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| Summary:  |
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| Proposal: |
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DRAFT CEPT BRIEF ON AGENDA ITEM 1.12

1.12 to consider an extension of the current worldwide allocation to the Earth exploration-satellite (active) service in the frequency band 9 300-9 900 MHz by up to 600 MHz within the frequency bands 8 700-9 300 MHz and/or 9 900-10 500 MHz, in accordance with Resolution 651 (WRC 12)

# ISSUE

**Resolution 651 (WRC-12)** invites WRC-15 to consider the possible extension of the current worldwide allocation to the EESS (active) in the frequency band 9 300-9 900 MHz by up to 600 MHz within the frequency range 8 700- 9 300 MHz and/or 9 900-10 500 MHz while ensuring protection of existing services and taking due account of the safety services allocated in the frequency band 9 000 to 9 300 MHz.

**Resolution 651 (WRC-12)** also invites ITU-R to conduct compatibility studies addressing

* EESS (active) and existing services in the frequency bands 8 700-9 300 MHz and 9 900-10 500 MHz in order to ensure the protection of the existing services, taking into account the constraints as per No. 5.476A;
* unwanted emissions from stations operating in the EESS (active) within the frequency band 8 700-9 300 MHz into stations of the space research service operating in the frequency band 8 400-8 500 MHz;
* unwanted emissions from stations operating in the EESS (active) within the frequency band 9 900-10 500 MHz into stations of the radio astronomy service, space research service (passive) and EESS (passive) operating in the frequency band 10.6-10.7 GHz.

# Preliminary CEPT position

CEPT currently supports the allocation of additional radio frequency spectrum of 600 MHz in the frequency band [9 200-9 300 MHz and 9.9-10.4 GHz / 9.9-10.5 GHz] to the Earth Exploration-Satellite Service (active) with a [primary] status. Stations in the Earth exploration-satellite service (active) shall not cause harmful interference to, nor claim protection from, stations operating in the Radio Determination Services allocated in the same frequency bands.

Provisions for the protection of Fixed, Mobile, Space Research and Radio Astronomy Services from EESS (active) need to be implemented, as appropriate.

# Background

During the study cycle for WRC-07, studies were performed by ITU-R under Agenda Item 1.3 (WRC-07) to investigate the conditions for the extension of the EESS (active) allocation by 200 MHz above or below the former allocation 9 500 – 9 800 MHz. Based on the results and conclusions in report ITU-R RS.2094, WRC-07 finally decided to extend the allocation to 9 300- 9 900 MHz. The frequency band 9 300-9 500 MHz was allocated to EESS (active) on a primary basis and the frequency band 9 800-9 900 MHz on a secondary basis. This was possible because the overall sharing conditions were found to be acceptable if certain conditions are obeyed. These conditions are regulated in footnotes no. **5.475A, 5.476A, 5.477, 5.478, 5.478A,** and **5.478B** to protect other radio service in countries mentioned in the footnotes.

Space-borne radars operating in the EESS (active) in this band have demonstrated their important contributions to a large number of scientific and geoinformation applications which is also recognised in **Resolution 673 (rev. WRC-12).** The growing demand for higher resolution radar picture raises the need to further increase the transmission bandwidth of the next generation of EESS-radars in this band because the effectively used transmission bandwidth has a direct correspondence to the achievable picture resolution.

Sharing studies are currently under performance for all radio services allocated in both potential frequency ranges 8 700-9 300 MHz and 9 900-10 500 MHz, considered for extension by Resolution 651 (WRC-12).

* **General sharing conditions for EESS (active)**

It is important to note that EESS radars using the high resolution mode transmit in the direction of the measuring object only for very short time intervals, i.e. for less than seven seconds per exposure. It has been shown that the next generation of wideband spaceborne radar systems will have transmission characteristics similar to those already used in the current allocation. It is assumed that the conditions for sharing with Radiolocation, Fixed and other Services within the existing allocation of 9.300-9.900 MHz can be widely extrapolated into the candidate extension bands.

The high resolution spotlight mode of SAR4, with a chirp bandwidth of 1 200 MHz as described in PDN Recommendation RS.[EESS-9GHz-CHAR], is the only characteristics considered in sharing studies in the candidate expansion bands as defined by Agenda item 1.12 (WRC-15).

Additional sharing studies investigated the sharing conditions within the two potential extension bands and with radio services that claim particularly protection from unwanted emissions. These services are SRS and RAS.

* **Sharing EESS (active) with the Radiodetermination Service (RLS and RNS)**

WP 5B Liaison Statement (Document 7C/77) indicated that the frequency range 8 700-10 500 MHz is used by many different types of radars: airborne radar systems, shipborne radar systems, and beacon/ground-based radar. It is important to note that Report ITU-R RS.2094 provides results that show the compatibility between spaceborne SAR systems and radars operating in the bands 9 300-9 500 MHz and 9 800-10 000 MHz, and that EESS (active) systems have been operating in the band 9 300-9 900 MHz with no report of interference. Radar systems, characterized in Recommendation ITU-R M.1796, that operate on frequencies anywhere within the frequency range of 9 300-10 000 MHz are assumed to be compatible with EESS (active). Therefore, studies under WRC-15 Agenda Item 1.12 focused on current radars, identified in the revision of PDR Recommendation ITU-R M.1796, operating in the frequency bands 8 700-9 300 MHz and 10 000-10 500 MHz that were not considered in previous studies.

The minimum silence period between two consecutive measurements is 1 second corresponding to a distance between two consecutive points of measurement between 45 and 56 km. In this case potential interference to the operation of the ground radar systems in the considered frequency bands maybe possible during 5-7 consecutive periods which last from 35 to 45 seconds.

The effect of pulsed interference is difficult to quantify and is strongly dependent on receiver-processor design and mode of system operation. In general, numerous features of radars can be expected to help suppress low duty-cycle pulsed interference. Techniques for suppression of low-duty-cycle pulsed interference are contained in Recommendation ITU R M.1372 (see also Recommendation ITU-R M.1461 and Report ITU-R M.2081).

* **Sharing EESS (active) with the Radiolocation Service (RLS)**
* **Impact of radiolocation systems on the new generation of SAR-4 (System SAR-4 in the Draft New Recommendation ITU-R RS.[EESS-9GHz-CHAR])**

In the bands 8 700 – 9 300 MHz and 10 000 – 10 500 MHz, the simulation results show that in any case the impact of radiolocation systems into the new generation of SAR (SAR-4) is more than 13 dB below the interference protection criteria.

* **Impact of SAR-4 on radiolocation systems in the band 8 700 – 9 300 MHz**

Under detailed study in ITU-R WP 7C and WP 5B. (see PDN Report RS.[EESS-9GHz\_RDS] in Annex 10 of WP 7C Chairman's report 7C/188)

* **Impact of SAR-4 on radiolocation systems in the band 10 000-10 500 MHz**

Under detailed study in ITU-R WP 7C and WP 5B. (see PDN Report RS.[EESS-9GHz\_RDS] in Annex 10 of WP 7C Chairman's report 7C/188)

* **Sharing EESS (active) with the Radionavigation Service (RNS)**

Under detailed study in ITU-R WP 7C and WP 5B (see PDN Report RS.[EESS-9GHz\_RDS] in Annex 10 of WP 7C Chairman's report 7C/188)

* **Sharing EESS (active) with the Fixed Service (FS)**

The conditions for sharing with FS have already been determined for the band 9800-9900 MHz resulting in footnotes no. 5.477 and 5.478B. Further sharing studies have been performed with fixed service allocated in some administrations in the bands 8 700 – 8 750 MHz and 10 – 10.5 GHz. The results were confirmed by Liaison Statement from WP 5C (7C/196) showing that sharing is feasible.

* **EESS (active) on FS**

The studies basically confirm the results obtained in ITU-R Report RS.2094, showing that fixed service would be protected with large margins from 18 to 30 dB. Only when the fixed service station is pointing towards high elevation angles (greater than 35°) and in two particular azimuths would the fractional degradation performance criterion of 10% be exceeded, due to main beam to main beam coupling possibilities.

Details on timing and corresponding geometries can be found in the new Recommendation ITU-R RS.[EESS-9GHz-CHAR]

* **FS on EESS (active)**

Study results show that the SAR receiver protection criterion would be met with a margin between 8 and 13 dB depending on the band, when considering a deployment of several thousands of FS links. The margin obtained is lower than the margin obtained in ITU-R report RS.2094 due to the larger number of FS links considered, the SAR mode of operation, as well as the SAR characteristics (only the best case SAR had been studied in Report ITU-R RS.2094).

Sharing between EESS (active) and FS is therefore feasible.

* **Sharing EESS (active) with the Mobile Service (MS)**

Allocations to the MS are in the band 10.0-10.5 GHz and through footnotes no. 5.468 and 5.469 as well as **5.480** and **5.481** in the upper and lower extension range, respectively. The only identified usage of these bands by MS is ENG/OB in the band 10-10.5 GHz.

* **EESS (active) on MS**

The studies show that the protection criterion for ENG/OB which is limited to a long-term criterion would be met, due to the low percentage of activity off the SAR system. An additional short-term protection criterion was also considered, and would be also met with margins in the order of 22 dB, even when considering worst case azimuth and elevation angles up to 40°.

Details on timing and corresponding geometries can be found in the new Recommendation ITU-R RS.[EESS-9GHz-CHAR]

* **MS on EESS (active)**

Study results show that the SAR receiver protection criterion would be met with a margin of 16 dB when considering a deployment of several hundreds of ENG/OB transmitting at full power.

Sharing between EESS (active) and MS is therefore feasible.

* **Sharing EESS (active) with the Amateur Service (AR) and Amateur-satellite Service**

The amateur service is allocated in the band 10.0-10.5 GHz and the amateur-satellite service in the band 10.45-10.5 GHz, both on secondary basis.

[With regard to the amateur service, the study of impact of the EESS (active) sensor into the Amateur station receivers indicates that the interference may exceed an I/N of -6 or -10 dB, but for a very limited period of time in the order of 10 times 4 seconds over 11 days, which in total represents 0.004% of the time. The studies of the impact of amateur transmitters into the SAR receiver show a margin of 24 dB.

With regard to the amateur-satellite service, the study of the impact of the EESS (active) sensor into the Amateur satellite receiving Earth station indicates that the interference may exceed an I/N of -6 or -10 dB, but for a very limited period of time representing 0.0015% of the total simulation time of 11 days, which represents two periods of about 6 seconds every 5 to 6 days. The studies of the impact of the EESS (active) sensor into the Amateur satellite, as well as of the Amateur satellite or the Amateur Earth stations into the SAR receiver indicate very large margins.]

It should be noted that two footnotes of the European allocation table refer to this topic as follows:

EU17: In the sub-bands 3 400 – 3 410 MHz, 5 660 – 5 670 MHz, 10.36 - 10.37 GHz, 10.45 - 10.46 GHz the amateur service operates on a secondary basis. In making assignments to other services, CEPT administrations are requested wherever possible to maintain these sub-bands in such a way as to facilitate the reception of amateur emissions with minimal power flux densities.

EU23: In the sub-bands 5 660-5 670 MHz (Earth-to-space), 5 830-5 850 MHz (space-to-Earth) and 10.45-10.50 GHz the amateur-satellite additionally operates on a secondary and non-interference basis to other services. In making assignments to other services, CEPT administrations are requested wherever possible to maintain these allocations in such a way as to facilitate the reception of amateur emissions with minimal power flux densities.

* **Protection of the Space Research Service (SRS) from EESS (active) unwanted emissions in the band 8 400-8 500 MHz**

Besides sharing with radio services potentially affected by an extension, further studies are needed to investigate compatibility conditions of unwanted emissions from wideband EESS systems into nearby SRS allocation in the frequency band 8 400-8 500 MHz. Initial studies (7C/247) were already performed in the last study cycle for WRC-12 and the results were confirmed during this study cycle..

Dynamic analyses show that unwanted emission attenuations in the order of 55 dB for deep space missions, or 30 dB for near Earth missions would be needed in order to meet the protection criteria given in relevant ITU-R recommendations related to SRS. It should however be noted that these protection criteria are defined for continuous interference, while the SAR interference has a pulse nature. Studies available on the web indicate that this constraint may be relaxed by more than 18 dB when considering SAR signals. The actual performance of unwanted emissions of wideband SAR systems still needs to be assessed.

Mitigation techniques have been proposed in order to avoid any harmful interference in particular during critical events, or to mitigate the risk of damage or saturation to SRS receivers. These mitigation techniques are still being investigated.

* **Protection of the Radio astronomy Service (RAS) from EESS (active) unwanted emissions in the band 10.6-10.7 GHz**

The RF impact of unwanted emissions from wideband EESS (active) systems into the Radioastronomy service allocated in the band 10.6-10.7 GHz has been assessed. Unwanted emissions of such SAR systems would generate a percentage of data loss in the order of 3% when considering unwanted emission attenuations up to 30 dB. Meeting the 2% protection criterion indicated in recommendation ITU-R RA.1513 would require a 63 dB attenuation which feasibility needs to be assessed. In addition, there may be a risk of damage to RAS sensitive receivers in case of main beam to main beam coupling. Direct illumination of the RAS location by the SAR system should be avoided as far as practicable. Alternatively, if the SAR system has to make an acquisition of an area where a RAS station is located, observations in the band 10.6-10.7 GHz should be avoided at the same time.

* **Protection of the Earth Exploration-satellite Service (passive) from EESS (active) unwanted emissions in the band 10.6-10.7 GHz**

Further affected in the band 10.6-10.7 GHz, there are two more radio services SRS (passive) and EESS (passive). As SRS (passive) systems are sensors used around other planets, no interference to SRS (passive) would be possible from space borne SARs, thus, no study required.

The impact of unwanted emissions of SAR systems into EESS (passive) sensors used in the band 10.6-10.7 GHz has been analysed. Due to the attenuation of unwanted emissions, as well as the difference in orbital characteristics of SAR systems compared to EESS (passive) systems, no impact is expected in EESS (passive) and no specific regulatory conditions would be required.

* **Publication of the characteristics of typical next generation EESS (active) spaceborne radars**

The characteristics of a typical wideband EESS radar instrument is provided in the Draft New Recommendation ITU-R RS.[EESS-9GHz-CHAR],approved by SG7.

# List of relevant documents

## ITU Documentation

* ITU-R Recommendations

Remote Sensing: ITU-R RS.1029, RS.1166, RS.1280, RS.1859, RS.1861, RS.1883, RS.2017,

Space applications and meteorology: ITU-R SA.509, SA.609, SA.1016, SA.1020, SA.1022, SA.1157,SA.1743

Radio astronomy: ITU-R RA.517, RA.611, RA.769, RA.1513, RA.1631

Mobile, radiodetermination, amateur satellite services: ITU-R M.628, M.629, M.824, M.1041, M.1044, M.1372, M.1461, M.1583, M.1732, M.1796, M.1824, M.1849, M.1851

Spectrum Management: ITU-R SM.337, SM.1138, SM.1535, SM.1541, SM.1542;

Fixed Service: ITU-R F.699, F.758, F.1108, F.1403, F.1245, F.1336

* ITU-R Reports:

Mobile, radiodetermination, amateur, amateur-satellite services: TU-R M.2050, M.2076, M.2081, M.2128

Remote Sensing: ITU-R RS.2094, RS.2178, RS.2188, RS.2274

Further new reports under development see section 5

## EU Documentation (Directives, Decisions, Recommendations, other), if applicable

## CEPT Documentation

ECC Report 018 “Sharing RAS operating in the band 10.6-10.7 GHz and other services”

ECC Report 173 “Fixed Service in Europe – Current use and future trends post 2011”

ERC Report 040 “Fixed Service system parameters for frequency sharing”

# Actions to be taken

In line with Resolution 651(WRC15), ITU-R Working Party 7C will have to develop the following documents. CEPT will observe the progress and contribute, as appropriate, to the development of the documents.

ITU-R Recommendation

1. Recommendation ITU-R RS.[EESS-9GHz-Char] [”Characteristics of synthetic aperture radars operating in the Earth exploration-satellite service (active) around 9.600 MHz”]

ITU-R Reports:

1. Report ITU-R RS.[EESS-9GHz\_OOBE] [RF compatibility of unwanted emissions from 9 GHz EESS synthetic aperture radars (SAR) with the EESS(passive), SRS (passive), SRS and RAS operating in the frequency bands 8.4-8.5 GHz and 10.6-10.7 GHz]
2. Report ITU-R RS.[EESS-9GHz\_RDS] [Sharing analyses of very wideband EESS SAR transmissions with stations in the radio determination service operating in the frequency bands 8 700-9 300 MHz and 9 900-10 500 GHz]
3. Report ITU-R RS.[EESS-9GHz\_FS/MS/AS] [Sharing between the Earth exploration-satellite service (active) and the fixed service, mobile service, amateur, amateur-satellite services in the frequency bands 8 700-8 750 MHz and 10 000-10 500 MHz ]

ITU-R CPM Report – Chapter 2 Agenda Item 1.12

See Annex 11 to WP 7C Chairman's report (document 7C/188).

# Relevant information from outside CEPT (examples of these are below)

## European Union (date of proposal)

## Regional telecommunication organisations:

APT (05 July 2013)

The APT preliminary views are that:

It supports current ITU-R studies concerning the sharing and compatibility issues for the extension of EESS (active) spectrum.

Appropriate protection of services to which the above mentioned frequency bands are currently allocated in the same frequency bands should be ensured according to the Radio Regulations.

Protection of services in adjacent frequency bands should be ensured.

Other Views

 View 1

If compatibility studies show adequate protection, the APT supports an extension of EESS (active) by up to 600 MHz within the frequency ranges 8 700-9 300 MHz and/or 9 900-10 500 MHz on a primary and/or secondary basis.

 View 2 (driven by one Administration)

If compatibility studies show adequate protection, the APT supports an extension of EESS (active) by up to 600 MHz within the frequency bands 8 700-9 300 MHz and/or 9 900-10 500 MHz on a secondary basis. Protection to existing services are to be provided by

* Hard pfd limits
* eirp density limits
* no constraints on future development of existing services

ATU (date of proposal)

Arab Group (28 November 2013)

Not supporting an extension of the current worldwide allocation to the Earth exploration-satellite (active) service because of heavy use of terrestrial fixed services in these candidate bands.

Follow up the current studies.

CITEL (8 November 2013)

Preliminary Views

Brazil, Canada, United States:

Supports studies that would lead to the potential extension of the current EESS (active) allocation in the frequency band 9 300-9 900 MHz by 600 MHz and supports the ITU-R study results on the EESS spectrum requirements which demonstrate that 1 200 MHz of contiguous spectrum is necessary.

Compatibility with existing services will have to be ensured; in accordance with the appropriate protection criteria and taking into account any available mitigation techniques that would reduce the level of unwanted emissions into adjacent band.

United States:

If studies demonstrate that the existing in-band services and the services in 10.5-10.7 GHz frequency range are protected, the United States supports extending the EESS allocation by up to 600 MHz. Studies should initially consider only the 9 900 MHz – 10.5 GHz range. Only if studies prove that existing services cannot be protected and/or sufficient spectrum cannot be made available in the 9 900 MHz – 10.5 GHz range, does the United States support consideration of the 8 700-9 300 MHz range.

RCC (4 December 2013)

The RCC Administrations consider that worldwide extension of the available allocation to the Earth exploration-satellite service (active) in the frequency band 9 300-9 900 MHz by up to 600 MHz would be more preferable within the frequency band 9 900-10 500 MHz and the extension would be possible only subject to defining the conditions for providing protection for systems in other services operating in the mentioned and adjacent frequency bands.

The RCC Administrations consider that in case of additional allocation of up to 600 MHz to the EESS (active) this frequency band shall be used only by the EESS systems with the pfd limits obtained through the ITU-R studies and also subject to not claiming protection from the systems in the services having allocations in this frequency band.

The RCC Administrations consider that protection shall be ensured for systems in other services, specifically RLS in the frequency band 9 900-10 500 MHz as well as for radiolocation stations operating in the frequency band 9 200-9 300 MHz deployed on river boats and sea ships.

## International organisations

IATA (date of proposal)

ICAO (4 October 2012, AN-Conf/12)

Oppose any allocation to the Earth exploration-satellite service in the frequency band 9 000 – 9 200 MHz unless

* it has been demonstrated through agreed studies that there will be no impact on aviation use
* no additional constraints are place on the use of the frequency band by aeronautical systems

No change to Nos. 5.337, 5.427, 5.474 and 5.475.

IMO (18 October 2013; ITU/IMO)

Protection of the maritime radionavigation service, operating in the frequency band 9 200-9 500 MHz, is essential for "safety of navigation" and "safety of life" and in accordance with Nos.1.59 and 4.10 of the Radio Regulations.

IMO requests that the band 9 200-9 500 MHz be excluded from consideration under agenda item 1.12, for Earth exploration satellite (active) service, due to the potential harmful impact on global shipping.

NATO (6 December 2013) (CaP 3 Civ/Mil)

Preliminary NATO Military Position

If studies show compatibility with the incumbent radio services and other services in nearby allocations are adequately protected from unwanted emissions, NATO will support an additional allocation of up to 600 MHz.

SFCG (03 July 2013)

SFCG supports an extension of the current worldwide allocation to the Earth exploration-satellite (active) service in the frequency band 9 300 – 9 900 MHz by 600 MHz.

Compatibility with SRS (space-to-Earth) links in the 8 400 – 8 500 MHz band and the EESS (passive) in the 10.6 – 10.7 GHz band will have to be ensured, in accordance with the appropriate protection criteria, taking into account any available mitigation techniques that would reduce the level of unwanted emissions in those two bands and the need for operational coordination with SRS (deep space) operators.

WMO (08 February 2013, SG-RFC)

WMO urges that a new EESS (active) allocation in the 9 GHz frequency range shall ensure adequate protection of meteorological applications, in particular, meteorological radars in the frequency band 9 300-9 500 MHz and passive sensors in the frequency band 10.6-10.7 GHz.

IARU (May 2013)

As noted under Agenda Item 1.6.1, the band 10.0-10.5 GHz is allocated to the amateur service on a secondary basis. It is a popular band for amateur experimentation, investigation of propagation phenomena, and point-to-point communication between networked repeater stations.

The band 10.45-10.5 GHz is allocated to the amateur-satellite service on a secondary basis. Owing to the popularity of the 10.0-10.5 GHz band for terrestrial amateur communication, increased use of this allocation for amateur satellite communication is anticipated.

The IARU requests that existing and future use of this band be taken into account and continue to be provided for. An illustration of how this can be accomplished is found in Recommendation ITU-R RS.1260-1; see no. 5.279A which applies to the use of the band 432-438 MHz by the Earth exploration-satellite service (active).

## OTHER INTERNATIONAL AND REGIONAL ORGANISATIONS

CRAF (January 2013)

The addition of 600 MHz to the existing allocation can only be supported if the Radio Astronomy Service and the Space Research Service (passive) using radio astronomy techniques in nearby bands are adequately protected from unwanted emissions via appropriate regulation. CRAF considers that the burden of any required co-ordination actions should rest with the satellite operator and not individual RAS observatories.

ESA (03 July 2013)

Same position as SFCG

EUMETNET (November 2012)

EUMETNET supports this agenda item but urges that it would not lead to any review of the conditions of use of EESS (active) in the currently existing band 9 300-9 500 MHz band used for meteorological radars.

Eurocontrol (date of proposal).

## OTHER INTERNATIONAL AND REGIONAL ORGANISATIONS

EBU (date of proposal)

GSMA (date of proposal)