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Dear Mark

RE: Updating regulatory requirements for earth stations in motion

Communications Alliance welcomes the opportunity to provide comments on the ACMA's *Updating regulatory requirements for earth stations in motion* consultation.

The Satellite Services Working Group (SSWG) wishes to provide the following comments on the Draft amendments to the four Business Operating Procedures (BOPs) relating to Ka band and Ku band satellite services, including Earth Stations in Motion (ESIMs) and Area-Wide Apparatus Licences (AWLs). As the four BOPs are similar in content, the following comments relate to all the BOPs and then address specific issues.

General Comments

PFDs and Guard Bands of Ka band ESIMs

The SSWG notes that there is an ongoing issue relating to the 600 MHz set aside for primary Fixed Wireless Access (FWA) in cities and major towns. Whilst the FWA operates under the AWL arrangement in 27.5 to 28.1 GHz, the band excluded by the BOPs lies in 27.5 to 28.5 GHz for ESIMs communicating with non-GSO systems or 27.5 to 28.3 GHz for ESIMs communication with GSO networks, that includes a guard band of at least 200 MHz.

We do not believe a guard band (or guard space of 50 km) is necessary, for the reasons noted below.

Both ECC Decision (13)01¹ (corresponding to ESIMs communicating with GSO networks) and ECC Decision (15)04² (corresponding to ESIMs communicating with non-GSO networks) define the Power Flux Density (PFD) from an Aeronautical ESIM (A-ESIM) received on the ground as follows:

For ESOMPs installed on aircraft the PFD values $dB(W/m^2)$ in a reference bandwidth of 14 MHz on the Earth's surface ground are the following:

¹ The harmonised use, free circulation and exemption from individual licensing of Earth Stations On Mobile Platforms (ESOMPs) within the frequency bands 17.3-20.2 GHz and 27.5-30.0 GHz, Approved 8 March 2013, Amended: 26 October 20.

² The harmonised use, free circulation and exemption from individual licensing of Land, Maritime and Aeronautical Earth Stations On Mobile Platforms (ESOMPs) operating with NGSO FSS satellite systems in the frequency ranges 17.3-20.2 GHz, 27.5-29.1 GHz and 29.5-30.0 GHz, Approved 3 July 2015, Amended 20 November 2020.

-124.7	for $0^\circ \leq \delta \leq 0.01^\circ$
$-120.9 + 1.9 \log_{10}(\delta)$	for $0.01^\circ < \delta \leq 0.3^\circ$
$-116.2 + 11.0 \log_{10}(\delta)$	for $0.3^\circ < \delta \leq 1.0^\circ$
$-116.2 + 18.0 \log_{10}(\delta)$	for $1.0^\circ < \delta \leq 2.0^\circ$
$-117.9 + 23.7 \log_{10}(\delta)$	for $2.0^\circ < \delta \leq 8.0^\circ$
-96.5	for $8.0^\circ < \delta \leq 90.0^\circ$

The SSWG notes, the Australian technical environment for the 28 GHz uplink is identical to ECC Decision (13)01 which uses exactly the same envelope for GSO ESIM. This was replicated for altitudes above 3 km in Resolution 169 (WRC-19)³. Given the 'below 3km' PFDs were not covered by ECC, neither were they supported initially by Australia at WRC-19 and because these 'limits' were a compromise, rather than based on studies, the SSWG believes they should not form the basis of domestic ESIM coordination or operation.

The ECC levels quoted above have been the subject of thorough CEPT studies. The SSWG believes that A-ESIM would be able to operate in the entire 27.5 to 29.5 GHz band without causing unacceptable interference to FWA. In addition, the ECC studies were looking at interference into the Fixed service (FS) with more sensitive antennas and receivers. These levels can be expected to be more than adequate to protect FWA.

Given that ECC levels have been proven to protect in-band systems, the SSWG submits the 200 MHz guard band is unnecessary and a waste of valuable spectrum that would deny services to many Australians. Not only is this expanded band wasted spectrum, access is denied to all ESIM across the entire country. Given, the populated areas chosen by the ACMA only cover around 5% of the land mass, this is, SSWG members believe, a massive waste of service opportunity.

Further, the technical requirements listed in Annex 3 of Resolution 169 (WRC-19), Parts I and II are only applicable to cross-border scenarios between States and, Australia as an island nation, there is no possibility of interference with neighbouring countries. Resolution 169 does not limit maritime or other ESIM operations in the 27.5-29.5 GHz band segment within an Administration's borders, but rather provides guidance for the rare cross-border case where, in a neighbouring country, terrestrial services are allocated and operating in the very same frequencies as ESIM

The SSWG suggests that the ACMA reopen technical debate on these requirements in an attempt to reduce spectrum wastage and to balance certainly with flexibility recognising the value of ESIM services.

Comments on 'Other Matters' that the ACMA must consider

The SSWG would like to bring the following item to the attention to the ACMA, noting that not all members support this view. It is noted that the following new text have been added to the draft revisions of BOPs:

Under section 100 (4) of the Act:

In deciding whether to issue an apparatus licence, the ACMA must have regard to:

- (a) all matters that it considers relevant; and*
- (b) without limiting paragraph (a), the effect on radiocommunications of the proposed operation of the radiocommunications devices that would be authorised under the licence.*

³ Use of the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz by earth stations in motion communicating with geostationary space stations in the fixed-satellite service.

The procedures outlined in this document record the typical satellite regulatory matters considered by the ACMA when deciding whether to issue a space or space receive apparatus licence. Depending on the specific of an application the ACMA might be required to consider additional matters and request additional information or seek the views of Australia satellite operators (satellite operators on whose behalf the ACMA has submitted a satellite filing to the ITU).

Also quoted in some drafts:

- > *consideration of consistency with current regulatory arrangements, including:*
 - > *Australian space regulations related to space and space receive licences*
 - > *the international (ITU) regulatory status of the subject satellite network*
 - > *the international (ITU) registration details of the subject satellite network*

While the SSWG has no concerns with ACMA's obligations under the Act, we are concerned that these considerations may suggest the ACMA could ignore ITU filing procedures and date of priority in the MIFR when considering 'other matters'.

Australia is a signatory to the Constitution and Convention of the ITU, which are complemented by the Radio Regulations as amended by the Final Acts of World Radiocommunication Conferences. A part of an Administration's treaty obligations is to abide by the process by which a satellite network is recorded in the MIFR. The SSWG seeks clarification from ACMA that they would not use any process defined in these BOPs to invalidate a finalised or ongoing ITU filing.

The SSWG suggests the following dot point be added:

- > the international (ITU) regulatory status of any domestic satellite networks

Comments on Draft Business Operating Procedures

1. Interim arrangements for the submission and processing of applications for space and space receive apparatus licences authorising the use of earth stations in motion in the fixed-satellite service communicating with:

- > **Non-geostationary space stations in the frequency ranges 17.7–18.2 GHz, 18.8–19.3 GHz, 19.7–20.2 GHz, 28.5–29.1 GHz and 29.5–30 GHz**

This BOP appears to have inherited a legacy from its previous version, i.e., while it permits land ESIM and maritime ESIM, it does not cover A-ESIM when this new draft BOP is repurposed to allow interim arrangement for non-GSO. Following advice from the ACMA, the SSWG believes that this is a historical omission based on the previous version of this BOP's relationship with ECC Decision (13)01. Given that ECC Decision (13)01 has been updated in October 2018 to include A-ESIM, while ECC Decision (15)04 was also amended in November 2020 to include A-ESIM, SSWG is of the view that the BOP should be amended accordingly.

The SSWG notes that these are interim arrangements pending the finalisation of Agenda Item 1.16 at WRC-23.

2. Submission and processing of applications for space and space receive apparatus licences

The SSWG welcomes the recent changes to the class licence, however:

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- as discussed above the 27.5 – 28.3 GHz band is excluded over the entire country.
 - the 200 MHz guard band is an unnecessary waste of spectrum given ECC studies.
 - ECC studies support the operation of ESIM where co-primary terrestrial systems are operating⁴.
 - in any case FWA are only co-primary within about 5% of the Australian land mass meaning this spectrum is mostly wasted everywhere else.
- Appendix A refers to Administration to Administration agreements. For an Australian filed network the ACMA will have these. However for foreign filed networks such agreements are confidential.
- Appendix C Table 1 seems to suggest that Space Receive licences are limited to non-renewable six month licences. The SSWG does not believe this is intentional.

Comments on Draft Business Operating Procedures Space and Space Receive

Appendix E refers to additional procedures to be applied when considering the issue of space or space receive licenses authorising the use of ubiquitous earth stations in motion communicating with space stations in the fixed satellite service in the frequency ranges 10.7 – 12.75 GHz (space-to-Earth) and 14-14.5 GHz (Earth-to-space).

The SSWG would like to share some thoughts in relation to Ku band ESIM regulations in Australia as follows:

As a premise:

- 1) NGSO ESIMs operate in the co-primary FSS allocation 14.0-14.5 GHz (Earth-to-space) and 10.7-12.75 GHz (space-to-Earth). Such allocations to the NGSO systems are based on ITU RR No. 5.441, No. 5.484A and No. 5.487A.
- 2) There are no FS links operating in Australia in the 14.0-14.5 GHz allocation.
- 3) There could be Radioastronomy sites operating in the 14.47-14.5 GHz secondary allocation of the Radioastronomy Service (RAS).
- 4) For both foreign and national Ku band ESIMs, and operating in and around Australia, there is no need to adopt any restrictive licensing measures, as provided by the ITU Radio Regulations, because:
 - a. There are no FS links in the band 14.0-14.5 GHz.

⁴ The ECC Decisions relate to FS with high gain antennas. FWA systems are less susceptible to interference.

- b. If there are RAS sites in 14.47-14.5 GHz ACMA may the proposed restriction in line with that provided in the Appendix to this document.
 - c. NGSO satellite systems protected GSO satellite receivers with the ITU Article 22 e.p.f.d. limits.
- 5) For Ku band ESIMS installed on national Australian aircraft and ships, flying, or navigation abroad, we propose that the ACMA, when licensing/authorising (also under class licence) the satellite operator of the ESIM equipment, or a third party associated to the satellite operator, to be responsible in negotiating the necessary spectrum access authorization and operation of the equipment with the corresponding foreign countries.
 - 6) The SSWG believes that the class of station codes specific for ESIM operation in the fixed satellite services have been introduced after WRC-15 and therefore it is understandable that ITU satellite filings for networks planned to be operated for Ku band ESIM operations only include class of station code EC (Space station in the fixed-satellite service), but no codes indicating mobile operation with the considerations that Ku-band ESIM applications (i.e. Aeronautical Earth Stations (AES) and Earth Stations on Vessels (ESV)) for GSO satellite network already known before WRC-15.
 - 7) The SSWG believes some Administrations have allowed the operations of earth stations in vessels in the 14 to 14.5 GHz frequency bands without the need of coordination requirement or any PFD mask (either because there are no FS links or because they believe there is no interference potential), refer to RR **5.506B**⁵. We understand that there are no FS links in Australia in this frequency range and there is no requirement to coordinate ESV operations with Australia. Therefore, the SSWG would recommend allowing the normal operation of earth stations on vessels in the 14 to 14.5 GHz frequency bands within the 125 km distance from shore (see ITU Resolution 902). Hence, adding Australia in a future revision of RR **5.506B** could be supported.
 - 8) Ku band ESIM operations in Australia could be licensed through a class license, refer to [Radiocommunications \(Communication with Space Object\) Class Licence 2015](#). While a class license for Ku-band ESIM operations would be considered as secondary status (noting that NGSO ESIM operate under co-primary FSS allocation), Ku band ESIM operator still need to pay for annual license fees in order to authorise the operation of associated space stations. Additionally, status of a class licence should reflect that the ESIM equipment does not cause harmful interference to any other service and thus should fall under such prerogative. although there is no other services that are impacted here. Therefore, the SSWG strongly recommends that annual license fees for ESIM systems under class license should be free of charge.
 - 9) In accordance with Resolution 172 (WRC-19), the SSWG would like to highlight the possibility of future Ku-band ESIM operations in the 12.75 to 13.25 GHz band subject to the WRC-23 decision.

⁵ Malta and Cyprus do not have FS links in the 14.0-14.5 GHz band, and so most of the CEPT/European countries. For this reason, many CEPT countries have adopted the free circulations and licence exemption required in ECC Decision (18)04 for GSO land ESIM equipment, ECC Decision 18(05) for NGSO ESIM equipment, ECC Decision (05)10 for ESV in 14.0-14.5 GHz, and ECC Decision (05)11 for AES in the 14.0-14.5 GHz.

- 10) The SSWG notes that ITU Resolution 902 is applicable for GSO ESV equipment and ITU-R Recommendation M.1643 will be applicable to GSO AES equipment operating in the 14.0 – 14.5 GHz band and further explanations on Ku band GSO ESIMs technical characteristics could be referred to Appendix 1
- 11) Finally, the SSWG believes that NGSO ESIMs pose no threat to FS receivers in the band 14.0-14.5 GHz FSS allocation As such, imposing the technical limitations (antenna size, pointing accuracy, 125 km coordination distance) given in ITU Resolution 902 (WRC03) and imposing the strict PFD as stated in ITU-R Recommendation M.1643 to Ku band NGSO ESIMs, will render NGSO ESIMs unnecessarily inoperable. Hence, we propose that the ITU Resolution 902 and the ITU-R M.1643 will not be applied for Ku-band NGSO ESIMs with more explanations under Appendix 2.
- 12) Appendix 3 list the proposed modification to the Appendix E of Draft Business Operating Procedures Space and Space Receive

General comment

The SSWG supports the use of Letters of Assurance to be extended for satellite networks operating under No. 11.41 as recorded in the MIFR.

If you have any questions with respect to this submission, please contact Mike Johns at Communications Alliance on 0414 898 841.

Yours sincerely,



John Stanton
Chief Executive Officer

About Communications Alliance

Communications Alliance is the primary telecommunications industry body in Australia. Its membership is drawn from a wide cross-section of the communications industry, including carriers, carriage and internet service providers, content providers, equipment vendors, IT companies, consultants and business groups. Its vision is to provide a unified voice for the telecommunications industry and to lead it into the next generation of converging networks, technologies and services. The prime mission of Communications Alliance is to promote the growth of the Australian communications industry and the protection of consumer interests by fostering the highest standards of business ethics and behaviour through industry self-governance.

For more details about Communications Alliance, see:

<http://www.commsalliance.com.au/>

Appendix 1: Ku band GSO ESIMs

The SSWG would like to share some ECC decisions which have allowed the Ku band ESIM operations in the 14.0 – 14.5 GHz band in CEPT countries such as ECC DECISION (05)11, (05)10, and ECC DECISION (18)04.

The following technical conditions are stated in **ECC DECISION (05)10⁶ for the Aeronautical GSO ESIM operations operating in the 14 GHz band**, i.e.:

- an e.i.r.p. not greater than 50 dBW;
- complying with the relevant European Telecommunication Standards (EN 302 186)
- compliant with Recommendation ITU-R M.1643,
- operating under the control of a network control facility

The following technical conditions) are stated in **ECC DECISION (05)11⁷ for the Maritime GSO ESIM operations operating in the 14 GHz band**, i.e.:

- shall comply with Resolution 902 (WRC-03);
- complying with the relevant European Telecommunication Standard (EN 302 340)
- having an antenna size of 0.6 m or larger;
- operating under the control of a network control facility;

However, the above technical conditions should be flexible considering the development of antenna technology, in particular the antenna size requirement. While operations within the minimum distances are subject to specific agreement with concerned administrations, licensing administrations may authorize the deployment of smaller antenna sizes (e.g. 0.37m) at 14 GHz band provided that the interference to the terrestrial services is no greater than that which would be caused with an antenna size of 0.6m, taking into account Recommendation ITU-R SF.1650. In any case, the use of smaller antenna size shall be in compliance with the tracking accuracy of ESV antenna, maximum ESV e.i.r.p. spectral density toward the horizon, maximum ESV e.i.r.p. towards the horizon and maximum off-axis e.i.r.p. density limits contained in ITU Resolution 902 (WRC-03) and the protection requirements of the FSS intersystem coordination agreements.

The following technical conditions) are incorporated into **ECC DECISION (18)04⁸ for the land based GSO ESIM operations operating in the 14 GHz band**, i.e.:

- The land based ESIM shall operate under the control of a Network Control Facility (NCF);
- The land based ESIM shall cease transmissions in protection zones in frequency bands where FS and RAS stations are operated;
- Land based ESIM shall conform to the Harmonised European Standard EN 302 977 for vehicle mounted earth stations or EN 302 448 for earth stations on trains.

⁶ See, <https://docdb.cept.org/download/1654>

⁷ See, <https://docdb.cept.org/download/1622>

⁸ See, <https://docdb.cept.org/download/fbff3f53-335c/ECCDec1804.pdf>

Appendix 2: NGSO ESIM in Ku band.

Premise

Aeronautical NGSO ESIMs

NGSO satellite systems in Ku-band (and also Ka-band) operated under the **co-primary allocation of the FSS** with various footnotes which being introduced by WRC-2000 and WRC-2003; i.e., **No. 5.441, 5.484A, 5.487A**.

While for GSO, the related ITU rules and recommendation, such as **ITU-R Recommendation M.1643**, and the related PFD limits will be applied to AES in the 14 GHz band in order to protect the Fixed Service, which AES will be operated under secondary MSS allocation. It is evident that such recommendation is not applicable to Aeronautical NGSO ESIMs operating in the same band. The CEPT studies have simulated the compatibility of Aeronautical NGSO **ESIM** vis-à-vis **FS** microwave links (using also parameters from the ITU Recommendation F.758), with the assumptions that the NGSO ESIMs are operating under the **co-primary FSS allocation**.

Such studies took nearly two years and resulted in an **ECC Report 271⁹**, and provides a specific **PFD mask value**, which is different to PFD mask stated in ITU-R Recommendation M.1643 and such PFD mask value only applicable for the Aeronautical NGSO ESIM.

We understand that in Australia there are no FS links in the 14 GHz band, and thus such PFD masks are not required to be adopted in the ACMA regulations. However, it is important to note this matter so that the appropriate regulations are applied to the Aeronautical NGSO ESIMs in Ku-band.

Maritime NGSO ESIMs

The ITU-R SG4 which is the main responsible group at WRC-2003 to study Earth station on vessels (**ESVs**) of **GSO** networks using the FSS allocation in 14.5-14.5 GHz. The studies undertaken by the SG4 were mainly in relation to the protection of FS microwave links, which resulted some technical limitations as indicated in ITU-R Resolution 902 (WRC-2003) as follows:

- Technical limitations for ESVs, such as antenna size and pointing accuracy;
- Operations limitations for ESVs, such as a coordination distance from countries that have FS links.
-

It is our view that, although ESVs have been allowed to operate under primary FSS allocation:

- i. the current ITU rules (e.g., ITU Resolution 902) are not directly applicable due to some technical aspects of Maritime NGSO ESIM as follows:
- ii.
 - a. the **EIRP** of GSO ESVs could reach values of 55 dBW per 36 MHz channel, while the Maritime NGSO ESIM is in the range of 36 dBW in a 20 MHz channel.

Hence the interference potential to FS links of NGSO systems is much lower, in the range of 20 dB (100 times) less than specified in Resolution 902 (WRC-2003)

- b. the **antenna pointing accuracy** of 0.2 degrees, provided in the Resolution 902 (WRC-2003), for ESV communicating with GSO FSS network. This is because the ESV is directly pointing to a GSO FSS network, and it was assumed with worst case scenario that another GSO satellite could be 2 degrees away with +/- 0.2 degrees accuracy of station keeping of GSO FSS network.

This is of course not applicable to the Maritime NGSO ESIMs, because they need to comply with **ITU-R RR Article 22 EPFD limits**, and therefore, maritime NGSO ESIMs antenna will not directly pointing to the GSO arc in order to comply with Article 22 EPFD limits. Usually, the antenna pointing accuracy for the Maritime NGSO ESIM will be between 6 to 8 degrees.

The antenna size limit of ESVs as indicated in Resolution 902 (WRC-2003) is not applicable to Maritime NGSO ESIM due to the EIRP of Maritime NGSO ESIM is 20 dB lower than the EIRP specified in Resolution 902 (WRC-2003)

c. .

- iii. **the operational limitations** of ITU **Resolution 902** (WRC2003) for a coordination distance (125 km in Ku-band from the shore of a country where FS links exists) was proposed at WRC2003 as a threshold distance to coordination.

To ease the administrative burden of this frequency coordination, CEPT and the European Administrations took two years to study Ku band NGSO ESIMs which resulted in PFD threshold aimed at:

- a. reducing the coordination burden to both Administrations and the ESIM operators;
- b. protecting from NGSO ESIM emissions:
 - a. the FS service in the 14.0-14.5 GHz band;
 - b. the secondary Radioastronomy Service (RAS) in the 14.47-14.5 GHz band.

The CEPT concluded **ECC Report 271** which provides the outcome of compatibility studies between NGSO ESIM with FS link and RAS receivers, and thus provide for several PFD masks which will applicable to NGSO ESIMs.

The following technical conditions) are contained in **ECC DECISION (18)05**¹⁰ for **the NGSO ESIMs operations**, i.e.:

i. PFD mask for ESIMs installed on Aircraft to protect FS links:

- o $-122 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for $\theta \leq 5^\circ$;
- o $-127 + \theta \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for $5^\circ < \theta \leq 40^\circ$;
- o $-87 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for $40^\circ < \theta \leq 90^\circ$

With θ being the elevation angle above the horizontal plane at a point in the Earth.

¹⁰ See, <https://docdb.cept.org/download/1462>

- ii. **PFD mask for ESIMs installed on Ships to protect FS links:**
 - $-116 \text{ dB(W/(m}^2 \cdot \text{MHz))}$

Applied at a height of 80 metres above mean sea level at the low-water mark of the territory of the administrations having FS links.
- iii. **PFD mask for ESIMs installed on Vehicles (land based service) to protect RAS:**
 - $-116 \text{ dBW/m}^2/\text{MHz}$

Applied at 30 m height above ground of the territory of the administrations having RAS receiver in 14.47-14.5 GHz.
- iv. **Limitations to ESIMs installed on Aircraft to protect RAS in the 14.47-14.5 GHz range:**
 - ESIM installed on aircraft are required to cease emissions when in visibility of a RAS station performing observations in the 14.47-14.5 GHz secondary RAS allocation;

Conclusion

We have shown above that NGSO ESIMs pose no threat to FS receivers in the band 14.0-14.5 GHz FSS allocation, as well these ESIMs do not pose any threat to GSO receivers. As such, imposing the technical limitations given in ITU Resolution 902 (WRC03), will render the ESIMs unnecessarily inoperable, and we propose that the ITU Resolution 902 is not applied for Ku-band NGSO ESIMs.

Instead, for the Australian based ESIMs, we propose that ACMA adopts new rules for the NGSO Ku band ESIM equipment, with that provided by the ECC Decision(18)05 on NGSO ESIMs, for the PFD masks to protect FS links (see i., ii., iii. above) and the no transmit limitation of land based ESIMs to protect RAS sites, if these exist (see iv. above).

Furthermore, ACMA should not adopt any of the technical limitations to NGSO ESIMs, which are given in both (1) the ITU-R Recommendation M.1643 and (2) the ITU Resolution 902. This is because such rules do not apply to NGSO ESIMs.

Appendix 3 list the proposed modification to the Appendix E of Draft Business Operating Procedures Space and Space Receive

Appendix 3: Proposed modification to Appendix E of Draft Business Operating Procedures Space and Space Receive

Appendix E: Earth stations in motion communicating with space stations in the fixed-satellite service (both GSO and NGSO) in the frequency ranges 10.7–12.75 GHz (space-to-Earth) and 14-14.5 GHz (Earth-to-space)

This appendix outlines additional procedures to be applied when considering the issue of space or space receive licences authorising the use of ubiquitous earth stations in motion communicating with space stations in the fixed-satellite service (both GSO and NGSO) in the frequency ranges 10.7–12.75 GHz (space-to-Earth) and 14–14.5 GHz (Earth-to-space).

Modified treatment when checking consistency with ITU registration details of the satellite network and proposed use

When determining the ITU registration details of an FSS filing involving the operation of ESIM, the procedures of *Section 3.3 Checking consistency with ITU registration details of the satellite network and proposed use* should be followed, along with other considerations. These other factors that are particularly relevant for ESIM operation when checking consistency of ITU registration details with the proposed service and the Spectrum Plan are the class of station and the service area of the filing, as detailed below:

- > service purpose/function of the space station must be consistent with the class(es) of station¹¹ of the satellite network. In the ACMA's experience, ESIM do not always meet this requirement. There are currently no class of station codes specific to ESIM operation in Ku band. Further, an analysis of ITU satellite filings for networks currently known to be operating or planning to operate ESIM only include class of station code EC (Space station in the fixed-satellite service), but no codes indicating mobile operation. However, it is noted that the class of station codes specific for ESIM operation in the fixed satellite services have been introduced after WRC-15 and therefore it is understandable that ITU satellite filings for networks planned to be operated for Ku band ESIM operations only include class of station code EC (Space station in the fixed-satellite service), but no codes indicating mobile operation with the considerations that Ku-band ESIM applications (i.e. Aeronautical Earth Stations (AES) and Earth Stations on Vessels (ESV)) for GSO satellite network already known before WRC-15.
- > proposed geographic area of the licence must be included within the satellite network filing and that area must include Australia. This requirement is to ensure the operation within Australia has been considered in the ITU satellite coordination process and as a way of ensuring services to Australia are within the operating envelope of the network. This requirement is to be maintained for Ku band ESIM.

There is a difference between the acronym Earth station in motion (ESIM), first introduced by WRC15 and AES (Aircraft Earth Station) defined in No. 1.84 of the ITU RR. ESIMs are satellite equipment installed on a moving platform using a co-primary FSS allocation, while AES is satellite equipment using an MSS allocation. This is the case of the range 14.0-14.5 GHz. While the AES equipment operates in the 14.0-14.5 GHz under secondary MSS allocation and on a No. 4.4 basis in the 10.7-12.75 GHz, ESIMs, operate in the co-primary allocation of FSS in both said allocations. However, for ESIMs operated under FSS allocations, which state that the use of such allocation by NGSO systems vis-à-vis GSO networks is on a non-protected basis, and unacceptable interference that may occur shall be eliminated. This is not the same as saying that ESIM operate on a No. 4.4 basis.

¹¹ See lists of space station class of station and earth station class of station in [Preface to the BR IFIC \(Space services\)](#).

For NGSO systems operating in Low Earth orbit, the operational parameters of NGSO ESIMs are very different that the GSO equipment (such as AES and ESV), As such, the ITU Resolution 902 and M.1643 is not applicable for NGSO equipment.

Downlink (space-to-Earth) 10.7–12.75 GHz:

Applicants of ESIMs should demonstrate that if the licence application was assessed assuming the use of traditional fixed Earth stations, the risk of interference would be low. Applicants must then demonstrate that use of receiving ESIM is within the operating envelope of the ITU registration details. Receiving ESIM will be supported provided the technical characteristics are within the envelope of the ITU registration details. In this case, receiving ESIM operation is supported under ITU RR No. 4.4.

Uplink (Earth-to-space) 14–14.5 GHz

ITU registration details should be checked to determine whether they include MSS, earth stations on board vessels (ESVs) or aircraft earth stations (AES). If so, GSO ESIM can be operated under existing ARSP allocation and footnotes. Alternatively, applicants should demonstrate that if the licence application was assessed assuming the use of traditional fixed Earth stations, the risk of interference would be low. Applicants must then demonstrate that use of transmitting ESIM is within the operating envelope of the ITU registration details. Transmitting ESIM will be supported provided the technical characteristics are within the envelope of the ITU registration details. In this case, transmitting ESIM operation is supported under ITU RR No. 4.4.

1. **For the GSO ESIMs** the technical and regulatory conditions are provided in the following:

Those that are installed on aircraft, the following technical conditions could apply:

an e.i.r.p. not greater than 50 dBW;
complying with the relevant European Telecommunication Standards (EN 302 186)
compliant with Recommendation ITU-R M.1643,
operating under the control of a network control facility

Those that are installed on a ship, the following technical conditions could apply.

shall comply with Resolution 902 (WRC-03);
complying with the relevant European Telecommunication Standard (EN 302 340)
having an antenna size of 0.6 m or larger;
operating under the control of a network control facility;

However, the above technical conditions will not be rigid considering the development of antenna technology, in particular the antenna size requirement. While operations within the minimum distances are subject to specific agreement, Ku band Maritime GSO ESIM could be authorized with smaller antenna sizes (e.g.. 0.37m) at 14 GHz band provided that the interference to the terrestrial services is no greater than that which would be caused with an antenna size of 0.6m, taking into account Recommendation ITU-R SF.1650. In any case, the use of smaller antenna size shall be in compliance with the tracking accuracy of ESV antenna, maximum ESV e.i.r.p. spectral density toward the horizon, maximum ESV e.i.r.p. towards the horizon and maximum off-axis e.i.r.p. density limits contained in ITU Resolution 902 (WRC-03) and the protection requirements of the FSS intersystem coordination agreements.

Those that are land based, the following technical conditions could apply,

The land based ESIM shall operate under the control of a Network Control Facility (NCF);
The land based ESIM shall cease transmissions in protection zones in frequency bands where FS and RAS stations are operated;
Land based ESIM shall conform to the Harmonised European Standard EN 302 977 for vehicle mounted earth stations or EN 302 448 for earth stations on trains.

2. **For the NGSO ESIMs** the Resolution 902 rules are not applicable because the operations conditions of NGSO systems than that of GSO network, such as lower EIRP, , not pointing directly to the GSO arc.the following apply for NGSO, i.e.:

a. **Those that are installed on aircraft**

i. **PFD mask** applicable when flying over or near a country with FS microwave links in the 14.0-14.5 GHz, i.e. PFD mask is:

- $-122 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for $\theta \leq 5^\circ$;
- $-127 + \theta \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for $5^\circ < \theta \leq 40^\circ$;
- $-87 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ for $40^\circ < \theta \leq 90^\circ$

ii. **Cease emissions** when in visibility of a Radioastronomy station performing observations in the 14.47-14.5 GHz secondary RAS allocation;

b. **Those that are installed on a ship** the following PFD mask is applicable when the ship is navigating near a country with FS microwave links, i.e.:

- $-116 \text{ dB(W/(m}^2 \cdot \text{MHz))}$

Applied at a height of 80 metres above mean sea level at the low-water mark of the territory of the administrations having FS links in 14.0-14.5 GHz.

c. **Those that are land based**, the following PFD mask applies in visibility of a Radioastronomy station performing observations in the 14.47-14.5 GHz secondary RAS allocation

- $-116 \text{ dBW/m}^2/\text{MHz}$

Applied at 30 m height above ground of the territory of the administrations having RAS receiver in 14.47-14.5 GHz.

Interference management and due diligence

When demonstrating due diligence and evidence of an engineering assessment that considers the risk and likelihood of interference to and from existing services in Australia, the procedures of *Section 3.5.1 Interference management and due diligence* should be followed. This may include information regarding compliance with relevant FCC or ECC requirements (and ETSI harmonised standard), including:

- > equivalent isotropically radiated power limits for ESIM
- > ESIM controlled by a network control facility
- > power flux density restrictions
- > ESIM that use closed-loop tracking of the satellite signal shall employ an algorithm that is resistant to capturing and tracking signals from nearby satellites; earth stations shall immediately cease transmissions when they detect that unintended satellite tracking has occurred or is imminent
- > **Other operational restrictions**

Summary of additional special conditions and advisory notes applicable to Ku band ESIM

Space apparatus licence authorising ESIM in 10.7–12.75 GHz

The following additional special conditions and advisory notes are to be applied to space licences authorising the use of earth stations in motion communicating with GSO space stations or NGSO space systems in the fixed-satellite service in the frequency band 10.7–12.75 GHz, in line with the procedures outlined above.

Category	Type	Item	Text
Special condition	Pre-defined	ESIM8	Earth stations in motion may be operated in association with this licence provided that these earth stations would, if stationary, otherwise be in accordance with the operating parameters published by the ITU in Special Sections of International Frequency Information Circulars and in accordance with any agreements reached as a result of an ITU frequency coordination process.
Special condition	Pre-defined	ESIM5	Radiocommunications between space stations and earth stations in motion authorised under this licence shall not be used or relied upon for safety-of-life applications.

Space receive apparatus licence authorising ESIM in 14–14.5 GHz

The following additional special conditions and advisory notes are to be applied to space receive licences authorising the use of earth stations in motion communicating with GSO space stations or NGSO space stations in the fixed-satellite service in the frequency band 14–14.5 GHz, in line with the procedures outlined above.

Category	Type	Item	Text
Special condition	Pre-defined	ESIM8	Earth stations in motion may be operated provided that these earth stations would, if stationary, otherwise be in accordance with the operating parameters published by the ITU in Special Sections of International Frequency Information Circulars and in accordance with any agreements reached as a result of an ITU frequency coordination process.
Special condition	Pre-defined	ESIM4	Radiocommunications between space stations and earth stations in motion authorised under this licence shall be subject to permanent monitoring and control by a Network Control and Monitoring Centre (NMC) or equivalent facility and be capable of receiving and acting upon at least 'enable transmission' and 'disable transmission' commands from the NMC.
Special condition	Pre-defined	ESIM5	Radiocommunications between space stations and earth stations in motion authorised under this licence shall not be used or relied upon for safety-of-life applications.