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|  | | CPG15(15)084 Annex IV-12 |
| Norway, Bergen, 14th - 18th September 2015 | | |  |
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CEPT BRIEF ON AGENDA ITEM 1.11

1.11 to consider a primary allocation for the Earth exploration-satellite service (Earth-to-space) in the 7-8 GHz range, in accordance with Resolution 650 (WRC-12).

# ISSUE

This agenda item considers the provision of a new primary allocation to the Earth exploration-satellite service EESS (Earth-to-space) in the 7-8 GHz range in order to complement telemetry operations of EESS (space-to-Earth) in the 8 025-8 400 MHz band.

Resolution 650 (WRC-12), “Allocation for the Earth exploration-satellite service (Earth-to-space) in the 7-8 GHz range”, resolves to invite ITU-R:

1. to study spectrum requirements in the 7-8 GHz range for EESS (Earth-to-space) telecommand operations in order to complement telemetry operations of EESS (space-to-Earth) in the 8 025-8 400 MHz band;
2. to conduct compatibility studies between EESS (Earth-to-space) systems and existing services, with priority to the band 7 145-7 235 MHz, and then within other portions of the 7-8 GHz range only if the band 7 145-7 235 MHz is found not to be suitable;
3. to complete the studies as a matter of urgency, taking into account the present use of the allocated band, with a view to presenting, at the appropriate time, the technical basis for the work of WRC-15,

Resolution 650 (WRC-12) also invites WRC-15 to review the results of these studies with a view to providing a worldwide primary allocation to EESS (Earth-to-space) in the range 7-8 GHz with priority to the band 7 145 -7 235 MHz.

# CEPT position

CEPT supports the allocation of the frequency band 7190-7250 MHz on a primary basis to the Earth exploration-satellite service (Earth-to-space), being the EESS usage restricted to tracking, telemetry and control (TT&C) for spacecraft operations.

Studies indicate that sharing is feasible with all the allocated services in the frequency range 7 190-7 250 MHz subject to the relevant regulatory provisions.

CEPT recognizes that the EESS (Earth-to-space) cannot share with the space research service SRS (deep space) the 7 145-7 190 MHz band and therefore does not support allocation of the frequency band 7 145-7 190 MHz on a primary basis to the EESS (Earth-to-space).

CEPT considers that the obtaining of agreement under No. 9.21 required for the existing space operation service (see RR No. 5.459) should not be applied with regard to the EESS within the range 7 190-7 235 MHz, as the EESS is a new service in the band.

The CEPT position is in line with CPM Method A.

# Background

The high concentration of satellites (several hundreds) using the band 2 025-2 110 MHz (Earth-to-space) and 2 200-2 290 MHz (space-to-Earth) for Tracking, Telemetry and Control (TT&C) is making the satellites coordination in these bands rather difficult.

Among the various satellite services using this band, the Earth exploration-satellite service (EESS) currently can only use the allocation at 2 025-2 110 MHz for the Earth-to-space transmissions, because no other Earth-to-space allocations are available at higher frequencies. The EESS (space-to-Earth) allocations at higher frequencies (8 025-8 400 MHz and 25.5-27 GHz) do not have any corresponding EESS (Earth-to-space) allocation and therefore in practice can be used only for payload data transmission and not for TT&C.

An EESS (Earth-to-space) allocation in the 7-8 GHz range would allow its use for TT&C in combination with the existing EESS (space-to-Earth) allocation in the band 8 025-8 400 MHz, thereby alleviating the congestion problem in S-Band, mitigating the frequency coordination problem, and eventually leading to a simplified on-board architecture and operational concept for future EESS missions. By this way some EESS new missions that already have to use the 8 025-8 400 MHz band for payload downlink, may use this band at higher frequencies also for TT&C. It is to be noted that only some EESS missions may be able to migrate to this higher frequency band for TT&C. And also these ones may still need using the bands 2 025-2 110 MHz and 2 200-2 290 MHz during LEOP (Launch and Early Orbital Phase) and in case of emergency, as other satellite systems using the space operation allocation in this band. Nevertheless a new EESS allocation would allow limiting the use of these very congested bands at 2 GHz in a way similar to what is done for many telecommunications satellites.

The frequency range 7 145-7 235 MHz was identified at the WRC 12 as the most promising frequency range for this potential new EESS (Earth-to-space) allocation. This range is sufficiently close to the existing EESS (space-to-Earth) allocation at 8 025-8 400 MHz and has been shared for more than 15 years between the SRS (Earth-to-space) worldwide and furthermore with the Space Operation Service SOS (Earth-to-space) in the Russian Federation, and systems of the Fixed/Mobile services with no specific sharing problems being reported.

The technical characteristics of potential new EESS (Earth-to-space) systems operating in the 7-8 GHz frequency range would be similar to those of SRS near Earth systems, but with lower transmit power requirements and smaller antenna size limited to a diameter between 11 and 15 m. Since the EESS (Earth-to-space) station will operate in a similar manner to the SRS stations but will require power levels typically much lower than the ones used by SRS in this band, sharing with terrestrial services in principle should be feasible.

The study results presented in sections 3.1 to 3.6 were obtained for non-geostationary (NGSO) EESS systems. Studies regarding geostationary (GSO) EESS systems are presented in section 3.7.

## Estimation of bandwidth requirements for EESS (EARTH-TO-sPACE) in the 7-8 GHz range

The results of spectrum requirement studies are summarised in the Report ITU-R SA.2272 “Spectrum requirements for future EESS missions operating under a potential new EESS uplink allocation in the 7-8 GHz range”. This report comes to the conclusion that the allocation to the EESS (Earth-to-space) in the 7-8 GHz band would need approximately 56 MHz, considering that most likely the EESS would be sharing the whole or part of the allocated band with other satellite services.

## Sharing between EESS (EARTH-TO-sPACE) and Space Research Service (SRS) in the band 7 145-7 235 MHz

The results of studies related to this issue are summarized in the Report ITU-R SA.2309 “Compatibility between EESS (Earth-to-space) and the space research service or the space operation service in the band 7 100-7 235 MHz”. All studies come to the same conclusion that in the band 7 190-7 235 MHz (SRS Earth-to-space near-Earth) interference levels from EESS uplinks into SRS uplinks are below the relevant ITU-R protection criterion, so this type of operation is compatible without any additional special mitigation techniques.

Studies have shown that there may be potential interference from SRS uplinks into EESS uplinks in some particular cases. However, these situations could be resolved, as currently done in S-Band, by application of Article 9.3 of the Radio Regulations.

On the contrary, the band 7 145-7 190 MHz (SRS Earth-to-space deep-space) has to be excluded from consideration for future EESS Earth-to-space links since EESS uplinks may interfere with SRS deep space spaceborne receivers. Additionally, SRS Earth station emissions would have the potential to saturate and damage the EESS spaceborne receivers.

## Sharing EESS (EARTH-TO-sPACE ) and Space Operations Service (SOS) in the bands 7 100-7 155 MHz and 7 190-7 235 MHz

Studies presented to PTA-5 (PTA(14)057 and PTA(14)089) show consistent results however differ with regards to the interpretation of the protection criteria given in Recommendation ITU-R SA.363-5.

The Russian Federation understands that “1% of the time, each day” has to be interpreted as “1% of the contact time, each day” (i.e. being understood that contact time is the cumulative time when the SOS Earth station can transmit towards the SOS satellite). However, other administrations consider that this percentage of time refers to the full day, consistently with the 15 minutes period referred to in the Annex 1, section 5.4, of Recommendation ITU-R SA.363-5.

Applying the interpretation of the Russian Federation the study indicates that, in case of non-co-located EESS and SOS Earth stations, the EESS Earth station could cause interference to SOS space receivers up to three days in one month, up to 2-3 minutes each of these days. SOS systems have in average nine passes per day with an average of 10 minutes duration per pass (i.e. 90 minutes daily contact). Applying the interpretation of the other administrations, the protection criteria in Recommendation ITU-R SA.363-5 is respected and therefore the EESS and SOS services are compatible.

The results of sharing studies between the SOS and the EESS systems are summarized in a dedicated section of the Report ITU-R SA.2309 “Compatibility between EESS (Earth-to-space) and the space research service or the space operation service in the band 7 100-7 235 MHz”.

## Sharing EESS (EARTH-TO-sPACE) and Fixed Service (FS) in the 7-8 GHz range

The results of studies between EESS (Earth-to-space) and FS are summarised in the Report ITU-R SA.2275 “Sharing between the EESS (Earth-to-space) and the fixed service in the 7-8 GHz range”. The analysis shows that the area around EESS earth stations where coordination would be required with the FS will depend on the location of the station, its characteristics and the orbit of the EESS satellite. The time varying gain (TVG) contour leads to maximum coordination distances of 74 km for an EESS earth station located in Kiruna (Sweden), 103 km for an EESS earth station in Villafranca (Spain) and 156 km for an earth station in Kourou (French Guiana). This coordination distance drops rapidly down to 3 km when the FS station does not point directly towards the EESS earth station, which would likely be the case when dealing with cross border coordination.

WP 5C agreed (see LS contained in 7B/94, Nov 2012) that based on the study results, compatibility with the fixed service could be achieved through coordination under 9.17, as already done for the SRS in the band 7 145-7 235 MHz. Similarly to what is happening for these SRS earth stations, for each individual EESS satellite mission and earth station, a specific uplink licence will have to be obtained from the relevant administration.

WP 5C informed WP 7B (see LS contained in 7B/235, Dec 2013) that had revised and had no comments to the Agenda item 1.11 in CPM Report.

Concerning the impact of the FS stations into the EESS space stations, no harmful interference is expected in the EESS satellite receivers due to impact of a deployment of FS links. The analysis is considering the number of links FS deployed in the whole range 7.1-8.5 GHz.

Concerning the impact of the inclusion of the frequency range 7235-7250 MHz in the new EESS (Earth-to-space) allocation, CEPT considers that the consequential changes in RR Article 21, Table 21-2 (Power limits for terrestrial stations) are not required to satisfy this Agenda Item, as the characteristics for the FS in the range 7 235-7 250 MHz are the same than those already applicable in the range 7 145-7 235 MHz. See ITU-R Recommendations F.758-5 (Table 7) and F.385-10.

## Sharing EESS (EARTH-TO-SPACE) and Mobile Service (MS) in the 7-8 GHz range

WP 5A, which is the group responsible for the mobile service in ITU-R, indicated that at this stage, it was not aware of any ITU-R deliverable providing the requested information for the MS regarding the 7-8 GHz frequency range, apart from ENG/OB applications operating below 7 125 MHz for which characteristics are given in Recommendation ITU-R M.1824 (see document 7B/103, Nov 2012).

## Sharing EESS (EARTH-TO-SPACE) and Fixed Satellite Service (FSS) in the band 7 150-7 250 MHz

WRC-15 Agenda item 1.9.1 considers possible new allocations to the Fixed Satellite Service (FSS), amongst others in the frequency band 7 150-7 250 MHz (space-to-Earth), as by Resolution 758 (WRC-12). Given that similar bands are being considered under WRC-15 Agenda items 1.9.1 (for FSS) and 1.11 (for EESS), compatibility studies between potential stations of both services have been performed and these are presented in section 3.4.4 of the PDN Report ITU-R S.[FSS 7/8 GHz Compatibility] (see Annex 2 to Doc. 4A/669, July 2015).

Concerning the impact of the EESS earth stations into the FSS (space-to-Earth) links: The analysis applies the time-variant gain (TVG) methodology to assess the coordination area around EESS earth stations. The results indicate a maximum coordination distance of approximately 350 km for an EESS earth station located in Sweden (high latitudes), 230 km for an EESS earth station located in medium latitudes and around 290 km for low latitude and this, only with the consideration that the FSS station is pointing directly towards the EESS earth station. These previous results take into account a flat terrain (the sea or the ocean and flat soil space). When taking into account real terrain elevation, on a site-by-site basis, the coordination distance would be reduced from 60% to more than 90%.

Concerning the impact of GSO FSS space stations into the EESS satellite receivers, the studies show that for the case of main-lobe to main-lobe coupling a separation distance of 800 km is necessary between the EESS and FSS satellites. The simulation results in the band 7 190-7 250 MHz are compliant with the applicable ITU protection criterion and this type of operation is compatible without the need of any special mitigation techniques.

Note: The PDN Report ITU-R S.[FSS 7/8 GHz Compatibility] includes the compatibility studies between the FSS and the FS, MS, SRS, SOS in the frequency bands 7 150-7 250 MHz and 8 400-8 500 MHz. Working Party 4A at its meeting in June 2015 discussed several contributions but the overall report could not be finalised.

## Studies regarding sharing with geostationary EESS systems

The Report ITU-R [SA.2349](http://www.itu.int/pub/R-REP-SA/publications.aspx?lang=en&parent=R-REP-SA.2349) presents the compatibility studies between the GSO EESS (Earth-to-space), and the FS, the MS, the SRS or the SOS in the band 7 190-7 235 MHz. The new Report was approved by SG7 in May 2015. The results of the analyses presented in this Report are consistent with and augment the results of the frequency sharing and compatibility analysis given in the Reports ITU-R SA.2309 and SA.2275.

## New study regarding the uplink earth station sizes for EESS systems

At the last ITU-R WP7B meeting in October 2014, some additional results of simulations were provided focusing on a wider range of uplink earth station sizes (4.2m to 15m) for EESS services. The new analysis results, which were presented in Doc. [7B/315](http://www.itu.int/md/R12-WP7B-C-0315/en), do not change the original conclusions. Therefore, WP7B concluded that those additional results would not need to be included in the Report ITU-R SA.2309 and might rather be used as elements for a potential future separate report on the effect of the earth station antenna sizes on sharing and compatibility with other services.

## CPM Text for AI 1.11

The CPM Report (Doc. R12-CPM15.02-R-0001, April 2015) proposes three methods to satisfy this agenda item. Methods A and B propose a new primary allocation to the EESS in the frequency band 7 190-7 250 MHz with different conditions establishing protection of currently allocated services. The third method, Method C, with the proposal of no change to the Radio Regulations was also included. All these methods support the suppression of Resolution 650 (WRC-12).

# List of relevant documents

ITU Recommendations

* Recommendation ITU-R SA.609-2 “Protection criteria for radiocommunication links for manned and unmanned near-Earth research satellites”
* Recommendation ITU-R SA.1157-1 “Protection criteria for deep-space research”
* Recommendation ITU-R SA. 514-3 “Interference criteria for command and data transmission systems operating in the Earth exploration satellite and meteorological satellite services”
* Recommendation ITU-R F.758-3 “Considerations in the development of criteria for sharing between the terrestrial fixed service and other services”

ITU Reports

* Report ITU-R SA.2272 “Spectrum requirements for future EESS missions operating under a potential new EESS uplink allocation in the 7-8 GHz range” .
* Report ITU-R SA.2309 “Compatibility between EESS (Earth-to-space) and the space research service or the space operation service in the band 7 100-7 235 MHz”.
* Report ITU-R SA.2275 “Sharing between the EESS (Earth-to-space) and the fixed service in the 7‑8 GHz range”
* PDN Report ITU-R S.[FSS 7/8 GHz Compatibility] (see Annex 2 to Doc. 4A/669, July 2015). (Editor’s Note: Report not completed at the last Working Party 4A meeting).
* Report ITU‑R SA.2349 “Compatibility between GSO EESS (Earth-to-space), the fixed service, the mobile service, the space research service, or the space operation service in the band 7 190-7 235 MHz”

Latest versions ITU-R of the relevant new reports are available at: <http://www.itu.int/ITU-R/go/rcpm-wrc-15-studies>

# Actions to be taken

none

# Relevant information from outside CEPT

## European Union (date of proposal)

## Regional telecommunication organisations:

APT (August 2015 )

The preliminary APT (Asian Pacific Telecommunity) Common Proposal, which was agreed the APG15-5 (27 July-1 August 2015, Seoul, Rep Korea), is to support a modified CPM Method A.

Most APT Members are supportive of a global primary allocation to the EESS (Earth-to-space) in the band 7 190-7 250 MHz. APT Members are also of the view that the allocated services in this band should be adequately protected from potential interference due to the possible new allocation to the Earth exploration-satellite service (Earth-to-space), in accordance with Resolution 650 (WRC-12), and no constraints should be placed on these services.

After discussion and consideration of the views of APT Members, the APG15-5 meeting agreed a text for a Preliminary APT Common Proposal (PACP) with variation to method A. It is proposed to add a new footnote in the Table of Frequency Allocations in RR Article 5 so that “space stations in the EESS (Earth-to-space) operating in the geostationary satellite orbit shall not claim protection from emissions from the space research service in the frequency band 7 190-7 235 MHz”.

ATU (July 2015)

The African Common Position, which was agreed at the ATU APM15-4 meeting (20-24 July 2015) in Nairobi, Kenya, is to support the CPM Method A.

The formal endorsement will conclude 30 September 2015 taking into account the sub-regional meetings ECOWAS in Lomè, Togo (25 August) and SADC in September.

Summary of different views within ATU:

* SADC (Southern Africa) and EACO (East Africa) support Method A;
* GUINEE and SUDAN support Method C (NOC). The rationale is that the new EESS allocation puts additional restrictions to the fixed service;
* ECOWAS (West Africa) common position is to support Method A;
* ICAO considers that any of the three CPM Methods could be supported given that Methods A and B look at the band 7190-7250 MHz, which does not affect aviation and Method C proposes no change. All methods for this Agenda Item in CPM text can be supported

Arab Spectrum Management Group ASMG (August 2015)

The Arab Common Position, which was agreed at the 20th Meeting of the ASMG (22-27 August 2015) in Rabat, Morocco, is to support the CPM Method B.

CITEL (August 2015)

The Draft Inter-American Proposal, which was agreed at the WRC-15 Preparatory Meeting held on Aug 17-21, 2015 in Ottawa, Canada, supports the CPM Method A.

* MOD Article 5 to add global primary allocation to EESS (Earth-to-space) in the 7 190-7 250 MHz band and divide the Table of Frequency Allocation at 7 190 MHz to clarify the allocation of services within the Table.
* MOD No. 5.459 to ensure SOS not subject to 9.21 coordination with EESS.
* MOD No. 5.460 – consequential to dividing the Table at 7190 MHz.
* ADD new footnote to indicate that geostationary EESS systems shall not claim protection from existing and future stations of the FS and to limit the usage to TT&C.
* No EESS GSO restriction.
* MOD Article 21 Tables 21-2 and 21-3 - consequential
* MOD Appendix 7 Table 7b - consequential
* SUP Resolution 650 (WRC-12)

RCC (September 2014)

The RCC administrations do not object to allocation of frequency band 7190-7250 MHz on a primary basis to the Earth exploration-satellite service (Earth-to-space) provided the compatibility with systems of SOS, SRS, FS and MS is ensured.

Compatibility conditions between EESS (Earth-to-space) and other existing services in the 7-8 GHz range shall be incorporated in the Radio Regulations.

(Method B of the CPM Report).

## International organisations

IATA (date of proposal)

ICAO (September 2015)

This agenda item seeks to identify suitable additional spectrum for allocation to the Earth exploration-satellite service in the frequency range 7-8 GHz to complement the existing allocation at 8 025- 8 400 MHz. Whilst the scope of this agenda item is limited in terms of frequency bands within which studies can take place, aviation does operate a number of airborne Doppler navigation systems in the frequency band 8 750-8 850 MHz that need to be appropriately protected. Any allocation to the EESS should not adversely impact on the operation of aeronautical services in the frequency band 8750-8850 MHz.

ICAO position is to oppose any new allocation to the Earth exploration-satellite service allocation, unless it has been demonstrated through agreed studies that there will be no impact on aviation use in the frequency band 8 750-8 850 MHz.

IMO (November 2014)

(IMO did not present any specific position for AI 1.11 at the 2nd ITU inter-regional workshop, Nov 2014)

NATO (September 2015)

The NATO Military Position for WRC-15 was presented to CPG PTA-8 in document INFO-020. NATO supports allocation of the band 7190-7250 MHz to the EESS (E-s), based on studies that demonstrate compatibility with incumbent services and a future FSS (s-E) under Agenda item 1.9.1.

SFCG (August 2015)

The Space Frequency Coordination Group (SFCG) supports a primary allocation to EESS (Earth-to-space) in the band 7 190-7 250 MHz as provided for in Method A of the CPM Report with addition of an appropriate provision to avoid any restriction on existing and future SRS earth stations from GSO EESS satellites..

The frequency range 7235-7250 MHz would be used for those cases of EESS spacecraft links presenting a difficult sharing scenario with SRS spacecraft and SOS links in the frequency range 7190-7235 MHz.

SFCG does not support an allocation to EESS (Earth-to-space) in the 7145-7190 MHz band due to incompatibility with SRS (deep space).

Method B is not considered a suitable Method since the unjustified application of RR No. 9.21 for operation of EESS systems with regard to SOS would make EESS de-facto secondary to SOS without any technical justification.

WMO (November 2014)

WMO supports a new global primary allocation to the EESS (Earth-to-space) in the frequency band 7 190-7 250 MHz as provided in Method A of the draft CPM Report.

The WMO will meet in week 26 2015 to consolidate their position

## Regional organisations

ESA (August 2015)

Support to SFCG positions.

EUMETNET (December 2014)

Support to WMO positions.

CRAF (August 2015)

Support to SFCG positions.

Eurocontrol (July 2015)

To oppose any new allocation to the Earth exploration-satellite, unless it has been demonstrated through agreed studies that there will be no impact on aviation use in the frequency band 8 750-8 850 MHz.

European Aeronautical Spectrum Frequency Consultation Group -ASFCG- (September 2015)

Supports ICAO positions.

## OTHER INTERNATIONAL AND REGIONAL ORGANISATIONS

EBU (date of proposal)

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GSMA (date of proposal)

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