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| **World Radiocommunication Conference (WRC-19) Sharm el-Sheikh, Egypt, 28 October – 22 November 2019** |  |
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|  | CPG(19)143 ANNEX VIII-05 |
| PLENARY MEETING | **Addendum 5 to Document 16-E** |
|  | **29 March 2019** |
|  | **Original: English** |
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| European Common Proposals | |
| Proposals for the work of the conference | |
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| Agenda item 1.5 | |

1.5 to consider the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service and take appropriate action, in accordance with Resolution **158 (WRC-15)**;

Introduction

Agenda item 1.5 is a continuation of the work accomplished at WRC-15, which adopted Resolution **156 (WRC-15)** to allow ESIM operation in the bands 19.7-20.2 GHz and 29.5-30.0 GHz. The main principles of the regulatory framework established for ESIM operation in Resolution **156 (WRC-15)** are generally applicable also in the bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space). However, additional regulatory provisions are required to address some coexistence situations with terrestrial and space services that are specific to the bands 17.7-19.7 GHz and 27.5-29.5 GHz.

Studies in the ITU-R and CEPT reviewed technical and operational issues for the introduction of ESIM in the 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) frequency bands and developed regulatory provisions to allow operation of aeronautical, land and maritime ESIM.

This ECP is based on Method B of the CPM Report.

Protection of space services in the 27.5-29.5 GHz band:

Studies concluded that if ESIM transmissions remain within the envelope of the GSO FSS network with which ESIM communicates, the interference environment for other space services would remain unchanged and would therefore be acceptable.

ITU-R studies concluded that in the band 27.5-28.6 GHz RRNo. **22.2** applies and therefore non-GSO FSS systems and GSO FSS networks do not coordinate, ESIM shall comply with additional provisions to protect non-GSO FSS systems. Based on these ITU-R studies, CEPT proposes provisions to limit ESIM off-axis emissions to protect non-GSO FSS systems in the band 27.5‑28.6 GHz and an EIRP limit of 55 dBW for any ESIM with emission bandwidth up to 100 MHz, which can be increased proportionally for bandwidths above 100 MHz.

Coexistence with space services in the 17.7-19.7 GHz band:

Studies concluded that if ESIM operation remains within the envelope of the GSO FSS network with which ESIM communicates, the operation of other space services would not be constrained. It is consequently noted that ESIM should not claim more protection from non-GSO FSS systems operating in the band 17.8-18.6 GHz than afforded by the epfd limits specified in RRNo. **22.5C**.

Additional provisions are only required for BSS feeder link operation in the band 17.7-18.4 GHz (Earth-to-space) which is in the opposite direction to ESIM operation (space-to-Earth). For this specific scenario, ITU-R and CEPT concluded that ESIM should not claim protection from BSS feeder link operation in the band 17.7-18.4 GHz.

Protection of terrestrial services in the 27.5-29.5 GHz band:

Based on ITU-R and CEPT studies, CEPT proposes that in the band 27.5-29.5 GHz, terrestrial fixed and mobile services can be protected as follows:

1. Aeronautical ESIM should comply with mandatory pfd limits at the surface of Earth, when in line-of-sight of a territory of an administration. The same methodology for the protection of terrestrial service stations is applied to aircraft earth station operation in the band 14‑14.5 GHz. Based on the ITU-R studies, CEPT considers that the Option 1 pfd limits provide adequate protection to terrestrial services; this pfd mask shall be considered a necessary and sufficient condition for the protection of terrestrial services, and, in complying with this mask, Aeronautical ESIM shall be deemed to not cause unacceptable interference into terrestrial services.
2. Maritime ESIM should comply with a mandatory minimum distance from the low-water mark of a coastal state and an associated maximum ESIM e.i.r.p spectral density limit towards that coastal state. The same methodology for the protection of terrestrial service stations is applied to operation of Earth Stations on Vessels (ESV) in the bands 5 925‑6 425 MHz and 14.0-14.5 GHz. Based on the ITU-R studies, CEPT considers that the minimum distance of 70 km provides adequate protection of terrestrial services together with an e.i.r.p limit of 24.44 dB(W/14 MHz);
3. Land ESIM should operate under the condition of no interference into terrestrial stations in neighbouring countries until coordination between concerned administrations is complete.

The limits defined for a) and b) above can only be exceeded with prior agreement from the concerned administrations and are considered to be sufficient for the protection of terrestrial services. Therefore, prior to authorising aeronautical and maritime ESIM, an administration is not required to perform coordination with regards to terrestrial service stations of other administrations provided that the limits in a) and b) are met.

It is essential that the limits defined for a) and b) above are deemed to provide protection for the terrestrial services in order to provide regulatory certainty for both the terrestrial services and for the operation of ESIM.

Coexistence with terrestrial services in the 17.7-19.7 GHz band:

In order to avoid undue constraints on the operation of terrestrial services, CEPT concluded that ESIM should not claim protection from terrestrial services in the band 17.7-19.7 GHz.

Additional information

In Addendum 1 to this ECP, CEPT presents supporting analysis to the CEPT position on this agenda item.

Proposals

ARTICLE 5

Frequency allocations

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

MOD EUR/16A5/1

15.4-18.4 GHz

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| 17.7-18.1  FIXED  FIXED-SATELLITE (space-to-Earth) 5.484A ADD 5.A15 (Earth-to-space) 5.516  MOBILE | 17.7-17.8  FIXED  FIXED-SATELLITE (space-to-Earth) 5.517 ADD 5.A15 (Earth-to-space) 5.516  BROADCASTING-SATELLITE  Mobile  5.515 | 17.7-18.1  FIXED  FIXED-SATELLITE (space-to-Earth) 5.484A ADD 5.A15 (Earth-to-space) 5.516  MOBILE |
|  | 17.8-18.1  FIXED  FIXED-SATELLITE (space-to-Earth) 5.484A ADD 5.A15 (Earth-to-space) 5.516  MOBILE  5.519 |  |
| 18.1-18.4 FIXED  FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.A15  (Earth-to-space) 5.520  MOBILE  5.519 5.521 | | |

**Reasons:** Modification to table of frequency allocations to add a new footnote to identify bands for operation of ESIM.

MOD EUR/16A5/2

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 ADD 5.A15  MOBILE | | |
| 18.6-18.8  EARTH EXPLORATION-SATELLITE (passive)  FIXED  FIXED-SATELLITE (space-to-Earth) 5.522B ADD 5.A15  MOBILE except aeronautical mobile  Space research (passive) | 18.6-18.8  EARTH EXPLORATION- SATELLITE (passive)  FIXED  FIXED-SATELLITE (space-to-Earth) 5.516B 5.522B ADD 5.A15  MOBILE except aeronautical mobile  SPACE RESEARCH (passive) | 18.6-18.8  EARTH EXPLORATION-SATELLITE (passive)  FIXED  FIXED-SATELLITE (space-to-Earth) 5.522B ADD 5.A15  MOBILE except aeronautical mobile  Space research (passive) |
| 5.522A 5.522C | 5.522A | 5.522A |
| 18.8-19.3 FIXED  FIXED-SATELLITE (space-to-Earth) 5.516B 5.523A ADD 5.A15  MOBILE | | |
| 19.3-19.7 FIXED  FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 5.523B 5.523C 5.523D 5.523E ADD 5.A15  MOBILE | | |

**Reasons:** Modification to table of frequency allocations to add a new footnote to identify bands for operation of ESIM

MOD EUR/16A5/3

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 5.539 ADD 5.A15  MOBILE  5.538 5.540 | | |
| 28.5-29.1 FIXED  FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 ADD 5.A15  MOBILE  Earth exploration-satellite (Earth-to-space) 5.541  5.540 | | |
| 29.1-29.5 FIXED  FIXED-SATELLITE (Earth-to-space) 5.516B 5.523C 5.523E 5.535A  5.539 5.541A ADD 5.A15  MOBILE  Earth exploration-satellite (Earth-to-space) 5.541  5.540 | | |

**Reasons:** Modification to table of frequency allocations to add a new footnote to identify bands for operation of ESIM.

ADD EUR/16A5/4

5.A15 The operation of earth stations in motion communicating with geostationary FSS space stations in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz shall be subject to Resolution **[EUR-A15] (WRC‑19)**.(WRC‑19)

ADD EUR/16A5/5

Draft New Resolution [EUR-A15] (WRC-19)

Use of the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz by earth stations in motion (ESIM) communicating with geostationary space stations  
in the fixed-satellite service

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

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 (ESIM) to communicate with space stations of geostationary-satellite orbit (GSO) fixed-satellite service (FSS) operating in the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space);

*b)* that appropriate regulatory and interference management mechanisms are necessary for the operation of ESIM;

*c)* that the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) are also allocated to terrestrial and space services used by a variety of different systems and these existing services and their future development need to be protected from the operation of ESIM without undue constraints;

recognizing

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

*b)* that for cases of incomplete coordination under No. **9.7** of the GSO FSS network with assignments to be used by ESIM, the operation of ESIM on those assignments in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz 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**;

*c)* that any course of action taken under this Resolution has no impact on the original date of receipt of the frequency assignments of the GSO FSS satellite network with which ESIM communicate or on the coordination requirements of that satellite network,

resolves

1 that for any ESIM communicating with a GSO FSS space station in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, the following conditions shall apply:

1.1 with respect to space services in the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands, ESIM shall comply with the following conditions:

1.1.1 with respect to satellite networks or systems of other administrations, the ESIM characteristics shall remain within the envelope of typical earth stations associated with the GSO FSS network with which these ESIM communicate and the GSO FSS network, when using ESIM, shall not cause more interference and shall not claim more protection than when using typical earth stations in this GSO FSS network;

1.1.2 that the notifying administration of the GSO FSS network, with which ESIM communicate, shall ensure that ESIM operation complies with coordination agreements for the frequency assignments of the typical earth stations of this GSO FSS network obtained under the relevant provisions of the Radio Regulations including *recognizing* b) above;

1.1*.*3 for the implementation of *resolves*1.1.1 above, the notifying administration of the GSO FSS network with which ESIM communicate shall send to the Bureau under this Resolutionthe relevant information, as per Annex 1, related to the characteristics of the ESIM intended to communicate with the space station of that GSO FSS network, together with the commitment that the ESIM operation shall be in conformity with the Radio Regulations and this Resolution;

1.1.4 upon receipt of the information provided in accordance with *resolves*1.1.3 above, the Bureau shall examine it in relation to the requirements referred to in *resolves*1.1.1 based on the complete information submitted. If, following this examination, the Bureau concludes that the ESIM characteristics are in compliance with these requirements, the Bureau shall publish the results for information in the BR IFIC, otherwise the information shall be returned to the notifying administration;

1.1.5 should the Bureau find, prior to entering the characteristics of a GSO FSS network into the MIFR, that the information submitted under *resolves* 1.1.3 is not in compliance with the requirements of *resolves* 1.1.1 the corresponding information previously published by the Bureau under *resolves* 1.1.4 shall be suppressed;

1.1.6 for the protection of non-GSO FSS systems operating in the frequency band 27.5-28.6 GHz, ESIM communicating with GSO FSS networks shall comply with the provisions contained in Annex 2 to this Resolution;

1.1.7 ESIM shall not claim protection from non-GSO FSS systems operating in the frequency band 17.8-18.6 GHz in accordance with the Radio Regulations, including No. **22.5C**;

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

1.2 with respect to terrestrial services in the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands ESIM shall comply with the following conditions:

1.2.1 the receiving ESIM in the 17.7-19.7 GHz frequency band shall not claim protection from terrestrial services in the above-mentioned frequency band operating in accordance with the Radio Regulations;

1.2.2 the transmitting aeronautical and maritime ESIM operating in the frequency band 27.5‑29.5 GHz shall comply with the provisions contained in Annex 3 of this Resolution and in doing so shall be deemed to not cause unacceptable interference to terrestrial services operating in accordance with the Radio Regulations;

1.2.3 the transmitting land ESIM in the 27.5-29.5 GHz frequency band shall not cause unacceptable interference to terrestrial services in neighbouring countries in the above-mentioned frequency band operating in accordance with the Radio Regulations;

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

3 that the operation of any type of ESIM (land, maritime and aeronautical) within the territory(-ies), territorial waters and airspace under the jurisdiction of an administration, shall be carried out only if authorized by that administration;

4 that the administration responsible for the GSO FSS satellite network with which the ESIM communicate shall ensure that:

4.1 techniques to maintain pointing accuracy with the associated GSO FSS satellite without inadvertently tracking adjacent GSO satellites are employed for the operation of ESIM;

4.2 all necessary measures are taken so that ESIM are subject to permanent monitoring and control by a Network Control and Monitoring Centre (NCMC) or equivalent facility in order to comply with requirements in Annex 2 and Annex 3 and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility;

4.3 ESIM are capable of limiting operations to the territory or territories of administrations having authorized those earth stations according to *resolves* 3 above and to comply with Article **18**;

4.4 a point of contact is provided for the purpose of tracing any suspected cases of unacceptable interference from ESIM;

5 that in case of unacceptable interference caused by any type of ESIM:

5.1 the administration[[1]](#footnote-1) of the country in which the ESIM is authorized shall cooperate with an investigation into the matter and provide, where possible, any required information on the operation of ESIM and a point of contact to provide such information;

5.2 the administration1 of the country in which the ESIM is authorized and the notifying administration of the satellite network with which the ESIM communicate shall, jointly or individually, as appropriate, upon receipt of a report of interference, ascertain the facts and take required action to eliminate or reduce interference to an acceptable level;

6 that the application of this Resolution does not provide regulatory status to ESIM different from that derived from the GSO FSS network with which they communicate taking into account the provisions referred to in this Resolution,

instructs the Director of the Radiocommunication Bureau

1 to take any necessary actions for the implementation of this Resolution;

2 to take any necessary actions to facilitate the implementation of this Resolution, including assisting in resolving interference, if any;

3 to report to future WRCs any difficulties or inconsistencies encountered in the implementation of this Resolution,

invites administrations

to collaborate, to the maximum extent practicable, 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 (IMO) and of the Secretary General of the International Civil Aviation Organization (ICAO).

Annex 1 to draft new Resolution [EUR-A15] (WRC-19)

Information to be sent to the BR under *resolves* 1.1.3 by the notifying administration of the GSO FSS network with which ESIM communicate

SATELLITE NETWORK IDENTITY

*a)* the identity of the satellite network;

*b)* the symbol of the notifying administration;

FREQUENCY ASSIGNMENTS OF SATELLITE NETWORK TO BE USED FOR ESIM OPERATION

*c)* beams identification;

*d)* groups identification code;

ESIM TRANSMIT CHARACTERISTICS

*e)* necessary bandwidth and the class of emission;

*f)* the maximum value of the peak envelope power, in dBW, supplied to the input of the antenna;

*g)* maximum power density, in dB(W/Hz), supplied to the input of the antenna;

*h)* antenna isotropic gain, in dBi, in the direction of maximum radiation;

*i)* beamwidth, in degrees, between the half-power points;

*j)* co-polar radiation pattern of the antenna.

ESIM RECEIVE CHARACTERISTICS

*k)* necessary bandwidth and the class of emission;

*l)* antenna isotropic gain, in dBi, in the direction of maximum radiation;

*m)* beamwidth, in degrees, between the half-power points;

*n)* co-polar radiation pattern of the antenna;

*o)* lowest total receiving system noise temperature, in kelvins, referred to the output of the receiving antenna of the earth station under clear-sky conditions.

Note – The content of Annex 1 reflects the transmit and receive characteristics of ESIM in accordance with provisions of resolves 1.1.1 and 1.1.3 of this Resolution.

Annex 2 to draft new Resolution [EUR-A15] (WRC-19)

Provisions for ESIM to protect non-geostationary FSS systems in the frequency band 27.5-28.6 GHz

1 In order to protect those non-GSO FSS systems referred to in *resolves*1.1.6 of this Resolution, ESIM shall comply with the following provisions:

*a)* the level of equivalent isotropically radiated power (e.i.r.p.) density emitted by an ESIM in a geostationary-satellite network in the 27.5-28.6 GHz frequency band shall not exceed the following values for any off-axis angle ϕ which is 3° or more off the main-lobe axis of an ESIM antenna and outside 3° of the GSO:

|  |  |  |
| --- | --- | --- |
| *Off-axis angle* |  | *Maximum e.i.r.p. density* |
| 3    7 |  | 28 – 25 log dB(W/40 kHz) |
| 7    9.2 |  | 7 dB(W/40 kHz) |
| 9.2    48 |  | 31 – 25 log dB(W/40 kHz) |
| 48    180 |  | −1 dB(W/40 kHz) |

*b)* for any ESIM that does not meet the condition *a)* above, outside of 3° of the GSO arc, the maximum ESIM on-axis e.i.r.p. shall not exceed 55 dBW for emission bandwidths up to and including 100 MHz. For emission bandwidths larger than 100 MHz, the maximum ESIM on‑axis e.i.r.p. may be increased proportionately;

Annex 3 to draft new Resolution [EUR-A15] (WRC-19)

Provisions for maritime and aeronautical ESIM to protect terrestrial services in the frequency band 27.5-29.5 GHz

Part 1: MARITIME ESIM

1 The notifying administration of the GSO FSS satellite network with which a maritime ESIM communicates shall ensure compliance of the maritime ESIM with both the following conditions:

1.1 the minimum distances from the low-water mark as officially recognized by the coastal State beyond which maritime ESIM can operate without the prior agreement of any administration is 70km in the 27.5-29.5 GHz frequency band. Any transmissions from maritime ESIM within the minimum distance shall be subject to the prior agreement of the concerned coastal State; and

1.2 the maximum maritime ESIM e.i.r.p. spectral density towards the horizon shall be limited to 24.44 dB(W/14 MHz). Transmissions from maritime ESIM 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 concerned coastal State together with the mechanism by which this level is to be maintained.

Part 2: AERONAUTICAL ESIM

2 The notifying administration of the GSO FSS satellite network with which an aeronautical ESIM communicates shall ensure compliance of the aeronautical ESIM with the following conditions:

2.1 When within line-of-sight of the territory of an administration, 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(δ) = −124.7 (dB(W/m2 ⋅ 14 MHz)) for 0° ≤ δ ≤ 0.01°

pfd(δ) = −120.9+1.9∙log10(δ) (dB(W/m2 ⋅ 14 MHz)) for 0.01° ≤ δ ≤ 0.3°

pfd(δ) = −116.2+11∙log10(δ) (dB(W/m2 ⋅ 14 MHz)) for 0.3° < δ ≤ 1°

pfd(δ) = −116.2+18∙log10(δ) (dB(W/m2 ⋅ 14 MHz)) for 1° < δ ≤ 2°

pfd(δ) = −117.9+23.7∙log10(δ) (dB(W/m2 ⋅ 14 MHz)) for 2° < δ ≤ 8°

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

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

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

SUP EUR/16A5/6

RESOLUTION 158 (WRC‑15)

Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with  
geostationary space stations in the fixed-satellite service

**Reasons:** Consequential suppression of Resolution **158 (WRC-15)**.

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| **World Radiocommunication Conference (WRC-19) Sharm el-Sheikh, Egypt, 28 October – 22 November 2019** |  |
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|  |  |
|  | **Addendum 1 to Addendum 5 to Document 16-E** |
| **29 March 2019** |
| **Original: English** |
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| Supporting Analysis to CEPT position  on wrc-19 agenda item 1.5 | |
|  | |

Introduction

WRC-19 agenda item 1.5 considers the operation of earth stations in motion (ESIM) in GSO FSS networks in the bands 17.7-19.7 GHz and 27.5-29.5 GHz.

CEPT has studied the CPM Report for this agenda item and in order to substantiate those parts of the CPM Report dealing with use of a pfd mask to protect terrestrial services, additional information is provided in this contribution regarding the options contained in the CPM Report on this issue, including further information regarding why a pfd mask makes unnecessary any altitude restriction on Aeronautical ESIM (A-ESIM).

Under PART 2 of Annex 2 to draft new Resolution [EUR-A15] (WRC-19) “Use of the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz by earth stations in motion (ESIM) communicating with geostationary space stations in the fixed-satellite service”, CPM 19-2 produced two masks to protect terrestrial services in Section 2.1 of Annex 2, under Option 1 and Option 2. In addition, Option 2 proposes an altitude limit on A-ESIM operations on top of the pfd mask as an extra measure to protect terrestrial services.

For the reasons outlined below, the CEPT supports Option 1 for Section 2.1 of Annex 2 and Option 2 for Section 2.2 of Annex 2.

CEPT is of the view that the pfd mask in Option 2 of Section 2.1 as well as the proposed altitude limit in Option 1 of Section 2.2 are based on a number of flawed assumptions and would result in over-protection of the terrestrial services and impose unnecessary constraints on operation of A-ESIM.

1. **pfd mask should be calculated considering dynamic nature of A-ESIM and MS operation**

Earth Stations in Motion and Mobile Service user terminals are, by definition, both moving, and both ESIM and MS systems operate in a dynamic environment. In addition, mobile service base stations also operate in a dynamic manner due to the use of antennas with narrow beamwidths which track user terminals using electronic beam steering. Therefore, a statistical analysis is the appropriate method to be used to determine the probability of interference between the two services.

Dynamic operation of aircraft and mobile stations is uncorrelated, so it is not reasonable or accurate to consider a static worst case scenario, based on a maximal alignment between ESIM and MS station antenna azimuths that does not account for the movement of either type of stations. The study used to produce the Option 2 mask did however apply a static scenario for both the MS base stations and MS user terminals.

Moreover, the pfd mask proposed under Section 2.1, Option 2 is derived from a single protection criterion of I/N = –6 dB as provided by ITU-R WP 5A, without considering either the short-term or long-term statistics. Essentially, this means the pfd mask is based on the assumption that the stated I/N = –6 dB protection criterion needs to be met for 100% of the time. Whilst no time percentage has been defined for the MS protection criterion by the ITU-R, ITU-R studies for other services commonly use an I/N of –6 dB in association with percentages of time of about 20%).

As both services are using antennas with narrow beamwidths in a dynamic manner, it would be unlikely for the main beam of the MS stations to be pointed towards the aircraft and the A-ESIM antenna to be pointed towards a target satellite on the same azimuth as the mobile station (BS or UE) main beam. Thus, significant gain reduction from the A-ESIM antenna can be expected both in the elevation plane and in the azimuth plane. This is in addition to attenuation due to airframe blockage between the A-ESIM antenna and the ground. A simultaneous alignment of the main beam of the MS station with the A-ESIM therefore is highly unlikely. If such an alignment occurs, it would be a very limited duration event. Also, the MS stations will most likely be operating in urban areas where clutter needs to be taken into account, and which would further limit the likelihood of in-line events between the A-ESIM and the MS station.

Since no time component is considered, and it is based on a static, worst case, the analysis underlying the pfd mask in Section 2.1 Option 2 is overly conservative in relation to the MS characteristics provided by ITU-R WP 5A. This flawed analysis is then used to try to substantiate an unreasonably constraining pfd mask for A-ESIM.

In contrast, studies in ITU-R WP 4A used to derive the mask in Option 1 use a statistical analysis which takes into consideration the dynamic nature of both systems and shows that mobile systems can be adequately protected.

A similar methodology was used to establish the pfd values in Recommendation ITU-R M.1643 for the operation of Aircraft Earth Stations (AES) in the band 14 14.5 GHz. AES have been operating in the band using this recommendation since 2003.

1. **Mask in Option 2 assumes incorrect and overly conservative Mobile Service (MS) characteristics**

The mask in Option 2 suffers from a number of inconsistencies and assumes unrealistic sharing conditions between ESIM and mobile service.

First of all, the mask is inconsistent with the technical characteristics for terrestrial systems provided by ITU-R WP 5A. That mask appears to be based on the assumption that the MS base station is pointing towards the horizon, and does not employ downtilt. According to the characteristics provided by ITU-R WP 5A, MS base station beam for System A can be electronically steered in a range of –6 degrees to –60 degrees for 20 m BS and –3 degrees to –60 degrees for the 10 m BS in the elevation plane and System B with a range of -5 degrees to -60 degrees for 20 m BS and -2 degrees to -60 degrees for the 10 m BS with respect to the horizontal plane. Hence, according to the guidance provided by ITU-R WP 5A, the MS beam cannot be pointed towards the horizon. However, the Option 2 pfd mask appears to be based on antenna pointing angles toward the horizon, which are not in conformity with the MS deployments described by ITU-R WP 5A, and would therefore unduly constrain A-ESIM operations.

The Option 2 mask also assumes ESIM and mobile service stations are operating with the same bandwidth. Mobile service stations use a minimum bandwidth of 100 MHz. If ESIM were to use the same bandwidth, without any use of duty cycle, it would result in an unrealistic conclusion that only 20 ESIM in 27.5-29.5 GHz could be served by a single satellite beam cluster. Studies in ITU-R WP 4A indicate that ESIM systems either operate bandwidths up to 10 MHz with high duty cycles or larger bandwidths such as 100 MHz with a typical duty cycle of 4%. In either case, this assumption results in a pfd mask that is conservative by a factor of at least 10 dB compared to the actual interference environment. The mask also does not take into consideration other parameters that are commonly used when analysing coexistence between mobile systems and other systems such as:

* body loss due to effects of the proximity of the user to the mobile service terminal;
* polarization loss as ESIM operate with circular and mobile service systems with linear polarisation;
* clutter loss as MS stations will operate in urban areas.

Including the above parameters into the analysis, would make the Option 2 mask much less stringent than the Option 1 mask.

In contrast, the studies performed in ITU-R Working Party 4A to establish Option 1 pfd mask also considered 100 MHz bandwidths (100% duty cycle) for ESIM without any body loss, polarization loss or clutter loss. Even under such conservative conditions the studies showed that MS stations remain fully protected, when the dynamic interference environment is taken into consideration.

1. **An altitude limit is not needed in addition to a pfd limit**

First and foremost, in the view of CEPT an altitude limit for A-ESIM is not needed because the terrestrial stations are fully protected by A-ESIM compliance with the pfd mask. An A-ESIM must (and can) reduce power, change frequencies, or inhibit transmissions if its emissions would exceed the pfd limits on the ground. The distance or altitude from the terrestrial station is immaterial. A pfd mask has previously been used in the Ku-band to protect FS systems from interference from Aircraft Earth Stations (Rec. ITU-R M.1643), without the need for an additional altitude limit to protect the terrestrial services. The pfd mask in Section 2.1 Option 1 was derived based on the protection criteria of FS systems and then validated for use with MS systems against the technical characteristics and protection criterion provided by the relevant ITU-R Working Parties. As long as A-ESIM satisfies the pfd limit, terrestrial stations are protected independent of the A-ESIM altitude. An altitude limit would only introduce an additional and unnecessary constraint on ESIM.

CEPT is of the view that the pfd limitation alone is enough to protect terrestrial services.

1. **Obligation to design systems in spectrum efficient manner**

The MS networks described above, which were used to justify Option 2 under Section 2.1 and the proposed altitude limit for A-ESIM, both allow their MS base stations to point towards the horizon in a manner that is not related to providing service to users on the ground. This results in them operating in a manner that maximizes their susceptibility to interference from other services, including existing FS and FSS systems. Allowing MS base stations to point towards the horizon make these systems more sensitive to interference from A-ESIM and therefore runs counter to the clear requirement of the Radio Regulations to design transmitting and receiving equipment in an efficient manner. Articles 3.2 and 3.3 clarify the overall obligation of administrations in this respect:

*3.2 Also, as far as is compatible with practical considerations, the choice of transmitting, receiving and measuring equipment shall be based on the most recent advances in the technique as indicated, inter alia, in ITU-R Recommendations.*

*3.3 Transmitting and receiving equipment intended to be used in a given part of the frequency spectrum should be designed to take into account the technical characteristics of transmitting and receiving equipment likely to be employed in neighbouring and other parts of the spectrum, provided that all technically and economically justifiable measures have been taken to reduce the level of unwanted emissions from the latter transmitting equipment and to reduce the susceptibility to interference of the latter receiving equipment.*

The systems on which the pfd mask in Section 2.1, Option 2 are based, do not seem to “*take into account the technical characteristics of transmitting and receiving equipment likely to be employed in neighbouring and other parts of the spectrum”* but to result in much larger susceptibility to potential interference from A-ESIMs.

1. The administration authorizing ESIM is the administration providing the licence for radio communication using the ESIM to the vehicle on which the ESIM operate. [↑](#footnote-ref-1)