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| Summary:  |
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| Proposal: |
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DRAFT CEPT BRIEF ON 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)

# ISSUE

Resolution 158 (WRC-15) in its resolves to invite ITU-R 1-3 invites the ITU-R:

* “to study the technical and operational characteristics and user requirements of different types of earth stations in motion that operate or plan to operate within geostationary FSS allocations in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, including the use of spectrum to provide the envisioned services to various types of earth station in motion and the degree to which flexible access to spectrum can facilitate sharing with services identified in recognizing further a) to n)”;
* “to study sharing and compatibility between earth stations in motion operating with geostationary FSS networks and current and planned stations of existing services allocated in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz to ensure protection of, and not impose undue constraints on, services allocated in those frequency bands, and taking into account recognizing further a) to n)”
* “to develop, for different types of earth stations in motion and different portions of the frequency bands studied, technical conditions and regulatory provisions for their operation, taking into account the results of the studies above”

Resolution 158 (WRC-15) in its resolves to further invite the 2019 World Radiocommunication Conference

* “to consider the results of the above studies and take necessary actions, as appropriate, provided that the results of the studies referred to in resolves to invite ITU-R are complete and agreed by ITU-R study groups.”

# Preliminary CEPT position

CEPT supports a regulatory framework for the operation of earth stations in motion (ESIM) in the bands 17.7-19.7 GHz and 27.5-29.5 GHz, while ensuring protection of, and not imposing undue constraints on, services allocated in those frequency bands.

Due to the foreseen growing demand for ESIM and because ESIM terminals are ‘in motion’ and world-wide use, the regulatory framework for these terminals needs to be as simple and practicable as possible. The following conditions are considered in the 27.5-29.5 GHz bands as a way forward:

* Maritime ESIM – together with other technical conditions, minimum distance limits at the low water mark officially recognized by coastal states might be adopted as has been done for Resolution 902 (WRC-03). ESIM should comply with these minimum distances unless prior agreement of the concerned administrations has been given.
* Aircraft ESIM – together with other technical conditions, the pfd limits on the earth’s surface as specified in [ECC Decision (13)01](http://www.erodocdb.dk/doks/filedownload.aspx?fileid=3962&fileurl=http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCDEC1301.PDF), should form the basis for considerations within the relevant ITU-R Working Parties. This together with other consideration would ensure protection of terrestrial systems. ESIM should comply with these pfd limits unless prior agreement of the concerned administrations has been given.
* Land ESIM – operating within national boundaries no specific regulatory action or amendments to the Radio Regulations at WRC-19 are needed, but further consideration may be needed on methods for:
	1. identifying with which countries an administration intending on authorising / deploying Land ESIM should first effect coordination and seek agreement with;
	2. which methodology(-ies) may be used to effect such coordination.

Regarding the 17.7-19.7 GHz band, CEPT is of the view that ESIM shall not claim protection from the fixed and mobile services in the band.

Regarding the 27.5-29.5 GHz band, the CEPT supports studying appropriate sharing techniques, including e.i.r.p. or pfd values for ESIM in order to protect the fixed and mobile services allocated in the bands. CEPT has developed a [Roadmap on 5G](http://cept.org/ecc/groups/ecc/client/meeting-documents/file-history/?fid=33486) (<http://www.cept.org/ecc/topics/spectrum-for-wireless-broadband-5g#roadmap>). In this respect it is noted that “Europe has harmonised the 27.5-29.5 GHz band for broadband satellite and is supportive of the worldwide use of this band for ESIM. This band is therefore not available for 5G”.

# Background

WRC-15 adopted Resolution 156 (WRC-15) which allows FSS frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz to be used by ESIM operating with geostationary space stations. The Resolution is largely based on Reports ITU-R S.2223 and ITU-R S.2357, which study technical and operational use of ESIM. Agenda item 1.5 of WRC-19 was proposed by CEPT to WRC-15 and can be viewed as continuation of the work accomplished during the previous cycle, in that it seeks to extend the operation of ESIM into the FSS frequency ranges of 17.7-19.7 GHz and 27.5-29.5 GHz by ensuring, at the same time, protection of other services. The detailed requirements for studies under this agenda item are contained in Resolution 158 (WRC-15).

The use of ESIM within the frequency bands 17.3-20.2 GHz and 27.5-30.0 GHz is harmonised within the CEPT with ECC Decision (13)01 on “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”. ECC Decision (13)01 is based on ECC Report 184, which considers the regulatory and technical aspects of the introduction of ESIM in the bands 17.3-20.2 GHz and 27.5-30.0 GHz. The studies that need to be performed under resolves to invite ITU-R 1-3 in Resolution 158 (WRC-15) are similar to those that were already established in ECC Report 184. The following methodology was used in the CEPT in order to introduce ESIM into the bands 17.3-20.2 GHz and 27.5-30.0 GHz:

It was established that from the perspective of potential uplink or downlink interference to FSS services, operation of ESIM is equivalent to stationary FSS earth stations, since:

In the space-to-Earth frequency range of 17.3-20.2 GHz, FSS satellites operating with ESIM comply with the same regulatory and technical constraints as FSS satellites operating with stationary FSS earth stations.

In the Earth-to-space frequency range of 27.5-30.0 GHz, ESIM comply with the same regulatory and technical constraints (e.g. Recommendation ITU-R S.524) as stationary FSS earth stations.

Based on the above, it was concluded that the operation of ESIM will not produce a different interference environment for other satellite services compared to the operation of stationary FSS earth stations.

In order to mitigate interference between administrations that have identified the band for ESIM and possible neighbouring administrations that have identified the band for terrestrial services[[1]](#footnote-2), the ECC Report 184 has identified the following possible methods:

Land based ESIM and fixed service networks can be coordinated using Recommendation ITU‑R SF.1707 on “Methods to facilitate the implementation of large numbers of earth stations in the FSS in areas where terrestrial services are also deployed”;

For maritime ESIM, a PFD threshold at the coast of a country in the 27.5-30.0 GHz band, combined with ESIM ability to regulate or even cease its transmissions dependent on the location, is suitable for the protection of fixed service deployment in that country;

For aircraft-mounted ESIM, a PFD mask, combined with ESIM ability to regulate or even cease its transmissions dependent on the location, provides adequate protection to the fixed service in the neighbouring administration.

ECC Decision (13)01[[2]](#footnote-3) gives the necessary conditions to allow ESIM operation in the band 17.3-20.2 GHz and 27.5-30.0 GHz within Europe. These conditions are based on ECC Report 184. The bands, which are already harmonised throughout CEPT for uncoordinated FSS earth stations, are also designated for use by ESIM. In those bands which are designated for fixed operation: 27.8285-28.4445 GHz and 28.9485-29.4525 GHz (and in some countries the band 28.8365-28.9485 GHz), ESIM may operate in international waters and international airspace in line with ECC Decision (13)01.

It is recognised that the development of satellites with higher levels of G/T, so called HTS (high-throughput satellites), results in increased sensitivity of the HTS satellite to interference, which could complicate coordination between satellite networks. This has been highlighted in Report ITU-R S.2409-0 which shows that interference levels from off-axis emissions based on Rec. ITU-R 524-9 could create high levels of I/N into such satellites. This is an issue that may affect most FSS satellites with a high G/T value in the frequency band 27.5-29.5 GHz as well as other FSS frequency bands, regardless of whether they operate with ESIM or not. Report ITU-R S.2409-0 identifies some potential mitigation techniques to address this issue, which are applicable to any “closely spaced” GSO FSS VSAT networks, including GSO FSS networks operating ESIM. This issue concerns not only GSO satellite networks with ESIM, but also GSO FSS networks with stationary earth stations (for example, ubiquitously deployed VSAT-terminals) and goes beyond the scope of studies conducted by ITU-R in accordance with Resolution 158 (WRC-15). The purpose of any studies on this subject should be to identify technical limitations and methods to reduce inter-system interference that can assist administrations in planning and coordination of the "closely spaced" GSO FSS networks. However, it is not necessary to complete these studies under agenda item 1.5.

Within ITU-R, at Working Party 4A (WP 4A)’s fourth meeting the main WD-PDN Report for this agenda item was updated. That report has a main body and separate annexes that address ESIM sharing with the fixed service (FS), the mobile service (MS), and MSS feeder links. Two Annexes address measures that can be considered for the case of land-based ESIM sharing with the FS and MS.

Progress was made on the draft Conference Preparatory Meeting (CPM) Report text and a liaison statement was sent to WP 5C seeking clarification on protection criteria for fixed services. Progress was also made on feeder link earth stations and their protection from ESIM transmissions in the 27.5-29.5 GHz.

The meeting spent considerable time updating the possible WRC Resolution that was preliminarily agreed as a way forward at the third meeting, but was not able to complete this task, which will continue at the next WP 4A meeting.

ESIM DEMAND and user requirements

Aeronautical ESIM

Over the next decade, a growing number of connected aircrafts and vessels are expected. In addition, there will be an increase of high capacity satellite systems (both GSO and NGSO) capable of delivering high-speed connection over satellite through high-powered narrow spot beams. Meeting that market demand is vital.

The air traffic sector is growing substantially. Boeing and Airbus are forecasting demand for 39620 and 33070 new aircrafts respectively through 2035, in total 72690 new aircrafts.

Table 1: Boeing New Aircraft Deliveries Through 2035

|  |  |  |
| --- | --- | --- |
| Aircraft type | Seats | Total deliveries through 2035 |
| Regional jets | ≤ 90 | 2380 |
| Single-aisle | 90 – 230 | 28140 |
| Small widebody | 200 – 300  | 5100 |
| Medium widebody | 300 – 400  | 3470 |
| Large widebody | ≥ 400 | 530 |
| Total | - | 39620 |

In total, the global aeronautical satellite communications market is forecast to grow from 47500 terminals in 2014 to 95500 in-service by the end of 2024.

The satellite industry is investing in high capacity satellite systems enabling service operators and airlines the flexibility to offer passengers a broad range of service packages to fit their different needs. By 2025, there will be over 3 Tbps of GSO-HTS capacity globally by 2025. At a minimum, this equates to triple the amount of traditional FSS capacity in orbit today, and depending on bits per hertz efficiencies, it could be even more.

Global IP traffic will nearly triple over the next five years, and by 2020 smartphones are expected to generate 30% of the total IP traffic. In this new age of connectivity, a record 3.6 billion airline passengers will board over 40 million commercial flights worldwide in 2016 and 65% of today’s travellers would choose to access entertainment services on their own device.

The majority of these passengers will expect to connect to high-speed Wi-Fi, stream video entertainment, text, and catch up on email and social media like they do on the ground. In fact, more than half of the world’s airline passengers say the availability and quality of inflight Wi-Fi is increasingly a factor in their airline choice when booking a flight. Passenger demand for inflight connectivity is increasing with aviation growing into one of the largest user segments of satellite capacity.

Responding to this demand, the number of connected commercial aircrafts globally is expected to grow from 5300 in 2015 to 23100 in 2025. The region with highest annual growth is Latin America growing from 44 to 1529 connected flights in 2025. The number of connected aircrafts in Europe is also facing a high growth with 28.2% annually up to 2025 booming from 455 aircrafts to 5465.

Table 2: Expected annual growth of connected aircrafts

|  |  |  |  |
| --- | --- | --- | --- |
| Region | Connected aircrafts in 2015 | Connected aircrafts in 2025 | Annual growth (%) |
| North America | 3940 | 7710 | 6.9 |
| Latin America | 44 | 1529 | 42.6 |
| Europe | 455 | 5465 | 28.2 |
| Middle East | 491 | 2131 | 15.8 |
| Asia & Oceania | 356 | 6256 | 33.2 |

Airlines are implementing inflight connectivity systems primarily to provide a better passenger experience as described above. However, carriers are also increasingly implementing inflight connectivity to drive cost savings, safety, and operational efficiencies across their fleets.

With a lightweight portable tablet pilots can receive critical real-time flight data, including regularly updated flight-path weather and turbulence reports. Agile flight plans that avoid major storms and turbulence can optimize the fuel consumption and reduce amount of toxic emissions into the atmosphere, avoid delays and hopefully provide passengers with a smoother, safer and more enjoyable journey.

The move to pilot EFBs and cabin crew tablets will have an impact on the environment as the transition to EFBs from paper reports is already saving hundreds of thousands of pages of daily inflight documentation, maps, charts and manuals (average of 12,000 pages per pilot), which cuts the weight on board planes and saves airlines more than 83 million litres of fuel consumption each year.

New age commercial aircraft engines feature thousands of sensors, constantly monitoring engine wear, oil pressure, and fuel consumption to enable predictive and preventative maintenance programs that can save time and money. By pinpointing engine issues airlines can schedule maintenance, avoid aircraft downtime and delays, improve turn times, reduce maintenance costs, and keep aircrafts running and passengers travelling on time.

A legacy Boeing 737, for example, generates a mere 3 gigabytes of data from a month of operations, while a single flight by a new Boeing 787 generates more than 500 gigabytes of operational data from thousands of sensors across the plane, resulting in more than 30 terabytes over the course of a month in flight. When the aircraft is in operation up in the air, most of this data is being transmitted locally around the aircraft and downloaded on a server on the aircraft for further analysis. Part of this data though, i.e. not the full data set, will be transmitted real-time with satellite communication to schedule for example maintenance in advance in order to avoid various issues as described above.

In summary, the connected aircraft will enable a variety of new features:

1. Connecting flight information to passengers in real-time
2. Inflight repair report
3. Real-time card processing
4. Passenger entertainment
5. Electronic flight bag
6. Real-time weather reports
7. Communication with air traffic controllers
8. Constant engine monitoring

It is noted that features such as safety-of-life services are not foreseen to be used in the connected aircraft.

Maritime ESIM

The number of maritime vessels in service grew by almost 25 per cent between 2012 and 2013 and revenues increased by more than 15 per cent. Surpassing a rate of increase of 20,000 vessels is seen as a tipping point for the industry and the new target is now an increase to around 50,000 vessels over the next few years. The enabler of this growth is satellite communications.

# List of relevant documents

* Report ITU-R S.2223: “Technical and operational requirements for GSO FSS earth stations on mobile platforms”;
* Report ITU-R S.2357: “Technical and operational guidelines for earth stations on mobile platforms communicating with geostationary space stations in the fixed-satellite service in the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz”;
* ECC Report 184: “The Use of Earth Stations on Mobile Platforms Operating with GSO Satellite Networks in the Frequency Ranges 17.3-20.2 GHz and 27.5-30.0 GHz”;
* ECC Decision (13)01: “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”;
* ETSI EN 303 978: “Satellite Earth Stations and Systems (SES); Harmonized EN for Earth Stations on Mobile Platforms (ESOMP) transmitting towards satellites in geostationary orbit in the 27,5 GHz to 30,0 GHz frequency bands covering the essential requirements of article 3.2 of the R&TTE Directive”;
* ECC Report 217: The Use of Land and Maritime Earth Stations on Mobile Platforms Operating with NGSO FSS Satellite Systems in the Frequency Range 17.3-20.2 GHz, 27.5-29.1 GHz and 29.5-30.0 GHz;
* ECC Report 232: Compatibility between Fixed Satellite Service uncoordinated receive Earth Stations and the Fixed Service in the band 17.7-19.7 GHz;
* ECC Report 241: Enhanced access to spectrum for FSS uncoordinated earth stations in the 17.7-19.7 GHz band;
* Recommendation ITU-R RS.1449: “Feasibility of sharing between the FSS (space-to-Earth) and the Earth exploration-satellite (passive) and space research (passive) services in the band 18.6-18.8 GHz”;
* Recommendation ITU-R M.1643: “Technical and operational requirements for aircraft earth stations of aeronautical mobile-satellite service including those using fixed-satellite service network transponders in the band 14-14.5 GHz (Earth-to-space)”.

# Actions to be taken

To propose sharing studies and regulatory solutions

To develop ECP

# Relevant information from outside CEPT (examples of these are below)

## European Union (date of proposal)

## Regional telecommunication organisations

APT (July 2017)

Preliminary View

Taking into account Resolution 158 (WRC-15), APT Members support ITU-R studies for regulatory issues and conditions on sharing and compatibility between ESIM and existing services allocated in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz to ensure protection of, and not impose undue constraints on the existing services and their future development.

ATU (September 2017)

The APM19-2 agreed to:

1. Note that EACO study results support the identification of the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz to the different type of ESIM, under the condition that sharing and compatibility between the three types of ESIMs and existing FS services allocated in the bands are feasible (see Info Doc 8annex - EACO ESIMs studies on protection of FS Links).

2. Note that SADC sharing and compatibility studies with three different types of ESIMs operating with geostationary FSS networks and current and planned stations of the existing FS allocated in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz indicate the coexistence is possible (see Input 26annex - APM19-2 - Zimbabwe and Tanzania Coexistence Studies between ESIM and FS (v20June)).

3. Note that study results in Ghana and Senegal further support identification of the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz for operation of the three types of ESIMs to co-exist with FS links allocated in the two identified bands;

4. Note the need for compatibility studies with adjacent bands due to the fact that this band is adjacent to the band 24.25-27.5 GHz being studied for IMT;

5. Conclude that there is an increasing need for mobile-satellite broadband communications and given the studies conducted both in ITU-R WP4A and by the sub-regions and countries identification of the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz for ESIM operations can be supported whilst ensuring protection of, and not imposing undue constraints on, other existing primary services allocated in these frequency bands.

6. Conclude that each sub-region and countries having carried out the detail studies should submit their findings and report to the forthcoming meeting of WP4A as a sub-regional or country specific contribution.

Arab Group (20 April 2017)

The division of use ESIM stations in the frequency bands and 05/27 to 05/29 07/17 to 07/19 GHz to three main types:

* Stations on ships
* Stations on board aircraft
* Earth stations

Invite Arab states to study the impact of these uses on the radio services allocated in the frequency bands 27.5-29.5 and 17.7-19.7 GHz with respect to different types of ESIM stations.

Preliminary position in support of No change to the Radio Regulations for the frequency bands 19.7 - 17.7 GHz and 29.5 - 27.5 GHz with respect to ESIM usage.

CITEL (December 2017)

Preliminary Views

Canada

Canada supports studies under the terms of Resolution 158 (WRC-15). Studies are necessary to determine compatibility of ESIMs with services allocated in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz. Sharing and compatibility studies between ESIM and FSS networks should include consideration of both geostationary and non-geostationary satellite systems, including non-GSO MSS feeder links, to ensure their protection.

Brazil, United States of America

Support studies under the terms of Resolution 158 (WRC-15) on sharing and compatibility between ESIMs and current and planned stations of existing services allocated in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, while ensuring protection and not imposing undue constraints on these allocated services, and to take appropriate action based on the results of these studies.

Before identifying use of the frequency bands, or portions thereof, for ESIM operation, studies should address each operational type of earth stations in motion to include the appropriate technical and regulatory provisions necessary to ensure protection of existing and planned allocated services.

RCC (September 2017)

The RCC Administrations consider that technical conditions and regulatory provisions shall be developed with regard to operation of earth stations in motion (ESIMs) communicating with geostationary space stations in the fixed-satellite service and using frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) to provide protection, based on existing criteria, of services having allocations in these (and adjacent) frequency bands, including EESS (passive) in the frequency band 18.6-18.8 GHz and future use of EESS (Earth-to-space) in the frequency band 28.5-29.5 GHz and also use of terrestrial services in the frequency bands 25.25‑27.5 GHz and 27.5-29.5 GHz.

The RCC Administrations consider that the methods including segmentation of the frequency bands, limitation of ESIM maximum off-axis e.i.r.p. spectral density, and other methods or their combinations, should be considered as the methods for sharing frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) between ESIMs and GSO FSS stations and stations of other services having allocations in these frequency bands. ESIMs in the frequency bands 17.7-19.7 GHz shall not claim protection from fixed and mobile services.

The RCC Administrations consider that when developing technical conditions and regulatory provisions for operation of ESIMs in the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5‑29.5 GHz (Earth-to-space) special measures shall be envisaged to exclude unauthorized use of ESIMs in the territory of States that haven’t granted relevant authorizations (licenses).

Regulations applicable to ESIM, which would be defined under the issue 9.1.7 of WRC-19 agenda item 9.1, shall be taken into account when developing regulations within the frameworks of WRC‑19 agenda item 1.5.

## International organisations

IATA (date of proposal)

ICAO (July 2017)

No impact on aeronautical services has been identified from WRC-19 Agenda Items 1.5 which is therefore not addressed in ICAO’s position.

IMO (November 2017)

Action to be taken

Ensure ITU is aware that IMO supports the use of ESIMs for the provision of maritime broad band services and invite ITU to take appropriate action to ensure availability of the frequency bands 17.7 to 19.7 GHz in the downlink and 27.5 to 29.5 GHz in the uplink to be used for the provisioning of maritime satellite broadband services.

Draft IMO position

Support the study of this agenda item, recognizing the growing need for global broadband satellite communications in motion by the maritime community.

SFCG, ESA (June 2016)

The band 18.6-18.8 GHz is allocated to the Earth exploration-satellite service (passive) on a primary basis in all three Regions and to the space research service (passive) on a secondary basis in Regions 1 and 3 and on a primary basis in Region 2. The band 28.5-29.5 GHz is further allocated on a secondary basis to the Earth exploration-satellite service in the Earth-to-space direction.

SFCG does not oppose the use of the 17.7-19.7 GHz and 27.5-29.5 GHz bands by earth stations in motion as long as EESS operations in the 18.6-18.8 GHz and 28.5-29.5 GHz bands are not adversely affected.

WMO and EUMETNET (3rd March 2017)

No position declared

## Regional organisations

Eurocontrol (date of proposal)

## OTHER INTERNATIONAL AND REGIONAL ORGANISATIONS

EBU (date of proposal)

GSMA (date of proposal)

CRAF (December 2016, Updated 8th March 2017)

There are no RAS frequency allocations within or adjacent to the frequency bands considered for this agenda item. CRAF has no position on this agenda item.

NOC declared in update of 8th March 2017.

1. ECC Report 184 did not study the protection of the Mobile Service in the 27.5-29.5 GHz because no applications were identified at the time of its development. [↑](#footnote-ref-2)
2. According to ECO web site information by June 2016, 21 CEPT Administrations have implemented this decision. [↑](#footnote-ref-3)