

NATIONAL PREPARATORY COMMITTEE TOWARDS WRC-27 AGENDA ITEM 1.15 BRIEF

Chapter: 4

Service: Science issues

Agenda Item: 1.15

Description of Agenda Item: Studies on frequency-related matters, including possible new or modified space research service (space-to-space) allocations, for future development of communications on the lunar surface and between lunar orbit and the lunar surface.

Objective: Establish new or modified SRS allocations and provisions to anchor local surface-to-surface and orbit-to-surface communications (including Positioning, Navigation, and Timing (PNT) arrays) without disrupting incumbent terrestrial and space infrastructure.

- **Resolves 1 :** Studies of the spectrum needs of systems in the SRS which may operate on the lunar surface, or systems in lunar orbit communicating with systems on the lunar surface, across the designated UHF, mid-band, and mm Wave ranges.
- **Resolves 2 :** Studies of technical and operational characteristics, alongside protection criteria, for these lunar systems, including parameters to shield the Radio Astronomy Service (RAS) and active/passive sensors (1.15).
- **Resolves 3 :** Studies of specific propagation considerations unique to lunar surface terrain and localized lunar-orbiting pathways (1.15).
- **Resolves 4 :** Studies of sharing and compatibility to ensure absolute protection of incumbent Earth/space services (stipulated in recognizing's g to n) and the RAS on Earth and in the SZM.
- **Resolves 5 :** Studies of potential new or modified frequency allocations and/or identifications to the SRS, complemented by appropriate regulatory provisions.

Frequency Bands Under Study

Per the explicit statutory mandate of Resolution 680 (WRC-23), studies evaluate specific frequency blocks partitioned into two primary operational environments:

- **UHF Zone (Strictly Limited to Outside the SZM) :** 390–406.1 MHz, 420–430 MHz, and 440–450 MHz (1.15).
- **Microwave & mmWave Zone (Global Lunar Vicinity) :** 2 400–2 690 MHz, 3 500–3 800 MHz, 5 150–5 570 MHz, 5 570–5 725 MHz, 5 775–5 925 MHz, 7 190–7 235 MHz, 8 450–8 500 MHz, and 25.25–28.35 GHz (1.15).

Potential Services Affected

- a) **Radio Astronomy Service (RAS) :** Exceptionally vulnerable to unintended electromagnetic radiation inside the Shielded Zone of the Moon (SZM).
- b) **Fixed & Mobile Services :** Incumbent terrestrial infrastructure heavily utilizing the 2.4 GHz, 3.5 GHz, and 26 GHz blocks on Earth.
- c) **Aeronautical Radionavigation & Radiolocation :** Primary safety and radar assets operating globally within the 420–450 MHz and 5 GHz blocks.

- d) **Fixed-Satellite & Broadcasting-Satellite Services (FSS/BSS)** : Active networks sharing parts of the 2.5 GHz, 3.5 GHz, and 5.8 GHz spectrum.
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2. Driving Anchor Documents

- **Draft New Report ITU-R SA.(LUNAR_PROPAGATION)** : Establishes terrain attenuation, soil permittivity, and path loss models for the lunar environment.
 - **Draft New Recommendation ITU-R SA.(LUNAR_CHAR)** : Defines baseline technical/operational characteristics and protection criteria for planned lunar assets.
 - **Recommendation ITU-R RA.479-5** : Protects frequencies for radioastronomical measurements in the SZM to preserve its unique capabilities.
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Status of Studies & Referenced Documentation

Link Parameters & Hardware Profiling (System Architecture)

- **Referenced Document:** Working document toward preliminary draft new Report ITU-R SA.[FUTURE LUNAR COMMUNICATION AND SYSTEMS STUDY] (Annex 3 to Document 7B/237) & Report ITU-R SA.2553-0.
- **Studies Carried Out:** WP 7B quantified the precise spectrum volumes needed for the lunar economy. Engineers modeled the equipment profiles for rovers, habitats, and orbiters, verifying that commercial terrestrial physical layers (LTE, 5G, and Wi-Fi) can be adapted for airless, high-radiation environments.
- **Output:** Provided the fixed baseline transmitter power, bandwidths, and antenna gain variables used as the static inputs for all subsequent sharing models.

Propagation Analysis & Coexistence Simulations (Sharing Studies)

- **Referenced Document:** Working document towards a preliminary draft new Report ITU-R SA.[LUNAR 1.15 STUDIES] (Annex 2 to Document 7B/237).
 - **UHF Bands (Issues A, B, C):** WP 7B utilized terrain masking and diffraction models from Study Group 3 (SG 3) to test whether the physical curve of the Moon and deep crater walls can completely trap signals, blocking them from skipping across space and hitting civil aviation radars on Earth.
 - **S & C Bands (Issues D, E, F, G, H):** Engineers calculated the aggregate line-of-sight propagation loss across the 384,000 km to Earth. This analysis determined the exact Power Flux-Density (pfd) limits required to ensure lunar orbiter downlinks drop below the noise floor of Earth's commercial 5G (IMT-2020) macro networks.
 - **SZM Protection:** Conducted geometric flight path and orbital propagation analysis with WP 7D (Radio Astronomy) to establish the exact horizon boundaries where an orbiter's sidelobes would spill into the pristine Shielded Zone of the Moon.

Regulatory CPM Text Formulation

- **Referenced Document:** Document towards draft CPM text for WRC-27 agenda item 1.15 (Annex 1 to Document 7B/237).
 - **Studies Carried Out:** Translates the propagation and threshold conclusions into clear options, organizing the 11 frequency bands into the explicit "Bunched Methods" for the WRC-27 plenary.
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Proposed Methods

Bands	Method	Regulatory & Footnote Conditions
Issues A, B, and C 390–406.1 MHz• 420–430 MHz• 440–450 MHz	A, B, C.	Primary SRS (space-to-space) allocation by modification of Article 5 in the RR with footnotes for: • strict legal restriction to use in the vicinity of the Moon. • absolute prohibition from operating within direct radio line-of-sight to Earth. • strict prohibition from operating inside the Shielded Zone of the Moon (SZM). • Suppresses Res. 680.
Issues D, E, F, G, and H• 2400–2690 MHz• 3500–3800 MHz• 5150–5570 MHz• 5570–5725 MHz• 5775–5925 MHz	D, E, F, G, H	Primary SRS (space-to-space) allocation by modification of Article 5 in the RR (or registration in the MIFR) with footnotes for: • strict Power Flux-Density (pfd) limits at the Earth's surface. • non-interference status relative to terrestrial mid-band 5G (IMT-2020), and active radars. • Suppresses Res. 680.
Issues I, J, and K• 7190–7235 MHz• 8450–8500 MHz• 25.25–28.35 GHz	I, J, K	Primary SRS (space-to-space / space-to-Earth) allocation by modification of Article 5 in the RR with footnotes for: • strict off-axis power limits to protect GSO satellite fleets. • minimum elevation angles for Earth tracking stations. • coordination rules to protect passive EESS/ocean sensors. • Suppresses Res. 680.

5. Legislative Annex: Draft New Resolution (A115) (WRC-27)

The primary legislative output of these studies is the structural implementation of Draft New Resolution (A115) (WRC-27), which legally establishes the operational parameters and boundary coordinates for space-to-space links in the lunar vicinity.

- **DRAFT NEW RESOLUTION (A115) (WRC-27)** - Use of the bands 390-406.1 MHz, 420-430 MHz, 440-450 MHz, 2 400-2 690 MHz, 3 500-3 800 MHz, 5 150-5 570 MHz, 5 570-5 725 MHz, 5 775-5 925 MHz, and 27.5-28.35 GHz by stations in the space research service (space-to-space) in the vicinity of the Moon.

Conclusions

The technical findings within Report ITU-R SA.[LUNAR 1.15 STUDIES] demonstrate that while the Moon functions as an excellent physical and distance shield (384,000 km away, the introduction of high-power lunar orbiters and extensive surface networks demands a legally airtight framework to completely insulate Earth-based incumbents. The studies verify that:

- **The UHF Band:** local civil aviation radar and maritime grids are fully insulated, provided that a strict Radio Horizon Lock and terrain masking completely suppress signals facing the Earth's horizon.
- **The S and C-Band:** the intense commercial value of domestic mid-band 5G (IMT-2020) macro cells and Wi-Fi networks is completely safeguarded, provided that the proposed

footnotes enforce mathematically conservative Power Flux-Density (pfd) limits at the Earth's surface.

- **The X/Ka-Band:** sovereign satellite allocations and passive sensors are protected by enforcing strict angular tracking alignments and off-axis power constraints on returning spacecraft.

In summary, the evolution of lunar communications does not require administrations to compromise the stability of their domestic spectrum markets. The active ITU-R study texts confirm that as long as the proposed footnote safeguards are legally binding and technically rigid, WRC-27 can successfully authorize the primary Space Research Service (SRS) allocations while guaranteeing total, uninterruptible protection for local infrastructure from harmful interference.

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.