



NATIONAL PREPARATORY COMMITTEE TOWARDS WRC-27 AGENDA ITEM

1.16 BRIEF

Chapter: 4

Service: Science issues (Radio Astronomy)

Agenda Item: 1.16

Description of Agenda Item: Studies on technical and regulatory provisions necessary to protect radio astronomy operating in specific Radio Quiet Zones and, in radio astronomy service primary allocated frequency bands globally, from aggregate radio-frequency interference caused by systems in the non-geostationary-satellite orbit, in accordance with Resolution 681 (WRC-23).

Objective: To analyse compatibility and develop regulatory mechanisms within the ITU Radio Regulations (RR) to protect the Radio Astronomy Service (RAS) operating in primary global bands and specialized Radio Quiet Zones (RQZs) from the unwanted emissions of non-geostationary satellite orbit (non-GSO) systems. This brief evaluates the structural options to protect sensitive radio telescopes without introducing undue technical barriers to active space communication networks.

Statutory Mandates: Resolution 681 (WRC-23)

The technical tasks assigned to the ITU Radiocommunication Sector are structured into six explicit study requirements:

- **Resolves 1:** Studies on how the interference from unwanted emissions from a *single* non-GSO satellite system operating in adjacent and nearby frequency bands affects the operation of Radio Astronomy Service (RAS) stations in frequency bands allocated to the RAS on a primary basis.
- **Resolves 2:** Studies on how the *aggregate* interference from unwanted emissions from *multiple* non-GSO satellite systems operating in adjacent and nearby frequency bands affects the operation of RAS stations in primary-allocated RAS bands.
- **Resolves 3:** Studies on the possible international recognition of specific elite global RQZs—specifically the Square Kilometre Array Observatory (SKAO) in South Africa and the Atacama Large Millimeter/submillimeter Array (ALMA) in Chile—based on their unique characteristics and existing ITU-R studies.
- **Resolves 4:** Studies on how aggregate interference from single and multiple non-GSO satellite systems affects the operation of RAS stations located inside these specific SKAO and ALMA RQZs.
- **Resolves 5:** Studies on new technical coexistence measures between non-GSO

satellite fleets and primary RAS stations operating within those designated RQZs.

- **Resolves 6:** Studies of calculation methods to establish necessary separation distances between ground gateways of non-GSO systems (operating in bands adjacent to or near RAS allocations) and the protected RAS stations inside the SKAO and ALMA zones.

Spectrum Profile under Study & Potential Services Affected

The dynamic sharing and compatibility simulations evaluate the following primary target frequency windows:

- **The 10 GHz Microwave Window (10.6GHz-10.7GHz):** Audited for single-entry and aggregate spillover from Fixed-Satellite Service (FSS) downlinks operating in the 10.7--10.95 GHz band.
- **The 42 GHz Millimetre-Wave Window (42.5-43.5GHz):** Audited for aggregate unwanted emissions originating from adjacent 42-42.5 GHz FSS satellite downlinks.
- **The 76 GHz High-Frequency Window (76-77.5GHz):** Reviewing aggregate impact from FSS and Mobile-Satellite Service (MSS) downlinks operating in the 74-76GHz band.
- **The 94 GHz and 100 GHz Windows (94.1-95GHz and 100-102GHz):** Reviewing aggregate impact from Radionavigation-Satellite Service (RNSS) and MSS downlinks operating in the 95-100 GHz band.
- **The 114 GHz Deep-Space Band (114.25-116GHz):** Audited for aggregate space-to-Earth interference from adjacent Inter-Satellite Service (ISS) allocations in the 116-119.98GHz band.
- **The 130 GHz Frontier Astro-Band (130-134GHz):** Reviewing cumulative adjacent emissions from active FSS, MSS, and RNSS systems operating in the 123-130 GHz range.

Potential Services Affected

- **Radio Astronomy Service (RAS):** Special facilities (SKAO and ALMA) are highly vulnerable because their scientific goals require observations across much larger frequency ranges than those currently allocated to the RAS.
- **Active Space Services (FSS, MSS, ISS, RNSS):** The rapidly expanding global non-GSO telecommunication, broadband constellation, and inter-satellite networks operating downlinks adjacent to or near passive science allocations.

Driving Anchor Documents

- **Recommendation ITU-R RA.769:** Provides the international threshold levels for non-GSO satellite interference received through the far side lobes of radio astronomy telescopes.

- **Recommendation ITU-R RA.1031:** Addresses the protection of radio astronomy in shared bands.
- **Recommendation ITU-R RA.1513:** Establishes acceptable levels of data loss (the 2% criterion) and percentage-of-time criteria for bands allocated to the RAS on a primary basis.
- **Recommendation ITU-R M.1583:** Provides the calculations for interference between non-GSO MSS or RNSS and radio astronomy telescope sites.
- **Recommendation ITU-R S.1586:** Provides the method for calculating unwanted emission levels produced by a non-GSO FSS at radio astronomy sites.
- **Report ITU-R RA.2259:** Contains the technical characteristics of national RQZs and administrative measures to establish them.

Status of Studies & Referenced Documentation

Link Parameters & Hardware Profiling (System Architecture)

- **Referenced Document:** Working document toward a draft new Report ITU-R RA.[SATCON-SINGLE] & **Report ITU-R RA.2259**.
- **Studies Carried Out:** Working Party 7D (WP 7D) compiled technical and operational profiles for individual non-GSO satellites. Modeling focused on evaluating transmitter filtering capabilities, phase noise characteristics, and antenna array side-lobe behavior when crossing over known astronomical facilities. Concurrently, studies profiled the exact coordinate geometries and terrain parameters of the SKAO and ALMA facilities.
- **Output:** Provided the single-entry power templates and static equipment variables used as inputs for cumulative network simulations.

Propagation Analysis & Coexistence Simulations (Sharing Studies)

- **Referenced Document:** Working document towards a draft new Report ITU-R RA.[SATCON-AGG].
- **Studies Carried Out: * Global Primary Bands (Issue A / Resolves 1):** Calculations applied the equivalent power flux-density (epfd) method outlined in Recommendations ITU-R M.1583 and ITU-R S.1586. Three specific studies evaluated non-GSO systems operating space-to-Earth in the 10.7-12.75 GHz range into the adjacent 10.6-10.7 GHz RAS band:
 - **Study A and Study C:** Assumed active antenna systems maintained a beamforming efficiency larger than zero within the adjacent RAS band.
 - **Study A** concluded that RAS thresholds were exceeded. Study C showed that System C exceeded thresholds by **75 dB** in the first adjacent

channel (10.7-10.95 GHz and **55 dB** in the potential second adjacent channel (10.95 -11.2 GHz).

- **Study B:** Factored in final parameter updates where beamforming efficiency vanishes in the adjacent channel (relying on a flat Block Edge Mask [BEM]). It concluded that thresholds were exceeded by **45 dB**, irrespective of the frequency gap.
- **RQZ Insulation & Separation Distances (Resolves 3 to 6):** Technical groups investigated geographic coexistence. Studies enhanced the technical understanding of RQZ implementation methods and coexistence issues, including those for the observatories specified in Resolution 681 (WRC-23). The findings support that managing RQZ protection is a national matter best addressed by administrations through specific national measures and operational coordination.

Regulatory CPM Text Formulation

- **Referenced Document:** Document towards draft CPM text for WRC-27 agenda item 1.16.
- **Studies Carried Out:** Translates technical data into clean options for the Radio Regulations, organizing the frequency issues into the explicit methods for the conference plenary.

CPM Methods Matrix (The Legislative Options for Debate)

The draft Conference Preparatory Meeting (CPM) text formalizes the regulatory options into specific, competing methods for the WRC-27 plenary:

CPM Issues	Proposed Methods	Regulatory Wording & Footnote Conditions
Issue A: Single non-GSO system interference into primary RAS bands.	Method A1: No Change (NOC)	Proposes No Change to the Radio Regulations based on the assertion that existing provisions sufficiently protect the RAS stations. Consequentially suppresses Resolution 681 (WRC-23).
	Method A2: Band Exclusion	Proposes to exclude the RAS band 114.25-116 GHz and its associated ISS band 116-122.25 GHz from further studies, applying a NOC designation to this block.
	Method A3: Mandatory Thresholds in	Proposes mandatory thresholds embedded into new Article 5 footnotes alongside an Appendix 4 commitment by notifying administrations to comply.

	Footnotes	
Issue B: Aggregate emissions from multiple networks.	Not Applicable	No regulatory output is possible under Resolution 681 (WRC-23), resolves 2, as the conference has no mandate to take actions in relation to potential aggregate interference from multiple non-GSO satellite systems.
Issue C & D: Ground Station Gateways & RQZ Recognition (SKAO / ALMA).	Method C1 (C1A & C1B): No Change (NOC)	Proposes No Change to the Radio Regulations (Articles 1, 2, and 4) and suppresses Resolution 681. Asserts that "coordination/protection zones" do not apply to space stations and remain a national issue. Effective protection is achieved through domestic practice and operational coordination.
	Method C2: Article 22 Modification	Proposes an amendment to RR Article 22 to add Section VIII (Control of interference in specific Radio Quiet Zones), drawing on principles from the lunar Shielded Zone of the Moon (No. 22.22). Includes ADD 22.41, 22.42, and 22.43, urging notifying administrations to take voluntary or agreed measures to limit harmful interference into RQZs, mandating that No. 4.4 systems cause no interference to notified RAS stations, and introducing

Conclusions & Recommendations

Conclusions

The technical findings compiled within the preparatory text demonstrate that out-of-band and spurious emissions from adjacent-band non-GSO satellite systems frequently exceed the baseline safety thresholds of the Radio Astronomy Service. While space platforms provide global connectivity, their unwanted emissions bypass traditional terrestrial boundaries, creating an escalation in the background noise floor of exceptionally sensitive scientific receivers.

The regulatory analyses reveal a significant divergence in strategy between global allocations and localized facility protection:

- **For Global Primary Bands (Issue A):** Dynamic epdf calculation limits can be

integrated into the Article 5 tables and Appendix 4 filing commitments to secure the protection of the RAS before systems are brought into use,

- **For Earth-Based RQZs (Issues C & D):** international consensus strongly supports maintaining RQZ enforcement as an exclusive matter of national sovereignty.

In summary, as long as appropriate footnote safeguards are applied to key adjacent satellite downlink bands, WRC-27 can establish an equitable framework that safeguards critical global radio astronomy observations while guaranteeing total, uninterrupted protection for local terrestrial and satellite telecommunications infrastructure.

Recommendation

The Country position is to continue active participation in the studies especially verifying the sharing and compatibility restrictions towards ensuring regulatory measurements provide sufficient protection of incumbent services.