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| **US Radiocommunication Sector**  **FACT SHEET** | | | |
| **Study Group:** USWP 7B | | | **Document No:** US7B\_27\_002\_NC |
| **Reference:** RES **256 (WRC-23)** | | | **Date:** 17 January 2024 |
| **Document Title:** Proposed updates to ITU-R Recommendation SA.2141 *Characteristics of space research service systems in the frequency range 14.8-15.35 GHz* to support sharing studies to be conducted in the 14.8 – 15.35 GHz band under WRC-27 agenda item 1.7 | | | |
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| **Purpose:** To propose any necessary revisions to the characteristics of SRS systems in the 14.8 – 15.35 GHz band documented in Recommendation ITU-R SA.2141 consistent with the SRS constraints in Resolution **678** **(WRC-23)** and footnote [**5.A113**] in order to facilitate sharing studies under WRC-27 agenda item 1.7. | | | |
| **Abstract:** As part of the work in association with WRC-23 agenda item 1.13, changes were made to the RR to upgrade allocations to the SRS in 14.8 – 15.35 GHz band from secondary to primary status. The upgrade encompasses allocations in the (s-s), (s-E), and (E-s) directions; although for the (E-s) and (s-E) cases, footnote [**5.A113**] was incorporated stipulating that SRS operations in nineteen administrations (including the US) remain on a secondary basis. The status upgrades for SRS were subject to numerous other constraints as well including the imposition of more restrictive power flux density limitations which may influence the design of future SRS systems in this band. Recommendation ITU-R SA.2141 was developed in 2021 to support the sharing studies under agenda item 1.13 (WRC-23). It contains characteristics of SRS systems in this band which may need to be updated to ensure consistency with the pfd constraints in [**COM5/7**]. This contribution is intended to initiate any work necessary to the Recommendation to facilitate the sharing studies to be conducted in association with WRC-27 agenda item 1.7. | | | |
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| **Radiocommunication Study Groups** | Logo  Description automatically generated |
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| **XX March 2024** |
| **English only** |
| United States of America  PRELIMINARY DRAFT REVISION OF RECOMMENDATION ITU-R SA.2141-0  **Characteristics of space research service systems in the frequency range 14.8 – 15.35 GHz** | |

This document provides additional revisions to the Recommendation ITU-R SA.2141-0 which provides characteristics of space research service (SRS) systems operating in the 14.8 – 15.35 GHz range. This recommendation was developed to support studies performed under WRC-23 agenda item 1.13 which examined sharing and compatibility between incumbent services and SRS systems operating downlinks, uplinks, and crosslinks in this band.

For some of the SRS direct downlink scenarios studied, information on existing SRS systems was incomplete or unavailable. For these cases, a set of Earth station parameters was developed which was just sufficient to close the link and meet the recommended SRS pfd limits given in Recommendation ITU-R SA.1626. This pfd limit was GSO SRS systems is specified as follows.

|  |  |  |
| --- | --- | --- |
| Limit (dB(W/m2)) in 1 MHz bandwidth for angle of arrival, δ, above the horizontal plane | | |
| 0°-5° | 5°-25° | 25°-90° |
| –126 | –126 + 0.5(δ – 5) | –116 |

Similarly, the pfd limit for NGSO SRS systems is specified as follows.

|  |  |  |
| --- | --- | --- |
| Limit (dB(W/m2)) in 1 MHz bandwidth for angle of arrival, δ, above the horizontal plane | | |
| 0°-5° | 5°-25° | 25°-90° |
| –124 | –124 + 0.5(δ – 5) | –114 |

As a consequence of agenda item 1.13 (WRC-23), the SRS allocation in the band was upgraded to primary status subject to a number of constraints to protect incumbent service systems. For SRS downlinks, Resolution **678 (WRC-23)** established a more restrictive power flux density limit of ‑138 dBW/m2 MHz. This contribution proposes the following modifications to the SRS downlink characteristics in Recommendation SA.2141:

* Reduction of SRS spacecraft EIRP where necessary to meet the more constrained SRS downlink pfd requirement
* Adjustment of SRS Earth station parameters where necessary to provide for closure of the downlink

Table 1 of Annex 1 to Recommendation ITU-R SA.2141 documents the Technical and operational system characteristics for the space research service in the 14.8-15.35 GHz band. The following revisions to the characteristic in this Table are proposed.

**Annex 1**

TABLE 1

Example high-rate direct data downlink SRS mission link budgets

| Case | NGSO 800 km alt @ 5 deg  ES ant elev | NGSO 800 km alt @ 10 deg ES ant elev | NGSO 800 km alt @ 90 deg ES ant elev | GSO  @ 10 deg elev | HEO | HEO | L1/L2 | L1/L2 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Frequency (GHz) | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0, 15.2 |
| Wavelength (m) | 0.020 | 0.020 | 0.020 | 0.020 | 0.020 |  | 0.020 |  |
| Polarization | RHCP or LHCP | | | | | | | |
| Satellite apogee (km) | 800 | 800 | 800 | 35 785 | 300 000 | 300 000 | 1 500 000 | 1 500 000 |
| Satellite perigee (km) | 800 | 800 | 800 | 35 785 | 500 | 500 | 1 500 000 | 1 500 000 |
| Data rate (Mbit/s) | 400 | 400 | 400 | 400 | 400 | 320 | 100 | 600 per channel |
| Modulation method | QPSK Uncoded | | | | |  | QPSK Uncoded | 8PSK |
| S/C transmit power (dBW) | -7.0 | -7.0 | -7.0 | 8.5 | 5.0 | 11.8 | 13 | 23 |
| S/C transmit filter, cable loss (dBW) | −0.5 | −0.5 | −0.5 | −0.5 | −0.5 | −0.5 | −0.5 | −0.5 |
| S/C transmit antenna diameter (m) | 0.1 | 0.1 | 0.1 | 0.86 | 0.6 | 1.5 | 1.5 | 2.3 |
| S/C transmit antenna efficiency | 0.5 | . 0.5 | 0.5 | 0.55 | 0.6 | 0.6 | 0.6 | 0.6 |
| S/C transmit antenna gain (dBi) | 20.9 | 20.9 | 20.9 | 40.0 | 37.3 | 45 | 45.2 | 49 |
| S/C transmit EIRP (dBW) | 13.4 | 13.4 | 13.4 | 48 | 41.8 | 55.8 | 57.7 | 71.5 |
| S/C peak EIRP density (dBW/MHz) | -9.6 | -9.6 | -9.6 | 25.0 | 18.8 | 35.8 | 40.7 | 48.5 |
| Path length (km) | 2 784 | 2 367 | 800 | 40 585 | 20 000 | 20 000 | 1 505 257 | 1 505 257 |
| Free space path loss (dB) | 184.9 | 183.5 | 174.0 | 208.1 | 202.0 | 225.5 | 239.5 | 239.5 |
| 10\*log(4\*pi\*d^2) | 139.9 | 138.5 | 129.1 | 163.2 | 157.0 | 157.0 | 194.5 | 194.5 |
| ES receive elevation angle (degree) | 5.0 | 10.0 | 90.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| PFD limit (dBW/m2 MHz) | -138 | -138 | -138 | -138 | -138 | -138 | -138 | -138 |

TABLE 1 (*end*)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Case | NGSO 800 km alt @ 5 deg ES ant elev | NGSO 800 km alt @ 10 deg ES ant elev | NGSO 800 km alt @ 90 deg ES ant elev | GSO @ 10 deg elev | HEO | HEO | L1/L2 | L1/L2 |
| PFD on Earth’s surface (dBW/m2 MHz) | -149.5 | -148.1 | -138.7 | -138.2 | -138.2 | −161.7 | −153.8 | −147.3 |
| ES receive antenna diameter | 18.0 | 18.0 | 18.0 | 9.0 | 7.0 | 12.0 | 34.0 | 32.0 |
| ES receive antenna efficiency | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| ES receive antenna gain (dBi) | 67.5 | 67.5 | 67.5 | 61.5 | 59.3 | 64.0 | 73.0 | 72.5 |
| Beam-edge allowance, rain and atmospheric loss (dB) | −3.0 | −3.0 | −3.0 | −3.0 | −4.0 | −4.0 | −4.0 | −4.0 |
| ES receiver system noise temperature (deg K) | 150.0 | 150.0 | 150.0 | 150.0 | 150.0 | 150 | 150.0 | 150 |
| No (dBW/Hz) | −206.8 | −206.8 | −206.8 | −206.8 | −206.8 | −206.8 | −206.8 | −206.8 |
| Receiver losses (dB) | −1.0 | −1.0 | −1.0 | −1.0 | −1.0 | −1.0 | −1.0 | −1.0 |
| Received Eb/No (dB) | 13.8 | 15.2 | 24.7 | 19.2 | 15.9 | 17.7 | 12.5 | 18.5 |
| Theoretical Eb/No (1E-6 BER) (dB) | 10.5 | 10.5 | 10.5 | 10.5 | 10.5 | 10.5 | 10.5 | 15 |
| Required Eb/No (1E-6 BER) (dB) | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 | 16 |
| Eb/No margin (dB) | 2.3 | 3.7 | 13.2 | 7.7 | 4.4 | 6.2 | 1.0 | 2.5 |
| Note: For the SRS S/C in HEO orbit, the PFD margin is calculated at an assumed minimum transmit altitude of 20,000 km and the link margin is calculated at a maximum range of 300 000 km. | | | | | | | | |