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| **The 6th Meeting of the APT Conference Preparatory****Group for WRC-23 (APG23-6)** | **APG23-6/INP-xx** |
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Thailand (Kingdom of)

**proposal for the preliminary apt common proposals
on wrc-23 agenda items 1.12, 1.13, 1.14, 9.1 Topic a and 9.1 Topic D**

**Agenda Item 1.12:**

*to conduct, and complete in time for WRC-23, studies for a possible new secondary allocation to the Earth exploration-satellite (active) service for spaceborne radar sounders within the range of frequencies around 45 MHz, taking into account the protection of incumbent services, including in adjacent bands, in accordance with Resolution* ***656 (Rev.WRC-19)****.*

**1. Background**

This agenda item seeks a new secondary allocation to the Earth exploration-satellite service (EESS) (active) for spaceborne radar sounders within a range of frequencies around 45 MHz while taking into account the protection of incumbent services including those in adjacent bands. Studies to support this agenda item have been developed in PDN Report ITU-R RS.[SPACEBORNE VHF RADAR SOUNDER]. Specifically, this Report contains the results of compatibility studies, based on the proposed EESS (active) radar characteristics provided in Recommendation ITU-R RS.2042 and the characteristics of the incumbent services as provided by the responsible Working Parties.

Five methods have been proposed in the CPM report:

* **Method A1** proposes to establish a new global secondary allocation to the EESS (active) in the frequency band 40-50 MHz. It also proposes a new footnote in the Table of Frequency Allocations of RR Article **5** that references a proposed new WRC Resolution to protect incumbent in-band and adjacent-band services.
* **Method A2** proposes to establish a new global secondary allocation to the EESS (active). This new secondary allocation is proposed to be limited, through a dedicated footnote, to the operation of spaceborne radar sounder systems, over the frequency band 40-50 MHz, in the Table of Frequency Allocations of RR Article **5**. This footnote would also include relevant technical conditions, such as the power flux-density at the surface of the Earth, to address the protection of incumbent services in the frequency band 40-50 MHz.
* **Method B** proposes to establish a new global secondary allocation to the EESS (active). This new secondary allocation is proposed to be limited, through a dedicated footnote, to the operation of spaceborne radar sounder systems, over the frequency band 40-50 MHz, in the Table of Frequency Allocations of RR Article **5**. In addition, this footnote would address the protection of the secondary radiolocation service in the frequency bands 42-42.5 MHz and 46‑68 MHz.
* **Method C** proposes to establish a global secondary allocation to the EESS (active) in the frequency band 40-50 MHz in the Table of Frequency Allocations of RR Article **5**.
* **Method D** proposes no change to the Radio Regulations (Articles and Appendices).

The five methods propose the suppression of Resolution **656** **(WRC‑19)**.

**2. Views**

Thailand supports the APT preliminary view at APG23-5.

In order to ensure the protection of the existing services in the frequency band 40-50 MHz and adjacent bands, Thailand supports the following elements:

* The Earth exploration-satellite service (active) should be limited to spaceborne radar sounder systems.
* Establishment of operation limits for EESS (active) should include the pfd limit at the surface of the Earth, specific coverage areas as well as operation time limit.
* Active spaceborne sensors in the Earth exploration-satellite service should not cause harmful interference to, nor claim protection from stations in the radiolocation and space research services operating in the 40-50 MHz band.

To ensure the aforementioned conditions, Method A1 Option 2 or Option 3 is preferred to address this agenda item.

**Agenda Item 1.13:**

*to consider a possible upgrade of the allocation of the frequency band 14.8-15.35 GHz to the space research service, in accordance with Resolution* ***661 (WRC-19)****.*

**1. Background**

Resolution **661 (WRC-19)** invites ITU-R to investigate and identify all relevant scenarios that need to be considered in assessment of a possible upgrade to the allocation to the space research service to primary status in the frequency band 14.8-15.35 GHz, and to conduct and complete such studies in time for WRC-23 so as to determine any associated technical and regulatory conditions to ensure protection of the current use and future development of the existing primary services. WRC-23 agenda item 1.13 calls for examination, on the basis of the results of studies by the ITU Radiocommunication Sector, of the possibility of upgrading the secondary status of the allocation to the space research service (SRS) to primary status.

Five methods have been proposed:

* **Method A** proposes no change to the RR and maintains the status of the SRS allocation as secondary;
* **Method B** proposes to make regulatory changes to the RR to upgrade the secondary allocation to the space research service (space-to-space) in the frequency band 14.8-15.35 GHz to primary status. This includes two alternatives to modify the RR Article **5** Table of Frequency Allocations in the frequency band 14.8-15.35 GHz to upgrade the secondary SRS (space-to-space) allocation to primary and retain the secondary allocation to SRS (space-to-Earth) and (Earth-to-space). The method also seeks to modify Table **21-4** in RR Article **21** to add a row to specify power flux-density (pfd) limits for SRS (space-to-space) in the frequency band;
* **Method C** includes a modification to the RR Article **5** Table of Frequency Allocations in the frequency band 14.8-15.35 GHz to upgrade the secondary SRS allocation, except SRS active and SRS passive applications, to primary and also modify Table **21-4** in RR Article **21** to add rows to specify pfd limits for SRS (space-to-Earth) and (space-to-space) in the frequency band 14.8-15.35 GHz. Table A of Annex 2 to RR Appendix **4** is modified to add commitment to follow regulatory provisions to protect the radio astronomy service (RAS). Tables 7b and 8c of Annex 7 to RR Appendix **7** are modified to add parameters for determination of coordination distances around SRS earth stations. Elements for a new WRC Resolution are proposed to upgrade the status of the existing assignments recorded in the Master International Frequency Register (MIFR) with the original date of receipt, subject to conformity with the new conditions of the allocation of the frequency band 14.8-15.35 GHz to the space research service;
* **Method D** proposes to upgrade the status of the SRS allocation to primary, with provisions to avoid imposing constraints on the current use and future development of existing systems of primary services, including the aeronautical mobile service (AMS). It also provides further protection to the RAS. This method also avoids the usage of deep-space missions in that frequency band because the impact of those missions was not studied;
* **Method E** allows upgrading of the SRS and provides provisions to both protect and avoid constraints on primary services for the fixed service (FS) and mobile service (MS) in the frequency band 14.8-15.35 GHz, as well as RAS in the adjacent frequency band 15.35-15.4 GHz. There are three sub-methods;
* Method E1: While this method allows the upgrading of the SRS it shall be ensured with provisions to avoid imposing constraints on existing and future systems of primary services in the frequency band 14.8-15.35 GHz and to ensure the protection of all primary services in the frequency band as well as the RAS in the adjacent frequency band 15.35-15.4 GHz and footnote to avoid the usage of passive and active sensors and deep space missions with primary status in that frequency band because the impact of those missions was not studied. Finally, Resolution **661 (Rev.WRC-19)** would be consequentially suppressed.
* Method E2: Although this method is proposing the upgrading of the SRS, the current studies of the impact of AMS on SRS earth stations led to a large horizontal separation distance to avoid exceeding the SRS threshold which would impose constraints on the AMS systems. Furthermore, the current studies also show that harmful interference could be caused to stations of the helicopter television transmission systems (HTTS) and RAS using the frequency band 15.35-15.40 GHz by stations of the SRS.

This method also includes modifications to Table **21-4** in RR Article **21** to add a row to specify pfd limits for the SRS (space-to-Earth) and (space-to-space) in order to protect the existing systems of primary services in the frequency band 14.8-15.35 GHz.

It is also proposed to have a pfd limit in order to protect the AMS, HTTS and RAS operated in neighbouring countries.

The method limits the usage of the SRS for near-Earth missions avoiding the upgrade of all other subsets of the SRS (SRS (passive), SRS (active) and SRS (deep space)) missions in that frequency band because the impact of those missions was not studied.

This method adds a footnote to state that the SRS shall not claim protection from existing fixed service and the mobile service.

* Method E3: This method proposes to make regulatory changes to the RR to upgrade the secondary allocation to the SRS in the frequency band 14.8*-*15.35 GHz into primary status and to protect the existing primary FS and MS in the same frequency band and services in the adjacent frequency band. The regulatory provisions contained in this Method E3 are considered based on the study of protection criteria derived by *I/N* concept with respect to systems in the FS and MS including AMS allocated in the frequency band 14.8*-*15.35 GHz. The method also avoids the usage of passive and active sensors and deep space missions with primary status in that frequency band because the impact of that mission was not studied. This method also proposes a footnote to state that the space research service shall not cause harmful interference to the RAS.

All these methods propose suppression of Resolution **661 (WRC-19)**.

**2. Views and Proposals**

Thailand is of the view that the upgrade of the SRS allocation from secondary to primary in the frequency band 14.8-15.35 GHz should ensure protection to and not adversely affect the existing services in the frequency band 14.8-15.35 GHz and adjacent bands, including the band 15.35-15.4 GHz to which the RAS is allocated.

Furthermore, stations in the SRS service should not claim protection from stations in the fixed and mobile services in this band.

In order to satisfy the above conditions, Method E Option 2 is preferred to address this agenda item.



**Agenda Item 1.14:**

*to review and consider possible adjustments of the existing or possible new primary frequency allocations to EESS (passive) in the frequency range 231.5-252 GHz, to ensure alignment with more up-to-date remote-sensing observation requirements, in accordance with Resolution* ***662 (WRC-19)****.*

**1. Background**

The objective of WRC-23 agenda item 1.14 is to review and consider possible adjustment of the existing or possible new primary frequency allocations to the Earth exploration-satellite service (EESS) (passive) in the frequency range 231.5-252 GHz, to ensure alignment with more up-to-date remote sensing observation requirements and to ensure that the allocations to EESS (passive) within the considered frequency range correspond to the observation requirements for satellite passive microwave sensing without unduly constraining the operation of other primary services currently allocated in this frequency range, taken into account the possible effect on the other primary services in the considered frequency range.

EESS (passive) microwave sensing mainly includes Ice Cloud Measurements and atmosphere gases measurement. The Ice Cloud Imager (ICI) instrument which is a conical scanning millimeter/sub-millimeter wave radiometer, performs measurements cloud ice water paths and cirrus clouds operating in two symmetric spectral bands of 239.2-242.2 GHz and 244.2-247.2 GHz. The Microwave Limb Sounder (MLS) instrument continuously observes thermal emission from utilizing spectrometers of numerous channels within the frequency band 231.5-252 GHz to measure the chemical processes and compounds within Earth’s atmosphere.

Compatibility studies show that, in the frequency bands 239.2-242.2 GHz and 244.2-247.2 GHz, the sharing between the conical scanning passive sensors (like ICI) and systems of fixed service (FS)/mobile service (MS) is not feasible. Studies also show that limb sounding passive sensors are compatible with systems of FS/MS in the whole frequency range 231.5-252 GHz. Further, the sharing between the fixed-satellite service (FSS) (GSO, space-to-Earth) and EESS (passive) is feasible within the whole frequency range 232-240 GHz.

Three methods are proposed:

* **Method A**: Addition of new primary allocations to the EESS (passive) in the frequency bands 239.2-242.2 GHz and 244.2-247.2 GHz, and implementation of power limits on the FS and MS in the frequency band 239.2-241 GHz;
* **Method B**: Addition of new primary allocations to the EESS (passive) in the frequency bands 239.2-242.2 GHz and 244.2-247.2 GHz, switch of the current FS and MS allocations in the frequency band 239.2-241 GHz to the frequency band 235-238 GHz and limitation of the EESS (passive) allocation in the 235-238 GHz to limb-sounding operations;
* **Method C**: No change.

**2. Views**

Thailand supports Method B that adds new primary allocations to the EESS (passive) in the frequency bands 239.2-242.2 GHz and 244.2-247.2 GHz and shift the current FS and MS allocations in the frequency band 239.2-241 GHz to the frequency band 235-238 GHz.

To ensure that there will be no potential future impact to the FS and MS in the frequency band 235-238 GHz, Method B Option 1 or Option 2 is preferred to address this agenda item.

**Agenda Item 9.1 topic a):**

*In accordance with Resolution* ***657 (Rev.WRC-19)****, review the results of studies relating to the technical and operational characteristics, spectrum requirements and appropriate radio service designations for space weather sensors with a view to describing appropriate recognition and protection in the Radio Regulations without placing additional constraints on incumbent services.*

**1. Background**

Space weather refers to the physical processes occurring in the space environment that ultimately affects human activities on Earth and in space. Space weather is influenced by the X-ray, Ultraviolet (UV), high energic particles and strong solar wind generated by Coronal Mass Ejection (CME). Space weather observations are important for detecting and forecasting solar activity events that impact services critical to the economy, safety and security of administrations and their population. These observations are made from ground-based and space-based systems. Some of the sensors operate by receiving signals of opportunity, including, but not limited to, low-level natural emissions of the Sun, Earth’s atmosphere and other celestial bodies, and therefore may suffer harmful interference at levels which could be tolerated by other radio systems. However, no frequency bands have been documented in any manner in the RR for space weather sensor applications.

Agenda item 9.1 topic a) was therefore established with a view to describing appropriate recognition and protection of space weather sensors in the RR without placing additional constraints on incumbent services.

As a responsible group for this agenda item, ITU-R WP 7C submitted the draft CPM text in October 2022.

The CPM report provided the following:

* example of space weather definition;
* potential radio service designation for space weather;
* possible solution under RR Articles **1** and **4** that WRC-23 could implement;
* that the candidate frequency bands to be protected need to be finalized and that the sharing studies and identification of new allocations could be done at WRC-27; and
* potential new WRC-23 Resolution on the importance of space weather sensor systems with 4 views specified in the CPM text for this issue.

**2. Views**

Thailand supports the definition of space weather as specified in the CPM text and the designation of space weather sensing as an application of the meteorological aids service.

Thailand also supports View D in the CPM text with the elaboration of the aforementioned definition and designation in the WRC resolution related to the WRC-27 preliminary agenda on space weather sensors in order to avoid the modification of the Radio Regulations at WRC-23.

**Agenda Item 9.1 topic d):**

*Protection of EESS (passive) in the frequency band 36-37 GHz from non GSO FSS space stations.*

**1. Background**

Under the WRC-23 agenda item 9.1, topic d), which is a continuation of study matters that began but were not fully resolved under WRC-19 agenda item 1.6, there are two potential interference scenarios that were studied, while taking into account the fixed-satellite service (FSS) characteristics provided by the relevant ITU-R contributing group and the Earth exploration-satellite service (EESS) (passive) characteristics contained in Recommendation [ITU-R RS.1861-1](https://www.itu.int/rec/R-REC-RS.1861/en):

* Interference into the sensing channel of EESS (passive) from FSS non-GSO constellations operating in the frequency band 37.5-38 GHz at a lower altitude than EESS (passive) sensors.
* Interference into the cold calibration channel of EESS (passive) from FSS non-GSO constellations operating in the frequency band 37.5-38 GHz at a higher altitude than EESS (passive) sensors.

The CPM report shows the following:

* With regard to the first scenario, the results of one study considering two different non-GSO FSS systems indicate that an unwanted emission power density limit of −31 dBW/100 MHz in the frequency band 36-37 GHz would be needed. This would be applicable to non-GSO FSS constellations operating at altitudes below 970 km (maximum altitude of EESS (passive) sensors in this frequency band). The results of another study considering one non-GSO FSS system show that there is a minimum positive margin of 10-15 dB to the EESS (passive) protection criteria. Both studies consider a side lobe level of 0 dBi, no additional satellite body blockage loss, and no apportionment of the EESS (passive) protection criterion. When considering an additional attenuation provided by the FSS satellite body of more than 18 dB, all studies conclude that no specific unwanted emission limit would be needed to cover this scenario.
* With regard to the second scenario, the results of two studies considering three different non-GSO FSS systems indicate that an unwanted emission power density limit of −31 dBW/100 MHz in the frequency band 36-37 GHz would be needed, without apportionment of the EESS (passive) protection criterion. This would be applicable to non‑GSO FSS constellations operating at altitudes above 407 km (minimum altitude of EESS (passive) sensors in this frequency band) and below 2 000 km (limited to LEO constellations). Another study that considers a different set of operational FSS characteristics has shown that there is a minimum margin of approximately 7 dB to the EESS (passive) protection criteria when only assessing interference from the particular constellation considered, and this study concludes that no specific unwanted emission limit would be needed to cover this scenario.

**2. Views**

Thailand supports the APT preliminary view at APG23-5 that supports the protection of EESS (passive) sensors operating in the frequency band 36-37 GHz, including cold-sky calibration, from non-GSO FSS systems operating in the frequency band 37.5-38 GHz under this agenda item.

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