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| **World Radiocommunication Conference (WRC-19)Sharm el-Sheikh, Egypt, 28 October – 22 November 2019** |  |
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| PLENARY MEETING | **Addendum 6 toDocument 12-E** |
|  | **2 October 2019** |
|  | **Original: Russian** |
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| Regional Commonwealth in the field of Communications Common Proposals |
| Proposals for the work of the conference |
|  |
| 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)**;

Introduction

WRC-19 agenda item 1.6 addresses the development of technical and regulatory conditions for the operation of non-geostationary (non-GSO) satellite systems in the fixed-satellite service (FSS) 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).

ITU-R and the Regional Commonwealth in the field of Communications (RCC) have carried out technical, operational and regulatory studies to determine the conditions for sharing between non-GSO and GSO FSS/broadcasting-satellite service (BSS)/mobile-satellite service (MSS) 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), including:

– determination of equivalent power flux-density limits, epfd ↑, produced at any point in the GSO by emissions from all the earth stations of a non-GSO FSS system, and epfd ↓ produced by emissions from all the non-GSO FSS space stations at any point on the Earth’s surface;

– development of proposals for the revision of Resolution **750 (Rev.WRC-15)** to ensure the protection of EESS (passive) in the frequency bands 36-37 GHz and 50.2-50.4 GHz from non-GSO FSS emissions, including study of the aggregate interference impact from GSO FSS networks and non-GSO FSS systems operating or planned to operate in the frequency bands considered under WRC-19 agenda item 1.6;

– development of proposals for ensuring protection of the radio astronomy service in the frequency bands 42.5-43.5 GHz, 48.94-49.04 GHz and 51.4-54.25 GHz from non-GSO FSS emissions;

– development of technical and regulatory conditions for sharing by non-GSO FSS systems operating in the frequency bands under consideration.

Based on the results of the studies carried out by ITU-R and RCC under WRC-19 agenda item 1.6, the RCC Administrations propose modifying the Radio Regulations (RR) as follows in order to regulate 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 non-GSO FSS satellite systems such as to ensure protection for stations of other existing services in the same and adjacent frequency bands:

– To address coordination between non-GSO FSS systems, it is proposed to add a new provision, RR No. **5.A16**, subjecting 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 protect GSO FSS and BSS satellite networks from non-GSO FSS systems, it is proposed to include in RR Article **22** a new provision containing a permissible single-entry interference criterion for degradation in terms of *C*/*N*, specified in the short-term and long-term performance objectives of GSO FSS and GSO BSS networks in the frequency bands under consideration.

– To protect GSO FSS and BSS satellite networks from the aggregate interference produced by non-GSO FSS systems, it is proposed to include in RR Article **22** a new provision containing a permissible aggregate interference criterion for degradation in terms of *C*/*N* of GSO FSS/BSS networks, and to adopt a new WRC Resolution containing a procedure for determining the course of action to be taken by the Radiocommunication Bureau and administrations in order to verify and comply with the single-entry and aggregate interference criteria.

– To verify the compliance of non-GSO FSS systems with single-entry and aggregate interference criteria, it is proposed that the new WRC Resolution contain GSO FSS/BSS reference links and a methodology for determining the compliance of non-GSO FSS systems with the single-entry and aggregate interference criteria for protecting GSO FSS/BSS networks.

– To address coordination between non-GSO FSS and non-GSO MSS systems, it is proposed to add a new provision, RR No. **5.B16**, making RR No. **9.12** effective in the frequency bands 39.5-40 GHz and 40-40.5 GHz in all Regions.

– To protect EESS (passive) systems operating in the band 50.2-50.4 GHz from harmful interference, it is proposed to modify Resolution **750 (Rev.WRC-15)** in regard to the establishment of limits on the power of unwanted emissions from GSO and non-GSO FSS earth stations operating in the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz and brought into use after [date of entry into force of the Final Acts of WRC-19].

– To ensure the protection of EESS (passive) in the frequency band 36-37 GHz, it is proposed to modify Resolution **750 (Rev.WRC-15)** in regard to limitation of the power of unwanted emissions from non-GSO FSS space stations operating in the frequency band 37.5-38 GHz.

The RCC Administrations consider that ensuring protection to the EESS (passive) in the frequency band 50.2-50.4 GHz should be achieved solely through the addition (inclusion) in Resolution **750 (Rev.WRC-15)** of mandatory limits on the power of unwanted emissions from GSO and non-GSO FSS earth stations operating in the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz.

The RCC Administrations consider that the operation of non-GSO FSS 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) should be in accordance with the provisions and conditions that have been developed and which are set forth in the “Proposals” part of this document.

The said proposals correspond to Method A of Issue 1 and Option B of Issue 2 in the CPM Report.

ARTICLE 5

Frequency allocations

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

MOD RCC/12A6/1#49996

34.2-40 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 37.5-38 FIXED FIXED-SATELLITE (space-to-Earth) MOD 5.338А ADD 5.A16 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) ADD 5.A16 MOBILE Earth exploration-satellite (space-to-Earth) 5.547 |
| 39.5-40 FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.A16 MOBILE MOBILE-SATELLITE (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547 ADD 5.B16 |

**Reasons:** New RR No. **5.A16** in the band 37.5-40 GHz ensures, under RR No. **9.12**, implementation of the coordination procedure between non-GSO FSS systems. New RR No. **5.B16** in the band 39.5-40 GHz ensures, under RR No. **9.12**, implementation of the coordination procedure between non-GSO MSS and non-GSO FSS systems. RR footnote No. MOD **5.338A** in the band 37.5-38 GHz reflects the revision of Resolution **750 (Rev.WRC-15)**.

MOD RCC/12A6/2#49997

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 ADD 5.A16 MOBILE MOBILE-SATELLITE (space-to-Earth)  SPACE RESEARCH (Earth-to-space) Earth exploration-satellite (space-to-Earth) ADD 5.B16 |
| 40.5-41FIXEDFIXED-SATELLITE (space-to-Earth) ADD 5.A16BROADCASTINGBROADCASTING-SATELLITEMobile5.547 | 40.5-41FIXEDFIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.A16BROADCASTINGBROADCASTING-SATELLITEMobileMobile-satellite (space-to-Earth)5.547 | 40.5-41FIXEDFIXED-SATELLITE (space-to-Earth) ADD 5.A16BROADCASTINGBROADCASTING-SATELLITEMobile5.547 |
| 41-42.5 FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.A16 BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 5.551F 5.551H 5.551I |
| ... |
| 47.2-47.5 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.A16 MOBILE 5.552A |

**Reasons:** New RR No. **5.A16** in the bands 40-42.5 GHz and 47.2-47.5 GHz ensures, under RR No. **9.12**, implementation of the coordination procedure between non-GSO FSS systems. New RR No. **5.B16** in the band 40-40.5 GHz ensures, under RR No. **9.12**, implementation of the coordination procedure between non-GSO MSS and non-GSO FSS systems

MOD RCC/12A6/3#49998

47.5-51.4 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 47.5-47.9FIXEDFIXED-SATELLITE(Earth-to-space) 5.552 ADD 5.A16 (space-to-Earth) 5.516B 5.554A MOBILE | 47.5-47.9 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.A16 MOBILE |
| 47.9-48.2 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.A16 MOBILE 5.552A |
| 48.2-48.54FIXEDFIXED-SATELLITE(Earth-to-space) 5.552 ADD 5.A16(space-to-Earth) 5.516B5.554A 5.555BMOBILE | 48.2-50.2 FIXED FIXED-SATELLITE (Earth-to-space) 5.516B MOD 5.338A 5.552 ADD 5.A16 MOBILE |
| 48.54-49.44FIXEDFIXED-SATELLITE(Earth-to-space) 5.552 ADD 5.A16MOBILE5.149 5.340 5.555 |  |
| 49.44-50.2FIXEDFIXED-SATELLITE(Earth-to-space) MOD 5.338A 5.552 ADD 5.A16(space-to-Earth) 5.516B5.554A 5.555BMOBILE |  5.149 5.340 5.555 |
| ... |
| 50.4-51.4 FIXED FIXED-SATELLITE (Earth-to-space) MOD 5.338A ADD 5.A16 MOBILE Mobile-satellite (Earth-to-space) |

**Reasons:** New RR No. **5.A16** in the bands 47.5-50.2 GHz and 50.4-51.4 GHz ensures, under RR No. **9.12**, implementation of the coordination procedure between non-GSO FSS systems. RR footnote No. MOD **5.338A** in the bands 48.2-50.2 GHz and 50.4-51.4 GHz reflects the revision of Resolution **750 (Rev.WRC-15)**.

ADD RCC/12A6/4#49999

5.A16The 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 non‑geostationary‑satellite systems in the fixed-satellite service for which complete coordination information is received by the Bureau after [date of entry into force of the Final Acts of WRC-19] 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. There is no provision for coordination of non-geostationary-satellite systems in the fixed-satellite service with non-geostationary-satellite systems in other services. Non-geostationary-satellite systems in the fixed-satellite service in these frequency bands shall operate in accordance with new Resolution **[RCC/A16] (WRC‑19)**. Such use is subject to continued application of the provisions of No.**22.2**.     (WRC‑19)

**Reasons:** New RR No. **5.A16** in the bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz ensures, under RR No. **9.12**, implementation of the coordination procedure between non-GSO FSS systems.

ADD RCC/12A6/5#50004

5.B16The 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 by non‑geostationary-satellite systems in the fixed-satellite service (space-to-Earth) for which complete coordination information is received by the Bureau after [date of entry into force of the Final Acts of WRC-19], is subject to coordination underNo.**9.12**.     (WRC‑19)

**Reasons:** New RR No. **5.B16** in the bands 39.5-40 GHz and 40-40.5 GHz ensures, under RR No. **9.12**, implementation of the coordination procedure between non-GSO FSS and non-GSO MSS systems

MOD RCC/12A6/6#50006

5.338AIn the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 30‑31.3 GHz, 37.5-38 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-19)** applies.     (WRC-19)

**Reasons:** Footnote MOD 5.338A reflects the revision of Resolution **750 (Rev.WRC-15)**.

ARTICLE 22

Space services1

Section II − Control of interference to geostationary-satellite systems

ADD RCC/12A6/7#50007

22.5L9) Administrations operating or planning to operate non-geostationary-satellite systems 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 ensure that the single-entry interference from all space or earth stations of each non-geostationary-satellite system in the fixed-satellite service does not exceed 3% of the time allowance for the *C*/*N* value specified in the short-term performance objective, while for systems using adaptive coding and modulation the reduction in the long-term time-averaged spectral efficiency indicator shall not exceed 3%, by applying the provisions of Resolution [**RCC/A16**] (**WRC-19**).      (WRC‑19)

**Reasons:** New RR provision No. **22.5L** for the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz introduces into RR Article **22**, for each non-GSO FSS system, a permissible single-entry interference criterion that will verified by the Radiocommunication Bureau at the stage of examination of notices for non-GSO FSS satellite networks pursuant to the provisions of RR Articles **9** and **11**.

ADD RCC/12A6/8#50008

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 (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 ensure that the aggregate interference to geostationary networks in the fixed-satellite service and broadcasting-satellite service from all non-geostationary-satellite systems in the fixed-satellite service does not exceed 10% of the allowance for degradation of the short-term and long-term performance objectives, by applying the provisions of Resolution [**RCC/A16**] (**WRC-19**).      (WRC‑19)

**Reasons:** New RR provision No. **22.5M** for the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz introduces into RR Article **22** a limit for permissible aggregate interference from all non-GSO FSS systems operating on the same frequency in the frequency bands under consideration. Administrations shall, in collaboration and in accordance with the new WRC Resolution, take all necessary steps to ensure that the aggregate interference to GSO FSS/BSS networks from non-GSO FSS systems operating on the same frequency in the frequency bands under consideration, does not exceed the level specified in new RR provision No. **22.5M** and new Resolution [**RCC/A16**] (**WRC-19**).

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations1, 2, 3, 4, 5, 6, 7, 8, 9    (WRC‑19)

Section II − Procedure for effecting coordination12, 13

Sub-Section IIA − Requirement and request for coordination

MOD RCC/12A6/9#50009

9.35 *a)* examine that information with respect to its conformity with No. 11.31MOD 19;     (WRC‑19)

MOD RCC/12A6/10#50010

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MOD 19 9.35.1The 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** of Article **22,** or the single-entry limits in No. **22.5L** of Article **22**, as applicable,in the publication under No. **9.38**.     (WRC‑19)

**Reasons:** The modification of RR No. **9.35.1** introduces a procedure for publication in the International Frequency Information Circular (BR IFIC) of the results of the Radiocommunication Bureau’s examination of notices for non-GSO FSS satellite networks in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth) and 47.2-50.2 GHz (Earth-to-space) to determine compliance with the criteria of No. **22.5L** of RR Article **22**.

ADD RCC/12A6/11#50011

draft new RESOLUTION [RCC/A16] (WRC‑19)

Protection of geostationary FSS and BSS networks from 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 (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) 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 (space-to-Earth) and 40-40.5 GHz (space-to-Earth) 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 geostationary-satellite orbit (GSO) and non-geostationary-satellite orbit (non-GSO) FSS systems in these bands in *considering* *a)*;

*e)* that, in accordance with No. **22.2**, non-GSO systems shall not cause unacceptable interference to GSO FSS and BSS networks and, unless otherwise specified in the Radio Regulations, shall not claim protection from GSO FSS and GSO BSS satellite networks;

*f)* that administrations planning to operate non-GSO FSS systems require quantification of technical regulatory measures required for protection of GSO FSS and GSO BSS satellite networks operating in the bands referred to in *considering* *a)*, *b)* and *c)* above;

*g)* that the operating parameters and orbital characteristics on non-GSO FSS systems are usually inhomogeneous and that, therefore, 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 long-term decrease of the throughput (indicator of spectral efficiency) caused to reference GSO FSS and GSO BSS links by non-GSO FSS systems will vary according to the parameters of such systems;

*h)* that the aggregate interference from multiple non‑GSO FSS systems depends on the number of non-GSO FSS systems sharing a frequency band;

*i)* that to protect GSO FSS and GSO BSS networks in the frequency bands listed in *considering* *a)* from unacceptable interference, the single-entry impact from any one non-GSO FSS system shall not exceed the impact specified in No. **22.5L** of the Radio Regulations, and the aggregate impact caused by all co-frequency non-GSO FSS systems shall not exceed the aggregate impact limit specified in No. **22.5M** of the Radio Regulations;

*j)* that to achieve the required level of protection of GSO FSS and GSO BSS reference links, administrations operating or planning to operate non-GSO FSS systems will need to agree cooperatively;

*k)* that the aggregate value 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 FSS and BSS reference links is the summation of the time allowance values for single-entry interference caused by non-GSO FSS systems,

recognizing

*a)* that non-GSO FSS systems may need to implement interference mitigation techniques, such as earth station site diversity and offsetting of the antenna’s main beam axis from the GSO arc, to facilitate sharing of frequencies among non-GSO FSS systems and to protect GSO FSS and GSO BSS networks;

*b)* that administrations operating or planning to operate non-GSO FSS systems shall agree cooperatively through consultation meetings to share the aggregate interference allowance for all non-GSO FSS systems sharing the frequency bands listed in *considering* *a)* in order to achieve the desired level of protection for GSO FSS and GSO 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 a summation of the time allowance for each single entry from each system;

*d)* 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, and that it is therefore desirable for GSO networks and non-GSO FSS systems to implement fade counter measures such as automatic signal level control, power control and adaptive coding and modulation,

noting

that Recommendation ITU‑R S.1503 provides guidance on how to compute the epfd levels from a non-GSO system into earth stations and satellites in the GSO,

resolves

1 that for the purposes of examining the frequency assignments to a non-GSO FSS satellite system 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) under Nos. **9.35** and **11.31**, as appropriate, the methodology given in Annex 2 to this Resolution and the technical characteristics of typical GSO FSS and GSO BSS reference links contained in Annex 1 shall be used;

2 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 the characteristics of their systems or networks, to ensure that the aggregate interference impact to geostationary FSS and BSS satellite networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate protection limit – that is, 10% 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 FSS and GSO BSS reference link and the decrease in the long-term one-year time-averaged spectral efficiency indicator for links using adaptive coding and modulation by more than 10%, as determined pursuant to No. **22.5M** of the Radio Regulations;

3 that to carry out the obligations in *resolves*2 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 FSS networks do not exceed the aggregate level of protection for geostationary satellite networks;

4 that to carry out the obligations in resolves 3 above, when applying the methodology set out in Annex 2 to this Resolution and using the results of the calculation of aggregate impact to GSO FSS and GSO BSS networks, account shall be taken of the technical characteristics of typical GSO FSS and GSO BSS reference links contained in Annex 1 to this Resolution;

5 that in the consultation meetings held pursuant to *resolves* 3 above, only those non-GSO FSS systems that meet the criteria listed in Annex 4 to this Resolution shall be taken into account;

6 that administrations, in developing agreements under *resolves*2 above, shall establish mechanisms to ensure that the examination and decision-making process is transparent for all potential notifying administrations and operators of FSS and BSS systems and networks;

7 that non-participation in the consultation process by an administration operating or planning to operate a non-GSO FSS system in the frequency bands referred to in *considering a)* above does not relieve it of its obligations under *resolves* 2 above;

8 that administrations participating in consultation discussions as referred to in *resolves*3 shall designate one convener to be responsible for informing the Bureau, as indicated in Annex 3, of the results of the calculation of the aggregate value for operational non-GSO FSS systems and determination of the sharing conditions for aggregate interference pursuant to *resolves* 2 above, irrespective of whether or not such determination has resulted in any changes in the declared characteristics of their respective systems, as well as for providing a draft record of each consultation meeting and publishing the approved record;

invites the Radiocommunication Bureau

to participate in the consultation meetings in *resolves* 3 as an observer and to provide advice as necessary with respect to the results of the aggregate interference impact calculation performed according to *resolves*2,

instructs the Radiocommunication Bureau

1 to publish in the International Frequency Information Circular (BR IFIC), the information referred to in *resolves*8;

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 [rcc/A16] (WRC-19)

List of geostationary-satellite network reference characteristics to be used in the determination of compatibility between GSO FSS and GSO BSS networks and non-GSO FSS 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)

# I Reference characteristics of GSO FSS and GSO BSS networks for verifying compliance with the conditions of *resolves* 1 and 2

The data in Annex 1 are to be seen as a list of reference technical characteristics of typical GSO FSS and BSS links, to be used solely for assessing the impact of interference from non-GSO FSS systems on GSO FSS and GSO BSS satellite networks, and not as a basis for coordination between satellite networks.

Table 1

Typical reference parameters of GSO FSS and BSS links for use in assessing the impact of interference from the space-to-Earth link of any non-GSO FSS network

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **1** | **Reference parameters of the link** |  |  |  |  |  |
|  | Type of link | User #1 | User #2 | User #3 | Gateway |  |
| 1.1 | Frequency range (GHz) | 40 | 40 | 40 | 40 |  |
| 1.2 | e.i.r.p. density (dB(W/MHz)) | 44 | 44 | 44 | 44 |  |
| 1.3 | Earth station antenna diameter (m) | 0.45 | 0.6 | 2 | 9 |  |
| 1.3 | Bandwidth (MHz) | 1 | 1 | 1 | 1 |  |
| 1.4 | Earth station antenna radiation pattern | S.1428 | S.1428 | S.1428 | S.1428 |  |
| 1.5 | Earth station antenna efficiency | 0.65 | 0.65 | 0.6 | 0.55 |  |
| 1.6 | Additional link losses (dB) | 1 | 1 | 1 | 1 |  |
| 1.7 | Additional link margin (dB) | 3 | 3 | 3 | 3 |  |
|  |  |
| **2** | **Reference link parameters – Parametric analysis** | **Parametric cases for assessment** |  |
| 2.1 | Change in e.i.r.p. density | ±3 dB relative to the value in 1.2 |  |
| 2.2 | Earth station antenna elevation (degrees) | 20, 55, 90 |  |
| 2.3 | Rainfall rate (0.01% (mm/h) | 10, 50, 100 |  |
| 2.4 | Earth station altitude (m) | 0, 500, 1 000 |  |
| 2.5 | Earth station noise temperature (K) | 250, 300 |  |
| 2.6 | *C*/*N* threshold (dB) | −2.5, 7, 12 |  |
|  |  |
| **3** | **Example of implementation – Link calculation** | **First parametric case, taken as an example** | **Equations for calculating downlink availability** |
| 3.1 | Maximum gain of earth station antenna (dBi) | 43.6 | 46.1 | 56.2 | 68.9 |  |
|  | *Intermediate step: calculate the latitude corresponding to the inclination, ε* |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 3.2 | Path length (km) | 39 554.4 | 39 554.4 | 39 554.4 | 39 554.4 |  |
| 3.3 | Path loss (dB) | 216.4 | 216.4 | 216.4 | 216.4 |  |
| 3.4 | Power of wanted signal without precipitation attenuation (dB(W/MHz)) | −129.8 | −127.3 | −117.2 | −104.5 |  |
| 3.5 | Noise plus link margin (dB(W/MHz)) | −141.6 | −141.6 | −141.6 | −141.6 |  |
|  |
| **4** | **Verifications** |  |
| 4.1 | Reserve for precipitation loss (dB) | 14.3 | 16.8 | 26.9 | 39.6 |  |
| 4.2 | *pfdverif* (dB(W/(m2 ⸱ MHz)) | −118.9 | −118.9 | −118.9 | −118.9 |  |
| 4.3 | Reserve relative to RR Article 21 levels | −11.4 | −11.4 | −11.4 | −11.4 |  |

The following verifications are carried out to determine the acceptability (repeatability) of combinations of the parametric analysis of the reference links:

1) The antenna diameter, D, must lie in the range 0.16 m ≤ D ≤ 9 m

2) The fading margin in the hydrometeors must be greater than zero Arain > 0

3) The calculated unavailability, p, must lie in the range 0.001 ≤ p ≤ 10%

4) The pfd levels must be lower than the limits given in RR Article 21

Table 2

Typical reference parameters of GSO FSS and BSS links for use in assessing the impact of interference from the Earth-to-space link of any non-GSO FSS network

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **1** | **Reference parameters of the link** |  |  |  |  |
|   | Type of link | Link #1 | Link #2 | Link #3 |  |
| 1.1 | Frequency range (GHz) | 48 | 48 | 48 |  |
| 1.2 | Earth station e.i.r.p. spectral density (dBW/Hz) | 0 | −5 | −10 |  |
| 1.3 | Size of satellite beam (degrees) | 0.2 | 0.2 | 0.3 |  |
| 1.4 | Side-lobes level pursuant to ITU-R S.672 (dB) | −25 | −25 | −25 |  |
| 1.5 | Antenna efficiency | 0.6 | 0.6 | 0.6 |  |
| 1.6 | Additional link losses (dB) | 1 | 1 | 1 |  |
| 1.7 | Additional link margin (dB) | 3 | 3 | 3 |  |
|  |  |
| **2** | **Reference link parameters – Parametric analysis** | **Parametric cases for assessment** |  |
| 2.1 | Change in e.i.r.p. density | ±3 dB relative to the value in 1.2 |  |
| 2.2 | Elevation angle (degrees) | 20, 55, 90 |  |
| 2.3 | Rainfall rate (0.01% (mm/h) | 10, 50, 100 |  |
| 2.4 | Earth station altitude (m) | 0, 500, 1 000 |  |
| 2.5 | Earth station noise temperature (K) | 750, 1000 |  |
| 2.6 | *C*/*N* threshold (dB) | −2.5, 7, 12 |  |
|  |  |
| **3** | **Example of implementation – Link calculation** | **First parametric case, taken as an example** | **Equations for calculating uplink availability** |
| 3.1 | Maximum gain of earth station antenna (dBi) | 58.6 | 58.6 | 55.1 |  |
|  | *Intermediate step: calculate the latitude corresponding to the inclination, ε* |  |  |  |  |
|  |  |  |  |  |  |
| 3.2 | Path length (km) | 39 554.4 | 39 554.4 | 39 554.4 |  |
| 3.3 | Path loss (dB) | 218.0 | 218.0 | 218.0 |  |
| 3.4 | Power of wanted signal without precipitation attenuation (dB(W/MHz)) | –100.4 | –105.4 | –113.9 |  |
| 3.5 | Noise plus link margin (dB(W/MHz)) | –136.8 | –136.8 | –136.8 |  |
|  |
| **4** | **Verifications** |  |
| 4.1 | Reserve for precipitation loss (dB) | 38.9 | 33.9 | 25.4 |  |

The following verifications are carried out to determine the acceptability (repeatability) of combinations of the parametric analysis of the reference links:

1) The fading margin in the hydrometeors must be greater than zero Arain > 0

2) The calculated unavailability, p, must lie in the range 0.001 ≤ p ≤ 10%

ANNEX 2 TO draft new RESOLUTION [RCC/A16] (WRC-19)

Description of parameters and procedures for evaluating interference from a non-GSO FSS system with respect to GSO FSS and GSO BSS reference links

# I Methodology for determining whether the non-GSO FSS system meets the requirements of *resolves* 1 and 2 in terms of the maximum permissible level of interference to GSO FSS and GSO BSS networks

Annex 2 describes the process for verifying the level of the single-entry interference from a non-GSO FSS into GSO FSS and GSO BSS for compliance with the permissible values, using the GSO FSS and GSO BSS network reference characteristics given in Annex 1, and the worst-case interference geometry (WCG) calculated on the basis of the latest version of Recommendation ITU‑R S.1503. The procedure for determining compliance with the permissible single-entry interference is based on the following principles.

Principle 1: Two time-varying sources of qualitative degradation in the parameters of the GSO FSS and BSS reference link that are taken into account in the verification are line attenuation (caused by rain, cloud, atmospheric gases and scintillation) and interference from other FSS or BSS networks.

The overall *C*/*N* ratio in the reference frequency band for a given carrier is:

 *C*/*N* = *C*/*NT* + I (1)

where:

 *C*: wanted power (W) in the reference bandwidth, which changes as a function of signal fading;

 *NT* : total system noise (W) in the reference bandwidth (i.e. thermal noise power);

 I : time-varying interference power (W) in the reference bandwidth caused by other networks

Principle 2: Spectral efficiency is calculated in the case of satellite systems using adaptive coding and modulation (ACM). This involves calculating throughput degradation as a function of *C*/*N*, which varies according to long-term propagation and the impact of interference on the satellite link.

Principle 3: During a fade event on the downlink, the interfering signal is attenuated by the same amount as the wanted signal.

The following steps are taken to determine the impact from the non-GSO FSS system on the availability and spectral efficiency of the GSO FSS and GSO BSS link. The reference parameters of the GSO FSS and GSO BSS links from Annex 1 are used with account being taken of all possible combinations of parametric analysis together with calculation of the epfd for the worst-case interference geometry (WCG) pursuant to Recommendation ITU-R S.1503. The reference characteristics in Annex 1 are used to create a global set of representative GSO FSS and GSO BSS link budgets. The result of the analysis pursuant to Recommendation ITU-R S.1503 is a set of statistical data on the interference caused by the non-GSO FSS system to each representative GSO FSS and GSO BSS link for all possible combinations of parametric analysis.

For each reference GSO FSS and GSO BSS link with all possible combinations of parametric analysis in accordance with Annex 1:

*Step 1*: Determine *xfade*, the probability distribution function (pdf) for wanted signal attenuation as a result of losses in the hydrometeors. These statistical data can be calculated using the procedures in the latest version of Recommendation ITU-R P.618.

*Step 2*: Determine *yint*, the impact of the interference on the reference GSO FSS and GSO BSS link from the considered non-GSO FSS system, using the procedures of Recommendation ITU-R S.1503.

*Step 3*: Determine *zconv*, the discrete convolution of the probability distribution function for degradation of the wanted signal due to rain pdf (*xfade*) with the probability distribution function for degradation of the wanted signal due to the impact of interference pdf (*yint*). For each pair of values X and Y from the multiplicity of xfade and yint, respectively, the resulting degradation value based on the convolution is determined as the product of degradation values xfade(X) and yint(Y) (this being equivalent to the sum of the logarithmic values in dB), and the combined probability, calculated as a product of the individual probabilities, is added to the corresponding convolution, zconv(Z).

Inasmuch as the assumption as to statistical independence between the degradation in wanted signal due to rain (xfade) and the degradation due to interference (yint) does not take account of the impact of propagation effects in the interfering link, a modification of the classical convolution is taken into account in the downlink. This modified convolution is equivalent to a regular discrete convolution except for the fact that the values of the degradation due to interference (yi) initially decrease through account being taken of the applicable attenuation of the interfering signal in rain, i.e. of the jth value of losses in rain (LR)j, from the corresponding discrete probability distribution function for degradation due to rain (xj).

The probability distribution function (pdf) zconv is a modified convolution for xfade and yint. Thus, the total *C*/*N* degradation, dB (zconv) is:

 *zconv* = *xfade* \* *yint*. (2)

*Step 4*: Using the results of the modified convolution procedures described above for obtaining the probability distribution function zconv, the total degradation of the wanted signal due to losses in the hydrometeors, xfade, and to the impact of interference from the non-GSO FSS system (yint), for single-entry interference, may be verified as follows:

 pz(zconv) = pxfade \* pyint (3)

The conditions for verification of compliance are:

 U(R+I)≤ 1.03 × U(R) (4)

where U(R + I) denotes unavailability of the reference link due to rain and interference, and U(R) denotes unavailability due only to rain.

For performance indicators of the reference links of GSO FSS systems using adaptive coding and modulation and associated with spectral efficiency (SE):

 (SE*xfade* – SE*zconv*)/SE*xfade*  0.03 (5)

where SExfade denotes the operational throughput of the GSO FSS link achieved in the presence of fading due to propagation in hydrometeors over a period of one year, and where SEzconv denotes the throughput of the GSO FSS link achieved in the presence of the combined impact of fading due to propagation and interference over one year. These equations represent conditions which have to be verified in order to guarantee that the percentage degradation in throughput caused by interference does not exceed a certain threshold by comparison with the degradation in throughput caused by the propagation conditions over an extended period of operation.

This procedure is to be repeated for each reference GSO FSS and GSO BSS link for all possible combinations of parametric analysis in accordance with Annex 1.

ANNEX 3 TO draft new RESOLUTION [rcc/A16] (WRC-19)

Format for the results of the aggregate interference calculation to be provided to BR for publication for information purposes

# I GSO FSS and GSO BSS network characteristics to be used in the calculation of the aggregate interference level from non-GSO FSS systems

**I-1 GSO FSS and GSO BSS network characteristics**

Annex 1

**I-2 Non-GSO FSS satellite system constellation parameters**

For each non‑GSO FSS satellite system, the following parameters should be provided to BR for publication of the aggregate interference level calculation:

– notifying administration;

– number of space stations used in the aggregate calculation;

– single-entry contribution to the aggregate of each non-GSO FSS system.

# II Results of the aggregate epfd calculation

To carry out the obligations set out in *resolves* 2, administrations participating in the consultation process shall perform calculations of the impact of aggregate interference on GSO FSS and GSO BSS networks with the aid of software agreed upon by the consultation meeting, as well as any software tools used by BR, using the methodology contained in Annex 2 to this Resolution and the characteristics of the reference GSO FSS and GSO BSS links listed in Annex 1 to this Resolution.

ANNEX 4 TO draft new RESOLUTION [RCC/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 guaranteedfunding 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.

**Reasons:** The new WRC Resolution contains procedures and a methodology for verifying the criteria in respect of single-entry and aggregate interference caused by non-GSO FSS systems 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, for the reference links of GSO FSS and GSO BSS networks.

MOD RCC/12A6/12#50013

RESOLUTION 750 (Rev.WRC‑19)

Compatibility between the Earth exploration-satellite service (passive) and relevant active services

…

TABLE 1-1

| EESS (passive) band | Activeservice band | Active service | Limits of unwanted emission power fromactive service stations in a specified bandwidthwithin the EESS (passive) band1 |
| --- | --- | --- | --- |
| 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 stations2, 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 |
| 36-37 GHz | 37.5-38 GHz | Fixed-satellite (non-geostationary systems)(space-to-Earth) | For space stations operating in non-GSO systems with an apogee lower than 700 km, brought into use after [the date of entry into force of the Final Acts of WRC-19]: epfd −34 dBW in 100 MHz of the EESS (passive) band above an angle of −18.6° |
| 50.2-50.4 GHz | 49.7-50.2 GHz | Fixed-satellite(Earth-to-space)4 | For 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 dBiFor stations operating in non-GSO systems and brought into use after [the date of entry into force of the Final Acts of WRC‑19]:−48.7  dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi;−51.3 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBiFor stations operating in GSO systems and brought into use after [the date of entry into force of the Final Acts of WRC‑19]:−37 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi and an elevation angle lower than 80°;−52 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi and an elevation angle equal to or greater than 80°;−58.1 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi |
| 50.2-50.4 GHz | 50.4-50.9 GHz | Fixed-satellite(E‑to‑s)4 | For 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 dBiFor stations operating in non-GSO systems and brought into use after [the date of entry into force of the Final Acts of WRC‑19]:−48.7  dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi;−51.3 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBiFor stations operating in GSO systems and brought into use after [the date of entry into force of the Final Acts of WRC‑19]:−37 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi and an elevation angle lower than 80°;−52 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi and an elevation angle equal to or greater than 80°;−58.1 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 |

**Reasons:** The modifications to Resolution **750 (Rev.WRC-15)** establish limits for unwanted emission power in the 50.2-50.4 GHz EESS (passive) band from non-GSO and GSO FSS (Earth-to-space) stations operating in the adjacent bands 49.7-50.2 GHz and 50.4-50.9 GHz. The modifications to Resolution **750 (Rev.WRC-15)** also establish limits for unwanted emissions from non-GSO FSS space stations with an apogee less than 700 km, operating in the frequency band 37.5-38 GHz, to protect EESS (passive) systems in the band 36-37 GHz.

SUP RCC/12A6/13

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)

**Reasons:** Consequential suppression of Resolution **159 (WRC-15)**.

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