ECC Decision (18)04

The harmonised use, exemption from individual licensing and free circulation and use of land based Earth Stations In-Motion (ESIM) operating with GSO FSS satellite systems in the frequency bands 10.7-12.75 GHz and 14.0-14.5 GHz

Approved 06 July 2018

EXPLANATORY MEMORANDUM

1 INTRODUCTION

Land based earth stations in-motion (ESIM) are being deployed with GSO (geosynchronous orbit) networks operating in the frequency bands 10.7-12.75 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space) under the allocations made to the Fixed-Satellite Service (FSS). The space-to-Earth and Earth-to-space frequency bands are collectively called the Ku-band. This ECC Decision addresses the harmonised use, exemption from individual licensing, and free circulation and use of land based ESIM operating to Ku-band GSO satellite networks. The land based ESIM offer a range of communication services, including broadband and Internet of things. Vehicle Mounted Earth Stations (VMES) and Earth Stations on Trains (EST) are applications of land based ESIM, and are being deployed within the CEPT as a part of a worldwide deployment.

This ECC Decision provides a regulatory framework for authorising land based ESIM on the condition that such deployment will not cause harmful interference to other authorised services. The regulatory framework specifies that land based ESIM should be exempt from individual licensing and offered free circulation and use. The other authorised services within the CEPT are limited to the fixed service (FS) in the band 14.25-14.5 GHz, deployed in five administrations, and radio astronomy service (RAS) in the 14.47-14.5 GHz, where astronomy observations are carried out at a limited number of observatories within the CEPT. The technical conditions established for land based ESIM to maintain compatibility with FS and RAS are also described in this ECC Decision.

2 BACKGROUND

Over the years, the CEPT developed several regulatory measures (i.e. ECC Decisions etc.) to facilitate the exemption from individual licensing and free circulation and use of earth stations, and these satellites earth stations included mobile earth stations and earth stations on mobile platforms (ESOMP). The ECC Decisions relating to ESOMP were: ECC Decision (13)01 [1] on Ka-band GSO ESOMP and ECC Decision (15)04 [2] on Ka-band NGSO ESOMP. The term earth stations in-motion (ESIM) was adopted at the WRC-15 to replace ESOMP.

The regulatory frameworks established by the CEPT for earth stations were underpinned by the legal framework established by the European Union for licensing. Article 5 of the Authorisation Directive (Directive 2002/20/EC) [3] requires the use of spectrum to be facilitated under general authorisations, where, amongst other things, the risk of harmful interference to other radio services is negligible. The Radio Equipment Directive (2014/53/EU) [4] (including its forerunner Radio and Telecommunication Terminal Equipment (R&TTE) Directive (1999/5/EC) [5]) ensures a Single Market for radio equipment by setting essential requirements for safety and health, electromagnetic compatibility, and the efficient use of the radio spectrum. The Radio Equipment Directive applies to all products using the radio frequency spectrum. The CEPT, in its ERC Recommendation 01-07 [6], adopted in 1995 and revised in 2004, also recommended the harmonised criteria for exempting radio equipment from individual licensing. These regulatory frameworks, enshrined in many ECC Decisions, provided the basis for administrations to exempt many types of radio equipment, including satellite terminals, from individual licensing.

Land based ESIM considered in this Decision are to be deployed with GSO satellite networks already in operation or such networks that may be deployed in the future. Technical studies have been carried out by the CEPT to assess the compatibility between land based ESIM and other services authorised in the 14-14.5 GHz band, namely the FS and the RAS. The 14-14.5 GHz band is allocated on a worldwide and primary basis to the FSS (Earth-to-space) in the ITU Radio Regulations [7] and is generally available for satellite services within the CEPT and elsewhere. A limited number of administrations within the CEPT also utilise the 14.25-14.5 GHz band for fixed links in the fixed service. The allocation to the radio astronomy service in the 14.47-14.5 GHz band is utilised at a limited number of observatories in the CEPT.

The ERC Recommendation 13-03 [8] on the use of the band 14.0-14.5 GHz for Very Small Aperture Terminals (VSAT) and Satellite News Gathering (SNG) recommended that the use of the 14.25-14.5 GHz band for the fixed service should be discouraged in those countries that have not already implemented fixed radio links in the band. In addition, the Recommendation said that flexible and unrestricted use of VSAT and SNG applications in the 14.25-14.5 GHz band should be allowed at least in those countries where no fixed links have been implemented so far. Subsequently, the ECC Decision (03)04 [9] was adopted, and it provided for exemption from individual licensing of VSAT operating in the 14.25-14.5 GHz band.

Exemption from individual licensing and free circulation and use

The ERC Recommendation 01-07 (revised in the year 2000) [6], recommended the harmonised criteria for exempting radio equipment from requiring individual licence, recognising that administrations and especially users, retailers and manufacturers will benefit from a more deregulated system of licensing. The ECC Decision (12)01 [10] on the exemption from individual licensing and free circulation and use of certain terrestrial and satellite mobile terminals, stipulated that such terminals should be under the control of terrestrial or satellite networks. The Decision also stated that "when the efficient use of the frequency spectrum is not at risk and as long as harmful interference is unlikely, the installation and use of radio equipment should be exempted from individual licensing." ECC Decision (12)01 (amended in 2016) also clarified the regulatory position "free circulation and use" as free circulation with permission to use the radio equipment. ECC Decision (12)01 applied to a limited number of satellite terminals and it did not apply to satellite terminals installed permanently on maritime vessels or aircraft.

Technical studies carried out by the CEPT have identified the technical solutions to protect the FS in the 14.25-14.5 GHz band and RAS in the 14.47-14.5 GHz band. Such protection is achieved by ceasing transmissions from land based ESIM in the frequency bands that overlap the frequency assignments of FS and/or RAS stations when the land based ESIM enter or located within the zones identified for the protection of FS and/or RAS stations ("protection zones"). The cessation of transmissions is carried out autonomously by certain inherent control functions of the land based ESIM and/or by the Network Control Facility (NCF) of the satellite networks specified in the harmonised standards EN 302 977 [11] for vehicles and EN 302 448 [12] for trains. Such transmissions remain disabled until an appropriate control signal is received from the NCF to re-establish transmissions in those frequency bands. These measures are implemented without the involvement of individual user of the land based ESIM. Such ability of GSO satellite networks deploying land based ESIM to protect FS and RAS deployments, without involving individual users of land based ESIM, allows administrations to consider exemption of land based ESIM from requiring individual licences for their operation in the 14-14.5 GHz band. Further, administrations will be able to consider offering free circulation and use. It should be noted that cessation of transmissions described above, to maintain compatibility with FS and RAS, applies only to the frequency bands that overlap the assignments of FS or RAS stations associated with the protection zones, and the land based ESIM will be able to continue to transmit, without such restrictions, in other frequency bands within the 14-14.5 GHz band.

The discussion above highlights the obligations placed on the service provider within the CEPT, who intends to benefit from this Decision for its deployment of land based ESIM. To this end, the service provider should provide a declaration assuring that:

i) it has identified the protection zones for the FS and/or RAS stations of CEPT administrations within which it intends to deploy land based ESIM operating in the 14.25-14.5 GHz band;

ii) the satellite network (or networks) provide for the cessation of transmissions, to maintain compatibility with FS and / or RAS, as specified by the Harmonised Standards EN 302 977 [11] for VMES and EN 302 448 [12] for trains.

The template for the declaration can be found in Annex 4 to this Decision.

The methodologies for determining protection zones to protect FS and RAS stations are detailed in this ECC Decision. It is noted such protection zones may include the territories of the neighbouring administrations.

High Intensity Radiated Field Protection of aircraft

The ECC Report 272 on "Earth stations operating in the frequency bands 4-8 GHz, 12-18 GHz and 18-40 GHz in the vicinity of aircraft" [13] concludes that no restrictions on the operations of land mobile earth stations are required in the proximity of or within airfields with the e.i.r.p. levels up to 54.5 dBW. Therefore,

this ECC Decision is to be applied to land based ESIM with the total e.i.r.p. limited to 54.5 dBW for which there should be no restriction on their operation near or within airfields.

3 REQUIREMENT FOR AN ECC DECISION

Land based ESIM operating to GSO FSS satellite networks in the frequency bands 10.7-12.75 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space) are being deployed in Europe with operational GSO satellite networks. Land based ESIM provide numerous two-way services which are of significant benefit to vehicle manufacturers and users on vehicles and trains. An ECC Decision is required to ensure that the authorisation of land based ESIM within the CEPT will be subject to harmonised conditions such as those stipulated in this ECC Decision.

ERC Recommendation 01-07 [6], adopted in 1995, lists harmonised criteria for administrations to decide whether an exemption from individual licence should be applied. This ECC Decision, prepared within the aim of exempting land based ESIM operating to GSO FSS satellite networks in the frequency band 14.0-14.5 GHz from individual licensing, fulfils the criteria for exemption listed in ERC Recommendation 01-07.

ECC DECISION OF 06 JULY 2018 ON THE HARMONISED USE, EXEMPTION FROM INDIVIDUAL LICENSING AND FREE CIRCULATION AND USE OF LAND BASED EARTH STATIONS IN-MOTION (ESIM) OPERATING WITH GSO FSS SATELLITE SYSTEMS IN THE FREQUENCY BANDS 10.7-12.75 GHZ AND 14.0-14.5 GHZ(ECC DECISION (18)04)

"The European Conference of Postal and Telecommunications Administrations,

considering

a) that within the CEPT administrations there is the recognition of the need for harmonisation of licensing regimes in order to facilitate the provision of Pan European services;

b) that administrations should work towards the exemption of relevant radio equipment from individual licensing based on harmonised criteria detailed in ERC/REC 01-07 [6];

c) that the introduction of land based ESIM operating to GSO satellite networks in the 10.7-12.75 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space) bands will contribute to enhanced broadband communications and deployment of satellite based Internet of Things within the CEPT;

d) that in the ITU Radio Regulations [7], the band 14-14.25 GHz is allocated on a worldwide and primary basis to the fixed-satellite service (Earth-to-space);

e) that in the ITU Radio Regulations [7], the band 14.25-14.5 GHz is allocated on a worldwide and primary basis to the fixed-satellite service (Earth-to-space) amongst other services;

f) that in the ITU Radio Regulations [7], the band 14-14.3 GHz is allocated on a worldwide and primary basis to the radionavigation service, and currently not utilised by CEPT administrations;

g) that the band 14.3-14.4 GHz in Region 1, 14.4-14.5 GHz on a worldwide basis and 14.25-14.3 GHz in some countries are allocated under the No 5.508 of the ITU Radio Regulations [7] to the fixed service on a primary basis, and the deployment of fixed service stations is limited to a few CEPT administrations;

h) that ITU Radio Regulations No. 5.149 [7] urges administrations in making assignments to stations of other services in the band 14.47-14.5 GHz, which is also allocated to radio astronomy service on a secondary basis, to take all practicable steps to protect the radio astronomy service from harmful interference;

i) that in the frequency band 10.7-12.50 GHz, fixed service systems are being operated on a shared basis;

j) that ERC Decision 00)08 [14] establishes the priority between fixed service and uncoordinated earth stations in the fixed-satellite service and the broadcasting-satellite service in the band 10.7-12.50 GHz including that CEPT administrations shall not deploy new fixed service systems in the band 11.7-12.5 GHz (also recognised by footnote ECA28 in the European Common Allocation Table – see ERC Report 25 [15]);

k) that the deployments of land based ESIM to GSO FSS satellite networks in the frequency bands 14.0-14.5 GHz need to maintain compatibility with other services mentioned in considerings g) and h) above;

l) that ECC Decision (03)04 [9] provides criteria for licence exemption of VSAT operating in the 14.25-14.5 GHz with e.i.r.p. of not greater than 50 dBW subject to the conditions stipulated in the said ECC Decision;

m) that the deployment of land based ESIM operating with GSO FSS satellite networks in the frequency band 14.0-14.5 GHz within a CEPT administration shall be subjected to relevant national regulatory requirements;

n) that land based ESIM operating to GSO FSS satellites networks in the frequency bands 10.7-12.75 GHz (space-to-Earth) and 14.0-14.50 GHz (Earth-to-space) shall be under the control of the satellite system;

o) that in EU/EFTA countries the radio equipment that is under the scope of this Decision shall comply with the RE Directive [4]. Conformity with the essential requirements of the RE Directive may be demonstrated by compliance with the applicable harmonised European standards EN 302 977 [11] for vehicles and EN 302 448 [12] for trains or by using the other conformity assessment procedures set out in the RE Directive;

p) that some CEPT administrations may require that operators of GSO FSS satellite systems to obtain an individual authorisation for their network due to national regulatory requirements.

DECIDES

1. that the **purpose of this ECC Decision** is to:
   a) harmonise the use of the frequency bands 10.7-12.75 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space) for the use of land based ESIM operating to GSO FSS satellite networks;
   b) exempt from individual licensing and allow free circulation and use of land based ESIM operating to GSO FSS satellite networks in the frequency bands 10.7-12.75 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth to space);
   c) establish the technical conditions necessary to ensure harmful interference is not caused by land based ESIM to stations of the radio astronomy service (RAS) and fixed service (FS);
2. that CEPT administrations shall designate frequency bands 10.7-12.75 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space) for the use of land based ESIM operating to GSO FSS satellite networks;
3. that CEPT administrations, without any deployments of the fixed service in the 14.25-14.5 GHz band and radio astronomy service in the 14.47-14.5 GHz band **shall** exempt such land based ESIM from individual licensing, and allow free circulation and use in frequency bands 10.7-12.75 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space);
4. that CEPT administrations with deployment of the fixed service in the 14.25-14.5 GHz:
   a) **shall** exempt land based ESIM from individual licensing, and allow free circulation and use in frequency bands 10.7-12.75 GHz (space-to-Earth) and 14.0-14.25 GHz (Earth-to-space);
   b) **shall** exempt land based ESIM from individual licensing and allow free circulation and use in frequency band 14.25-14.5 GHz (Earth-to-space) provided that the protection zones for the fixed service stations have been implemented using the methodology given in **Annex 1** to this Decision;
5. that CEPT administrations, with deployment of radio astronomy service in the 14.47-14.5 GHz:
   a) **shall** exempt land based ESIM from individual licensing, and allow free circulation and use in frequency bands 10.7-12.75 GHz (space-to-Earth) and 14.0-14.47 GHz (Earth-to-space);
   b) **shall** exempt land based ESIM from individual licensing and allow free circulation and use in frequency band 14.47-14.5 GHz (Earth-to-space) provided that the protection zones for the radio astronomy service stations have been implemented using the methodology given in **Annex 2** to this Decision;
6. that CEPT administrations with deployment of fixed service in the 14.25-14.5 GHz and radio astronomy service in the 14.47-14.5 GHz:
   a) **shall** exempt land based ESIM from individual licensing and allow free circulation and use in frequency bands 10.7-12.75 GHz (space-to-Earth) and 14.0-14.25 GHz (Earth-to-space);
   b) **shall** exempt land based ESIM from individual licensing and allow free circulation and use in frequency bands 14.25-14.5 (Earth-to-space) on the basis of Decides 4b and Decides 5b;
7. that all land based ESIM operating to GSO satellite networks shall:
   a) comply with the requirements in **Annex 3**;

b) operate on a non-protected basis with regard to the fixed service stations of the frequency band 10.7-11.7 GHz;

c) maintain compatibility with fixed and radio astronomy services as mentioned in considering i) above;

8. that the total equivalent isotropically radiated power (e.i.r.p.) of land based ESIM shall not exceed 54.5 dBW;

9. that **Annex 4** information shall be provided to the Office by the ESIM operator;

10. that this Decision **enters into force** on 06 July 2018;

11. that the preferred **date for implementation** of this Decision shall be 06 January 2019;

12. that CEPT administrations shall communicate the **national measures** implementing this Decision to the ECC Chairman and the Office when this ECC Decision is nationally implemented."

Note:

Please check the Office documentation database https://www.ecodocdb.dk for the up to date position on the implementation of this and other ECC Decisions.

ANNEX 1: DETAILED METHODOLOGY FOR DETERMINING THE PROTECTION ZONE AROUND FS STATIONS

A1.1 INTRODUCTION

This Annex describes the methodology for determining the protection contour around a given FS station. The main parameter needed for this determination is the land based ESIM e.i.r.p. towards the horizon, which is the direction of the FS station.

A1.2 DETERMINATION OF THE FS ANTENNA GAIN TOWARDS THE FSS EARTH STATION

Only the discrimination in azimuth is taken into account, which constitutes a worst case. In order to determine the antenna gain of the FS station in the direction of the FSS earth station, it is necessary to determine the offset angle between the pointing direction of the FS station and the location of the FSS earth station.

For each azimuth $az_{contour}$ of the contour,

$$offset = az_{contour} - az_{FS} \quad (1)$$

where

- $az_{contour}$ (°) is the azimuth under consideration (from -180 to 180°, or 0 to 360°)
- az_{FS} (°) is the azimuth where the FS station is pointing
- $offset$ (°) is the offset angle between both directions

The FS antenna gain is then determined by using the last version of Recommendation ITU-R F.699 [16] with the appropriate maximum antenna gain for the FS station and the offset angle found in (1).

A1.3 DETERMINATION OF THE FSS EARTH STATION E.I.R.P. TOWARDS THE FS STATION

The e.i.r.p. towards the horizon can be provided by the FSS operator.

Alternatively, since the land based ESIM will be the same equipment as those used in the US, the FCC e.i.r.p. mask can be used to determine the maximum e.i.r.p. towards the horizon. In order to do so, the location of the FSS earth station and the position of the GSO satellite have to be known. They are the converted in an Earth Centered Earth Fixed (ECEF) reference using equations (2) and (3) for respectively the earth station and the FSS satellite.

$$\begin{aligned} x_{ES} &= alt_{ES}\,(R_e + alt_{ES})\cos(lat_{ES})\cos(long_{ES}) \\ y_{ES} &= (R_e + alt_{ES})\cos(lat_{ES})\sin(long_{ES}) \\ z_{ES} &= (R_e + alt_{ES})\sin(lat_{ES}) \end{aligned} \quad (2)$$

where

- lat_{ES} (°) is the latitude of the earth station
- $long_{ES}$ (°) is the longitude of the earth station
- R_e (km) is the Earth radius (6378 km)
- alt_{ES} (km) is the altitude of the earth station
- x_{ES}, y_{ES}, z_{ES} (km) are the ECEF coordinates of the earth station

$$\begin{aligned} x_{SAT} &= (R_e + alt_{SAT})\cos(long_{SAT}) \\ y_{SAT} &= (R_e + alt_{SAT})\sin(long_{SAT}) \\ z_{SAT} &= 0 \end{aligned} \quad (3)$$

where

- $long_{SAT}$ (°) is the longitude of the FSS satellite
- R_e (km) is the Earth radius (6378 km)
- alt_{SAT} (km) is the altitude of the GSO satellite (36000 km)
- x_{SAT}, y_{SAT}, z_{SAT} (km) are the ECEF coordinates of the FSS satellite

The vector from the earth station towards the FSS satellite is given by (4)

$$\begin{aligned} x_{ES-SAT} &= x_{SAT} - x_{ES} \\ y_{ES-SAT} &= y_{SAT} - y_{ES} \\ z_{ES-SAT} &= z_{SAT} - z_{ES} \end{aligned} \quad (4)$$

The direction of the FS station as seen from the ES station V_{FS} is given by equation (5)

$$\begin{aligned} x_{FS} &= \sin(az_{contour})\sin(long_{ES}) + \cos(az_{contour})\cos(long_{ES})\sin(lat_{ES}) \\ y_{FS} &= -\sin(az_{contour})\cos(long_{ES}) + \cos(az_{contour})\sin(long_{ES})\sin(lat_{ES}) \\ z_{FS} &= -\cos(az_{contour})\cos(\mathrm{lat_{ES}}) \end{aligned} \quad (5)$$

The offset angle theta between the pointing direction of the FSS earth station and the direction of the FS station is given by (6).

$$\theta = \arcsin\left(\frac{V_{ES-SAT} \times V_{FS}}{|V_{ES-SAT}|}\right) \quad (6)$$

where × is the cross product.

The e.i.r.p. of the FSS earth station e.i.r.p._{ES} is then given by the table below, function of θ.

Table 1: Maximum e.i.r.p. of FSS earth station

e.i.r.p._{ES} (dBW/(4 kHz))	Offset angle θ
15-25logθ	1.5° ≤ θ ≤7°
-6	7° < θ ≤9.2°
18-25logθ	9.2° < θ ≤19.1°
-14	19.1° < θ ≤180°

A1.4 DETERMINATION OF THE REQUIRED PROPAGATION LOSS TO MEET THE FS PROTECTION CRITERIA

The minimum propagation loss required to meet the FS long-term and short term protection criteria is given by (7), and can be calculated for all azimuths around the FS station.

$$L = \text{e.i.r.p.}_{ES} + G_{FS} - N - I/N - L_F - 10\log(4000) \quad (7)$$

where

- $e.i.r.p._{ES}$ (dBW/4 kHz) is the e.i.r.p. of the FSS earth station towards the horizon
- G_{FS} (dBi) is the FS antenna gain in the direction of the FSS earth station
- N (dBW/Hz) is the noise level of the FS station
- I/N (dB) is the protection criterion threshold, either short or long-term
- L_F (dB) is the FS feeder loss

The protection criterion to be used should be either based on ITU-R recommendations such as ITU-R F.758 [17] or SF.1650 [18], or any protection criterion imposed by the individual administration.

A1.5 DETERMINATION OF THE SEPARATION DISTANCES

The determination of separation distances that would meet the required propagation loss can be done using a relevant propagation model. Recommendation ITU-R P.452 [19] is recommended to this effect with a relevant digital terrain elevation model such as SRTM (Shuttle Radio Topography Mission).

The percentage of time to be used in the propagation model is the percentage of time associated with the FS protection criterion considered.

The final separation distance for the azimuth $az_{contour}$ considered is the maximum between the distance obtained for the short-term and the distance obtained for the long-term. The protection contour around a given FS station is given by the envelope of separation distances calculated over all 360° azimuths.

ANNEX 2: DETAILED METHODOLOGY TO DETERMINE THE PROTECTION CONTOUR AROUND RAS STATIONS

A2.1 INTRODUCTION

This Annex describes the methodology for determining the protection contour around a given RAS station. The main parameter needed for this determination is the land based ESIM e.i.r.p. towards the horizon, which is the direction of the RAS station.

A2.2 DETERMINATION OF THE FSS LAND BASED ESIM E.I.R.P. TOWARDS THE RAS STATION

The e.i.r.p. towards the horizon can be provided by the FSS operator.

Alternatively, the FCC e.i.r.p. mask can be used to determine the maximum e.i.r.p. towards the horizon (as discussed in the main body of the document the land based ESIM comply with the US FCC mask). In order to do so, the location of the FSS earth station and the position of the GSO satellite have to be known. They are the converted in an Earth Centered Earth Fixed (ECEF) reference using equations (8) and (9) for respectively the earth station and the FSS satellite.

$$\begin{aligned} x_{ES} &= (R_e + alt_{ES})\cos(lat_{ES})\cos(long_{ES}) \\ y_{ES} &= (R_e + alt_{ES})\cos(lat_{ES})\sin(long_{ES}) \\ z_{ES} &= (R_e + alt_{ES})\sin(lat_{ES}) \end{aligned} \quad (8)$$

where

- lat_{ES} (°) is the latitude of the earth station
- $long_{ES}$ (°) is the longitude of the earth station
- R_e (km) is the Earth radius (6378 km)
- alt_{ES} (km) is the altitude of the earth station
- x_{ES}, y_{ES}, z_{ES} (km) are the ECEF coordinates of the earth station

$$\begin{aligned} x_{SAT} &= (R_e + alt_{SAT})\cos(long_{SAT}) \\ y_{SAT} &= (R_e + alt_{SAT})\sin(long_{SAT}) \\ z_{SAT} &= 0 \end{aligned} \quad (9)$$

where

- $long_{SAT}$ (°) is the longitude of the FSS satellite
- R_e (km) is the Earth radius (6378 km)
- alt_{SAT} (km) is the altitude of the GSO satellite (36000 km)
- x_{SAT}, y_{SAT}, z_{SAT} (km) are the ECEF coordinates of the FSS satellite

The vector from the earth station towards the FSS satellite is given by (10)

$$\begin{aligned} x_{ES-SAT} &= x_{SAT} - x_{ES} \\ y_{ES-SAT} &= y_{SAT} - y_{ES} \\ z_{ES-SAT} &= z_{SAT} - z_{ES} \end{aligned} \quad (10)$$

The direction of the RAS station as seen from the ES station V_{ES} is given by equation (11)

$$\begin{aligned} x_{RAS} &= \sin(az_{contour})\sin(long_{ES}) + \cos(az_{contour})\cos(long_{ES})\sin(lat_{ES}) \\ y_{RAS} &= -\sin(az_{contour})\cos(long_{ES}) + \cos(az_{contour})\sin(long_{ES})\sin(lat_{ES}) \\ z_{RAS} &= -\cos(az_{contour})\cos(\mathrm{lat_{ES}}) \end{aligned} \quad (11)$$

The offset angle theta between the pointing direction of the FSS earth station and the direction of the RAS station is given by (12).

$$\theta = \arcsin\left(\frac{V_{ES-SAT} \times V_{RAS}}{|V_{ES-SAT}|}\right) \quad (12)$$

where × is the cross product.

The e.i.r.p. of the FSS earth station e.i.r.p.$_{ES}$ is then given by the table below, function of θ.

Table 2: Maximum e.i.r.p. of FSS earth station

e.i.r.p.$_{ES}$ (dBW/(4 kHz))	Offset angle θ
15-25logθ	1.5° ≤ θ ≤7°
-6	7° < θ ≤9.2°
18-25logθ	9.2° < θ ≤19.1°
-14	19.1° < θ ≤180°

A2.3 DETERMINATION OF THE REQUIRED PROPAGATION LOSS TO MEET THE RAS PROTECTION CRITERIA

The minimum propagation loss required to meet the RAS protection criteria is given by (13), and can be calculated for all azimuths around the RAS station.

$$L = \text{e.i.r.p.}_{ES} - I - 10\log(4) + 10\log(150) \quad (13)$$

where

- $e.i.r.p._{ES}$ (dBW/4 kHz) is the e.i.r.p. of the FSS earth station towards the horizon
- I (dBW/150 kHz) is the RAS detrimental threshold level

The interference threshold level I is given in Recommendation ITU-R RA.769 [20] as a received power of -214 dBW/150 kHz. The data loss threshold value of 2% from ITU-R RA.1513 [21] applies to this band.

A2.4 DETERMINATION OF THE SEPARATION DISTANCES

The determination of separation distances that would meet the required propagation loss can be done using a relevant propagation model. Recommendation ITU-R P.452 [19] is recommended to this effect, with a relevant digital terrain elevation model such as SRTM (Shuttle Radio Topography Mission).

The percentage of time to be used in the propagation model is 2%.

The protection contour around a given RAS station is given by the envelope of separation distances calculated over all 360° azimuths.

ANNEX 3: TECHNICAL AND OPERATIONAL REQUIREMENTS FOR LAND BASED EARTH STATIONS IN-MOTION OPERATING TO GSO FSS SATELLITE NETWORKS IN THE FREQUENCY BANDS 10.7-12.75 GHZ AND 14.0-14.5 GHZ

Land based ESIM operating to GSO FSS satellite networks in the frequency bands 10.7-12.75 GHz and 14.0-14.5 GHz shall comply with the following technical and operational requirements:

1. The land based ESIM shall operate under the control of a Network Control Facility (NCF);

2. The design, coordination and operation of the land based ESIM shall take into account the following factors:

    a) antenna mis-pointing;

    b) variations in the antenna pattern;

    c) variations in the transmit e.i.r.p..

3. Land based ESIM that use closed-loop tracking of the satellite signal shall employ an algorithm that is resistant to capturing and tracking signals from nearby satellite. The earth stations shall immediately cease transmissions when they detect that unintended satellite tracking has happened or is about to happen;

4. The land based ESIM shall cease transmissions in protection zones in frequency bands where FS and RAS stations are operated;

5. Land based ESIM shall conform to the Harmonised European Standard EN 302 977 [11] for vehicle-mounted earth stations or EN 302 448 [12] for earth stations on trains.

ANNEX 4: DECLARATION TO BE SUBMITTED TO THE OFFICE BY THE ESIM OPERATOR DEPLOYING LAND BASED ESIM AND INFORMATION RELATING TO FS (14.25 – 14.50 GHZ) AND RAS (14.47 – 14.50 GHZ) DEPLOYMENTS

A 4.1 DECLARATION TO BE SUBMITTED BY THE ESIM OPERATOR

Any GSO ESIM operator intending to deploy land based ESIM within the framework of this ECC Decision is required to submit to the Office (http://www.cept.org/eco) a declaration given in Table 3. Any future changes to the information sought by the declaration should also be brought to the attention of the Office as soon as possible.

Table 3 Declaration to be provided to the Office

Information required	Information
ESIM operator's name	
ESIM operator's Contact information	
Commercial name of the satellite network(s)	
Network Control Facility (NCF) contact details (address, telephone number, email)	
Confirmation of the system compatibility with each of the services mentioned in decides 3 to 7	
Names of the CEPT administrations where protection measures have been implemented by the ESIM Operator to protect FS stations	
Names of the CEPT administrations where protection measures have been implemented by the ESIM Operator to protect RAS stations	
Confirmation that Land based ESIM operating comply with the following technical and operational requirements in Annex 3	

A4.2 INFORMATION ON ADMINISTRATIONS DEPLOYING FS AND RAS STATIONS[1]

Administrations currently with fixed service deployments in the frequency band 14.25 – 14.50 GHz:

- France
- Germany
- Italy
- Romania
- Russian Federation
- United Kingdom

Relevant RAS stations deployed in the CEPT (Source: ECC Report 271):

[1] Any request for update of the following lists of Administrations with FS deployments and RAS stations shall be notified to ECO and submitted to WG FM for updating the ECC Decision accordingly.

Table 4: CEPT RAS observatories using the band 14.47-14.5 GHz

Administration	Name	Longitude	Latitude
Germany	Effelsberg	06° 53′ 01″	50° 31′ 29″
Italy	Medicina	11° 38′ 49″	44° 31′ 15″
Russian Federation	Kalyazin	37° 54′ 01″	57° 13′ 22″
	Puschino	37° 40′ 00″	54°49′ 00″
Portugal	Santa Maria	-25° 07′ 33″	36° 59′ 07″
Sweden	Onsala (OTT)	11° 55′ 11″	57° 23′ 37″
United Kingdom	Cambridge	00° 02′ 20″	52° 10′ 00″
	Jodrell Bank	-02° 18' 26"	53° 14′ 10"

ANNEX 5: LIST OF REFERENCE

This annex contains the list of relevant reference documents.

[1] 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", March 2013

[2] ECC Decision (15)04 – "The harmonised use, free circulation and exemption from individual licensing of Land and Maritime Earth Stations On Mobile Platforms (ESOMPs) operating with NGSO FSS satellite systems in the frequency ranges 17.3-20.2 GHz, 27.5-29.1 GHz and 29.5-30.0 GHz", July 2015

[3] Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services (Authorisation Directive)

[4] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC

[5] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity

[6] Recommendation ERC/REC 01-07 – "Harmonised regime for exemption from individual licensing for the use of radio spectrum", revised June 2004

[7] ITU Radio Regulations, edition of 2016

[8] ERC Recommendation 13-03 – "The use of the band 14.0-14.5 GHz for Very Small Aperture Terminals (VSAT) and Satellite News Gathering (SNG)", December 1996

[9] ECC Decision (03)04 – "Exemption from Individual Licensing of Very Small Aperture Terminals (VSAT) operating in the frequency bands 14.25 - 14.50 GHz Earth-to-space and 10.70-11.70 GHz space-to-Earth", October 2003

[10] ECC Decision (12)01 - "Exemption from individual licensing and free circulation and use of terrestrial and satellite mobile terminals operating under the control of networks", amended November 2016

[11] ETSI EN 302 977 V2.1.1 - Satellite Earth Stations and Systems (SES); Harmonised Standard for Vehicle-Mounted Earth Stations (VMES) operating in the 14/12 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU

[12] ETSI EN 302 448 V2.1.1 - Satellite Earth Stations and Systems (SES); Harmonised Standard for tracking Earth Stations on Trains (ESTs) operating in the 14/12 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU

[13] ECC Report 272 - "Earth Stations operating in the frequency bands 4-8 GHz, 12-18 GHz and 18-40 GHz in the vicinity of aircraft", January 2018

[14] ERC Decision (00)08 – "on the use of the band 10.7 - 12.5 GHz by the fixed service and Earth stations of the broadcasting-satellite and fixed-satellite Service (space-to-Earth)", October 2000

[15] ERC Report 25 - "The European table of frequency allocations and applications in the frequency range 8.3 kHz to 3000 GHz", updated October 2017

[16] Recommendation ITU-R F.699-7 - Reference radiation patterns for fixed wireless system antennas for use in coordination studies and interference assessment in the frequency range from 100 MHz to about 70 GHz

[17] Recommendation ITU-R F.758-6 - System parameters and considerations in the development of criteria for sharing or compatibility between digital fixed wireless systems in the fixed service and systems in other services and other sources of interference

[18] Recommendation ITU-R SF.1650-1 - The minimum distance from the baseline beyond which in-motion earth stations located on board vessels would not cause unacceptable interference to the terrestrial service in the bands 5 925-6 425 MHz and 14-14.5 GHz

[19] Recommendation ITU-R P.452-16 - Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz

[20] Recommendation ITU-R RA.769-2 - Protection criteria used for radio astronomical measurements

[21] Recommendation ITU-R RA.1513-2 - Levels of data loss to radio astronomy observations and percentage-of-time criteria resulting from degradation by interference for frequency bands allocated to the radio astronomy service on a primary basis

[22] ECC Report 271 - "Compatibility and sharing studies related to NGSO satellite systems operating in the FSS bands 10.7-12.75 GHz (space-to-Earth) and 14-14.5 GHz (Earth-to-space", January 2018