
PLENARY MEETING

04 October 2019

Committee on Radio Astronomy Frequencies (CRAF)

**CRAF POSITION ON WRC-15 AGENDA ITEMS RELEVANT TO RADIO
ASTRONOMY**

FOR INFORMATION

The Expert Committee on Radio Astronomy Frequencies (CRAF) of the European Science Foundation (ESF) represents European radio astronomers and observatories in matters of spectrum management. It is a sector member of the ITU and active in the study and promotion of the protection of the frequency bands used by the Radio Astronomy Service (RAS). In this document the WRC-19 Agenda Items of interest to CRAF are discussed and CRAF's position on each is stated.

CRAF requests that the views in this document be taken into account by administrations when spectrum allocations and Methods are considered at the Conference under these agenda items.

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CRAF Position on WRC-19 Agenda Items Relevant to Radio Astronomy

AI 1.1 to consider an allocation of the frequency band 50-54 MHz to the amateur service in Region 1, in accordance with Resolution 658 (WRC-15);

Comments

The frequency band 50-54 MHz is allocated to the amateur service on a primary basis in Region 2 and Region 3. Under WRC-19 AI 1.1 the proposed use of the 50 – 54 MHz band can be split into narrowband use for the 50 – 52 MHz band and wideband use for the 52 – 54 MHz band.

There are several radio telescopes in Region 1 that operate in the band 50-54 MHz, many of which are also involved in passive space weather research. Due to the relatively large bandwidth of the wideband transmissions and a high activity factor, the 52 – 54 MHz band would become practically unusable for the LOFAR and NENUFAR radio telescopes. Separation distances between radio telescopes and amateur stations in the order of 500 km (calculated according to the methodology in Recommendation ITU-R P.526) would be required in order to achieve compatibility (according to the detrimental threshold level for radio astronomy given in Recommendation ITU-R RA.769) and not to limit research for radio astronomy and related fields, such as space weather research. Radio telescopes identified as space weather sensors are LOFAR (several stations across Europe), NENUFAR (France), the Radio Heliograph and ORFEES (France), the Decametre Array (France), GURT (Ukraine) and 32 CALLISTO instruments (with a station in Switzerland).

CRAF Position

CRAF requests that great care be taken in allocating bands to active services, which may block the further development of space weather research. CRAF supports method D ‘NOC’, and opposes Methods A and C, which propose to allocate all or part of the frequency band 50-54 MHz to the amateur service on a primary basis in Region 1

AI 1.6 to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), in accordance with Resolution 159 (WRC-15);

Comments

The radio astronomy bands 42.5 - 43.5 GHz and 48.94 - 49.04 GHz may be affected by allocations as a result of this Agenda Item. The RAS frequency band 42.5-43.5 GHz is protected by RR Footnotes 5.551H and 5.551I. Studies have shown that substantial filtering of the satellite emissions, or other operational measures by FSS operators, would be needed to satisfy these protection requirements. Separation distances for the protection of the RAS frequency

bands 48.94-49.04 GHz and 51.4-53.4 GHz from the earth stations can reach up to 129 km, which in some countries may require cross-border coordination. Work within the ITU-R study groups did not succeed in deriving the epfd limits required by the resolution. Two diverging methodologies were therefore proposed to resolve the Agenda Item. One Method, to facilitate the rapid adoption of a regulatory framework, proposes complex regulatory changes; the alternative Method defers regulatory changes until acceptable epfd limits can be derived by the appropriate competent groups in time for the next WRC in 2023.

CRAF Position

CRAF supports Method B, which proposes further work and hence deferment of regulatory changes until appropriate epfd limits can be derived.

AI 1.7 to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with RES 659 (WRC-15);

Comments

CRAF supports the protection of existing RAS allocations in the 150.05-153.0 MHz and 406.1-410.0 MHz bands. These bands are widely used by radio astronomers around the world for a number of different types of astronomical observations. Studies have shown that in-band sharing between RAS and non-GSO satellites with short duration missions is not possible. For out-of-band emissions, compatibility studies conclude that a guard-band to the edge of the RAS frequency bands of at least 1.5 MHz may be required to facilitate acceptable separation distances for the protection of RAS operations.

CRAF Position

Although none of the current Methods as stated in the CPM text ensures complete protection of the RAS, Method C may be acceptable, with SOS (space-Earth) operation in the proposed band and SOS (earth-Space) needs met using the lower edge of the 148 – 149.9 MHz frequency band, together with appropriate separation distances between RAS sites and SOS ground stations.

AI 1.8 *to consider possible regulatory actions to support Global Maritime Distress Safety Systems (GMDSS) modernisation and to support the introduction of additional satellite systems into the GMDSS, in accordance with Resolution 359 (Rev.WRC-15);*

Comments

As stated in Res. 359, the new GMDSS provider must provide protection of incumbent services in accordance with the Radio Regulations, including those in adjacent frequency bands, from harmful interference. CRAF supports the protection of the existing primary RAS allocation in the 1610.6 - 1613.8 MHz band from a proposed future GMDSS provider in the MSS band. Since this proposed future GMDSS provider's satellites became operational, some administrations operating RAS in the frequency band 1 610.6-1 613.8 MHz have reported that harmful interference has been experienced from the downlink operations of this MSS system; these reports were brought to the attention of the ITU-R and the responsible administration for the satellite system. However, harmful interference to RAS operations has continued despite efforts on all sides to resolve the issue. A second generation of satellites became operational earlier this year. Measurements on the second generation satellites are described in a recent working document towards a preliminary new ITU-R Report. This work has not yet been finalized and does not establish compatibility or incompatibility with the RAS for these satellites; the issue of harmful interference to RAS operations is still unresolved.

CRAF Position

Method B4 requires effective regulatory actions such as setting obligatory EPFD threshold limits in the Radio Regulations for the protection of the RAS band from NGSO satellite systems operating in the band 1 613.8-1 626.5 MHz. This could be acceptable to CRAF but if no mandatory thresholds, according to ITU-R RA.769-2, are included in the RR, CRAF supports Method B3 – 'NOC'.

to consider, based on the results of ITU-R studies:

AI 1.9

1.9.1

regulatory actions within the frequency band 156-162.05 MHz for autonomous maritime radio devices to protect the GMDSS and automatic identifications system (AIS), in accordance with Resolution 362 (WRC-15);

1.9.2

modifications of the Radio Regulations, including new spectrum allocations to the maritime mobile-satellite service (Earth-to-space and space-to-Earth), preferably within the frequency bands 156.0125-157.4375 MHz and 160.6125-162.0375 MHz of Appendix 18, to enable a new VHF data exchange system (VDES) satellite component, while ensuring that this component will not degrade the current terrestrial VDES components, applications specific messages (ASM) and AIS operations and not impose any additional constraints on existing services in these and adjacent frequency bands as stated in recognizing d) and e) of Resolution 360 (Rev.WRC-15);

Agenda Item 1.9.1

Comments

The RAS band potentially affected by allocations proposed within this Agenda Item is 322.0-328.6 MHz (primary, all regions and RR No. 5.149), which contains an important spectral line at 327.4 MHz and is additionally important for continuum observations because of its near octave spacing with the RAS allocations at VHF & UHF around it. AMRD are grouped and identified as: AMRD Group ‘A’, that enhance the safety of navigation; and, AMRD Group ‘B’ that do not enhance the safety of navigation. Compatibility studies performed conclude that the second harmonic emissions of various channels in the frequency range 160 – 162 MHz used by AMRD equipment may exceed the threshold interference levels detrimental to the RAS in the 322.0-328.6 MHz band in some circumstances. In this case additional measures for suppressing the spurious emissions for protecting the RAS would be needed. Proposals under the CPM Methods do not contain adequate specific protection measures for the RAS, although the proposed, new footnote texts include a reference: “...use should be in accordance with the most recent version of Recommendation ITU R M.[AMRD]”. However, as yet there is no specific text in this Recommendation which covers RAS protection issues.

CRAF Position

CRAF does not oppose the proposals in Method A for Group A AMRD that enhance the safety of navigation. For Group B AMRD equipment, CRAF prefers Method B2, as within the proposals for revision of the RR Appendix 18 footnotes, coordination with affected administrations to protect the RAS is implicit.

Agenda Item 1.9.2

Comments

The RAS bands potentially affected by the new regulatory provisions proposed within this Agenda Item are 150.05-153.00 MHz (primary in R1, Australia & India and RR No. 5.149) and 322.0-328.6 MHz (primary, all regions and RR No. 5.149); the latter band contains an important spectral line at 327.4 MHz and is additionally important for continuum observations because of its near octave spacing with the 150.05-153.00 MHz band. Before WRC-15, relevant compatibility studies were performed in relation to this Agenda Item and a pfd mask was defined for the satellite downlink emissions for the protection of incumbent services. This included the requirement for the protection of the RAS operating in the nearby band 150.05-153.00 MHz, and it was assumed to be technologically feasible to implement via a filter on board the satellite. In addition it is also necessary to protect the RAS band at 322.0-328.6 MHz from harmonics in the spurious domain. For protecting the RAS frequency bands, all downlink emissions of the satellite in the spurious domain including harmonics need to meet the interference threshold defined for the relevant bands in Recommendation ITU-R RA.769-2. Methods proposed under this Agenda Item in the CPM text (except Method A 'NOC') propose to modify RR Nos. **5.208A** and **5.208B** and Annex 1 to Resolution **739 (Rev.WRC-15)** in order to ensure the protection of the RAS in these frequency bands.

CRAF Position

CRAF supports any of the Methods B-F, which propose to modify RR Nos. **5.208A** and **5.208B** and Annex 1 to Resolution **739 (Rev.WRC-15)** in order to ensure the protection of the RAS in the frequency bands 150.05-153 MHz and 322-328.6 MHz.

AI 1.13 *to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 238 (WRC-15);*

Comments

This Agenda Item is one of the most significant for the RAS at WRC-19. The targeted frequency range encompasses a dozen bands from 24.25 GHz through to 86 GHz, a number of which are shared, adjacent to or nearby allocated RAS bands. These RAS bands are a valuable area for spectroscopy as the range is very rich in spectral lines compared with lower frequencies. However, because of the greater allocated bandwidths at these frequencies there is also important astronomy to be done via continuum observations. This frequency range is therefore extremely important for the RAS, which is reflected in the numerous existing primary and secondary allocations.

CRAF has performed compatibility studies for the potentially affected RAS allocations at 23.6-24.0 GHz, 31.3-31.5 GHz, 42.5-43.5 GHz and 76-86 GHz and determined sizes of required exclusion zones considering two different levels of out-of-band emissions. RAS-IMT compatibility studies showed that exclusion or coordination zones of varying sizes around RAS sites would be needed to ensure adequate protection of the RAS. Given the expected dimensions of the coordination zones around RAS stations, it was concluded that the protection of RAS stations could be established on a national level. However, for RAS sites close to national boundaries, cross-border coordination may also be required. Careful coordination by national administrations in case of in-band and adjacent band sharing scenarios is necessary for each individual RAS station.

CRAF Position

CRAF supports the protection of existing RAS frequency allocations at 23.6-24.0 GHz, 31.3-31.5 GHz, 42.5-43.5 GHz and 76-86 GHz from future IMT operations and prefers ‘NOC’ for the bands proposed for allocations/identification under this Agenda Item that may affect these RAS bands. However, if allocations/identifications are made, administrations are urged to support strong regulatory protection for the RAS as expressed in the Methods in the table below:

Band	Method preferred	Method Option
A (24.25-27.5 GHz)	A2f	Option 2 (preferred) or Option 1
D (40.5-42.5 GHz)	D2b	Option 2 (preferred) or Option 1
E (42.5-43.5 GHz)	E2b	Option 2 (preferred) or Option 1
K (71-76 GHz)	K2c	Option 2
L (81-86 GHz)	L2c	Option 2 (preferred) or Option 1

CRAF also supports the proposal to limit the identification of IMT to LMS.

AI 1.14 *to consider, on the basis of ITU-R studies in accordance with Resolution 16 (WRC-15), appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed- service allocations;*

Comments

High-altitude platform stations (HAPS) have been the subject of work within the ITU-R for several years. HAPS are defined in RR No. 1.66A as a station located on an object at an altitude of 20-50 km and at a specified, nominal, fixed point relative to the Earth, and are subject to No. 4.23. WRC-97 added a global identification for HAPS in the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz. WRC-2000 agreed on a HAPS identification for the frequency band 27.9-28.2 GHz (fixed downlink), paired with the frequency band 31.0-31.3 GHz (fixed uplink) outside Region 2, and decided on additional spectrum identifications for HAPS links under No. 5.388A and No. 5.388B in some countries. At WRC-12 five countries joined footnote 5.457 for a HAPS designation in the fixed service for frequency bands 6440-6520 MHz (HAPS-to-ground) and 6560-6640 MHz (ground-to-HAPS). For WRC-19, additional spectrum needs were studied for gateway and fixed terminal links for HAPS to provide broadband connectivity in the fixed service globally at 38-39.5 GHz, and in Region 2 at 21.4-22 GHz and 24.25-27.5 GHz.

The bands currently allocated or targeted under this Agenda Item are shared, adjacent or near adjacent to various allocated RAS bands. These RAS bands are used for both spectroscopy (as the range is very rich in spectral lines) and continuum observations; most are subject to RR No. 5.149, but of particular concern in R2 is the proposed HAPS band near to the RAS primary passive band at 23.6-24 GHz (subject to RR No. 5.340). HAPS platforms circulating at altitudes ~20-25 km over a nominal nadir position could be radio visible for 500 km or more to RAS sites and hence permanent interferers to RAS observations at some frequencies. ITU-R compatibility studies performed with assumed spurious emission limits showed that compatibility between RAS and HAPS could be possible if the HAPS meet appropriate unwanted emission pfd values at a RAS site and operate within a coordination framework to achieve proper pointing and physical separation of RAS and HAPS operations.

CRAF Position

CRAF supports the protection of RAS in the bands 6650.0 - 6675.2 MHz, 31.3 - 31.5 GHz and 48.94-49.04 GHz as well as the RAS operations in other regions in the bands 22.01 – 22.50 GHz, 23.6 – 24 GHz. To resolve this Agenda Item CRAF prefers a generic Method B1 applied per band, with unwanted emission requirements to protect the RAS taken from Rec ITU-R RA.769-2. CRAF also supports the view of some administrations that Method B3 is out-of-scope of Resolution 160.

AI 1.15 *to consider identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz, in accordance with Resolution 767 (WRC-15);*

Comments

A number of bands in the frequency range 275-1000 GHz are identified for use by administrations for passive services, such as the RAS, EESS (passive) and the SRS (passive). RR No. 5.565 states that the use of the range above 275 GHz by the passive services does not preclude use of this range by active services. ITU-R Recommendation RA. 2189 provides some generic compatibility calculations on sharing between the RAS and active services above 275 GHz. The new applications proposed under this agenda item have different characteristics than those used for studies in ITU-R RA.2189, therefore new compatibility studies were needed to investigate the feasibility in protecting RAS from such applications. The studies under this Agenda Item concluded that atmospheric attenuation independent of free-space losses at 275-450 GHz is not sufficient to provide compatibility between FS and RAS operations in the absence of other considerations. Separation distances and/or avoidance angles between RAS stations and FS stations may be required, depending on the deployment environment of FS stations. It was assumed that for the RAS studies, FS also covered the case for LMS. CRAF also notes that Methods B-G identify bands that are more than sufficient to meet the spectrum needs summarized in the ITU-R studies.

CRAF Position

CRAF urges protection of the existing RAS, SRS, and EESS (passive) frequency identifications and supports Method 'D' if additional text is placed in the proposed new footnote 5.B115 indicating that specific conditions (e.g. minimum separation distances and/or avoidance angles) should be considered to ensure protection of radio astronomy sites from land mobile and/or fixed service applications, as required on a case-by-case basis. CRAF also supports the development of propagation models for this frequency range and the development of appropriate mitigation techniques for the protection of the RAS from active services use above 275 GHz.