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| --- | --- |
| **World Radiocommunication Conference (WRC-19)Sharm el-Sheikh, Egypt, 28 October – 22 November 2019** |  |
|  |  |
|  | PTB(19)081 ANNEX V-06 |
| PLENARY MEETING | **Addendum 6 toDocument XXX-E** |
|  | **Date** |
|  | **Original: English** |
|  |
| European 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

Studies in CEPT reviewed technical, operational issues and regulatory provisions for non-geostationary fixed-satellite service systems in the 50/40 GHz frequency range.

CEPT studies have shown that in the 50/40 GHz frequency bands propagation impairments can substantially affect FSS satellite links. To account for the differences in propagation from lower frequency bands, a new ITU-R Resolution on sharing criteria for FSS systems in the 50/40 GHz frequency bands is being developed in parallel with the studies associated with this agenda item.

Multiple sharing studies have been conducted on sharing between non-GSO and GSO FSS networks. The results of these studies showed that it is possible to achieve compatibility in the 50/40 GHz band by FSS systems that would allow non-GSO systems to operate while ensuring protection to GSO satellite networks in the FSS, MSS, and BSS.

CEPT studies of compatibility between non-GSO FSS systems and EESS (passive) have shown that the limits currently in Resolution **750 (WRC-15)** are not sufficient for the protection of EESS (passive) in the adjacent band 50.2-50.4 GHz. These studies show that an unwanted emission limit of -51.3 dBW/200 MHz for non-GSO FSS user equipment, -48.7 dBW/200 MHz for non-GSO gateways would be required to meet the EESS (passive) protection criteria in Recommendation ITU-R RS.2017, taking into account an apportionment of 3 dB.

CEPT studies of compatibility between GSO FSS systems and EESS (passive) have shown that the limits currently in Resolution **750 (WRC-15)** are not sufficient for the protection of EESS (passive) in the adjacent band 50.2-50.4 GHz. These studies show that an unwanted emission limit of -58.1 dBW/200 MHz for GSO FSS user equipment and --37 dBW/200 MHz for GSO gateways with elevation angles lower than 80° and -52 dBW/200 MHz for GSO gateways with elevation angles higher or equal to 80° would be required to meet the EESS (passive) protection criteria in Recommendation ITU-R RS.2017, taking into account an apportionment of 3 dB.

This studies have also shown that the Out-Of-Band emission mask contained in Recommendation ITU-R SM.1541 would not be sufficient to ensure the protection of EESS (passive) in the band 36 – 37 GHz when considering constellations of more than 1000 satellites which altitude is below the EESS (passive) satellite altitude. The unwanted emission e.i.r.p. limit radiated by NGSO FSS satellites towards space (i.e. above -18.6° elevation for satellites at 350 km altitude) would be -34 dBW/100 MHz considering no apportionment.

Based on the sharing studies results CEPT proposes a method to satisfy this agenda item which includes the following modifications to the Radio Regulations: PART I

**Option 1**

* Include a new footnote No. **5.A16** in order to address the coordination between non-GSO FSS systems under RR No. **9.12** of the subject frequency bands;
* Add a new footnote in the frequency band 39.5-40.5 GHz in all Regions to address the coordination between MSS and non-GSO FSS systems under RR No. **9.12**;
* Use the Recommendation ITU-R S1503 to calculate the levels of interference from non-GSO satellite systems;
* Modify RR Article **22** to include single-entry limits in terms of degradation of availability and throughput in order to protect GSO FSS satellite networks in the 50/40 GHz frequency bands from non-GSO FSS systems operating in the subject frequency ranges;
* Modify RR Article **22** to include aggregate limits in terms of availability and throughput in order to protect GSO FSS satellite networks from multiple non-GSO FSS systems operating in the subject frequency ranges and develop a new WRC Resolution providing the procedure to ensure that aggregate limits will not be exceeded;
* Develop a new Resolution containing generic GSO Reference Links and calculation procedures, , which will be used to verify the compliance of non-GSO systems with single-entry and aggregate limits;

**Option 2**

* Bullets of Option 1;
* Modify RR Article **22** to include a provision for multiple performance objectives and include a provision to take into account supplemental links contained in Resolution in order to take into account the development of GSO satellite networks and operational capabilities of future operational GSO satellite networks

**Option 3**

Explanatory note: This option was submitted to CPG PTB as a compromise between OPTION 1 and OPTION 2. Consideration of multiple performance objectives in **22.5L** would require extensive modifications to existing recommendation ITU-R S.1503. This compromise is therefore based on the premise that multiple performance objectives are not evaluated in the single entry calculation in **22.5L**, but can be considered by supplemental links in **22.5N**.

* Bullets of Option 1;
* Modify RR Article **22** to include a provision for a BR database of supplemental links in order to take into account the continued development of GSO satellite networks and operational capabilities of future operational GSO satellite networks

PART II.

Option A

* Modify Resolution **750 (Rev.WRC-15)** to include unwanted emission power limits in order to protect EESS systems from non-GSO and GSO FSS systems operating in the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz.

Option B

* Modify Resolution **750 (Rev.WRC-15)** to include unwanted emission power limits in order to protect EESS systems from non-GSO FSS systems operating in the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz.

Option C

* Postpone modification of Resolution **750 (Rev.WRC-15)** to WRC-23 for 50.2-50.4 GHz band.

Proposals

PART I.

Option 1, 2, 3

ARTICLE 5

Frequency allocations

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

MOD EUR/XXXA6/1

34.2-40 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 37.5-38 FIXED FIXED-SATELLITE (space-to-Earth) 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:** Add a new footnote 5.A16 to address the coordination between non-GSO FSS systems under RR No. **9.12.** Add a new footnote 5.B16 in the frequency band 39.5-40.5 GHz in all Regions to address the coordination between MSS and non-GSO FSS systems under RR No. **9.11A**.

MOD EUR/XXXXA6/2

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 |
| 42.5-43.5 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE except aeronautical mobile RADIO ASTRONOMY 5.149 5.547 |
| 43.5-47 MOBILE 5.553 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554 |
| 47-47.2 AMATEUR AMATEUR-SATELLITE |
| 47.2-47.5 FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.A16 MOBILE 5.552A |

**Reasons:** Add a new footnote 5.A16 to address the coordination between non-GSO FSS systems under RR No. **9.12.** Add a new footnote 5.B16 in the frequency band 39.5-40.5 GHz in all Regions to address the coordination between MSS and non-GSO FSS systems under RR No. **9.11A**.

MOD EUR/XXXXA6/3

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 5.554AMOBILE | 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 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) 5.338A 5.552 ADD 5.A16(space-to-Earth) 5.516B5.554A 5.555BMOBILE |  5.149 5.340 5.555 |
| 50.2-50.4 EARTH EXPLORATION-SATELLITE (passive) SPACE RESEARCH (passive) 5.340 |
| 50.4-51.4 FIXED FIXED-SATELLITE (Earth-to-space) 5.338A ADD 5.A16 MOBILE Mobile-satellite (Earth-to-space) |

**Reasons:** Add a new footnote **5.A16** to address the coordination between non-GSO FSS systems under RR No. **9.12.**

ADD EUR/XXXA6/4

5.A16 The use of the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space‑to‑Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by a non‑geostationary‑satellite system in the Fixed Satellite Service is subject to the application of the provisions of No. **9.12** for coordination with other non-geostationary satellite systems in the Fixed Satellite Service, , but not with non-geostationary satellite systems in other services.     (WRC-19)

**Reasons:** Add RR footnote No. 5.A16 to include the subject frequency bands in order to address the coordination between non-GSO FSS systems under No. **9.12**.

ADD EUR/XXXA6/5

5.B16 The use of the frequency bands 39.5-40 and 40-40.5 GHz by the non-geostationary satellite-systems in the mobile-satellite service (space-to-Earth) and non‑geostationary-satellite systems in the Fixed Satellite Service (space-to-Earth) is subject to coordination under No. **9.12**, but not with non-geostationary satellite systems in other services.(WRC-19)

**Reasons:** Resolution **159 (WRC-15)** resolves to conduct studies of regulatory provisions for the operation of non-GSO FSS satellite systems, while ensuring protection of GSO satellite networks in the FSS, MSS and BSS. The protection of GSO satellite networks in the FSS and BSS is provided by applying the limitations of Article **22** of the RR. In order to cover MSS case it is proposed to address the coordination between MSS and non-GSO FSS systems under No. **9.12**.

Option 1:

ARTICLE 22

Space services1

Section II − Control of interference to geostationary-satellite systems

ADD EUR/XXXXA6/6

22.5L 9) A non-geostationary-satellite system in the fixed-satellite service in the frequency bands 37.5-39.5, 39.5-42.5, 47.2-50.2, and 50.4-51.4 GHz shall not exceed:

* a single-entry increase of 3% of time allowance for the C/N values associated with the shortest percentage of time specified in the short-term performance objectives of the generic GSO reference links; and
* a single-entry permissible allowance of at most 3% reduction in time average spectral efficiency calculated on an annual basis of the generic GSO reference links long term performance relative to the long term maximum achievable throughput in the presence of propagation calculated on an annual basis

The calculation procedures given Resolution [EUR-A16-SingleEntry] shall apply.

**Reasons:** Updates to the provision to calculate the maximum permissible interference from a non-GSO satellite system based on the probability density function issued from Recommendation ITU-R S.1503.

ADD EUR/XXXA6/7

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 GSO FSS and BSS networks caused by all non-GSO FSS systems operating in these frequency bands does not exceed 10% of the short-term and long-term performance objectives of GSO satellite networks by applying the provisions of Resolution **[EUR-A16-AGG.SHARING] (WRC-19)**. (WRC-19)

**Reasons:** Modify RR Article **22** to include aggregate unavailability and decreased capacity limits for multiple non-GSO FSS systems of 10% to protect GSO networks in these bands.

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 EUR/XXXXA6/9

9.35 *a)* examine that information with respect to its conformity with No. 11.31MOD**19**; (WRC‑2019)

**Reasons:**

MOD EUR/XXXXA6/10

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-** or the applicable single entry limits in No. **22.5L** of Article **22** in the publication under No. **9.38**.      (WRC‑2019)

**Reasons:** Resolution **159 (WRC-15)** resolves to conduct studies of regulatory provisions for the operation of non-GSO FSS satellite systems, while ensuring protection of GSO satellite networks in the FSS, MSS and BSS. In order to cover FSS and BSS cases it is proposed to address this issue by Bureau examination of NGSO filings on the criteria presented in in **22.5L**.

ADD EUR/XXXA6/11

**DRAFT NEW RESOLUTION [EUR-A16-SingleEntry] (WRC-19)**

Application of Article 22 of the Radio Regulations to the Protection of Geostationary Fixed-Satellite Service and Broadcasting-Satellite Service Networks from Non-Geostationary Fixed-Satellite Service 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

The World Radiocommunication Conference (2019),

considering

*a)* that geostationary (GSO) and non-geostationary (non-GSO) fixed-satellite service (FSS) networks may operate 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;

recognizing

a) that, in accordance with calculations utilizing Recommendation ITU-R S.1503, the verification of the global epfd interference of a non-GSO system can be carried out by a set of representative link budgets having characteristics that encompass worldwide GSO network deployments that are independent of any specific geographic locations;

 *resolves*

1 that during the examination under Nos. **9.35** and **11.31**, as applicable, of a non-GSO FSS satellite system with frequency assignments 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 representative technical characteristics of generic GSO satellite networks contained in Annex 1 shall be used in conjunction with the methodology in Annex 2 to establish compliance with No. ***22.5L***;

2 that notified frequency assignments to non-GSO FSS systems shall receive either a favourable finding or an unfavourable finding following the examination under No. **9.35** or  **11.31**, as applicable, with respect to the single-entry operating provisions given in ***22.5L***,

ANNEX 1 TO RESOLUTION [EUR-A16-SingleEntry ] (WRC-19)

Generic GSO satellite system characteristics for evaluation of compliance with single-entry requirements for non-GSO systems

The data in Annex 1 are to be regarded as a generic range of representative technical characteristics of GSO networks deployments that are independent of any specific geographic location, to be used only for establishing the interference impact of a non-GSO system into GSO satellite networks and not as a basis for coordination between satellite networks.

Table 1: Generic link parameters of GSO links to be used in examination of the downlink (space-Earth) impact from a non-GSO network

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Generic Link Parameters = service |  |  |  |  |  |
|  | Link type | User #1 | User #2 | User #3 | Gateway |  |
| 1.1 | Frequency band (GHz) | 40 | 40 | 40 | 40 |  |
| 1.2 | e.i.r.p. density (dBW/MHz) | 44 | 44 | 44 | 44 |  |
| 1.3 | Dish size (m) | [0.16] | 0.6 | 2 | 9 |  |
| 1.3 | Bandwidth (MHz) | 1 | 1 | 1 | 1 |  |
| 1.4 | ES antenna gain pattern | S.1428 | S.1428 | S.1428 | S.1428 |  |
| 1.5 | ES 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** | **Generic Link Parameters -Parametric Analysis** | **Parametric Cases for Evaluation** |  |
| 2.1 | e.i.r.p. density variation | ± 3 dB from value in 1.2 |  |
| 2.2 | Elevation angle (deg) | 20, 55, 90 |  |
| 2.3 | 0.01% Rain Rate (mm/hr) | 10, [25], 50, 100 |  |
| 2.4 | Height of ES (m) | 0, 500, 1000 |  |
| 2.5 | ES noise temperature (K) | [250, 300] |  |
| 2.6 | Threshold C/N (dB) | [-2.5, 7, 12] |  |
|  |  |
| **3** | **Example Implementation – Link Calculation** | **First Case parametric taken for examples** | **Equations to Calculate Downlink Availability** |
| 3,1 | ES Peak gain (dBi) | 34.7 | 46.1 | 56.2 | 68.9 |  |
|  | *Interim step: calculate the latitude corresponding with the elevation, ε* |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 3.2 | Path length (km) | 39554.4 | 39554.4 | 39554.4 | 39554.4 |  |
| 3.3 | Path loss (dB) | 216.4 | 216.4 | 216.4 | 216.4 |  |
| 3.4 | Unfaded wanted single strength (dBW/MHz) | -138.8 | -127,3 | -117.2 | -104.5 |  |
| 3.5 | Noise plus margin (dBW/MHz) | -141.6 | -141.6 | -141.6 | -141.6 |  |
|  |
| **4** | **Validation Checks** |  |
| 4.1 | Margin for rain fade (dB) | 2.8 | 14.3 | 24.4 | 37.1 |  |
| 4.2 | *PFDval* (dB(W/(m2 · MHz))) | -118.9 | -118.9 | -118.9 | -118.9 |  |
| 4.3 | Delta from Article 21 | -11.4 | -11.4 | -11.4 | -11.4 |  |

The following checks are done to ensure the combination of Generic and Parametric Parameters are valid:

1. The dish size, D, should be in the range [0.16 m] ≤ D ≤ 9m
2. The rain margin should be greater than zero Arain > 0
3. The calculated unavailability, p, should be in the range 0.001 ≤ p ≤ 10%
4. The PFD should be below the limits in Article 21

Table 2: Generic link parameters of GSO links to be used in examination of the uplink (Earth-space) impact from a non-GSO network[[1]](#footnote-1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Generic Link Parameters = service |  |  |  |  |
|   | Link type | Link #1 | Link #2 | Link #3 |  |
| 1.1 | Frequency band (GHz) |  |  |  |  |
| 1.2 | ES EIRP (dBW/Hz) |  |  |  |  |
| 1.3 | Spot beam size (deg) |  |  |  |  |
| 1.4 | ITU-R S.672 sidelobe level (dB) |  |  |  |  |
| 1.5 | ES antenna efficiency |  |  |  |  |
| 1.6 | Additional link losses (dB) |  |  |  |  |
| 1.7 | Additional link margin (dB) |  |  |  |  |
|  |  |
| **2** | **Generic Link Parameters -Parametric Analysis**  | **Parametric Cases for Evaluation** |  |
| 2.1 | e.i.r.p. density variation |  |  |
| 2.2 | Elevation angle (deg) |  |  |
| 2.3 | 0.01% Rain Rate (mm/hr)  |  |  |
| 2.4 | Height of ES (m) |  |  |
| 2.5 | Satellite noise temperature (K) |  |  |
| 2.6 | Threshold C/N (dB) |  |  |
|  |  |
| **3** | **Example Implementation – Link Calculation** | **First Case parametric cases taken for examples** | **Equations to Calculate Uplink Availability** |
| 3,1 | ES Peak gain (dBi) |  |  |  |  |
|  | *Interim step: calculate the latitude corresponding with the elevation, ε* |  |  |  |  |
|  |  |  |  |  |  |
| 3.2 | Path length (km) |  |  |  |  |
| 3.3 | Path loss (dB) |  |  |  |  |
| 3.4 | Unfaded wanted single strength (dBW/MHz) |  |  |  |  |
| 3.5 | Noise plus margin (dBW/MHz) |  |  |  |  |
|  |
| **4** | **Validation Checks** |  |
| 4.1 | Margin for rain fade (dB) |  |  |  |  |

The following checks are done to ensure the combination of Generic and Parametric Parameters are valid:

1. The rain margin should be greater than zero Arain > 0
2. The calculated unavailability, p, should be in the range 0.001 ≤ p ≤ 10%

ANNEX 2 TO RESOLUTION [EUR-A16-SingleEntry] (WRC-19)

Description of parameters and procedures for the evaluation of interference from a non-GSO system into global set of representative GSO links

This Annex provides the process to validate compliance with the single-entry permissible interference of a non-GSO system into GSO networks using the generic link parameters in Annex 1 and the worst-case geometry interference impact using the latest version of Recommendation ITU-R S.1503. The procedure to determine the compliance with the single-entry permissible interference relies on the following principles.

*Principle 1*: The two time-varying sources of link performance degradation considered in the verification are link fading (from rain, cloud, gas and scintillation attenuation) plus the characteristics of the link and interference from other FSS or BSS networks.

The total *C*/*N* in the reference bandwidth for a given carrier is:

 (1)

where:

 *C*: wanted power (W) in the reference bandwidth, which varies as a function of fades and as a function of transmission configuration

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

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

*Principle 2*: The calculation of spectral efficiency is focused on satellite systems utilizing adaptive coding and modulation (ACM) by calculating the throughput degradation as a function of C/N, which varies depending on the long-term propagation and interference impacts on the satellite link.

*Principle 3*: During a fading event in the downlink direction, the interfering carrier is attenuated by the same amount as the wanted carrier. This results in some under-estimation of the total downlink degradation under circumstances where interference peaks and fading occur simultaneously.

By applying the following steps, the single-entry interference impact from a non-GSO system on the availability and spectral efficiency of a GSO link is determined. The generic GSO link parameters of Annex 1 are used, considering all possible parametric permutations, in conjunction with the worst case geometry (“WCG”) epfd output of Recommendation ITU-R S.1503. The generic link parameters of Annex 1 are used to create a global set of representative GSO link budgets. The output of Recommendation ITU-R S.1503 is a set of interference statistics that a non-GSO system creates into each representative GSO link.

**For each generic GSO link from Annex 1:**

*Step 1*: Determine xfade,the probability distribution function (pdf) of the propagation fading plus other time variations in the characteristics of the generic GSO link. These statistics can be calculated using the procedures of the latest version of Recommendation ITU-R P.618.

*Step 2*: Determine yint, the interference impact into the generic GSO link from the non-GSO system under examination using the procedures of Recommendation ITU-R S.1503.

*Step 3*: Determine zconv, a modified discrete convolution of the rain degradation pdf (xfade), with the interference degradation pdf (yint). For each pair of degradation values, *X* and *Y* from xfade and yint, respectively, the convolved degradation value is determined by the product of the xfade(*X*) and yint(*Y*) degradation values (or equivalently, the sum of the log values in dB) and the combined probability, computed as the product of each of the individual probabilities, is added to the appropriate convolved degradation pdf, zconv(*Z*).

Since the assumption of statistical independence between rain degradation (xfade) and interference degradation (yint) does not account for propagation effects on the interference path, a modification to the classic convolution for the downlink direction is proposed to account for this. This modified convolution is equivalent to a regular discrete convolution with the exception that the interference degradation values (yi) are first reduced by the applicable rain attenuation, i.e., the jth rain loss value, (LR)j, from the rain degradation pdf bin (xj) for which it is being combined.

The probability density function (pdf) of *zconv* is the modified convolution of the pdf of *xfade* and *yint* The total *C*/*N* degradation *zconv* (dB) is therefore:

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

*Step 4:* Using the results of the modified convolution procedures to obtain the pdf zconv described above for the total degradation for the propagation fade xfade and the interference impact from the non-GSO system (yint), the conditions for the single-entry case can be verified:

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

Conditions to be verified for compliance are:

U\_(R+I)<= 1.03 x U\_(R) (4)

Where U\_(R+I) is the unavailability time due to rain and interference, U\_(R) is the unavailability time due to rain only. This formula should be applied for the short term performance objectives of generic GSO reference links

For the long term performance objective related to the spectral efficiency (SE) of the generic GSO links:

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

Where SExfade represents the operational capacity of the FSS link achieved due to propagation fading over a time period of one year and SEzconv represents the operational capacity of the FSS link due to the combined mechanism of propagation and interference over a period of one year. These equations represent the conditions to be checked to ensure that the percent degraded throughput caused by interference fades does not exceed a certain threshold, when compared to fades caused by propagation conditions over a long term period of operation.

This procedure is repeated for each generic GSO link from Annex 1, considering all parametric permutations and validation checks.

Draft New Resolution [EUR-A16-AGG.SHARING]

Protection of geostationary FSS, BSS and MSS networks from the aggregate interference produced by multiple 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 and 40-40.5 GHz are allocated, on a primary basis to the mobile-satellite service (MSS) in all regions;

*d)* that Article **22** contains regulatory and technical provisions on sharing between 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 broadcasting-satellite service (BSS) networks and, unless otherwise specified in the Radio Regulations, shall not claim protection from GSO FSS and BSS satellite networks;

*f*) that non-GSO FSS systems would benefit from increased certainty that would result from the quantification of technical regulatory measures required for protection of GSO satellite networks operating in the bands referred to in *considering a), b)* and *c)* above;

*g)* that GSO FSS, MSS, and BSS networks can be protected without placing undue constraints on non-GSO FSS systems in the bands in *considering a), b) and c)* above;

*h)* that WRC-19 modified Article **22** to limit single-entry and aggregate permissible time allowance for degradation in terms of C/N by non-GSO FSS systems to GSO satellite networks,

*i)* that the operating parameters and orbital characteristics on non-GSO FSS systems are usually inhomogeneous;

*j)* that, as a result of this inhomogeneity, the time allowance for the *C*/*N* value specified in the short-term performance objective associated with the shortest percentage of time (lowest *C*/*N*) or decrease of the long-term throughput (spectral efficiency) caused to reference GSO FSS links by non-GSO FSS systems is likely to vary between such systems;

*k)* that, the aggregate interference levels from multiple non‑geostationary FSS systems will be related to the actual number of systems sharing a frequency band based on the single-entry operational use of each system;

*l)* that to protect GSO FSS, MSS, and BSS networks in the frequency bands listed in *considering* *a), b)* and *c)* from unacceptable interference, the aggregate impact of interference caused by all co-frequency non-GSO FSS systems should not exceed the maximum aggregate impact specified in No. **22.5M** of the Radio Regulations;

*m)* that to achieve the level of protection of GSO reference links, administrations operating or planning to operate non-GSO FSS systems will need to agree cooperatively through consultation meetings;

*n)* that the aggregate level of the time allowance for the *C*/*N* value specified in the short-term performance objective associated with the shortest percentage of time (lowest *C*/*N*) of GSO reference link is likely to be the summation of single-entry levels caused by non-GSO FSS systems,

recognizing

*a)* that non-GSO FSS systems may need to implement interference mitigation techniques, such as avoidance angles, earth station site diversity, and GSO arc avoidance to facilitate sharing frequencies among non-GSO FSS systems and to protect GSO networks;

*b)* that administrations operating or planning to operate non-GSO FSS systems will need to agree cooperatively through consultation meetings to share the aggregate interference impact allowance for all non-GSO FSS systems operating in the frequency bands listed in *considering* *a), b)* and *c)* in a manner that achieves the level of protection for GSO FSS, MSS and BSS networks that is stated in No. **22.5M** of the Radio Regulations;

*c)* that, taking into account the single-entry allowance in No. **22.5L,** the aggregated impact of all non-GSO FSS systems can be computed without the need for specialized software tools based on the results of the single-entry impact for each system;

*d)*the need for administrations operating non-GSO FSS systems in the frequency bands listed in *considering* *a)* to agree cooperatively through consultation meetings takes on particular urgency whenever there could be aggregate interference at levels higher than the aggregate impact allowance from operational non-GSO FSS systems;

*e)* that representatives of administrations operating or planning to operate GSO FSS, MSS and BSS networks are encouraged to be involved in the determinations made pursuant to *recognizing* *b)*;

*f)* that in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space‑to‑Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), signals experience high levels of attenuation due to atmospheric effects such as rain, cloud cover and gaseous absorption;

*g)* that given these expected high levels of fading, it is desirable for GSO networks and non-GSO FSS systems to implement fade counter measures such as automatic level control, power control and adaptive coding and modulation,

noting

*a)* that Resolution [EUR-A16-SingleEntry] contains the methodology for determining conformity to the single-entry limits to protect the GSO networks;

*b)* that Recommendation ITU-R S.1503 provides guidance on how to compute the epfd levels from a non-GSO system into GSO earth stations and satellites;

*c)* that Resolution [EUR-A16-SingleEntry] contains GSO satellite system characteristics to be used in non-GSO/GSO frequency sharing analyses in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz

resolves

1 that administrations operating or planning to operate non‑geostationary FSS systems in the frequency bands referred to in *considering a)* above, shall, in collaboration, take all necessary steps, including, if necessary, by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference impact to geostationary FSS, MSS and BSS satellite networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate limits specified in No. **22.5M**;

2 that to carry out the obligations in *resolves*1 above, administrations operating or planning to operate non-geostationary FSS systems shall agree cooperatively through regular consultation discussions referred to in *recognizing b)* to ensure that operations of all non-GSO networks do not exceed the aggregate level of protection for geostationary satellite networks;

3 that participation in the consultation process by administrations operating or planning to operate non-GSO FSS systems that are subject to this Resolution is required, and that failure by a responsible administration to participate in the consultation process does not relieve that administration of obligations under *resolves* 1 above, nor does it remove their systems from consideration in any aggregate calculations by the consultation group;

4 that *resolves 2 and 3* above begin to apply when a second non-geostationary FSS systems with frequency assignments in the frequency bands referred to in *considering a)* meets the criteria listed in Annex 2 to this Resolution;

5 that to carry out the obligations of *resolves 2* above*,* administrations shall use the generic GSO satellite characteristics listed in Resolution [EUR-A16-SingleEntry] to determine the results of the aggregate impact to GSO networks;

6 that administrations (including representatives of administrations operating GSO FSS, MSS and BSS networks) participating in a consultation meeting are allowed to use their own software in conjunction with any software tools used by the BR for the calculation and verification of the aggregate limits, subject to the agreement of the consultation meeting;

7 that administrations, in carrying out their obligations under *resolves*1 above, shall take into account only those non-geostationary FSS systems with frequency assignments in the frequency bands referred to in *considering a)* above that have met the criteria listed in Annex 2 to this Resolution through appropriate information provided in the course of consultation discussions referred to in *resolves* 2;

8 that administrations, in developing agreements to carry out their obligations under *resolves*1 above, shall establish mechanisms to ensure that all potential FSS system and network notifying administrations and operators are given full visibility of and the opportunity to participate in the process;

9 that each administration, in the absence of an agreement reached at consultation meetings referred to in *resolves* 2, shall ensure that each of its non-geostationary FSS systems subject to this Resolution is operated in accordance with reduced single-entry interference impact allowances, calculated by the apportionment of the aggregate allowance commensurate to the number of simultaneously operating non-GSO systems, so as to ensure that the aggregate allowance in No. **22.5M** is not exceeded in operation;

10 that, in specific implementation of *resolves* 8above, if the consultation discussions show that there would be an exceedance of the aggregate allowance from non-GSO FSS systems in operation, every operational non-GSO FSS system shall reduce its emissions by means of appropriate modifications to their systems;

11 that the administrations participating at the consultation discussion referred to in *resolves 2* shall designate one convener to be responsible for communicating to the Bureau such as shown in Annex 1 that the results of the aggregate non-GSO system operational calculation and sharing determinations made in application of *resolves*1, 3 and 9 above, without regard to whether such determinations result in any modifications to the published characteristics of their respective systems providing a draft record of each consultation meeting, and posting the approved record,

invites the Radiocommunication Bureau

to participate in the consultation meetings in *resolves* 2 as an observer and to provide advice as necessary with respect to the results of the aggregate interference impact calculation performed according to *resolves*1,

instructs the Radiocommunication Bureau

1 to publish in the International Frequency Information Circular (BR IFIC), the information referred to in *resolves*11.

2 to exclude the aggregate calculations given in No. **22.5M** as part of a satellite network examination under **11.31**,

urges administrations

to provide the Radiocommunication Bureau and all participants to the consultation meetings with the methodology, assumptions, inputs and results from the calculation performed under *resolves* 5.

ANNEX 1 TO DRAFT NEW RESOLUTION [EUR-A16-AGG.SHARING] (WRC-19)

*Editorial note: the material of this Annex need to be further worked on. Alternatively, deletion should be considered.*

 List of geostationary networks characteristics and format of the result of the aggregate calculation to be provided to BR for
publication for information

I GSO network characteristics to be used in the calculation of aggregate emissions from non-GSO FSS systems

I-1 GSO network Characteristics

Generic links

I-2 Non-GSO satellite system constellation parameters

For each non GSO satellite system, the following parameters should be provided to BR for publication in the aggregate calculation:

– Notifying administration;

– Number of space stations used in aggregate calculations;

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

# II Results of the aggregate epfd calculation

– Single entry use of each non-GSO FSS systems

ANNEX 2 DRAFT NEW TO RESOLUTION [EUR-A16-AGG.SHARING] (WRC-19)

**List of criteria for the application of *resolves* 7**

1 Submission of appropriate 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:** Modify Article **22** to include a single-entry and aggregate interference limits, in order to protect GSO satellite networks from non-GSO FSS systems operating in the subject frequency bands and develop a new Resolution providing the procedure to ensure aggregate limits will not be exceeded.

Option 2:

ARTICLE 22

Space services1

Section II − Control of interference to geostationary-satellite systems

ADD EUR/XXXXA6/6

22.5L The single-entry interference from any non-geostationary-satellite system in the fixed-satellite service in the frequency bands 37.5-39.5, 39.5-42.5, 47.2-50.2, and 50.4-51.4 GHz shall not cause more than:

* an increase of 3% in unavailability for the C/N values associated with each of the short-term performance objectives;
* and in case of GSO networks using adaptive coding and modulation, a reduction of [TBD]% in the time-averaged spectral efficiency calculated on an annual basis, using the latest version of Recommendation ITU-R [ACM-PERF] to define the time-averaged spectral efficiency

for each of the generic links included in the Draft New Resolution [EUR-A16-Single entry].

Draft New Resolution [EUR-A16-SingleEntry] shall apply.

**Reasons:** Use the new DRAFT NEW RESOLUTION [EUR-A16-SingleEntry] to calculate the maximum permissible level of interference from non-GSO satellite systems based on the probability density function issued from Recommendation ITU-R S.1503.

ADD EUR/XXXXA6/7

**22.5M** 10)

Compliance with the limits in Nos. 22.5M does not preclude fulfilling the obligation under 22.5L.

Administrations operating or planning to operate non-geostationary-satellite systems in the fixed-satellite service in the frequency bands 37.5-39.5, 39.5-42.5, 47.2-50.2, and 50.4-51.4 GHz shall ensure that the single-entry interference from each of those systems does not cause more than:

− an increase of 3% in unavailability for the C/N values associated with each of the short-term performance objectives; and

− in case of GSO networks using adaptive coding and modulation, a reduction of [TBD]% in the time-averaged spectral efficiency calculated on an annual basis, using the latest version of Recommendation ITU-R [ACM-PERF] to define the time-averaged spectral efficiency

for each of the supplemental GSO reference links included in the Draft New Resolution [EUR-A16-single entry].

Draft New Resolution [EUR-A16-SingleEntry] shall also apply.

**Reasons:** Modify RR Article **22** to include aggregate unavailability and decreased capacity limits for multiple non-GSO FSS systems of 10% to protect GSO networks in these bands.

ADD EUR/XXXA6/8

22.5N Administrations operating or planning to operate non-geostationary-satellite system(s) in the fixed-satellite service in the frequency bands 37.5-39.5, 39.5-42.5, 47.2-50.2, and 50.4-51.4 GHz shall ensure that that the aggregate interference from those systems does not cause more than:

* an increase of 10% in unavailability for the C/N values associated with each of the short-term performance objectives; and
* in case of GSO networks using adaptive coding and modulation, a reduction of [TBD]% in the time-averaged spectral efficiency calculated on an annual basis, using the latest version of Recommendation ITU-R [ACM-PERF] to define the time-averaged spectral efficiency

for each of the generic links included in the Draft New Resolution [EUR-A16-GSO REF LINKS]. And,

* an increase of 10% in unavailability for the C/N values associated with each of the short-term performance objectives; and
* in case of GSO networks using adaptive coding and modulation, a reduction of [TBD]% in the time-averaged spectral efficiency calculated on an annual basis , using the latest version of Recommendation ITU-R [ACM-PERF] to define the time-averaged spectral efficiency

for each of the supplemental GSO reference links included in the Draft New Resolution [EUR-A16-single entry].

Resolution [EUR-A16-AGG.SHARING] (WRC-19) shall also apply.

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 EUR/XXXXA6/8

9.35 *a)* examine that information with respect to its conformity with No. 11.31MOD**19**; (WRC‑2019)

**Reasons:**

MOD EUR/XXXXA6/9

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- or the applicable single entry limits in No. **22.5L** of Article 22 in the publication under No. 9.38.     (WRC‑2019)

**Reasons:** Resolution **159 (WRC-15)** resolves to conduct studies of regulatory provisions for the operation of non-GSO FSS satellite systems, while ensuring protection of GSO satellite networks in the FSS, MSS and BSS. In order to cover FSS and BSS cases it is proposed to address this issue by Bureau examination of NGSO filings on the criteria presented in in **22.5L**.

ADD EUR/XXXA6/10

**DRAFT NEW RESOLUTION [EUR-A16-SingleEntry] (WRC-19)**

Application of Article 22 of the Radio Regulations to the Protection of Geostationary Fixed-Satellite Service and Broadcasting-Satellite Service Networks from Non-Geostationary Fixed-Satellite Service 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

The World Radiocommunication Conference (2019),

considering

*a)* that geostationary (GSO) and non-geostationary (non-GSO) fixed-satellite service (FSS) networks may operate 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;

*b)* that this conference adopted, in Article 22, single-entry and aggregate operating provisions applicable to the operations of 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 GHzto protect GSO networks operating in the same frequency bands;

*c)* that ITU‑R has developed Recommendation ITU‑R S.1503 to provide a methodology on how to compute the equivalent power flux density (epfd) concept for calculation of interference from a non-GSO system into potentially affected GSO earth stations and satellites;

*d)* that the calculation methodology contained in Recommendation ITU-R S.1503 results in the epfd generated by a non-GSO FSS system considered and a GSO location that corresponds to the worst case geometry (WCG) that generates the highest levels of epfd down corresponding to the considered receive GSO earth station antenna size;

recognizing

a) that, in accordance with calculations utilizing Recommendation ITU-R S.1503, the verification of the global epfd interference of a non-GSO system can be carried out by a set of representative link budgets having characteristics that encompass worldwide GSO network deployments that are independent of any specific geographic locations;

 *resolves*

1 that during the examination under Nos. **9.35** and **11.31**, as applicable, of a non-GSO FSS satellite system with frequency assignments 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 representative technical characteristics of generic GSO satellite networks contained in Annex 1 shall be used in conjunction with the methodology in Recommendation [Computation Procedure for 5040 Single Entry Sharing] to establish compliance with No. ***22.5L***;

2 that notified frequency assignments to non-GSO FSS systems shall receive either a favourable or an unfavourable finding following the examination under Nos. **9.35** or **11.31**, as applicable, with respect to the single-entry operating provisions given in ***22.5L***

 *invites administrations*

that are in the development stages of future GSO satellite networks operating in the frequency bands listed in *resolves* 1 to submit supplemental technical characteristics of GSO reference links to the ITU-R for the evaluation of operational interference from non-GSO systems specified in Nos. **22.5M**,

invites the ITU Radiocommunication Sector

 to study and develop, as appropriate, a methodology for validation of supplemental technical characteristics representing future GSO satellite network parameters for evaluation of the aggregate interference calculations into GSO networks produced by all non‑GSO FSS systems,

instructs the Director of the Radiocommunication Bureau

 to encourage administrations to support the development of validation software for the supplemental links submitted under *invites administrations* above.

instructs administrations

 that are responsible for the NGSO notification, to check the compliance with No. ***22.5M.***

ANNEX 1 TO RESOLUTION [EUR-A16-SingleEntry ] (WRC-19)

Generic GSO satellite system characteristics for evaluation of compliance with single-entry requirements for non-GSO systems

The data in Annex 1 are to be regarded as a generic range of representative technical characteristics of GSO networks deployments that are independent of any specific geographic location, to be used only for establishing the interference impact of a non-GSO system into GSO satellite networks and not as a basis for coordination between satellite networks.

Table 1: Generic link parameters of GSO links to be used in examination of the downlink (space-Earth) impact from a non-GSO network

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Generic Link Parameters = service |  |  |  |  |  |
|  | Link type | User #1 | User #2 | User #3 | Gateway |  |
| 1.1 | Frequency band (GHz) | 40 | 40 | 40 | 40 |  |
| 1.2 | e.i.r.p. density (dBW/MHz) | 44 | 44 | 44 | 44 |  |
| 1.3 | Dish size (m) | [0.16] | 0.6 | 2 | 9 |  |
| 1.3 | Bandwidth (MHz) | 1 | 1 | 1 | 1 |  |
| 1.4 | ES antenna gain pattern | S.1428 | S.1428 | S.1428 | S.1428 |  |
| 1.5 | ES 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** | **Generic Link Parameters -Parametric Analysis** | **Parametric Cases for Evaluation** |  |
| 2.1 | e.i.r.p. density variation | ± 3 dB from value in 1.2 |  |
| 2.2 | Elevation angle (deg) | 20, 55, 90 |  |
| 2.3 | 0.01% Rain Rate (mm/hr) | 10, 25, 50, 100 |  |
| 2.4 | Height of ES (m) | 0, 500, 1000 |  |
| 2.5 | ES noise temperature (K) | Option 1: 250, 300 ; Option 2: TBD |  |
| 2.6 | Threshold C/N (dB) | Option 1:-2.5, 7, 12 ; Option 2: TBD |  |
|  |  |
| **3** | **Example Implementation – Link Calculation** | **First Case parametric taken for examples** | **Equations to Calculate Downlink Availability** |
| 3,1 | ES Peak gain (dBi) | 34.7 | 46.1 | 56.2 | 68.9 |  |
|  | *Interim step: calculate the latitude corresponding with the elevation, ε* |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 3.2 | Path length (km) | 39554.4 | 39554.4 | 39554.4 | 39554.4 |  |
| 3.3 | Path loss (dB) | 216.4 | 216.4 | 216.4 | 216.4 |  |
| 3.4 | Unfaded wanted single strength (dBW/MHz) | -138.8 | -127,3 | -117.2 | -104.5 |  |
| 3.5 | Noise plus margin (dBW/MHz) | -141.6 | -141.6 | -141.6 | -141.6 |  |
|  |
| **4** | **Validation Checks** |  |
| 4.1 | Margin for rain fade (dB) | 2.8 | 14.3 | 24.4 | 37.1 |  |
| 4.2 | *PFDval* (dB(W/(m2 · MHz))) | -118.9 | -118.9 | -118.9 | -118.9 |  |
| 4.3 | Delta from Article 21 | -11.4 | -11.4 | -11.4 | -11.4 |  |

The following checks are done to ensure the combination of Generic and Parametric Parameters are valid:

1. The dish size, D, should be in the range [0.16 ]m ≤ D ≤ 9m
2. The rain margin should be greater than zero Arain > 0
3. The calculated unavailability, p, should be in the range 0.001 ≤ p ≤ 10%
4. The PFD should be below the limits in Article 21

Table 2: Generic link parameters of GSO links to be used in examination of the uplink (Earth-space) impact from a non-GSO network[[2]](#footnote-2)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Generic Link Parameters = service |  |  |  |  |
|   | Link type | Link #1 | Link #2 | Link #3 |  |
| 1.1 | Frequency band (GHz) |  |  |  |  |
| 1.2 | ES EIRP (dBW/Hz) |  |  |  |  |
| 1.3 | Spot beam size (deg) |  |  |  |  |
| 1.4 | ITU-R S.672 sidelobe level (dB) |  |  |  |  |
| 1.5 | ES antenna efficiency |  |  |  |  |
| 1.6 | Additional link losses (dB) |  |  |  |  |
| 1.7 | Additional link margin (dB) |  |  |  |  |
|  |  |
| **2** | **Generic Link Parameters -Parametric Analysis**  | **Parametric Cases for Evaluation** |  |
| 2.1 | e.i.r.p. density variation |  |  |
| 2.2 | Elevation angle (deg) |  |  |
| 2.3 | 0.01% Rain Rate (mm/hr)  |  |  |
| 2.4 | Height of ES (m) |  |  |
| 2.5 | Satellite noise temperature (K) |  |  |
| 2.6 | Threshold C/N (dB) |  |  |
|  |  |
| **3** | **Example Implementation – Link Calculation** | **First Case parametric cases taken for examples** | **Equations to Calculate Uplink Availability** |
| 3,1 | ES Peak gain (dBi) |  |  |  |  |
|  | *Interim step: calculate the latitude corresponding with the elevation, ε* |  |  |  |  |
|  |  |  |  |  |  |
| 3.2 | Path length (km) |  |  |  |  |
| 3.3 | Path loss (dB) |  |  |  |  |
| 3.4 | Unfaded wanted single strength (dBW/MHz) |  |  |  |  |
| 3.5 | Noise plus margin (dBW/MHz) |  |  |  |  |
|  |
| **4** | **Validation Checks** |  |
| 4.1 | Margin for rain fade (dB) |  |  |  |  |

The following checks are done to ensure the combination of Generic and Parametric Parameters are valid:

1. The rain margin should be greater than zero Arain > 0
2. The calculated unavailability, p, should be in the range 0.001 ≤ p ≤ 10%

ANNEX 2 TO RESOLUTION [EUR-A16-SingleEntry ] (WRC-19)

Supplemental GSO satellite system characteristics for evaluation of compliance with single-entry requirements for non-GSO systems

List of supplemental links.

**Working Document Towards Preliminary Draft New Recommendation [Computation Procedure for 5040 Single Entry Sharing]**

Description of parameters and procedures for the evaluation of interference from a non-GSO FSS system into a GSO FSS link in Q/V bands

The ITU Radiocommunication Assembly,

considering

*a)* that to facilitate frequency sharing, the unavailability allowance for an FSS or BSS link should be shared between that caused by propagation effects and that due to interference from other systems;

 *recommends*

1. that the methodology in Annex 1 should be used to determine if the interference statistics caused by the earth and space station emissions of non-GSO systems meets the requirements of **No. 22.5L and 22.5M**;

ANNEX 1 TO RECOMMENDATION [Computation Procedure for 5040 Single Entry Sharing] (WRC-19)

Description of procedures for the evaluation of interference from a non-GSO FSS system into a GSO FSS link in Q/V bands

# 1 Basic assumptions

*Assumption 1*: The two time-varying sources of degradation considered in the analysis are link fading plus any other time variations in the characteristics of the link and interference from other non-GSO FSS networks.

The total *C*/*N* in the reference bandwidth for a given carrier is:

 

where:

 *C*: wanted power (W) in the reference bandwidth, which varies as a function of the uplink and downlink fades and also as a function of the transmission configuration (multiple access, use of uplink power control, etc.) Thus *C* can be described as a function of *A*, the uplink fade attenuation, and *A*, the downlink fade attenuation as:

 *C*  *Ccs* / *F* (*A*, *A*)

 *Ccs*: wanted power in clear-sky conditions (long-term condition)

 *F* (*A*, *A*): total attenuation due to the uplink and downlink fading

 *NT* : total system noise power (W) in the reference bandwidth (i.e. the thermal power including uplink and downlink contributions at the demodulator input, the noise power resulting from the multi-carrier operation of the involved power amplifier – in the earth stations and in the space stations – , the cross polarization isolations of the different transmit and receive antennas, the thermal power increase due to the rain fades, which also varies as a function of the transmission configuration and with the uplink and downlink fades. *NT* also includes the long-term (i.e. *not* time-varying) contributions from other GSO networks. Thus *NT* can be described as a function of *A* and *A* as:

 *NT*  *NT*,*cs* · *G*(*A*, *A*)

 *NT,cs*: noise power in clear-sky conditions (long-term condition) (W)

 *G*(*A*, *A*): noise increase in the uplink and the downlink

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

*Assumption 2*: Due to fading plus other time variations in the characteristics of the link, carrier power reduction due to the uplink fade *A* and the downlink fade *A* i.e. *F* (*A*, *A*), and the noise increase, *G*(*A*, *A*), can be accounted for by substituting *C*/*X* for *C*, with *X*  *H*(*A*, *A*)  *F* (*A* , *A*) ⋅ *G* (*A*, *A*), and the corresponding degradation *x* (dB), is:

 *x*  10 log *X*  10 log (*H*(*A*, *A*)) (1)

The effect of interference can be represented by increasing the noise power from *NT* to *Y* *NT* and the corresponding degradation *y* (dB) is:

 *y*  10 log *Y* (2)

The total *C*/*N* degradation *z* (dB) is therefore:

 *z*  *x*  *y* (3)

If the continuous random variables of *x* and *y* can be assumed to be statistically independent then the probability density function (pdf) of *z, pz*(*Z*) is the convolution of the pdfs of *x* and *y,* i.e.*,*

  (3b)

where *px*(*X*) and *py*(*Y*) are pdfs of continuous random variables of *x* and *y*.

Independence between these two random variables is an approximation because the presence of fading may increase the noise level and also lead to a reduction of *I* (fading in the interference path). In both respects, the assumption of independence is conservative in the sense of over-estimating the effect of interference.

Further, it follows from the definition of *y* that:

 *Y*  1  (*I*/*NT*) (4a)

where *I* is the time-varying interference power (W) in the reference bandwidth generated by other networks.

Since the assumption of statistical independence between degradation due to atmospheric conditions (x) and interference degradation (y) does not account for propagation effects on the interference path, a modification to the classic convolution for the downlink direction is proposed to account for this.

When pdfs are defined for discrete random variables of *x*, *y* and *z*, then the pdf of *z* can be found by using convolution summation of pdfs of *x* and *y*, instead of convolution integral for continuous random variables, i.e.:

  (4b)

where *px*(*X*) and *py*(*Y*) are pdfs of discrete random variables of *x* and *y*. This conventional discrete convolution summation in (4b) needs to be modified in order to consider atmospheric attenuation on the interference path. Therefore, when estimating  in (4b), in first reduced by *k*th atmospheric attenuation value is as follows:

  (4c)

where *LR* is the atmosphere attenuation value. Otherwise, when estimating  in (4b), *k* in first reduced by (*Z-k*)th atmospheric attenuation value is as follows:

  (4d)

In order to permit the computation of the probability density function of the degradation *x*, it is necessary to identify, prior to the application of this methodology, the exact carrier parameters of the considered network, as well as the necessary parameters required to develop the computation of the uplink and downlink fades as well as the power reduction and noise increase functions (*F* and *G*).

*Assumption 3*: This analysis assumes that, during a fading event in the downlink direction, the interfering carrier is attenuated by the same amount as the wanted carrier. This assumption results in some under-estimation of the total downlink degradation under circumstances where interference peaks and downlink fading occur simultaneously.

# 2 Input data

The following data is required to verify compliance with **Nos 22.5L and M** or to determine the interference allowances corresponding to any specific desired carrier.

a) The performance requirements of the desired carrier, as expressed by the values of *C/N* associated with different percentages of time have to be known. In general, this will be a set of values (*C/N*) *j* ( *j*  1, , *J* ) and the corresponding percentages of the year *pj* ( *j*  1, , *J* ) for which the (C/N) can be lower than (C/N)*j*

b) The clear-sky carrier-to-noise ratio (*C*/*N*)*cs*..

c) The pdf, *px*(*X*) of the random variable of *x,* which expresses in dB the degradation in performance due to fading plus any other time variations in the characteristics of the link.

d) The spectral efficiency of the desired carrier, as a function of the C/N ratio at the input of the receiver

In addition, the pdf, *py*(*Y*), of the degradation due to interference must be provided. This pdf can be derived by the application of Recommendation UIT-R S.1503.

ADD EUR/XXXA6/11

Draft New Resolution [EUR-A16-AGG.SHARING]

Protection of geostationary FSS, BSS and MSS networks from the aggregate interference produced by multiple 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 and 40-40.5 GHz are allocated, on a primary basis to the mobile-satellite service (MSS) in all regions;

*d)* that Article **22** contains regulatory and technical provisions on sharing between 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 broadcasting-satellite service (BSS) networks and, unless otherwise specified in the Radio Regulations, shall not claim protection from GSO FSS and BSS satellite networks;

*f*) that non-GSO FSS systems would benefit from increased certainty that would result from the quantification of technical regulatory measures required for protection of GSO satellite networks operating in the bands referred to in *considering a), b)* and *c)* above;

*g)* that GSO FSS, MSS, and BSS networks can be protected without placing undue constraints on non-GSO FSS systems in the bands in *considering a), b) and c)* above;

*h)* that WRC-19 modified Article **22** to limit single-entry and aggregate permissible time allowance for degradation in terms of C/N by non-GSO FSS systems to GSO satellite networks,

*i)* that the operating parameters and orbital characteristics on non-GSO FSS systems are usually inhomogeneous;

*j)* that, as a result of this inhomogeneity, the time allowance for the *C*/*N* value specified in the short-term performance objective associated with the shortest percentage of time (lowest *C*/*N*) or decrease of the long-term throughput (spectral efficiency) caused to reference GSO FSS links by non-GSO FSS systems is likely to vary between such systems;

*k)* that, the aggregate interference levels from multiple non‑geostationary FSS systems will be related to the actual number of systems sharing a frequency band based on the single-entry operational use of each system;

*l)* that to protect GSO FSS, MSS, and BSS networks in the frequency bands listed in *considering* *a), b)* and *c)* from unacceptable interference, the aggregate impact of interference caused by all co-frequency non-GSO FSS systems should not exceed the maximum aggregate impact specified in No. **22.5M** of the Radio Regulations;

*m)* that to achieve the level of protection of GSO reference, administrations operating or planning to operate non-GSO FSS systems will need to agree cooperatively through consultation meetings;

*n)* that the aggregate level of the time allowance for the *C*/*N* value specified in the short-term performance objective associated with the shortest percentage of time (lowest *C*/*N*) of GSO reference link is likely to be the summation of single-entry levels caused by non-GSO FSS systems,

recognizing

*a)* that non-GSO FSS systems may need to implement interference mitigation techniques, such as avoidance angles, earth station site diversity, and GSO arc avoidance to facilitate sharing frequencies among non-GSO FSS systems and to protect GSO networks;

*b)* that administrations operating or planning to operate non-GSO FSS systems will need to agree cooperatively through consultation meetings to share the aggregate interference impact allowance for all non-GSO FSS systems operating in the frequency bands listed in *considering* *a), b)* and *c)* in a manner that achieves the level of protection for GSO FSS, MSS and BSS networks that is stated in No. **22.5M** of the Radio Regulations;

*c)* that, taking into account the single-entry allowance in No. **22.5L,** the aggregated impact of all non-GSO FSS systems can be computed without the need for specialized software tools based on the results of the single-entry impact for each system;

*d)*the need for administrations operating non-GSO FSS systems in the frequency bands listed in *considering* *a)* to agree cooperatively through consultation meetings takes on particular urgency whenever there could be aggregate interference at levels higher than the aggregate impact allowance from operational non-GSO FSS systems;

*e)* that representatives of administrations operating or planning to operate GSO FSS, MSS and BSS networks are encouraged to be involved in the determinations made pursuant to *recognizing* *b)*;

*f)* that in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space‑to‑Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), signals experience high levels of attenuation due to atmospheric effects such as rain, cloud cover and gaseous absorption;

*g)* that given these expected high levels of fading, it is desirable for GSO networks and non-GSO FSS systems to implement fade counter measures such as automatic level control, power control and adaptive coding and modulation,

noting

*a)* that Resolution [EUR-A16-SingleEntry] contains the methodology for determining conformity to the single-entry limits to protect the GSO networks;

*b)* that Recommendation ITU-R S.1503 provides guidance on how to compute the epfd levels from a non-GSO system into GSO earth stations and satellites;

*c)* that Resolution [EUR-A16-SingleEntry contains GSO satellite system characteristics to be used in non-GSO/GSO frequency sharing analyses in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz

resolves

1 that administrations operating or planning to operate non‑geostationary FSS systems in the frequency bands referred to in *considering a)* above, shall, in collaboration, take all necessary steps, including, if necessary, by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference impact to geostationary FSS, MSS and BSS satellite networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate limits specified in No. **22.5N**;

2 that to carry out the obligations in *resolves*1 above, administrations operating or planning to operate non-geostationary FSS systems shall agree cooperatively through regular consultation discussions referred to in *recognizing b)* to ensure that operations of all non-GSO networks do not exceed the aggregate level of protection for geostationary satellite networks;

3 that participation in the consultation process by administrations operating or planning to operate non-GSO FSS systems that are subject to this Resolution is required, and that failure by a responsible administration to participate in the consultation process does not relieve that administration of obligations under *resolves* 1 above, nor does it remove their systems from consideration in any aggregate calculations by the consultation group;

4 that *resolves 2 and 3* above begin to apply when a fourth non-geostationary FSS systems with frequency assignments in the frequency bands referred to in *considering a)* meets the criteria listed in Annex 2 to this Resolution;

5 that to carry out the obligations of *resolves 2* above*,* administrations shall use the generic and supplemental GSO satellite characteristics listed in Resolution [EUR-A16-SingleEntry] when applying the methodology contained in PDN Recommendation ITU-R S.[50/40 GHz sharing methodology] and the results of the aggregate impact to GSO networks;

6 that administrations (including representatives of administrations operating GSO FSS, MSS and BSS networks) participating in a consultation meeting are allowed to use their own software in conjunction with any software tools used by the BR for the calculation and verification of the aggregate limits given in, subject to the agreement of the consultation meeting;

7 that administrations, in carrying out their obligations under *resolves*1 above, shall take into account only those non-geostationary FSS systems with frequency assignments in the frequency bands referred to in *considering a)* above that have met the criteria listed in Annex 2 to this Resolution through appropriate information provided in the course of consultation discussions referred to in *resolves* 2;

8 that administrations, in developing agreements to carry out their obligations under *resolves*1 above, shall establish mechanisms to ensure that all potential FSS system and network notifying administrations and operators are given full visibility of and the opportunity to participate in the process;

9 that each administration, in the absence of an agreement reached at consultation meetings referred to in *resolves* 2, shall ensure that each of its non-geostationary FSS systems subject to this Resolution is operated in accordance with reduced single-entry interference impact allowances, calculated by the apportionment of the aggregate allowance commensurate to the number of simultaneously operating non-GSO systems, so as to ensure that the aggregate allowance in No. **22.5M** is not exceeded in operation;

10 that, in specific implementation of *resolves* 8above, if the consultation discussions show that there would be an exceedance of the aggregate allowance from non-GSO FSS systems in operation, every operational non-GSO FSS system shall reduce its emissions by means of appropriate modifications to their systems;

11 that the administrations participating at the consultation discussion referred to in *resolves 2* shall designate one convener to be responsible for communicating to the Bureau such as shown in Annex 1 that the results of the aggregate non-GSO system operational calculation and sharing determinations made in application of *resolves*1, 3 and 9 above, without regard to whether such determinations result in any modifications to the published characteristics of their respective systems providing a draft record of each consultation meeting, and posting the approved record;

invites the Radiocommunication Bureau

to participate in the consultation meetings in *resolves* 2 as an observer and to provide advice as necessary with respect to the results of the aggregate interference impact calculation performed according to *resolves*1,

instructs the Radiocommunication Bureau

1 to publish in the International Frequency Information Circular (BR IFIC), the information referred to in *resolves*11.

2 to exclude the aggregate calculations given in No. **22.5M** as part of a satellite network examination under **11.31**,

urges administrations

to provide the Radiocommunication Bureau and all participants to the consultation meetings with the methodology, assumptions, inputs and results from the calculation performed under *resolves* 5.

ANNEX 1 TO DRAFT NEW RESOLUTION [EUR-A16-AGG.SHARING] (WRC-19)

*Editorial note: the material of this Annex need to be further worked on. Alternatively, deletion should be considered.*

 List of geostationary networks characteristics and format of the result of the aggregate calculation to be provided to BR for
publication for information

I GSO network characteristics to be used in the calculation of aggregate emissions from non-GSO FSS systems

I-2 Non-GSO satellite system constellation parameters

For each non GSO satellite system, the following parameters should be provided to BR for publication in the aggregate calculation:

– Notifying administration;

– Number of space stations used in aggregate calculations;

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

# II Results of the aggregate epfd calculation

– Single entry use of each non-GSO FSS systems

ANNEX 2 TO DRAFT NEW RESOLUTION [EUR-A16-AGG.SHARING] (WRC-19)

**List of criteria for the application of *resolves* 7**

1 Submission of appropriate 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:** Modify Article **22** to include a single-entry and aggregate interference limits, in order to protect GSO satellite networks from non-GSO FSS systems operating in the subject frequency bands and develop a new Resolution providing the procedure to ensure aggregate limits will not be exceeded.\_Option 3:

ARTICLE 22

Space services1

Section II − Control of interference to geostationary-satellite systems

ADD EUR/XXXXA6/6

22.5L 9) A non-geostationary-satellite system in the fixed-satellite service in the frequency bands 37.5-39.5, 39.5-42.5, 47.2-50.2, and 50.4-51.4 GHz shall not exceed:

* a single-entry increase of 3% of time allowance for the C/N values associated with the shortest percentage of time specified in the short-term performance objectives of the generic GSO reference links; and
* a single-entry permissible allowance of at most 3% reduction in time average spectral efficiency calculated on an annual basis of the generic GSO reference links long term performance relative to the long term maximum achievable throughput in the presence of propagation calculated on an annual basis

The calculation procedures given Resolution [EUR-A16-SingleEntry] shall apply.

**Reasons:** Updates to the provision to calculate the maximum permissible interference from a non-GSO satellite system based on the probability density function issued from Recommendation ITU-R S.1503.

ADD EUR/XXXA6/7

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 GSO FSS and BSS networks caused by all non-GSO FSS systems operating in these frequency bands does not exceed 10% of the short-term and long-term performance objectives of GSO satellite networks by applying the provisions of Resolution **[EUR-A16-AGG.SHARING] (WRC-19)**. (WRC-19)

**Reasons:** Modify RR Article **22** to include aggregate unavailability and decreased capacity limits for multiple non-GSO FSS systems of 10% to protect GSO networks in these bands.

ADD EUR/XXXA6/8

22.5N An administration operating a non-geostationary-satellite system in the fixed-satellite service which is in compliance with the limits in Nos. 22.5L shall be considered as having fulfilled its obligations under No. 22.2 with respect to any geostationary-satellite network, irrespective of the dates of receipt by the Bureau of the complete coordination or notification information, as appropriate, for both the non-geostationary-satellite system and the geostationary-satellite network, provided that the resulting interference from the non-geostationary-satellite system in the fixed-satellite service into any supplemental GSO reference link does not exceed

− a single-entry increase of 3% of time allowance for the C/N values associated with the short-term performance objectives of the supplemental GSO reference links; and

− a single-entry permissible allowance of at most 3% reduction in time average spectral efficiency calculated on an annual basis of the generic GSO reference links long term performance relative to the long term maximum achievable throughput in the presence of propagation calculated on an annual basis

where the supplemental GSO reference links are submitted in accordance with Draft new Resolution [EUR-A16-SingleEntry].

**Reasons:** To establish operational limits that must be met by operational non-GSO systems based on supplemental GSO link budgets provided by administrations and reflecting GSO links that supplement the generic links already considered under No. **22.5L**.

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 EUR/XXXXA6/9

9.35 *a)* examine that information with respect to its conformity with No. 11.31MOD**19**; (WRC‑2019)

**Reasons:**

MOD EUR/XXXXA6/10

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** or the applicable single entry limits in No. **22.5L** of Article **22** in the publication under No. **9.38**.     (WRC‑2019)

**Reasons:** Resolution **159 (WRC-15)** resolves to conduct studies of regulatory provisions for the operation of non-GSO FSS satellite systems, while ensuring protection of GSO satellite networks in the FSS, MSS and BSS. In order to cover FSS and BSS cases it is proposed to address this issue by Bureau examination of NGSO filings on the criteria presented in in **22.5L**.

ADD EUR/XXXA6/11

**DRAFT NEW RESOLUTION [EUR-A16-SingleEntry] (WRC-19)**

Application of Article 22 of the Radio Regulations to the Protection of Geostationary Fixed-Satellite Service and Broadcasting-Satellite Service Networks from Non-Geostationary Fixed-Satellite Service 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

The World Radiocommunication Conference (2019),

considering

*a)* that geostationary (GSO) and non-geostationary (non-GSO) fixed-satellite service (FSS) networks may operate 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;

*b)* that this conference adopted, in Article **22**, single-entry and aggregate operating provisions applicable to the operations of 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 GHzto protect GSO networks operating in the same frequency bands;

*c)* that ITU‑R has developed Recommendation ITU‑R S.1503 to provide a methodology on how to compute the equivalent power flux density (epfd) concept for calculation of interference from a non-GSO system into potentially affected GSO earth stations and satellites;

*d)* that the calculation methodology contained in Recommendation ITU-R S.1503 results in the epfd generated by a non-GSO FSS system considered and a GSO location that corresponds to the worst case geometry (WCG) that generates the highest levels of epfd down corresponding to the considered receive GSO earth station antenna size;

recognizing

a) that, in accordance with calculations utilizing Recommendation ITU-R S.1503, the verification of the global epfd interference of a non-GSO system can be carried out by a set of representative link budgets having characteristics that encompass worldwide GSO network deployments that are independent of any specific geographic locations;

 *resolves*

1 that during the examination under Nos. **9.35** and **11.31**, as applicable, of a non-GSO FSS satellite system with frequency assignments 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 representative technical characteristics of generic GSO satellite networks contained in Annex 1 shall be used in conjunction with the methodology in Annex 2 to establish compliance with No. ***22.5L***;

2 that notified frequency assignments to non-GSO FSS systems shall receive either a favourable finding or an unfavourable finding following the examination under No. **9.35** or  **11.31**, as applicable, with respect to the single-entry operating provisions given in ***22.5L***,

 *invites administrations*

that are in the development stages of future GSO satellite networks operating in the frequency bands listed in *resolves* 1 to submit supplemental technical characteristics of GSO reference links to the ITU-R for the evaluation of operational interference from non-GSO systems specified in Nos. **22.5N**,

invites the ITU Radiocommunication Sector

to study and develop, as appropriate, an electronic database for submission of supplemental links and a methodology for validation of supplemental technical characteristics representing future GSO satellite network parameters for evaluation of the aggregate interference calculations into GSO networks produced by all non‑GSO FSS systems,

instructs the Director of the Radiocommunication Bureau

1 to assist in the development and maintenance of the supplemental technical links database referred to in *invites the ITU Radiocommunication Sector* above;

2 to encourage administrations to support the development of validation software for the supplemental links submitted under *invites administrations* above.

ANNEX 1 TO RESOLUTION [EUR-A16-SingleEntry ] (WRC-19)

Generic GSO satellite system characteristics for evaluation of compliance with single-entry requirements for non-GSO systems

The data in Annex 1 are to be regarded as a generic range of representative technical characteristics of GSO networks deployments that are independent of any specific geographic location, to be used only for establishing the interference impact of a non-GSO system into GSO satellite networks and not as a basis for coordination between satellite networks.

Table 1: Generic link parameters of GSO links to be used in examination of the downlink (space-Earth) impact from a non-GSO network

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Generic Link Parameters = service |  |  |  |  |  |
|  | Link type | User #1 | User #2 | User #3 | Gateway |  |
| 1.1 | Frequency band (GHz) | 40 | 40 | 40 | 40 |  |
| 1.2 | e.i.r.p. density (dBW/MHz) | 44 | 44 | 44 | 44 |  |
| 1.3 | Dish size (m) | [0.16] | 0.6 | 2 | 9 |  |
| 1.3 | Bandwidth (MHz) | 1 | 1 | 1 | 1 |  |
| 1.4 | ES antenna gain pattern | S.1428 | S.1428 | S.1428 | S.1428 |  |
| 1.5 | ES 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** | **Generic Link Parameters -Parametric Analysis** | **Parametric Cases for Evaluation** |  |
| 2.1 | e.i.r.p. density variation | ± 3 dB from value in 1.2 |  |
| 2.2 | Elevation angle (deg) | 20, 55, 90 |  |
| 2.3 | 0.01% Rain Rate (mm/hr) | 10, [25], 50, 100 |  |
| 2.4 | Height of ES (m) | 0, 500, 1000 |  |
| 2.5 | ES noise temperature (K) | [250, 300] |  |
| 2.6 | Threshold C/N (dB) | [-2.5, 7, 12] |  |
|  |  |
| **3** | **Example Implementation – Link Calculation** | **First Case parametric taken for examples** | **Equations to Calculate Downlink Availability** |
| 3,1 | ES Peak gain (dBi) | 34.7 | 46.1 | 56.2 | 68.9 |  |
|  | *Interim step: calculate the latitude corresponding with the elevation, ε* |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 3.2 | Path length (km) | 39554.4 | 39554.4 | 39554.4 | 39554.4 |  |
| 3.3 | Path loss (dB) | 216.4 | 216.4 | 216.4 | 216.4 |  |
| 3.4 | Unfaded wanted single strength (dBW/MHz) | -138.8 | -127,3 | -117.2 | -104.5 |  |
| 3.5 | Noise plus margin (dBW/MHz) | -141.6 | -141.6 | -141.6 | -141.6 |  |
|  |
| **4** | **Validation Checks** |  |
| 4.1 | Margin for rain fade (dB) | 2.8 | 14.3 | 24.4 | 37.1 |  |
| 4.2 | *PFDval* (dB(W/(m2 · MHz))) | -118.9 | -118.9 | -118.9 | -118.9 |  |
| 4.3 | Delta from Article 21 | -11.4 | -11.4 | -11.4 | -11.4 |  |

The following checks are done to ensure the combination of Generic and Parametric Parameters are valid:

1. The dish size, D, should be in the range 0.16 m ≤ D ≤ 9m
2. The rain margin should be greater than zero Arain > 0
3. The calculated unavailability, p, should be in the range 0.001 ≤ p ≤ 10%
4. The PFD should be below the limits in Article 21

Table 2: Generic link parameters of GSO links to be used in examination of the uplink (Earth-space) impact from any one non-GSO network[[3]](#footnote-3)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Generic Link Parameters = service |  |  |  |  |
|   | Link type | Link #1 | Link #2 | Link #3 |  |
| 1.1 | Frequency band (GHz) |  |  |  |  |
| 1.2 | ES EIRP (dBW/Hz) |  |  |  |  |
| 1.3 | Spot beam size (deg) |  |  |  |  |
| 1.4 | ITU-R S.672 sidelobe level (dB) |  |  |  |  |
| 1.5 | ES antenna efficiency |  |  |  |  |
| 1.6 | Additional link losses (dB) |  |  |  |  |
| 1.7 | Additional link margin (dB) |  |  |  |  |
|  |  |
| **2** | **Generic Link Parameters -Parametric Analysis**  | **Parametric Cases for Evaluation** |  |
| 2.1 | e.i.r.p. density variation |  |  |
| 2.2 | Elevation angle (deg) |  |  |
| 2.3 | 0.01% Rain Rate (mm/hr)  |  |  |
| 2.4 | Height of ES (m) |  |  |
| 2.5 | Satellite noise temperature (K) |  |  |
| 2.6 | Threshold C/N (dB) |  |  |
|  |  |
| **3** | **Example Implementation – Link Calculation** | **First Case parametric cases taken for examples** | **Equations to Calculate Uplink Availability** |
| 3,1 | ES Peak gain (dBi) |  |  |  |  |
|  | *Interim step: calculate the latitude corresponding with the elevation, ε* |  |  |  |  |
|  |  |  |  |  |  |
| 3.2 | Path length (km) |  |  |  |  |
| 3.3 | Path loss (dB) |  |  |  |  |
| 3.4 | Unfaded wanted single strength (dBW/MHz) |  |  |  |  |
| 3.5 | Noise plus margin (dBW/MHz) |  |  |  |  |
|  |
| **4** | **Validation Checks** |  |
| 4.1 | Margin for rain fade (dB) |  |  |  |  |

The following checks are done to ensure the combination of Generic and Parametric Parameters are valid:

1. The rain margin should be greater than zero Arain > 0
2. The calculated unavailability, p, should be in the range 0.001 ≤ p ≤ 10%

ANNEX 2 TO RESOLUTION [EUR-A16-SingleEntry] (WRC-19)

Description of parameters and procedures for the evaluation of interference from a non-GSO system into global set of representative GSO links

This Annex provides the process to validate compliance with the single-entry permissible interference of a non-GSO system into GSO networks using the generic link parameters in Annex 1 and the worst-case geometry interference impact using the latest version of Recommendation ITU-R S.1503. The procedure to determine the compliance with the single-entry permissible interference relies on the following principles.

*Principle 1*: The two time-varying sources of link performance degradation considered in the verification are link fading (from rain, cloud, gas and scintillation attenuation) plus the characteristics of the link and interference from other FSS or BSS networks.

The total *C*/*N* in the reference bandwidth for a given carrier is:

 (1)

where:

 *C*: wanted power (W) in the reference bandwidth, which varies as a function of fades and as a function of transmission configuration

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

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

*Principle 2*: The calculation of spectral efficiency is focused on satellite systems utilizing adaptive coding and modulation (ACM) by calculating the throughput degradation as a function of C/N, which varies depending on the long-term propagation and interference impacts on the satellite link.

*Principle 3*: During a fading event in the downlink direction, the interfering carrier is attenuated by the same amount as the wanted carrier. This results in some under-estimation of the total downlink degradation under circumstances where interference peaks and fading occur simultaneously.

By applying the following steps, the single-entry interference impact from a non-GSO system on the availability and spectral efficiency of a GSO link is determined. The generic GSO link parameters of Annex 1 are used, considering all possible parametric permutations, in conjunction with the worst case geometry (“WCG”) epfd output of Recommendation ITU-R S.1503. The generic link parameters of Annex 1 are used to create a global set of representative GSO link budgets. The output of Recommendation ITU-R S.1503 is a set of interference statistics that a non-GSO system creates into each representative GSO link.

**For each generic GSO link from Annex 1:**

*Step 1*: Determine xfade,the probability distribution function (pdf) of the propagation fading plus other time variations in the characteristics of the generic GSO link. These statistics can be calculated using the procedures of the latest version of Recommendation ITU-R P.618.

*Step 2*: Determine yint, the interference impact into the generic GSO link from the non-GSO system under examination using the procedures of Recommendation ITU-R S.1503.

*Step 3*: Determine zconv, a modified discrete convolution of the rain degradation pdf (xfade), with the interference degradation pdf (yint). For each pair of degradation values, *X* and *Y* from xfade and yint, respectively, the convolved degradation value is determined by the product of the xfade(*X*) and yint(*Y*) degradation values (or equivalently, the sum of the log values in dB) and the combined probability, computed as the product of each of the individual probabilities, is added to the appropriate convolved degradation pdf, zconv(*Z*).

Since the assumption of statistical independence between rain degradation (xfade) and interference degradation (yint) does not account for propagation effects on the interference path, a modification to the classic convolution for the downlink direction is proposed to account for this. This modified convolution is equivalent to a regular discrete convolution with the exception that the interference degradation values (yi) are first reduced by the applicable rain attenuation, i.e., the jth rain loss value, (LR)j, from the rain degradation pdf bin (xj) for which it is being combined.

The probability density function (pdf) of *zconv* is the modified convolution of the pdf of *xfade* and *yint* The total *C*/*N* degradation *zconv* (dB) is therefore:

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

*Step 4:* Using the results of the modified convolution procedures to obtain the pdf zconv described above for the total degradation for the propagation fade xfade and the interference impact from the non-GSO system (yint), the conditions for the single-entry case can be verified:

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

Conditions to be verified for compliance are:

* U\_(R+I)<= 1.03 x U\_(R) (4)

Where U\_(R+I) is the unavailability time due to rain and interference, U\_(R) is the unavailability time due to rain only. This formula should be applied for the short term performance objectives of generic GSO reference links

* For the long term performance objective related to the spectral efficiency (SE) of the generic GSO links:

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

This procedure is repeated for each generic GSO link from Annex 1, considering all parametric permutations and validation checks.

Draft New Resolution [EUR-A16-AGG.SHARING]

Protection of geostationary FSS, BSS and MSS networks from the aggregate interference produced by multiple 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 and 40-40.5 GHz are allocated, on a primary basis to the mobile-satellite service (MSS) in all regions;

*d)* that Article **22** contains regulatory and technical provisions on sharing between 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 broadcasting-satellite service (BSS) networks and, unless otherwise specified in the Radio Regulations, shall not claim protection from GSO FSS and BSS satellite networks;

*f*) that non-GSO FSS systems would benefit from increased certainty that would result from the quantification of technical regulatory measures required for protection of GSO satellite networks operating in the bands referred to in *considering a), b)* and *c)* above;

*g)* that GSO FSS, MSS, and BSS networks can be protected without placing undue constraints on non-GSO FSS systems in the bands in *considering a), b) and c)* above;

*h)* that WRC-19 modified Article **22** to limit single-entry and aggregate permissible time allowance for degradation in terms of C/N by non-GSO FSS systems to GSO satellite networks,

*i)* that the operating parameters and orbital characteristics on non-GSO FSS systems are usually inhomogeneous;

*j)* that, as a result of this inhomogeneity, the time allowance for the *C*/*N* value specified in the short-term performance objective associated with the shortest percentage of time (lowest *C*/*N*) or decrease of the long-term throughput (spectral efficiency) caused to reference GSO FSS links by non-GSO FSS systems is likely to vary between such systems;

*k)* that, the aggregate interference levels from multiple non‑geostationary FSS systems will be related to the actual number of systems sharing a frequency band based on the single-entry operational use of each system;

*l)* that to protect GSO FSS, MSS, and BSS networks in the frequency bands listed in *considering* *a), b)* and *c)* from unacceptable interference, the aggregate impact of interference caused by all co-frequency non-GSO FSS systems should not exceed the maximum aggregate impact specified in No. **22.5M** of the Radio Regulations;

*m)* that to achieve the level of protection of GSO reference links, administrations operating or planning to operate non-GSO FSS systems will need to agree cooperatively through consultation meetings;

*n)* that the aggregate level of the time allowance for the *C*/*N* value specified in the short-term performance objective associated with the shortest percentage of time (lowest *C*/*N*) of GSO reference link is likely to be the summation of single-entry levels caused by non-GSO FSS systems,

recognizing

*a)* that non-GSO FSS systems may need to implement interference mitigation techniques, such as avoidance angles, earth station site diversity, and GSO arc avoidance to facilitate sharing frequencies among non-GSO FSS systems and to protect GSO networks;

*b)* that administrations operating or planning to operate non-GSO FSS systems will need to agree cooperatively through consultation meetings to share the aggregate interference impact allowance for all non-GSO FSS systems operating in the frequency bands listed in *considering* *a), b)* and *c)* in a manner that achieves the level of protection for GSO FSS, MSS and BSS networks that is stated in No. **22.5M** of the Radio Regulations;

*c)* that, taking into account the single-entry allowance in No. **22.5L,** the aggregated impact of all non-GSO FSS systems can be computed without the need for specialized software tools based on the results of the single-entry impact for each system;

*d)*the need for administrations operating non-GSO FSS systems in the frequency bands listed in *considering* *a)* to agree cooperatively through consultation meetings takes on particular urgency whenever there could be aggregate interference at levels higher than the aggregate impact allowance from operational non-GSO FSS systems;

*e)* that representatives of administrations operating or planning to operate GSO FSS, MSS and BSS networks are encouraged to be involved in the determinations made pursuant to *recognizing* *b)*;

*f)* that in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space‑to‑Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), signals experience high levels of attenuation due to atmospheric effects such as rain, cloud cover and gaseous absorption;

*g)* that given these expected high levels of fading, it is desirable for GSO networks and non-GSO FSS systems to implement fade counter measures such as automatic level control, power control and adaptive coding and modulation,

noting

*a)* that Resolution [EUR-A16-SingleEntry] contains the methodology for determining conformity to the single-entry limits to protect the GSO networks;

*b)* that Recommendation ITU-R S.1503 provides guidance on how to compute the epfd levels from a non-GSO system into GSO earth stations and satellites;

*c)* that Resolution [EUR-A16-SingleEntry] contains GSO satellite system characteristics to be used in non-GSO/GSO frequency sharing analyses in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz

resolves

1 that administrations operating or planning to operate non‑geostationary FSS systems in the frequency bands referred to in *considering a)* above, shall, in collaboration, take all necessary steps, including, if necessary, by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference impact to geostationary FSS, MSS and BSS satellite networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate limits specified in No. **22.5M**;

2 that to carry out the obligations in *resolves*1 above, administrations operating or planning to operate non-geostationary FSS systems shall agree cooperatively through regular consultation discussions referred to in *recognizing b)* to ensure that operations of all non-GSO networks do not exceed the aggregate level of protection for geostationary satellite networks;

3 that participation in the consultation process by administrations operating or planning to operate non-GSO FSS systems that are subject to this Resolution is required, and that failure by a responsible administration to participate in the consultation process does not relieve that administration of obligations under *resolves* 1 above, nor does it remove their systems from consideration in any aggregate calculations by the consultation group;

4 that *resolves 2 and 3* above begin to apply when a second non-geostationary FSS systems with frequency assignments in the frequency bands referred to in *considering a)* meets the criteria listed in Annex 2 to this Resolution;

5 that to carry out the obligations of *resolves 2* above*,* administrations shall use the generic and supplemental GSO satellite characteristics listed in Resolution [EUR-A16-SingleEntry] to determine the results of the aggregate impact to GSO networks;

6 that administrations (including representatives of administrations operating GSO FSS, MSS and BSS networks) participating in a consultation meeting are allowed to use their own software in conjunction with any software tools used by the BR for the calculation and verification of the aggregate limits, subject to the agreement of the consultation meeting;

7 that administrations, in carrying out their obligations under *resolves*1 above, shall take into account only those non-geostationary FSS systems with frequency assignments in the frequency bands referred to in *considering a)* above that have met the criteria listed in Annex 2 to this Resolution through appropriate information provided in the course of consultation discussions referred to in *resolves* 2;

8 that administrations, in developing agreements to carry out their obligations under *resolves*1 above, shall establish mechanisms to ensure that all potential FSS system and network notifying administrations and operators are given full visibility of and the opportunity to participate in the process;

9 that each administration, in the absence of an agreement reached at consultation meetings referred to in *resolves* 2, shall ensure that each of its non-geostationary FSS systems subject to this Resolution is operated in accordance with reduced single-entry interference impact allowances, calculated by the apportionment of the aggregate allowance commensurate to the number of simultaneously operating non-GSO systems, so as to ensure that the aggregate allowance in No. **22.5M** is not exceeded in operation;

10 that, in specific implementation of *resolves* 8above, if the consultation discussions show that there would be an exceedance of the aggregate allowance from non-GSO FSS systems in operation, every operational non-GSO FSS system shall reduce its emissions by means of appropriate modifications to their systems;

11 that the administrations participating at the consultation discussion referred to in *resolves 2* shall designate one convener to be responsible for communicating to the Bureau such as shown in Annex 1 that the results of the aggregate non-GSO system operational calculation and sharing determinations made in application of *resolves*1, 3 and 9 above, without regard to whether such determinations result in any modifications to the published characteristics of their respective systems providing a draft record of each consultation meeting, and posting the approved record,

invites the Radiocommunication Bureau

to participate in the consultation meetings in *resolves* 2 as an observer and to provide advice as necessary with respect to the results of the aggregate interference impact calculation performed according to *resolves*1,

instructs the Radiocommunication Bureau

1 to publish in the International Frequency Information Circular (BR IFIC), the information referred to in *resolves*11.

2 to exclude the aggregate calculations given in No. **22.5M** as part of a satellite network examination under **11.31**,

urges administrations

to provide the Radiocommunication Bureau and all participants to the consultation meetings with the methodology, assumptions, inputs and results from the calculation performed under *resolves* 5.

ANNEX 1 TO DRAFT NEW RESOLUTION [EUR-A16-AGG.SHARING] (WRC-19)

*Editorial note: the material of this Annex need to be further worked on. Alternatively, deletion should be considered.*

 List of geostationary networks characteristics and format of the result of the aggregate calculation to be provided to BR for
publication for information

I GSO network characteristics to be used in the calculation of aggregate emissions from non-GSO FSS systems

I-1 GSO network Characteristics

Generic and supplemental links

I-2 Non-GSO satellite system constellation parameters

For each non GSO satellite system, the following parameters should be provided to BR for publication in the aggregate calculation:

– Notifying administration;

– Number of space stations used in aggregate calculations;

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

# II Results of the aggregate epfd calculation

– Single entry use of each non-GSO FSS systems

ANNEX 2 DRAFT NEW TO RESOLUTION [EUR-A16-AGG.SHARING] (WRC-19)

**List of criteria for the application of *resolves* 7**

1 Submission of appropriate 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: Modify Article 22 to include a single-entry and aggregate interference limits, in order to protect GSO satellite networks from non-GSO FSS systems operating in the subject frequency bands and develop a new Resolution providing the procedure to ensure aggregate limits will not be exceeded.

PART II. Resolution 750

**Option A (non-GSO and GSO)**

RESOLUTION 750 (Rev.WRC‑19)

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

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

…

 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) band**1 |
| 36 – 37 GHz | 37.5 – 38 GHz | NGSO FSS(s‑to‑E) | For space stations operating with non-GSO systems having more than 1000 satellites at an altitude below 700 km brought into use after the date of entry into force of the Final Acts of WRC‑19:e.i.r.p. of -34 dBW into the 100 MHz of the EESS (passive) band above -18.6° elevation |
| … | … | … | … |
| 50.2-50.4 GHz | 49.7-50.2 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 with non-GSO systems 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 with GSO networks 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 below 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 or above 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 dBi For stations operating with non-GSO systems 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 with GSO networks 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 below 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 or above 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 |
| 1 The unwanted emission power level is to be understood here as the level measured at the antenna port.2 This limit does not apply to mobile stations in the IMT systems for which the notification information has been received by the Radiocommunication Bureau by 28 November 2015. For those systems, −60 dBW/27 MHz applies as the recommended value.3 The unwanted emission power level is to be understood here as the level measured with the mobile station transmitting at an average output power of 15 dBm.4 The limits apply under clear-sky conditions. During fading conditions, the limits may be exceeded by earth stations when using uplink power control. |

…

**Reasons:** To add unwanted emission power limits in the Earth-to-space direction in order to protect EESS (passive) in the band 50.2‑50.4 GHz from non-GSO FSS and GSO systems operating in the adjacent frequency bands 49.7-50.2 GHz and 51.4-52.6 GHz.

**Option B (non-GSO only)**

**MOD EUR/XXXA6/11**

RESOLUTION 750 (Rev.WRC‑19)

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

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

…

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) band**1** |
| 36 – 37 GHz | 37.5 – 38 GHz | NGSO FSS(s‑to‑E) | For space stations operating with non-GSO systems having more than 1000 satellites at an altitude below 700 km brought into use after the date of entry into force of the Final Acts of WRC‑19:e.i.r.p. of -34 dBW into the 100 MHz of the EESS (passive) band above -18.6° elevation |
| … | … | … | … |
| 50.2-50.4 GHz | 49.7-50.2 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:−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 with non-GSO systems 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 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:−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 with non-GSO systems 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 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 |
| 1 The unwanted emission power level is to be understood here as the level measured at the antenna port.2 This limit does not apply to mobile stations in the IMT systems for which the notification information has been received by the Radiocommunication Bureau by 28 November 2015. For those systems, −60 dBW/27 MHz applies as the recommended value.3 The unwanted emission power level is to be understood here as the level measured with the mobile station transmitting at an average output power of 15 dBm.4 The limits apply under clear-sky conditions. During fading conditions, the limits may be exceeded by earth stations when using uplink power control. |

…

**Reasons:** To add unwanted emission power limits in the Earth-to-space direction in order to protect EESS (passive) in the band 50.2‑50.4 GHz from non-GSO FSS systems operating in the adjacent frequency bands 49.7-50.2 GHz and 51.4-52.6 GHz.

**Option C (postpone to WRC-23 for 50.2-50.4 GHz band)**

**MOD EUR/XXXA6/11**

RESOLUTION 750 (Rev.WRC‑19)

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

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

…

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) band**1 |
| 36 – 37 GHz | 37.5 – 38 GHz | NGSO FSS(s‑to‑E) | For space stations operating with non-GSO systems having more than 1000 satellites at an altitude below 700 km brought into use after the date of entry into force of the Final Acts of WRC‑19:e.i.r.p. of -34 dBW into the 100 MHz of the EESS (passive) band above -18.6° elevation |
| … | … | … | … |
| 50.2-50.4 GHz | 49.7-50.2 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:−10 dBW5 into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi−20 dBW5 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:−10 dBW5 into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi−20 dBW5 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 |
| 1 The unwanted emission power level is to be understood here as the level measured at the antenna port.2 This limit does not apply to mobile stations in the IMT systems for which the notification information has been received by the Radiocommunication Bureau by 28 November 2015. For those systems, −60 dBW/27 MHz applies as the recommended value.3 The unwanted emission power level is to be understood here as the level measured with the mobile station transmitting at an average output power of 15 dBm.4 The limits apply under clear-sky conditions. During fading conditions, the limits may be exceeded by earth stations when using uplink power control.5 The limit is a temporary limit and shall be reviewed or confirmed by a subsequent WRC. |

…

**Reasons:** To add unwanted emission power limits in the Earth-to-space direction in order to protect EESS (passive) in the band 36‑37 GHz from non-GSO FSS systems operating in the adjacent frequency bands 37.5-38 GHz and postpone the decision to a next WRC in the band 50.2-50.4 GHz from non-GSO FSS systems operating in the adjacent frequency bands 49.7-50.2 GHz and 51.4-52.6 GHz.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. All values are TBD [↑](#footnote-ref-1)
2. All values are TBD [↑](#footnote-ref-2)
3. All values are TBD [↑](#footnote-ref-3)