfied.

The intensive use of the frequency band 37.5-39.5 GHz by fixed service stations and outcome of WRC-19 on agenda item 1.13 should be considered.

6/10/5 WRC-23 preliminary agenda item 2.5 – Resolution 235 (WRC-15)

Resolution **235 (WRC-15)** and the preliminary agenda item 2.5 were adopted to respond to some proposals at WRC-15 under agenda item 1.1 in relation to IMT use of the frequency band 470-694 MHz in Region 1. The deliberation of these requests was considered premature at WRC-15 and WRC-19, and hence the issue was included in the preliminary agenda for WRC-23.

The preliminary agenda item refers to the review of the spectrum use and spectrum needs of existing services in the frequency band 470-960 MHz in Region 1 as well as consideration of possible regulatory actions in the frequency band 470-694 MHz in Region 1 on the basis of the review in accordance with Resolution **235 (WRC-15)**.

Resolution **235 (WRC-15)** invites ITU-R to review in particular the spectrum requirements of the broadcasting and mobile, except aeronautical mobile, services. Resolution **235 (WRC-15)** also invites to carry out sharing and compatibility studies, as appropriate, in the frequency band 470-694 MHz in Region 1 between the broadcasting and mobile, except aeronautical mobile, services and to conduct sharing and compatibility studies, as appropriate, in order to provide relevant protection of systems of other existing services.

6/10/6 Additional suggestions on WRC-23 agenda items

Some suggestions for agenda items currently under consideration for inclusion on the agenda item for WRC-23 were submitted by Member States to the CPM19-2 and noted here for information purposes (Documents CPM19-2/7, 84, 154, 178, 190).

Regional organizations and administrations are still in the process of preparing for AI10 of WRC-19. It is expected that this process will take into account Resolution **804 (Rev.WRC-12)**. Additional information on views and proposals for agenda items for WRC-23 may be available on websites of ITU and regional organizations:

ITU Inter-regional Workshops on WRC-19 Preparation

<https://www.itu.int/en/ITU-R/conferences/wrc/2019/irwsp/Pages/default.aspx>

African Telecommunications Union (ATU)

<http://www.atu-uat.org/>

Arab Spectrum Management Group (ASMG)

<http://www.asmg.ae/>

Asia-Pacific Telecommunity (APT)

<http://www.apr.int/APTAPG>

Inter-American Telecommunication Commission (CITEL)

<http://www.citel.oas.org/en/Pages/PCCII>

European Conference of Postal and Telecommunications Administrations (CEPT)

<http://www.cept.org/ecc/groups/ecc/cpg>

Regional Commonwealth in the Field of Communications (RCC)

http://www.en.rcc.org.ru/about_en/RCC_positionWRC-19

ANNEX TO THE CPM REPORT

Reference List of ITU-R Resolutions, Recommendations and Reports, as well as other ITU and non-ITU publications, used in the CPM Report

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1 List of existing ITU-R Resolutions

| Resolution ITU-R* | Latest publication | Resolution title | Agenda item | CPM chapter |
|-------------------|---|--|---------------------|-------------|
| 2-7 | Res. ITU-R 2-7 (RA-15) | Conference Preparatory Meeting | 1.9.1 9.1, 9.1.1 | 5 2 |
| 54-2 | Res. ITU-R 54-2 (RA-15) | Studies to achieve harmonization for short-range devices | 9.1, issue 9.1.8 | 2 |
| 56 | Res. ITU-R 56-2 (RA-15) | Naming for International Mobile Telecommunications | 1.13 | 2 |
| 65 | Res. ITU-R 65 (RA-15) | Principles for the process of future development of IMT for 2020 and beyond | 1.13 | 2 |
| 66 | Res. ITU-R 66 (RA-15) | Studies related to wireless systems and applications for the development of the Internet of Things | 9.1, issue 9.1.8 | 2 |
| 68 | Res. ITU-R 68 (RA-15) | Improving the dissemination of knowledge concerning the applicable regulatory procedures for small satellites, including nanosatellites and picosatellites | 7, issue I | 3 |

2 List of existing ITU-R Recommendations

| ITU-R Series | Recommendation number* | Latest publication | Recommendation title | Agenda item | CPM chapter |
|--------------|------------------------------------|--------------------------------------|--|---------------------|-------------|
| SM.329 | | Rec. ITU-R SM.329-12 | Unwanted emissions in the spurious domain | 1.13 | 2 |
| SA.363-5 | | Rec. ITU-R SA.363-5 | Space operation systems | 1.7 | 4 |
| P.368 | Rec. ITU-R P.368-9 | | Ground-wave propagation curves for frequencies between 10 kHz and 30 MHz | 1.8 | 5 |
| P.368-9 | | | | | |
| P.372-13 | | Rec. ITU-R P.372-13 | Radio noise | 9.1, issue 9.1.6 | 6 |

* Reference(s) used in the CPM Report.

| ITU-R Series | Recommendation number* | Latest publication | Recommendation title | Agenda item | CPM chapter |
|--------------|---|---|--|-------------|-------------|
| P.452 | Rec. ITU-R P.452-16 | Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz | 1.7 1.13 9.1, issues 9.1.2 & 9.1.9 | 4 2 3 | |
| P.452-16 | | | 1.14 9.1, issue 9.1.1 9.1, issue 9.1.2 | 1 2 3 | |
| S.465 | Rec. ITU-R S.465-6 | Reference radiation pattern of earth station antennas in the fixed-satellite service for use in coordination and interference assessment in the frequency range from 2 to 31 GHz | 9.1, issues 9.1.3 9.1.9 | 3 | |
| M.493-14 | Rec. ITU-R M.493-14 | Digital selective-calling system for use in the maritime mobile service | 1.9.1 | 5 | |
| SA.509 | Rec. ITU-R SA.509-3 | Space research earth station and radio astronomy reference antenna radiation pattern for use in interference calculations, including coordination procedures, for frequencies less than 30 GHz | 1.14 | 1 | |
| SA.509-3 | | | | | |
| SA.514-3 | Rec. ITU-R SA.514-3 | Interference criteria for command and data transmission systems operating in the Earth exploration-satellite and meteorological-satellite services | 1.7 | 4 | |
| RA.517 | Rec. ITU-R RA.517-4 | Protection of the radio astronomy service from transmitters operating in adjacent bands | 9.1, issue 9.1.9 | 3 | |
| S.524-9 | Rec. ITU-R S.524-9 | Maximum permissible levels of off-axis e.i.r.p. density from earth stations in geostationary-satellite orbit networks operating in the fixed-satellite service transmitting in the 6 GHz, 13 GHz, 14 GHz and 30 GHz frequency bands | 1.5 | 3 | |
| P.525 | Rec. ITU-R P.525-3 (Rec. ITU-R P.525-2 is incorporated by reference in the RR) | Calculation of free-space attenuation | 1.6 9.1, issue 9.1.9 | 3 | |
| P.525-3 | | | 1.14 | 1 | |

| ITU-R Series | Recommendation number* | Latest publication | Recommendation title | Agenda item | CPM chapter |
|--------------|---|---|--|---------------------|-------------|
| P.526-14 | | Rec. ITU-R P.526-14 (Rec. ITU-R P.526-13 is incorporated by reference in the RR) | Propagation by diffraction | 1.1 | 5 |
| BS.560 | | Rec. ITU-R BS.560-4 | Radio-frequency protection ratios in LF, MF and HF broadcasting | 9.1, issue 9.1.6 | 6 |
| S.580 | | Rec. ITU-R S.580-6 | Radiation diagrams for use as design objectives for antennas of earth stations operating with geostationary satellites | 9.1, issue 9.1.3 | 3 |
| M.585-7 | | Rec. ITU-R M.585-7 (incorporated by reference in the RR) | Assignment and use of identities in the maritime mobile service | 1.9.1 | 5 |
| M.589-3 | | Rec. ITU-R M.589-3 | Technical characteristics of methods of data transmission and interference protection for radionavigation services in the frequency bands between 70 and 130 kHz | 9.1, issue 9.1.6 | 6 |
| SA.609 | | Rec. ITU-R SA.609-2 | Protection criteria for radiocommunication links for manned and unmanned near-Earth research satellites | 1.7 1.14 | 4 1 |
| RA.611 | | Rec. ITU-R RA.611-4 | Protection of the radio astronomy service from spurious emissions | 9.1, issue 9.1.9 | 3 |
| P.618 | | Rec. ITU-R P.618-13 | Propagation data and prediction methods required for the design of Earth-space telecommunication systems | 1.6 | 3 |
| P.619 | Rec. ITU-R P.619-3 | | Propagation data required for the evaluation of interference between stations in space and those on the surface of the Earth | 1.13 | 2 |
| P.619-3 | | | | 1.14 | 1 |
| S.672-4 | Rec. ITU-R S.672-4 (incorporated by reference in the RR) | | Satellite antenna radiation pattern for use as a design objective in the fixed-satellite service employing geostationary satellites | 1.13 | 2 |
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| M.2047 | | Rec. ITU-R M.2047-0 | Detailed specifications of the satellite radio interfaces of International Mobile Telecommunications-Advanced (IMT-Advanced) | 9.1, issue 9.1.1 | 2 |
| M.2057 | | Rec. ITU-R M.2057-1 | Systems characteristics of automotive radars operating in the frequency band 76-81 GHz for intelligent transport systems applications | 1.13 | 2 |
| M.2058 | Rec. ITU-R M.2058-0 | | Characteristics of a digital system, named navigational data for broadcasting maritime safety and security related information from shore-to-ship in the maritime HF frequency band | 1.8 | 5 |
| M.2058-0 | | | | | |
| M.2071 | | Rec. ITU-R M.2071-1 | Generic unwanted emission characteristics of mobile stations using the terrestrial radio interfaces of IMT-Advanced | 1.13 | 2 |
| M.2083 | | Rec. ITU-R M.2083-0 | IMT Vision – "Framework and overall objectives of the future development of IMT for 2020 and beyond" | 1.13 9.1, issue 9.1.8 | 2 |
| M.2092-0 | | Rec. ITU-R M.2092-0 | Technical characteristics for a VHF data exchange system in the VHF maritime mobile band | 1.9.2 | 5 |
| BO.2098 | | Rec. ITU-R BO.2098-0 | Transmission system for UHDTV satellite broadcasting | 7, issue J | 3 |

| ITU-R Series | Recommendation number* | Latest publication | Recommendation title | Agenda item | CPM chapter |
|--------------|------------------------|--------------------------------------|--|--|-----------------|
| M.2101 | | Rec. ITU-R M.2101-0 | Modelling and simulation of IMT networks and systems for use in sharing and compatibility studies | 1.13 9.1, issues 9.1.1, 9.1.2 & 9.1.9 | 2 2 3 |
| F.2086 | | Rec. ITU-R F.2086-0 | Deployment scenarios for point-to-point systems in the fixed service | 9.1, issue 9.1.9 | 3 |
| F.2086-0 | | | | 1.14 | 1 |
| M.2101 | | Rec. ITU-R M.2101-0 | Modelling and simulation of IMT networks and systems for use in sharing and compatibility studies | 9.1, 9.1.9 | 3 |
| M.2101-0 | | | | 1.14 | 1 |
| SM.2103 | | Rec. ITU-R SM.2103-0 | Global harmonization of SRD categories | 9.1, issue 9.1.8 | 2 |
| P.2108 | | Rec. ITU-R P.2108-0 | Prediction of Clutter Loss | 1.7 1.13 1.14 | 4 2 1 |
| M.2114-0 | | Rec. ITU-R M.2114-0 | Technical and operational characteristics of and protection criteria for aeronautical mobile service systems in the frequency bands 22.5-23.6 GHz and 25.25-27.5 GHz | 1.14 | 1 |
| M.2120-0 | | Rec. ITU-R M.2120-0 | Technical characteristics and protection criteria for aeronautical mobile systems operating in the mobile service in the frequency range 21.2-22 GHz | 1.14 | 1 |
| M.2121 | | Rec. ITU-R M.2121-0 | Harmonization of frequency bands for Intelligent Transport Systems in the mobile service | 1.12 | 1 |

3 List of draft new (DN) or draft revised (DR) ITU-R Recommendations (may include preliminary draft new (PDN) or revised (PDR) ITU-R Recommendations and working documents toward preliminary draft new (WDPDN) or revised (WDPDR) ITU-R Recommendations)

| ITU-R Series | Recommendation draft number* | Available document / status | Draft Recommendation title | Agenda item | CPM chapter |
|--------------|---------------------------------------|--|---|------------------|-------------|
| | [50/40 GHz FSS S.SHARING METHODOLOGY] | PDN Rec. ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] (Doc. 4A/826 , Annex 1) | Maximum permissible levels of interference in a satellite network (GSO and non-GSO) in the fixed-satellite service caused by other co-directional FSS and BSS networks operating in the 50/40 GHz frequency bands | 1.6 | 3 |
| | S.[50/40 REFERENCE LINKS] | WDPDN Rec. ITU-R S.[50/40 REFERENCE LINKS] (Doc. 4A/826 , Annex 5) | Satellite system characteristics to be considered in frequency sharing analyses within the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz | 1.6 | 3 |
| | M.[AMRD] | WDPDN Rec. ITU-R M.[AMRD] (Doc. 5B/646 , Annex 10) | Technical characteristics of autonomous maritime radio devices operating in the frequency band 156-162.05 MHz | 1.9.1 | 5 |
| | [MSS&IMT-M.ADVANCED SHARING] | WDPDN [Rec. or Rep.] ITU-R M.[MSS&IMT-ADVANCED SHARING] (Doc. 4C/417 , Annex 4) | Coexistence and compatibility study between the terrestrial component and the satellite component of IMT in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz in different countries | 9.1, issue 9.1.1 | 2 |
| | M.[RSTT_FRQ] | WDPDN Rec. ITU-R M.[RSTT_FRQ] (Doc. 5A/976 , Annex 8) | Harmonization of frequency bands for railway radiocommunication systems between train and trackside | 1.11 | 1 |
| | M.2084 | PDR Rec. ITU-R M.2084-0 (Doc. 5A/976 , Annex 22) | Radio interface standards of vehicle-to-vehicle and vehicle-to-infrastructure communications for Intelligent Transport System applications | 1.12 | 1 |
| | M.2084[-1] | | | | |
| | SM. 2110 | PDR Rec. ITU-R SM.2110-0 (Doc. 1A/340 , Annex 4) | Frequency ranges for operation of non-beam wireless power transmission systems | 9.1, issue 9.1.6 | 6 |

4 List of existing ITU-R Reports

| ITU-R Series | Report number* | Latest publication | Report title | Agenda item | CPM chapter |
|--------------|----------------|--------------------------------------|--|------------------|-------------|
| M. 2039 | | Rep. ITU-R M.2039-3 | Characteristics of terrestrial IMT-2000 systems for frequency sharing/interference analyses | 9.1, issue 9.1.1 | 2 |
| SM. 2091 | | Rep. ITU-R SM.2091-0 | Studies related to the impact of active space services allocated in adjacent or nearby bands on radio astronomy service | 9.1, issue 9.1.9 | 3 |
| SM. 2092 | | Rep. ITU-R SM.2092-0 | Studies related to the impact of active services allocated in adjacent or nearby bands on Earth exploration-satellite service (passive) | 9.1, issue 9.1.9 | 3 |
| RS. 2095 | | Rep. ITU-R RS.2095-0 | Sharing of the 36-37 GHz band by the fixed and mobile services and the Earth exploration-satellite service (passive) | 1.13 | 2 |
| M. 2115 | | Rep. ITU-R M.2115-1 | Testing procedures for implementation of dynamic frequency selection | 1.16 | 2 |
| RA. 2126 | | Rep. ITU-R RA.2126-1 | Techniques for mitigation of radio frequency interference in radio astronomy | 9.1, issue 9.1.9 | 3 |
| RA. 2131 | | Rep. ITU-R RA.2131-0 | Supplementary information on the detrimental threshold levels of interference to radio astronomy observations in Recommendation ITU-R RA.769 | 9.1, issue 9.1.9 | 3 |
| SM. 2153 | | Rep. ITU-R SM.2153-6 | Technical and operating parameters and spectrum requirements for short range radiocommunication devices | 9.1, issue 9.1.8 | 2 |
| RS. 2165 | | Rep. ITU-R RS.2165-0 | Identification of degradation due to interference and characterization of possible interference mitigation techniques for passive sensors operating in the Earth exploration satellite service (passive) | 1.13 | 2 |
| SM. 2181 | | Rep. ITU-R SM.2181-0 | Use of Appendix 10 of the Radio Regulations to convey information related to emissions from both GSO and non-GSO space stations including geolocation information | 7, issue G | 3 |
| RA. 2188 | | Rep. ITU-R RA.2188-0 | Power flux-density and e.i.r.p. levels potentially damaging to radio astronomy receivers | 9.1, issue 9.1.9 | 3 |
| RA. 2189-1 | | Rep. ITU-R RA.2189-1 | Sharing between the radio astronomy service and active services in the frequency range 275-3 000 GHz Note - This Report has been published only in English | 1.15 | 1 |

| ITU-R Series | Report number* | Latest publication | Report title | Agenda item | CPM chapter |
|--------------|----------------|--------------------------------------|---|--|-------------|
| RS.2194-0 | | Rep. ITU-R RS.2194-0 | Passive bands of scientific interest to EESS/SRS from 275 to 3 000 GHz Note - This Report has been published only in English | 1.15 | 1 |
| M.2201 | | Rep. ITU-R M.2201-0 | Utilization of the 495-505 kHz band by the maritime mobile service for the digital broadcasting of safety and security related information from shore-to-ships | 1.8 | 5 |
| M.2224 | | Rep. ITU-R M.2224-0 | System design guidelines for wide area sensor and/or actuator network (WASN) systems | 9.1, issue 9.1.8 | 2 |
| M.2227-2 | | Rep. ITU-R M.2227-2 | Use of multiple gigabit wireless systems in frequencies around 60 GHz | 1.13 | 2 |
| M.2228 | | Rep. ITU-R M.2228-1 | Advanced intelligent transport systems (ITS) radiocommunications | 1.12 | 1 |
| M.2228-1 | | | | | |
| F.2239 | | Rep. ITU-R F.2239-0 | Coexistence between fixed service operating in 71-76 GHz, 81-86 GHz and 92-94 GHz bands and passive services | 1.13 9.1, issue 9.1.9 | 2 3 |
| F.2240-0 | | Rep. ITU-R F.2240-0 | Interference analysis modelling for sharing between HAPS gateway links in the fixed service and other systems/services in the range 5 850-7 075 MHz | 1.14 | 1 |
| M.2292-0 | | Rep. ITU-R M.2292-0 | Characteristics of terrestrial IMT-Advanced systems for frequency sharing/interference analyses | 1.13 9.1, issues 9.1.1 &9.1.2 | 2 2 3 |
| SM.2303-2 | | Rep. ITU-R SM.2303-2 | Wireless power transmission using technologies other than radio frequency beam | 9.1, issue 9.1.6 | 6 |
| SA.2312 | | Rep. ITU-R SA.2312-0 | Characteristics, definitions and spectrum requirements of nanosatellites and picosatellites, as well as systems composed of such satellites | 7, issue I | 3 |
| M.2320 | | Rep. ITU-R M.2320-0 | Future technology trends of terrestrial IMT systems | 1.13 | 2 |
| RS.2336 | | Rep. ITU-R RS.2336-0 | Consideration of the frequency bands 1 375-1 400 MHz and 1 427-1 452 MHz for the mobile service – Compatibility with systems of the Earth exploration-satellite service within the 1 400-1 427 MHz frequency band | 1.13 9.1, issue 9.1.9 | 2 3 |

| ITU-R Series | Report number* | Latest publication | Report title | Agenda item | CPM chapter |
|--------------|-------------------------------------|--------------------------------------|--|---------------------|-------------|
| SA.2348 | | Rep. ITU-R SA.2348-0 | Current practice and procedures for notifying space networks currently applicable to nanosatellites and picosatellites | 7, issue I | 3 |
| SM.2352-0 | | Rep. ITU-R SM.2352-0 | Technology trends of active services in the frequency range 275-3 000 GHz | 1.15 | 1 |
| S.2361 | | Rep. ITU-R S.2361-0 | Broadband access by fixed-satellite service systems | 9.1, issue 9.1.9 | 3 |
| M.2369 | Rep. ITU-R M.2369-0 | | Use of non-geostationary orbit mobile satellite systems to enhance maritime safety | 1.8 | 5 |
| M.2369-0 | | | | | |
| M.2370 | | Rep. ITU-R M.2370-0 | IMT Traffic estimates for the years 2020 to 2030 | 1.13 | 2 |
| M.2376 | | Rep. ITU-R M.2376-0 | Technical feasibility of IMT in bands above 6 GHz | 1.13 | 2 |
| BT.2387-0 | | Rep. ITU-R BT.2387-0 | Spectrum/frequency requirements for bands allocated to broadcasting on a primary basis | 1.1 | 5 |
| BO.2397 | | Rep. ITU-R BO.2397-0 | Satellite transmission for UHDTV satellite broadcasting | 7, issue J | 3 |
| M.2412 | | Rep. ITU-R M.2412-0 | Guidelines for evaluation of radio interface technologies for IMT-2020 | 1.13 | 2 |
| F.2416-0 | | Rep. ITU-R F.2416-0 | Technical and operational characteristics and applications of the point-to-point fixed service applications operating in the frequency band 275-450 GHz | 1.15 | 1 |
| M.2417-0 | | Rep. ITU-R M.2417-0 | Technical and operational characteristics of land-mobile service applications in the frequency range 275-450 GHz | 1.15 | 1 |
| M.2418 | | Rep. ITU-R M.2418-0 | Description of Railway Radiocommunication Systems between Train and Trackside (RSTT) | 1.11 | 1 |
| SM.2423 | | Rep. ITU-R SM.2423-0 | Technical and operational aspects of low-power wide-area networks for machine-type communication and the Internet of Things in frequency ranges harmonised for SRD operation | 9.1, issue 9.1.8 | 2 |
| SM.2424 | | Rep. ITU-R SM.2424-0 | Measurement techniques and new technologies for satellite monitoring | 9.1, issue 9.1.7 | 6 |
| SA.2425-0 | | Rep. ITU-R SA.2425-0 | Studies to accommodate spectrum requirements in the space operation service for non-geostationary satellites with short duration missions | 1.7 | 4 |

| ITU-R Series | Report number* | Latest publication | Report title | Agenda item | CPM chapter |
|--------------|----------------------|--------------------------------------|--|---------------------|-------------|
| | SA.2426-0 | Rep. ITU-R SA.2426-0 | Technical characteristics for telemetry, tracking and command in the space operation service below 1 GHz for non-GSO satellites with short duration missions | 1.7 | 4 |
| | SA.2427-0 | Rep. ITU-R SA.2427-0 | Studies on the suitability of existing allocations to the space operation service below 1 GHz and additional sharing studies on possible new and/or upgraded allocations | 1.7 | 4 |
| | SA.2429-0 | Rep. ITU-R SA.2429-0 | Studies related to proposed change in 460-470 MHz secondary allocation for METSAT (space-to-Earth) to primary and addition of primary allocation to EESS (space-to-Earth) | 1.3 | 4 |
| | SA.2430 SA.2430-0 | Rep. ITU-R SA.2430-0 | Technical studies for establishing in-band power limits for earth stations operating in the frequency ranges 399.9-400.05 MHz and 401-403 MHz within the MSS, EESS and MetSat services | 1.2 | 4 |
| | RS.2431-0 | Rep. ITU-R RS.2431-0 | Technical and operational characteristics of EESS (passive) systems in the frequency range 275-450 GHz | 1.15 | 1 |
| | M.2435-0 | Rep. ITU-R M.2435-0 | Technical studies on the satellite component for the VHF data exchange system | 1.9.2 | 5 |
| | M.2436 M.2436-0 | Rep. ITU-R M.2436-0 | The global aeronautical distress and safety system | 1.10 | 5 |
| | F.2437 | Rep. ITU-R F.2437-0 | Sharing and compatibility studies of HAPS systems in the 6 440-6 520 MHz frequency range | 1.14 | 1 |
| | F.2438 | Rep. ITU-R F.2438-0 | Spectrum needs of high altitude platform stations (HAPS) broadband links operating in the fixed service | 1.14 | 1 |
| | F.2439 | Rep. ITU-R F.2439-0 | Deployment and technical characteristics of broadband high altitude platform stations in the fixed service in the bands 6 440-6 520 MHz, 21.4-22.0 GHz, 24.25-27.5 GHz, 27.9-28.2 GHz, 31.0-31.3 GHz, 38.0-39.5 GHz, 47.2-47.5 GHz and 47.9-48.2 GHz used in sharing and compatibility studies | 1.14 | 1 |
| | M.2440-0 | Rep. ITU-R M.2440-0 | The use of the terrestrial component of International Mobile Telecommunication (IMT) for Narrowband and Broadband Machine-Type Communications | 9.1, issue 9.1.8 | 2 |

| ITU-R Series | Report number* | Latest publication | Report title | Agenda item | CPM chapter |
|--------------|----------------|-------------------------------------|--|-------------|-------------|
| M.2442 | | Rep. ITU-R M.2442-0 | Current and future usage of railway radiocommunication systems between train and trackside | 1.11 | 1 |
| M. 2445 | | Rep. ITU-R M.2445-0 | Intelligent transport systems (ITS) usage | 1.12 | 1 |

5 List of draft new (DN) or draft revised (DR) ITU-R Reports (may include preliminary draft new (PDN) or revised (PDR) ITU-R Reports and working documents toward preliminary draft new (WDPDN) or revised (WDPDR) ITU-R Reports)

| ITU-R Series | Report draft number* | Available document / status | Report title | Agenda item | CPM chapter |
|--------------------------------------|----------------------|--|--|-------------|-------------|
| M. [AMATEUR_50_MHZ] | | WPDN Rep. ITU-R M.[AMATEUR_50_MHZ] (Doc. 5A/976 , Annex 5) | Spectrum needs for the amateur service in the frequency band 50-54 MHz in Region 1 and sharing with mobile, fixed, radiolocation and broadcasting services | 1.1 | 5 |
| BO.[AP30.ANNEX7] | | WDPDN Rep. ITU-R BO.[AP30.ANNEX7] (Doc. 4A/826 , Annex 18) | Assessment on limitations mentioned in Annex 7 to RR Appendix 30 (Rev.WRC-15) in the 11.7-12.7 GHz band for the GSO broadcasting-satellite service in all Regions | 1.4 | 3 |
| S. [50/40 GHz ADJACENT BAND STUDIES] | | WDPDN Rep. ITU-R S.[50/40 GHz ADJACENT BAND STUDIES] (Doc. 4A/826 , Annex 11) | Protection of EESS (passive) and RAS systems from non-GSO fixed satellite systems operating in the 37.5-42.5 GHz, 47.2 50.2 GHz and 50.4-51.4 GHz frequency bands | 1.6 | 3 |
| M.[GMDSS-SATREG] | | PDN Rep. ITU-R M.[GMDSS-SATREG] (Doc. 4C/417 , Annex 2) | Introduction of additional mobile-satellite service systems into the GMDSS | 1.8 | 5 |
| M.[RAS-COMPAT] | | WDPDN Rep. ITU-R M.[RAS-COMPAT] (Doc. 4C/417 , Annex 6) | Unwanted emissions in the RAS band from space-to-Earth transmissions from MSS satellites | 1.8 | 5 |
| M. [AMRD] | | WDPDN Rep. ITU-R M.[AMRD] (Doc. 5B/646 , Annex 12) | Autonomous maritime radio devices | 1.9.1 | 5 |
| M. [NEW_MARNUM] | | WDPDN Rep. ITU-R M.[AMRD] (Doc. 5B/646 , Annex 12) | Autonomous maritime radio devices | 1.9.1 | 5 |

| ITU-R Series | Report draft number* | Available document / status | Report title | Agenda item | CPM chapter |
|--------------|---|--|--|------------------|-------------|
| | F.[HAPS-21 GHz] | PDN Rep. ITU-R F.[HAPS-21 GHz] (Doc. 5C/617 , Annex 16) | Sharing and compatibility studies of HAPS systems in the 21.4-22 GHz frequency range | 1.14 | 1 |
| | F.[HAPS-25 GHz] | PDN Rep. ITU-R F.[HAPS-25 GHz] (Doc. 5C/617 , Annex 17) | Sharing and compatibility studies of HAPS systems in the 24.25-27.5 GHz frequency range | 1.14 | 1 |
| | F.[HAPS-31 GHz] | PDN Rep. ITU-R F.[HAPS-31 GHz] (Doc. 5C/617 , Annex 18) | Sharing and compatibility studies of HAPS systems in the 27.9-28.2 GHz and 31.0-31.3 GHz frequency ranges | 1.14 | 1 |
| | F.[HAPS-39 GHz] | PDN Rep. ITU-R F.[HAPS-39 GHz] (Doc. 5C/617 , Annex 19) | Sharing and compatibility studies of HAPS systems in the 38-39.5 GHz frequency range | 1.14 | 1 |
| | F.[HAPS-47 GHz] | PDN Rep. ITU-R F.[HAPS-47 GHz] (Doc. 5C/617 , Annex 20) | Sharing and compatibility studies of HAPS systems in the 47.2-47.5 and 47.9-48.2 GHz frequency range | 1.14 | 1 |
| | SM. ^[275-450GHz SHARING] | PDN Rep. ITU-R SM.[275-450GHZ_SHARING] (Doc. 1A/340 , Annex 3) | Sharing and compatibility studies between land-mobile, fixed and passive services in the frequency range 275-450 GHz | 1.15 | 1 |
| | M.[RLAN REQ-PAR] | WDPDN Rep. ITU-R M.[RLAN REQ-PAR] (Doc. 5A/976 , Annex 16) | Technical characteristics and operational requirements of WAS/RLAN in the 5 GHz frequency range | 1.16 | 2 |
| | [MSS&IMT-M. ADVANCED SHARING] | WDPDN [Rec. or Rep.] ITU-R M.[MSS&IMT-ADVANCED SHARING] (Doc. 4C/417 , Annex 4) | Coexistence and compatibility study between the terrestrial component and the satellite component of IMT in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz in different countries | 9.1, issue 9.1.1 | 2 |
| | M. ^[IMT&BSS COMPATIBILITY] | PDN Rep. ITU-R M.[IMT&BSS COMPATIBILITY] (See Chapter 4.5 of Doc. 5D/1184) | Compatibility studies between IMT systems and BSS (sound) systems in the band 1 452-1 492 MHz in different countries in Regions 1 and 3 | 9.1, issue 9.1.2 | 3 |
| | S.[NGSO_6/4-GHz] | WDPDN Rep. ITU-R S.[NGSO_6/4-GHz] (Doc. 4A/826 , Annex 23) | Technical and regulatory studies for 6/4 GHz non-GSO FSS sharing | 9.1, issue 9.1.3 | 3 |

| ITU-R Series | Report draft number* | Available document / status | Report title | Agenda item | CPM chapter |
|--------------|------------------------------|---|--|------------------|-------------|
| | S.[NGSO FSS 6/4 GHz SHARING] | WDPDN Rep. ITU-R S.[NGSO FSS 6/4 GHz SHARING] (Doc. 4A/364 , Annex 16) | Sharing between non- geostationary-satellite orbit systems in the fixed-satellite service and existing and planned systems in the terrestrial and space services allocated on a primary basis in the frequency bands 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz and 6 725-7 025 MHz | 9.1, issue 9.1.3 | 3 |
| | M.[SUBORBITAL VEHICLES] | PDN Rep. ITU-R M.[SUBORBITAL VEHICLES] (Doc. 5B/646 , Annex 3) | Radiocommunications for suborbital vehicles | 9.1, issue 9.1.4 | 5 |
| | SM.[WPT_EV_IMPACT] | WDPDN Rep. ITU-R SM.[WPT_EV_IMPACT] (Doc. 1B/341 , Annex 2) | Assessment of impact of wireless power transmission for electric vehicle (WPT-EV) on radiocommunication services | 9.1, issue 9.1.6 | 6 |
| | M.[NON_IMT.MTC_USAG E] | PDN Rep. ITU-R M.[NON_IMT.MTC_USAG E] (Doc. 5A/976 , Annex 23) | Technical and operational aspects of Internet of Things and Machine-to-Machine applications by systems in the Mobile Service (excluding IMT) | 9.1, issue 9.1.8 | 2 |
| | S. [SPECTRUM_NEEDS] | DN Rep. ITU-R S.[SPECTRUM_NEEDS] (Doc. 4A/826 (Attachment)) | Spectrum needs for the FSS in the 51.4-52.4 GHz band | 9.1, issue 9.1.9 | 3 |
| | S. [SPECTRUM_SHARING] | PDN Rep. ITU-R S.[SPECTRUM_SHARING] (Doc. 4A/826 , Annex 3) | Sharing with incumbent services in the 51.4-52.4 GHz band and adjacent and nearby bands | 9.1, issue 9.1.9 | 3 |
| | RS. [Space_Weather_Sensors] | PDN Rep. ITU-R RS.[SPACE_WEATHER_SENSORS] (Doc. 7C/344 , Annex 3(Rev.2)) | Technical and operational characteristics of RF-based space weather sensors | 10 | 6 |
| | RS.[VHF_SOUNDER] | DN Rep. ITU-R RS.[VHF_SOUNDER] (Doc. 7/103) | Preliminary results of sharing studies between a 45 MHz radar sounder and incumbent fixed, mobile, broadcasting and space research services operating in the 40-50 MHz frequency range | 10 | 6 |

6 Other ITU publications

| Reference | Publication | Title | Agenda item | CPM chapter |
|---|--|---|---------------------|-------------|
| Article 44 of the ITU Constitution | Article 44 of the ITU Constitution | Use of the Radio-Frequency Spectrum and of the Geostationary-Satellite and Other Satellite Orbits | 1.4 7, issue F | 3 |
| Resolution 71 (Rev. Busan, 2014) | Resolution 71 (Rev. Busan, 2014) | Strategic plan for the Union for 2016-2019 | 1.4 | 3 |
| BR IFIC 2788 | BR IFIC No. 2788 (2015) | BR International Frequency Information Circular (BR IFIC) – Space Services: <i>SRS – Removal</i> | 1.6 | 3 |
| BR IFIC 2081 | BR IFIC No. 2081 | BR International Frequency Information Circular | 1.8 | 5 |
| BR IFIC 2418 | BR IFIC No. 2418 | BR International Frequency Information Circular | 1.8 | 5 |
| Annex 1 to the TG 5/1 Chairman's Report | Document 5-1/478 (Annex 1) | System parameters and propagation models to be used in sharing and compatibility studies | 1.13 | 2 |
| CA/226 | BR Administrative Circular CA/226 | Results of the first session of the Conference Preparatory Meeting for WRC-19 (CPM19-1) | 1.13 | 2 |
| Question ITU-R 77-7/5 | Question ITU-R 77-7/5 | Consideration of the needs of developing countries in the development and implementation of IMT | 1.13 | 2 |
| Question ITU-R 229/5 | Question ITU-R 229-4/5 | Further development of the terrestrial component of IMT | 1.13 | 2 |
| IFIC 2885 | BR IFIC No. 2885 | | 7, Issue A | 3 |
| BR IFIC (# 2833) | BR IFIC No. 2833 (2016) | BR International Frequency Information Circular (BR IFIC) – Space Services: <i>BR Soft and SRS V8-BETA</i> | 7, issue H | 3 |
| DSB Handbook | DSB Handbook (2002) | Terrestrial and satellite digital sound broadcasting to vehicular, portable and fixed receivers in the VHF/UHF bands | 9.1, issue 9.1.2 | 3 |
| ETSI EN 303 417 | ETSI EN 303 417 V1.1.1 (2017-09) | Wireless power transmission systems, using technologies other than radio frequency beam in the 19-21 kHz, 59-61 kHz, 79-90 kHz, 100-300 kHz, 6 765-6 795 kHz ranges; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU | 9.1, issue 9.1.6 | 6 |

| Reference | Publication | Title | Agenda item | CPM chapter |
|-----------------------------|------------------------------------|--|-------------|-------------|
| ITU-R RRB 17.1 Document [2] | Document RRB17-1/2 | Submission by the Administrations of Latvia, Lithuania, The Netherlands, Spain and Switzerland concerning the Iridium satellite system (HIBLEO-2) causing harmful interference to the radio astronomy service in the frequency band 1 610.6-1 613.8 MHz | 1.8 | 5 |
| ITU-R RRB 17.1 Document [5] | Document RRB17-1/5 | Submission from the Administration of the United States in response to Document RRB17-1/2, “Submission by the Administrations of Latvia, Lithuania, The Netherlands, Spain and Switzerland concerning the Iridium satellite system (HIBLEO-2) causing harmful interference to the radio astronomy service in the frequency band 1 610.6-1 613.8 MHz” | 1.8 | 5 |

7 Non-ITU publications

| Reference | Publication | Title | Agenda item | CPM chapter |
|----------------------------|--|---|----------------------|-------------|
| IMO Resolution MSC.434(98) | IMO Resolution MSC.434(98) | Performance Standards for a Ship Earth Station for use in the GMDSS (June 2017) | 1.8 | 5 |
| NAVTEX Manual | NAVTEX Manual | NAVTEX Manual | 1.8 | 5 |
| SOLAS | International Convention for the Safety of Life at Sea, 1974 (amendments 1988) | International Convention for the Safety of Life at Sea, 1974 | 1.8 1.9.1 1.10 | 5 |
| ConOps | ConOps version 6.0 | Global Aeronautical Distress & Safety System (GADSS) | 1.10 | 5 |

Lists of abbreviations used in the CPM Report

| Abbreviations | Radio services | RR definition |
|----------------------|--|----------------------|
| AMS | aeronautical mobile service | No. 1.32 |
| AM(R)S | aeronautical mobile (route) service | No. 1.33 |
| AMS(OR)S | aeronautical mobile-satellite (off-route) service | No. 1.34 |
| AMSS | aeronautical mobile-satellite service | No. 1.35 |
| AMS(R)S | aeronautical mobile-satellite (route) service | No. 1.36 |
| ARNS | aeronautical radionavigation service | No. 1.46 |
| ARNSS | aeronautical radionavigation-satellite service | No. 1.47 |
| ARS | amateur service | No. 1.56 |
| ARSS | amateur-satellite service | No. 1.57 |
| BS* | broadcasting service | No. 1.38 |
| BSS | broadcasting-satellite service | No. 1.39 |
| EESS | Earth exploration-satellite service | No. 1.51 |
| FS | fixed service | No. 1.20 |
| FSS | fixed-satellite service | No. 1.21 |
| ISS | inter-satellite service | No. 1.22 |
| LMS | land mobile service | No. 1.26 |
| LMSS | land mobile-satellite service | No. 1.27 |
| MetAids | meteorological aids service | No. 1.50 |
| MetSat | meteorological-satellite service | No. 1.52 |
| MMS | maritime mobile service | No. 1.28 |
| MMSS | maritime mobile-satellite service | No. 1.29 |
| MRNS | maritime radionavigation service | No. 1.44 |
| MRNSS | maritime radionavigation-satellite service | No. 1.45 |
| MS | mobile service | No. 1.24 |
| MSS | mobile-satellite service | No. 1.25 |
| RAS | radio astronomy service | No. 1.58 |
| RDS | radiodetermination service | No. 1.40 |
| RDSS | radiodetermination-satellite service | No. 1.41 |
| RLS | radiolocation service | No. 1.48 |
| RLSS | radiolocation-satellite service | No. 1.49 |
| RNS | radionavigation service | No. 1.42 |
| RNSS | radionavigation-satellite service | No. 1.43 |
| SOS | space operation service | No. 1.23 |
| SFTSS | standard frequency and time signal service | No. 1.53 |
| SFTSSS | standard frequency and time signal-satellite service | No. 1.54 |

* In the draft CPM texts on WRC-19 agenda items 1.13 and 9.1 issue 9.1.1, this abbreviation stands for “base station” (see RR No. 1.71) and is not used to refer to the “broadcasting service” therein.

| Abbreviations | Radio services | RR definition |
|---------------|------------------------|---------------|
| SRS | space research service | No. 1.55 |

Other abbreviations:

| Abbreviations | Description |
|---------------|---|
| 3GPP | Third-Generation Project Partnership |
| AAS | active antenna system |
| ACM | adaptive coding and modulation |
| AES | aircraft earth station |
| A-ESIM | Aeronautical ESIM |
| AIS | automatic identification system |
| AM | Amplitude modulation |
| AMRD | autonomous maritime radio devices |
| API | advance publication information |
| APSK | Amplitude phase shift keying |
| ASM | application specific messages |
| ATC | ancillary terrestrial component |
| AtoN | aid to navigation |
| ATS | Automatic Train Stop |
| BBIU | bringing back into use |
| BFWA | Broadband Fixed Wireless Access |
| BIU | bringing into use |
| BR | Radiocommunication Bureau |
| BR IFIC | Radiocommunication Bureau International Frequency Information Circular |
| CDF | cumulative distribution function |
| CEPT | Conférence Européenne des Administrations des Postes et Télécommunications (European Conference of Postal and Telecommunications Administrations) |
| CGC | complementary ground component |
| Ch. | channel |
| C/I | carrier-to-interference ratio |
| C/N | carrier-to-noise ratio |
| $C/(N+I)$ | carrier to noise plus interference ratio |
| CISPR | International Special Committee on Radio Interference (abbreviation for the French name: “Comité International Spécial des Perturbations Radioélectriques”) |
| CISPR/.../CDV | CISPR/.../Committee Draft for Vote |
| COMPAT | Compatibility |
| ConOps | concept of operations |
| CPE | customer premises equipment |
| CPM | conference preparatory meeting |
| CPMS | close proximity mobile system |
| CR/C | coordination request |
| CTDRS | Chinese Data Tracking and Relay System |

| Abbreviations | Description |
|---------------|--|
| D&S-OPS | distress and safety operations |
| DCP | data collection platform |
| DCS | data collection systems |
| DF | Deployment Factor |
| DFS | dynamic frequency selection |
| DN | draft new |
| DR | draft revision |
| DRS | data relay satellite |
| ECDIS | electronic display and information system |
| EDRS | European data relay satellite |
| e.i.r.p. | equivalent isotropically radiated power (see RR No. 1.161) |
| EIRP | Equivalent Isotropically Radiated Power |
| eMBB | enhanced mobile broadband |
| EPM | equivalent protection margin |
| epfd | equivalent power flux-density |
| EPIRB | emergency position indicating radio beacon |
| ERA | European Railway Agency |
| E-s | Earth-to-space |
| E/S or ES | earth station |
| ESIM | earth stations in motion |
| ETSI | European Telecommunications Standards Institute |
| ETSI EN | ETSI European Standard |
| FDD | frequency-division duplex |
| FL | feeder link |
| FM | Frequency Modulation |
| GADSS | Global Aeronautical Distress and Safety System |
| Gbit/s | Gigabits per second |
| GE89 | Plan for VHF/UHF television broadcasting in the African Broadcasting Area and neighbouring countries, Geneva, 1989 Rev. 2006 |
| GIMS | Graphical Interference Management System |
| GLONASS | Global Navigation Satellite System |
| GMDSS | global maritime distress and safety system |
| GMPCS | Global Mobile Personal Communications by Satellite |
| GSM-R | Global system for mobile communications – railway |
| GSO | geostationary-satellite orbit (see RR No. 1.190) |
| GSO | Geosynchronous orbit |
| GW | Gateway |
| HAPS | high altitude platform station |
| HDFSS | high density fixed satellite systems |
| HEO | highly elliptical Earth orbit |
| HF | high frequency |
| HTS | high throughput satellite |

| Abbreviations | Description |
|---------------|---|
| IARU | International Amateur Radio Union |
| ICAO | International Civil Aviation Organization |
| IEC | International Electrotechnical Commission |
| IEEE | Institute of Electrical and Electronic Engineers |
| IFOV | instantaneous field of view |
| IMF | interplanetary magnetic field |
| IMO | International Maritime Organization |
| IMT | International Mobile Telecommunications |
| I_{new} | interference power |
| I/N | interference to noise ratio |
| IoT | Internet of Things |
| IP | Internet Protocol |
| ISM | industrial, scientific and medical (see RR No. 1.15) |
| ISO | International Organization for Standardization |
| ITS | intelligent transportation systems |
| ITU | International Telecommunication Union |
| ITU CS | ITU Constitution |
| ITU-R | ITU Radiocommunication Sector |
| IUCAF | Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science |
| LEO | Low Earth Orbit / low Earth orbit |
| L-ESIM | Land ESIM |
| LF | low frequency |
| LTAN | Local Time of the Ascending Node |
| LTE | long-term evolution |
| M2M | machine-to-machine |
| MCL | minimum coupling loss |
| MEO | medium Earth orbit |
| MES(s) | mobile earth station(s) |
| M-ESIM | Maritime ESIM |
| MF | medium frequency |
| MGWS | Multiple Gigabit Wireless Systems |
| MIFR | Master International Frequency Register (or Master Register) |
| MIMO | multiple-input and multiple-output |
| MMSI | Maritime Mobile Service Identity |
| mMTC | massive machine-type communications |
| MOB | man overboard |
| MR | regular milestone-based approach |
| MT | transitional milestone-based approach |
| MTC | Machine-Type Communication |
| MWI | microwave imaging |
| N/A | <i>not applicable</i> |
| NAVDAT | navigational data |

| Abbreviations | Description |
|----------------|--|
| NAVTEX | Navigational text |
| NBDP | narrow-band direct printing |
| NCMC | <i>Network Control and Monitoring Centre</i> |
| NGSO / non-GSO | non-geostationary-satellite orbit |
| NGSO SD | non-GSO satellites with short duration |
| No. | number |
| OFDM | Orthogonal frequency division multiplexing |
| OOBE | out-of-band emission |
| PDN | preliminary draft new |
| PDR | preliminary draft revision |
| Pfd | power flux-density |
| P-MP | point-to-multipoint |
| P-P | point-to-point |
| PSD | power spectrum density |
| PSTN | public switched telephone network |
| RAC | Rural Area Coverage |
| QPSK | Quadrature Phase-Shift Keying |
| RAAN | right ascension of the ascending node |
| RA | Radiocommunication Assembly |
| Rec. | Recommendation |
| Rep. | Report |
| Res. | Resolution |
| RF | radio frequency |
| RF CSA | radio-frequency mesh network central alarm |
| RFI | radio-frequency interference |
| RLAN | radio local area network |
| RoP | Rule of Procedure |
| RR | Radio Regulations |
| RRB | Radio Regulations Board |
| RSTT | Railway radiocommunication Systems between Train and Trackside |
| RTTT | Road Transport and Traffic Telematics |
| SAC | Suburban Area Coverage |
| SAE | Society of Automotive Engineers |
| SAR | search and rescue |
| SARPs | standards and recommended practices |
| SART | Search And Rescue Transmitter |
| SAT-COM | Satellite Communications |
| s-E | space-to-Earth |
| SDOs | standards developing organizations |
| SM | Spectrum Management |
| SNR | signal-to-noise ratio |
| SOLAS | International Convention for the Safety of Life at Sea |

| Abbreviations | Description |
|---------------|---|
| SRD | Short Range Device |
| SSB | Single Side Band |
| SSCS | Space-to-Space Communication System |
| ST61 | Plan for television and sound broadcasting in the European broadcasting area, Stockholm, 1961 Rev. 2006 |
| TBD | to be defined/determined/developed (according to the context, used as a placeholder) |
| TDD | time-division duplex |
| TDRS | Tracking and data relay satellite |
| TETRA | Terrestrial Trunked Radio |
| TRP | total radiated power |
| TT&C | tracking, telemetry and command |
| UAC | Urban Area Coverage |
| UE | user equipment |
| UHDTV | ultra high definition television |
| UHF | ultra high frequency |
| UIC | International Union of Railways |
| UN | United Nations |
| URLLC | ultra-reliable and low-latency communications |
| V2I | vehicle-to-infrastructure |
| V2N | vehicle-to-network |
| V2P | vehicle-to-pedestrian |
| V2V | vehicle-to-vehicle |
| V2X | vehicle-to-everything |
| VDE | VHF data exchange |
| VDE-SAT | VDE Satellite component |
| VDE-TER | VDE – Terrestrial specific |
| VDES | VHF data exchange system |
| VHF | very high frequency |
| VLBI | very long baseline interferometry |
| WARC | World Administrative Radio Conference |
| WAS | Wireless Access System |
| WAVE | Wireless Access in Vehicular Environment |
| WD | Working document |
| WDPDN | Working document towards a preliminary draft new |
| Wi-Fi | a trademarked term meaning IEEE 802.11x |
| WIA | Wireless Industrial Applications |
| WPR | Wind Profiler Radar |
| WPT | Wireless Power Transmission |
| WPT-EV | WPT for electric vehicles |
| WRC | World Radiocommunication Conference |

Report of the CPM to WRC-19

ISBN 978-92-61-28351-3 SAP id



Published in Switzerland
Geneva, 2019
Photo credits: Shutterstock