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| **US Radiocommunication Sector****FACT SHEET** |
| **Study Group:** USWP 7B | **Document No:** US7B\_27\_013\_NC |
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| **Document Title:** Proposed updates to Recommendation ITU-R SA.2141 *Characteristics of space research service systems in the frequency range 14.8-15.35 GHz* to support sharing studies to be conducted under WRC-27 agenda item 1.7 |
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| **Purpose:** To finalize updates 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. The status upgrades for SRS are subject to power flux density limitations which may influence the design of future SRS systems. At the March 2024 WP 7B meeting, a proposal was considered to revise the SRS system characteristics contained in Recommendation ITU-R SA.2141 consistent with the pfd constraints in Resolution **678** **(WRC-23)**. This contribution is intended to progress the work on revising the Recommendation to facilitate sharing studies to be conducted in association with WRC-27 agenda item 1.7.  |
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| PROPOSED UPDATES TO RECOMMENDATION ITU-R SA.2141 to support sharing studies to be conducted under WRC-27 agenda item 1.7  |
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WRC-27 agenda item 1.7 calls for the consideration of potential identifications to International Mobile Telecommunications (IMT) operating in the mobile service in several frequency ranges including the 14.8 – 15.35 GHz band. Working Party (WP) 5D will conduct sharing and compatibility studies with other services in these bands and, in contribution 7B/3, has solicited information on the technical and operational characteristics of relevant space research service systems. The SRS currently operates or plans to operate links in the (space-to-space), (space-to-Earth), and (Earth-to-space) directions in the band.

As part of the work in association with WRC-23 agenda item 1.13, WP 7B developed Recommendation ITU-R SA.2141 *Characteristics of space research service systems in the frequency range 14.8-15.35 GHz* documenting the characteristics of SRS systems operating in this band. For links in the (space-to-Earth) direction, limited information on existing SRS systems was available at that time so the characteristics in the Recommendation were derived using those of SRS systems in other bands adapted based on the anticipated system bandwidth requirements and the pfd limits given in Recommendation ITU-R SA.1626 *Feasibility of sharing between the space research service (space-to-Earth) and the fixed and mobile services in the band 14.8-15.35 GHz.*

As part of the solution developed for WRC-23 AI 1.13, modifications were made to the RR to upgrade the allocations to the SRS in 14.8 – 15.35 GHz band from secondary to primary status and to impose a pfd limit for SRS (space-to-Earth) links in this band that is more constraining than that given in Recommendation ITU-R SA.1626. At the March 2024 WP 7B meeting, a proposal was considered to revise the SRS (space-to-Earth) system characteristics contained in Recommendation ITU-R SA.2141 to be consistent with the pfd constraints in Resolution **678** **(WRC-23)**.

This contribution is intended to further progress the work on the Preliminary Draft Revision of Recommendation ITU-R SA.2141.

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| PRELIMINARY DRAFT REVISION OF RECOMMENDATION ITU-R SA.2141-0 |
| Characteristics of space research service systemsin the frequency range 14.8-15.35 GHz |

This document provides additional revisions to the Recommendation [ITU-R SA.2141-0](https://www.itu.int/rec/R-REC-SA.2141/en) 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](https://www.itu.int/rec/R-REC-SA.1626/en). This pfd limit was GSO SRS systems is specified as follows:

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

Similarly, the pfd limit for non-GSO SRS systems is specified as follows.

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| Limit (dB(W/m2)) in 1 MHz bandwidth for angleof 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 dB(W/(m2 ‧ MHz)). This contribution proposes the following modifications to the SRS downlink characteristics in Recommendation ITU-R SA.2141:

– Reduction of SRS spacecraft e.i.r.p. 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 | Non-GSO 800 km alt @ 5 deg ES ant elev | Non-GSO 800 km alt @ 10 deg ES ant elev | Non-GSO 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 e.i.r.p. (dBW) | 13.4  | 13.4  | 13.4  | 48  | 41.8  | 55.8 | 57.7 | 71.5 |
| S/C peak e.i.r.p. 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 \* π \* *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 (dB(W/(m2 ‧ MHz))) | 138  | 138  | 138  | 138  | 138  | 138  | 138  | 138  |

TABLE 1 (*end*)

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| Case | Non-GSO 800 km alt @ 5 deg ES ant elev | Non-GSO 800 km alt @ 10 deg ES ant elev | Non-GSO 800 km alt @ 90 deg ES ant elev | GSO @ 10 deg elev | HEO | HEO | L1/L2 | L1/L2 |
| Pfd on Earth’s surface (dB(W/(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. |