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| U.S. Radiocommunications SectorFact Sheet |
| **Working Party:** ITU-R WP1A | **Document No:** USWP1A-01\_NC |
| **Ref:** WRC-19 Res. **731**  | **Date:** 23 October 2020 |
| Document Title: Proposal to initiate work under Resolution 731 (Rev.WRC-19)  |
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| **Purpose/Objective:** WRC-19 Res. **731** requested ITU-R studies on potential sharing and adjacent band compatibility between passive and active services above 71 GHz. This contribution will consider the high dependency of uplink path propagation loss to path elevation angle at these frequencies. This model can then be used to calculate possible limits for high elevation angle sidelobe EIRP to protect EESS stations from harmful interference.  |
| **Abstract:** Building on the P.676-11 and P.525 propagation methods are developed for computing the incidental illumination of EESS systems by sidelobes of terrestrial Fixed Service systems with low elevation angle paths. This method could then be used to develop EIRP limits for high elevation angle emissions as a possible method to meet interference-free sharing objectives of Res. **731**. Both individual and cumulative signal strengths from such uses are considered in the context of meeting RS.2017 protection limits. |

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| Reference Resolution **731 (Rev.WRC-19)** |  |
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| United States of America |
| PROPOSAL TO INITIATE WORK UNDER RESOLUTION **731 (REV. WRC-19)** |
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**Introduction**

Resolution **731 (Rev. WRC-19)** addresses issues of sharing and adjacent-band compatibility between passive and active services above 71 GHz.[[1]](#footnote-1)

The Resolution invites the ITU-R:

1 to continue its studies to determine if and under what conditions sharing is possible between active and passive services in the frequency bands above 71 GHz, such as, but not limited to, 100‑102 GHz, 116‑122.25 GHz, 148.5‑151.5 GHz, 174.8‑191.8 GHz, 226‑231.5 GHz and 235‑238 GHz;

**Discussion**

This work will begin to determine if and under what conditions sharing is possible between the ground-based fixed service and passive services in the frequency bands above 71 GHz as invited in Resolution **731**. Sharing with the Radio astronomy (RAS) may be accomplished in a straightforward manner by determination of geographic exclusion and coordination zones based on the atmospheric characteristics of the RAS geographic site, aggregate interference, and the frequency under consideration. The most difficult sharing issues, both from a technical and regulatory perspective, involve protecting earth exploration-satellite service (EESS) (passive) use in bands listed in RR No. **5.340**.

RAS receiver sites at frequencies above 71 GHz tend to be in remote locations and high-altitude and/or arid sites in order to reduce the impact of terrestrial-based interference and decrease atmospheric absorption at these frequencies. However, the selection of high-altitude and/or arid sites, leading to lower atmospheric absorption, also increases the susceptibility of these sites to interference as attenuation decreases (e.g., see variations in attenuation between sea level, 3km and 5km for frequencies above 275 GHz in Report ITU-R RA.2189-1[[2]](#footnote-2)). The coordination approach of Recommendation ITU-R RA.1031-2 discusses protection of RAS receivers in bands where sharing may be possible via the establishment of coordination zones around RAS stations, though it only addresses frequencies up to 40 GHz in Figures 1 and 2. To determine whether sharing is possible and under what conditions, the aforementioned Report and Recommendation would need to be revised to include the frequency range 71 – 275 GHz, or a new Report/Recommendation should be developed by WP 7D.

EESS (passive) protection is complex because these passive satellites operate globally, have antennas pointing either tangential to the orbit or pointed towards the Earth’s surface taking measurements over the entire Earth’s surface and regularly performing critical meteorological and environmental measurements, usually from low altitude orbits. Fixed service communications is the primary focus for consideration for this work at this time as its fixed geometry and usually non-active antennas may present a less complex sharing scenario when compared to any Mobile service application. Fixed systems above 71 GHz have the potential for quick deployment (compared to wired/fiber links) for paths with a distance of a few km as well as lower costs in places with difficult terrain for wired installations, requirements for temporary high-bandwidth restoration links and other short term connectivity needs. While RR No. **5.340** bands individually have bandwidths of a few GHz, the locations of the 11 such bands in 71-275 GHz limit the ability to create large contiguous blocks of spectrum for use by active services unless a sharing environment can be created to ensure the protection of the passive operations.

Protection of RAS and EESS (passive) systems is especially critical for RR No. **5.340** bands where no emissions are allowed. Assembling defined fixed service system characteristics and passive sensor characteristics and protection criteria are an important first step in beginning this work to determine the feasibility of interference-free sharing and the possibility of what specific conditions could be established to enable the sharing of these frequency bands by active and passive services, noting, as outlined in Resolution **731** (Rev. WRC-19) the principles of burden-sharing to the extent practicable in the studies.

Sharing above 71 GHz raises different technical issues than in the lower passive bands. Above 71 GHz atmospheric absorption is a key factor, and thus overall propagation loss, can vary greatly with respect to frequency and elevation angle. Thus, a method has to be found to limit Fixed emissions to levels that do not cause harmful interference to RAS and EESS (passive) systems. Resolution **731 (Rev. WRC-19)** cites existing ITU-R recommendations for the required protection levels.

Initial studies may consider addressing sharing by the development of appropriate EIRP limits for emissions at various elevation angles for Fixed service transmitters operating in or near passive bands. It should also be noted that, due to the spacecraft altitude, passive sensors operating in these bands have a large field-of-view and are highly sensitive to the aggregation effects from multiple interferers. Thus, a method has to be found to prevent interference to EESS (passive) systems from aggregated interference. On possible approach would be to limit the geographic density of Fixed transmitters.

As noted above, Fixed service systems generally have low elevation angles, so main beam illumination of EESS receivers by the direct signal path results in the signal having significant path loss due to molecular absorption in addition to the usual free space loss. This high absorption at low elevation angles tends to mitigate the direct path illumination of EESS sensors. However, other factors, such as sidelobe illumination and multipath propagation/reflections are possible interference sources. Consequently, advice from WP 3J and WP 3M is needed on these issues. Also, while all finite size antennas must have sidelobes for practical reasons, it may be possible to decrease sidelobes at high elevation angles below the typical values generally encountered in today’s Fixed service applications, which were designed in a terrestrial-to-terrestrial sharing environment where such sidelobes were not of concern. Information could be sought from antenna researchers on the feasibility of such antenna designs.

**Proposal**

The United States proposes initiating the studies called for in Resolution **731 (Rev.WRC-19)** to explore under what conditions for sharing are possible between active and passive services in the frequency bands above 71 GHz. In order to facilitate this work, technical studies may consider developing methods for computing the unwanted illumination of EESS (passive) systems by direct-path and/or multipath propagation effects from terrestrial Fixed Service systems with a range of elevation angle paths, based on propagation information and system characteristics that are available or being developed. If studies show that interference-free sharing will be achieved, then this method could then be used to develop EIRP limits based on Fixed system elevation angle as a possible method to ensure that the aggregate interference from all fixed service usage meets the EESS (passive) protection criteria defined in Rec. ITU-R RS.2017.

At this time, the US proposes to evaluate the suitability of this approach considering only systems operating under the Fixed Service. In order to seek the technical characteristics of the fixed services that could be representative of those operating in various frequency bands above 71 GHz, WP1A is invited to send a liaison statement to WP5C. In addition, a liaison statement is proposed to WP 3J and 3M on the appropriate propagation aspects, and WP 7C and 7D on the technical, operational and protection criteria of the passive services.

In order to initiate this work, the US proposes requesting characteristics and propagation information from the relevant working parties. Draft liaison statements are provided for the consideration of WP 1A.

Attachments (3): Draft liaison statements

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| Working Party 1A |
| DRAFT LIAISON STATEMENT TO Working Parties 3j AND 3M (copy for information TO WORKING PARTIES 7C and 7D) |
| Propagation information related to proposed studies under Resolution 731 (Rev. WRC-19) |

In accordance with *invites the ITU-R 1* of Resolution **731 (Rev. WRC-19)**, Working Party (WP) 1A is considering if, and under what conditions, sharing is possible between active and passive services in passive bands between 86 and 252 GHz. As such, WP 1A requests WPs 3J and 3M to provide guidance on which ITU-R Recommendations should be used to appropriately model the propagation effects (e.g., free-space attenuation, atmospheric absorption, hydrometeor scatter, multipath, etc.) that exist for this frequency range between terrestrial-based fixed service interferers and satellite-based passive sensors. Working Parties 3J and 3M are kindly invited to respond in a timely manner before the deadline of 15 May 2021, at the latest, and in advance if possible.

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| DRAFT LIAISON STATEMENT TO Working Party 5C (COPY FOR INFORMATION TO WORKING PARTY 5A) |
| Information related to proposed studies under Resolution 731 (Rev. WRC-19) |

In accordance with *invites the ITU-R 1* of Resolution **731 (Rev. WRC-19)**, Working Party (WP) 1A is considering if, and under what technical conditions, sharing is possible between active and passive services in the frequency bands above 71 GHz.

WP 1A would like to inform WPs 5A and 5C that the initial focus of these studies will be on fixed service operations. For conducting studies called for in this Resolution, WP 1A requests information on the technical characteristics of fixed service systems that are planned to operate in the bands specified in Resolution **731**.

 WP 1A is also considering additional elements on how to address the complex sharing environment with these frequency bands. WP1A would request specific guidance on:

1. Are fixed service system characteristics, including antenna and deployment information, available in the relevant frequency range, and can they be designed in such a way as to minimize radiation in the direction toward space?

While there are some passive bands above 71 GHz that are already shared with other services, certain bands are protected by RR **5.340** from any emissions and any shared use is presently prohibited. With that in mind, more information is needed on antenna characteristics, particularly sidelobe behaviour, in order to determine if it is possible to permit sharing without any interference to EESS (passive) sensors.

2. What are the system characteristics and deployment models for fixed service applications in these frequency ranges?

 Fixed systems generally have low elevation angles and atmospheric absorption is a key propagation issue above 71 GHz. As a result, for low elevation angle fixed links, the interference path (ground-to-satellite) can have significant losses. However, this path loss decreases as the path elevation angle increases and zenith propagation is comparable to much lower bands.

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| DRAFT LIAISON STATEMENT TO Working PartY 7C AND 7D |
| Information related to proposed studies under Resolution 731 (Rev. WRC-19) |

In accordance with *invites the ITU-R 1* of Resolution **731 (Rev. WRC-19)**, Working Party (WP) 1A is considering whether, and under what technical conditions, sharing is possible between active and passive services in the frequency bands above 71 GHz. WP 1A would be pleased to cooperate with Study Group 7, including WP 7C and WP 7D, in this effort.

For the purpose of conducting timely studies on Res. **731** to protect earth exploration-satellite service (EESS) (passive) and radio astronomy (RAS) sensors above 71 GHz, WP 1A requests the viewpoints of WP 7C and 7D on its planned approach to addressing this complex sharing issue.

In studies for Report ITU-R F.2239 and for WRC-19 AI 1.15, the basic approach taken was to start with assumptions for fixed service (FS) transmitter characteristics and specific deployments in specific band ranges and to study the impact on EESS (passive) systems using the protection level given in Recommendation ITU-R RS.2017. In a parallel liaison statement, WP5C is being asked for system characteristics including antenna parameters and deployment models.

To this end, we are considering a different approach for a new proposed technical evaluation of mitigation methods and seek your inputs. WP 1A is considering developing a method of calculating an EIRP mask as a function of elevation angle to determine the impact between the fixed service and passive services in the passive bands above 71 GHz. Aggregate interference potential is a key issue so the study will review the maximum geographic density of FS transmitters in these bands that is consistent with interference-free sharing taking into account the effects of aggregate interference and as invited in Resolution **731**.

WP1A notes that RAS facilities at these frequencies are typically located in remote and/or high altitude, arid sites in order to avoid terrestrial interference and reduce atmospheric absorption. These facilities are best protected by geographic exclusion and coordination zones, and studies should be completed, including aggregate interference, to determine whether sharing is feasible and under what conditions. For the RAS service, it is noted that Figures 1 and 2 in Recommendation ITU-R RA.1031-2 only go up to 40 GHz and Report ITU-R RA.2189-1 begins considering sharing and compatibility at 275 GHz. It is kindly requested that WP 7D provide updates to the relevant Recommendation and/or Report for the frequency range 71 GHz – 275 GHz.

WP 7C is invited to provide information on these topics for EESS (passive) sensors operating in the ranges around the passive bands above 71 GHz.

WP 7D is invited to provide information on these topics for RAS sensors in the frequency range 71 GHz – 275 GHz, including those bands allocated to the RAS service and those frequency bands immediately adjacent to RAS allocations.

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1. WRC Resolution **731** was first developed at WRC-2000 and includes the *invites the ITU-R 1* referenced. It was revised at WRC-19 but the *invites the ITU-R 1* was not changed. [↑](#footnote-ref-1)
2. Available at URL: <https://www.itu.int/pub/R-REP-RA.2189-1-2018> [↑](#footnote-ref-2)