# UNITED STATES OF AMERICA

# DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

**AGENDA ITEM 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)***

**BACKGROUND INFORMATION**:

The global demand for broadband communications continues unabated and is not location specific. Such demand includes requirements of connectivity for users on vessels, aircraft and vehicles that operate at both fixed locations and while in motion, often in very remote parts of the globe. ITU for many years has and continues to address ways of meeting this important need. State of the art 30/20 GHz GSO FSS satellite networks and earth stations that employ advanced technology available today are capable of meeting the connectivity requirements of broadband users on vehicles and vessels, including high-throughput applications.

Advances in satellite manufacturing and directional earth station technology, particularly the development of multi-axis stabilized earth station antennas capable of maintaining a high degree of pointing accuracy while stationary or on rapidly moving platforms, have made earth stations with very stable pointing characteristics both available and practical. These earth stations can operate in the same interference environment, and comply with same regulatory and technical constraints as typical GSO FSS earth stations. Satellite network operators are designing, coordinating, and bringing into use GSO FSS networks that can offer both stationary and moving broadband services using a single stabilized directional antenna within existing GSO FSS technical parameters.

The ITU-R has been studying deployment of earth stations in motion (ESIM) communicating with GSO FSS space stations for many years. WRC-15 adopted regulatory provisions for the operation of ESIM communicating with GSO FSS space stations in the 29.5-30 GHz and 19.7-20.2 GHz bands under No. **5.527A** and Resolution **156 (WRC-15)**, and prior Conferences adopted provisions for operation of ESIM on maritime vessels communicating with GSO FSS space stations in lower FSS bands.

The latest bands to be considered for ESIM communication with GSO FSS space stations are the 27.5-29.5 GHz and 17.7-19.7 GHz bands. These bands were considered separately from the “upper 500 MHz” of the 30/20 GHz band due to the fact that the upper bands are allocated predominantly to satellite services while the lower portions of the 30/20 GHz bands are shared on a global basis with the fixed and mobile services as well as other users.

The sharing cases requiring study in the 27.5-29.5 GHz and 17.7-19.7 GHz bands were set out in Resolution **158 (WRC-15)**. Where provisions were shown to be required for the protection of existing services and applications – such as the mobile service, the fixed service, and non-GSO FSS systems in portions of the band subject to No. **22.2** – studies leading to the conditions necessary for such protection have been identified or are nearing conclusion. The ITU-R determined that a resolution containing the regulatory, technical, and operational conditions for ESIM operation on aircraft, maritime vessels, and land vehicles could be developed and effectively implemented.

Adoption of the proposals below will provide up to 2000 megahertz, in each the uplink and downlink directions, to support these important and growing global broadband requirements, on an equal basis in all three Regions and result in rational and efficient use of the radio spectrum resource. Adoption of this proposal will also assure the protection of existing services.

Proposals

ARTICLE 5

Frequency allocations

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

MOD USA/1.5/1

|  |  |  |
| --- | --- | --- |
| 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 ADD5.A15  (Earth-to-space) 5.516  MOBILE | 17.7-17.8  FIXED  FIXED-SATELLITE (space-to-Earth) 5.517 ADD5.A15 (Earth-to-space) 5.516  BROADCASTING-SATELLITE  Mobile  5.515 | 17.7-18.1  FIXED  FIXED-SATELLITE (space-to-Earth) 5.484A ADD5.A15  (Earth-to-space) 5.516  MOBILE |
|  | 17.8-18.1  FIXED  FIXED-SATELLITE (space-to-Earth) 5.484A ADD5.A15  (Earth-to-space) 5.516  MOBILE  5.519 |  |
| 18.1-18.4 FIXED  FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD5.A15  (Earth-to-space) 5.520  MOBILE  5.519 5.521 | | |

MOD USA/1.5/2

|  |  |  |
| --- | --- | --- |
| 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 ADD5.A15  MOBILE | | |
| 18.6-18.8  EARTH EXPLORATION-SATELLITE (passive)  FIXED  FIXED-SATELLITE (space-to-Earth) 5.522B ADD5.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 ADD5.A15  MOBILE except aeronautical mobile  SPACE RESEARCH (passive) | 18.6-18.8  EARTH EXPLORATION-SATELLITE (passive)  FIXED  FIXED-SATELLITE (space-to-Earth) 5.522B ADD5.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 ADD5.A15  MOBILE | | |
| 19.3-19.7 FIXED  FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 5.523B 5.523C 5.523D 5.523E ADD5.A15 MOBILE | | |

|  |  |  |
| --- | --- | --- |
| MOD USA/1.5/3  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 ADD5.A15  MOBILE  5.538 5.540 | | |
| 28.5-29.1 FIXED  FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 ADD5.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 ADD5.A15  MOBILE  Earth exploration-satellite (Earth-to-space) 5.541  5.540 | | |

ADD USA/1.5/4

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

**Reasons:** Adoption of these proposals would provide the availability of 2 GHz of additional spectrum in each the FSS uplink and downlink directions at 30/20 GHz to support important and growing global broadband communication requirements for users on ships, airplanes, and land vehicles, on an equal basis in all three Regions and result in rational and efficient use of the radio spectrum resource.

ADD USA/1.5/5

draft new RESOLUTION [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 service1

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 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,

*d)* that ITU-R studies have shown that aeronautical ESIM are capable of operating without causing harmful interference interfering with non-GSO mobile-satellite service feeder link satellite receivers in the 29.1-29.5 GHz band,

recognizing

*a)* that the administration authorising 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 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, or portions thereof, 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 bands, ESIM shall comply with the following conditions:

1.1.1 with respect to satellite networks or systems of other administrations, ESIM shall remain within the envelope of the satellite network with which these ESIM communicate;

1.1*.*2 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 Appendix **4** information related to the characteristics of the ESIM intended to communicate with the space station of that GSO FSS network, including a commitment that the ESIM operation would be in conformity with the Radio Regulations and this Resolution (including its annexes, as applicable);

1.1.3 upon receipt of the information provided in accordance with *resolves* 1.1.2 above, the Bureau shall examine it in relation to the requirements referred to in *resolves* 1.1.1 based on the complete information submitted to the Bureau under No. **11.2,** and complying with No. **11.28,** for the satellite network of the GSO FSS space station with which the ESIM is intended to communicate;

1.1.4 If, following the examination referred to in *resolves* 1.1.3 above, the Bureau concludes that the ESIM characteristics are within the envelope of the satellite network, it shall publish the results in a Special Section annexed to the BR IFIC, and retain the original date of protection for the assignment being modified where the information is presented as a modification of an existing notice;

1.1.5 if, following the examination referred to in *resolves* 1.1.3 above, the Bureau concludes that the ESIM characteristics are not within the envelope of the satellite network, the information shall be returned to the notifying administration;

1.1.6 for the protection of non-GSO FSS systems operating in the band 27.5-28.6 GHz, ESIM communicating with GSO FSS networks shall comply with the provisions contained in Annex 1 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 and shall not affect their future development;

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 any stations in the terrestrial services in this band operating in accordance with the Radio Regulations and shall not affect the future development of these services;

1.2.2 the transmitting aeronautical and maritime ESIM in the 27.5-29.5 GHz frequency band shall not cause unacceptable interference to any stations in the terrestrial services in this band operating in accordance with the Radio Regulations and shall not affect the future development of these services, and Annex 2 applies;

1.2.3 the transmitting land ESIM in the 27.5-29.5 GHz frequency band shall not cause interference to any stations in the terrestrial services in this band operating in accordance with the Radio Regulations and shall not affect the future development of these services, and Annex 3 applies;

1.2.4 for the implementation of *resolves* 1.2.2 and 1.2.3 above, the notifying administration responsible for the GSO FSS satellite network with which ESIM communicate shall, in making the commitment referred to in *resolves* 1.1.2 above, be deemed to have committed that it shall, upon receipt of a report of unacceptable interference (in the case of aeronautical or maritime ESIM) or interference (in the case of land ESIM), take necessary action to immediately cease or reduce interference to an acceptable level;

1.2.5 any transmitting aeronautical or maritime ESIM that conforms to the requirements in Annex 2 to this Resolution shall be deemed to have met its obligation to terrestrial stations under *resolves* 1.2.2 above;

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

3 that for the implementation of this Resolution, administrations may consider relevant parts of Annex 3 when considering to authorise ESIM as well as in their bi-lateral or multi-lateral negotiations;

4  that, in addition to *resolves* 3, administrations authorizing land ESIM shall ensure that land ESIM operating in their territory do not cause unacceptable interference to terrestrial services of other countries operating in accordance with the Radio Regulations

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

5.1 ESIM employ techniques to track the associated GSO FSS satellite without inadvertently tracking adjacent GSO satellites;

5.2 the ESIM network operator puts in place all necessary measures so that its ESIM are subject to permanent monitoring and control by a Network Control and Monitoring Centre (NCMC) or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility (see also Annex 3);

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 by administrations, including assisting in resolving any potential interference issues;

3 to report to WRC-23 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 any potential interference.

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

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

1 In order to protect those non-GSO FSS 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 Condition 1.a above, outside of 3 deg of the GSO, 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 2 to draft new Resolution [A15] (WRC-19)

Part 1:

Provisions for maritime ESIM to protect terrestrial services operating in the frequency band 27.5-29.5 GHz for the implementation of resolves 1.2.2

Part 2:

Provisions for aeronautical ESIM to protect terrestrial services operating in the frequency band 27.5-29.5 GHz for the implementation of resolves 1.2.2

Part 1: Maritime ESIM

1 Maritime ESIM shall comply with items 1.1 and 1.2 below:

1.1 The minimum distance 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 km 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.

1.2 The maximum maritime ESIM e.i.r.p. spectral density towards the territory of any coastal State will be limited to 24.44 dBW in reference bandwidth of 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.

Part 2: Aeronautical ESIM

1 Aeronautical ESIM communicating with GSO FSS networks shall comply with the provisions of items 1.1 and 1.2 below:

1.1 When within line-of-sight of the territory of an administration, the maximum pfd produced (in a reference bandwidth of 14 MHz) at the surface of the Earth within the territory of that administration by emissions from a single aeronautical ESIM shall not exceed:

PFD(δ)=-124.7 (dBW/m2/14 MHz) for 0°≤δ≤0.01°

PFD(δ)=-120.9+1.9∙log10(δ) (dBW/m2/14 MHz) for 0.01°≤ δ≤0.3°

PFD(δ)=-124.7 (dBW/m2/14 MHz) for 0°≤δ≤0.01°

PFD(δ)=-120.9+1.9∙log10(δ) (dBW/m2/14 MHz) for 0.01°≤ δ≤0.3°

PFD(δ)=-116.2+11∙log10(δ) (dBW/m2/14 MHz) for 0.3°<δ≤1°

PFD(δ)=-116.2+18∙log10(δ) (dBW/m2/14 MHz) for 1°<δ≤2°

PFD(δ)=-117.9+23.7∙log10(δ) (dBW/m2/14 MHz) for 2°<δ≤8°

PFD(δ)=-96.5 (dBW/m2/14 MHz) for 8°<δ≤90.0°

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

1.2 Higher pfd levels than provided in 1.1 above produced by aeronautical ESIM on surface of the Earth within the territory of an administration that is within line-of-sight of the aeronautical ESIM shall be subject to the prior agreement of that administration.

NOTE 1 – When calculating whether an ESIM meets the pfd levels specified in provision 1.1 above, free-space propagation, atmospheric absorption, and any attenuation due to the aircraft fuselage should be considered.

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

Guidelines to assist administrations to authorize ESIM   
in the frequency band 27.5-29.5 GHz

The following guidelines are provided for all administrations involved in the authorization and operation of ESIM in the 27.5-29.5 GHz and 17.7-19.7 GHz frequency bands:

1. With regard to Land ESIM (L-ESIM), the administration authorizing L-ESIM has the right to require:

1.1 that L-ESIM operate within the territory under the jurisdiction of an administration only if authorised by that administration;

1.2 the operator of any ESIM network within which the L-ESIM operate to confirm that such L-ESIM have the capability to limit operations to the territory of administrations having authorized those L-ESIM;

1.3 The operator of the ESIM network within which the L-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from L-ESIM.

2. With regard to Maritime ESIM (M-ESIM), the administration authorizing M-ESIM has the right to require:

2.1 that M-ESIM operate within the territorial waters under the jurisdiction of an administration only if authorised by that administration.

2.2. the operator of any ESIM network within which the M-ESIM operate to confirm that such M-ESIM have the capability to limit operations to the territorial waters of administrations having authorized those M-ESIM.

2.3 The operator of the ESIM network within which the M-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from M-ESIM.

3. With regard to Aeronautical ESIM (A-ESIM), the administration authorizing A-ESIM has the right to require:

3.1 that A-ESIM operate within the territorial airspace under the jurisdiction of an administration only if authorized by that administration;

3.2 the operator of any ESIM network within which the A-ESIM operate to confirm that such A-ESIM have the capability to limit operations to the territorial airspace of administrations having authorized those A-ESIM.

3.3 The operator of the ESIM network within which the A-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from A-ESIM.

**Reasons:** Adoption of this proposal would provide the availability of 2 GHz of additional spectrum in each the FSS uplink and downlink directions at 30/20 GHz to support important and growing global broadband communication requirements for users on ships, airplanes, and land vehicles, on an equal basis in all three Regions and result in rational and efficient use of the radio spectrum resource.

MOD USA/1.5/6

APPENDIX 4 (REV.WRC‑15)

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

ANNEX 2

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

Footnotes to Tables A, B, C and D

MOD

TABLE A

Table of characteristics to be submitted for space andradio astronomy services   
(Rev.WRC ‑12)

| Items in Appendix | *A \_ GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,  EARTH STATION OR RADIO ASTRONOMY STATION* | *Advance publication of a geostationary- satellite network* | *Advance publication of a non-geostationary-satellite network subject to coordination under Section II  of Article 9* | *Advance publication of a non-geostationary-satellite network not subject to coordination under Section II  of Article 9* | *Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)* | *Notification or coordination of a non-geostationary-satellite network* | *Notification or coordination of an earth station (including notification under  Appendices 30A or 30B)* | *Notice for a satellite network in the broadcasting-satellite service under  Appendix 30 (Articles 4 and 5)* | *Notice for a satellite network  (feeder-link) under Appendix 30A  (Articles 4 and 5)* | *Notice for a satellite network in the fixed- satellite service under Appendix 30B  (Articles 6 and 8)* | *Items in Appendix* | *Radio astronomy* |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| \* \* \* | **\* \* \*** |  |  |  |  |  |  |  |  |  | \* \* \* |  |
| **A.18** | **COMPLIANCE WITH NOTIFICATION OF AIRCRAFT EARTH STATION(S)** |  |  |  |  |  |  |  |  |  |  |  |
| A.18.a | a commitment that the characteristics of the aircraft earth station (AES) in the aeronautical mobile-satellite service are within the characteristics of the specific and/or typical earth station published by the Bureau for the space station to which the AES is associated  Required only for the band 14-14.5 GHz, when an aircraft earth station in the aeronautical mobile-satellite service communicates with a space station in the fixed-satellite service |  |  |  | **+** | **+** |  |  |  |  | A.18.a |  |
| **A.19** | **COMPLIANCE WITH § 6.26 OF ARTICLE 6 OF APPENDIX 30B** |  |  |  |  |  |  |  |  |  | **A.19** |  |
| A.19.a | a commitment that the use of the assignment shall not cause unacceptable interference to, nor claim protection from, those assignments for which agreement still needs to be obtained  Required if the notice is submitted under § 6.25 of Article 6 of Appendix **30B** |  |  |  |  |  |  |  |  | **+** | A.19.a |  |
| **A.20** | **COMPLIANCE WITH *Resolves* 1.1.2 of Resolution [AI 1.5/XXX] (WRC-19)** |  |  |  |  |  |  |  |  |  | **A.20** |  |
| A.20.a | indicator (yes) if an assignment for the 27.5‑29.5 GHz and/or 17.7-19.7 GHz band in the satellite network will be used by ESIM |  |  |  |  |  | **O** |  |  |  | A.20.a |  |
| A.20.b | if yes under A.20.a, a commitment that the ESIM operation would be in conformity with the Radio Regulations and Resolution **[AI1.5/XXX] (WRC-19)** (including its annexes) |  |  |  |  |  | **+** |  |  |  | A.20.b |  |

Reasons: This Appendix **4** element is needed to implement *resolves* 1.1.2 of Draft New Resolution **[A1.5] (WRC-19).**

**SUP USA/1.5/7**

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.

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