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Radio Astronomy Spectrum management – The Impact of WRC19

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Abstract

The Final Acts of the 38th world radiocommunications conference (WRC19) held in Sharm Elsheikh, Egypt during October and November 2019 concluded several frequency allocations to a wide range of radio communications services. Among these allocations are frequencies that are in-band, adjacent to or others spuriously impacting the Radio Astronomy Service (RAS) frequencies. The impact on RAS due to these allocations would vary with the varying nature of the different radiocommunication services. The IMT2020 (5G) globally harmonized allocations in the 26 GHz and 40 GHz bands will require geographical separation around the RAS telescopes to minimize the interferences expected in the RAS 23.6-24 GHz and 42.5 - 43.5 GHz bands. The updated regulations of the satellite services in the 37.5-50.4 GHz band in favor of the non-geostationary satellite systems would also impose extra pressure on the 42.5 - 43.5 GHz band. Other allocations such as the High Altitude Platform systems (HAPS) allocation in the 31-31.3 GHz and 47.9 – 48.2 GHz bands will require ~ 50 km separation zones and limits on power flux density to protect the RAS spectral lines in the 31.3 – 31.5 GHz and 48.94 – 49.04 GHz bands. The RAS bands above 275 GHz will also start coordinating protection from the rapidly emerging terahertz technologies. The survival of RAS in such a hungry-bandwidth radio communication environment will largely depend on active spectrum management at the national, regional and global levels.

1 Introduction

WRCs are held every four years to revise and review global radio regulations based on proposed new spectrum allocations to radiocommunication services. Since its recognition as a radiocommunication service by ITU in 1959, the Radio Astronomy Service (RAS) has been allocated multiple frequency bands for astronomical observations over the consecutive WRCs. While no additional frequency allocations for RAS were included in the WRC19 agenda, the protection of the existing allocations from harmful interference was the main objective for RAS at this conference.

WRC19 decisions have paved the way for the new generation of International Mobile Telecommunications (IMT) networks, commercially known as 5G. The service that is already under deployment now in many countries was allocated frequency bands overlapping with the RAS bands in the 42.5 – 43.5 GHz and adjacent to the 23.6 – 24 GHz spectral lines. Another major threat for RAS is the huge numbers of non-geostationary satellite orbits (NGSO) systems planned during the next decade for which the conference have updated the regulations to allow sharing with the GSO systems in the 37.5 -51.4 GHz band. Allocations made to other services such as the Global Maritime Distress Satellite Systems (GMDSS) , HAPS and fixed services above 275 GHz would affect other various RAS bands as well.

The results of WRC19 are in general satisfactory for the RAS community. The key outcomes of WRC19 impacting the RAS bands are briefly presented in the next section, along with the protection conditions introduced by the conference for each of them.

2 Key WRC19 Outcomes

2.1 IMT 2020 – 5G

The deployment of 5G networks will demonstrate different scenarios over wide range of applications for Internet of Things (IoT), smart cities, industrial automation and many others. This could result in more unpredictable interference situations than those created by the previous IMT generations. New globally harmonized frequency allocations were identified for IMT 2020 by the conference for a total of 14.75 GHz in the bands 24.25–27.5 GHz, 37–43.5 GHz and 66–71 GHz. The compatibility studies carried out by the Committee on Radio Astronomy Frequencies (CRAF) in Europe showed the potential interfering impact of these allocations on the RAS observations using the 23.6–24 GHz and 42.5–43.5 GHz bands. The studies recommended introducing separation zones around radio observatories away from the 5G services to mitigate interference (e.g. Table 1) [1]. As no detailed terrain profiles were used in most of these studies, the conference left the protection specifications to be on a case-by-case basis through coordination with national administrations.

Being officially recognized as a national issue now, the radio astronomy observatories are advised to follow up with their national administrations and mobile network operators in order to secure adequate protection through separation zones around the radio telescopes.

Table 1. Example of the CRAF study results on the required separation distances around radio telescopes for the 40 GHz band (BS: Base Station, UE: User Equipment).

Zone	P_{inband} (BS / UE) (dBm/MHz)	BS (km)	UE (km)	BS+UE (km)
Single interferer				
Urban	3 / 4	68	42	n/a
Suburban	3 / 4	68	42	n/a
Suburban open space	3 / 4	70	n/a	n/a
Aggregate scenario, uniform density (2%)				
	3 / 4	56	45	56
Aggregate scenario, clustered density (2%)				
	3 / 4	57	47	57

2.2 Satellite Services

The major outcome of the conference with respect to the satellite services is updating the regulations for spectrum sharing between non-GSO systems and GSO networks in the 37.5 – 51.4 GHz frequency range. The relevant RAS primary band 42.5 – 43.5 GHz will face extra pressure from the NGSO satellite constellations largely planned during the next decade. The RAS studies before the conference failed to derive specific impact and the community hoped the issue can be differed to the next WRC for more inspection. Following the regulatory framework agreed by the conference, RAS would need to coordinate the band protection on higher regional and global levels.

The NGSO satellites with short durations were allocated the frequency band 137-138 MHz for downlink (Space to Earth) and 148 – 149.9 MHz for the uplink (Earth to Space). According to the compatibility studies, the required separation to the RAS band 150.05 – 153 MHz should be a minimum of 1.5 MHz which is not achieved (only 1.05 MHz). The corresponding RAS protection limits will need to be re-evaluated following these allocations.

2.3 Maritime Services

The approval of Iridium satellite services as a (GMDSS) service provider has added several concerns on the proposed regulations for the service. The discussions for 10 MHz extension for the service from 1616 MHz to 1626 MHz have taken long debating time among regional groups and administrations. The Iridium tragic interference to the RAS band 1610 – 1613 MHz for over 20 years now has limited the allocation to 5 MHz only from 1621 MHz to 1626 MHz. The limited allocation was associated with stricter regulatory limits on the service in an attempt to put an end to the interference.

2.3 HAPS

HAPS is not a new service and has been on the ITU agenda since around 1996. Although not widely spread, the service is expected to grow during the next decade to serve various applications. On top of these applications is the backhauling solutions to the 5G mobile networks. This is already approved as an agenda item for the next conference WRC23 under the term high altitude platform station as IMT base stations (HIBS).

The conference identified the new bands 31-31.3 GHz and 38-39.5 GHz harmonized globally, in addition to updating the regulations for the existing bands 47.2 – 47.5 GHz and 47.9 – 48.2 GHz. RAS regulatory protection through separation distances and limits on power flux densities was included in the conference final acts.

2.4 Fixed Services above 275 GHz

The interest in the terahertz frequencies by the industrial telecommunication services was rarely expressed previously due to the high attenuation and high cost of implementation. The growing pressure on the low frequency bands and the need for large bandwidths in addition to the recent technology developments at lower costs have introduced great potential for using the higher bands above 275 GHz.

The high atmospheric attenuation made the usage of the band not also common for all radio observatories. RAS observatories at high altitudes such as the NOEMA observatory in France enjoyed the passive service identifications in several portions above the 275 GHz band. These frequencies were identified but not reserved to the passive services. The conference approved the access of the land mobile and fixed services to these bands. A new footnote was introduced for RAS protection on a case-by-case basis.

3 Conclusion

As for all WRCs in the past three decades, the pressure on RAS frequencies increases following the new frequency allocations decided for the different radiocommunication services. Close follow up by the RAS observatories with their national administrations is required to coordinate the appropriate protection for the local issues such as the 5G deployments and the emerging terahertz technologies. The conference agreed regulations for the NGSO satellite constellations would require higher level of coordination at the regional and global levels.

4 References

1. The Committee on Radio Astronomy Frequencies (CRAF)., "SHARING AND COMPATIBILITY STUDIES OF THE RAS IN THE FREQUENCY BAND 42.543.5 GHZ AND IMT SYSTEMS OPERATING IN THE FREQUENCY RANGE 3743.5 GHZ," *Attachment 5 to Annex 5 to Task Group 5/1 Chairman's Report*, Document 51/478E https://www.itu.int/md/R15-TG5.1-C-0291/en 18, October 2018.