

## Working Group FM

**Project Team FM44**  
**20<sup>th</sup> meeting**  
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**Subject: Draft new ECC Report on the use of Earth Stations on Mobile Platforms operating with GSO networks in the Ka-band**

Password protection required? (Y/N) \*

N

### Summary:

This document proposes revisions to the draft ECC Report on the use of Earth stations on mobile platforms (ESOMPs) operating with GSO networks in the frequency bands 17.3-20.2 GHz and 27.5-30 GHz.

The baseline document used is the version submitted to the correspondence group on 6 February, with all revision marks accepted. Some corrections to the formatting of the text have been made without being shown with revision marks.

The changes made in this contribution are draft and are offered to progress the work in FM44. Further work and discussions will be necessary in order to complete the report.

### Proposal

Some improvements to the text of the draft Report are proposed in this document. It is proposed that following discussion in FM44, this document should be sent to WGFM (meeting 23-27 April 2012) for comments.

Recognising the need for some of the technical studies to be completed, it is proposed that FM44 aims to complete this Report at its following meeting (13-15 June 2012), and transmit the Report for adoption by WGFM at its meeting in September 2012.

### Background

WGFM tasked FM44 with the development of a new Report related to the use of ESOMPs in Ka-band FSS networks. Work on the report has progressed in a correspondence group established by FM44.

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DRAFT



# ECC Report XXX

Draft Report on the use of [E](#)arth stations on mobile platforms operating with GSO [satellite](#) networks in the frequency bands 17.3-20.2 [GHz](#) and 27.5 – 30.0 GHz

**Month Year (Arial 9pt bold)**

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~~*[Editor's note: for each addition/modification proposed, the origin of the proposal is indicated at the end of the proposal, e.g. [administrations symbol, sector member. This draft version reflects proposals and comments made in contributions and within the correspondence groups, with a view to reflect issues raised and views provided. All those are for discussion at FM44, no conclusion has been drawn on any these elements.]*~~

## 0 EXECUTIVE SUMMARY

~~[Editor's note: This section to be inserted at the end of the drafting work, in light of the final content of the report.]~~

Earth stations on mobile platforms (ESOMPs) are planned to be operated in Ka-band FSS networks. This report examines the regulatory and technical issues surrounding such use with reference to similar developments in the C-band and Ku-band where mobile earth stations have operated in FSS networks for many years, under certain technical and regulatory conditions.

With the technical conditions recommended in this Report, ESOMPs may be treated in a similar fashion to uncoordinated FSS earth stations. This report recommends that ESOMPs should be authorised in the Ka-band frequencies already identified by CEPT administrations for the operation of uncoordinated FSS earth stations with the necessary technical conditions to ensure protection of other satellite and terrestrial services.

The report identifies certain technical, operational and regulatory requirements to be included in an ECC Decision on Ka-band ESOMPs. Such technical requirements are necessary to ensure, among other things, that ESOMP antennas maintain a high pointing accuracy and do not cause interference to other satellite networks. Furthermore, in some cases - for example where one country has authorised a particular band for uncoordinated FSS earth stations and another has authorised the same band for fixed service networks - cross-border interference issues could occur. To address those issues for maritime ESOMPs, a pfd threshold applicable to the coastline of some administrations is necessary. Moreover, to address the same issues for aircraft ESOMPs, a pfd threshold at the ground applicable to the territory of a country operating fixed or mobile systems is needed.

In the downlink FSS bands (17.3-20.2 GHz), ESOMPs would receive the same protection from interference as uncoordinated FSS earth stations. In some instances, this means ESOMPs operate on a non-protected basis.

This report recommends that the new ECC Decision on ESOMPs applies the necessary technical and operational requirements for ESOMPs to ensure no harmful interference is caused to other services and systems. The new ECC Decision should require the exemption of individual licensing for ESOMPs to allow the free circulation of ESOMP terminals.

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## LIST OF ABBREVIATIONS

<b>Abbreviation</b>	<b>Explanation</b>
<b><u>AES</u></b>	<u>Aircraft earth station</u>
<b><u>AMSS</u></b>	<u>Aeronautical mobile-satellite service</u>
<b>CEPT</b>	European Conference of Postal and Telecommunications Administrations
<b><u>CPM</u></b>	<u>Conference preparatory meeting (ITU)</u>
<b>ECC</b>	Electronic Communications Committee
<b><u>ESOMP</u></b>	<u>Earth station on mobile platform</u>
<b><u>ESV</u></b>	<u>Earth station on board vessel</u>
<b><u>ETSI</u></b>	<u>European Telecommunications Standards Institute</u>
<b><u>FS</u></b>	<u>Fixed service</u>
<b><u>FSS</u></b>	<u>Fixed-satellite service</u>
<b><u>GSO</u></b>	<u>Geostationary satellite orbit</u>
<b><u>G/T</u></b>	<u>Gain to noise temperature ratio (of a receiving earth station)</u>
<b><u>HEST</u></b>	<u>High e.i.r.p. satellite terminals</u>
<b><u>HDFSS</u></b>	<u>High-density applications in the fixed-satelliteservice</u>
<b><u>LEST</u></b>	<u>Low e.i.r.p. satellite terminals</u>
<b><u>MS</u></b>	<u>Mobile service</u>
<b><u>MSS</u></b>	<u>Mobile-satellite service</u>
<b><u>NCMC</u></b>	<u>Network control and monitoring centre</u>
<b><u>R&amp;TTE</u></b>	<u>Radio equipment and telecommunications terminal equipment</u>
<b><u>VSAT</u></b>	<u>Very small aperture terminal</u>
<b>&lt;abbr&gt;</b>	<b>&lt;explanation — edit the table as necessary&gt;</b>

**1 INTRODUCTION**

Recently there has been an increase in the use of fixed satellite service networks by Eearth stations mounted on mobile platforms (ESOMPs) to provide telecommunications services to aircraft, ships, trains and other vehicles using both the C- and Ku-band. As the

demand for these systems evolves, service providers are turning to other FSS bands, in particular Ka-band, to meet this growing need.

Advances in satellite antenna technology, particularly the development of ~~3-axis~~-stabilized antennas capable of maintaining a high degree of pointing accuracy even on rapidly moving platforms, have already allowed the development of mobile ~~e~~Earth stations with very stable pointing characteristics. The pointing accuracy performance of systems currently either in production or under development for use in Ka-band is equal to or better than that currently achieved by Ku-band platforms. These mobile ~~E~~earth stations are designed to operate in the same interference environment and comply with same regulatory constraints as typical uncoordinated FSS ~~e~~Earth stations.

WRC-03 adopted technical, operational and regulatory provisions for aeronautical mobile satellite service (AMSS) systems and ~~e~~Earth stations on-board vessels (ESVs) to allow these systems to operate in FSS frequencies in the C- and Ku-bands. Since 2003, numerous networks have been operating successfully under these provisions.

The ~~e~~Earth stations on mobile platforms for GSO systems contemplated for the Ka-band are similar to those contemplated in the C- and Ku-bands.

This report examines the requirements for ESOMPs in the Ka-band frequencies, and recommends a regulatory approach which could be adopted by the CEPT. The technical requirements which would need to be included in an appropriate ECC Decision for Ka-band ESOMPs are identified.

This ECC Report covers ESOMPs operating with GSO networks in the Ka-band (17.3-20.2 GHz ~~and~~; 27.5-30 GHz). ESOMPs operating with ~~NGSO non-geostationary~~ FSS networks are out of scope of this Report.

## **2 NEED FOR ACCESS BY GSO ESOMPS TO PORTIONS OF THE BANDS 27.5-30.0 GHZ AND 17.3-20.2 GHZ**

ECC Report 152 on the use of the frequency bands 27.5-30.0 GHz and 17.3-20.2 GHz by satellite networks identified a number of reasons, listed below, why some satellite operators and service providers are moving from Ku-band to Ka-band. In fact, some of the reasons, such as the ability to use smaller user terminals, are particularly relevant to the mobile markets served by ESOMPs, where the size and weight of the user antenna are critical considerations.

- Great spectrum efficiency due to the use of narrow spot beams;
- Better individual coverage and higher gain compared to lower frequency bands;
- Smaller user terminal size due to higher satellite EIRP and G/T;
- Improved spectrum efficiency;
- Higher system capacity;
- Greater amount of spectrum available for FSS systems.

Users of ESOMPs on mobile platforms such as aircraft, ships, trains and other vehicles often have no other alternative for broadband access besides satellites. In Europe, for example, while studies are underway to identify spectrum for broadband ~~A~~air-to-Ggground communications, no such spectrum currently is available to the aeronautical community. Similarly, ships, even those in inland waterways are often beyond the reach of terrestrial wireless networks.

As described in CEPT ECC Report 152, Ka-band ~~GEO-geostationary~~ FSS systems are now in operation in Europe. The vast majority of these Ka-band FSS systems operate their user-links (i.e. to/from Ka-band ~~SITs/SUTs/LESTs/HESTs~~) within the 29.5 – 30.0 GHz / 19.7 – 20.2 GHz bands. Ka-band ~~GEO-geostationary~~ satellite systems<sup>1</sup> are intended to support the realisation of the EU Digital Agenda 2013 and 2020 objectives for broadband provision to EU customers and so take part to the realisation of EU policy objectives.

There is a significant requirement for additional Ka-band FSS satellite capacity (i.e. ~~Ka-band~~ satellite systems operating in the above ~~2x-X-500~~ MHz frequency bands) to be deployed over Europe to support FSS type applications.

~~[this sentence has been move to a more appropriate place below, under section 3.3]~~

### 3 REGULATORY FRAMEWORK FOR ESOMPS

#### 3.1 ITU-R

##### 3.1.1 WRC-03 Decisions on AMSS operating in the 14.0-14.5 GHz band

Extensive work was carried out by ITU-R study groups prior to WRC-03 under Resolution 216 (Rev.WRC-2000), which invited the ITU-R:

“to complete, in time for WRC-03, the technical and operational studies on the feasibility of sharing of the band 14.0-14.5 GHz between the services referred to in considering c) [above] and the aeronautical mobile-satellite service, with the latter service on a secondary basis.”

Working Party 4A carried out technical studies which identified several essential requirements that an AMSS system should meet in order to protect FSS. In the case where an AMSS system was implemented within FSS assignments, the ITU-R concluded that the interference levels reaching GSO satellites must at all times be no more than the levels agreed to in coordination. These agreed levels are based on stable antenna platforms with well-defined antenna patterns and aggregate levels that are not to be exceeded. To achieve this goal, the ITU-R identified several requirements that should be placed on AMSS systems to protect FSS:

- Aggregation of off-axis power from multiple aircraft where applicable, for example in systems using spread spectrum multiple access;
- Antenna gain pattern;

<sup>1</sup>Such as Avanti’s HYLAS-1 and Eutelsat’s KA-SAT satellite systems.

- Antenna capture by adjacent satellites;
- Input power to the antenna;
- Antenna mispointing.

These factors formed the basis of a Recommendation on use of this band by AMSS and these were adopted as part of Recommendation ITU-R M.1643. The CPM Report to WRC-03 concluded that sharing with the FSS was possible in the 14.0-14.5 GHz frequency band, “provided aggregate co-frequency AES emissions in the direction of adjacent satellites are limited to levels that are equal to or less than the levels that have been accepted by other satellite networks.”<sup>2</sup>

Because several administrations have implemented Fixed Service (FS) networks in the 14.0-14.5 GHz band, studies were also carried out within former WP-8D to examine the feasibility of sharing between AMSS and the FS. Recommendation ITU-R M.1643 adopted a pfd mask to protect FS networks in the 14.0-14.5 GHz band. In practice, sharing between AMSS and FS networks operating in the 14.0-14.5 GHz band has proven to be more difficult when the services are operating in the same geographic area.

### 3.1.2 WRC-03 Decisions on ESVs operating at C-Band and Ku-Band

In the case of eEarth Stations on board Vessels (ESVs), WP-4-9S was the lead working party for studies. Unlike AMSS, ESVs were treated from the start as operating in the FSS. The CPM Report to WRC-03 concluded that ESVs could protect other FSS networks so long as they complied with the off-axis e.i.r.p. limits given in Recommendation ITU-R S.524. WRC-03 added a new footnote in Article 5 to clarify that ESVs should be treated as FSS:

“**5.457A** In the bands 5 925-6 425 MHz and 14.0-14.5 GHz, earth stations located on board vessels may communicate with space stations of the fixed-satellite service. Such use shall be in accordance with Resolution 902 (WRC-03).”

WRC-03 adopted Resolution 902 (WRC-03), which included technical and operational constraints to avoid interference from ESVs into FS-terrestrial networks.

### 3.1.3 WRC-03 Decisions on HDFSS

WRC-03 adopted Resolution 143 (Rev.WRC-07) “Guidelines for the implementation of high-density applications in the fixed-satellite service in frequency bands identified for these applications”. As described by Resolution 143, “HDFSS are characterized by flexible, rapid and ubiquitous deployment of large numbers of cost-optimized earth stations employing small antennas and having common technical characteristics.”

Resolution 143 recognizes “that co-frequency sharing between transmitting HDFSS earth stations and terrestrial services is difficult in the same geographical area” and that administrations implementing HDFSS should take into account “that HDFSS deployment will be simplified in bands that are not shared with terrestrial services.”

<sup>2</sup>Report to the 2003 World Radiocommunication Conference (WRC-03) at 2.4.2.

WRC-03 adopted a footnote which identified bands for use by HDFSS:

“**5.516B** the following bands are identified for use by high-density applications in the fixed-satellite service:

17.3-17.7 GHz (space-to-Earth) in Region 1,  
 18.3-19.3 GHz (space-to-Earth) in Region 2,  
 19.7-20.2 GHz (space-to-Earth) in all Regions,  
 39.5-40 GHz (space-to-Earth) in Region 1,  
 40-40.5 GHz (space-to-Earth) in all Regions,  
 40.5-42 GHz (space-to-Earth) in Region 2,  
 47.5-47.9 GHz (space-to-Earth) in Region 1,  
 48.2-48.54 GHz (space-to-Earth) in Region 1,  
 49.44-50.2 GHz (space-to-Earth) in Region 1,

and

27.5-27.82 GHz (Earth-to-space) in Region 1,  
 28.35-28.45 GHz (Earth-to-space) in Region 2,  
 28.45-28.94 GHz (Earth-to-space) in all Regions,  
 28.94-29.1 GHz (Earth-to-space) in Region 2 and 3,  
 29.25-29.46 GHz (Earth-to-space) in Region 2,  
 29.46-30 GHz (Earth-to-space) in all Regions,  
 48.2-50.2 GHz (Earth-to-space) in Region 2.

This identification does not preclude the use of these bands by other fixed-satellite service applications or by other services to which these bands are allocated on a co-primary basis and does not establish priority in these Radio Regulations among users of the bands. Administrations should take this into account when considering regulatory provisions in relation to these bands. See Resolution 143 (WRC-03).”

#### **3.1.4 Study Group 4 Work on Ka-band ESOMPs**

ITU-R SG-4 at its meeting on 29–30 Sep 2011 in Geneva adopted a draft new Report ITU-R S.2223. This Report identifies the technical and operational requirements for the operation of ESOMPs in Ka-band FSS networks.

*[Inmarsat comment: this text was originally Section 8 of the Report. We suggest replacing it here.]*

## 3.2 CEPT

### 3.2.1 CEPT Regulatory Framework for HDFSS

As a result of the WRC-03 identification of bands for HDFSS, the ECC Decision (00)09 was replaced by ECC/DEC/(05)01 which implements a band plan in the 27.5-29.5 GHz that segmented the band between FS and FSS. In addition, the ECC adopted ECC/DEC/(05)08 which makes available for HDFSS deployment subject to market demand the following bands:

- 17.3-17.7 GHz and 19.7-20.2 GHz bands (space-to-Earth)
- 29.5-30.0 GHz band (Earth-to-space).

ECC/DEC(06)02 and ECC/DEC(06)03 were also developed, providing exemption from individual licensing of Low ~~EIRP~~ e.i.r.p. Satellite Terminals (LESTs) and High ~~e.i.r.p.~~ EIRP Satellite Terminals (HESTs). The exemption requires the terminals to have an e.i.r.p. ~~EIRP~~ not exceeding 34 dBW for LESTs and 50-60 dBW for HESTs.

The LEST and HEST Decisions do not contain specific off-axis e.i.r.p. ~~EIRP~~ limits. Instead, they require compliance with EN 301 459 or EN 301 428 or equivalent technical specifications. These standards contain requirements and test methods for ensuring compliance with the off-axis e.i.r.p. ~~EIRP~~ limits contained in Recommendation ITU-R S.524.

~~[Reason for deleting: this para was repeating a concept better explained above]~~ By a Decision taken on 18 March 2005 (ECC/DEC/(05)01), the CEPT administrations, in conjunction with industry, decided to “segment” the frequency band 27.5-29.5 GHz between FS and FSS (uncoordinated FSS earth stations). The frequency bands 27.5-27.8285 GHz, 28.4445-28.8365 GHz and 29.4525-29.5 GHz are designated for the use of uncoordinated FSS earth stations (including transportable terminals). This represents 768 MHz for uncoordinated FSS earth stations: one block of 328.5 MHz, one block of 392 MHz and one block of 47.5 MHz.

The frequency band 28.8365-28.9485 GHz is designated for the use of uncoordinated FSS earth stations without prejudice to the FS systems licensed in this band in some countries before the date of adoption of this Decision. This represents an additional 112 MHz within which no new FS stations can be deployed except in countries which make use of Decides 2) and 4) of ECC/DEC/(05)01.

So far, As of February 2012, this Decision has been declared as having been implemented by 23 CEPT administrations (4 *Not Implemented*, 5 *Implementation Under Study*, 16 *No Information*). Given the transnational nature of satellite services, these satellite systems cannot be deployed in CEPT unless a major part of the CEPT administrations implement ECC/DEC/(05)01.

### **3.2.1 CEPT Regulatory Framework for AESs and ESVs**

Under established international law, national sovereignty over radio spectrum resources extends above the national territory up to the limits of the atmosphere. Any aeronautical eEarth station operating over the territory of a country must therefore be duly authorized by that country. Under maritime law, national sovereignty extends out 12 nautical miles

from the low-water mark of the coast. Similarly, any [eEarth](#) stations on vessels operating in territorial waters must also be duly authorized.

Three ECC Decisions were adopted following WRC-03 to allow for the free circulation of aircraft [Eearth](#) stations and ESVs. ECC/DEC/(05)09 and ECC/DEC/(05)10 were adopted for C- and Ku-bands ESVs while ECC/DEC/(05)11 was adopted for Ku-band aircraft [eEarth](#) stations (AESs).

All three ECC Decisions adopted technical, operational and regulatory requirements that ensured that the ESVs and AESs had the same interference characteristics as a typical uncoordinated FSS [Eearth](#) station. Since the adoption of these ECC Decisions, hundreds of ESVs and AESs have operated successfully in European waters and airspace. Similar conditions could be adopted and applied to the terminals operating on mobile platforms in the parts of the Ka-band identified for uncoordinated FSS operations.

### 3.2.2 Applicability of Previous Frameworks to ESOMPs in Ka-band

The previous frameworks adopted for [AESs and ESVs in C- and Ka-band](#) only apply to GSO FSS.

ESOMPs for GSO systems operating in the Ka-band present a sharing environment similar to that found in the 14.0-14.5 GHz band for AMSS, ESV and VSAT networks. Each of these types of networks is characterized by large numbers of small, technically identical [Eearth](#) stations which are not coordinated on an individual basis.

Earth stations on mobile platforms are also similar to AMSS, ESV and VSAT networks in that sharing between such [Eearth](#) stations and co-frequency FS networks which are located in the same geographic area is difficult for the three types of [Eearth](#) stations because they could be located anywhere within the operational area of such an FS network.

Technical, operational and regulatory requirements have been adopted within the ITU-R to ensure that the ESVs and AESs operating between 14.0 [GHz](#) and 14.5 GHz have the same interference characteristics as typical FSS [eEarth](#) stations. Regulators have ensured that Ku-band ESVs and AESs operate only in bands which have no use or limited use by terrestrial services. Since the adoption of these regulations, hundreds of AESs and ESVs have operated successfully worldwide on aircraft and ships.

Taking into account the success of the previous ECC Decisions, a similar regulatory framework could be adopted in the Ka-band. The suggested Ka-band frequencies within which ESOMPs may operate are those identified for uncoordinated FSS earth stations, such as those identified in ECC Decision ECC/DEC/(05)01 and ECC/DEC(05)08, thereby limiting potential interference to terrestrial services only to some instances of cross-border interference. Any technical requirements needed to prevent the risk of unacceptable interference to other services should be developed to ensure that [terminals operating on mobile platforms ESOMPs operating](#) in the Ka-band [frequencies](#) identified for uncoordinated FSS operations have the equivalent interference characteristics as typical uncoordinated FSS [eEarth](#) stations and do not cause unacceptable interference to any terrestrial services operating in the same bands.

~~Instead of defining new regulatory provisions specifically for aeronautical and maritime Earth stations operating in the Ka-band, new and more general provisions could be developed defining the conditions under which ESOMPs could be treated as typical uncoordinated FSS Earth stations. Such provisions could cover all types of Ka-band ESOMPs, i.e. land, maritime and aeronautical. These Earth stations would then be required to follow defined regulatory and technical requirements including compliance with relevant ETSI standards. [reason for deletion: the same issue is discussed in section 7]~~

Any regulatory framework adopted in these bands to accommodate ESOMPs should ~~in any case~~ also ensure that it does not prejudice the use of these bands by other FSS and terrestrial applications.

~~[Inmarsat comment: this sentence has been moved three paras up and merged to the existing text]~~

~~[Inmarsat comment: Figure 1 has been included in Section 7.1]~~

#### 4 CONSIDERATIONS ABOUT THE OPERATION OF ESOMPs IN FSS NETWORKS

~~[OR 4.1 COULD BE A SECTION AS SUCH (SECTION 4) AS THERE IS AN EXPLICIT REQUIREMENT FROM WGFm TO JUSTIFY WHY ESOMP OPERATE UNDER FSS AND NOT MSS. THEN, THE TECHNICAL REQUIREMENTS WOULD BE ANOTHER DISTINCT SECTION (SECTION 5) FOLLOWED BY A SECTION (SECTION 6) ON THE RESULTS OF THE TECHNICAL STUDIES FROM SE40 AND BY ANOTHER ONE (SECTION 7) MAKING REGULATORY PROPOSALS] [INMARSAT COMMENT: THE STRUCTURE SUGGESTED BY BENOIST HAS BEEN APPLIED]~~

In considering what regulatory provisions should be adopted for ESOMPs, several options were available. One option was to treat ESOMPs as an application in the Mobile Satellite Service (MSS), which would need a new MSS allocation in the FSS band(s). Another was to change the definition of FSS to include service to mobile platforms. A third option, which has been finally endorsed, was to treat ESOMPs as an application in the FSS. ~~Section 6.1 contains a description of a new ECC Decision that would be needed to implement this option.~~

ESOMPs represent one of many examples of service convergence that CEPT administrations are confronting. In the past, any eEarth station that moved while transmitting was considered to be part of the Mobile Satellite Service (MSS). Historically, there were significant technical differences between the MSS and FSS. MSS antennas were often non-directional, making co-frequency sharing with other MSS systems difficult. MSS systems operated in distinct bands that were much lower in frequency than FSS systems. Changes in technology have allowed ESOMPs to operate in bands allocated to the FSS.

The issue of convergence is a serious matter for CEPT administrations to consider since it is raised both in satellite and terrestrial services. The approach adopted by the ECC for ESOMPs should be neutral to both existing and new users. The ECC should also strive to the extent possible to adopt a consistent approach both for satellite and terrestrial services.

Regarding the [service](#) classification of ESOMPs, several considerations should be taken into account:

- ESOMPs are assumed to be designed and operated in compliance with the existing rules for FSS. No rules (such as off-axis EIRP limits) exist for MSS in bands above 17 GHz, making implementation as MSS problematic;
- Requiring compliance with existing FSS rules provides FSS operators with certainty that existing systems will be protected;
- ~~*[Reasons for deletion: the only way through which an operator already owning an FSS assignment would be favoured would be in the case that some potential ESOMPs operators have designed their system only to operate in the 100 MHz spectrum allocated to MSS. We don't think there is any basis to believe this scenario has occurred. In fact most planned ESOMP operators will also provide conventional FSS services in the same network. Furthermore, the group has already agreed that ESOMPs shall be treated as FSS.]*~~ While MSS allocations exist in the bands above 17 GHz, the majority of these are secondary allocations or reserved for non-civilian applications. In Region 1 / Europe ~~2x~~ 100 MHz of co-primary spectrum for MSS is available at 29.9 – 30.0 GHz / 20.1 – 20.2 GHz. These allocations are not considered adequate by ESOMP system operators for four reasons: 1) if ESOMP networks were required to operate only in the ~~2x~~100 MHz allocated to the MSS on a co-primary basis with the FSS, the result would in any case be that they should coordinate with existing and future FSS networks, leading to the same technical constraints as if they were treated as FSS. Hence, there is no benefit to other services or systems by operating ESOMPs in a smaller frequency band; 2) the key-feature of the systems that are planned to be launched soon is that they will be capable of offering to European citizens travelling on mobile platforms connectivity and network performance similar to those they can experience with terrestrial wired and wireless solutions, where data rates of up to 100 Mbit/s are planned. If only ~~2x~~100 MHz were available, allowing for the need to assign different frequencies in adjacent beams, only a few 10s of MHz could be made available in each beam, shared among multiple users within it. To allow data rates comparable to terrestrial systems in a satellite system, with sufficient users to support the business case for a satellite network, at least ~~2x~~500 MHz of available spectrum, would be required. 3) The capital and operating costs of an ESOMP network operating in ~~2x~~100 MHz would be similar to those for an ESOMP network operating in, for example, ~~2x~~500 MHz. However the capacity of the system (in terms of number of users of comparable data requirements) is increased five-fold. Hence, the cost of the service to end users is significantly lowered if the system can operate in a larger frequency band, benefiting both the operator and the end users. 4) All systems currently planning to provide ESOMP services in Europe would be capable of operating at least in ~~2x~~500 MHz spectrum.
- Treating ESOMPs as FSS provides ESOMP operators and regulators with a well-established and proven set of rules for authorizing these [eEarth](#) stations.
- GSO ESOMPs must comply with same off-axis EIRP limits as typical uncoordinated FSS [Eearth](#) stations
- In many planned networks, ESOMPs will operate on the same networks and frequencies as stationary [Eearth](#) stations. If ESOMPs are classified as MSS and stationary [Eearth](#) stations are classified as FSS, there may be situations where

terminals using the same network and frequencies must comply with different rules simply because one type is in motion and the other is not.

Therefore, so long as GSO ESOMPs on an aggregate basis per GSO network are designed and operated in compliance with the same requirements (such as off-axis EIRP limits) placed on uncoordinated FSS eEarth stations, no sharing issues exist between ESOMPs and other FSS networks. Within the CEPT framework, this means that ESOMPs may be treated as typical uncoordinated FSS eEarth stations and operate in bands available to them.

## 5 TECHNICAL CONSIDERATIONS ON ESOMPS

### 5.1 SHARING WITH FS - DIFFERENCE BETWEEN TYPICAL UNCOORDINATED FSS EARTH STATIONS AND ESOMPS

As a general consideration, it should be noticed that the work done within both the ITU-R and CEPT has shown that co-frequency sharing between uncoordinated FSS eEarth stations and terrestrial networks in the same geographic area is difficult to accomplish. The same conclusion holds true for ESOMPs. Since implementation of ESOMPs is only contemplated in bands where uncoordinated FSS eEarth stations are allowed, however, ESOMPs should not represent any increased interference risk to FS or mobile service (MS) networks beyond that presented by uncoordinated FSS eEarth stations. If administrations conclude that implementation of uncoordinated FSS eEarth stations is permissible in a band, introduction of GSO ESOMPs in the same band should not raise any additional interference concern to FS or MS networks.

There is the possibility that neighbouring countries could implement different allocations in the 27.5-29.5 GHz and 17.3-19.7 GHz bands either to uncoordinated FSS or to FS applications. The aim of this section is therefore to address any sharing issue that could arise from such a scenario.

#### 5.1.1 ESOMPS INSTALLED ON ~~MARITIME AND~~ LAND PLATFORMS

ESOMPs installed on ~~maritime~~ or land platforms do not differ substantially from typical uncoordinated stationary FSS stations. It should be noticed that Recommendation ITU-R SF.1707 already provides methods and means to facilitate the implementation of large numbers of eEarth stations operating in the fixed-satellite service (FSS) in areas where terrestrial services are also deployed. This Recommendation could therefore be considered a basis for coordination procedures between neighbouring administrations implementing different allocations in this band.

Section 7 of this document provides an overview of a possible approach for resolving cross-border coordination requirements.

#### 5.1.2 ESOMPS INSTALLED ON MARITIME PLATFORMS

ESOMPs on vessels or other mobile maritime platforms have the potential to cause interference to any FS or MS applications deployed in parts of the band 27.5-29.5 GHz. FS or MS systems operating near the coast could receive interference from a maritime ESOMP, which could be operating in the territorial waters of another administration, or in

non territorial waters (i.e. beyond 12nm from the low-water mark of the concerned administration).

A pfd threshold combined with a suitable mandatory automatic mechanism to regulate the ESOMP power, at a given position, could be developed that would apply to the coast of a country and would provide adequate protection to FS or MS systems deployed. The pfd threshold could be exceeded only if the concerned administration agreed. The ESOMP would be able to take into account its actual antenna gain pattern, its pointing and transmitter power to comply with the pfd threshold.

The actual frequency ranges used by administrations for FS applications would need to be identified and made available to the operators of maritime ESOMPs so that any pfd restrictions are applied only on the necessary frequencies.

[This section will need to be updated to reflect the conclusions of the SE40 studies on maritime use, and the practical means to ensure compliance with the pfd thresholds]

### 5.1.23 AIRCRAFT-MOUNTED ESOMPS

ESOMPs installed on aircrafts should be treated differently, because of the particular geometrical scenario in which they operate. Actually, since the eEarth station is normally not operating on the ground, but at a higher altitude<sup>3</sup>, the same cross-border sharing considerations as for other types of eEarth stations cannot be applied to aircraft-mounted terminals.

[There are currently ongoing studies addressing this matter and provisional results seem to indicate that in the worst case scenario, and when considering FS stations with characteristics reflecting real deployed networks, aircraft-mounted ESOMPs operating at an altitude higher than a certain limit do not cause and do not suffer from any harmful interference, either when the aircraft is flying near or over a country which has allowed the deployment of FS networks operating in the same band.

It should also be noticed that when the ESOMP terminal is operating with the maximum allowed e.i.r.p., that the provisional pfd threshold is met well down to a certain aircraft altitude, well below that of the cruise phase of a typical flight/aircraft cruise altitude; therefore, the provisional results suggest that interference may occur only during the take-off and landing phases of a flight.

A possible cross-border coordination approach covering this type of ESOMPs is then discussed in Section 7 of this document.]

*[Comment: this section will need to be revised to reflect the conclusions of the studies in SE40 on aircraft-mounted ESOMPs]*

<sup>3</sup> In the case where administrations may also choose to allow operation of aircraft mounted ESOMPs on the ground at airports, the cross-border sharing issues would be the same as with other eEarth stations.

## 5.2 ETSI STANDARDS

Under the R&TTE Directive, all radio equipment placed on the market in the EU must meet the essential requirements defined in the Directive. In most cases, the requirements are met by compliance with the relevant ETSI harmonised standard. Compliance with ETSI standards is also an essential element of the licensing regimes in CEPT countries.

The specific ETSI standard with which ESOMPs must comply with will need to be developed and be noted in any ECC Decision adopted for ESOMPs. ETSI has been tasked with developing a new standard (draft EN 303 978) for ESOMPs operating in the bands between 17.3 and 30 GHz.

## 5.3 OTHER TECHNICAL REQUIREMENTS FOR KA-BAND ESOMPS

~~Especially, inter alia, t~~To address potential interference with other co-frequency GSO FSS networks, ESOMPs should comply with the same constraints, such as off-axis EIRP limits, as other FSS earth stations. Such limits would be determined by both the inter-system satellite coordination agreements and the limits in the ETSI standard. In considering aggregate interference levels, it should be noted that there is no evidence that FSS systems supporting ESOMPs will have more spot beams or better frequency reuse than other FSS systems, so by applying existing FSS rules at least the same level of protection will be provided to neighbouring satellite networks as is currently the case. These requirements will ensure that such earth stations are essentially equivalent to stationary FSS earth stations from the perspective of potential uplink interference to other satellite networks.

The level of protection provided to ESOMPs from other satellite networks will be determined through coordination among the concerned administrations/satellite operators following the same rules and processes as those applicable to all FSS networks. ESOMP terminals will be protected to the same extent as FSS earth stations included in the inter-system coordination. As there are no limitations on antenna sizes or patterns in these bands for FSS today, there is also no need to define any such additional requirements for ESOMPs.

Realizing that earth stations on mobile platforms operate in a dynamic environment, it is important to address this aspect in specifying an essential set of technical and operational requirements. The design, coordination and operation of earth stations on mobile platforms should be such that, in addition to the static requirements discussed above, the interference levels generated by such earth stations account for the following factors:

- Mispointing of the earth station antenna. Where applicable, this includes, at least, motion-induced antenna pointing errors, effects caused by bias and latency of their pointing systems, tracking error of open or closed loop tracking systems, misalignment between transmit and receive apertures for systems that use separate apertures, and misalignment between transmit and receive feeds for systems that use combined apertures
- Variations in the antenna pattern of the earth station antenna. Where applicable, this includes, at least, effects caused by manufacturing tolerances, ageing of the antenna and environmental effects. Networks using certain types of antennas, such

as phased arrays, should account for variation in antenna pattern with scan angles (elevation and azimuth). Networks using phased arrays should also account for element phase error, amplitude error and failure rate.

- Variations in the transmit e.i.r.p. from the earth station. Where applicable, this includes, at least, effects caused by measurement error, control error and latency for closed loop power control systems, and motion-induced antenna pointing errors.

Earth stations on mobile platforms that use closed loop tracking of the satellite signal need to employ an algorithm that is resistant to capturing and tracking adjacent satellite signals. Such earth stations must be designed and operated such that they immediately inhibit transmission when they detect that unintended satellite tracking has occurred or is about to occur. Such earth stations must also immediately inhibit transmission when their mispointing would result in off-axis e.i.r.p. levels in the direction of neighbouring satellite networks above those of other specific and/or typical FSS earth stations operating in compliance with Recommendation ITU-R S.524-9 or with any other limits coordinated with neighbouring satellite networks. These earth stations also need to be self-monitoring and, should ~~a~~ harmful interference to FSS networks be detected, must automatically mute any transmissions.

In addition to these autonomous capabilities, earth stations on mobile platforms will need ~~should~~ to be subject to the monitoring and control by a Network Control and Monitoring Center (NMC) or equivalent facility and these earth stations should be able to receive at least “enable transmission” and “disable transmission” commands from the NMC. It ~~should~~ will need to be possible for the NMC to monitor the operation of the earth station to determine if it is malfunctioning.

Earth stations affixed to mobile platforms that comply with these requirements will not create unacceptable levels of interference to other FSS systems and terminals operating in the same bands or sub-bands. It is assumed that any ESOMP operating in the territory of a CEPT administration will have to comply with any relevant CEPT requirements, e.g. a new ECC Decision. Any use of non-compliant equipment would be unlawful and subject to national enforcement provisions and sanctions.

The level of protection provided to ESOMPs from other satellite networks will be determined through coordination among the concerned administrations/satellite operators following the same rules and processes as those applicable to all FSS networks. ESOMP terminals will be protected to the same extent as FSS ~~E~~ earth stations included in the inter-system coordination. As there are no limitations on antenna sizes or on the patterns in these bands for FSS today, there is no need to define such requirements for ESOMPs.

When considering the level of protection provided to other satellite networks from ESOMPs, technical requirements should adequately be defined in order to avoid that poorly pointed or poorly controlled Ka-band terminals (whether fixed or mobile) would cause unacceptable interference to adjacent Ka-band GEO FSS satellites and so prejudice the provision of Ka-band FSS services to European customers. Furthermore, the use of low-gain antennae and their potential impact on other satellite networks should not be an issue, since any terminal, in order to be able to operate, shall be compliant with the relevant Harmonised ETSI Standard which will include an off-axis EIRP limit and the other Recommendations and coordination requirements applicable to FSS networks.

## 6 SUMMARY OF THE RESULTS OF THE SHARING STUDIES BETWEEN ESOMPS AND OTHER SERVICES OPERATING IN THE KA-BAND.

*[Comment: this section will need to be revised to reflect the conclusions of the studies in SE40 on aircraft-mounted ESOMPs]*

## 7 REGULATORY FRAMEWORK NEEDED TO TREAT AND OPERATE ESOMPS AS FSS IN THE BANDS 27.5-30.0 GHZ AND 17.3-20.2 GHZ

~~*[Inmarsat comment: based on Benoit's suggestion, this Section doesn't need to be replaced anymore, since it represents the regulatory proposal to allow ESOMPs to operate as FSS in the Ka-Band]*~~

~~*[Inmarsat comment: this para has been merged with the text in Section 4 above]*~~ ~~*[Inmarsat comment: this para has been merged with the text in Section 4 above]*~~ ~~*[Inmarsat comment: this para has been merged with the text in Section 4 above, with an additional edit]*~~

~~*[Inmarsat comment: the para that was here has been moved to the Conclusion, with some additional edits]*~~

~~*[Discussions within drafting group stopped here.]*~~

~~*[Sections 5.1 and 5.2 are not relevant in this ECC Report as it as already been endorsed that ESOMP can operate under FSS allocation. This section should describe the regulatory framework that is necessary both to allow development of ESOMP and protection of existing/other users.][Inmarsat comment: Sections 5.1 and 5.2 are suggested to be deleted, then]*~~

Under ~~this~~ the recommended approach, a new ECC Decision would be developed to authorise the use of ESOMPs in the Ka-band frequencies, without any change to the Radio Regulations. The Decision would ~~allow~~ provide a framework for ESOMPs to operate in FSS networks and would establish technical and regulatory requirements. While, for ESOMPs terminals installed on land, authorisation is managed by the single administrations, in the case of ESOMPs on maritime platforms, a process based on mutual recognition of licences and free circulation may be considered. When they are operated under certain technical conditions, the same regime could also apply to ESOMPs installed on aeronautical platforms. ~~The following~~ Figure 1 outlines the process through which a new ECC Decision (and ETSI Standard) could be used for authorising ESOMPs to operate in those parts of the Ka-band allocated to uncoordinated FSS ~~e~~Earth Stations.

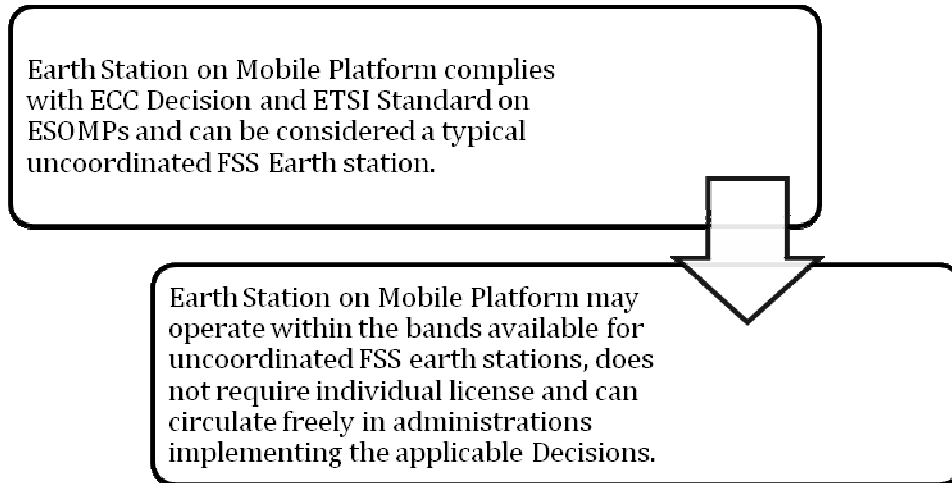


Figure 1: Proposed treatment of ESOMPs in CEPT

The prior ECC Decisions on AESs and ESVs, as well as the ITU-R Resolutions and Recommendations on which they are based, provide a basis for developing the requirements for inclusion in such a new Decision. The following table summarizes the requirements from these Decisions, Resolutions and Recommendations that may be used for developing criteria for determining whether a mobile platform communicating with an FSS network may be treated as a typical uncoordinated FSS Eearth station.

**Table 1: Requirements for C-band and Ku-band ESOMPs to be considered for inclusion in new Regulations on Ka-band ESOMPs**

*[Inmarsat comment: the table below had lost its formatting, so is restored below, without showing revision marks]*

Requirement	Source
[The network] must operate under the control of a network control facility.	Recommendation ITU-R M.1643
[The network] should be coordinated and operated in such a manner that the aggregate off-axis e.i.r.p. levels produced by all co-frequency [Earth stations] within the network are no greater than the interference levels that have been published and coordinated for the specific and/or typical Earth station(s) pertaining to the FSS networks where FSS transponders are used.	Recommendation ITU-R M.1643 Resolution 902 Rec. ITU-R S.524-9
The design, coordination and operation of the Earth stations should take into account:	
- Antenna mispointing	Recommendation ITU-R M.1643
- Variations in antenna pattern of the Earth station	Recommendation ITU-R M.1643
- Variations in the transmit e.i.r.p. from the Earth station	Recommendation ITU-R M.1643
[Earth stations] that use close loop tracking of the satellite signal need to employ an algorithm that is resistant to capturing and tracking adjacent satellite signals. [Earth stations] must immediately inhibit transmissions when they detect that unintended satellite tracking has happened or is about to happen.	Recommendation ITU-R M.1643
The [Earth station] should be self-monitoring and, should a fault which can cause harmful interference to FSS networks be detected, the [Earth station] must automatically mute its transmissions.	Recommendation ITU-R M.1643; Resolution 902

Some of the above requirements are expected to be contained in the ETSI standard for Ka-band ESOMPs. Other requirements may need to be included in the ECC Decision.

Instead of defining distinct decisions for aeronautical and maritime Earth stations operating in the Ka-band, more general provisions would be developed defining the conditions under which these Earth stations could be treated as ESOMPs, operating under the same conditions as typical uncoordinated FSS Earth stations. Maritime and aeronautical ESOMPs would then be required to follow similar regulatory requirements to those applicable to typical uncoordinated FSS Earth stations operating in the band in order to achieve free circulation for aero and maritime terminals and licence exemption or general authorisation for land based terminals.

This approach provides a more simplified and consistent regulatory treatment of such terminals since it requires them to comply with the same type of requirements as the fixed FSS terminals they are designed to emulate.

## 8 CROSS-BORDER COORDINATION

*[to be reviewed on the basis of the SE40 studies]*

The implementation of ESOMPs in the frequency bands 27.5–30.0 GHz and 17.3-20.2 GHz will be limited ~~their implementation~~ to the portions of such these bands in which uncoordinated FSS earth stations are allowed. The Ka-band frequencies identified for uncoordinated FSS earth stations have been harmonised throughout CEPT by ECC Decisions ECC/DEC/(05)01 and ECC/DEC/(05)08. Hence, in the general case, the bands available for ESOMPs will be common throughout Europe, and there would be no cross-border interference issues. However in some cases, for example on the borders of CEPT, a band identified for uncoordinated FSS earth stations by one administration, could be used for terrestrial services by a neighbouring administration.

The issue of potential cross-border interference caused by the use of uncoordinated FSS Earth stations in one country into FS stations in a neighbouring country has been addressed by Recommendation ITU-R SF.1707 which, among other things, provides an example, based on worst case assumptions, of how to develop a single transmit and a single receive coordination distance for consideration as a mean to ease bilateral agreements for a given geographical area. Also, Recommendation ITU-R SF.1719 has examined interference using more typical assumptions and indicates that far smaller separation distances are applicable in most practical cases.

When assessing the interference generated by aircraft-mounted ESOMPs, the studies mentioned in [Section 6.2.2] of this document indicate that the potential area where any FS stations might be impacted is when the aircraft is below a certain altitude, which would typically be only within the vicinity of airports for takeoff and landing. The use of the proposed pfd mask would allow administrations to authorise the operation of aircraft-mounted ESOMPs in bands for which neighbouring countries might operate terrestrial services.

In any case, it should be noted that the possibility of interference between FS stations and aircraft-mounted ESOMPs in the bands 27.5-29.5 GHz and 17.3-19.7 GHz ~~band~~, beyond

that posed by stationary uncoordinated FSS ~~e~~Earth stations, can be considered highly unlikely since it can occur only if the following circumstances are present simultaneously:

1. FS stations in one country are deployed near the border of a neighbouring country that allows aircraft-mounted ESOMPs;
2. The FS stations are not already limited by existing uncoordinated FSS ~~E~~earth stations deployed in the neighbouring country;
3. The FS stations are deployed near an airport located in the neighbouring country;
4. The neighbouring country allows aircraft-mounted ESOMPs to operate below a minimum altitude;
5. The FS stations are pointing North (aircraft-mounted ESOMPs operating in Europe will never point towards the North, so there will never be a case of main beam to main beam interference from an aircraft-mounted ESOMP into a South-pointing FS station).

If all these conditions exist, administrations could still define a protection area around airports in order to protect FS stations in neighbouring countries.

## 9 CONCLUSIONS

*[to be reviewed once the SE40 studies are completed]*

Ka-band FSS networks capable of providing ESOMP services in Europe are already in operation and operators are planning to introduce ESOMP services in Europe in the near future.

This report has examined possible regulatory approaches to allow the CEPT administrations to authorise ESOMPs to operate in FSS networks in the Ka-band. It is recommended that a new ECC Decision be developed, with the following elements:

- Authorising the use of ESOMPs operating in FSS networks in the Ka-band frequencies designated by administrations for uncoordinated FSS earth stations.
- Establishing the technical and operational requirements for ESOMPs to avoid causing interference to other services and systems.
- To establish the free circulation of ESOMPs, subject to national licensing requirements.

Taking into account that ESOMPs networks are planned to be launched in a short time frame, it is in the interest of operators, users and the CEPT regulators to have an agreed framework in place to harmonize their operations as soon as possible.

[\[the ECC Report is not the place to have such draft ECC Decision\]](#)

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**ANNEX 1: HEADING**

Just as an example if needed

Body text (style: ECC Paragraph)

**A.1.1 HEADING 2**

**A.1.1.1 Heading 3**

*A.1.1.1.1 Heading 4*

**ANNEX 2: LIST OF REFERENCE**

- [1] Reference one (style: reference)
- [2] Reference two
- [3] Etc.

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