

Draft CEPT Brief on agenda item 1.7

Agenda item 1.7: to consider the results of ITU-R studies regarding sharing between the mobile-satellite service and the space research service (passive) in the band 1 668-1 668.4 MHz, and between the mobile-satellite service and the mobile service in the band 1 668.4-1 675 MHz in accordance with Resolution 744 (WRC-03);

Issue 1 - Sharing between MSS and SRS (passive)

WRC-03 made a global allocation to the MSS (Earth to space) in the band 1 668-1 675 MHz, subject to Resolution 744 which invited ITU-R to complete in time for the WRC-07 studies to protect space research (passive) stations from harmful interference from mobile earth stations in the band 1668-1668.4 MHz. These studies should take care to avoid undue constraints on the relevant services, and the results should be brought to the attention of WRC-07.

Preliminary CEPT position

With respect to the band 1668-1670 MHz which is heavily used by the radio astronomy service in Europe, it is recognized that MESs will not generally be able to operate in this band within CEPT. However, CEPT supports regulatory provisions applicable to the band 1 668-1 668.4 MHz that would permit MSS operations while providing adequate protection of space research passive systems, in particular taking into account the planned RADIOASTRON space-VLBI system.

CEPT supports a solution where coordination between MSS and SRS(passive) systems would be triggered when either the MES e.i.r.p. spectral density exceeds -4dBW/4kHz or the total power spectral density delivered to an MES antenna exceeds -11 dBW/4kHz.

Background

The allocation to Space Research (passive) in the band 1660.5-1668.4 MHz is currently used by space based radio astronomy applications. The last reported system to use this frequency allocation was the Japanese system MUSES-B/HALCA that was operated throughout the band 1 600-1 730 MHz where there already exist some allocations to the MSS in the Earth-to-space direction that were used by several systems. These observations were conducted in accordance with **RR** 4.4, on an “as available” basis in the frequency bands not allocated for SRS (passive).

In spite of the fact that HALCA receiver front end covers the 1 600-1 730 MHz band, it was indicated that the actual band observed was one or two bands of 16 MHz bandwidth each within the range 1 600-1 730 MHz. During HALCA operations the actual observing bands were always selected carefully with a view of minimizing the number of interfering sources within the (2 × 16 MHz) bandwidth. Furthermore, in allocated radio astronomy bands (1660-1670 MHz) these observations were conducted at all times without detrimental interference to the S-VLBI system.

The HALCA system is no longer operational but a new space radio telescope (RADIOASTRON) under the leadership of the Russian Federation is now planned to be operated in the 1.6 GHz range, including the band 1668-1668.4 MHz.

Technical and operational information for the RADIOASTRON have been provided by the Russian Federation.

The interference criterion for S-VLBI systems is set to 1% of the system noise temperature. Both the proposed Radioastron system and the HALCA system have receiver temperatures of about 70 K. In a bandwidth of 400 kHz, this equates to an interference threshold of -174 dBW. Current technology for spaceborne receivers would allow a system noise temperature of about 30-40 K. However, it is also envisaged that in the future lower system noise temperatures may be achievable. By about 2010, values of about 20K can be expected. In a bandwidth of 400 kHz, this equates to an interference threshold of -179.6 dBW. Protection requirements for future S-VLBI systems need to be taken into account.

Additionally, Recommendation ITU-R RA.1513 recommends that interference from a single network may cause a radio astronomy data loss of up to 2%. This Recommendation also recommends that up to 5% data loss may be caused by all networks.

Studies performed have indicated that sharing is generally feasible between planned MSS systems and the planned SRS(p) system. Constraints could be required on the e.i.r.p. of some MESs or on the power delivered to the MES antennas. There are different regulatory options, i.e. coordination thresholds or hard e.i.r.p. limits and different parameters and values can be chosen depending on the desired balance of constraints on future SRS(p) systems and MSS systems.

Some of the parameter values required for the sharing analyses cannot be determined at the current time (for example the average antenna gain of the space-VLBI satellite). Furthermore the sharing studies have necessarily made conservative assumptions with respect to MSS system operations. However, based on the range of values considered, it is concluded that sharing of some types of MESs with the RADIOASTRON system is feasible while sharing of other types of MES with the RADIOASTRON system may be feasible, but would require more detailed interference assessment. The simulations based on the characteristics of the HALCA system have shown that interference about 15-25 dB higher than the threshold values described below can occur. On the other hand, the proposed RADIOASTRON system would operate at relatively high altitudes and would therefore be less susceptible to interference from MESs. The studies have shown that sharing between the MSS and this S-VLBI system is feasible, but some MESs with relatively high e.i.r.p. or relatively high transmitter power would be constrained.

In accordance with 5.379B the use of the band 1668-1675 MHz by the mobile satellite service is subject to coordination under No. 9.11A. A coordination process may allow for the additional mitigating factors to be taken into account. At the same time additional regulatory measures are needed to ensure the adequate protection of the space research service (passive) in the band 1 668-1 668.4 MHz, taking care to avoid undue constraints on both services. It has been determined that if a new S-VLBI system with orbital characteristics similar to the old HALCA system were to expect protection to the level of the agreed criterion, it would

become a significant constraint on MSS operations, almost certainly preventing MSS operations altogether.

On the other hand if a new MSS system started to operate in this frequency band with a maximum value of MES' e.i.r.p spectral density, it would be practically impossible to ensure adequate protection of practically all new S-VLBI system based on a coordination agreement (in this case new passive system would be coordinated with MSS system). Therefore any future S-VLBI systems with less benign orbital characteristics, depending on the protection requirements of such systems could be severely constrained.

As a result of these simulations, three methods (and two sub-methods) to solve this agenda item have been included in the CPM Report and values for coordination thresholds and hard limits considered in these methods have been calculated.

It needs to be reminded that in theory, this allocation to the MSS can also be used for non-GSO MSS systems but due to the fact that there is currently GSO MSS systems filed with the ITU BR it is unlikely that non-GSO MSS systems will complete the coordination process with GSO MSS in the band 1668 - 1668.4 MHz. Therefore, only GSO MSS systems have been studied.

Summary of technical and operational studies within ITU-R

Working Party 8D has been designated as the responsible Working Party for this agenda item. At the WP 8D meeting in September 2004, an input document with system parameters of RADIOASTRON was presented to the meeting. The WP 8D produced as an output a Working Document for studies relating to WRC-07 Agenda Item 1.7, which provides sufficient information to allow the commencement of the sharing studies relevant to this agenda item.

WP7D at its September 2004 meeting, developed a liaison statement to WP8D with the technical characteristics of RADIOASTRON system. At the March 2005 meeting of WP7D another liaison statement to WP8D was developed, proposing that the interference criterion for S-VLBI systems be calculated in accordance with Recommendation ITU-R RA.769 as 1% of the system noise temperature. This noise temperature is 70 K for RADIOASTRON, but may be as low as 20 K for future SRS(p) systems. Furthermore, the liaison statement proposes that the criterion of 2% data loss of Recommendation ITU-R RA.1513 should be used in the analysis of sharing between an MSS network and SRS(passive).

During November 2005 meeting WP7D developed:

- a liaison statement to WP 8D proposing a value of -5 dBi which may be used in the absence of other information as an average side- and back-lobe RADIOASTRON antenna gain. Also the additional information which is necessary for the sharing study between the MSS (E-s) and the SRS (passive) in the frequency band 1 668-1 668.4 MHz in connection with spaceborne radio telescope parameters was presented. Due to the fact that interference will be received by the RADIOASTRON receiver through the far side-lobes and not the main antenna lobe, it was stated that polarization discrimination can not be considered
- a liaison statement to WP 8D with comments on the Working Document towards a PDNR "Interference calculations to assess sharing between the MSS and space research (passive) service in the band 1 668-1 668.4 MHz"

WP 8D at its February 2006 meeting:

- confirmed that polarization discrimination can not be considered to assess sharing between the MSS and space research (passive) service;
- could not agree to the value of space-VLBI on-board antenna gain towards the Earth and decided to continue the sharing studies between the MSS and the SRS (passive) for both proposed values (-5 dBi and -10 dBi);
- developed a single set of simulation scenarios that would be included in the draft new Recommendation. This simulation would be done in the existing correspondence group previously established in relation to Agenda item 1.7;
- agreed that the interference criteria are based on an interference limit of 1% of receiver noise ($I/N = -20$ dB) may be exceeded by up to 2% of the time by one single MSS network or up to 5% time for all MSS networks.

WP 8D at its September 2006 meeting:

- approved the results of the computer simulations in relation to WRC-07 agenda item 1.7;
- identified the need for further studies with regard to interference produced by handheld type MESs.
- developed Draft CPM text in relation to WRC-07 Agenda item 1.7;
- decided to produce a Draft New Report ITU-R M.[MSS-SRS-1.6GHz] "Interference calculations to assess sharing between the MSS and space research (passive) service in the band 1668 - 1668.4 MHz" instead of a Draft New Recommendation

The RADIOASTRON system has been planned for several years, and has submitted advance publication information. Despite the fact that No. 9.11A has applied to the band 1 668-1 668.4 MHz since WRC-03, it has not been possible for coordination information to be submitted to the ITU BR. This may be because the necessary characteristics were not included in App 4. As a consequence, a new regulatory provision applicable to the band 1 668-1 668.4 MHz could be required to ensure that all MSS systems which exceed the threshold, as a minimum, coordinate with the RADIOASTRON system. A method to achieve this was discussed at the Special Committee meeting in December 2006 and is included in the CPM Report.

As a result of work on the above simulations, three different options emerged, which were further refined during the CPM07-2 in February 2007, that finally established in their Provisional Report of the CPM to WRC-07 three methods to satisfy this issue of the agenda item:

- Method A1. The existing coordination trigger based on frequency overlap would be complemented by a coordination threshold based on an e.i.r.p spectral density of 2.2 dBW/4 kHz of an MES that would ensure adequate protection to RADIOASTRON from two types of MES considered but may not provide adequate protection from the "handheld" type MES This e.i.r.p threshold would be added to Table 5-1 of Appendix 5 of **RR**.
- Method A2. The existing coordination trigger based on frequency overlap would be complemented by a coordination threshold based on the total power delivered to the

MES antenna of 1.5 dBW that is intended to ensure adequate protection to the RADIOASTRON system from all types of MES considered. This total power threshold would be added to Table 5-1 of Appendix 5 of **RR**.

- Method A3. The coordination requirement is suppressed, and instead hard limits are placed on MESs operating in the GSO MSS networks. The maximum e.i.r.p. spectral density would be limited to -4dBW/4kHz and the power spectral density delivered to the MES antenna would be limited to -11.5 dBW/4kHz in any part of the frequency band 1668-1668.4 MHz. These values would ensure adequate protection of the RADIOASTRON system and of any future SRS(p) system with orbital parameters similar to those of RADIOASTRON without coordination but would prohibit the operation of the “Type B” MES and “handheld” type MES.. These limits to the e.i.r.p. spectral density / power spectral density delivered to the antenna of an MES would be added to Art. 5 **RR** by means of a new footnote.
- A variant to methods 1 and 2 designated as 1b) and 2b) establishes that all MSS systems which exceed the threshold condition (Table 5-1 of Appendix 5) in the band 1668-1668.4 MHz would be required to coordinate with SRS (passive) systems which have submitted advance publication information, received before 8 December 2005. This date is proposed to ensure that the Radioastron system (ITU filing name “SPECTR-R”) is taken into account since the date of receipt of the advance publication information for that system is 7 December 2005. This proposal could be implemented by an addition to RR No. **5.379B**,

WP 8D is developing a draft new ITU-R Report containing the sharing studies between MSS systems and space research (passive) systems, expected to be completed during the June 2007 WP8D meeting.

List of relevant documents

- ITU-R resolution 744 (WRC-03);
- ECC Decision (02) 07
- ECC Decision(04)09
- Recommendation ITU-R RA. 769-2
- Report of the computer simulation results in relation to WRC-07 agenda item 1.7 (8D/436);
- Draft new ITU-R Report M.[MSS-SRS-1.GHz] (8D/TEMP/287)

Actions to be taken

To complete the new simulation assessing the sharing between the handheld type MESs and the space research (passive) service in the band 1668-1668.4 MHz and prepare contributions to WP 8D to allow the draft new ITU-R Report to be completed;

Proposals from outside CEPT

Regional Telecommunication Organisations

APT (January 2007)

APT Members are of the view that sharing study results between MSS and SRS (passive) in the band 1 668 – 1 668.4 MHz and between MSS and MS in the band 1 668.4 – 1 675 MHz conducted by ITU-R should be taken into account in order to protect the services to which the bands are currently allocated without any undue constraints on the MSS. Regarding Issue A for this Agenda Item APT Members are of the view that the coordination procedure may be adopted. Regarding to Issue B for this Agenda Item APT Members are suggested to consider Methods B1 or B2 toward their final decision.

CITEL (October 2006)

Preliminary views:

1. . Brazil, Canada and the United States of America support the completion of studies demonstrating how: a) Radio astronomy and Space Research (passive) services, and b) Radio astronomy stations and MetAids earth stations can be protected from interference from mobile earth stations, in the bands 1 668 – 1 668.4 MHz and 1 668.4-1 670 MHz, respectively.

Preliminary studies within the ITU-R show that co-frequency sharing between RAS stations and mobile earth stations (MES) is feasible, e.g. by employing coordination zones of radii of the order of 300 km, under worst case scenarios. To date, these studies considered only terrestrial MES; the airborne case was not considered.

2. Canada and the United States of America support the completion of sharing studies within the ITU-R between the mobile service and MSS in the band 1 668.4 – 1 675 MHz, recognizing that stations in the MSS shall not claim protection from fixed and mobile stations operating in the Canada and the United States of America (see the resolves of Resolution **744** with respect to United States of America). These studies need to identify solutions so that the implementation of MSS networks in this band would not constrain the development of new/advanced applications in the mobile service that may be more susceptible to interference.

RCC

The band 1668–1668.4 MHz is planned for use by the space research (passive) service in the frame of the international project “Radioastron” (radio telescope on the space platform) so this use shall be protected from interference from the mobile-satellite service (Earth-to-space) (MSS).

Furthermore, the band 1668–1670 MHz is allocated to the radioastronomy service (studies of the maser line of OH radical), the protection of which requires the coordination distance of up to 600 km between the radioastronomy observatories and the MSS earth stations.

Issue 2- Sharing between MSS and MS

WRC-03 made a global allocation to the MSS (Earth to space) in the band 1 668-1 675 MHz, subject to Resolution 744 (through No. **5.379D**). Resolution 744 resolved that in the band 1 670-1 675 MHz stations in the MSS should not claim protection from fixed and mobile stations operating within the United States, and invited ITU-R to study the use of the band 1668.4-1675 MHz by the mobile service, and to complete sharing studies between the mobile service and the MSS in the band 1 668.4-1 675 MHz, in time for the WRC-07. These studies should take care to avoid undue constraints on the relevant services, and the results should be brought to the attention of WRC-07.

Preliminary CEPT position

Decision ECC/DEC/(04)09 of 12 November 2004 designates the band 1670-1675 MHz to the Mobile Satellite Service (Earth to space) from 1st April 2007.

CEPT has conducted studies to facilitate the introduction in Europe of systems of the MSS (Earth-to-space) in the band 1670-1675 MHz

With respect to the band 1668-1670 MHz which is heavily used by the radio astronomy service in Europe, it is recognized that MESs will not generally be able to operate in this band within CEPT. However, CEPT has also participated in the sharing studies as required by agenda item 1.7 in this frequency band in accordance with **Resolution 744**.

CEPT supports the restriction of the use of the allocation to the MS in the 1668.4-1675 MHz band to transportable radio relays systems only (with the exception of the territory of the United States of America). CEPT also supports encouraging Administrations operating transportable radio-relay systems to limit the e.i.r.p. in the direction of the geostationary arc to -27 dBW/4 kHz in accordance with ITU-R Recommendation M.[MS-MSS-1.6 GHz] (Doc 8/165 Rev 1).

CEPT strongly opposes the addition of other countries to Resolution 744, since this would result in considerable and unacceptable additional constraints on the mobile satellite service made at WRC03, making the allocation unusable. However, the potential differential constraint on the allocation caused by the addition of Canada to Resolution 744 is extremely small.

Background

The European Commission has issued a Mandate to CEPT to consider the future use of the frequency bands 1670 – 1675 MHz and 1800 – 1805 MHz, (the so called TFTS bands), in order to maintain the harmonised use of these bands.

In response to this mandate a report to the EC was prepared by ECC WGFM and approved by the ECC Plenary. The Decision ECC/DEC/(04)09 designates the band 1670-1675 MHz to the Mobile Satellite Service (Earth-to-space) from 1st April 2007; it entered into force on 12th November 2004.

The band 1 670-1 675 MHz is allocated to the mobile service on a primary basis, intended for aeronautical public correspondence (through No. **5.380**), but no aeronautical public correspondence systems are currently implemented and no future plans exist for implementation of such systems in this band, which was foreseen for use on the ground-to-air link. Decision ERC/DEC/(92)01 designated this band for use by TFTS systems, but was withdrawn (see ECC/DEC/ (02)07), although the condition still exists that the band be reserved for harmonised European use.

The band 1 668.4-1 670 MHz is also allocated to the mobile service on a primary basis. Some CEPT countries had suggested the suppression of the mobile service allocation in the band 1 668.4-1 675 MHz during the discussion on WRC-03 agenda item 1.31 preparation. The band 1668.4-1675 MHz is also used in some CEPT countries by transportable radio-relay systems operating in the mobile service. Because of regulatory and other constraints, those transportable radio-relay systems may only use only a limited part of their tuning range between 1350 MHz and 1850 MHz (and up to 2690 MHz).

It should be noted that the band 1670-1675 MHz has been auctioned in the United States for fixed and mobile operations.

Summary of technical and operational studies within ITU-R

Working Party 8D has been designated as the responsible Working Party for this agenda item. The WP 8D meeting in September 2006 produced as an output a Draft New Recommendation relating to WRC-07 Agenda Item 1.7 and in particular sharing between the MS and MSS in the band 1668.4-1675 MHz (8/165)

Interference calculations in this document have shown that:

- to ensure MSS spacecraft are adequately protected, the e.i.r.p. of transportable radio-relay stations should not exceed -27 dBW in a reference bandwidth of 4 kHz in the direction of the geostationary orbit. This figure applies to the aggregate interference, and a lower value may be necessary to account for multiple interferers. This could require pointing and/or e.i.r.p restrictions unacceptable for transportable radio-relay systems (up to 60% of the azimuths would be excluded) and would therefore prevent the use of such applications in the band. It is therefore concluded that, in general, sharing of such systems with the MSS is not feasible. It has however to be noted that such systems could continue to operate in the band 1 668.4-1 675 MHz under the fixed service (FS) in some administrations .
- aeronautical public correspondence systems should not be operated in this band; it is concluded that sharing between aeronautical public correspondence systems and the MSS is not feasible
- use of cellular mobile systems or similar high density mobile systems outside the United States would prevent MSS operations even in countries with considerable distance from the places where mobile systems are deployed. Consequently these systems should not be operated in the band 1668.4 - 1675 MHz.

- In recognition of the resolves of Resolution 744 (WRC-03), operation of cellular or high density mobile systems in the United States in the band 1670-1675 MHz can not be excluded. The resulting constraints on available orbital locations for MSS systems are similar to those resulting from the current restrictions in the downlink band 1518-1525 MHz in Article 21 **RR**.

It was suggested that Canada's name could be added to the *resolves* of Resolution **744 (WRC-03)** at the CPM. Bearing in mind the constraints that apply to the MSS as a consequence of the existing provisions applicable to the territory of the United States in the band 1 518-1 525 MHz (see RR Article **21**), which result in restrictions on the orbital locations available to MSS networks, the addition of this particular country, due to its geographical location, would have negligible additional impact on MSS operations. However the studies have shown that if other territories were to be included, the impact on MSS operations would be very severe: not only preventing MSS operations within those territories, but also preventing MSS operations in other geographical areas and leading to further constraints on the orbital locations available for MSS networks.

CPM07-2 has identified the following methods to satisfy this issue of agenda item 1.7

Three methods to deal with transportable radio-relay systems in the 1668.4 – 1675 MHz band are identified in the draft CPM report. In Method 1, a hard limit on the e.i.r.p. spectral density of transportable radio-relay stations would be applied. In Method 2, Administrations would be encouraged to limit the e.i.r.p. spectral density in the direction of the geostationary arc to -27dBW/4kHz and this would encourage the transition of transportable radio-relay systems to alternative frequency bands. In Method 3, no limits would be applied to transportable radio-relay stations.

With respect to aeronautical public correspondence systems , the band 1670-1675 MHz could be removed from footnote **5.380** or the footnote could be suppressed. With respect to cellular or similar high density mobile systems, the exclusion of such systems from the 1668.4-1675 MHz band is proposed. This restriction would not apply to a certain territory in North America in accordance to Resolution 744 (WRC-03).

List of relevant documents

- ITU-R Resolution 744 (WRC-03);
- ECC Decision (02) 07
- ECC Decision (04) 09
- PT2(04)38rev2 Survey of Radio services in the 1668.4-1675 MHz band in CEPT countries
- Recommendation ITU-R M.1040
- Draft new Recommendation ITU-R M.[MS-MSS-1.6 GHz] (DOC. 8/165(REV.1)), Sharing between the mobile service and the mobile-satellite service in the band 1 668.4-1 675 MHz

Actions to be taken

Proposals from outside CEPT

Regional Telecommunication Organisations

APT (January 2007)

APT Preliminary views

APT Members are of the view that sharing study results between MSS and SRS (passive) in the band 1 668 – 1 668.4 MHz and between MSS and MS in the band 1 668.4 – 1 675 MHz conducted by ITU-R should be taken into account in order to protect the services to which the bands are currently allocated without any undue constraints on the MSS. Regarding Issue A for this Agenda Item APT Members are of the view that the coordination procedure may be adopted. Regarding to Issue B for this Agenda Item APT Members are suggested to consider Methods B1 or B2 toward their final decision.

CITEL (June 2006)

Preliminary views:

Canada and the United States support the completion of sharing studies within the ITU-R between the mobile service and MSS in the band 1 668.4 – 1 675 MHz, recognizing that stations in the MSS shall not claim protection from fixed and mobile stations operating in the Canada and the United States (see the resolves of Resolution 744 with respect to United States). These studies need to identify solutions so that the implementation of MSS networks in this band would not constrain the development of new/advanced applications in the mobile service that may be more susceptible to interference.

International Organisations

NATO (February 2007)

NATO Military Position

Undue constraints on the mobile service should be avoided.

RCC

The frequency band 1668.4-1675 MHz is used by transportable RRL stations. Therefore any proposals on the protection of space stations of mobile satellite service from the terrestrial services interference shall not impose constraints on usage of the transportable RRL stations.