



GSC position on key WRC-19 AI 1.5 ESIMs

Goal: To facilitate the operation of ESIMs in GSO FSS networks in the Ka-band

- ❑ **Genesis:** Resolution 158 (WRC-15)
- ❑ **Issue:** *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*
- ❑ **Background:** WRC-15 adopted provisions for ESIM operations within the FSS allocation in the 19.7 – 20.2 GHz and 29.5 – 30 GHz bands subject to conditions in Resolution 156. Resolution 156 recognizes the need for global broadband mobile-satellite communications, and that some of this need could be met by allowing ESIMs to communicate with space stations of the fixed-satellite service (FSS)
- ❑ AI 1.5 of WRC-19 addresses operation of ESIMs beyond these bands to meet the increasing demand for broadband satellite communications with mobility
- ❑ Today many ESIMs are operating in the air, in the sea and on the land, and airlines in particular are seeking to provide gate-to-gate passenger connectivity.

GSC General Position: *Establish provisions for aeronautical, maritime, and land ESIM operations within GSO FSS networks in the Bands 17.7-19.7GHz and 27.5-29.5GHz, subject to technical and regulatory protection mechanisms for existing FSS operations & other allocated services.*

Background - Current status:

□ Resolution 158 of WRC-15 resolves to invite the ITU-R to:

1. To study the technical and operational characteristics and user requirements of ESIM and the requirement for flexible use of spectrum to provide ESIM services;
Further information in: Sections 2 & 3 of WP4A preliminary draft new Report ITU-R S.[AGENDA ITEM 1.5] & Reports ITU-R S.2223 & S.2357-0
2. To study sharing and compatibility between ESIM and current and planned stations of existing services allocated in the bands;
Further information in: Section 4 of WP4A preliminary draft new Report ITU-R S.[AGENDA ITEM 1.5] as well as PDNRs S./M.[ESIM-MS], S./F.[ESIM-FS] and S.[ESIM]
3. To develop technical conditions and regulatory provisions for the three types of ESIMs operation (Land, Maritime, Aero)

Based on text developed by WP 4A, the CPM Report includes an example Resolution for WRC-19, which includes the regulatory framework for ESIM operation as well as measures to ensure protection of other services. Most of the Resolution has been agreed at CPM, but there are some provisions for which the views of different administrations are indicated as options.

Method A

No change

Method B

This method proposes to add a new footnote No. **5.A15** in RR Article **5** and a reference to a new WRC Resolution providing the conditions for the operation of ESIM and protection of the services to which the frequency bands are allocated, and consequential suppression of Resolution **158 (WRC-15)**. An example modification to RR Appendix 4 called for by the new WRC Resolution is also included.

The new Resolution to address Method B is agreed by all parties, but with options on some of the specific details.

- ❑ Use of ESIMs with a GSO FSS network would not change the sharing environment with other GSO FSS networks, as ESIMs would operate within the same technical envelope as existing GSO FSS networks. The interference environment for other space services would remain unchanged and would therefore be acceptable.
- ❑ For the 17.7-19.7 GHz band (i.e. the ESIM receive band), use of ESIMs would not impact the sharing with other services (space or terrestrial) as ESIMs will not claim additional protection and there would be no change to the transmission parameters from the GSO FSS satellite to serve ESIMs.

	Resolution part	Issue	GSC position
1	Resolves 1.1.4	Defining when ESIM can be associated with the existing GSO FSS network, i.e. only after recording the FSS network in the MIFR or during the CR/C stage	Support <u>Option 2</u> , allowing submission of ESIM characteristics during the CR/C stage
2	Resolves 1.1.6	Whether limits for protection of NGSO FSS should be applied (27.5-28.6 or 27.5-29.1 GHz)	Supports <u>Option 1</u> . No limits required in 28.6-29.1 GHz due to the current coordination procedures. For the band 28.6-29.1 GHz, the current provisions of RR Nos. 9.12A and 9.13 together with <i>resolves</i> 1.1.1 of the draft new Resolution [A15] (WRC-19) provide enough assurance that ESIM would not cause interference to non-GSO FSS space station receivers.
3	Resolves 1.1.7	Whether limits are required to protect NGSO MSS feeder links	Support <u>Option 2</u> . No limits are necessary, interference issues are dealt with in the current coordination process
4	Resolves 1.2.2 and Resolves 1.2.3	Whether the provisions for protection of terrestrial services should include a requirement not to affect the future development of these services	Support <u>View 1</u> . Such a condition could lead to additional constraints on ESIM at any time in the future are therefore opposed.
5	Resolves 1.2.5	Whether the limits for protection of terrestrial services are deemed to ensure that unacceptable interference is not caused	Support <u>Option 3</u> . Meeting the pfd and distances limits ensures that unacceptable interference is not caused. Proposals for additional conditions to avoid causing interference could lead to additional constraints on ESIM at any time in the future are therefore not supported.
6	Annex 2, para 2.1	The values for the pfd mask to protect terrestrial services from aero ESIM	The <u>Option 1</u> pfd mask provides adequate protection. The Option 2 mask overprotects terrestrial services and unnecessarily constrains aero-ESIM operations
7	Annex 2, para 2.2	The need for an altitude limit in addition to a pfd mask	Support <u>Option 2</u> . There is no need for an altitude limit. The pfd mask provides all the protection necessary and an altitude limit would unnecessarily constrain aero-ESIM operations.
8	Annex 3	The need for Annex 3	Support deletion as the main body of the Resolution now covers the content of Annex 3.

➤ Examination of ESIM in relation to a GSO satellite network

- Option 1: After recording in the MIFR.
 - 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 information recorded in the MIFR and any other reliable information available to it and publish the results in a Special Section of the BR IFIC;
- Option 2: at either coordination stage or subsequently recorded in the MIFR.
 - 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 within the envelope of the satellite network, the Bureau shall publish the results for information in the BR IFIC, otherwise the information shall be returned to the notifying administration;

Inmarsat supports Option 2 – this option provides more flexibility for administrations intending to operate ESIM and more transparency for other administrations.

➤ **Protection non-GSO FSS satellite receivers in band 28.6 – 29.1 GHz (resolves 1.1.6).** It is not agreed whether the emission limits should apply to 27.5-28.6 GHz or to 27.5-29.1 GHz.

- Option 1: Emission limits are required for the band 27.5-28.6 GHz only, where coordination does not apply between GSO FSS and non-GSO FSS. For the band 28.6-29.1 GHz, the current provisions of RR Nos. **9.12A** and **9.13** together with *resolves* 1.1.1 of the draft new Resolution **[A15] (WRC-19)** provide enough assurance that ESIM would not cause interference to non-GSO FSS space station receivers.
- Option 2: Limits are required for the band 27.5-28.6 GHz + 28.6-29.1 GHz. In addition to the current procedures for coordination between GSO FSS and non-GSO FSS, transmitting ESIM should comply with the emission limits to protect non-GSO satellite receivers in this frequency band.

Inmarsat supports Option 1. No limits required in 28.6-29.1 GHz due the current coordination procedures

➤ **Furthermore, there are options regarding the definition of limits for ESIM to protect non-GSO FSS:**

- Option 1: “For emission bandwidths larger than 100 MHz, the maximum ESIM on-axis e.i.r.p. may be increased proportionately”
- Option 2: “For emission bandwidths smaller or larger than 100 MHz, the maximum ESIM on-axis e.i.r.p. may be decreased or increased proportionately, as appropriate

Inmarsat supports Option 1, which is technically valid for planned non-GSO FSS systems.

Non-GSO MSS feeder links. In the band 29.1-29.5 GHz, ESIM could potentially interfere with non-GSO satellite receivers with which MSS feeder-link earth stations communicate (see Resolves 1.1.7).

▪ Option 1:

- That additional (currently unspecified) limits shall be applied to ESIM for the protection of non-GSO MSS feeder links from ESIM communicating with GSO FSS networks.

▪ Option 2:

- That the provisions of RR No. 9.11A together with resolves 1.1.1 of the draft new Resolution [A15] (WRC-19) provide enough assurance that ESIM would not cause interference to space station receivers of non-GSO MSS feeder links. Hence resolves 1.1.7 is not required.

Inmarsat support Option 2, no limits required, coordination is sufficient.

Operation of ESIM within the envelope of characteristics of the FSS network. In order to ensure that ESIM operate within the envelope of the FSS network with which they communicate, the notifying administration of the FSS network should submit to the BR the relevant technical parameters of the ESIM.

Inmarsat supports proposal to specify the required parameters in an Annex to the new Resolution. This proposal is not included in the CPM Report but is proposed by the CEPT.

□ Regulatory language regarding protection of terrestrial services (resolves 1.2.2 and 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 and shall not affect the future development of these services* and Annex 3 with appropriate title applies”;

- View 1: Remove the underlined text since it implies that the limits could be changed in the future if more sensitive terrestrial systems are deployed
 - View 2: Retain the underlined text as the proposed pfd limits alone are not sufficient.
- *Inmarsat supports View 1, since View 2 may imply that the limits could be changed in the future if more sensitive terrestrial systems are deployed.*

Maritime ESIM – minimum distance

- 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 (60 to 120 km, with preference to 60 to 70 km, depending on the results of studies)* 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;

* WRC-19 is invited to consider this range and decide upon a single value.

- The maximum maritime ESIM e.i.r.p. spectral density towards the horizon shall be limited to 12.98 dB(W/1 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.

Inmarsat is of the view that the minimum distance of 60 km provides adequate protection of terrestrial services but 70 km is acceptable. Inmarsat supports an e.i.r.p limit towards the horizon of 24.44 dB(W/14 MHz) (which is equivalent to 12.98 dB(W/1 MHz), reflecting the minimum receiver bandwidth of the terrestrial services of 14 MHz.

Annex 2 To Draft new Resolution [A15] (WRC-19)

☐ Aeronautical ESIM – PFD Mask

The values for the PFD mask to protect terrestrial services:

- Option 1

$\text{pfd}(\delta) = -124.7$	(dB(W/m ² · 14 MHz))	for	0°	$\leq \delta \leq 0.01^\circ$
$\text{pfd}(\delta) = -120.9 + 1.9 \cdot \log_{10}(\delta)$	(dB(W/m ² · 14 MHz))	for	0.01°	$\leq \delta \leq 0.3^\circ$
$\text{pfd}(\delta) = -116.2 + 11 \cdot \log_{10}(\delta)$	(dB(W/m ² · 14 MHz))	for	0.3°	$< \delta \leq 1^\circ$
$\text{pfd}(\delta) = -116.2 + 18 \cdot \log_{10}(\delta)$	(dB(W/m ² · 14 MHz))	for	1°	$< \delta \leq 2^\circ$
$\text{pfd}(\delta) = -117.9 + 23.7 \cdot \log_{10}(\delta)$	(dB(W/m ² · 14 MHz))	for	2°	$< \delta \leq 8^\circ$
$\text{pfd}(\delta) = -96.5$	(dB(W/m ² · 14 MHz))	for	8°	$< \delta \leq 90.0^\circ$

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

- Option 2

$\text{pfd}(\delta) = -122.7$	(dBW/m ² /1 MHz)	for	0°	$\leq \delta \leq 2^\circ$
$\text{pfd}(\delta) = -122.7 + 2 * (\delta - 2)$	(dBW/m ² /1 MHz)	for	2°	$< \delta \leq 2.3^\circ$
$\text{pfd}(\delta) = -122.6 + 1.5 * (\delta - 2)$	(dBW/m ² /1 MHz)	for	2.3°	$< \delta \leq 7.9^\circ$
$\text{pfd}(\delta) = -113.9$	(dBW/m ² /1 MHz)	for	7.9°	$< \delta \leq 90^\circ$

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

Aeronautical ESIM – PFD Mask (cont'd)

- Extensive studies in WP 4A studies have shown that pfd mask in Option 1 fully protects mobile service and fixed service deployments. See A-ESIM Study D in Annex 14 to document 4A/826.
- The pfd mask in Option 2 has been derived solely for the protection of the mobile service during studies in WP 4A. These studies have made a number of flawed assumptions and produce a pfd mask that over-protects terrestrial services and unnecessarily restricts A-ESIM operation.
- The effectiveness and reliability of Option 1 pfd mask is already established in CEPT, where the mask has been successfully used for protection from A-ESIM interference since 2013.

Inmarsat is of the view that A-ESIM fully protects terrestrial services by complying with the pfd limits in Option 1 based on WP 4A study results.

Aeronautical ESIM – Altitude limit

- The need for an altitude limit in addition to PFD mask:

- Option 1

Unless agreement from concerned administrations, aeronautical ESIM shall not transmit below 5/6/TBD km of altitude above the territory of the administration concerned;

- Option 2

An altitude limit is not needed. A minimum altitude is not required since the compliance with a pfd mask in 1.1 above is sufficient to protect terrestrial services;

Inmarsat is of the view that an altitude limit for A-ESIM is not needed in addition to the pfd mask because the pfd mask alone fully protects terrestrial services. 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 altitude at which the pfd mask is just met varies from case to case and location to location and so an altitude limit would unnecessarily constrain some ESIMs. An altitude limit is unnecessary, as the pfd limit maintains the required protection irrespective of the aircraft altitude.

A pfd mask has previously been successfully used in the ITU for Aircraft Earth Stations in the band 14-14.5 GHz (Rec. ITU-R M.1643) without the need for an additional altitude limit to protect the terrestrial services and there is no justification to use it for agenda item 1.5. Inmarsat supports Option 2.

- ❑ **Annex 3.** The example Resolution contained in the CPM Report includes an Annex 3 to provide guidance on the responsibilities administrations with regard to licensing and interference management for ESIM. Due to time constraints, Annex 3 of the Resolution was not considered during the preparation of the CPM Report.
- ❑ However, administrations proposed to address the regulatory provisions for licensing and interference management as part of the main body of the Resolution. These provisions were carefully discussed and included in *recognizing d), resolves 3 and resolves 4* of the example Resolution.
- ❑ *Inmarsat supports the view that Annex 3 of the example Resolution is therefore no longer needed.*

- To support Method B of the draft CPM Report.**
- In order to protect terrestrial systems in the band 27.5-29.5 GHz, WPC considers that**
 - a. A-ESIM should comply with the PFD mask presented in Option 1 that provides adequate protection to terrestrial services without the need for an additional altitude limit.
 - b. M-ESIM should operate at a minimum distance of 70 km together with an e.i.r.p. limit of 24.44 dB (W/14 MHz), which provides adequate protection of terrestrial services.
- Inmarsat proposes that WPC maintains this same position as CEPT, CITELE, ASMG, ATU, RCC, and a number of other Administrations in Asia-Pacific. WPC may also consider submitting a draft Common Proposal to the forthcoming APG-5 meeting.*
- WPC is invited to consider support for Inmarsat views on remaining open issues in this proposal.*



Thank You