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| A close up of a sign  Description automatically generated | **World Radiocommunication Conference (WRC-23)Dubai, 20 November - 15 December 2023** |  |
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| PLENARY MEETING | **Addendum 17 toDocument 65-E** |
|  | **29 October 2023** |
|  | **Original: English** |
|  |
| European Common Proposals |
| PROPOSALS FOR THE WORK OF THE CONFERENCE |
|  |
| Agenda item 1.17 |

1.17 to determine and carry out, on the basis of ITU‑R studies in accordance with Resolution **773 (WRC‑19)**, the appropriate regulatory actions for the provision of inter-satellite links in specific frequency bands, or portions thereof, by adding an inter-satellite service allocation where appropriate;

Introduction

This proposal addresses a regulatory framework to enable the operation of satellite-to-satellite links in the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz, while ensuring protection of existing services in the same frequency bands and adjacent frequency bands.

In particular the following regulatory measures are suggested:

1 To enable satellite-to-satellite links in the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz under an inter-satellite service (ISS) allocation, for the space research, space operation and Earth exploration-satellite service (EESS) applications and also transmissions of data originating from industrial and medical activities in space.

2 To add a footnote in RR Article **5** with reference to a new Resolution **[EUR-A117-SAT-TO-SAT] (WRC-23)** providing the conditions for the operation of satellite-to-satellite links.

3 To consider RR Table **21-4** pfd limits on the Earth’s surface in order to address the compatibility with the mobile and fixed services in the frequency band 27.5-29.5 GHz.

4 To add an out of band pfd limit on the Earth’s surface in order to address the protection of the EESS (passive) in the frequency band 18.6-18.8 GHz.

5 To add maximum e.i.r.p. and maximum e.i.r.p. density limits and antenna pattern in order to address the protection of non-GSO fixed-satellite service (FSS) in the frequency bands 27.5-29.1 GHz and 29.5-30 GHz.

6 To add a “under the envelope” compliance check to address the protection of GSO FSS in the frequency band 27.5-30 GHz from emissions by non-GSO space stations to GSO space stations and from emissions by non-GSO space stations to non-GSO space stations in the frequency bands 27.5-29.1 GHz and 29.5-30 GHz.

7 To add a pfd limit on the GSO arc to protect GSO from emissions by non-GSO space stations to non-GSO space stations in the frequency bands 27.5-28.6 GHz and 29.5-30 GHz.

8 To add a new footnote in RR Article **5** to protect non-GSO mobile-satellite service (MSS) feeder links in the frequency band 19.3-19.7 GHz.

9 To consider hard limits with the non-GSO MSS feeder links in the frequency band 29.1-29.5 GHz.

10 To enable the concept of operation of “Expanded cone” when the service provider is a GSO.

Proposals

ARTICLE 5

Frequency allocations

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

NOC EUR/65A17/1#1891

11.7-13.4 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 11.7-12.5FIXEDMOBILE except aeronautical mobileBROADCASTINGBROADCASTING-SATELLITE5.492 | 11.7-12.1FIXED 5.486FIXED-SATELLITE(space-to-Earth) 5.484A 5.484B 5.488 Mobile except aeronautical mobile5.485 | 11.7-12.2FIXEDMOBILE except aeronautical mobileBROADCASTINGBROADCASTING-SATELLITE5.492 |
| 12.1-12.2FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.488  |
| 5.485 5.489 | 5.487 5.487A |
| 12.2-12.7FIXEDMOBILE except aeronauticalmobileBROADCASTINGBROADCASTING-SATELLITE5.492 | 12.2-12.5FIXEDFIXED-SATELLITE(space-to-Earth) 5.484BMOBILE except aeronauticalmobileBROADCASTING |
| 5.487 5.487A | 5.487 5.484A |
| 12.5-12.75FIXED-SATELLITE(space-to-Earth) 5.484A 5.484B (Earth-to-space) 5.494 5.495 5.496 | 5.487A 5.488 5.490  | 12.5-12.75FIXEDFIXED-SATELLITE(space-to-Earth) 5.484A 5.484BMOBILE except aeronauticalmobileBROADCASTING-SATELLITE 5.493 |
| 12.7-12.75FIXEDFIXED-SATELLITE(Earth-to-space) MOBILE except aeronauticalmobile |

NOC EUR/65A17/2#1892

5.487 In the band 11.7-12.5 GHz in Regions 1 and 3, the fixed, fixed-satellite, mobile, except aeronautical mobile, and broadcasting services, in accordance with their respective allocations, shall not cause harmful interference to, or claim protection from, broadcasting-satellite stations operating in accordance with the Regions 1 and 3 Plan in Appendix 30.     (WRC-03)

MOD EUR/65A17/3#1893

15.4-18.4 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 18.1-18.4 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.517A (Earth-to-space) 5.520 INTER-SATELLITE ADD 5.A117 MOBILE 5.519 5.521 |

MOD EUR/65A17/4#1894

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 5.517A  INTER-SATELLITE ADD 5.A117 MOBILE |
| **…** |
| 18.8-19.3 FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.517A 5.523A  INTER-SATELLITE ADD 5.A117 MOBILE |
| 19.3-19.7 FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 5.517A 5.523B5.523C 5.523D 5.523E  INTER-SATELLITE ADD 5.A117 ADD 5.B117MOBILE |
| 19.7-20.1FIXED-SATELLITE(space-to-Earth) 5.484A 5.484B 5.516B 5.527A INTER-SATELLITE ADD 5.A117Mobile-satellite (space-to-Earth) | 19.7-20.1FIXED-SATELLITE(space-to-Earth) 5.484A 5.484B 5.516B 5.527A INTER-SATELLITE ADD 5.A117MOBILE-SATELLITE(space-to-Earth) | 19.7-20.1FIXED-SATELLITE(space-to-Earth) 5.484A 5.484B 5.516B 5.527A INTER-SATELLITE ADD 5.A117Mobile-satellite (space-to-Earth) |
| 5.524 | 5.524 5.525 5.526 5.527 5.528 5.529 | 5.524 |
| 20.1-20.2 FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.516B 5.527A  INTER-SATELLITE ADD 5.A117 MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528 |

MOD EUR/65A17/5#1895

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 5.517A 5.539  INTER-SATELLITE ADD 5.A117 MOBILE 5.538 5.540 |
| 28.5-29.1 FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.517A 5.523A 5.539 INTER-SATELLITE ADD 5.A117  MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540 |
| **29.1-29.5** FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.517A 5.523C 5.523E 5.535A 5.539 5.541A  INTER-SATELLITE ADD 5.A117 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540 |
| 29.5-29.9FIXED-SATELLITE(Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 INTER-SATELLITE ADD 5.A117Earth exploration-satellite(Earth-to-space) 5.541Mobile-satellite (Earth-to-space) | **29.5-29.9**FIXED-SATELLITE(Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 INTER-SATELLITE ADD 5.A117MOBILE-SATELLITE(Earth-to-space)Earth exploration-satellite(Earth-to-space) 5.541 | 29.5-29.9FIXED-SATELLITE(Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 INTER-SATELLITE ADD 5.A117Earth exploration-satellite(Earth-to-space) 5.541Mobile-satellite (Earth-to-space)  |
| 5.540 5.542 | 5.525 5.526 5.527 5.529 5.540  | 5.540 5.542 |

MOD EUR/65A17/6#1897

29.9-34.2 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 29.9-30 FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539  INTER-SATELLITE ADD 5.A117 MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.543 5.525 5.526 5.527 5.538 5.540 5.542 |

ADD EUR/65A17/7#1896

5.A117 For use of the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz, or parts thereof, by space stations in the inter-satellite service, Resolution **[EUR-A117-SAT-TO-SAT] (WRC‑23)** shall apply. Such use is limited to space research, space operation and Earth exploration-satellite applications, and also transmissions of data originating from industrial and medical activities in space.

For use of the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz, 27.5-29.1 and 29.5-30 GHz by space stations, the allocation is limited to satellite-to-satellite links between non-geostationary satellites or between non-geostationary satellites and geostationary satellites.

For use of the frequency bands 29.1-29.5 GHz by space stations, the allocation is limited to satellite-to-satellite links between non-geostationary satellites and geostationary satellites.

Such use in the inter-satellite links in the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz are not subject to coordination under No. **9.11A**.

No. **4.10** does not apply.     (WRC‑23)

ADD EUR/65A17/8

5.B117 In order to protect feeder links of non-geostationary networks in the mobile-satellite service in the frequency band 19.3-19.7 GHz, the power flux-density values produced at the surface of the Earth for all angles of arrival by a space station in the inter-satellite service operating in this frequency band in accordance with Resolution **[EUR-A117-SPACE-TO-SPACE] (WRC‑23)** shall not exceed −140 dB(W/m2) in any 1 MHz at the receiving antenna of any of the above feeder link earth stations recorded in the Master International Frequency Register.     (WRC‑23)

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section V − Limits of power flux-density from space stations

MOD EUR/65A17/9#1898

TABLE **21-4**     (Rev.WRC‑23)

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency band | Service\* | Limit in dB(W/m2) for anglesof arrival (δ) above the horizontal plane | Reference bandwidth |
| 0°-5° | 5°-25° | 25°-90° |
| … | … | … | … | … | … |
| 27.5-29.5 GHz | Inter-satellite(non-geostationary satellite orbit) | −115 | −115 + 0.5(δ – 5) | −105 | 1 MHz |
| … | … | … | … | … | … |

APPENDIX 4 (REV.WRC‑19)

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 EUR/65A17/10#1899

**TABLE A**

GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK OR SYSTEM,
EARTH STATION OR RADIO ASTRONOMY STATION     (Rev.WRC‑23)

| **Items in Appendix** | ***A \_ GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK OR SYSTEM, EARTH STATION OR RADIO ASTRONOMY STATION*** | **Advance publication of a geostationary-satellite network** | **Advance publication of a non-geostationary-satellite network or system subject to coordination under Section II of Article 9** | **Advance publication of a non-geostationary-satellite network or system 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 or system** | **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.24** | **COMPLIANCE WITH NOTIFICATION OF A NON-GSO SHORT DURATION MISSION** |  | **A.24** |  |
| A.24.a | a commitment by the administration that, in the case that unacceptable interference caused by a non-GSO satellite network or system identified as short-duration mission in accordance with Resolution **32 (WRC‑19)** is not resolved, the administration shall undertake steps to eliminate the interference or reduce it to an acceptable levelRequired only for notification |  |  |  |  | **+** |  |  |  |  | A.24.a |  |
| **A.25** | **COMPLIANCE WITH RESOLUTION** **[EUR-A117-SAT-TO-SAT] (WRC‑23)** |  | **A.25** |  |
| A.25.a | a commitment from the notifying administration of a non-GSO space station receiving in the frequency bands 27.5-28.6 GHz and 29.5-30.0 GHz that the equivalent power flux-density produced at any point in the geostationary-satellite orbit by emissions from all combined operations of inter-satellite links in the inter-satellite service and Earth-to-space links in the FSS shall not exceed the limits given in Table **22‑2** |  |  | **+** |  | **+** |  |  |  |  | A.25.a |  |
| A.25.b.1 | a commitment from the notifying administration that, upon receiving a report of unacceptable interference, from its non-GSO space station transmitting in the frequency band 27.5-30 GHz the notifying administration will follow the procedures in *resolves further* 2 of Resolution **[EUR-A117-SAT-TO-SAT] (WRC‑23)**Required only for the notification of non-GSO space stations submitted in accordance with Resolution **[EUR-A117-SAT-TO-SAT] (WRC‑23)** |  |  |  |  | **+** |  |  |  |  | A.25.b.1 |  |
| A.25.b.2 | a commitment of compliance with per-satellite power flux-density level in the frequency band 19.3-19.7 GHz, as defined in No. **5.B117**Required only for the notification of space stations submitted in accordance with Resolution **[EUR-A117-SAT-TO-SAT] (WRC‑23)** |  |  | **+** |  | **+** |  |  |  |  | A.25.b.2 |  |
| A.25.c.1 | Exclusion zone angle (degrees), the minimum angle to the geostationary-satellite orbit at the non-geostationary space station transmitting space station at which it will operate  |  |  | **+** |  | **+** |  |  |  |  | A.25.c.1 |  |
| A.25.c.2 | Mask pattern defined in terms of the e.i.r.p. in a 40 kHz bandwidth as a function of the latitude and the off-axis angle between the non-geostationary transmitting space station boresight line and the line from the non-geostationary transmitting space station to a point on the geostationary arc |  |  | **+** |  | **+** |  |  |  |  | A.25.c.2 |  |
| A.25.d | **COMPLIANCE WITH *resolves* 3.3 OF RESOLUTION [EUR-A117-SAT-TO-SAT] (WRC‑23)** |  |  |  |  |  |  |  |  |  | A25.d |  |
| A.25.d.1 | a commitment by the notifying administration for a non-GSO FSS system with an orbital apogee of less than 20 000 km communicating with lower orbiting non-GSO space stations in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz that the pfd shall be in conformity with the pfd limits on the Earth’s surface specified in Annex 3 to Resolution **[EUR-A117-SAT-TO-SAT] (WRC‑23)**Required only for the notification of non-GSO space stations submitted in accordance with Resolution **[EUR-A117-SAT-TO-SAT] (WRC‑23)** |  |  |  |  | **+** |  |  |  |  | A.25.d.1 |  |

MOD EUR/65A17/11#1900

**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‑23)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 or system subject to coordination under Section II of Article 9** | **Advance publication of a non-geostationary-satellite network or system 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 or system** | **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.11** | **SERVICE AREA (S)***For all space applications except active or passive sensors* |  | **C.11** |  |
| C.11.a | the service area or areas of the satellite beam on the Earth, when the associated transmitting or receiving stations are earth stationsFor a space station submitted in accordance with Appendix **30**, **30A** or **30B**, the service area identified by a set of a maximum of 100 test points and by a service area contour on the surface of the Earth or defined by a minimum elevation angle*Note* – When an assignment converted from an allotment is reinstated in the Appendix **30B** Plan, the notifying administration may choose a maximum of 20 test points within its national territory for the reinstated allotment |  |  | **X** | **X** | **X** |  | **X** | **X** | **X** | C.11.a |  |
| C.11.a.1 | areas of the satellite beam on the Earth, when the associated transmitting or receiving stations are space stationsRequired for space stations in the inter-satellite service transmitting in the frequency bands 18.1-18.6 GHz and 18.8-20.2 GHz |  |  | **+** |  | **+** |  |  |  |  | **C.11.a.1** |  |
| … | … |  |  |  |  |  |  |  |  |  |  |  |

ADD EUR/65A17/12#1901

draft new RESOLUTION [EUR-A117-SAT-TO-SAT] (WRC‑23)

Use of the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz for satellite-to-satellite transmissions

The World Radiocommunication Conference (Dubai, 2023),

considering

*a)* that there is a need for non-geostationary-satellite orbit (non-GSO) space stations to be able to relay data to the Earth, and that part of this need could be met by allowing such non-GSO inter-satellite service (ISS) space stations to communicate with space stations operating in the geostationary-satellite orbit (GSO) and in the non-GSO in the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz;

*b)* that the administration responsible for the notification of non-GSO space stations communicating with GSO or non-GSO space stations in the ISS at higher altitude does not need to be the same administration that has already notified assignments in the ISS;

*c)* that imposing hard limits necessary to protect other services would provide regulatory certainty for notifying administrations of both non-GSO space stations communicating with ISS space stations and potentially impacted services;

*d)* that there is growing interest for utilizing satellite-to-satellite links for a variety of applications;

*e)* that the ITU Radiocommunication Sector (ITU‑R) has carried out sharing and compatibility studies between incumbent services in the frequency bands 18.1-18.6 GHz, 18.8-20.2 and 27.5-30 GHz and adjacent frequency bands and satellite-to-satellite transmissions in the ISS;

*f)* that these studies were based on certain principles including the limitation of the use of frequency bands in specific direction in accordance with the existing fixed-satellite service (FSS) allocations in these frequency bands, the use of power control and antenna steering capabilities and compliance with applicable epfd and off-axis e.i.r.p. limits to protect incumbent services;

*g)* that the frequency bands 18.1-18.6 GHz (space-to-Earth), 18.8-20.2 GHz (space-to-Earth) and 27.5-30 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, without the imposition of undue constraints, from the operation of satellite-to-satellite links,

recognizing

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 or the non-GSO FSS system with which non-GSO space stations communicate or on the coordination requirements of that satellite network,

resolves

1 that, for a non-GSO space station subject to this Resolution communicating with a GSO or non-GSO space station within the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz, the following conditions shall apply:

1.1 the non-GSO space station transmitting in the frequency band 27.5-30 GHz and receiving in the frequency bands 18.1-18.6 GHz and 18.8-20.2 GHz shall only operate inter-satellite links when its apogee altitude[[1]](#footnote-1)1 is lower than the minimum operational altitude[[2]](#footnote-2)2 of the GSO or non-GSO space station it communicates with;

1.2 the GSO/non-GSO space station receiving in the frequency band 27.5-30 GHz and transmitting in the frequency bands 18.1-18.6 GHz and 18.8-20.2 GHz, shall only operate inter-satellite links when its minimum operational altitude is higher than the apogee altitude of the non-GSO space station with which it communicates;

1.3 that the use of inter-satellite links by GSO or non-GSO space stations transmitting in the frequency bands 18.1-18.6 GHz and 18.8-20.2 GHz and receiving the frequency band 27.5-30 GHz is limited to those with recorded assignments in the relevant FSS (space-to-Earth) and (Earth-to-space) allocations in these bands;

2 that for a non-GSO space station transmitting in the space-to-space direction in the frequency band 27.5-30 GHz, the following conditions shall apply:

2.1 this non-GSO space station shall only transmit when within the cone whose apex is the GSO or non-GSO receiving space station and whose angle is θMax (as defined in Annex 1 to this Resolution);

2.2 the emissions of this non-GSO space station shall remain within the envelope of the notified/recorded characteristics of the associated transmitting FSS earth stations of the GSO FSS network or non-GSO FSS system;

2.3 this non-GSO space stationshall comply with the limits contained in Table **21-4**, taking into account the provisions in Annex 2 to this Resolution for protection of terrestrial services in the frequency band 27.5-29.5 GHz;

2.4 this non-GSO space station shall comply with the provisions contained in Annex 4 to this Resolution;

2.5 this non-GSO space station shall not produce a power flux-density at any point in the GSO arc greater than the power flux-density produced by earth stations associated with the satellite network/system with which they communicate, and Annex 5 to this Resolution applies;

3 that for a space station transmitting in the space-to-space direction in the frequency bands 18.1-18.6 GHz and 18.8-20.2 GHz or parts thereof, the following conditions shall apply:

3.1 this non-GSO or GSO space station shall only transmit when the non-GSO receiving space station is within the cone whose apex is the GSO or non-GSO transmitting space station and whose angle is θ*Max* (as defined in Annex 1 to this Resolution);

3.2 the transmissions shall remain within the envelope of the notified/recorded characteristics of transmitting GSO FSS or non-GSO FSS towards its associated FSS earth stations;

3.3 that, with respect to the Earth exploration-satellite service (EESS) (passive) operating in the frequency band 18.6-18.8 GHz, any non-GSO FSS system with an orbital apogee of less than or equal to 20 000 km communicating with lower orbiting non-GSO space stations in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz and for which the complete notification information has been received by the Radiocommunication Bureau (BR) after 1 January 2025 shall comply with the provisions indicated in Annex 3 to this Resolution;

4 that non-GSO space stations receiving in the frequency bands 18.1-18.6 GHz and 18.8-20.2 GHz, or parts thereof shall not claim protection from mobile-satellite service (MSS) networks and systems and meteorological satellites as well as terrestrial services operating in conformity with the Radio Regulations;

5 that the notifying administration of a non-GSO FSS system communicating with a non-GSO space station in the frequency bands 18.1-18.6 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz and 29.5-30.0 GHz shall ensure that the equivalent power flux-density produced by the emissions from all combined operations of inter-satellite links in the ISS and Earth-to-space and space-to-Earth links in the FSS comply with the epfd limits contained in Article **22,** Tables **22-1B**, **22-1C** and **22-2**;

6 that space stations receiving inter-satellite transmissions in the frequency band 27.5-30 GHz from non-GSO space stations shall, for these inter-satellite links, not claim protection from FSS and MSS networks and systems as well as terrestrial services operating in conformity with the Radio Regulations;

7 that assignments to inter-satellite links in the frequency bands 18.1-18.6 GHz, 18.8-19.7 GHz and 27.5-30 GHz shall not claim protection from GSO FSS services operating in the frequency band allocated to FSS; No. **5.43A** does not apply;

8 that assignments to inter-satellite links in the frequency bands 19.7-20.2 GHz shall not cause harmful interference to nor claim protection from GSO FSS services operating in the frequency band allocated to FSS,

resolves further

1 that, subject to this Resolution:

1.1 the notifying administration of the non-GSO system choosing to operate inter-satellite links and receiving in the frequency bands 27.5-28.6 GHz and 29.5-30.0 GHz shall indicate to the BR the commitment that the equivalent power flux-density produced at any point in the geostationary-satellite orbit by emissions from all combined operations of inter-satellite links and associated earth station transmissions shall not exceed the limits given in Table **22‑2**;

1.2 the notifying administration of the non-GSO space station/stations transmitting in the frequency band 27.5-30 GHz towards a GSO network and receiving in the frequency bands, 18.1-18.6 GHz and 18.8-20.2 GHz shall send to the BR the relevant Appendix **4** information containing the characteristics of the non-GSO space station/stations and the associated name of the notified GSO network with which it intends to communicate;

1.3 the notifying administration of the non-GSO space station/stations transmitting in the frequency bands 27.5-29.1 GHz and 29.5-30.0 GHz towards a non-GSO system and receiving in the frequency bands 18.1-18.6 GHz and 18.8-20.2 GHz shall send to the BR the relevant Appendix **4** information containing the characteristics of the non-GSO space station/stations and the associated name of the notified non-GSO system with which it intends to communicate;

1.4 the notifying administration for the non-GSO transmitting space station in the frequency band 27.5-30 GHz which communicate with a GSO network or non-GSO system shall send to the BR, when submitting Appendix **4** data, a formal commitment that, upon receiving a report of unacceptable interference, the notifying administration for the non-GSO transmitting space station which communicate to a GSO network or non-GSO system shall follow the procedures in *resolves further*2;

2 that in case of unacceptable interference caused by a non-GSO space station transmitting in the frequency band 27.5-30 GHz:

2.1 the notifying administration for the non-GSO space station transmitting in the frequency band 27.5-30 GHz shall cooperate with an investigation on the matter and provide information on the operation of the transmitting space station and a point of contact to provide such information;

2.2 the notifying administration for the non-GSO space station transmitting in the frequency band 27.5-30 GHz and the notifying administration of the GSO or non-GSO network or system with which the non-GSO transmitting space station communicates shall, jointly or individually, as the case may be, upon receipt of a report of unacceptable interference, take the required actions to eliminate or reduce the interference to an acceptable level;

3 that the notifying administration for the GSO or non-GSO network or system with which the non-GSO transmitting space station communicates shall ensure that:

3.1 the non-GSO space stations transmitting in the frequency band 27.5-30 GHz employed techniques to maintain pointing accuracy with the associated receiving space station and avoid tracking inadvertently adjacent GSO space stations of any other notifying administration or space stations in a non-GSO system of any other notifying administration;

3.2 all necessary measures are taken so that non-GSO transmitting space stations in the frequency band 27.5-30 GHz 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;

3.3 a permanent point of contact is provided for the purpose of tracing any cases of unacceptable interference from non-GSO transmitting space stations in the frequency band 27.5-30 GHz in the ISS service and to immediately respond to the relevant requests,

instructs the Director of the Radiocommunication Bureau

1 to take all necessary actions to facilitate the implementation of this Resolution, together with providing any assistance for the resolution of interference, if and when required;

2 to report to future world radiocommunication conferences any difficulties or inconsistencies encountered in the implementation of this Resolution;

3 to use the methodology given in Annex 2 of this Resolution when assessing compliance with the pfd limits in Table **21-4**;

4 to use the methodology given in Appendixes 1 to 3 to Annex 5 of this Resolution when assessing compliance with paragraphs 1 to 6 of Annex 5;

5 not to examine, under No. **11.31**, the conformity of non-GSO FSS systems with the provisions of *resolves*5 of this Resolution.

ANNEX 1 TO draft new RESOLUTION [EUR-A117-SPACE-TO-SPACE] (WRC‑23)

Determination of the off-nadir angle

1 A non-GSO space station transmitting in the frequency band 27.5-30 GHz and receiving in the frequency bands 18.1-18.6 GHz and 18.8-20.2 GHz shall only communicate with a GSO or non-GSO space station when the off-nadir angle between this GSO or non-GSO space station and the non-GSO space station with which it communicates is equal to or smaller than:

 

where

 *REarth* = 6 378 km

 *AltHigher* = altitude of the non-GSO space station at higher orbital altitude in km.

Figure 1



2 A non-GSO space station transmitting in the frequency band 27.5-30 GHz and receiving in the frequency bands 18.1-18.6 GHz, and 18.8-20.2 GHz shall only communicate with a GSO space station when the off-nadir angle between this GSO space station and the non-GSO space station with which it communicates is equal to or smaller than:

– if the altitude of the non-GSO space station is less than 2 000 km:

 

– if the altitude of the non-GSO space station is greater than or equal to 2 000 km:

 

where:

 *REarth*= 6 378 km

 *AltGSO* = altitude of the GSO space station in km

 *Altnon-GSO* = altitude of the non-GSO space station in km.

Figure 2



3 If the altitude of the non-GSO space station transmitting in the frequency band 27.5-30 GHz and receiving in the frequency bands 18.1-18.6 GHz, and 18.8-20.2 GHz is less than 2 000 km, the angle between the vector from this space station to the centre of the Earth and the vector between this space station and the GSO space station, shall be at least 90°.

4 In case the notified service area of the non-GSO network/system at higher orbital altitude is not global, the maximum off-nadir angle θ*Max* will vary at each azimuth according to the notified service area and there will be a specific maximum off-nadir angle associated to each azimuth based on the position in space of the FSS network/system at higher orbital altitude and the geographic coordinates (latitude, longitude) of the border of the notified service area at each azimuth, which are extracted from the Graphical Interference Management System (GIMS) database container that was submitted to the BR when notifying a specific non-global service area.

 

with:

 

 

 

 

 

 

 

where:

 *latsab*(φ) = latitude of the service area border for the azimuth φ

 *lonsab*(φ) = longitude of the service area border for the azimuth φ

 *latSS* = latitude of the sub-satellite point of the GSO/non-GSO space station

 *lonSS* = longitude of the sub-satellite point of the GSO/non-GSO space station.

ANNEX 2 TO draft new RESOLUTION [EUR-A117-SPACE-TO-SPACE] (WRC‑23)

Provisions for non-GSO space stations inter-satellite links in the
frequency band 27.5-29.5 GHz to protect terrestrial services
in the frequency band 27.5‑29.5 GHz

To check the compliance of the non-GSO emissions with the pfd mask described in Table 21-4, the following procedures shall be followed:

1 Parameter *a* is the orbital altitude (km) of the non-GSO system identified in *resolves further* 1.3 or in *resolves further* 1.4, *PSD* is the power spectral density in the reference bandwidth associated with the pfd limit, and compute the off-axis gain pattern *Gtx*(φ), with φ being the off-axis angle in the direction of the terrestrial receiver. Assume the Earth is a sphere whose radius, *Re*, is 6 378 km.

2 Compute the angle, as seen from the non-GSO system transmitting in frequency range 27.5-29.5 GHz (the user space station), between the centre of the Earth and the GSO network or non-GSO systems receiving in the frequency range 27.5-29.5 GHz (the service provider space station) assuming that the user is at the edge of the cone of coverage with the formula:

 

3 Sweep angle of arrival to the terrestrial station, θ from 0 to 90 degrees in 0.1-degree increments.

4 Compute satellite angle .

5 Compute off-axis angle φ = 180 − δ − γ.

6 Compute the gain *Gtx* in dBi towards the Earth point for each of the angles from Step 5, using the user space station transmit antenna pattern.

7 Compute slant range .

8 Compute the atmospheric attenuation *Aatm* in dB, for the corresponding angle of arrival, θ, using Recommendation ITU‑R P.676‑13 with the mean global standard atmosphere from Recommendation ITU‑R P.835‑6.

9 Compute the *PFD* on the ground as:

 

ANNEX 3 TO draft new RESOLUTION [EUR-A117-SPACE-TO-SPACE] (WRC‑23)

Provisions for non-GSO space stations[[3]](#footnote-3)3 inter-satellite links in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz towards non-GSO space stations with respect to EESS (passive) operating in the frequency band 18.6-18.8 GHz

Non-GSO space stations operating with an orbit apogee of more than 2 000 km and less than 20 000 km in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz when communicating with a non-GSO space station as described in *resolves*1.1 shall not exceed a power flux-density produced at the surface of the oceans across the 200 MHz of the frequency band 18.6-18.8 GHz, of −118 dB(W/(m² · 200 MHz)).

Non-GSO space stations operating with an orbit apogee less than or equal to 2 000 km in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz when communicating with a non-GSO space station as described in *resolves*1.1 shall not exceed a power flux-density produced at the surface of the oceans across the 200 MHz of the frequency band 18.6-18.8 GHz, of −110 dB(W/(m² · 200 MHz)).

ANNEX 4 TO draft new RESOLUTION [EUR-A117-SPACE-TO-SPACE] (WRC‑23)

Provisions for non-GSO inter-satellite links in the frequency
band 27.5-30.0 GHz to protect non-GSO space stations

The following conditions for non-GSO space stations transmitting in the frequency band 27.5-30.0 GHz to protect non-GSO space stations shall apply:

*a)* The emissions from any non-GSO space station transmitting in the frequency bands 27.5-29.1 GHz and 29.5-30 GHz to communicate with a GSO network shall not exceed the following on-axis e.i.r.p. spectral density limits:

– for non-GSO space station transmit on-axis antenna gains greater than 40.6 dBi: 52.5 dBW/10 MHz;

– for non-GSO space station transmit on-axis antenna gains less than or equal to 40.6 dBi: 52.5 – (40.6 – X) dBW/10 MHz.

where X is the on-axis gain of the non-GSO space station antenna in dBi.

*b)* To protect FSS feeder links to non-GSO mobile-satellite service systems the following conditions for non-GSO space stations and systems transmitting in the frequency band 29.1-29.5 GHz shall apply:

– emissions from any non-GSO space station communicating with a GSO network shall not exceed a maximum power spectral density of –65 dBW/Hz at the input of the antenna of the non-GSO space station,

– any non-GSO space station communicating with a GSO network shall have a minimum antenna diameter of 0.3 m whose gain should not exceed the gain envelope of the most recent version of Recommendation ITU‑R S.580,

– non-GSO systems communicating with a GSO network shall not contain more than 100 satellites.

*c)* The emissions from any non-GSO space station transmitting in the frequency bands 27.5-29.1 GHz and 29.5-30 GHz to communicate with a non-GSO system with a minimum operational altitude higher than or equal to 2 000 km shall not exceed an on-axis e.i.r.p. spectral density of −20 dBW/Hz and the total e.i.r.p. from any non-GSO space station shall not exceed:

|  |  |  |
| --- | --- | --- |
| Transmitting non-GSO space station operational altitude (km) | Maximum total e.i.r.p. (dBW) until 31 December 2033 | Maximum total e.i.r.p. (dBW) after 31 December 2033 |
| altitude < 450 | 63 | 66 |
| 450 ≤ altitude < 600 | 61 | 64 |
| 600 ≤ altitude < 750 | 58 | 58 |
| 750 ≤ altitude < 900 | 55 | 55 |
| 900 ≤ altitude < 1290 | 25  | 48.5 |
| altitude ≥ 1 290 | N/A | N/A |

*d)* The emissions from any non-GSO space station transmitting in the frequency bands 27.5-29.1 GHz and 29.5-30 GHz to communicate with a non-GSO system with a minimum operational altitude lower than 2 000 km shall not exceed an on-axis e.i.r.p. spectral density of −28 dBW/Hz and the total e.i.r.p. from any non-GSO space station shall not exceed:

|  |  |  |
| --- | --- | --- |
| Transmitting non-GSO space station operational altitude (km) | Maximum total e.i.r.p. (dBW) until 31 December 2033 | Maximum total e.i.r.p. (dBW) after 31 December 2033 |
| altitude < 450 | 60 | 60 |
| 450 ≤ altitude < 600 | 58 | 58 |
| 600 ≤ altitude < 750 | 55 | 55 |
| 750 ≤ altitude < 900 | 53 | 53 |
| 900 ≤ altitude < 1 290 | 25  | 47 |
| altitude ≥ 1 290 | N/A | N/A |

*e)* For off-axis angles greater than 3.5 degrees, the off-axis e.i.r.p. emissions of a non-GSO space station transmitting in the frequency bands 27.5-29.1 GHz and 29.5‑30 GHz to communicate with a non-GSO system with a minimum operational altitude higher than 2 000 km shall not exceed the envelope generated by the combination of an input power spectral density at the antenna flange of −62 dBW/Hz coupled with the following off-axis gain:

– 29-25 log(ϕ) dBi for angles between 3.5 and 4.9 degrees;

– 11.71 dBi for angles between 4.9 and 9.5 degrees;

– 43-32log(ϕ) dBi for angles between 9.5 and 20 degrees.

ANNEX 5 TO draft new RESOLUTION [EUR-A117-SPACE-TO-SPACE] (WRC‑23)

Provisions for non-GSO inter-satellite links in the frequency band 27.5‑30.0 GHz to protect GSO space stations

For the non-GSO-to-GSO cases

1 In the frequency band 27.5-30 GHz, when a non-GSO system as identified in *resolves further*1.2 identifies a GSO network as described in *resolves further*1.2, to operate inter-satellite links, the BR shall perform the examination in Appendix 1 to this Annex.

2 The notifying administration of the GSO network identified in paragraph 1 above shall commit that the non-GSO space stations with which it communicates will respect all bilateral coordination agreements that have already been signed, noting the provisions from *resolves further*1.4, 2 and 3.

3 The notifying administration of the GSO network identified in paragraph 2 above is urged to provide, upon any request from the notifying administration of a GSO network involved in the coordination agreements referred above, additional information on how the relevant coordination agreements will be respected. Efforts should be made to provide this information as soon as practicable.

For the non-GSO-to-non-GSO cases

4 In the frequency bands 27.5-29.1 GHz and 29.5-30 GHz, when a non-GSO system as identified in *resolves further*1.3 identifies a non-GSO system as described in *resolves further*1.3, to operate inter-satellite links, the BR shall perform the examination in Appendix 2 to this Annex.

5 The notifying administration of the receiving non-GSO network identified in paragraph 4 above shall commit that the transmitting non-GSO space stations with which it communicates will respect all bilateral coordination agreements that have already been signed, noting the provisions from *resolves further*1.4, 2 and 3.

6 In the frequency bands 27.5-28.6 GHz and 29.5-30 GHz, the pfd on the geostationary arc produced by a non-GSO satellite system as mentioned in *resolves further*1.4 shall not exceed a pfd of −165 dBW/m²/40 kHz.

APPENDIX 1

The aim of this Appendix is to provide a method to be used by the BR to assess whether the emissions from a non-GSO space station operating inter-satellite links with a GSO space station are within the envelope of the typical earth stations of the GSO network.

For non-GSO transmitter at altitude lower than 2 000 km

Step 1: For each group of the transmitting non-GSO notification.

Step 2: For each of the receiving GSO networks, as listed in *resolves further*1.2.

Step 3: For each beam in the Earth-to-space direction of the receiving GSO network notification, compute the maximum e.i.r.p. produced in one hertz (*EIRPSD*).

Step 4: Compute the reduction in free space loss at the altitude of the user using:

 

 where *NGSOalt* is the altitude of the transmitting non-GSO system space stations, and *GSOalt* = 35 786 km. It should be noted that if several altitudes are included in the notification, each altitude shall be tested.

Step 5: Compute the reduced e.i.r.p. spectral density as *EIRPSDreduced* = *EIRPSD* − Δ*FSL*.

Step 6: For all beams in the non-GSO system notification with a class of station ES, the e.i.r.p. spectral density mask is given in Appendix **4** data item A.25.c.2.

Step 7: For all emissions in the GSO network notification, compute the e.i.r.p. spectral density mask for all off-axis angles between 0 and 80°, with a Step of 1°, and reduce it by ∆*FSL*. The e.i.r.p. spectral density mask computation should assume that the maximum gain is for an off-axis angle of 0°.

Step 8: Frequency assignments to non-GSO systems shall receive a favourable finding with respect to paragraph 2 of Annex 5 if, for all beams:

– the maximum value of the e.i.r.p. spectral density mask from Step 6 does not exceed the *EIRPSDreduced* quantity, computed at the same altitude,

– the e.i.r.p. spectral density mask of the transmitting non-GSO space station from Step 6 is less than the reduced e.i.r.p. spectral density mask, compared in one hertz, from Step 7 for all angles for at least one emission in the GSO network notification.

Otherwise, the assignments shall receive an unfavourable finding.

For non-GSO transmitter at altitude greater than 2 000 km

Step 1: For each group of the transmitting non-GSO notification.

Step 2: For each of the receiving GSO networks, as listed in *resolves further*1.2.

Step 3: For all beams in the non-GSO system notification with a class of station ES, the e.i.r.p. spectral density mask is given in Appendix **4** data item A.25.c.2.

Step 4: For all beams in the non-GSO system notification with a class of station ES, calculate the pfd along the GSO arc based on the e.i.r.p spectral density in Step 3 (*pfdNGSO* dBW/m2/Hz). The point in the non-GSO orbit from which the pfd will be calculated will be the closest point in the orbit to the beam-peak of the GSO beam.

Step 5: For all emissions in the GSO network notification, compute e.i.r.p. spectral density mask for all off axis between 0 and 80°, with a Step of 1°. The e.i.r.p. spectral density mask computation should assume that the maximum gain is for an off axis angle of 0°.

Step 6: For all emissions in the GSO network notification, compute the pfd along the GSO arc based on the e.i.r.p. spectral density mask calculated in Step 5 (*pfdGSO* in dBW/m2/Hz).The point on Earth from which the pfd will be calculated will be the beam-peak of the GSO beam.

Step 7: Frequency assignments to non-GSO systems shall receive a favourable finding with respect to Annex 5 if, for all beams:

– the maximum value of the *pfdNGSO* mask from Step 4 does not exceed the *pfdGSO* from Step 6, computed at the same altitude,

Otherwise the assignments shall receive an unfavourable finding.

APPENDIX 2

The aim of this Appendix is to provide a method to be used by the BR to assess whether the emissions from a non-GSO space station operating inter-satellite links with a non-GSO space station are within the envelope of the typical earth stations of the non-GSO system.

Step 1: For each group of the transmitting non-GSO notification.

Step 2: For each of the receiving non-GSO systems, as listed in *resolves further*1.3*.*

Step 3: For each beam in the Earth-to-space direction of the receiving non-GSO system notification, compute the maximum e.i.r.p. produced in one hertz (*EIRPSD*).

Step 4: Compute the reduction in free space loss at the altitude of the user using:

 

 where *NGSOalt* is the altitude of the transmitting non-GSO system space stations, and *GSOalt* = 35 786 km. It should be noted that if several altitudes are included in the notification, each altitude shall be tested.

Step 5: Compute the reduced e.i.r.p. spectral density as *EIRPSDreduced* = *EIRPSD* − Δ*FSL*.

Step 6: For all beams in the non-GSO system notification with a class station ES, the e.i.r.p. spectral density mask is given in Appendix **4** data item A.25.c.2.

Step 7: For all emissions in the receiving non-GSO network notification, compute the e.i.r.p. spectral density mask for all off-axis angles between 0 and 80°, with a Step of 1°, and reduce it by ∆*FSL*. The e.i.r.p. spectral density mask computation should assume that the maximum gain is for an off-axis angle of 0°.

Step 8: Frequency assignments to non-GSO systems shall receive a favourable finding with respect to Annex 5 if, for all beams:

– the maximum value of the mask from Step 6 does not exceed the *EIRPSDreduced* quantity, computed at the same altitude,

– the e.i.r.p. spectral density mask of the transmitting non-GSO space station from Step 6 is less than the reduced e.i.r.p. spectral density mask from Step 7 for all angles.

Otherwise, the assignments shall receive an unfavourable finding.

APPENDIX 3

To check the compliance of the non-GSO emissions with the pfd limit given in Annex 5, § 6, the following procedure shall be followed.

Step 1: For each of the latitudes in the e.i.r.p. spectral density mask given in Appendix **4** data item A.25.c.2, elect the corresponding value to the GSO arc avoidance, and denote it as *eirpα*. If the mask is non-monotonic, select the largest value in the e.i.r.p. mask considering all angles greater than or equal to the GSO arc avoidance angle as given in Appendix **4** data item A.25.c.1.

Step 2a: Compute the slant distance to the GSO arc as:

 

where *alt* is the altitude of the transmitting non-GSO space station, in kilometres.

Step 2b: Compute the *PFD* on the GSO arc using:

 

Step 3: Frequency assignments to non-GSO systems shall receive a favourable finding with respect to Annex 5, § 6 if all pfd values calculated in Step 3 are below the threshold given in Annex 5, § 6.

SUP EUR/65A17/13#1890

RESOLUTION 773 (WRC-19)

Study of technical and operational issues and regulatory provisions for
satellite-to-satellite links in the frequency bands 11.7-12.7 GHz,
18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz

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1. 1 See item A.4.b.4.d of Appendix **4**. [↑](#footnote-ref-1)
2. 2 See item A.4.b.4.f of Appendix **4**. [↑](#footnote-ref-2)
3. 3 These provisions do not apply to non-GSO systems using orbits with an apogee less than or equal to 2 000 km that employ frequency reuse schemes of at least three colours. [↑](#footnote-ref-3)