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| **Radiocommunication Study Groups** |  |
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| Received: 7 September 2022Subject: WRC-23 agenda item 1.16Resolution **173 (WRC-19)** | **Document 4A/849-E** |
| **12 September 2022** |
| **English only** |
| Djibouti (Republic of), Egypt (Arab Republic of), Tunisia (Republic of), Saudi Arabia (Kingdom of), United Arab Emirates |
| Modification TO DRAFT CPM TEXT FOR WRC-23 AGENDA ITEM 1.16 |
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In accordance with the work plan of WRC-23 agenda item 1.16, Working Party 4A in its 7th meeting need to accomplish the work on the draft CPM text. The signatory of this contribution proposes some modifications to draft CPM text highlighted in yellow in the Attachment for the purpose of further progressing the work to be conducted under WRC-23 agenda item 1.16.

**Attachment:** 1

Attachment

PRELIMINARY DRAFT CPM TEXT AND DRAFT NEW RESOLUTION FOR WRC-23 AGENDA ITEM 1.16

NOTE: The way the interference management function is carried out is yet to be clarified and agreed upon.

In this connection the required sequence of actions to be taken, including the detection of interference, identification of source/origin, the reporting facilities as well as the timing action by the notifying administration of the satellite network responsible for the operation of ESIM together with the involvement of NCMC to cease or decrease the reported interference to an acceptable level need to be described in detail in contributions to WP 4A.

It is also necessary to describe the function of the NCMC and description of the mechanism to command the ESIM to command the action described above, as well as the way in which the ESIM would cease emission/transmission approaching to the countries which are neither in the service area nor given the authorization for ESIM operation need to be described clearly in the above-mentioned contributions to WP 4A.

NOTE: This document includes initial CPM text based on inputs received at the October/November 2021 and May 2022 meetings of WP 4A, including discussions and comments received at those meeting. This document was presented and generally discussed and yet to be agreed upon. The membership is invited to provide its comments, suggestions and amendments to the draft new Resolution, which might have direct or indirect impact to the preliminary draft CPM text

CHAPTER 4

Satellite issues

(Agenda items 1.15, 1.16, 1.17, 1.18, 1.19, 7)

Agenda item 1.16

**(WP 4A / WP 3M, WP 4C, WP 5A, WP 5B, WP 5C, WP 7B, WP 7C)**

*1.16 to study and develop technical, operational and regulatory measures, as appropriate, to facilitate the use of the frequency bands 17.7-18.6 GHz and 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by non-GSO FSS earth stations in motion, while ensuring due protection of existing services in those frequency bands, in accordance with Resolution* ***173 (WRC-19)****;*

Resolution **173 (WRC-19)** – *Use of the frequency bands 17.7-18.6 GHz and 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by earth stations in motion communicating with non-geostationary space stations in the fixed-satellite service*

[Editor’s note: There may be a need to address sharing issues related to overlapping frequency bands 18.1-18.6 GHz, 29.5-30.0 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz considered under WRC‑23 agenda item 1.17, as studies carried in agenda item 1.17 mature.]

# 4/1.16/1 Executive summary

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WRC-23 agenda item 1.16 considers the use of the frequency 17.7-18.6 GHz and 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by earth stations in motion communicating with non-geostationary (non-GSO) space stations in the fixed-satellite service (FSS). The studies under this agenda item considered two types of ESIM: aeronautical, maritime only, depending on the type of vehicle on which they are installed. Studies have been carried out on sharing and compatibility between ESIM and terrestrial as well as space services allocated in the frequency bands above. The studies carried out so far have identified example provisions to protect such services and example guidelines to assist an administration wishing to authorize ESIM to operate on the territory under its jurisdiction. For this agenda item, two methods have been identified: Method A This method proposes no changes to the RR and suppression of Resolution 173(WRC-19). Method B This method proposes to add a new footnote No. 5.A116 in RR Article 5 and a reference to a new WRC Resolution providing the conditions for the operation of ESIM and protection of the services to which the frequency bands are allocated, and consequential suppression of Resolution 173 (WRC-19).

# 4/1.16/2 Background

ESIMs (earth stations in motion) under agenda item (AI) 1.16 are earth stations that communicate with non‑geostationary (non-GSO) space stations in the fixed-satellite service (FSS) in the bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space)and operate on mobile platforms.

While *resolves* 1 and 2 of Resolution **173 (WRC-19)** do not specifically refer to the type of ESIMs, however *resolves* 3 of that Resolution specifically refers to aeronautical and maritime ESIMs. Therefore, technical and regulatory provisions for the operation of the abovementioned ESIMs under AI 1.16 are limited to aeronautical and maritime ESIMs.

ESIMs can be used to provide broadband communications to mobile platforms.

There are a number of differences between geostationary satellite networks and non-geostationary satellite systems, including the number, the altitude and the coverage of space stations. The impact of these differences and, in particular, the interference environment resulting from the operation of non-GSO aeronautical and maritime ESIMs, has been studied in order to develop technical, operational and regulatory provisions for their operations in the frequency bands subject to Resolution **173 (WRC-19)**.

# 4/1.16/3 Summary and analysis of the results of ITU-R studies

## 4/1.16/3.1 Technical and operational requirements of ESIMs operating with non-GSO FSS space stations

One of the key components of non-GSO ESIMs is the Antenna Control Unit (ACU) which performs two main functions. First, it detects and cancels relative movements of the ship or airplane in any direction to ensure the antenna maintain an accurate pointing toward the satellite with which the non-GSO ESIMs communicate. Secondly, the ACU performs a closed loop tracking of the satellite signal to ensure accurate pointing of the antenna towards the satellite.

There is a need that the notifying administration of the satellite system through appropriate facilities established for the operation of ESIMs (e.g., Network Control and Management Center (NCMC)) ensures that ESIMs operates only in territories for which its operation is authorized by the administration having the jurisdiction on that territory.

In addition, there is a need that the notifying administration of the satellite system through appropriate facilities established for the operation of ESIMs (e.g., NCMC) monitors the operation of such an earth station to determine if it is malfunctioning (including if there is any change in its nominal operations). In case a malfunctioning is determined, the notifying administration of the satellite system through NCMC should send to the malfunctioning ESIMs a “disable transmission” command.

There is also the need that the notifying administration of the satellite system through NCMC cease transmissions immediately upon receipt of a report of unacceptable interference or reduce the interference to an acceptable level. The function of the NCMC could also include transmission level adjustment, frequency or modulation change, confirming antenna pointing accuracy and other requirements, ensuring that the operation of ESIM meets the applicable technical and regulatory requirements in the Radio Regulations as well as those required in national authorizations.

NOTE: There is the need to explore how the term “immediately” could be implemented.

*NOTE: the way the interference management function is carried out is yet to be clarified and agreed upon.*

*In this connection the required sequence of actions to be taken, including the detection of interference, identification of source/origin, the reporting facilities as well as the timing action by the notifying administration of the satellite network responsible for the operation of ESIM together with the involvement of NCMC to cease or decrease the reported interference to an acceptable level need to be described in detail in contributions to WP 4A.*

*It is also necessary to describe the function of the NCMC and description of the mechanism to command the ESIM to command the action described above, as well as the way in which the ESIM would cease emission/transmission approaching to the countries which are neither in the service area nor given the authorization for ESIM operation need to be described clearly in the above-mentioned contributions to WP 4A.*

The notifying administration of the associated satellite system needs to ensure that ESIMs comply with all provisions that may be included in a new WRC Resolution and all applicable provisions of the Radio Regulations. To this effect, the notifying administration of the satellite system need to ensure that ESIMs comply with the epfd limits specified in the Radio Regulations and/or any other limits or operational constraints contained in coordination agreements reached pursuant to Nos. **9.7B,** **9.11A**, **9.12**, **9.12A** or **9.13** of the Radio Regulations for the protection of other satellite networks and systems.

## 4/1.16/3.2 Identification of services allocated in these bands

In accordance with Resolution **173 (WRC-19)**, non-GSO ESIMs communicating with FSS space stations should protect the existing services to which the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz, 19.7-20.2 GHz, 27.5-29.1 GHz and 29.5-30 GHz are allocated, in addition to protecting Earth exploration-satellite service (EESS) (passive) and space research service (SRS) (passive) in the adjacent frequency bands.

The following table summarizes the services which should be protected from the operation of non-GSO ESIMs in the concerned frequency bands.

Table 1

[Editor’s note: The membership is invited to review this table and provide amendments to the September 2022 WP 4A meeting.]

| Frequency range (GHz) | ESIMs direction of transmission | Service allocation | Existing provisions in the RR relevant to sharing between non-GSO FSS and other allocated services |
| --- | --- | --- | --- |
| Terrestrial services | Space services |
| 17.7-17.8 | space-to-Earth | FIXED |  | Article **21** |
| MOBILE |  | Article **21** |
|  | GSO FSS (space-to-Earth) | RR No. **22.2**  |
|  | GSO FSS (Earth-to-space) | RR No. **22.2**  |
|  | BSS | RR No. **22.2**  |
|  | Non-GSO FSS (space-to-Earth) | **9.12** |
| 17.8-18.4 | space-to-Earth | FIXED |  | Article **21** |
| MOBILE |  | Article **21** |
|  | GSO FSS (space-to-Earth) | RRNos. **22.5C** and **22.5CA** […] |
|  | GSO FSS (Earth-to-space) | Applicable parts of RR No. **22.2** as contained in Note 1 belowand **22.5F**, NOTE 1 |
|  | Non-GSO FSS (space-to-Earth) | **9.12** |
|  | Meteorological satellite service | **5.519** |
| 18.4-18.6 | space-to-Earth | FIXED |  | Article **21** |
| MOBILE |  | Article **21** |
|  | GSO FSS (space-to-Earth) | Article **22**, No. **22.2**1 |
|  | Non-GSO FSS (space-to-Earth) | **9.12** |
| 18.6-18.8 |  |  | EESS (passive)SRS (passive) | **5.522B, 21.16.2** |
| 18.8-19.3 | space-to-Earth | FIXED |  | Article **21** |
| MOBILE |  | Article **21** |
|  | GSO FSS (space-to-Earth) | **9.12A** |
|  | Non-GSO FSS (space-to-Earth) | **9.12** |
| 19.7-20.2 | space-to-Earth |  | GSO FSS (space-to-Earth) | Article **22**, No. **22.2**1 |
|  | Non-GSO FSS (space-to-Earth) | **9.12** |
|  | MSS | No relevant provision |
| FIXED |  | **5.524** |
| MOBILE |  | **5.524** |

NOTE 1: The non-geostationary-satellite systems referred to in the parts of the Table above, shall not claim protection from geostationary satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with the Radio Regulations. RR No. **5.43A** does not apply in this case.

*This Note is derived from relevant parts of RR No.* ***22.2****.*

| Frequency range (GHz) | ESIMs direction of transmission | Service allocation | Existing provisions in the RR relevant to sharing between non-GSO FSS and other allocated services |
| --- | --- | --- | --- |
| Terrestrial services | Space services |
| 27.5-28.5 | Earth-to-space | FIXED |  | No relevant provision |
| MOBILE |  | No relevant provision |
|  | GSO FSS (Earth-to-space) | Article **22**, No. **22.2**1, |
|  | Non-GSO FSS (Earth-to-space) | **9.12** |
| 28.5-28.6 | Earth-to-space | FIXED |  | No relevant provision |
| MOBILE |  | No relevant provision |
|  | GSO FSS (Earth-to-space) | Article **22**, No. **22.2**1, |
|  | Non-GSO FSS (Earth-to-space) | **9.12** |
|  | Earth exploration-satellite service | No relevant provision |
| 28.6-29.1 | Earth-to-space | FIXED |  | No relevant provision |
| MOBILE |  | No relevant provision |
|  | GSO FSS (Earth-to-space) | **9.12A** |
|  | Non-GSO FSS (Earth-to-space) | **9.12** |
|  | Earth exploration-satellite service | No relevant provision |
| 29.5-30 | Earth-to-space |  | GSO FSS (Earth-to-space) | Article **22**, No. **22.2**1, |
|  | Non-GSO FSS (Earth-to-space) | **9.12** |
|  | Earth exploration-satellite service | No relevant provision |
|  | MSS | No relevant provision |
|  | Fixed |  | **5.542** |
|  | Mobile |  | **5.542** |

The following sections include details of the sharing and compatibility studies.

## 4/1.16/3.3 Sharing with terrestrial services (fixed and mobile)

### 4/1.16/3.3.1 Frequency bands 17.7-18.6 GHz and 18.8-19.3 GHz

There are pfd limits in RR Article **21** to protect terrestrial services from FSS space station emissions. Therefore, whether an FSS space station communicates with a stationary terminal or with an ESIMs, the interference environment with respect to receiving fixed and mobile service stations would be unchanged as long as the applicable provisions of RR Article **21** do not change.

In this frequency bands, non-GSO ESIMs receivers shall not claim protection from terrestrial services to which the frequency bands are allocated.

### 4/1.16/3.3.2 Frequency band 19.7-20.2 GHz

This frequency band is allocated to fixed and mobile services on a primary basis in some countries in accordance with RR No. **5.524**.

In this frequency band, non-GSO ESIMs receivers shall not claim protection from terrestrial services to which the frequency band is allocated.

[Editor’s note: the May 2022 meeting of WP 4A discussed the above draft CPM text in detail.]

### 4/1.16/3.3.3 Frequency band 27.5-29.1 GHz

In this band, there is no coordination procedure between non-GSO ESIMs and terrestrial services as stated in *considering k)* of Resolution **173 (WRC-19)**. Therefore, sharing studies between non-GSO ESIMs in the frequency band 27.5-29.1 GHz and terrestrial services are required

[Editor’s note: USA proposes deletion of the paragraph above, Canada proposes amendments]

Reason for deletion: this text is repeated below in section 3.3.3.1 and 3.3.3.2

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ESIMs

#### [Editor’s note: USA and Canada propose to delete the table above]4/1.16/3.3.3.1 Sharing between Aeronautical non-GSO ESIMs with terrestrial services

Table 2

Summary of sharing studies between A-ESIMs and FS stations

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Study A | Study B | Study H-1 | Study C | Study H-2 | Study H-3 | Study H-4 | Study F | Study J |
| Type of Study | Worst-case flight geometrySingle entry | Worst-case flight geometrySingle entry | Worst-case flight geometrySingle entry | Worst-case flight geometryAggregate effect | Worst-case flight geometrySingle entry | Dynamic – Monte CarloSingle Entry | Dynamic – Monte CarloAggregate effect | Worst-case flight geometrySingle entry | Dynamic – Air traffic dataAggregate effect |
| Results | Interference protection criteria not exceeded for any altitude or deployment type | Interference protection criteria not exceeded for altitude 2 km and above. The long-term protection criterion exceeded for 1 km | Interference protection criteria not exceeded | Interference protection criteria not exceeded for any of deployment scenarios | Interference protection criteria not exceeded in any altitude | Interference protection criteria not exceeded in any altitude or location | Interference protection criteria not exceeded in any altitude or location | Interference protection criteria not exceeded for any altitude | Interference protection criteria not exceeded for any of deployment scenarios |

[Editor’s Note: the table above is a summary of Table 1.1 included in Annex 16 to Doc. 4A/522]

Table 3

Summary of sharing studies between A-ESIMs and MS stations

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Study I-1 | Study D | Study E-Airborne Case | Study E-Ground Operations Case | Study I-2 | Study I-3 | Study I-4 | Study J | Study G |
| Type of Study | Worst-case flight geometrySingle entry | Worst-case flight geometrySingle entry | Worst-case geometrySingle entry | Worst-case ground geometrySingle entry | Worst-case flight geometrySingle entry | Dynamic – Monte CarloSingle Entry | Dynamic – Monte CarloAggregate effect | Worst-case flight geometrySingle entry | Dynamic – Air traffic dataAggregate effect |
| Results | Interference protection criteria not exceeded | Interference protection criteria not exceeded for altitude 2 km and above. The long-term protection criterion exceeded for 1 km | In majority of the cases the interference protection criterion is exceeded | In majority of the cases the interference protection criterion is exceeded | Interference protection criteria not exceeded in any altitude | Interference protection criteria not exceeded in any altitude or location | Interference protection criteria not exceeded in any altitude or location | Interference protection criteria not exceeded for any altitude | Interference protection criteria not exceeded for any of deployment scenarios |

[Editor’s note: The table above is a summary of Table 1.2 included in Annex 16 to Doc. 4A/522]

The ITU-R examined sharing conditions between aeronautical non-GSO ESIMs and terrestrial services in the 27.5‑29.1 GHz frequency band and concluded that there would be potential interference to receiving stations of terrestrial services from ESIMs transmitters, if operational and regulatory measures are not applied. Therefore, aeronautical and maritime ESIMs should operate under the specified technical, operational and regulatory conditions to avoid causing unacceptable interference to receiving stations of terrestrial services operating in accordance with RR. Result of the conducted sharing studies are included in working document [Doc #, Section #]. Further information is provided in the relevant parts of the draft new Resolution **[A116] (WRC-23)**.

#### 4/1.16/3.3.3.2 Sharing between Maritime non-GSO ESIMs with terrestrial services

Studies analysed the interference that would be received by fixed service and mobile service stations from maritime ESIMs (M-ESIMs) operating with a non-GSO FSS constellation in the Earth-to-space direction in the 27.5-29.1 GHz considering the limits agreed in Resolution **169 (WRC-19)**.

Up to 7 vessels passes per day were considered taking into account the maritime traffic in the busiest ports in the world. Furthermore, a number of conservative assumptions were considered (100% duty cycle, no antenna polarization mismatch, no rain fade, no clutter loss or terrain, no body loss,..).

In all cases the results show that the protection criteria of the FS and MS stations is met assuming the non-GSO M-ESIMs complies with the minimum distance from the low-water mark (70 km) agreed in Resolution **169 (WRC-19)** for protection of terrestrial service from GSO M‑ESIMs The ITU-R examined sharing conditions between maritime ESIMs and terrestrial services in the 27.5-29.5 GHz frequency band and concluded that there would be potential interference to receiving stations of terrestrial services from maritime non-GSO ESIMs transmitters. However, when the mitigations are applied by the maritime non-GSO ESIMs, interference is kept within acceptable levels. Therefore, maritime ESIMs should operate under the specified technical, operational and regulatory conditions to avoid causing unacceptable interference to receiving stations of terrestrial services operating in accordance with RR. Result of the conducted sharing studies are included in working document [Doc #, Section #].

### Further information is provided in the relevant parts of the draft new Resolution **[A116] (WRC-23)**. 4/1.16/3.3.4 Frequency band 29.5-30 GHz

This frequency band is allocated to fixed and mobile services on a secondary basis in some countries in accordance with RR No. **5.542**.

In this band, there is no coordination procedure between non-GSO ESIMs and terrestrial services as stated in *considering k)* of Resolution **173 (WRC-19)**. Therefore, sharing studies between non-GSO ESIMs in the frequency band 29.5-30 GHz and terrestrial services are required for protection of fixed and mobile services in the administrations mentioned in RR No. 5.542 in this frequency band.

## 4/1.16/3.4 Sharing with space services

### 4/1.16/3.4.1 Fixed-satellite service

#### 4/1.16/3.4.1.1 GSO FSS networks

##### 4/1.16/3.4.1.1.1 Frequency band 17.7-17.8 GHz

In this band, the provision of RR No. **22.2** apply, therefore, non-GSO FSS systems, shall not cause unacceptable interference to and shall not claim protection from GSO FSS and BSS.

In addition, in this band, GSO FSS earth stations and non-GSO ESIMs are both receiving; therefore, no interference can be caused by non-GSO ESIMs into the GSO FSS receiving earth stations.

##### 4/1.16/3.4.1.1.2 Frequency bands 17.8-18.6 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz and 29.5‑30 GHz

Article **22** includes epfd limits for non-GSO FSS systems in the frequency bands 17.8‑18.6 GHz, 19.7-20.2 GHz (space-to-Earth), 27.5-28.6 GHz (Earth-to-space), and 29.5-30 GHz (Earth-to-space) for protection of GSO networks from non-GSO systems.

Therefore, non-GSO ESIMs operating in these bands shall comply with the applicable Article **22** epfd limits to protect GSO networks.

In addition, in accordance with the provisions of RR No. **22.2**, non-GSO satellite system shall not claim protection from geostationary-satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations. RR No. 5.43A does not apply in this case.

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ESIMs

##### 4/1.16/3.4.1.1.3 Frequency bands 18.8-19.3 GHz and 28.6-29.1 GHz

In these frequency bands, non-GSO FSS networks are subject to coordination under RR No. **9.12A** with GSO FSS networks therefore the interference environment for GSO FSS is expected to remain unchanged.

#### 4/1.16/3.4.1.2 Non-GSO FSS systems in the frequency bands 17.7-18.6 GHz, 18.8‑19.3 GHz, 19.7-20.2 GHz, 27.5-29.1 GHz and 29.5-30 GHz

In these frequency bands non-GSO FSS networks are subject to coordination under RR No. **9.12** with other non-GSO FSS networks, therefore, the interference environment for non-GSO FSS is expected to remain unchanged.

[Reason for deletion: the bands 19.3-19.7 GHz and 29.1-29.5 GHz are outside of the scope of Resolution **173 (WRC-19)**]

Editor’s note: CEPT supports deletion of 4.1.16/3.5.1.3.1 Frequency band 29.1-29.5 GHz and 4/1.16/3.5.1.3.2 Frequency band 19.3-19.7 GHz

#### 4/1.16/3.4.1.3 Broadcasting-satellite service feeder-link

##### [4/1.16/3.4.1.3.1 Frequency band 17.7-18.4 GHz

In this band, non-GSO ESIMs are receiving and GSO FSS satellites with which BSS feeder link earth stations are transmitting. Therefore, no potential interference may be caused by non-GSO ESIMs to feeder link to the BSS.

ESIMs shall not claim protection from BSS feeder link earth stations operating in accordance with the Radio Regulations.]

##### 4/1.16/3.4.1.3.2 Frequency bands 27.5-28.6 GHz and 29.5-30 GHz

In this band, non-GSO ESIMs are transmitting and GSO FSS satellites with which BSS feeder link earth stations communicate are receiving.

Article **22** includes EPFD limits for non-GSO FSS systems in these frequency bands for protection of GSO FSS networks from non-GSO systems. Therefore, non-GSO ESIMs operating in these bands shall comply with the applicable Article **22** EPFD limits to protect GSO FSS satellites with which BSS feeder-link earth stations communicate.

**4/1.16/3.4.1.3.3 Frequency band 28.6-29.1GHz**

Non-GSO ESIMs should be operated within the envelope of the characteristics and envelope of coordination of typical earth stations of the non-GSO FSS systems initially published and included in the International Frequency Information Circular (BR IFIC) to protect GSO FSS satellites with which BSS feeder-link earth stations communicate, in this frequency band as stated in *considering further d)* of Resolution **173 (WRC-19)**.

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### 4/1.16/3.4.2 Broadcasting-satellite service in the frequency band 17.7-17.8 GHz in Region 2

In this band, GSO FSS earth stations and non-GSO ESIMs are both receiving; therefore, no interference can be caused by non-GSO ESIMs into the GSO FSS receiving earth stations.

In addition, in this band RR No. **22.2** applies. Therefore, therefore, non-GSO FSS systems, shall not cause unacceptable interference to and shall not claim protection from GSO FSS and BSS.

### 4/1.16/3.4.3 Mobile-satellite service in the frequency bands 19.7-‑20.2 GHz and 29.5-‑30 GHz

To date, No ITU-R Recommendations or Reports related to the characteristics of MSS systems operating in these bands have been identified .

### 4/1.16/3.4.4 Space-to-space communication for Earth exploration-satellite service in the frequency band 29.95-30 GHz

In order to protect space-to-space communications for the Earth exploration-satellite service, in the frequency band 29.95-30 GHz non-GSO ESIMss should be operated within the envelope of the characteristics of typical earth stations of the non-GSO FSS systems initially published and included in the International Frequency Information Circular (BR IFIC.

### 4/1.16/3.4.5 Earth exploration-satellite service (passive) and space research service (passive)

#### 4/1.16/3.4.5.1 Frequency band 18.6-18.8 GHz

The EESS (passive) is allocated on a primary basis in all three ITU Regions, while the SRS (passive) is primary in Region 2 in the 18.6-18.8 GHz frequency band; the two services are adjacent to the bands proposed for use by FSS non-GSO downlink to ESIMs. As SRS (passive) consists in sensors on board spacecraft around other planets or telescopes looking towards outer space, no interference is expected on this service.

Four compatibility studies between non-GSO FSS space stations operating in the 17.8-18.6 GHz and 18.8-19.3 GHz bands and EESS (passive) stations operating in the 18.6-18.8 GHz band have been performed.

Study 1: [The FSS downlink signal for communication with ESIMs is unchanged from the FSS downlink signal that is used for fixed FSS earth stations. Further analysis would verify whether a non-GSO FSS earth station receiving these transmissions would alter the adjacent band FSS interference environment to the primary EESS (passive) or SRS (passive) band from what is currently permitted by the International Radio Regulations. Given the ESIMs concept of operations and technical characteristics for this agenda item, the non-GSO FSS space stations will operate in the same manner as traditional non-GSO FSS space stations (i.e., in the space-to-Earth direction with no change in transmit parameters), and ESIMs stations would only be receiving the same downlink transmissions that are also being directed to the Earth’s surface in accordance with current international regulatory provisions applicable to the non-GSO FSS. ESIMs

Taking the above into account, as long as the non-GSO FSS downlink signal for communication with ESIMs stations is unchanged from the non-GSO FSS downlink signal that is used for fixed FSS earth stations and ESIMs stations maintain the same operations for the non-GSO FSS that are currently in conformity with the international Radio Regulations~~.~~, additional sharing and compatibility studies with primary EESS (passive) and SRS (passive) may not be required in this adjacent frequency band.]

Study 2: The introduction of shipborne or airborne ESIMs with non-GSO FSS in Ka-band will lead to an increase of the number of FSS beams covering the oceans compared to the current situation, which is limited to coverage of fixed earth stations, e.g. located on islands and oil rigs. As a result, it will lead to an increase of the interference to EESS (passive) in the band 18.6-18.8 GHz, in particular in open oceans, due to scattering over water of FSS unwanted emissions.

Based on the current studies, it has been determined that the unwanted emission pfd at the Earth’s surface that would offer protection to EESS (passive) from these scattered unwanted emissions falling into the passive band would be in the range of −125 to −118 dBW/m²/200 MHz for the two particular non-GSO FSS systems considered.

Study 3: This study showed that non-GSO FSS out-of-band power flux density at the earth’s surface of −126.4 dB(W/(m2 · 200 MHz)) within the 18.6-18.8 GHz frequency band will meet the EESS (passive) protection criteria in this frequency band.

Study 4: This study investigates the possible changes to the current sharing environments in 18.6‑18.8 GHz based on introduction of non-GSO ESIMs while considering the recently developed sea reflection model. The result showed that the protection criteria of the EESS passive is not exceeded. Furthermore, it is shown that out-of-band operation of non-GSO FSS does not impact the sharing condition, and that the interference environment is driven by in-band interference from other primary services.

USA note: As reflected in the companion working document containing the studies, both of the studies 3 and 4 above are preliminary, and will be updated, as appropriate, for the September 2022 WP 4A meeting.

Canada Note: Several assumptions in this study do not represent actual operations of non-GSO satellite constellation, mainly due to unavailability of operational information at the time of the study.

The study considers that one beam is used in the entire field of view of the non-GSO satellite. Employing frequency reuse and dividing the field of view into multiple beams that selectively switch on only in the presence of ESIMs would minimize the occurrences when the EESS sensor beam fully or partially overlaps with the FSS beam. Furthermore, some operators operate at a significantly lower PFD than the maximum allowed PFD limit which is currently used in the study.

Taking these points into consideration would lead to results that are more representative of real life operations and would likely show a reduced impact of ESIMs into EESS receivers.

#### 4/1.16/3.4.5.2 Frequency band 28.5-29.1 GHz and 29.5-30 GHz2 (Earth-to-Space)

In these bands, non-GSO ESIMs are transmitting and EESS space stations are receiving. There is potential interference from non-GSO ESIMs to EESS space station in these bands.

The use of ESIMs in the 28.6-29.1 GHz and 29.5-30 GHz frequency bands would not change the current interference environment with respect to the secondary EESS in the 28.5-30 GHz range, as non-GSO ESIMs should be operated within the envelope of the characteristics and envelope of coordination of typical earth stations of the non-GSO FSS systems initially published and included in the International Frequency Information Circular (BR IFIC) as stated in *considering further d)* of Resolution **173 (WRC-19)**.

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*ESIMs*1 The frequency band 19.7-20.1 GHz and 29.5-29.9 GHz is allocated to mobile satellite services as a primary service in Region 2 only.

2 The frequency band 28.5-30 GHz is allocated to earth exploration satellite service as a secondary service.

3 The frequency band 18-18.3 GHz is allocated to meteorological satellite services as a primary service in Region 2 only. The frequency band 18.1-18.4 GHz is allocated to meteorological satellite service as a primary service in Region 1 and Region 3 only.

### 4/1.16/3.4.6 Meteorological-satellite service in the frequency band 18-18.4 GHz3

In this frequency band the meteorological-satellite earth station and non-GSO ESIMs are both receiving. RR No. **5.519** allocates the bands 18-18.3 GHz in Region 2 and 18.1-18.4 GHz in Regions 1 and 3 to the meteorological-satellite service (space-to-Earth) on a primary basis. Therefore, the interference environment with respect to meteorological-satellite receiving stations would be unchanged as long as the non-GSO FSS space stations transmitting to aeronautical and maritime non-GSO ESIMs will operate in the same manner as traditional non-GSO FSS space stations (i.e., in the space-to-Earth direction with no change in transmit parameters).

4/1.16/3.4.7 Potential satellite-to-satellite links NOTE: Provisions with regards to satellite-to-satellite links may be determined by WRC‑23 under agenda item 1.17.

[Editor’s note: the title of this sub section may need to be changed based on the decision of WRC-23 towards AI1.17]

**4/1.16/3.4.7.1 frequency bands 18.1-18.6 GHz,18.8-19.3 GHz and 19.7-20.2 GHz**

In these frequency bands, non-GSO ESIMs are receiving. Therefore, the interference environment for potential satellite-to-satellite links is expected to remain unchanged in these frequency bands.

**4/1.16/3.4.7.2 frequency bands 27.5-29.1 GHz and 29.5-30 GHz**

In these frequency bands, non-GSO ESIMs characteristics should remain within the envelope characteristics of typical earth stations associated with the satellite system with which these earth stations communicate. Therefore, the coexistence of non-GSO ESIMs with potential satellite-to-satellite links should be ensured through the same measures established for the coexistence with FSS under agenda item 1.17, if any.

## 4/1.16/3.5 Interference management and mitigation mechanism

.*[Reason for deletion: repeating the same ideas as those stated in the paragraphs just below]*

The only administration that is responsible in case interference occurs is the notifying administration of the satellite system under which the ESIM would operate.

Prior agreement of the authorizing administration is required before any of the ESIM under this agenda item can use spectrum in its airspace or territorial water.

The authorizing administration of ESIM in its airspace or territorial water wouldn’t be responsible on the operation of this type earth stations.

**4/1.16/3.5.1** **Course of actions to be followed in case of unacceptable interference**

in case that interference caused by the operation of ESIM terminals to the terrestrial or space services of other administrations, the appropriate course of action and operational procedure on how rapidly reduce the interference to the acceptable level or its elimination is addressed as following:

1. Interference occurrence to station(s) in territory of administration other than the notifying administration of the satellite system under which the ESIM would operate.
2. The affected administration in cooperation with the notifying administration of the satellite system under which the ESIM would operate detect the location of the source of the interference.
3. The affected administration informs the notifying administration of the satellite system under which the ESIM would operate and the point of contact for the ESIM with all available information about interference case.
4. The NCMC commands the ESIM to disable the transmission.
5. The notifying administration of the satellite system under which the ESIM would operate informs the affected administration with the disable of the transmission.
6. The notifying administration of the satellite system under which the ESIM would operate investigate the root cause of the interference and take action from the following options based on the reason of the interference.
	1. Request the NCMC to transmission level adjustment, frequency or modulation change, antenna pointing accuracy change or others.
	2. Submit to the BR the modified characteristics of ESIM to comply with the technical .and operational requirements in the RR.

# 4/1.16/4 Methods to satisfy the agenda item

[Editor’s note: Additional methods may be considered in the future.]

[TBD]

[Reason for deletion: superseded, as it was decided for the draft new Resolution **[A116] (WRC-19)** to be part of the draft CPM text for this agenda item]

## 4/1.16/4.1Method A

No changes to the Radio Regulations and suppression of Resolution **173 (WRC-19)**.

4/1.16/4.2Method B

Add a new footnote in RR Article **5** that refers to a new WRC Resolution with technical, operational and regulatory conditions for the operation of non-GSO maritime and aeronautical ESIMs while ensuring protection of allocated services and consequential suppression of Resolution **173 (WRC-19)**.

# 4/1.16/5 Regulatory and procedural considerations

4/1.16/5.1 For Method A

NOC

ARTICLES

NOC

APPENDICES

SUP

RESOLUTION 173 (WRC‑19)

Use of the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by
earth stations in motion communicating with non-geostationary space stations
in the fixed-satellite service

4/1.16/5.2 For Method B

ARTICLE 5

Frequency allocations

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

MOD

15.4-18.4 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| ... |
| 17.7-18.1FIXEDFIXED-SATELLITE(space-to-Earth) 5.484A 5.517A ADD 5.A116(Earth-to-space) 5.516MOBILE | 17.7-17.8FIXEDFIXED-SATELLITE(space-to-Earth) 5.517 5.517A ADD 5.A116(Earth-to-space) 5.516BROADCASTING-SATELLITEMobile5.515 | 17.7-18.1FIXEDFIXED-SATELLITE(space-to-Earth) 5.484A 5.517A ADD 5.A116(Earth-to-space) 5.516MOBILE |
|  | 17.8-18.1FIXEDFIXED-SATELLITE(space-to-Earth) 5.484A 5.517A ADD 5.A116(Earth-to-space) 5.516MOBILE5.519 |  |
| 18.1-18.4 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.517A ADD 5.A116(Earth-to-space) 5.520 MOBILE 5.519 5.521 |

MOD

18.4-22 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| 18.4-18.6 FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.517A ADD 5.A116 MOBILE |
|  |  |  |
|  |  |  |
| 18.8-19.3 FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.517A 5.523A ADD 5.A116 MOBILE |
|  |
| 19.7-20.1FIXED-SATELLITE(space-to-Earth) 5.484A 5.484B 5.516B 5.527A ADD 5.A116Mobile-satellite (space-to-Earth) | 19.7-20.1FIXED-SATELLITE(space-to-Earth) 5.484A 5.484B 5.516B 5.527A ADD 5.A116MOBILE-SATELLITE(space-to-Earth) | 19.7-20.1FIXED-SATELLITE(space-to-Earth) 5.484A 5.484B 5.516B 5.527A ADD 5.A116Mobile-satellite (space-to-Earth) |
| 5.524 | 5.524 5.525 5.526 5.527 5.528 5.529 | 5.524 |
| 20.1-20.2FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.516B 5.527A ADD 5.A116 MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528 |
|  |
| … |

MOD

24.75-29.9 GHz

|  |
| --- |
| Allocation to services |
| Region 1 | Region 2 | Region 3 |
| … |
| 27.5-28.5 FIXED 5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.517A 5.539 ADD 5.A116 MOBILE 5.538 5.540 |
| 28.5-29.1 FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.517A 5.523A 5.539.. ADD 5.A116 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540 |
|  |
| 29.5-29.9FIXED-SATELLITE(Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 ADD 5.A116Earth exploration-satellite(Earth-to-space) 5.541Mobile-satellite (Earth-to-space) | 29.5-29.9FIXED-SATELLITE(Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 ADD 5.A116MOBILE-SATELLITE(Earth-to-space)Earth exploration-satellite(Earth-to-space) 5.541 | 29.5-29.9FIXED-SATELLITE(Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 ADD 5.A116Earth exploration-satellite(Earth-to-space) 5.541Mobile-satellite (Earth-to-space)  |
| 5.540 5.542 | 5.525 5.526 5.527 5.529 5.540  | 5.540 5.542 |

MOD

29.9-34.2 GHz

|  |
| --- |
| Allocation to services |
| **Region 1** | Region 2 | **Region 3** |
| 29.9-30 FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 ADD 5.A116 MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.543 5.525 5.526 5.527 5.538 5.540 5.542 |

ADD

5.A116The operation of earth stations in motion communicating with non-geostationary space stations in the fixed satellite service in the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) shall be subject to Resolution **[A116] (WRC-23)**.     (WRC-23)

ADD

draft new RESOLUTION [A116] (WRC-23)

Use of the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) GHz
by earth stations in motion communicating with non-geostationary space stations in the fixed-satellite service

*NOTE 1: The portions of this Draft New Resolution that are included in “boxes” refers to the provisions on responsibilities related to the operation of ESIMs that were agreed upon at the May 2022 meeting of WP 4A.*

*NOTE 2: This draft new Resolution and Annexes represent a compilation of the contributions received by the chairman of SWG 4A1b carried out at the May 2022 meeting of WP 4A. The text should not be considered as agreed and the membership is invited to provide amendments to the text to be considered at the September 2022 meeting of WP 4A.*

The World Radiocommunication Conference (Dubai, 2023),

considering

*a)* that there is a need for global broadband mobile satellite communications, and that some of this need could be met by allowing earth stations in motion (ESIMs) to communicate with space stations of non-geostationary satellite orbit (non-GSO) fixed-satellite service (FSS) operating in the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5‑29.1 GHz and 29.5-30.0 GHz (Earth-to-space);

*b)* that the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) are allocated to terrestrial and space services used by a variety of different systems and these existing services and their future development need to be protected, without any additional constraints, from the operation of non-GSO ESIMs;

*c)* that the frequency band 18.6-18.8 GHz is allocated to EESS (passive) and SRS (passive) and that these services need to be protected from operation of non-GSO FSS space-to-Earth links towards ESIMss;

*d* there is no specific regulatory procedure for the coordination of non-GSO ESIMss relative to terrestrial stations for these services;

*e)* that the ITU Radiocommunication Sector (ITU‑R) has studied the technical and operational requirements for earth stations on mobile platforms operating in non-GSO FSS systems in the frequency bands 17.3-18.6 GHz, 18.8-19.3 GHz, 19.7-20.2 GHz, 27-29.1 GHz and 29.5‑30 GHz;

*f)* that appropriate regulatory and interference-management mechanisms, including necessary mitigation measures are required for the operation of non-GSO ESIMs to protect other space and terrestrial services in the frequency bands mentioned in *considering a)*,

considering further

*a)* that there is no publicly available information on the conditions for coordination agreements reached among administrations regarding non-GSO FSS satellite systems;

*b)* that there is no established and agreed interference management procedure or mitigation measures together with associated techniques to address the potential interference arising from the use of non-GSO ESIMs referred to in this Resolution;

*[Editor’s note:* Considering further b) *supposed to be deleted once the interference management and mitigation measures is agreed].*

*c)* that administrations intending to authorize non-GSO ESIM, when establishing national licensing rules, may consider adopting other interference management procedures and/or mitigation measures than those contained in this Resolution;

*d)* that there is a need to identify all responsible entities involved in the operation of aeronautical and maritime non-GSO ESIMs and the responsibility of those involved entities in this operation is not defined,

*[Editor’s note:* Considering further d) *supposed to be deleted once the interference management and mitigation measures is agreed].*

*e)* that aeronautical and maritime ESIMs operating within the service area of the satellite systems with which it/they communicates/communicate may provide service within the territories under the jurisdiction of multiple administrations/countries;

*f)* that the operation of an ESIMs within the territory under the jurisdiction of administrations/countries mentioned in considering further a) above is subject to obtaining authorization from that administration/country,

recognizing

*a)* that the administration authorizing non-GSO ESIMs on the territory under its jurisdiction has the right to require that non-GSO ESIMs referred to above only use those assignments associated with non-GSO FSS systems which have been successfully coordinated, notified, brought into use and recorded in the MIFR with a favourable finding under Articles **9** and **11**, including Nos. **11.31**, **11.32** or **11.32A**, where applicable;

*b)* that for cases of incomplete coordination under No. **9.7B** of the non-GSO FSS system with which non-GSO ESIMs communicate, the operation of non-GSO ESIMs in the frequency bands 17.8-18.6 GHz and 19.7-20.2 GHz (space-to-Earth) needs to be in accordance with the provisions of No. **11.42** with respect to any recorded frequency assignment which was the basis of the unfavourable finding under No. **11.38**;

Reason for deletion: It is mentioned in recognizing d) previously.

*c)* that for the protection of GSO FSS and GSO BSS networks operating in the frequency band 17.7-17.8 GHz from unacceptable interference caused by non-GSO ESIMs, the provision of No. **22.2** shall apply;

Reason for deletion: It is mentioned in recognizing d) previously.

*f)* that under the provisions of No. **22.2**, non-GSO ESIMs in the frequency bands 17.8‑18.6 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz and 29.5-30 GHz shall not claim protection from geostationary-satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations. No. **5.43A** does not apply in this case;

*g)* that any course of action taken under this Resolution has no impact on the original date of receipt of the frequency assignments of the non-GSO FSS satellite system with which non-GSO ESIMs communicate or on the coordination requirements of that satellite system;

*h)* that successful compliance with this Resolution does not oblige any administration to authorize/license non-GSO ESIMs to operate within the territory under its jurisdiction (see *resolves* 3);

*i)* that the availability of the methodology that enables the Bureau to examine conformity with the power flux-density (pfd) limits on the Earth’s surface specified in Part II of in Annex 1 of this Resolution is a fundamental element for the proper operation of the non-GSO ESIMs subject to this Resolution;

*j)* that for the protection of any other satellite network in the fixed-satellite service using the geostationary-satellite orbit operating in the frequency bands 18.8-19.3 GHz (space-to-Earth) and 28.6-29.1 GHz (Earth-to-space), No. **9.12A** applies;

*k)* that for the protection of any other satellite system in the fixed-satellite service using the non-geostationary-satellite orbit operating in the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5‑29.1 GHz and 29.5-30 GHz (Earth-to-space), No.  **9.12** applies,

recognizing further

*a)* that under *resolves* 1.1.3 of this Resolution, frequency assignments to ESIMs need to be notified to the Radiocommunication Bureau,

*b)* that for the operation of ESIMs, notification of any frequency assignment under Article **11** of the Radio Regulations shall only be made by one single administration;

*c)* that, an administration authorizing the operation of ESIMs within the territory under its jurisdiction may modify/withdraw that authorization at any time;

resolves

1 that, for any ESIMs communicating with non-GSO FSS space stations referred to in this Resolution within the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5‑29.1 GHz and 29.5-30 GHz (Earth-to-space), or parts thereof, the following conditions shall apply:

1.1 with respect to space services in the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz, 19.7-20.2 GHz (space-to-Earth), 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) and their adjacent bands, non-GSO ESIMs shall comply with the following conditions:

1.1.1 with respect to satellite networks or systems of other administrations, including potential interference caused to or claimed from these, non-GSO ESIMs characteristics shall remain within the envelope characteristics of typical earth stations associated with the non-GSO satellite system with which these earth stations communicate;

1.1.2 the notifying administration of the non-GSO FSS system with which the ESIMs communicate shall ensure that the operation of ESIMs complies with the coordination agreements for the frequency assignments of the typical earth station of this non-GSO FSS system obtained under the relevant provisions of the Radio Regulations;

1.1.2.1 For the implementation of the relevant parts of *resolves* 1.1.2 above, administrations shall apply the epfd limits referred to in Nos. **22.5C**, **22.5D** and **22.5F** for the protection of GSO FSS networks operating in the frequency bands 17.8‑18.6 GHz, 19.7-20.2 GHz (space-to-Earth), 27.5-28.6 GHz and 29.5-30 GHz (Earth-to-space);

1.1.3 for the implementation of *resolves* 1.1.1 above, the notifying administration for the non-GSO FSS system with which the non-GSO ESIMs communicate shall, in accordance with this Resolution, send to the Radiocommunication Bureau (BR) the relevant Appendix **4** notification information related to the characteristics of the non-GSO ESIMs intended to communicate with that non-GSO FSS system, together with the commitment that the operation shall be in conformity with the Radio Regulations, including this Resolution and within the coordination agreements with the other administrations in accordance with the provisions of Article **9**;

1.1.4 upon receipt of the notification information referred to in *resolves* 1.1.3 above, the Bureau shall examine it with respect to the provisions referred to in *resolves* 1.1.1 above, including the commitment referred to in *resolves* 1.1.3 above, and publish the result of such examination in the International Frequency Information Circular (BR IFIC);

1.1.5 non-GSO ESIMs shall not claim protection from broadcasting-satellite service feeder-link earth stations operating in accordance with the Radio Regulations in the frequency band 17.7‑18.4 GHz;

1.1.6 for the protection of EESS (passive) sensors operating in the band 18.6-18.8 GHz, the non-GSO FSS systems with which aeronautical and/or maritime ESIMs communicate in the frequency bands 17.7-18.6 GHz and 18.8-19.3 GHz shall comply with the provisions contained in Annex 3 to this Resolution;

1.2 with respect to the protection of terrestrial services to which the frequency bands 17.7‑18.6 GHz, 18.8-19.3 GHz, 19.7-20.2 GHz, 27.5-29.1 GHz and 29.5-30 GHz are allocated and that operate in accordance with the Radio Regulations, non-GSO ESIMs shall comply with the following conditions:

1.2.1 receiving non-GSO ESIMs in the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (*see* No. **5.524**) shall not claim protection from terrestrial services to which the frequency band is allocated and operating in accordance with the Radio Regulations;

1.2.2 Transmitting aeronautical and maritime non-GSO ESIMs in the frequency bands 27.5‑29.1 *GHz and 29.5-30 GHz (see No.* **5.542***)*, shall not cause unacceptable interference to terrestrial services to which the frequency band is allocated and that operate in accordance with the Radio Regulations, and Annex 1 to this Resolution shall apply;

Reason for deletion: The land non-GSO ESIM is out of the scope of this agenda item as mentioned in resolves 3 of Resolution **173 (WRC-19)**.

1.2.3 the provisions in this Resolution, including Annex 1, set the conditions for the purpose of protecting terrestrial services from unacceptable interference from aeronautical and maritime non-GSO ESIMs in neighbouring countries in accordance with the provisions included in *resolves* 1.2.3 and 1.2.4 above in the frequency bands 27.5-29.1 GHz and 29.5-30.0 GHz; however, the requirement not to cause unacceptable interference to, or claim protection from, terrestrial services to which the frequency band is allocated and operating in accordance with the Radio Regulations remains valid (see *resolves* 6);

*Option 1 (Applies if the relevant methodology is included in Annex 2)*

1.2.4 the Bureau shall examine, in accordance with the provisions included in *resolves* 1.2.3 above and with the methodology in Annex 2, the characteristics of aeronautical non-GSO ESIMs with respect to the conformity with the power flux density (pfd) limits on the Earth’s surface specified in Part II of Annex 1 and publish the results of such examination in the BR IFIC;

*Option 2 (Applies if the relevant methodology is not included in Annex 2 by the end of WRC-23)*

1.2.4 the Bureau shall examine, in accordance with the provisions included in *resolves* 1.2.3 above, the characteristics of aeronautical non-GSO ESIMs with respect to the conformity with the power flux-density (pfd) limits on the Earth’s surface specified in Part II of Annex 1 and publish the results of such examination in the BR IFIC;

1.2.5that, if the BR is unable to examine, in accordance with *resolves* 1.2.5 above, non-GSO aeronautical ESIMs with respect to conformity with the limits specified in Part II of Annex 1, the notifying administration shall send to BR a commitment to ensure that the aeronautical non-GSO ESIMs comply with those limits;

1.2.6 that BR shall formulate a qualified favourable finding under No. **11.31** with respect to the limits contained in Part II of Annex 1, if *resolves* 1.2.5 is applied successfully, otherwise the BR shall formulate an unfavourable finding;

1.2.7 that, after the application of *resolves* 1.2.6 and 1.2.7 successfully, once the methodology to examine the characteristics of aeronautical ESIMs with respect to conformity with the pfd limits on the Earth’s surface specified in Part II of Annex 1 is available, *resolves*1.2.5 shall be applied by the Bureau.

2 that non-GSO ESIMs shall not be used or relied upon for safety-of-life applications;

3 that the operation of non-GSO ESIMs within the territory, including territorial waters and territorial airspace of an administration shall be carried out only if a licence according to No. 18.1 of the Radio Regulations of that administration is obtained;

4 that the notifying administrations of those non-GSO FSS systems with which non-GSO ESIMs in the frequency bands detailed in *considering a)* above are intended to operate shall submit a commitment to the Bureau to undertake, to immediately eliminate the unacceptable interference upon receiving a report of unacceptable interference (*see resolves* 5);

5 that the notifying administration of the non-GSO FSS satellite system with which non-GSO ESIMs communicate shall ensure:

5.1 that all necessary measures are taken so that non-GSO ESIMs are subject to permanent monitoring and control by a network control and monitoring centre (NCMC) or equivalent facility in order to comply with the provisions in this Resolution, and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility;

5.2 that measures, when required, shall be taken to limit the operation of non-GSO ESIMs in the territory, including territorial waters and territorial airspace, under the jurisdiction of the administrations authorizing non-GSO ESIMs;

5.3 that a permanent point of contact shall be designated and provided by the notifying administration of the non-GSO FSS satellite systems with which the above-mentioned non-GSO ESIMs communicate for the purpose of tracing any suspected cases of unacceptable interference from non-GSO ESIMs and to immediately respond to requests from the focal point of the authorizing administration;

6 that in case of unacceptable interference caused by any type of non-GSO ESIMs:

6.1 the notifying administration of the non-GSO FSS satellite system with which non-GSO ESIMs communicate shall be assisted by the authorizing administration on the territory under its jurisdiction the non-GSO ESIMs operate, to the extent of ability of the latter administration, undertake an investigation on the matter and provide the required information on the operation of those non-GSO ESIMs;

6.2 the notifying administration of the non-GSO FSS satellite system with which non-GSO ESIMs communicate and the administration of the country in which the non-GSO ESIMs is authorized shall cooperate to undertake an investigation on the matter and inform the affected administration on the progress of the investigation;

6.3 the administration of the country in which non-GSO ESIMs is authorized and the notifying administration of the non-GSO FSS system with which the aeronautical and maritime non-GSO ESIMs communicates shall, jointly or individually, as the case may be and to the extent of ability of the former administration, upon receipt of a report of unacceptable interference, take required actions to eliminate interference;

6.4 the administration of the country in which the non-GSO ESIMs is authorized and the notifying administration of the non-GSO FSS system with which the non-GSO ESIMs communicates shall, jointly or individually, as the case may be, upon receipt of a report of unacceptable interference, take required action to eliminate or reduce interference to an acceptable level;]

7 that the application of this Resolution does not provide regulatory status to non-GSO ESIMs different from that derived from the non-GSO FSS satellite system with which they communicate, taking into account the provisions referred to in this Resolution (see *recognizing b)* above),

resolves further

1 that frequency assignments to ESIMs shall be notified by the notifying administration of the satellite system with which ESIMs communicate;

2 that, the notifying administration of the satellite system shall ensure that ESIMs operate only in the territory under the jurisdiction of any administration/country from which an authorization has been obtained, taking into account *recognizing further* *d)* above;

3 that for the implementation of *resolves further* 2 above, the notifying administration of the satellite system with which ESIMs communicate shall ensure that ESIMs are designed and operate so as to cease transmission over the territory of any administration/country from which authorization has not been obtained;

4 that for the implementation of *resolves further* 1 above, the notifying administration responsible for the operation of aeronautical and maritime ESIMs shall also be responsible to observe and comply with all relevant regulatory and administrative provisions applicable to the operation of the above-mentioned ESIMs as included in this Resolution and those contained in the Radio Regulations;

5 that the authorization to an ESIMs to operate in the territory under the jurisdiction of an administration shall in no way release the notifying administration of the satellite system with which ESIMs communicate from the obligation to comply with the provisions included in this Resolution and those contained in the Radio Regulations;

6 that, should an administration authorizing aeronautical non-GSO ESIMs agree to pfd levels higher than the limits contained in Part II of Annex 1 within the territory under its jurisdiction, such agreement shall not affect other countries that are not party to that agreement,

invites the ITU Radio Communication sector

TBD

instructs the Director of the Radiocommunication Bureau

to report to future world radiocommunication conferences any difficulties or inconsistencies encountered in the implementation of Recommendation ITU-R S.1503 for verifying that the non-GSO FSS systems under this resolution comply with the epfdlimits specified in Article **22** of RR*,*

invites administrations

to collaborate for the implementation of this Resolution, in particular for resolving interference, if any,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of the International Maritime Organization and of the Secretary General of the International Civil Aviation Organization.

Annex 1 to draft new Resolution [A116] (WRC-23)

Provisions for maritime and aeronautical non-GSO ESIMs to protect terrestrial services operating in the frequency band 27.5-29.1 GHz
and 29.5-30.0 GHz

The parts below contain provisions to ensure that maritime and aeronautical non-GSO ESIMs do not cause unacceptable interference in neighbouring countries to terrestrial service operations when non-GSO ESIMs operate in frequencies overlapping with those used by terrestrial services at any time to which the frequency band 27.5-29.1 GHz and 29.5-30.0 GHz is allocated and operating in accordance with the Radio Regulations.

Part 1: Maritime non-GSO ESIMs

1 The notifying administration of the non-GSO FSS network with which a maritime ESIMs communicates shall ensure compliance of the maritime ESIMs operating within the frequency band 27.5-29.1 and 29.5-30.0 GHz, or parts thereof, with both of the following conditions for the protection of terrestrial services to which the frequency band is allocated within a coastal State:

1.1 The minimum distance from the low-water mark as officially recognized by the coastal State beyond which maritime ESIMs can operate without the prior agreement of any administration is [70/TBD] km within the 27.5-29.1 and 29.5-30.0 GHz frequency band. Any transmissions from maritime ESIMs within the minimum distance shall be subject to the prior agreement of the coastal State(s) concerned.

1.2 The maximum maritime ESIMs e.i.r.p. spectral density towards the territory of any coastal State will be limited to [24.44/TBD] dBW in a reference bandwidth of [14/TBD] MHz. Transmissions from maritime ESIMs with higher e.i.r.p. spectral density levels towards the territory of any coastal state shall be subject to the prior agreement of the coastal State(s) concerned.

Part 2: Aeronautical non-GSO ESIMs

2 The notifying administration of the non-GSO FSS satellite network with which an aeronautical ESIMs communicates shall ensure compliance of the aeronautical ESIMs operating within the frequency band 27.5-29.1 and 29.5-30.0 GHz, or parts thereof, with all of the following conditions for the protection of terrestrial services to which the frequency band is allocated:

2.1 When within line-of-sight of the territory of an administration, and above an altitude of 3 km, the maximum pfd produced at the surface of the Earth on the territory of an administration by emissions from a single aeronautical ESIMs shall not exceed:

 pfd(θ) = −124.7 (dB(W/(m2 ⋅ 14 MHz))) for 0° ≤ θ ≤ 0.01°

 pfd(θ) = −120.9 + 1.9 ∙ logθ (dB(W/(m2 ⋅ 14 MHz))) for 0.01° < θ ≤ 0.3°

 pfd(θ) = −116.2 + 11 ∙ logθ (dB(W/(m2 ⋅ 14 MHz))) for 0.3° < θ ≤ 1°

 pfd(θ) = −116.2 + 18 ∙ logθ (dB(W/(m2 ⋅ 14 MHz))) for 1° < θ ≤ 2°

 pfd(θ) = −117.9 + 23.7 ∙ logθ (dB(W/(m2 ⋅ 14 MHz))) for 2° < θ ≤ 8°

 pfd(θ) = −96.5 (dB(W/(m2 ⋅ 14 MHz))) for 8° < θ ≤ 90.0°

where θ is the angle of arrival of the radio-frequency wave (degrees above the horizon).

2.2 When within line-of-sight of the territory of an administration, and up to an altitude of 3 km, the maximum pfd produced at the surface of the Earth on the territory of an administration by emissions from a single aeronautical ESIMs shall not exceed:

 pfd(θ) = −136.2 (dB(W/(m2 ⋅ 1 MHz))) for 0° ≤ θ ≤ 0.01°

 pfd(θ) = −132.4 + 1.9 ∙ logθ (dB(W/(m2 ⋅ 1 MHz))) for 0.01° < θ ≤ 0.3°

 pfd(θ) = −127.7 + 11 ∙ logθ (dB(W/(m2 ⋅ 1 MHz))) for 0.3° < θ ≤ 1°

 pfd(θ) = −127.7 + 18 ∙ logθ (dB(W/(m2 ⋅ 1 MHz))) for 1° < θ ≤ 12.4°

 pfd(θ) = −108 (dB(W/(m2 ⋅ 1 MHz))) for 12.4° < θ ≤ 90°

where θ is the angle of arrival of the radio-frequency wave (degrees above the horizon).

2.3 An aeronautical ESIMs operating in the 27.5-29.5 GHz band, or portions thereof, within the territory of an administration that has authorized fixed-service and/or mobile-service operation in the same frequency bands shall not transmit in these frequency bands without prior agreement of that administration (see also *resolves* 3 of this Resolution).

2.4 The maximum power in the out-of-band domain should be attenuated below the maximum output power of the aeronautical ESIMs transmitter as described in Recommendation ITU‑R SM.1541.

Annex 2 to draft new Resolution [A116] (WRC-23)

Methodology with respect to the examination referred to in *resolves* 1.2.6

# 1 Overview of the methodology

This methodology determines the maximum allowable off-axis e.i.r.p. spectral density (“*EIRPC*”) for an aeronautical earth station in motion (A-ESIMs) transmitter communicating with a non-GSO FSS satellite that would ensure compliance with a set of pre-established power flux-density (pfd) limits defined on the Earth surface. This methodology derives the *EIRPC*considering the relevant loss and attenuation in the geometry considered, among other things.

The methodology then compares the computed *EIRPC* with the reference off-axis e.i.r.p. towards the ground (“*EIRPR*”) of the A-ESIMs. For each emission in each group of a non-GSO satellite system, *EIRPR* can be calculated by using the Appendix **4** data for that system as well as other input parameters that shall be provided by the notifying administration for that system.

Specifically, for each emission in the ITU non-GSO satellite system associated with a to-be-defined non‑GSO A-ESIMs class of station, the *EIRPR* is the algebraic summation (in logarithmic terms) of the maximum power at the antenna flange (element C.8.a.1 of Appendix **4**), the peak gain of the A‑ESIMs antenna (element C.10.d.3 of Appendix **4**), the maximum achievable off-axis gain isolation towards the ground of the A-ESIMs antenna and a parameter that would compensate for any difference between the emission bandwidth and the reference bandwidth of the pre-established set of pfd limits.

The operations of A-ESIMs shall be evaluated over multiple predefined altitude ranges in order to establish as many *EIRPC*levels for comparison with *EIRPR*. This comparison is at the basis of the methodology and examination that are described more in detail in the following section.

# 2 Parameters and geometry

Figure A.2.1 provides a description of the geometry considered under this methodology. The figure shows an ESIMs flying at two different altitudes and also some of the parameters used for the calculation. The model is agnostic to non-GSO ESIMs geographical locations on Earth and assumes a spherical Earth model with a fixed radius for the calculation.

Figure a.2.1

Geometry for the examination of compliance for two different ESIMs altitudes



All the parameters required by the Bureau to carry out the examination process are listed and briefly described in Table A.2.1. Additional considerations are further elaborated in section 3.

Table a.2.1

Relevant parameters for pfd compliance examination

| Parameter  | Symbol | Type of parameter | Observation |
| --- | --- | --- | --- |
| Aeronautical non-GSO ESIMs altitude | *H* | Established by the methodology as: *Hmin*= 0.01 km,  *Hmax*=[13/15] km,  *Hstep*=[1] km | The altitudes at which the examination is carried out range from *Hmin* to *Hmax* at *Hstep* intervals. |
| Angle of arrival of the incident wave on the Earth’s surface  |  | Specified by the pre-established set(s) of pfd limits, variable from 0° to 90° | pre-established set(s) of pfd should cover incident angles from 0° to 90°  |
| Angle below the horizontal plane of the ESIMs corresponding to the angle of arrival under examination |  | Calculated from the geometry  | This angle is calculated considering the non-GSO ESIMs altitude Hj examined and angle of arrival under examination (see Fig. A.2.1) |
| Distance between the ESIMs and the point on the ground under examination | D | Calculated from the geometry | This distance is a function of the A-ESIMs altitude and the angles and  |
| Frequency  | *f* | Established by the methodology | To evaluate the propagation loss either at the central frequency or at the upper and lower limits of the frequency range |
| Atmospheric loss | *Latm* | Calculated and established by the methodology | Based on Recommendation ITU-R P.676 |
| Polarization loss | *LPol* | Determined depending on the pfd limits and the system characteristics | Possible polarization loss between the polarisation of A-ESIMs antenna and the one used by terrestrial services that needs to be taken into consideration in this methodology  |
| Fuselage attenuation | *Lf* | Report ITU-R M.2221 or other model supported by ITU-R studies (e.g. Reports and/or Recommendations) | The attenuation depends on the angle () below the horizontal plane of the non-GSO ESIMs. The value(s) could come from ITU-R studies (e.g. Reports and/or Recommendations) based on: Measurements  Simulations  |
| A-ESIMs antenna peak gain and off-axis gain pattern | *Gmax*, *G*(θ) | Taken from the Appendix **4** data (elements C.10.d.3 and C.10.d.5.a.1, respectively) of the non-GSO system under examination | The A-ESIMs antenna gain is used to compute EIRPR |
| Emission bandwidth  | *BWEmission* | Taken from the Appendix **4** data (as part of element C.7.a) of the non-GSO system under examination | These two bandwidths shall be compared and a correcting factor needs to be included in the computation of *EIRPR* in case *BWEmission* < BWRef |
| Reference bandwidth | *BWRef* | Taken from the set(s) of pre-established pfd limits |
| Effective isotropic radiated power required for compliance with the pfd limits in a reference bandwidth  | *EIRPC* | *EIRPC* is the result of the calculation; it depends on the ESIMs altitude and the angle of arrival () of the incident wave on the Earth’s surface  | For each of the altitudes *Hj*, the e.i.r.p. for compliance is calculated for the different incident angles () considered to cover all the range of the pfd limits to be established by WRC-23. This leads to a number of values of *EIRPC* associated to a given altitude *Hj*; for each altitude *Hj*, the lowest e.i.r.p. value is the one to be retained and compared with *EIRPR* (see section 3)  |
| A set of pre-established PFD limits on the Earth’s surface | *PFD*() | A possible outcome of the studies carried out under WRC-23 AI 1.16 | The pfd limits, expressed in dB(W/m2/BWref), are a function of the angle of arrival  |

# 3 Calculation procedure

This section includes a step-to-step description of how the examination methodology would be implemented for a given group associated to the class of earth station for non-GSO A-ESIMs in a non-GSO satellite system.

START

Calculate *EIRPR*

i) For each of the emissions included in the Group under consideration, compute the reference e.i.r.p. (EIRPR, dB(W)) as:

 (1)

where:

 *Gmax* is the A-ESIMs antenna peak gain in dBi

 *GIsol\_Max*is the maximum achievable gain isolation of the A-ESIMs antenna towards the ground in dB

 *Pmax* is the maximum power density at the A-ESIMs antenna flange in dB(W/Hz).

 BW in Hz is:

• *BWRef* if *BWemission*> *BWRef*

• *BWemission*if *BWemission*< *BWRef*

Calculate *EIRPC*

ii) For each aircraft altitude, it is necessary to generate as many angles (angle of arrival of the incident wave) as required in order to test the full compliance with the set(s) of pre-established pfd limits. The N angles must be comprised between 0° and 90° and have a resolution compatible with the granularity of the pre-established pfd limits. Each of the angles will correspond to as many *N* points on the ground.

iii) For each altitude *Hj* = *Hmin*, *Hmin* + *Hstep*, …, *Hmax*, compute *EIRPC*\_*j* using the following algorithm

a) Set the altitude of the A\_*ESIMs* to *Hj*

b) Compute the angle below the horizon γj,n as seen from the A-ESIMs for each of the *N* angles generated in ii. using the following equation:

 (2)

where is the mean earth radius.

c) Compute the distance *Dj,n*, in km, for *n* = 1, …, *N* between the A-ESIMs and the tested point on the ground:

 (3)

d) Compute the fuselage attenuation *Lf j,n* (dB) applicable to each of the angles computed in b) above.

e) Compute the atmospheric loss *Latm\_j,n* (dB) applicable to each of the distances computed in c) above.

f) Compute the *EIRPC\_j,n* (dB(W/BWRef)), that is the maximum e.i.r.p. that can be radiated in the pfd mask’s reference bandwidth by the A-ESIMs towards each of the *N* points to be compliant with the set(s) of pre-established pfd limits, as per the following equation:

 (4)

g) Compute the minimum *EIRPC\_j* across all values calculated at the previous step, *EIRPC\_j* = Min (*EIRPC\_j,n* (δ*n*, γ*n*)). The output of this last step is the maximum *EIRPC* that can be radiated by the A-ESIMs to ensure it complies with the set(s) of pre-established pfd limits with respect to all angles at the altitude *Hj*. There will be one *EIRPC\_j* for each of the *Hj* altitudes considered.

The output of step iii) is summarised in Table A.2.2 below:

Table a.2.2

Computed *EIRPC\_j* values

|  |  |  |  |
| --- | --- | --- | --- |
| *j* | *Hj* | *EIRPC\_j,n* (δn, γn) dB(W/BWRef) | *EIRPC\_j* |
| - | (km) | δ = 0° | δ = 0.01° | … | δ = 90° | dB(W/BWRef) |
| 1 | *Hmin* | xxx | xxx | xxx | xxx | XXX |
| 2 | *Hmin* + *Hstep* | yyy | yyy | yyy | yyy | YYY |
| … | … | … | … | … | … | … |
| *jmax* | *Hmax* | zzz | zzz | zzz | zzz | ZZZ |

Compare *EIRPC* and *EIRPR*, and produce an examination finding

iv) For each of the emissions, check whether there is at least one j for which *EIRPC\_j* > *EIRPR*. The results of this check are illustrated in Table 7 below.

Table a.2.3

Comparison between *EIRPC\_j* and *EIRPR*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Group ID | Emission n. | EIRPRdB(W) | Is there at least one altitude *Hj* for which *EIRPC\_j* > *EIRPR*? | Smallest *Hj* for which *EIRPC\_j* > *EIRPR*(km) |
| X | 1 | XXX | Yes/No | AAA |
| Y | 2 | YYY | Yes/No | BBB |
| … | … | … | … | … |
| Z | N | ZZZ | Yes/No | CCC |

v) If there is at least one emission among those included in the Group under examination which passes the test detailed in iv. above, the results of the Bureau’s examination for that Group is ***favorable***, otherwise it is ***unfavorable***.

***Option 1:***

vi) The Bureau shall publish:

– the finding (favorable or unfavorable) for each group of the non-GSO system examined;

– Table A.2.3, *that* is the output of step iii) of the algorithm, published for information only.

***Option 2:***

vi) The Bureau publishes:

 The finding (*favorable* or *unfavorable*) for each group of emissions of the non-GSO system examined

# 4 Example application of the methodology

Table A.2.2 below describes the emissions included in one Group of a fictitious satellite system that are associated to the class of e/s indicating the non-GSO aeronautical ESIMs (A-ESIMs) transmitting in the 27.5-29.1 GHz and 29.5-30.0 GHz. Three different type of emissions are included in the group to cover different performance objectives of the communication link.

**Option 1:**

Table a.2.2

Example A-ESIMs emissions in the group examined

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Emission n. | C7aDesignation of emission | C8a2/C8b2Maximum Power DensitydB(W/Hz) | C8c3Minimum Power DensitydB(W/Hz) | C8e1C/N objective(total – clear sky)dB |
| 1 | 6MD7W-- | −56.0 | −69.7 | −5.0 |
| 2 | 6MD7W-- | −51.0 | −64.7 | 0.0 |
| 3 | 6MD7W-- | −42.0 | −55.7 | 9.0 |

Table A.2.3 below includes additional assumptions needed for the application of the methodology described in Section 3.

Table a.2.3

Additional assumptions

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Notation | Value | Unit |
| Test frequency | *f* | 29.5 | GHz |
| A-ESIMs antenna peak gain | *Gmax* | 37.5 | dBi |
| Antenna gain pattern | *-* | APEREC015V01 |
| Polarisation loss | *LPol* | 0.0 | dB |
| Fuselage attenuation model | *Lf* | See Table A.2.6 |
| Atmospheric loss | *Latm* | Recommendation ITU-R P.676 |
| Minimum examination altitude range | *Hmin* | 0.02 | km |
| Maximum examination altitude range | *Hmax* | 15.0 | km |
| Examination altitude range spacing | *Hstep* | 1.0 | km |

**OPTION 2:**

Table a.2.4

Example A-ESIMs emissions in the Group ID n. 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Emission n. | C7aDesignation of emission | C8a2/C8b2maximum power densitydB(W/Hz) | C8c3minimum power densitydB(W/Hz) | C8e1*C/N* objective(total – clear sky)dB |
| 1 | 6MD7W-- | −56.0 | −69.7 | −5.0 |
| 2 | 6MD7W-- | −51.0 | −64.7 | 0.0 |
| 3 | 6MD7W-- | −46.0 | −59.7 | 5.0 |

Table A.2.5 below includes additional assumptions needed for the application of the methodology described in Section 3.

Table a.2.5

Additional assumptions

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Notation | Value | Unit |
| Test frequency | *f* | 30.0 | GHz |
| A-ESIMs antenna peak gain | *Gmax* | 37.5 | dBi |
| Antenna gain pattern | - | Recommendation ITU-R S.580 |
| Polarisation loss | *LPol* | 0.0 | dB |
| Fuselage attenuation model | *FA* | See Table A.2.6 |
| Atmospheric attenuation | *Latm* | Section 2.21.2 of Recommendation ITU-R P.676 |
| Reference atmosphere | – | “Winter High Latitude” from Recommendation ITU-R P.835.6 |
| Minimum examination altitude range | *Hmin* | 0.02 | km |
| Maximum examination altitude range | *Hmax* | 15.0 | km |
| Examination altitude range spacing | *Hstep* | 1.0 | km |
| Altitude of the interfered with terrestrial station | *HT* | 0.01 | km |

Table a.2.4

Fuselage attenuation model from Report ITU-R M.2221

|  |  |  |  |
| --- | --- | --- | --- |
|  | dB | for | 0°≤ γ ≤ 10° |
|  | dB | for | 10°< γ ≤ 34° |
|  | dB | for | 34°< γ ≤ 50° |
|  | dB | for  | 50°< γ ≤ 90° |

Table a.2.5

Tested PFD limits on the ground



The paragraphs below represent the step-by -step application of the calculation methodology described in Section 3.

***START***

i) For each of the emissions listed in Table A.2.2, the reference e.i.r.p. (*EIRPR*, dBW) is computed and the relevant results are included in Table A.2.6 below:

**OPTION 1:**

Table a.2.6

Computed values of EIRPR for the group under consideration

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Emission | , dBi | , dB | , dB(W/Hz) | BW, MHz | , dBW |
| 1 | 37.5 | 42.4 | −56.0 | 6.0 | 6.89 |
| 2 | −51.0 | 11.89 |
| 3 | −42.0 | 20.89 |

ii) Generate angles compatible with the PFD limits described in Table A.2.5:

 = 0°, 0.01°, 0.02°, …, 0.3°, 0.4°,…, 12.3°, 12.4°,…, 13°, 14°,…, 90°.

iii) For each altitude *Hj* = *Hmin*, *Hmin* + *Hstep*, …, *Hmax*, compute *EIRPC\_j*. The output of this step is summarised in Tables A.2.7 below:

Table a.2.7

Computed *EIRPC\_j* values
(see embedded file for full results)

|  |  |  |  |
| --- | --- | --- | --- |
| *j* | *Hj* | *EIRPC\_j,n* (δn, γn) dB(W/BWRef) | *EIRPC*\_j |
| - | (km) | δ = 0° | δ = 0.01° | … | δ = 90° | dB(W/BWRef) |
| 1 | 0.02 | (See Annex to this contribution) | −40.6 |
| 2 | 1.00 | −6.04 |
| 3 | 2.00 | 0.38 |
| … | … | … |
| 16 | 15.00 | 17.45 |

iv) For each of the emissions, check whether there is at least one altitude for which *EIRPC\_j* > *EIRPR*. The result of this step is summarised in Table A.2.8 below.

Table a.2.8

Comparison between *EIRPC\_j* and *EIRPR*

|  |  |  |  |
| --- | --- | --- | --- |
| Emission  | *EIRPR*dB(W) | Smallest *j* for which *EIRPC\_j* > *EIRPR* | *EIRPC\_j* > *EIRPR* |
| 1 | 6.89 | 6 | Yes |
| 2 | 11.89 | 9 | Yes |
| 3 | 20.89 | None | No |

v) Since there is at least one emission among those included in the Group under examination which passes the test detailed in iv. above, the results of the Bureau’s examination for this Group is ***favorable***.

vi) The Bureau publishes:

 The ***favorable*** finding for the Group of the non-GSO system examined

***Option 2:***

Table a.2.8

Computed values of *EIRPR* for the group under consideration

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Emission n. | , dBi | , dB | , dB(W/Hz) | BW, MHz | , dBW |
| 1 | 37.5 | 42.4 | −56.0 | 6.0 | 6.89 |
| 2 |  | −51.0 | 11.89 |
| 3 | −46.0 | 16.89 |

i) Generate angles compatible with the PFD limits described in Table A.2.7:

 = 0°, 0.01°, 0.02°, …, 0.3°, 0.4°,…, 12.3°, 12.4°,…, 13°, 14°,…, 90°.

ii) For each altitude *Hj*= *Hmin*, *Hmin* + *Hstep*, …, *Hmax*, compute *EIRPC\_j*. The output of this step is summarised in Tables A.2.9 below:

Table a.2.9

Computed *EIRPC\_j*values
(see embedded file for full results)

|  |  |  |  |
| --- | --- | --- | --- |
| *j* | *Hj* | *EIRPC\_j,n* (δ*n*, γ*n*) dB(W/BWRef) | *EIRPC\_j* |
| - | (km) | δ = 0° | δ = 0.01° | … | δ = 90° | dB(W/BWRef) |
| 1 | 0.02 |  | −40.6 |
| 2 | 1.00 | −6.04 |
| 3 | 2.00 | 0.38 |
| … | … | … |
| 16 | 15.00 | 17.45 |

iii) For each of the emissions, check whether there is at least one j for which *EIRPC\_j* > *EIRPR*. The result of this step is summarised in Table A.2.10 below

Table a.2.10

Comparison between *EIRPC\_j* and *EIRPR*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Group ID | Emission n. | *EIRPR*dB(W) | Is there at least one altitude *Hj* for which *EIRPC\_j* > *EIRPR*? | Smallest *Hj* for which *EIRPC\_j* > *EIRPR*(km) |
| 1 | 1 | 6.89 | Yes | 5.0 |
| 1 | 2 | 11.89 | Yes | 8.0 |
| 1 | 3 | 16.89 | Yes | 14.0 |

iv) Since there is at least one emission among those included in the Group under examination which passes the test detailed in iv. above, the results of the Bureau’s examination for this Group is ***favorable***.

v) The Bureau shall publish:

– The ***favorable*** finding for the Group ID n.1 of the non-GSO system examined

– Table A.2.10, published for information only.

**END**

ATTACHMENT TO ANNEX 2

An example of a satellite filing Group is provided below to facilitate the understanding of the methodology.



APPENDIX 4 (REV.WRC‑19)

Consolidated list and tables of characteristics for use in the
application of the procedures of Chapter III

ANNEX 2

Characteristics of satellite networks, earth stations
or radio astronomy stations2    (Rev.WRC‑12)

Footnotes to Tables A, B, C and D

 MOD

**TABLE A**

**GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK OR SYSTEM,
EARTH STATION OR RADIO ASTRONOMY STATION     (Rev.WRC‑19)**

| **Items in Appendix** | ***A \_ GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION***  | **Advance publication of a geostationary-satellite network** | **Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9** | **Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9** | **Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)**  | **Notification or coordination of a non-geostationary-satellite network** | **Notification or coordination of an earth station (including notification under Appendices 30A or 30B)**  | **Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)** | **Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)** | **Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)** | **Items in Appendix** | **Radio astronomy** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A.24** | **COMPLIANCE WITH NOTIFICATION OF A NON-GSO SHORT DURATION MISSION** |  |  |  |
| A.24.a | a commitment by the administration that, in the case that unacceptable interference caused by a non-GSO satellite network or system identified as short-duration mission in accordance with Resolution **32 (WRC‑19)** is not resolved, the administration shall undertake steps to eliminate the interference or reduce it to an acceptable levelRequired only for notification |  |  |  |  | **+** |  |  |  |  | A.24.a |  |
| **A.25** | **COMPLIANCE WITH *resolves* 1.1.3 OF RESOLUTION 169 (WRC-19)** |  |  |  |  |  |  |  |  |  |  |  |
| A.25.a | a commitment that the ESIM operation would be in conformity with the Radio Regulations and draft Resolution **A116 (WRC‑23)**Required only for the notification of earth stations in motion submitted in accordance with draft Resolution **A116 (WRC‑23)** |  |  |  |  | **+** |  |  |  |  | A.25.a |  |
| A.26 | **COMPLIANCE WITH *resolves* 4 OF DRAFT RESOLUTION A116** **(WRC**‑**23)** |  |  |  |  |  |  |  |  |  |  |  |
| A.26.a | a commitment that, upon receiving a report of unacceptable interference, the notifying administration for the non-GSO FSS network with which ESIMs communicate shall follow the procedures in *resolves*6 of draft Resolution **A116 (WRC‑23)**Required only for the notification of earth stations in motion submitted in accordance with draft Resolution **A116 (WRC‑23)** |  |  |  |  | **+** |  |  |  |  | A.26.a |  |
| A.27 | **COMPLIANCE WITH *resolves* 1.2.7 OF DRAFT RESOLUTION A116** **(WRC‑23)** |  |  |  |  |  |  |  |  |  |  |  |
| A.27.a | a commitment that aeronautical ESIMs would be in conformity with the pfd limits on the Earth’s surface specified in Part II of Annex 1 to draft Resolution **A116 (WRC‑23)**Required only for the notification of earth stations in motion submitted in accordance with draft Resolution **A116 (WRC‑23)** |  |  |  |  | **+** |  |  |  |  | A.27.a |  |

ADD

Annex 3 to draft new Resolution [A116] (WRC-23)

Provisions for non-GSO satellites operating with maritime and aeronautical ESIMs in the bands 17.7-18.6 GHz and 18.8-19.3 GHz to protect the EESS (passive) in the band 18.6-18.8 GHz

[TBD]

SUP

RESOLUTION 173 (WRC‑19)

Use of the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by
earth stations in motion communicating with non-geostationary space stations
in the fixed-satellite service

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