

Draft Brief Agenda Item 1.17

Agenda item 1.17 : to consider the results of ITU-R studies on compatibility between the fixed-satellite service and other services around 1.4 GHz, in accordance with Resolution 745 (WRC-03)

Issue

WRC-03 made a secondary allocation to the FSS for feeder links for non-geostationary-satellite networks in the mobile-satellite service with service links below 1 GHz through No 5.339A in the bands 1390-1392 MHz (Earth-to-space) and 1430-1432 MHz (space-to-Earth). However, due to the fact that there was a lack of studies and test measurements with regard to the protection of other services in the bands or in the passive band 1400-1427 MHz it was decided that these additional allocations shall not be used until the completion of all studies and the results of these studies reported to WRC-07.

Preliminary CEPT position

Because of all the constraints listed in the background section, the FSS allocations will not be usable in CEPT countries. Moreover, the 'passive' attitude of the proponents of the allocation seems to indicate that the allocation is no longer needed, and that other allocated frequency bands may be used by those MSS feeder links.

Because of these two reasons, CEPT proposes to suppress the provisional allocation to FSS in the 1.4 GHz band, in line with the only method provided in the CPM text.

Background

Agenda item 1.16 of WRC-03 asked a possible primary allocation to FSS for MSS feeder links nearby 1.4 GHz. Due to the lack of sharing studies with regard to the radio astronomy, the radiolocation and the mobile services, and the lack of tests which would have proved that attenuations of up to 128 dB were feasible with regard to the protection of passive services in the band 1400-1427 MHz, WRC-03 made a provisional secondary allocation to the FSS dedicated to MSS feeder links. However, this provisional allocation shall not be used until completion of all compatibility or sharing studies and presentation of the results to the next conference. Due to the fact that the allocation is now on a secondary basis, regulatory limits such as pfd mask assessed during the preparation of WRC-03 and based on protection criteria for interference from a primary service, (e.g. for fixed service the protection criteria defined in Recommendation ITU-R F-1094 is 1% fractional degradation performance for secondary service and 10% for primary service) need to be reconsidered.

Allocation scenario

The frequency band 1 350 – 1 400 MHz is allocated on a primary basis in all Regions to the radiolocation service and in Region 1 to the fixed and mobile services. The band 1 370 – 1 400 MHz is in all three Regions allocated on a secondary basis to the space research (passive) and Earth exploration-satellite (passive) services by 5.339. In addition, in 5 CEPT countries existing installations of the radio navigation service may continue to operate in the band 1 350- 1 400 MHz.

The band 1330 – 1400 MHz is also used by the RAS for observations of the red-shifted hydrogen line and RR 5.149 urges administrations to take all practicable steps to protect it from harmful interference.

The band 1 400-1 427 MHz is allocated to the Earth exploration-satellite (passive) service, the radio astronomy service and the space research (passive) service on a worldwide basis. For the radio astronomy service (RAS) this band is the most important band for studies of the hydrogen line and for continuum observations. This band is also used world-wide for the Very Long Baseline Interferometry (VLBI) technique which is utilised for radio astronomical studies requiring the highest angular resolution. For the Earth exploration satellite service, the band 1400 – 1427 MHz is a vital resource for measuring salinity and other aspects of the Earth and its atmosphere. This band is one of the few bands for which footnote 5.340 prohibits all emissions, emphasising its particular importance for the science community.

The band 1427-1452 MHz is allocated on a primary basis to the fixed and mobile services worldwide. The band 1427-1429 MHz is also allocated on a primary basis to the space operation service (Earth-to-space) in all 3 Regions. In 8 countries the band 1429-1535 MHz is also allocated on a primary basis to the aeronautical mobile service exclusively for the purposes of aeronautical telemetry within the national territory by 5.342.

Summary of technical and operational studies within ITU-R

The compatibility issue of agenda item 1.17 needs to be divided into five main categories:

1. Fixed service

The frequency bands 1350-1400 MHz and 1427 – 1452 MHz are in many countries intensively used for low capacity long haul radio relays, including some security applications. The FS does not share these bands with space services and has, without this constraint, evolved its applications globally, primarily low cost rural systems in developing and developed countries.

The FSS is allocated on a secondary basis and shall therefore not cause harmful interference to nor claim protection from the fixed service in this band. However, due to the importance and development of FS applications in this band, it is felt that hard pfd limits shall be imposed to FSS satellites for the downlink. These limits should be more stringent than those applicable in the nearby MSS frequency bands (-154/-144 dBW/m²/4 kHz). CEPT and ITU-R studies based on the fractional degradation of performance criterion have concluded that a pfd limit of -164 dBW/m² in 4 kHz should be adequate to protect the fixed service in the 1.4 GHz band.

Concerning the uplink, adequate separation distances shall be respected when an Administration deploys an FSS Earth station with respect to FS stations operating in the band 1390-1392 MHz so that the FSS Earth station does not cause harmful interference to FS stations in the territory of other Administrations.

2. Radio astronomy service

FSS downlink:

Recommendation ITU-R RA.769 lists the levels of interference detrimental to the RAS in the band 1400 – 1427 MHz. Recommendation ITU-R RA.1513 provides criteria for data loss to the RAS due to any one system. Recommendation ITU-R RA.1631 gives the RAS station antenna pattern and maximum gain to be considered in compatibility studies. From these values it is possible to derive epfd levels that the FSS shall respect:

- An epfd limit of -243 dBW/m² in the entire 1400-1427 MHz band for more than 98 % of integration periods of 2000 seconds at any radio astronomy station conducting continuum observations in this band, and
- An epfd limit of -259 dBW/m² in any 20 kHz of the 1400-1427 MHz band for more than 98 % of integration periods of 2000 seconds at any radio astronomy station conducting spectral line observations in this band.

The application of recommendation ITU-R M.1583 to a representative radio astronomy station leads to the following pfd limits, to be respected by each satellite of an FSS network:

- A pfd limit of -185 dBW/m² in the entire 1400-1427 MHz band at any radio astronomy station conducting continuum observations in this band, and
- A pfd limit of -201 dBW/m² in any 20 kHz of the 1400-1427 MHz band at any radio astronomy station conducting spectral line observations in this band.

In order to accommodate full duplex telecommunications in two frequency channels separated by only 40 MHz, a post-transmitter filter is required on both the FSS satellites and Earth stations.

Studies have shown through laboratory tests and simulation that the combination of such a filter with a GMSK modulation using a 300 kHz bandwidth and an output power of 3 W at the input of the antenna would lead to an amount of unwanted emissions at the antenna input of -90 dBW in the entire passive band, and -103 dBW in a 20 kHz bandwidth at 1 427 MHz. No measurements of emissions from equipment that would be employed in operational systems have been provided.

Assuming an antenna gain of -6 dBi and a distance of 1 000 km this leads to a pfd per satellite of -227 dBW/m² in the entire 1 400-1 427 MHz band and -240 dBW/m² in a 20 kHz bandwidth at 1 427 MHz. These numbers correspond to a margin of 40 dB with regard to the pfd limits determined above, which is largely sufficient to accommodate any difference that may appear between the laboratory tests/simulations and the real system in orbit.

FSS uplink:

for FSS uplink transmissions operating in the band 1390 – 1392 MHz, interference detrimental to radio astronomy in the bands 1330 – 1400 MHz or 1400 – 1427 MHz can be prevented by a combination of geographic separation, and appropriate attenuation of unwanted emissions, so that the total data loss due to the uplink and the downlink does not exceed 2%.

The distance required for the protection of radioastronomy stations has been determined to be in the order of 100 km for radioastronomy stations performing observations in the 1400-1427 MHz band and greater than 600 km for radioastronomy stations performing observations in the 1330-1400 MHz band. Those separation distances may be readily achievable for the limited number of FSS Earth stations that would be implemented.

The 100 km distance was determined assuming that the FSS Earth station unwanted emission levels were those necessary for the protection of EESS (-63 dBW). Actual systems will emit power that is up to 40 dB lower, leading to separation distances of the order of 7 km. The actual separation distance will therefore need to be calculated on a case-by-case basis.

3. Earth exploration-satellite (passive) and space research (passive) services

Regarding the impact on EESS (passive), Recommendation ITU-R SA.1029-2 contains the acceptable interference levels and related time excess criteria or data availability criteria to the bands 1370 – 1400 MHz and 1400 – 1427 MHz. The acceptable interference power is -174 dBW in a reference bandwidth of 27 MHz not to be exceeded more than 0.1% of the time. As the interference comes from several sources, ITU-R has decided to allocate 10% of this interference time to the MSS feeder links.

FSS downlink:

Studies available in the ITU have shown that an unwanted power limit of -46 dBW in the passive band 1400-1427 MHz at the satellite antenna port would be sufficient to protect all EESS systems which are expected to use the band, including the ESA SMOS sensor. In practice, the epfd limits required for the protection of Radio astronomy stations would be sufficient to protect satellite passive sensors in the EESS from the downlink.

In order to accommodate full duplex telecommunications in two frequency channels separated by only 40 MHz, a post-transmitter filter is required on both the FSS satellites and Earth stations.

ITU-R Studies have shown through laboratory tests and simulation that the combination of such a filter on the FSS satellite with a GMSK modulation using a 300 kHz band and an output power of 3 W at antenna input would lead to an amount of unwanted emissions at antenna input of -90 dBW in the whole passive band, corresponding to a 44 dB margin.

FSS uplink:

CEPT studies have shown that an emission power limit of -63 dBW in the whole band 1400-1427 MHz at the antenna port of the MSS feeder link Earth station would protect all EESS passive sensors operating in the 1400-1427 MHz band from harmful interference from the uplink.

ITU-R studies have shown that the combination of a post-transmitter filter on the FSS Earth station with a GMSK modulation using a 300 kHz band and an output power of 30 W at antenna input would lead to an amount of unwanted emissions at antenna input of -108 dBW in the whole passive band, corresponding to a 45 dB margin.

4. Mobile service

The ECA specifies (note 15A) that the use of this frequency range by the mobile service is limited to tactical radio relay applications. However, some CEPT countries use this band for aeronautical telemetry and compatibility with this application still needs to be studied.

The characteristics of tactical radio relay systems provided by NATO appear to be comparable to the characteristics of Point-to-multipoint FS stations given in recommendation ITU-R F.758. Document ITU-R 8D/110, approved by CEPT within SE40, shows that the pfd limit of -164 dBW/m² in 4 kHz will adequately protect these P-MP FS stations.

In 8 countries the band 1430-1432 MHz is also allocated on a primary basis to the aeronautical mobile service exclusively for the purposes of aeronautical telemetry in accordance with No. **5.342**. Criteria for protection aeronautical telemetry systems of the mobile service should be used from Recommendation ITU-R M.1459. The pfd produced on the Earth surface by any non-geostationary-satellite orbit space station visible to any aeronautical mobile receiving station operating in accordance with No. **5.342** in the band 1 430-1 432 MHz shall not exceed the following limits in any 4 kHz reference bandwidth:

-181 dB(W/m ²)	$0 \leq \alpha \leq 4$
$-193 + 20 \log \alpha$ dB(W/m ²)	$4 < \alpha \leq 20$
$-213.3 + 35.6 \log \alpha$ dB(W/m ²)	$20 < \alpha \leq 60$
-150 dB(W/m ²)	$60 < \alpha \leq 90$

where α is the angle of arrival (degrees above the horizontal plane);

5. Radiolocation service

The protection of fixed ground-based systems in the radiolocation service from emissions of MSS feeder links in the band 1390-1392 MHz may be afforded by adequate separation distances between radiolocation stations and FSS Earth stations.

The studies performed within ITU-R have shown that the separation distances to protect radiolocation receivers operating in the band 1390-1392 MHz from interference from MSS feeder link Earth stations vary between 150 and 600 kilometers, depending of the cases considered. Propagation paths over large bodies of water are likely to require higher distances. The high number of radiolocation systems deployed in all 3 Regions, including transportable and maritime stations which position can not be determined in advance, will make the deployment of MSS feeder link Earth stations hardly possible in this band.

ITU-R studies have also shown that sharing with aeronautical radiolocation systems will not be feasible, as required protection levels would be exceeded by orders of magnitude.

List of relevant documents

- Resolution ITU-R 745 (WRC-03);
- Recommendation ITU-R M.1748 – Protection of the RAS
- Draft new Recommendation ITU-R M.1747 – Protection of the EESS
- Draft new Recommendation ITU-R M.[MSS-SHAR-1.4 GHz] – Protection of FS, MS, and RL
- Draft new Report ITU-R M.[MSS-UE-1.4 GHz] – Control of MSS feeder link unwanted emissions

Actions to be taken

None

Proposals from outside CEPT

Regional telecommunication organisations

APT (January 2007)

APT members note that, based on ITU-R studies, sharing between FSS feeder link and other services is not feasible, because large separation distance, geographical separation, or additional constrains are required.

Therefore, APT Members support Method 1 (Proposed by some administrations)S, that is, suppression of the secondary FSS allocation for MSS feeder links in the frequency bands 1 390-1 392 MHz (Earth-to-space) and 1 430-1 432 MHz (space-to-Earth).

ATU (date of proposal)

Arab Group (date of proposal)

CITEL (IAP - November 2006)

Canada, United States, Brazil

From these study results given in Resolution **745 (WRC-03)**, it is likely that the NGSO-MSS feederlinks will be able to use the allocated bands only with significant constraints required to protect the existing services. It is clear that some studies have indicated problems sharing the 1 390 – 1 392 MHz band with existing services. Furthermore, no service providers are continuing to pursue opportunities or participating in relevant studies to use this allocation. Their absence indicates a lack of need for the allocation. Therefore, suppression of the conditional allocation to the NGSO-MSS feederlink allocations in the 1 390 – 1 392 MHz and 1 430 – 1 432 MHz bands is proposed.

The absence of NGSO-MSS interests indicated the lack of need for the allocation.

RCC (January 2007)

Protection should be provided for the existing services in the bands 1390 – 1392 MHz and 1430-1432 MHz, in particular, for aeronautical mobile service operating in the band 1 430 - 1 432 MHz in accordance with RR No. **5.342 RR**, as well as for passive services operating in adjacent frequency bands.

RCC administrations offer to suppress the secondary allocation to the non-geostationary systems for the fixed-satellite service in the bands 1390 – 1392 MHz and 1430-1432 MHz.

International organisations

ICAO (November 2006)

Use of the band around 1.4 GHz by the fixed satellite service for feeder links for non-geostationary satellite systems should not be introduced in any of the aeronautical bands in this frequency range; aeronautical usage needs to be protected from harmful interference.

IMO (date of proposal)

NATO (February 2007)

NATO Military Position

- (a) Military interests are focussing on the use of the frequency range around 1.4 GHz by tactical radio relay and by radars;
- (b) In line with the intent of Res. **745**, spectrum access by these existing services must be safeguarded.

SFCG (January 2007)

SFCG supports the suppression of the provisional allocation made to FSS feeder links for non-GSO satellite systems in the MSS with service links operating below 1 GHz (RR No. **5.339A**) - (Method 1 in the draft CPM text). It is further recognised in the draft CPM text that MSS is not compatible with RLS and MS.

WMO and EUMETNET (January 2007)

WMO and EUMETNET are of the view that such a secondary FSS allocation should not be confirmed at WRC-07. The current CPM text on Agenda item 1.17 adequately protects WMO and EUMETNET interests. WMO and EUMETNET oppose changes that would support retaining the secondary FSS allocation.

Regional organisations

ESA (date of proposal)

Same as SFCG

Eurocontrol (date of proposal)

Use of the band around 1.4 GHz by the fixed satellite service for feeder links for non-geostationary satellite systems should not be introduced in any of the aeronautical bands in this frequency range. Aeronautical usage needs to be protected from harmful interference.