World Radiocommunication Conference (WRC-23)
Dubai, 20 November - 15 December 2023

PLENARY MEETING

Addendum 16 to
Document 6217-E
9 October 2023
Original: English

African Common Proposals

PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda item 1.16

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, 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-geostationary fixed-satellite service earth stations in motion, while ensuring due protection of existing services in those frequency bands, in accordance with Resolution **173 (WRC-19)**;

Introduction

This proposal presents the African common proposals (AfCP) from the African group on this agenda item. Essentially, ATU supports Method B if the following conditions are fulfilled:

1. For the protection of terrestrial services operating in the frequency band 27.5-29.1 GHz, transmitting non-GSO ESIMs in this frequency band shall not cause unacceptable interference to terrestrial services to which the frequency band is allocated and that operate in accordance with the Radio Regulations (RR), and Annex 1 to the new Resolution under this agenda item shall apply.

2. For the protection of secondary allocation to terrestrial services (No. 5.542) in the frequency band 29.5-30 GHz, transmitting non-GSO ESIMs in this frequency band shall not adversely affect the operations of terrestrial services to which this frequency band is allocated and that operate in accordance with the Radio Regulations, and technical conditions in Annex 1 to the new Resolution under this agenda item shall apply with respect to administrations mentioned in RR No. 5.542.

3. Non-GSO ESIM operating 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.

4. For the protection of space services, non-GSO ESIM characteristics shall remain within the envelope characteristics of typical earth stations associated with the non-GSO satellite system with which these ESIMs communicate.

5. For the protection of GSO systems in FSS and BSS, operating in the frequency bands 17.7–18.6 GHz, from non-GSO FSS systems using ESIMs, RR No. 22.2 is applied.

6. For the protection of GSO FSS networks operating in the frequency bands 17.8-18.6 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz and 29.5-30.0 GHz, the relevant EPFD limits in Nos. 22.5C, 22.5D and 22.5F shall apply.

7. For the protection of GSO systems in FSS and BSS, operating in the frequency bands where epfd limits do not apply:

a. Non-GSO ESIM characteristics shall remain within the envelope characteristics of typical earth stations associated with the non-GSO satellite system with which the ESIM communicates;

b. Non-GSO ESIM shall not cause more interference and shall not claim more protection than typical earth stations in this non-GSO system;

c. The operation of non-GSO ESIM shall comply with the coordination agreements obtained following the application of provisions under No. **9.11A**.

8. Development of a methodology regarding examination by the Bureau of compliance with pfd limits by NGSO aeronautical ESIM to protect terrestrial services from earth station in motion to be agreed before the conference.

9. The only administration that could notify the ESIM is the same administration that notified NGSO satellite network with which the ESIM will communicate.

10. The capability of ESIMs to restrict operations to territories of those administrations where authorization for such operations has been granted.

11. The notifying administration is the only responsible to resolve any reporting of interference, in case more than one administration has notified satellites in a single NGSO constellation each of the notifying administrations is responsible to eliminate of any unacceptable interference from ESIMs that have been authorized to operate.

12. Determination of detailed procedures for the interference management mechanism to deal with the interference that occurs from the operation of earth stations in motion of other administrations as there are still several issues on the operation of ESIMs to be clarified and specified in the Draft New Resolution regarding the interference management mechanism and its due functionality.

13. The Radiocommunication bureau publish a list of satellite networks with which Non-GSO ESIM communicate and brought into use with information about its service area and administrations authorize such use to assist affected administration to identify source of interference.

ARTICLE 5

Frequency allocations

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

MOD AFCP/6217A16/1

15.4-18.4 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td rowspan="2">17.7-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A 5.517A
ADD 5.A116
(Earth-to-space) 5.516
MOBILE</td><td>17.7-17.8
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.517 5.517A
ADD 5.A116
(Earth-to-space) 5.516
BROADCASTING-SATELLITE
Mobile
5.515</td><td rowspan="2">17.7-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A 5.517A
ADD 5.A116
(Earth-to-space) 5.516
MOBILE</td></tr>
<tr><td>17.8-18.1
FIXED
FIXED-SATELLITE
(space-to-Earth) 5.484A 5.517A
ADD 5.A116
(Earth-to-space) 5.516
MOBILE
5.519</td></tr>
<tr><td>18.1-18.4</td><td colspan="2">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</td></tr>
</table>

MOD AFCP/6217A16/2

18.4-22 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>18.4-18.6</td><td colspan="2">FIXED
FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.517A
ADD 5.A116
MOBILE</td></tr>
<tr><td>…</td><td colspan="2"></td></tr>
</table>

18.8-19.3	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.517A 5.523A ADD 5.A116 MOBILE	
…		
19.7-20.1 FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.516B 5.527A ADD 5.A116 Mobile-satellite (space-to-Earth) 5.524	**19.7-20.1** FIXED-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 5.529	**19.7-20.1** FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.516B 5.527A ADD 5.A116 Mobile-satellite (space-to-Earth) 5.524
20.1-20.2	FIXED-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 AFCP/6217A16/3

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	
…		
29.5-29.9 FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 ADD 5.A116 Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542	**29.5-29.9** 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 5.525 5.526 5.527 5.529 5.540	**29.5-29.9** FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 ADD 5.A116 Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542

MOD AFCP/6217A16/4

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 AFCP/6217A16/5

5.A116 The 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 (space-to-Earth), 18.8-19.3 GHz (space-to-Earth) and 19.7-20.2 GHz (space-to-Earth), 27.5-29.1 GHz (Earth-to-space) and 29.5-30 GHz (Earth-to-space) shall be subject to the application of Resolution **[AFCP-A116] (WRC-23)**. (WRC-23)

ADD AFCP/6217A16/6

DRAFT NEW RESOLUTION [AFCP-A116]

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 aeronautical and maritime earth stations in motion communicating with non-geostationary space stations in the fixed-satellite service

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 the 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 space services, and the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz, and 27.5-29.1 GHz are allocated to terrestrial services on a primary basis worldwide; in the countries identified in No. **5.524** of the Radio Regulations, the frequency band 19.7-20.2 GHz is allocated to the fixed and mobile services on a primary basis; and, in the countries identified in No. **5.542** of the Radio Regulations, the frequency band 29.5-30 GHz is allocated to the fixed and mobile services on a secondary basis, and 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;

NOTE: There should be a necessary assurance that these secondary status assignments could continue to render services which were designed for before any allocation be made to ESIM under agenda item 1.16. This assurance does not exist to date.

c) that the frequency band 18.6-18.8 GHz is allocated to the Earth exploration-satellite service (EESS) (passive) and space research service (SRS) (passive) and that these services need to be protected from operation of non-GSO FSS in the space-to-Earth direction;

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

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

considering further

a) that administrations intending to authorize non-GSO ESIMs, when establishing national licensing rules, may consider adopting other interference management procedures and/or mitigation measures mutually agreed than those contained in this Resolution as long as the provisions in Annex 1 are unchanged in cross-border applications;

b) that aeronautical and maritime non-GSO ESIMs operating within the service area of the non-GSO FSS systems with which they communicate may provide service within the territories under the jurisdiction of multiple administrations;

c) that this Resolution does not establish any technical or regulatory provisions for the operation and use of land non-GSO ESIMs communicating with non-GSO FSS space stations, and any authorization of land non-GSO ESIMs remains strictly a national matter, taking also into account the need to avoid cross-border interference,

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 Master International Frequency Register (MIFR) with a favourable finding under Articles **9** and **11**, including Nos. **11.31**, **11.32** or **11.32A**, where applicable;

b) that the provisions of No. **22.2** apply to non-GSO FSS satellite systems with which ESIMs operate in the frequency band 17.7-17.8 GHz (space-to-Earth) with respect to GSO FSS and GSO BSS networks;

c) that, under the provisions of No. **22.2**, non-GSO ESIMs in the frequency bands 17.8-18.6 GHz and 19.7-20.2 GHz shall not claim protection from GSO FSS and GSO BSS networks operating in accordance with these Regulations, and non-GSO ESIMs in the frequency bands 27.5-28.6 GHz and 29.5-30 GHz shall not cause unacceptable interference to GSO FSS and GSO BSS networks operating in accordance with the Radio Regulations, and No. **5.43A** does not apply in this case;

d) that there is no obligation for administration to authorize/license any non-GSO ESIMs to operate within the territory under its jurisdiction;

e) that a non-GSO FSS system operating in the frequency bands 17.8-18.6 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-28.6 GHz and 29.5-30 GHz (Earth-to-space) in compliance with the epfd limits referred to in Nos. **22.5C**, **22.5D** and **22.5F** is considered as having fulfilled its obligations under No. **22.2** with respect to any geostationary-satellite network;

f) that, with respect to GSO FSS networks, in the frequency bands 18.8-19.3 GHz (space-to-Earth) and 28.6-29.1 GHz (Earth-to-space) Nos. 9.12A and 9.13 apply, and No. **22.2** does not apply;

g) that, for the 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 non-GSO FSS systems, No. **9.12** applies,

h) that administration experiencing unacceptable interference from an ESIM may contact any administration involved in the operation of ESIM However, the responsibility for resolving the case of unacceptable interference is remain under notifying administration of the GSO FSS network with which ESIMs communicate.

recognizing further

a) that frequency assignments to non-GSO ESIMs need to be notified to the Radiocommunication Bureau (BR);

b) that the notification by different administrations of frequency assignments to be used by the same non-GSO satellite system may create difficulties to identify the responsible administration in case of unacceptable interference;

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

resolves

1 that, for any aeronautical or maritime ESIM communicating with non-GSO FSS space stations 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), 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), and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space), and in their adjacent bands in the frequency band 18.6-18.8 GHz, non-GSO ESIMs shall comply with the following conditions:

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

1.1.1.1 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 BR 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;

1.1.1.2 upon receipt of the notification information referred to in *resolves* 1.1.1.1 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* 1.1.1.1 above, and publish the result of such examination in the International Frequency Information Circular (BR IFIC);

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 provisions of Article **9** of the Radio Regulations, taking into account *recognizing b)*;

1.1.3 notifying administration of the non-GSO FSS system with which the ESIMs communicate shall ensure that non-GSO ESIMs comply with 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) (see *recognizing e)*);

1.1.4 non-GSO ESIMs shall not claim protection from BSS feeder-link earth stations operating in accordance with the Radio Regulations in the frequency band 17.7-18.4 GHz;

1.1.5 with respect to protection of EESS (passive) operating in the frequency band 18.6-18.8 GHz, any non-GSO FSS systems with an orbital apogee of less than 20 000 km operating in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz with which aeronautical and/or maritime ESIMs communicate and for which the complete notification information has been received by the BR after 1 January 2025 shall comply with the provisions indicated in Annex 3 to this Resolution;

1.1.5.1 for the implementation of *resolves* 1.1.5 above, the notifying administration for the non-GSO FSS system with which the non-GSO ESIMs communicate shall send to the BR the relevant Appendix **4** notification information including the commitment that the operation shall be in conformity with *resolves* 1.1.5;

1.2 with respect to terrestrial services 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, 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 and 18.8-19.3 GHz and 19.7-20.2 GHz (see No. **5.524**) shall not claim protection from assignments in the terrestrial services to which those frequency bands are allocated and that operate in accordance with the Radio Regulations;

1.2.2 transmitting non-GSO ESIMs in the frequency band 27.5-29.1 GHz 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;

1.2.3 transmitting non-GSO ESIMs in the frequency band 29.5-30.0 GHz shall not adversely affect the operations of terrestrial services to which this frequency band is allocated on secondary basis and that operate in accordance with the Radio Regulations, and limits in Annex 1 to this Resolution shall apply with respect to administrations mentioned in No. **5.542**;

1.2.4 the provisions in this Resolution, including Annex 1, set the conditions for the purpose of protecting terrestrial services from unacceptable interference from non-GSO ESIMs in neighbouring countries in accordance with the provisions included in *resolves* 1.2.2

and 1.2.3 above in the frequency band 27.5-29.1 GHz and in the frequency band 29.5-30.0 GHz with respect to administrations mentioned in No. **5.542**; however, the requirement not to cause unacceptable interference to, or claim protection from, terrestrial services to which the frequency bands are allocated and operating in accordance with the Radio Regulations remains valid (see *resolves* further 1);

1.2.5 the Bureau shall examine, in accordance with the provisions included in *resolves* 1.2.2 and 1.2.3 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 2 of Annex 1 to this Resolution and publish the results of such examination in the BR IFIC;

1.2.5.1 however, the compliance with the technical conditions in Annex 1, does not release the notifying administration of the A-ESIM and M-ESIM with respect to discharging its responsibility that such earth station shall not cause unacceptable interference and any interrelated receiving part shall not claim protection from the terrestrial stations;

1.3 that, in the case unacceptable interference caused by A-ESIM and/or M-ESIM is reported:

1.3.1 only the notifying administration of the non-GSO FSS system with which ESIMs communicate is responsible for resolving the case of unacceptable interference;

1.3.2 the notifying administration of the non-GSO FSS system with which the ESIMs communicate shall immediately take the required action to eliminate or reduce interference to an acceptable level;

1.3.2 *bis* that, for the implementation of *resolves* 1.3.2 above, the system shall employ the minimum capabilities listed in Annex 4;

Note: moved from below resolves further 9

1.3.3 that the notifying administrations of those non-GSO FSS systems with which non-GSO ESIMs in the frequency bands in *considering a)* above are intended to operate shall submit a commitment to the Bureau to immediately act to eliminate or reduce the interference to an acceptable level upon receiving a report of unacceptable interference;

Note: moved from below resolves 4

1.3.4 the affected administration(s) may assist to the extent of its ability in resolving or provide information that would facilitate resolving the case of unacceptable interference;

1.3.5 the administration authorizing the operation of A-ESIM and M-ESIM on territory under its jurisdiction, subject to its explicit agreement, may to the extent of its ability provide assistance, including information for the resolution of unacceptable interference, However, that administration has no obligation nor any mandate, to be responsible in detection, identification, reporting, resolution of any interference caused by the operation of the ESIM the operation of which was authorized;

1.3.6 an administration the territory of which is situated inside the service area of a non-GSO FSS satellite system and has provided explicit authorization to receive the service/to be served by any type of ESIM has no obligation nor any mandate, whatsoever, to be involved directly or

indirectly in detection, identification, reporting, resolution of any interference caused by the operation of the ESIM which was authorized:

Note: moved from above resolves 1.1 bis

1.3.7 that, in case of continued unacceptable interference despite of the commitment referred to in *resolves 1.3.3*, the assignment causing interference shall be submitted to the Radio Regulation Board for review;

Note: moved from below resolves 4

1.3.8 in case there is more than one administration involved in the notification of frequency assignments of the same non-GSO satellite system with which ESIMs communicate, those administrations shall nominate one administration as the notifying administration responsible to act on their behalf to be responsible to eliminate any unacceptable interference cases and inform the Bureau accordingly;

Note: moved from below resolves 5

1.4 that the notifying administration(s) of non-GSO FSS satellite system with which ESIMs communicate shall ensure that:

1.4.1 for the operation of A-ESIM and M-ESIM, techniques are employed to maintain adequate antenna pointing accuracy with the associated non-GSO FSS satellite;

1.4.2 all necessary measures shall be taken so that earth stations on aircraft and vessels are subject to permanent monitoring and control by a Network Control and Monitoring Centre (NCMC) in order to comply with the provisions in this Resolution, and are capable of receiving and immediately acting upon inter alia “enable transmission” and “disable transmission” commands from the NCMC (see Annex 4);

1.4.3 measures are taken so that the A-ESIM and/or M-ESIM do not transmit on the territory under the jurisdiction of an administration, including its territorial waters and its national airspace, that has not authorized its use;

1.4.4 a permanent point of contact shall be provided in the Appendix **4** submission and this shall be published in the relative special section of the BR IFIC for the purpose of tracing any suspected cases of unacceptable interference from A-ESIMs or M-ESIMs and for the purpose of immediately responding to the relevant requests;

1.4.5 non-GSO ESIMs operate only in the territory under the jurisdiction of administrations from which an authorization has been obtained, taking into account *recognizing further c)*;

Note: moved from below resolves further 72 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 airspace, under the jurisdiction of any administration shall be carried out only if an authorization or a licence according to No. **18.1** of from that administration is obtained;

Note: moved up to be new resolves 1.3.3

Note: moved up to be new resolves 1.3.8

4 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);

5 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;

6 the implementation of this Resolution remains in abeyance pending an agreement to be universally reached on the issue of the interference management system, monitoring facilities' effectiveness and immediate response of NCMC, cessation of transmission over territories which have not explicitly authorized the functioning and operation of any ESIM over their territories providing satisfactory resolution of the problem, as referred to in *recognizing further d)* above, in addition to reach agreement on the methodology which has to be used by the Bureau to verify the PFD limits mentioned in Part 2 of Annex 1 to this resolution;

NOTE: Provided the description and the methodology mentioned above is properly addressed and concluded, *resolves* 6 above may be deleted at WRC-23

resolves further

1 that ESIMs shall not cause unacceptable interference to nor claim protection from other services as referred to *recognizing c)* and in *resolves* 1.1.1.1, 1.1.6.1, 1.2.1 and 1.2.4;

Note: redundant with resolves 1.3.3

2 that the commitment referred to in *resolves* 1.3.3 shall be objective, measurable and enforceable;

Note: moved above to be resolves 1.3.7

3 that compliance with the provisions contained in Annex 1 does not release the notifying administration of the non-GSO satellite system with which ESIMs communicate of its obligations mentioned in *resolves further* 1 above.

4 that frequency assignments to non-GSO ESIMs shall be notified by the notifying administration of the satellite system in the FSS with which ESIMs communicate;

Note: moved up to be new resolves 1.4.5

Note: covered in resolves 1.4.3

9

Note: moved up to be resolves 1.3.2 bis

5 that, for the implementation of *resolves further* 1 above, the notifying administration responsible for the operation of aeronautical and maritime non-GSO ESIMs shall also be responsible for observing and complying 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 non-GSO 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 non-GSO 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 2 of Annex 1 to this Resolution within the territory

under its jurisdiction, such agreement shall not affect other countries that are not party to that agreement;

7 that administrations intending to authorize non-GSO ESIMs, when establishing national licensing rules shall ensure that the provisions of Annex 1 are unchanged in cross-border applications;

8 that the notifying administration of the Non-GSO satellite system with which the ESIM communicate shall provide to the BR list of administration(s) that authorize use of Non-GSO ESIM,

instructs the Director of the Radiocommunication Bureau

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

2 to report to future world radiocommunication conferences any difficulties or inconsistencies encountered in the implementation of this Resolution, including whether or not the responsibilities relating to the operation of aeronautical and maritime non-GSO ESIMs have been properly addressed;

Note: examination of compliance with the conditions to protect the EESS in the frequency band 18.6-18.8 GHz is must.

3 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 epfd limits specified in Article **22**;

4 to publish the list of non-GSO satellite systems with which ESIM communicate brought into use with information about its service area and countries authorize such use if any; this information shall be updated regularly(see resolves further 8),

Note: It was agreed that the issue of identifying the notifying administration is still ambiguous and requires further discussions before taking the decision regarding this draft new resolution, in order to develop a means for the affected administration to identify the notifying administration of the satellite network space station with which the ESIM communicates.

invites administrations

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

2 to take into consideration the relevant recommendations to employ Annex 4 procedures when licensing/authorizing the operation of earth stations in motion in their territories,

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.

NOTE: END of a section that was not discussed in detail at CPM23-2

ANNEX 1 TO DRAFT NEW RESOLUTION [AFCP-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 for the frequency band 29.5-30.0 GHz with respect to administrations mentioned in No. 5.542

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 is allocated and that operate in accordance with the Radio Regulations. The provisions in the parts below also apply in the frequency band 29.5-30 GHz with respect to administrations mentioned in No. **5.542** of the Radio Regulations.

Note : redundant with the previous text

Part 1: Maritime non-GSO ESIMs

1 The notifying administration of the non-GSO FSS satellite system with which maritime ESIMs communicates shall ensure compliance of the maritime ESIMs operating within the frequency bands 27.5-29.1 GHz and 29.5-30 GHz, or parts thereof, with both of the following conditions for the protection of terrestrial services to which the frequency bands are 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 km within the frequency bands 27.5-29.1 GHz and 29.5-30.0 GHz. 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 shall be limited to 24.44 dBW in a reference bandwidth of 14 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 system with which aeronautical ESIMs communicates shall ensure compliance of the aeronautical ESIMs operating within the frequency bands 27.5-29.1 GHz and 29.5-30 GHz, with all of the following conditions for the protection of the terrestrial services to which the frequency bands are 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 ESIM shall not exceed:

Option 1:

$pfd(\theta) = -124.7$ $(dB(W/(m^2 \cdot 14\ MHz)))$ for $0° \le \theta \le 0.01°$

$pfd(\theta) = -120.9 + 1.9 \cdot \log\theta$ $(dB(W/(m^2 \cdot 14\ MHz)))$ for $0.01° < \theta \le 0.3°$

$pfd(\theta) = -116.2 + 11 \cdot \log\theta$ $(dB(W/(m^2 \cdot 14\ MHz)))$ for $0.3° < \theta \le 1°$

$pfd(\theta) = -116.2 + 18 \cdot \log\theta$ (dB(W/(m^2 · 14 MHz))) for $1° < \theta \leq 2°$

$pfd(\theta) = -117.9 + 23.7 \cdot \log\theta$ (dB(W/(m^2 · 14 MHz))) for $2° < \theta \leq 8°$

$pfd(\theta) = -96.5$ (dB(W/(m^2 · 14 MHz))) for $8° < \theta \leq 90.0°$

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 ESIM shall not exceed:

$pfd(\theta) = -136.2$ (dB(W/(m^2 · 1 MHz))) for $0° \leq \theta \leq 0.01°$

$pfd(\theta) = -132.4 + 1.9 \cdot \log\theta$ (dB(W/(m^2 · 1 MHz))) for $0.01° < \theta \leq 0.3°$

$pfd(\theta) = -127.7 + 11 \cdot \log\theta$ (dB(W/(m^2 · 1 MHz))) for $0.3° < \theta \leq 1°$

$pfd(\theta) = -127.7 + 18 \cdot \log\theta$ (dB(W/(m^2 · 1 MHz))) for $1° < \theta \leq 12.4°$

$pfd(\theta) = -108$ (dB(W/(m^2 · 1 MHz))) for $12.4° < \theta \leq 90°$

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

2.3 The pfd levels provided in §§ 2.1 and 2.2 above relate to the pfd and angles of arrival that shall be obtained using free-space propagation and attenuation due to the aircraft fuselage. Unless there is an available ITU-R Recommendation to calculate attenuation due to the aircraft fuselage in the frequency bands 27.5-29.1 GHz and 29.5-30 GHz, the formulas in the table below shall be used for the calculation of attenuation due to the aircraft fuselage in these frequency bands.

Fuselage attenuation model from Report ITU-R M.2221

$L_{fuse}(\gamma) = 3.5 + 0.25 \cdot \gamma$	dB	for	$0° \leq \gamma \leq 10°$
$L_{fuse}(\gamma) = -2 + 0.79 \cdot \gamma$	dB	for	$10° < \gamma \leq 34°$
$L_{fuse}(\gamma) = 3.75 + 0.625 \cdot \gamma$	dB	for	$34° < \gamma \leq 50°$
$L_{fuse}(\gamma) = 35$	dB	for	$50° < \gamma \leq 90°$

2.4 An aeronautical ESIM operating in the frequency bands 27.5-29.1 GHz and 29.5-30 GHz, 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.

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

2.6 Higher pfd levels than those provided in 2.1 and 2.2 above produced by aeronautical non-GSO ESIMs on the surface of the Earth within an administration shall be subject to the prior agreement of that administration.

ANNEX 2 TO DRAFT NEW RESOLUTION [AFCP-A116] (WRC-23)

Methodology with respect to the examination referred to in Scenario 1 *resolves* 1.2.5

NOTE: This methodology has been developed based on the discussions in Working Party 4A regarding draft new Recommendation ITU-R S.[RES.169_METH] which contains a methodology for assessing compliance of A-ESIM communicating with GSO FSS satellites to meet the

*obligations to protect terrestrial services in Resolution **169 (WRC-19)**. Proposals to WRC-23 on agenda item 1.16 including Doc. CPM23-2/175 may need to take into account any further progress/updates to this draft new Recommendation when considering a methodology for assessing compliance with Part 2 of Annex 1 of Resolution **[AFCP-A116]** for A-ESIM communicating with non-GSO FSS satellites.*

However, it should be emphasized that the discussion in the CG would lead to a satisfactory conclusion on the matter and there is no certainty that the work of the CG will be agreed at WP 4A and SG4. Consequently, decisions of the CPM on this matter should not be based on other actions by SG4 or RA-23 that may not be conclusive.

Option 1 for the methodology:

1 Overview of the methodology

Option 1:

Aeronautical earth station in motion (A-ESIM) can operate over time at different locations defined by latitude, longitude and altitude. This methodology determines the maximum allowable off-axis e.i.r.p. spectral density ("$EIRP_C$") for an A-ESIM 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's surface. This methodology derives the $EIRP_C$ considering the relevant loss and attenuation in the geometry considered, among other things.

Option 2:

An aeronautical earth station in motion (A-ESIM) can operate over time at different locations defined by latitude, longitude and altitude. This methodology determines the maximum allowable off-axis e.i.r.p. spectral density ("$EIRP_C$") for an A-ESIM transmitter communicating with a non-GSO FSS space station that ensures compliance with a set of the defined pfd limits on the Earth's surface in Annex 1 to this Resolution. This methodology derives the $EIRP_C$ considering the relevant loss and attenuation in the geometry considered, among other things.

The methodology then compares the computed $EIRP_C$ with the reference off-axis e.i.r.p. towards the ground ("$EIRP_R$") of the A-ESIMs. For each emission in each group of a non-GSO FSS satellite system, $EIRP_R$ 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 non-GSO FSS satellite system associated with a to-be-defined non-GSO A-ESIM class of station, the $EIRP_R$ is the algebraic summation (in logarithmic terms) of the maximum input power to the antenna (item C.8.a.1 of Appendix **4**), the peak gain of the A-ESIM antenna (item C.10.d.3 of Appendix **4**), the maximum achievable off-axis gain isolation towards the ground of the A-ESIM 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.

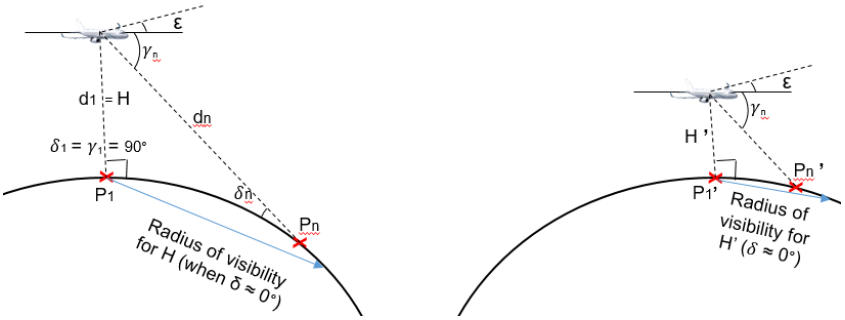
The operations of A-ESIMs shall be evaluated over multiple predefined altitude ranges in order to establish as many $EIRP_C$ levels for comparison with $EIRP_R$. This comparison is at the basis of the methodology and examination that are described more in detail in the following section. An examination by the Bureau shall apply this methodology for each altitude range, to determine whether the A-ESIM operating under a given non-GSO satellite system complies with the defined pfd limits on the Earth's surface in Annex 1 to this Resolution to ensure the protection of terrestrial services.

2 Parameters and geometry

Figure A2-1 provides a description of the geometry considered under this methodology. The figure shows A-ESIMs flying at two different altitudes and also some of the parameters used for the calculation. The model is agnostic to non-GSO ESIM geographical locations on Earth and assumes a spherical Earth model with a fixed radius for the calculation.

FIGURE A2-1

Geometry for the examination of compliance for two different ESIMs altitudes



The notifying administration for the non-GSO FSS system with which the A-ESIM communicates shall send to the Bureau the relevant characteristics of the A-ESIM intended to communicate with that non-GSO FSS network under *resolves* 1.1.3 above. All the parameters required by the Bureau to carry out the examination process are listed and briefly described in Table A2-1. Additional considerations are further elaborated in section 3.

Option 1:

TABLE A2-1

Relevant parameters for pfd limits compliance examination

Parameter	Symbol	Type of parameter	Observation
Aeronautical non-GSO ESIM altitude	H	Established by the methodology as: H_{min} = 0.01 km, H_{max} = [13/15] km, H_{step} = 1 km	The altitudes at which the examination is carried out range from H_{min} to H_{max} at H_{step} intervals.
Angle of arrival of the incident wave on the Earth's surface	δ	Specified by the pre-established set(s) of pfd limits, variable from 0° to 90°	Pre-established set(s) of pfd limits should cover incident angles from 0° to 90°

Parameter	Symbol	Type of parameter	Observation
Angle below the horizontal plane of the ESIMs corresponding to the angle of arrival δ under examination	γ	Calculated from the geometry	This angle is calculated considering the non-GSO ESIMs altitude H_j examined and angle of arrival δ 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 δ and γ
Frequency	f	Taken from the Appendix **4** data	To evaluate the propagation loss or at the lower limits of the frequency range
Atmospheric loss	L_{atm}	Calculated and established by the methodology	Based on Recommendation ITU-R P.676
Fuselage attenuation	L_f	See § 2.3 in Annex 1	The attenuation depends on the angle (γ) below the horizontal plane of the non-GSO ESIMs.
A-ESIM antenna peak gain and off-axis gain pattern	G_{max}, $G(\theta)$	Taken from the Appendix **4** data (items C.10.d.3 and C.10.d.5.a.1, respectively) of the non-GSO system under examination	The A-ESIM antenna gain is used to compute $EIRP_R$
Emission bandwidth	$BW_{Emission}$	Taken from the Appendix **4** data (as part of item 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 $EIRP_R$ in case $BW_{Emission} < BW_{Ref}$
Reference bandwidth	BW_{Ref}	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	$EIRP_C$	$EIRP_C$ is the result of the calculation; it depends on the ESIM altitude and the angle of arrival (δ) of the incident wave on the Earth's surface	For each of the altitudes H_j, the e.i.r.p. for compliance is calculated for the different incident angles (δ) considered to cover all the range of the pfd limits to be established by WRC-23. This leads to a number of values of $EIRP_C$ associated to a given altitude H_j; for each altitude H_j, the lowest e.i.r.p. value is the one to be retained and compared with $EIRP_R$ (see section 3)
A set of pre-established pfd limits on the Earth's surface	$PFD(\delta)$	Taken from Annex 1 to this Resolution	The pfd limits, expressed in $dB(W/m^2/BW_{ref})$, are a function of the angle of arrival δ

Option 2:

TABLE A2-1

Relevant parameters for pfd compliance examination

Parameter	Symbol	Type of parameter	Observation
Aeronautical non-GSO ESIM altitude	H	Established by the methodology as: H_{min} = 0.01 km, H_{max} = 15.01 km	The altitudes at which the examination is carried out range from H_{min} to H_{max} at the following altitudes: H_{min}, 1.01 km, 2.01 km, 3.00 km, 3.01 km, 4.01 km… H_{max}.
Angle of arrival of the incident wave on the Earth's surface	δ	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 ESIM corresponding to the angle of arrival δ under examination	γ	Calculated from the geometry	This angle is calculated considering the non-GSO A-ESIM's altitude H_j examined and angle of arrival δ under examination (see Fig. A.2.1)
Distance between the ESIM 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 δ and γ
Frequency	f	Provided by the Appendix **4** data	To evaluate the propagation loss either at the centre frequency or at the upper and lower limits of the frequency range
Atmospheric loss	L_{atm}	Calculated and established by the methodology	Based on Recommendation ITU-R P.676
Fuselage attenuation	L_f	Report ITU-R M.2221-0 or other ITU-R Reports or Recommendations	The attenuation depends on the angle (γ) below the horizontal plane of the non-GSO A-ESIM. The value(s) could come from ITU-R Reports and/or Recommendations, such as Report ITU-R M.2221. Note, the model contained in Report ITU-R M.2221-0 might require updating and/or clarifications.
A-ESIM antenna peak gain and off-axis gain pattern	G_{max}, $G(\theta)$	Taken from the Appendix **4** data (items C.10.d.3 and C.10.d.5.a.1, respectively) of the non-GSO system under examination	The A-ESIM antenna gain is used to compute $EIRP_R$
Emission bandwidth	$BW_{Emission}$	Taken from the Appendix **4** data (as part of item 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 $EIRP_R$ in case $BW_{Emission} < BW_{Ref}$
Reference bandwidth	BW_{Ref}	Taken from the set(s) of pre-established pfd limits	

Parameter	Symbol	Type of parameter	Observation
Effective isotropic radiated power required for compliance with the pfd limits in a reference bandwidth	$EIRP_C$	$EIRP_C$ is the result of the calculation; it depends on the ESIM altitude and the angle of arrival (δ) of the incident wave on the Earth's surface	For each of the altitudes H_j, the e.i.r.p. for compliance is calculated for the different incident angles (δ) considered to cover all the range of the pfd limits to be established by WRC-23. This leads to a number of values of $EIRP_C$ associated to a given altitude H_j; for each altitude H_j, the lowest e.i.r.p. value is the one to be retained and compared with $EIRP_R$ (see section 3)

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 $EIRP_R$

i) For each of the emissions included in the Group under consideration, compute the Reference EIRP ($EIRP_R$, dB(W)) as:

$$EIRP_R = G_{Max} - G_{Isol_{Max}} + P_{Max} + 10\log_{10}(BW) \quad (1)$$

where:

G_{Max} is the A-ESIM antenna peak gain in dBi

$G_{Isol_{Max}}$ is the maximum achievable gain isolation of the A-ESIM antenna towards the ground in dB when operating in the examined non-GSO system

P_{Max} is the maximum power density at the A-ESIM antenna flange in dB(W/Hz).

BW in Hz is:

BW_{Ref} if $BW_{emission} > BW_{Ref}$

$BW_{emission}$ if $BW_{emission} < BW_{Ref}$

Calculate $EIRP_C$

ii) For each aircraft altitude, it is necessary to generate as many δ_n 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 δ_n shall be comprised between 0° and 90° and have a resolution compatible with the granularity of the pre-established pfd limits. Each of the angles δ_n will correspond to as many N points on the ground.

iii) For each altitude $H_j = H_{min}, \ldots, H_{max}$, compute $EIRP_{C\_j}$ using the following algorithm:

a) Set the altitude of the A_ESIM to H_j

b) Compute the angle below the horizon $\gamma_{j,n}$ as seen from the A-ESIM for each of the N angles δ_n generated in ii) using the following equation:

$$\gamma_{j,n} = \arccos\left(\frac{R_e \cdot \cos(\delta_n)}{(R_e + H_j)}\right) \quad (2)$$

where R_e is the mean Earth radius.

c) Compute the distance $D_{j,n}$, in km, for $n = 1, \ldots, N$ between the A-ESIM and the tested point on the ground:

$$D_{j,n} = \sqrt{R_e^2 + \left(R_e + H_j\right)^2 - 2R_e\left(R_e + H_j\right)\cos\left(\gamma_n - \delta_n\right)} \quad (3)$$

d) Compute the fuselage attenuation $L_{f\,j,n}$ (dB) applicable to each of the N points on the ground as a function of the angles $\gamma_{j,n}$ computed in *b)* above

e) Compute the atmospheric loss $L_{atm\_j,n}$ (dB) applicable to each of the distances $D_{j,n}$ computed in *c)* above

f) Compute the $EIRP_{C\_j,n}$ (dB(W/BW_{Ref})), that is the maximum e.i.r.p. that can be radiated in the pfd mask's reference bandwidth by the A-ESIM towards each of the N points to be compliant with the set(s) of pre-established pfd limits, as per the following equation:

$$EIRP_{C\_j,n}\left(\delta_n, \gamma_n\right) = pfd\left(\delta_n\right) + 10\log_{10}\left(4\pi\left(D_{j,n} \cdot 1\,000\right)^2\right) + L_{f\,j,n} + L_{atm\_j,n} \quad (4)$$

g) Compute the minimum $EIRP_{C\_j}$ across all values calculated at the previous step, $EIRP_{C\_j}$ = Min ($EIRP_{C\_j,n}$ (δ_n, γ_n)). The output of this last step is the maximum $EIRP_C$ that can be radiated by the A-ESIM to ensure it complies with the set(s) of pre-established pfd limits with respect to all angles δ_n at the altitude H_j. There will be one $EIRP_{C\_j}$ for each of the H_j altitudes considered.

The output of step iii) is summarized in Table A2-2 below:

TABLE A2-2

Computed $EIRP_{C\_j}$ values

J	**H_j**	**$EIRP_{C\_j,n}$ (δ_n, γ_n) dB(W/BW_{Ref})**				**$EIRP_{C\_j}$**
-	(km)	$\delta = 0°$	$\delta = 0.01°$	…	$\delta = 90°$	dB(W/BW_{Ref})
1	H_{min}	xxx	xxx	xxx	xxx	XXX
2		yyy	yyy	yyy	yyy	YYY
…	…	…	…	…	…	…
j_{max}	H_{max}	zzz	zzz	zzz	zzz	ZZZ

Compare $EIRP_C$ and $EIRP_R$, and produce an examination finding

iv) For each of the emissions, check whether $EIRP_{C\_j} > EIRP_R$. The results of this check are illustrated in Table A2-3 below.

TABLE A2-3

Comparison between $EIRP_{C\_j}$ and $EIRP_R$

Group ID	**Emission No.**	**$EIRP_R$ dB(W)**	**Is there at least one altitude H_j for which $EIRP_{C\_j} > EIRP_R$?**	**Smallest H_j for which $EIRP_{C\_j} > EIRP_R$ (km)**
X	1	XXX	Yes/No	AAA

Y	2	YYY	Yes/No	BBB
…	…	…	…	…
Z	*N*	ZZZ	Yes/No	CCC

v) For the emissions included in the Group under examination which pass the test detailed in iv) above, the results of the Bureau's examination for that Group is ***favourable*** (after removing emissions that have failed the examination), otherwise it is ***unfavourable***.

vi) The Bureau shall publish:

– the finding (favourable or unfavourable) for each Group of the non-GSO system examined;

– Table A2-3, that is the output of step iii) of the algorithm.

Note: As part of standard procedure, the Bureau would publish the emissions with unfavourable findings in BR IFIC Part III-S, which concerns frequency assignments that are returned to the responsible administration.

Option 2 for the methodology:

1 Examination methodology

1.1 Introduction

An A-ESIM can operate at different locations defined by latitude, longitude and altitude. This methodology determines the maximum allowable off-axis e.i.r.p. spectral density ("$EIRP_C$") for an A-ESIM transmitter communicating with a non-GSO FSS satellite and still ensure compliance with the pfd limits included in Part 2 of Annex 1 of this Resolution to protect terrestrial services, for a defined set of altitude ranges. The methodology derives the $EIRP_C$ taking into account the relevant loss and attenuation in the geometry considered.

The methodology then compares the computed $EIRP_C$ with the Reference A-ESIM off-axis e.i.r.p. towards the ground ("$EIRP_R$") under which the A-ESIM operates. The $EIRP_R$ of the non-GSO satellite system is calculated from the data included in the Appendix **4** Notification information of non-GSO satellite system with which the ESIM communicates and on the ESIM characteristics, as applicable. For the emission in each group of a non-GSO satellite system, $EIRP_R$ 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.

The operations of A-ESIM may be evaluated over a number of predefined altitude ranges in order to establish a number of $EIRP_C$ levels. Each altitude range would have its own $EIRP_C$ such that, all other assumptions being equal, higher altitude A-ESIM operation would allow for a higher $EIRP_C$, since the distance between the A-ESIM and the chosen location on the ground is larger and so are the applicable losses and attenuations.

An examination by the Bureau would apply this methodology for each altitude range, to determine whether the A-ESIM operating under a given non-GSO satellite system would comply with the pfd limits included in Part 2 of Annex 1 of this Resolution to protect terrestrial services.

1.2 Input parameters

Considering a hypothetical non-GSO satellite system, Table 1 below describes the emissions that are examined and that are included in one Group associated to the "UO" class of e/s transmitting in the 27.5-29.5 GHz band. Tables 2 and 3 provide additional parameters.

TABLE 1

Example of a Group of applicable A-ESIM emissions (with reference to relevant RR Appendix 4 data fields)

Emission No.	C.7.a Designation of emission	$BW_{emission}$ MHz	C.8.c.3 minimum power density dB(W/Hz)	C.8.a.2/C.8.b.2 Maximum power density dB(W/Hz)
1	6M00G7W--	6.0	−69.7	−66.0
2	6M00G7W--	6.0	−64.7	−61.0
3	6M00G7W--	6.0	−59.7	−56.0

TABLE 2

Additional example assumptions

ID	Parameter	Notation	Value	Unit
1	Frequency assignment	f	29.5	GHz
2	Reference bandwidth of pfd mask	BW_{Ref}	14.0	MHz
3	A-ESIM antenna peak gain	G_{max}	37.5	dBi
4	A-ESIM antenna gain pattern	-	As per Rec. ITU-R S.580 (see C.10.d.5.a.1)	

TABLE 3

Additional assumptions defined in the methodology

ID	Parameter	Notation	Value	Unit
9[2)]	Atmospheric attenuation	L_{atm}	Computed with Rec. ITU-R P.676	dB
10	Angle of arrival of the incident wave on the Earth's surface	δ	Specified by the pre-established sets of pfd limits, variable from 0° to 90°	deg
11	Minimum examination altitude	H_{min}	0.01	km
12	Maximum examination altitude	H_{max}	15	km
13	Examination altitude spacing	H_{step}	1.0	km
14	Fuselage attenuation	L_f	See Table 4	dB

FIGURE 1

Geometry for the examination of compliance for two different ESIM altitudes

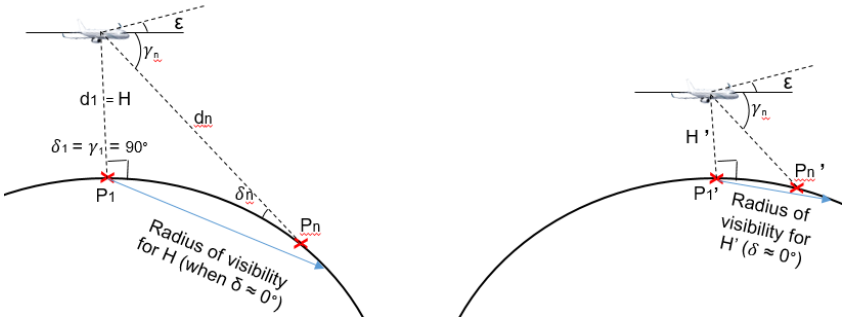


FIGURE 2

A-ESIM main beam gain points at satellite

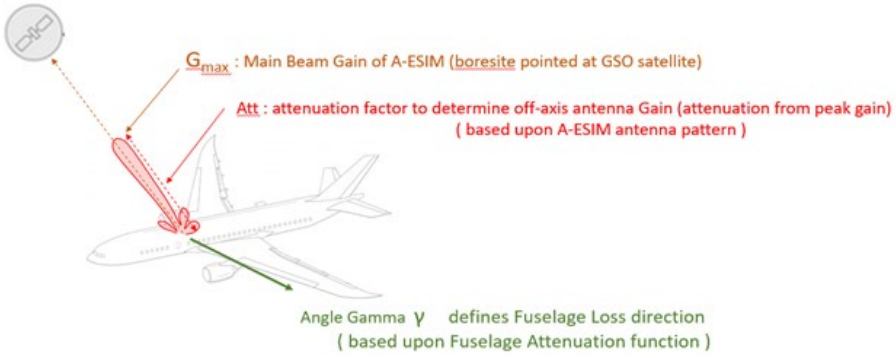


TABLE 4

Fuselage attenuation model

$L_{fuse}(\gamma) = 3.5 + 0.25 \cdot \gamma$	dB	for	$0° \leq \gamma \leq 10°$
$L_{fuse}(\gamma) = -2 + 0.79 \cdot \gamma$	dB	for	$10° < \gamma \leq 34°$
$L_{fuse}(\gamma) = 3.75 + 0.625 \cdot \gamma$	dB	for	$34° < \gamma \leq 50°$
$L_{fuse}(\gamma) = 35$	dB	for	$50° < \gamma \leq 90°$

Note: This example fuselage attenuation model from on Report ITU-R M.2221-0. [Additional models are being developed in WP 4A.]

TABLE 5A

Required conformance pfd mask for altitudes up to 3 km

$pfd(\delta) = -136.2$	(dB(W/(m^2 · 1 MHz)))	for	$0° \le \delta \le 0.01°$
$pfd(\delta) = -132.4 + 1.9 \cdot \log \delta$	(dB(W/(m^2 · 1 MHz)))	for	$0.01° < \delta \le 0.3°$
$pfd(\delta) = -127.7 + 11 \cdot \log \delta$	(dB(W/(m^2 · 1 MHz)))	for	$0.3° < \delta \le 1°$
$pfd(\delta) = -127.7 + 18 \cdot \log \delta$	(dB(W/(m^2 · 1 MHz)))	for	$1° < \delta \le 12.4°$
$pfd(\delta) = -108$	(dB(W/(m^2 · 1 MHz)))	for	$12.4° < \delta \le 90°$

TABLE 5B

Required conformance pfd mask for altitudes above 3 km

$pfd(\delta) = -124.7$	(dB(W/(m^2 · 14 MHz)))	for	$0° \le \delta \le 0.01°$
$pfd(\delta) = -120.9 + 1.9 \cdot \log \delta$	(dB(W/(m^2 · 14 MHz)))	for	$0.01° < \delta \le 0.3°$
$pfd(\delta) = -116.2 + 11 \cdot \log \delta$	(dB(W/(m^2 · 14 MHz)))	for	$0.3° < \delta \le 1°$
$pfd(\delta) = -116.2 + 18 \cdot \log \delta$	(dB(W/(m^2 · 14 MHz)))	for	$1° < \delta \le 2°$
$pfd(\delta) = -117.9 + 23.7 \cdot \log \delta$	(dB(W/(m^2 · 14 MHz)))	for	$2° < \delta \le 8°$
$pfd(\delta) = -96.5$	(dB(W/(m^2 · 14 MHz)))	for	$8° < \delta \le 90.0°$

1.3 Step-by-step algorithm

This section includes a step-by-step description of how the examination methodology would be implemented.

START

i) For each aircraft altitude, it is necessary to generate as many δ_n angles (angle of arrival of the incident wave) as required in order to test the full compliance with the applicable set of pfd limits. The N angles δ_n 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 δ_n will correspond to as many N points on the ground.

ii) For each altitude $H_j = H_{min}, H_{min} + H_{step}, \ldots, H_{max}$, compute $EIRP_{C\_j}$ and $EIRP_{R\_j}$ using the following algorithm:

a) set the altitude of the A-ESIM to H_j

b) compute the angle below the horizon $\gamma_{j,n}$ as seen from the A-ESIM for each of the N angles δ_n generated in ii. using the following equation:

$$\gamma_{j,n} = \arccos\left(\frac{R_e \cdot \cos(\delta_n)}{(R_e + H_j)}\right) \quad (1)$$

where R_e is the mean earth radius.

c) Compute the distance $D_{j,n}$, in km, for $n = 1, \ldots, N$ between the A-ESIM and the tested point on the ground:

$$D_{j,n} = \sqrt{R_e^2 + (R_e + H_j)^2 - 2R_e(R_e + H_j)\cos(\gamma_n - \delta_n)} \quad (2)$$

d) Compute the fuselage attenuation $L_{f\,j,n}$ (dB) with $i = 1, \ldots, N$ applicable to each of the of the angles $\gamma_{j,n}$ computed in *b)* above

e) Compute the gaseous absorption $L_{atm\_j,n}$ (dB) with $i = 1, \ldots, N$ applicable to each of the distances Dj,n computed in *c)* above, using the applicable sections of Recommendation ITU-R P.676

f) Compute the maximum $EIRP_{C\_j,n}$ (dB(W/BW_{Ref})) that is the maximum e.i.r.p. that can be radiated by the A-ESIM at altitude H_j towards each of the angles $\gamma_{j,n}$ and still be compliant with the pfd limits indicated in Table 5, as per the following equation:

$$EIRP_{C\_j,n}(\delta_n,\gamma_n) = pfd(\delta_n) + 10\log_{10}\left(4\pi\left(D_{j,n}\cdot 1\,000\right)^2\right) + L_{f\ j,n} + L_{atm\_j,n} \qquad (3)$$

g) Compute the minimum $EIRP_{C\_j}$ across all values calculated at the previous step, $EIRP_{C\_j}$ = Min ($EIRP_{C\_j,n}$ (δ_n, γ_n)). The output of this step is the maximum $EIRP_{C\_j}$ that can be safely radiated by the A-ESIM to ensure it complies with the pfd limits indicated in Table 5A or 5B, as applicable, with respect to all angles δ_n at the altitude H_j. There will be one $EIRP_{C\_j}$ for each of the H_j altitudes considered.

h) For each emission included in the Group under consideration, compute the reference e.i.r.p. ($EIRP_{R\_j,n}$ (dBW)) as:

$$EIRP_{R\_j,n} = P_{Max} + Gtx\left(\gamma_{j,n} + \varepsilon\right) + 10\log_{10}(BW) \qquad (4)$$

where:

P_{Max} is the maximum power density at the A-ESIM antenna flange in dB(W/Hz).

$Gtx(\gamma_{j,n} + \varepsilon)$ is the transmit antenna gain with the separation angle from the peak direction consisting of each the angle $\gamma_{j,n}$ and the elevation angle ε.

ε is the A-ESIM elevation angle towards the satellite.

BW in Hz is:

BW_{Ref} if $BW_{emission} > BW_{Ref}$

$BW_{emission}$ if $BW_{emission} < BW_{\text{Ref}}$

i) Compute the $EIRP_{R\_j}$ across all values calculated at the previous step, $EIRP_{R\_j}$ = Max ($EIRP_{R\_j,n}$ (δ_n, γ_n)). Note that the $EIRP_{R\_j}$ is calculated for each emission.

The output of steps g*)* and *i)* is summarized in Table 7 below:

TABLE 7

Computed $EIRP_{C\_j}$ and $EIRP_{R\_j}$ values

H_j (km)	$EIRP_{C\_j}$ dB(W/BW_{Ref})	$EIRP_{R\_j}$ dB(W/BW_{Ref})
0.01	*TBD*	*TBD*
1.0	*TBD*	*TBD*
2.0	*TBD*	*TBD*
3.0	*TBD*	*TBD*

H_j (km)	$EIRP_{C\_j}$ dB(W/BW_{Ref})	$EIRP_{R\_j}$ dB(W/BW_{Ref})
4.0	*TBD*	*TBD*
5.0	*TBD*	*TBD*
6.0	*TBD*	*TBD*
7.0	*TBD*	*TBD*
8.0	*TBD*	*TBD*
9.0	*TBD*	*TBD*
10.0	*TBD*	*TBD*
11.0	*TBD*	*TBD*
12.0	*TBD*	*TBD*
13.0	*TBD*	*TBD*
14.0	*TBD*	*TBD*
15.0	*TBD*	*TBD*

Note: This methodology computes the e.i.r.p. backwards, upwards from the ground, starting with the power flux-density (pfd, either the one specified in Table 5A or 5B, depending on the altitude H_j, as applicable) and:

- converting it to an effective received power at the ground;
- translating back to the aircraft location based upon the slant distance and subtracting propagation losses based upon distance;
- computing and subtracting atmospheric losses based upon distance;
- computing and subtracting fuselage attenuation losses based upon the angle below the aircraft local horizon.

All to allow the A-ESIM operator to operate in compliance with an effective on-axis boresight isotropic radiated power (e.i.r.p.) that would ensure it complies with the pfd mask at the airborne A-ESIM altitude and location considered.

iv) For each of the groups, check whether there is at least one *j)* for which $EIRP_{C\_j} > EIRP_J$. The results of this check are illustrated in Table 8 below.

TABLE 8

Comparison between $EIRP_{C\_j}$ and $EIRP_{R,j}$

Group No.	C.7.a Designation of emission	Lowest altitude H_j (km) for which $EIRP_{C\_j} > EIRP_{R,\,j}$
1	6M00G7W--	TBD
2	6M00G7W--	TBD
3	6M00G7W--	TBD

For the emissions included in the Group under examination which pass the test detailed in iv) above, the results of the Bureau's examination for that Group is ***favourable****, after removing emissions that have failed the examination*, otherwise it is ***unfavourable***.

v) The Bureau should publish:

a) The finding (favourable or unfavourable) for the examined Group of the non-GSO system examined; and

b) the information included in Table 8, along with the comment: The operation of A-ESIM with the Emission **XXX** (Emission Code) under examination shall be possible below the altitude of **YYY** km (minimum altitude for favourable finding of that emission) referred to in Table 8 only if the appropriate mitigation techniques are used to ensure that the power flux-density produced on Earth's surface respect the limits indicated in Part 2 of Annex 1 of this Resolution on territories where those limits apply.

Note: As part of standard procedure, the Bureau would publish the emissions with unfavourable finding in BR IFIC Part III-S, which concerns frequency assignments that are returned to the responsible administration.

END

Option 1:

2 Example application of the methodology

Table A2-4 below describes the emissions included in one group of a fictitious satellite system that are associated to the class of earth station indicating the non-GSO aeronautical ESIM (A-ESIM) transmitting in the frequency band 27.5-29.1 GHz. Three different types of emissions are included in the group to cover different performance objectives of the communication link.

Option 1:

TABLE A2-4

Example A-ESIM emissions in the group examined

Emission No.	C.7.a Designation of emission	C.8.a.2/C.8.b.2 Maximum power density dB(W/Hz)	C.8.c.3 Minimum power density dB(W/Hz)	C.8.e.1 *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--	−42.0	−55.7	9.0

Table A2-5 below includes additional assumptions needed for the application of the methodology described in section 3.

TABLE A2-5

Additional assumptions

Parameter	Notation	Value	Unit
Test frequency	f	29.5	GHz
A-ESIMs antenna peak gain	G_{max}	37.5	dBi
Antenna gain pattern	-	APEREC015V01	
Polarization loss	L_{Pol}	0.0	dB
Fuselage attenuation model	L_f	See Table A2-6	
Atmospheric loss	L_{atm}	Rec. ITU-R P.676	
Minimum examination altitude range	H_{min}	0.02	km
Maximum examination altitude range	H_{max}	15.0	km
Examination altitude range spacing	H_{step}	1.0	km

Option 2:

TABLE A2-4

Example A-ESIMs emissions in the Group ID No. 1

Emission No.	C.7.a Designation of emission	C.8.a.2/C.8.b.2 Maximum power density dB(W/Hz)	C.8.c.3 Minimum power density dB(W/Hz)	C.8.e.1 *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 A2-5 below includes additional assumptions needed for the application of the methodology described in section 3.

TABLE A2-5

Additional assumptions

Parameter	Notation	Value	Unit
Test frequency	f	30.0	GHz
A-ESIMs antenna peak gain	G_{max}	37.5	dBi
Antenna gain pattern	-	Rec. ITU-R S.580	
Polarization loss	L_{Pol}	0.0	dB
Fuselage attenuation model	FA	See Table A2-6	
Atmospheric attenuation	L_{atm}	Section 2.21.2 of Rec. ITU-R P.676	
Reference atmosphere	-	“Winter high latitude” from Rec. ITU-R P.835.6	
Minimum examination altitude range	H_{min}	0.02	km
Maximum examination altitude range	H_{max}	15.0	km

Parameter	Notation	Value	Unit
Examination altitude range spacing	H_{step}	1.0	km
Altitude of the interfered with terrestrial station	H_T	0.01	km

TABLE A2-6

Fuselage attenuation model from Report ITU-R M.2221

$L_{fuse}(\gamma) = 3.5 + 0.25 \cdot \gamma$	dB	for	$0° \leq \gamma \leq 10°$
$L_{fuse}(\gamma) = -2 + 0.79 \cdot \gamma$	dB	for	$10° < \gamma \leq 34°$
$L_{fuse}(\gamma) = 3.75 + 0.625 \cdot \gamma$	dB	for	$34° < \gamma \leq 50°$
$L_{fuse}(\gamma) = 35$	dB	for	$50° < \gamma \leq 90°$

TABLE A2-7

Tested pfd limits on the ground

$pfd(\theta) = -124.7$	$(dB(W/(m^2 \cdot 14\ MHz)))$	for	$0° \leq \theta \leq 0.01°$
$pfd(\theta) = -120.9 + 1.9 \cdot \log\theta$	$(dB(W/(m^2 \cdot 14\ MHz)))$	for	$0.01° < \theta \leq 0.3°$
$pfd(\theta) = -116.2 + 11 \cdot \log\theta$	$(dB(W/(m^2 \cdot 14\ MHz)))$	for	$0.3° < \theta \leq 1°$
$pfd(\theta) = -116.2 + 18 \cdot \log\theta$	$(dB(W/(m^2 \cdot 14\ MHz)))$	for	$1° < \theta \leq 2°$
$pfd(\theta) = -117.9 + 23.7 \cdot \log\theta$	$(dB(W/(m^2 \cdot 14\ MHz)))$	for	$2° < \theta \leq 8°$
$pfd(\theta) = -96.5$	$(dB(W/(m^2 \cdot 14\ MHz)))$	for	$8° < \theta \leq 90.0°$

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 A2-4, the reference e.i.r.p. ($EIRP_R$, dBW) is computed and the relevant results are included in Table A2-8 below:

Option 1:

TABLE A2-8

Computed values of $EIRP_R$ for the group under consideration

Emission No.	G_{Max} (dBi)	$G_{Isol_{Max}}$ (dB)	P_{Max} (dB(W/Hz))	BW, MHz	$EIRP_R$ (dBW)
1	37.5	42.4	−56.0	6.0	6.89
2			−51.0		11.89
3			−42.0		20.89

ii) Generate δ_n angles compatible with the pfd limits described in Table A2-7:
$\delta_n = 0°, 0.01°, 0.02°, \ldots, 0.3°, 0.4°, \ldots, 12.3°, 12.4°, \ldots, 13°, 14°, \ldots, 90°$.

iii) For each altitude $H_j = H_{min}, H_{min} + H_{step}, \ldots, H_{max}$, compute $EIRP_{C\_j}$. The output of this step is summarized in Table A2-9 below:

TABLE A2-9

Computed $EIRP_{C\_j}$ values
(see embedded file for full results)

j	***H_j***	***$EIRP_{C\_j,n}$ (δ_n, γ_n)*** **dB(W/*BW_{Ref}*)***				***$EIRP_{C\_j}$***
-	**(km)**	**δ = 0°**	**δ = 0.01°**	**…**	**δ = 90°**	**dB(W/*BW_{Ref}*)**
1	0.02	 Table A.2.9_full.xlsx (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 $EIRP_{C\_j} > EIRP_R$. The result of this step is summarized in Table A2-10 below.

TABLE A2-10

Comparison between $EIRP_{C\_j}$ and $EIRP_R$

Emission No.	***$EIRP_R$*** **dB(W)**	**smallest *j* for which *$EIRP_{C\_j} > EIRP_R$***	***$EIRP_{C\_j} > EIRP_R$***
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 ***favourable***.

vi) The Bureau publishes:

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

Option 2:

TABLE A2-8

Computed values of $EIRP_R$ for the group under consideration

Emission No.	***G_{Max}*** **(dBi)**	***$G_{Isol_{Max}}$*** **(dB)**	***P_{Max}*** **(dB(W/Hz))**	***BW*, MHz**	***$EIRP_R$*** **(dBW)**
1	37.5	42.4	−56.0	6.0	6.89
2			−51.0		11.89
3			−46.0		16.89

i) Generate δ_n angles compatible with the pfd limits described in Table A2-7:

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

ii) For each altitude $H_j = H_{min}, H_{min} + H_{step}, \ldots, H_{max}$, compute $EIRP_{C\_j}$. The output of this step is summarized in Table A2-9 below:

TABLE A2-9

Computed $EIRP_{C\_j}$ values
(see embedded file for full results)

j	***H_j***	***$EIRP_{C\_j,n}$ (δ_n, γ_n) dB(W/BW_{Ref})***				***$EIRP_{C\_j}$***
-	**(km)**	**δ = 0°**	**δ = 0.01°**	**…**	**δ = 90°**	**dB(W/BW_{Ref})**
1	0.02	Table A.2.9_full.xlsx				−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 $EIRP_{C\_j} > EIRP_R$. The result of this step is summarized in Table A2-10 below.

TABLE A2-10

Comparison between $EIRP_{C\_j}$ and $EIRP_R$

Group ID	**Emission No.**	***$EIRP_R$*** **dB(W)**	**Is there at least one altitude H_j for which $EIRP_{C\_j} > EIRP_R$?**	**Smallest H_j for which $EIRP_{C\_j} > EIRP_R$ (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 ***favourable***.

v) The Bureau shall publish:

– the ***favourable*** finding for the Group ID No. 1 of the non-GSO system examined

– Table A2-10, published for information only.

END

Option 2: suppress section 2

Option 1:

ATTACHMENT TO ANNEX 2 OF DRAFT NEW RESOLUTION [AFCP-A116] (WRC-23)

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

SECTION SPECIALE / SPECIAL SECTION / SECCIÓN ESPECIAL / 特节 / СПЕЦИАЛЬНАЯ СЕКЦИЯ / القسم الخاص — CR/C/5111

A	*A1a* Sat. Network	TELSTAR-LEO	*A1f1* Notif. adm.	CAN	*A1f3* Inter. sat. org.		*BR1* Date of receipt	17.09.2019	*BR20/BR21* BR IFIC no./part 2911/
BR6a/BR6b Id. no.	119520219		*BR3a/BR3b* Provision reference	9.6	C	*BR2* Adm. serial no.		KUI1	R

A15a EPFD compliance: | *A18a* Aircraft earth station commitment:

B1a/BR17 Beam designation: KUI1	*B1b* Steerable: Y	*B2* Emi-Rcp: R	*B3a1* Max. co-polar gain: 29		

B2bis.a Transmit only when visible from notified service area: | *B2bis.b* Min. Elev. Angle:

B3c1 Co-polar antenna pattern

Co-polar ref. pattern	Coef. A	Coef. B				Co-polar rad. diag.
REC-1528						

List of orbital planes

7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26

B4a3a1 Angle alpha: 0 | *B4a3a2* Angle beta: 0

BR7a/BR7b Group id.	119740373	*BR1* Date of receipt	17.09.2019	*C2c* RR No. 4.4		*BR98* For use in accordance with Res 163/164	
A2b Period of valid.	50	*A3a* Op. agency	003	*A3b* Adm. resp.	B	*BR16* Value of type C8b	
BR62 Expiry date for bringing into use	17.09.2026					*BR64* Date of receipt of 1st Res49	
BR14 Special Section	CR/C/5111						
C4a Class of station	EC	*C3a* Assigned freq. band	100000	*C5a* Noise temperature	730	*B4b5* Peak of pfd	
C4b Nature of service	CP	*C6a* Polarization type	M	*C6b* Polarization angle			
C11a1 Service area no.		*C11a2* Service area	XAA			*C11a3* Service area diagram	
C9c1 Type of multiple access	1	*C9c2* Spectrum mask diagram	1	*C11b* Affected region			

A5/A6 Coordinations/Agreements: 9.12 | F | CHN CYP F G HOL ISR LIE LUX NOR NZL RUS/IK RUS USA VTN

C2a1 Assigned frequency

27.55	GHz	27.75	GHz	27.95	GHz	28.15	GHz	28.35	GHz	28.55	GHz				
27.65	GHz	27.85	GHz	28.05	GHz	28.25	GHz	28.45	GHz						

A13 Ref. to Special Sections
API/C /816

	C7a Design. of emission	*C8a1/C8b1* Max. peak pwr	*C8a2/C8b2* Max. pwr dens.	*C8c1* Min. peak pwr	*C8c2* Attch.	*C8c3* Min. pwr dens.	*C8c4* Attch.	*C8e1* C/N ratio	*C8e2* Attch.
1	100MD7W--	16	-64	5		-75		9.1	
2	10M0D7W--	6	-64	-5		-75		9.1	
3	1M00D7W--	-4	-64	-15		-75		9.1	

C10b1 Assoc. earth station id.	*C10b2* Type	*C10c1* Geographical coord.		*C10c2* Ctry	*C10d1/C10d2* Cls. / Nat.		*C10d3* Max. iso. gain	*C10d4* Bmwdth		*C10d7* Ant. diameter		*C8g1* Max. aggr. pwr.	*C8g2* Aggr. bandwidth	*C8g3* Transp. bandwidth = Aggr. bandwidth
KA U1	T				1	TC	CP	45.7	0.9					

C10d5a Co-polar antenna pattern

C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
KA U1	REC-580-6						

Findings | *2D* Date of protection: 17.09.2019 | *13A* Conformity with RR: A- -- -- | *13B1* Prov. | *13B2* Remarks | *13B3* Date of Review

13C Remarks

ANNEX 3 TO DRAFT NEW RESOLUTION [AFCP-A116] (WRC-23)

Provisions for non-GSO FSS systems[1] transmitting to aeronautical and/or maritime ESIMs operating in or over an ocean in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz with respect to EESS (passive) operating in the frequency band 18.6-18.8 GHz (in accordance with *resolves* 1.1.6)

Option 1:

Non-GSO fixed-satellite space stations operating with an orbit apogee less than 20 000 km in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz with an aeronautical or maritime ESIM shall not exceed a pfd produced at the surface of the oceans across the 200 MHz of the frequency band 18.6-18.8 GHz, of −123 dB(W/(m² · 200 MHz)). This value can be exceeded provided that the non-GSO fixed-satellite system does not exceed a pfd across the 200 MHz of the frequency band 18.6-18.8 GHz of −137 dB(W/(m² · 200 MHz)) averaged over an area of 10 000 000 km² at the surface of the oceans.

Option 2:

Non-GSO fixed-satellite space stations operating with an orbit apogee less than 20 000 km in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz over oceans with aeronautical or maritime ESIM shall not exceed the following pfd values produced at the surface of the oceans across the 200 MHz of the 18.6-18.8 GHz band:

−123 dB(W/(m² · 200 MHz)) for non-GSO FSS space stations operating at orbital altitudes greater than 2 000 km;

−117 dB(W/(m² · 200 MHz)) for non-GSO FSS space stations operating at orbital altitudes between 1 000 km and 2 000 km;

−104 dB(W/(m² · 200 MHz)) for non-GSO FSS space stations operating at orbital altitudes below 1 000 km.

Option 3:

Any non-GSO fixed satellite space station operating in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz with (i) an orbit apogee less than 20 000 km (ii) communicating with an aeronautical or maritime ESIM over the ocean, and (iii) for which complete notification information has been received by the Radiocommunication Bureau after 1 January 2025, shall not exceed an unwanted emission power flux-density produced at the surface of the ocean in the 18.6-18.8 GHz band, based on the following piecewise equation:

for N ≥ 10: $pfd = min(-77 - 10 * \log(S), -110)$ dB(W/(m² · 200 MHz))

for N < 10: $pfd = min(-67 - 10 * \log(S) - 10 * \log(N), -110)$ dB(W/(m² · 200 MHz))

where S is the non-GSO fixed satellite space station 3 dB beam footprint area on the ground expressed in km² and N is the maximum number of co-frequency beams

[1] These provisions do not apply to non-GSO systems using orbits with an apogee less than 2 000 km that employ a frequency reuse factor of at least three.

generated by the non-GSO fixed satellite system within a 10 000 000 km^2 square on the Earth.

NOTE: Annex 4 was not discussed in detail at CPM23-2

ANNEX 4 TO DRAFT NEW RESOLUTION [AFCP-A116] (WRC-23)

Required ESIM capabilities

In order to enable the ESIM to cease transmission when the conditions described are met, the ESIM network shallbe designed with appropriate capabilities. Table A4.1 describes applicable capabilities, with a justification for their requirement.

It is also important to note that the NCMC has a database of allowed power spectral density limits per angles (azimuth, elevation and skew), altitude and attitude that are critical to ensure pfd limits are met. The NCMC draws upon this comprehensive and detailed database of allowed levels and continually monitors feedback from the terminal to ensure emissions are fully compliant with regulatory limits.

For each ESIM, the NCMC should have a record of the location, the latitude, longitude and altitude, the transmit frequency, channel bandwidth and non-GSO satellite system with which the non-GSO ESIM communicates. This data can be made available to an administration or authorized agency for the purposes of detecting and resolving interference events.

Table a4-1

Minimum ESIM capabilities and justification

Capability	Justification
GNSS (or other geolocation capabilities)	Required to assess the ESIM's geographic location so the ESIM is aware when entering an administration's territory that has not given authorization and feedback to software to cease transmissions accordingly.
Monitor loss of frequency lock	Required to anticipate an error in transmission frequency, which could potentially lead to interference out of assigned transmission band.
Monitor loss of LO signal	Required to anticipate an error in transmission frequency, which could potentially lead to interference out of assigned transmission band.
Monitor and control of the transmission frequency	Required to anticipate an error in transmission frequency, which could potentially lead to interference out of assigned transmission band.
Internal power off/on/reset	Required for the ESIM to have the ability to self-power down after experiencing a fault condition, then restart or power back on when fault is resolved.
Disable/enable transmission and level adjustment	Required to cease, adjust and re-enable transmissions as necessary to mitigate interference or unauthorized transmissions.

Capability	Justification
Receive and execute commands from NCMC	Required to receive commands to enable/disable transmission from NCMC or other commands as necessary to mitigate interference or unauthorized transmissions.

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 stations[2] (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-23)

Items in Appendix	*A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK OR SYSTEM, EARTH STATION OR RADIO ASTRONOMY STATION*	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network or system subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network or system not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network or system	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
...												
A.20	**COMPLIANCE WITH *resolves* 1.1.4 OF RESOLUTION 169 (WRC-19)**										**A.20**	
A.20.a	a commitment that the ESIM operation would be in conformity with the Radio Regulations and Resolution **169 (WRC-19)** Required only for the notification of earth stations in motion submitted in accordance with Resolution **169 (WRC-19)**				+						A.20.a	
A.21	**COMPLIANCE WITH *resolves* 1.2.6 OF RESOLUTION 169 (WRC-19)**										**A.21**	
A.21.a	a commitment that, upon receiving a report of unacceptable interference, the notifying administration for the GSO FSS network with which ESIMs communicate shall follow the procedures in *resolves* 4 of Resolution **169 (WRC-19)** Required only for the notification of earth stations in motion submitted in accordance with Resolution **169 (WRC-19)**				+						A.21.a	
A.22	**COMPLIANCE WITH *resolves* 7 OF RESOLUTION 169 (WRC-19)**										**A.22**	
A.22.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 3 to Resolution **169 (WRC-19)** Required only for the notification of earth stations in motion submitted in accordance with Resolution **169 (WRC-19)**				+						A.22.a	
A.23	**COMPLIANCE WITH RESOLUTION 35 (WRC-19)**										**A.23**	
A.23.a	a commitment stating that the characteristics as modified will not cause more interference or require more protection than the characteristics provided in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system					**O**					A.23.a	
A.24	**COMPLIANCE WITH NOTIFICATION OF A NON-GSO SHORT DURATION MISSION**										**A.24**	
A.24.a	a commitment by the administration that, in the case that unacceptable interference caused by a non-GSO satellite network or system identified as short-duration mission in accordance with Resolution **32 (WRC-19)** is not resolved, the administration shall undertake steps to eliminate the interference or reduce it to an acceptable level Required only for notification					+					A.24a	
A.25	**COMPLIANCE WITH *resolves* 1.1.1.1 OF RESOLUTION [AFCP-A116] (WRC-23)**										**A.25**	
A.25.a	a commitment that the ESIM operation would be in conformity with the Radio Regulations and Resolution **[AFCP-A116] (WRC-23)** Required only for the notification of earth stations in motion submitted in accordance with Resolution **[AFCP-A116] (WRC-23)**					+					A.25.a	
A.26	**COMPLIANCE WITH *resolves* 1.1.5 OF RESOLUTION [AFCP-A116] (WRC-23)**										**A.26**	

A.26.a	a commitment that the ESIM operation would be in conformity with the *resolves* 1.1.5 of Resolution **[AFCP-A116] (WRC-23)** Required only for the notification of earth stations in motion submitted in accordance with Resolution **[AFCP-A116] (WRC-23)**					+					A.26.a	
A.27	**COMPLIANCE WITH *resolves* 1.3.3 OF RESOLUTION [AFCP-A116] (WRC-23)**										**A.27**	
A.27.a	a commitment that, upon receiving a report of unacceptable interference, the notifying administration for the GSO FSS network with which ESIMs communicate shall follow the procedures in *resolves* 5 of Resolution **[AFCP-A116] (WRC-23)** Required only for the notification of earth stations in motion submitted in accordance with Resolution **[AFCP-A116] (WRC-23)**					+					A.27.a	
A.28	**COMPLIANCE WITH *resolves* 1.2.2 OF RESOLUTION [AFCP-A116] (WRC-23)**										**A.28**	
A.28.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 Resolution **[AFCP-A116] (WRC-23)** Required only for the notification of earth stations in motion submitted in accordance with Resolution **[AFCP-A116] (WRC-23)**					+					A.28.a	

…

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

Formatted: Portuguese (Portugal)

Field Code Changed