| **U.S. Radiocommunication Sector** **FACT SHEET** |
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| **Study Group:** WP7B | **Document No:** US7B\_27\_015\_R02 |
| **Reference:** Doc.7B/35, Annex 4 | **Date:** 25 July 2024 |
| **Document Title:**Proposed revisions to reply liaison statement to WP5D on AI-1.7 (WRC-27). |
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| **Purpose/Objective**:To liaise additional SRS/EESS/SOS system characteristics and the methodologies to be used in sharing/compatibility studies for AI-1.7 (WRC-27) in WP5D in the 7-8 GHz & 14-15 GHz bands. |
| **Abstract**: Under Agenda item 1.7 (WRC-27), WP5D is conducting sharing/compatibility studies and developing technical conditions for the use of IMT in the 7 125-8 400 MHz SRS/EESS/SOS and 14.8.-15.35 GHz SRS frequency bands taking into account the existing primary services operating in these and the adjacent frequency bands. WP7B has replied to WP5D by providing a list of applicable SRS/EESS/SOS recommendations for this purpose. It also established a correspondence group to collect characteristics of additional SRS/EESS/SOS systems and determine methodologies to be used by WP5D in their studies. This document proposes to revise the preliminary draft liaison statement Doc. 7B/35 (Annex 4) to include additional system characteristics for both bands and a description of the methodology to be used in sharing and compatibility studies to determine the separation distances needed to protect the SRS/EESS/SOS earth stations in the 7 125-8 400 MHz band and the methodology to be used to apply the protection criteria in the 14.8-15.35 GHz band. |
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| **Radiocommunication Study Groups** |  |
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| PROPOSED REVISIONS TO REPLY LIAISON STATEMENT TO WP 5D ON WRC-27 AGENDA ITEM 1.7 |
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Under WRC-27 agenda item 1.7, WP 5D is conducting sharing and compatibility studies and developing technical conditions for the use of IMT in the 7 125-8 400 MHz SRS/EESS/SOS and 14.8.-15.35 GHz SRS frequency bands taking into account the existing primary services operating in these and the adjacent frequency bands.

WP 7B, in its March 2024 meeting, has sent a liaison statement to WP 5D that provided a list of ITU-R recommendations applicable to EESS, SRS, and SOS to be used in the sharing and compatibility studies for WRC-27 AI-1.7. WP 7B has also established a correspondence group to collect characteristics of additional SRS/EESS/SOS systems and determine methodologies to be used by WP 5D in their studies.

This document proposes to revise the preliminary draft liaison statement attached to the WP 7B Chairman’s Report (Doc. 7B/35-Annex 4) to include additional system characteristics and to describe the methodology to be used in the sharing and compatibility studies in the 7 125-8 400 MHz band to determine the separation distances needed to protect the SRS/EESS/SOS earth stations and the methodology to be used in the 14.8-15.35 GHz band to protect the SRS systems.

**ANNEX 4 TO WORKING PARTY 7B CHAIR’S REPORT**

**Draft liaison statement to Working Party 5D**

**(Copy to Working Parties 1B, 3K, 3M, 4A, 4C, 5A, 5B, 5C, 7C, and 7D)**

**WRC-27 agenda item 1.7**

*{Editor’s note: Body of liaison statement not copied}*

ANNEX 1

**System parameters for EESS, SRS, MetSat and SOS in the frequency band 7 125-8 400 MHz, and in adjacent frequency bands**

**1 SOS in the frequency band 7 100-7 155 MHz and 7 190-7 250 MHz**

1.1 General description

1.2 Technical and operational characteristics

1.3 Deployment scenarios for associated earth stations

1.4 Protection criterion

1.5 Methodology to apply protection criterion

**2 EESS in the frequency band 7 190-7 250 MHz**

2.1 General description

2.2 Technical and operational characteristics

2.3 Deployment scenarios for associated earth stations

2.4 Protection criterion

2.5 Methodology to apply protection criterion

**3 MetSat in the frequency band 7 450-7 550 MHz and 8 175-8 215 MHz**

3.1 General description

3.2 Technical and operational characteristics

3.3 Deployment scenarios for associated earth stations

3.4 Protection criterion

3.5 Methodology to apply protection criterion

**4 EESS in the frequency band 8 025-8 400 MHz**

4.1 General description

4.2 Technical and operational characteristics

Table 1 and Table 2 provide additional 8 025-8 400 MHz band EESS characteristics currently omitted in Report ITU-R SA.2488 and the initial WP 5D-to-WP 7B liaison statement (Document 5D/92).

Table 1

Additional Space-to-Earth EESS Systems in the Frequency Band 8 025-8 400 MHz

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | System 1 | System 2 | System 3 | System 4 | System 5 |
| Satellites | N/A | 200 | 18 | 4 | 32 | 148 |
| Orbital altitude  | km | 450 to 580 | 400 to 630 | 402 to 435 | 325 to 375 | 582 |
| Inclination angle | deg | 97.4 | 40 to 6097 to 97.9[[1]](#footnote-1) | 97.05 | 5396.7[[2]](#footnote-2) | 4597.9[[3]](#footnote-3) |
| Center frequency | MHz | 8072.25 to 8352.75 | 8025.128 to 8399.8728055 to 8370 | 8025.1 to 8399.9 | 8025.1 to 8399.9 | 8030 to 8395 |
| Necessary bandwidth | MHz | 94.5 | 256,00060 | 200,000 | 200,000 | 10 |
| Satellite transmit power  | dBW | 18 | 22 | 0 | 0 | 0 |
| Satellite antenna maximum gain | dBi | 16 | 27 | 5 | 5 | 20 |
| Satellite antenna pattern | N/A | Rec ITU-R​ S.152​8 | Rec ITU-R​ S.152​8 | Rec ITU-R​ S.152​8 | Rec ITU-R​ S.152​8 | Rec ITU-R​ S.152​8 |
| Satellite antenna polarization | N/A | RHCPLHCP | RHCP | RHCPLHCP | RHCPLHCP | Linear |
| Ground station maximum antenna gain | dBi | 42.8 (2.7-meter dish)49.8 (6-meter dish) | 42.8 (2.7-meter dish)49.8 (6-meter dish) | 42.8 (2.7-meter dish)49.8 (6-meter dish) | 42.8 (2.7-meter dish)49.8 (6-meter dish) | 15 |
| Ground station antenna (3 dB full) beamwidth | deg | 1.3 (2.7-meter dish)0.6 (6-meter dish) | 1.3 (2.7-meter dish)0.6 (6-meter dish) | 1.3 (2.7-meter dish)0.6 (6-meter dish) | 1.3 (2.7-meter dish)0.6 (6-meter dish) | 31.53 |
| Ground station antenna pattern | N/A | Rec. ITU-R S.465-5 | Rec. ITU-R S.465-5 | Rec. ITU-R S.465-5 | Rec. ITU-R S.465-5 | Rec. ITU-R S.465-5 |
| Ground station antenna polarization | N/A | RHCPLHCP | RHCP | RHCPLHCP | RHCPLHCP | Linear |
| Ground station minimum elevation | deg | 5 | 5 | 5 | 5 | 5 |
| Ground station receiver noise temperature | K | 45 | 45 | 45 | 45 | 100 |

Table 2

Additional Specific Earth Station Locations in the Frequency Band 8 025-8 400 MHz

|  |  |  |
| --- | --- | --- |
| **Non-GSO and GSO Earth Stations** | **Longitude** **(degrees)** | **Latitude** **(degrees)**  |
| Fairbanks, AK, USA | 147.3 W | 64.9 N |
| Prudhoe Bay, AK, USA | 148.4 W | 70.2 N |
| Clewiston, FL, USA | 80.99 W | 26.75 N |
| Kapolei, HI, USA | 158.09 W | 21.34 N |
| Dublin, OH, USA | 83.2 W | 40.1 N |
| Boardman, OR, USA | 119.632 W | 45.86 N |
| Green River, WY, USA | 109.4 W | 41.5 N |
| Punta Arenas, Chile | 70.85 W | 52.94 S |
| Punta Arenas, Chile | 70.86 W | 52.95 S |
| Tromso, Norway | 18.94 E | 69.66 N |
| Vasteras, Sweden | 16.58 E | 59.65 N |
| Dublin, Ireland | 6.23 W | 53.41 N |
| Dubai, United Arab Emirates | 55.47E | 25.29 N |
| Zallaq, Bahrain | 50.5 E | 26.05 N |
| Canary Islands, West Africa | 15.636 W | 27.767 N |
| Bel Ombre, Mauritius | 57.45 E | 20.5 S |
| Hartebeesthoek, South Africa | 27.72 E | 25.89 S |
| Cape Town, South Africa | 18.72 E | 34.03 S |
| Bangalore, India | 77.54 E | 12.91 N |
| Singapore, Singapore | 103.83 E | 1.4 N |
| Seoul, South Korea | 127.138 E | 37.31 N |
| Hokkaido, Japan | 142.62 E | 43.28 N |
| Dongara, Australia | 115.43 E | 29.19 S |
| Sydney, Australia | 150.77 E | 34.04 S |
| Troll, Antarctica | 2.54 E | 72.0 S |

4.3 Deployment scenarios for associated earth stations

Satellites may communicate in three primary earth station deployment scenarios.

* Under deployment scenario 1, fixed earth stations would operate in currently known and future unknown locations in any environment (*i.e.*, rural, suburban, urban). These fixed earth station operations resemble the Systems 1 to 4 earth station operations in Table 1.
* Under deployment scenario 2 (low density), large transportable earth stations would operate in future unknown locations in any environment (*i.e.*, rural, suburban, urban). These transportable earth station operations resemble the Systems 1 to 4 earth station operations in Table 1 and can be relocated at any time to different fixed operating locations.
* Under deployment scenario 3 (high density), miniature transportable earth stations would operate in future unknown locations in any environment (*i.e.*, rural, suburban, urban). These transportable earth station operations resemble the System 5 earth station operations in Table 1 and can be relocated at any time to different fixed operating locations. For example, a nominal deployment configuration would have approximately 100 portable, ground-based remote sensors per 100 square kilometers with multiple such deployments occurring simultaneously.

4.4 Protection criteria

4.5 Methodology to apply protection criteria

 See Annex 3.

**5 SRS in the frequency band 8 400-8 500 MHz**

5.1 General description

5.2 Technical and operational characteristics

5.3 Deployment scenarios for associated earth stations

5.4 Protection criteria

5.5 Methodology to apply protection criteria

 See Annex 3.

ANNEX 2

**System parameters for SRS in the frequency band 14.8-15.35 GHz**

**1 SRS in the frequency band 14.8-15.35 GHz**

1.1 General description

1.2 Technical and operational characteristics

1.3 Deployment scenarios for associated earth stations

1.4 Protection criteria

1.5 Methodology to apply protection criteria

ANNEX 3

**Methodology for calculating the separation distances
for the protection of SRS/EESS earth stations in the 7-8 GHz bands**

**1 Introduction**

The standard methodology for calculating the separation distances around receiving SRS/EESS Earth stations is described in Section 2.

**2 Standard methodology to determine the separation distances around a receiving SRS/EESS Earth station**

This standard methodology is applicable for the protection of SRS (deep-space) in the 8400-8450 MHz (space-to-Earth) band and for EESS in the 8025-8400 MHz (space-to-Earth) band when proposed IMT base stations are operating in-band and in adjacent band to SRS (deep space) receiving stations.

The interference received by an SRS/EESS earth station from a transmitting IMT base station at a given azimuth angle is expressed by the following equation:

$$I\_{r}\left(d,p\right)= P\_{t}+G\_{t}\left(θ\_{t}\right)+ G\_{r}\left(θ\_{r}\right)-L\_{x} - L\left(d,p\right)$$

where:

*d* : separation distance (km) between the transmitter and the receiver;

*p* : exceedance time probability to be used in propagation loss calculation;

*Ir* : interference power (dBW) received in the SRS/EESS reference bandwidth at the input of the SRS/EESS earth station antenna;

*𝑃t* : total IMT transmit power (dBW) in the IMT reference bandwidth at the antenna port – note that specifying *Pt* and *Gt* separately is equivalent to specifying only the e.i.r.p of IMT transmitters towards SRS/EESS receiver;

*𝐺t* : IMT transmitter antenna gain (dB) towards the horizon for the given azimuth;

*θt* : horizon separation angle of the IMT transmitter antenna. The IMT base station antenna beam is assumed to be steered to point in the azimuth direction of the SRS/EESS earth station with the lowest 0-degree horizon separation angle resulting in the highest transmit e.i.r.p. towards the SRS/EESS earth station;

*𝐺𝑟* : receiver antenna gain (dB) towards the physical horizon of the SRS/EESS earth station for a given azimuth with the minimum elevation angle;

 *θr* : horizon separation angle of the SRS/EESS receiver antenna. It is the difference between the minimum pointing elevation angle and the physical horizon angle.

*Lx* : coupling losses (dB) between the IMT transmit spectrum in the IMT reference bandwidth and SRS/EESS receiver in the SRS/EESS reference bandwidth due to frequency separation, interference spectrum overlaps, and spectrum roll-offs;

*L* : propagation loss (dB) calculated for a probability of 𝑝 when the separation distance between the transmitter and the receiver is d km. Note that WP 3K and 3M provided a Reply Liaison Statement to WP 5D (Doc. 5D/160, Doc. 7B/57) with guidance on the propagation models to be used for sharing between stations on the surface of the Earth, including use of Rec. ITU-R P.452. This propagation model includes the path specific clutter losses applicable to the SRS/EESS earth station and IMT base station

For most SRS mission trajectory types and for some EESS mission trajectory types, during the tracking of a spacecraft, the earth station antenna pointing varies very slowly. For other EESS mission trajectory types, including LEOs, the antenna pointing varies quicker. In most cases, the earth station antenna spends significant periods of time pointing at low elevation angles. Thus separation distances around SRS/EESS earth stations are necessary to ensure scientific mission needs to mitigate interference geometry involving the SRS or EESS earth station antenna pointing towards the azimuth of the IMT station at its minimum elevation angle.

 The separation distance (*dmax*) for each azimuth is determined by finding the maximum of all the separation distances such that beyond which the received interference satisfies the protection level of the SRS/EESS earth station, i.e.

$$d\_{max}=max\left\{d :I\_{r}\left(d,p\right)\geq I\_{0}\right\}$$

where *I*0 is the protection level of the SRS/EESS earth station, *p* is the exceedance time percentage used in calculating the propagation losses, and *d* km is the separation distance between the transmitter and the receiver. With this definition, the interference received from an IMT base station would satisfy the protection level of the SRS/EESS earth station for all separation distances *d* ≥ *d*max along the given azimuth. Calculation of *dmax* for each azimuth direction around a SRS/EESS earth station would ensure that no additional or regulatory constraints be place on the incumbent SRS/EESS earth station operation to satisfy invites 2 of Resolution **256 (WRC-23)**.

**3 IMT base station transmit power and IMT antenna gain towards horizon**

The IMT transmit power in the SRS/EESS receiver bandwidth depends on the frequency separation, spectrum roll-off, the spectrum overlap between the IMT transmitter reference bandwidth and SRS/EESS receiver reference bandwidth, and the polarization mismatch losses.

The IMT base station transmit power and antenna gain towards the horizon will be specified by WP 5D.

**4 SRS/EESS protection level and reference bandwidth**

For SRS (deep space) systems operating in the 8400-8450 MHz band, Rec. ITU-R SA.1157 gives the protection level (*I*0) as −221 dBW in a reference bandwidth of 1 Hz. The probability *p* that is to be used in propagation loss calculation is either 0.1% for unmanned missions or 0.001% for manned missions. Since most of SRS earth stations can support both manned and unmanned missions, the value of 0.001% should be used.

For EESS systems operating in the 8025-8400 MHz band, Rec. ITU-R SA. 1027 gives the protection level (*I0*) of −133 dBW in a reference bandwidth of 10 MHz. The interference power probability *p* not to be exceeded is 0.005%.

**5 SRS/EESS antenna gain towards the horizon**

Note that the exceedance probability of 0.001% or 0.005% given for the protection criteria of SRS/EESS earth stations corresponds to very short time durations. Since the acceptable interference events are short, and the transmitter and receiver antennas do not change their pointing directions considerably during these events, the separation distances are calculated for the minimum pointing elevation angles.

For SRS (deep space) earth stations, **RR No.** 21.15 specifies that the minimum elevation angle to be used in sharing/compatibility studies is 10 degrees.

For near-Earth SRS earth stations, the minimum elevation is 5 degrees.

For EESS earth stations, **RR No.** 21.14 specifies that the minimum elevation angle to be used in sharing/compatibility studies is 3 degrees.

The SRS/EESS antenna gain towards the horizon is determined using the minimum pointing elevation angle for the azimuth considered and the relevant antenna pattern.

For SRS, the antenna pattern given in Rec. ITU-R SA. 509 can be used to determine the SRS receiver antenna gain towards the physical horizon as shown in Fig-5.1 below for a 70-m SRS antenna.

*Figure 5.1 70-m SRS antenna gain at 8400 MHz*

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Note that this antenna has a gain of 39.5 dB for an off-axis angle of 0.5 degrees and a gain of 7 dB for an off-axis angle of 10 degrees. The height of the antenna is 39 m above the ground.

For EESS, the antenna pattern given in Rec. ITU-R F. 699 can be used to determine the EESS receiver antenna gain towards the physical horizon, as shown in Fig-5.2 below for a 11.6-m EESS antenna.

*Figure 5.2 11.6-m EESS antenna gain at 8200 MHz*



Note that this antenna has a gain of 37.2 dB for an off-axis angle of 0.5 degrees and a gain of 14.5 dB for an off-axis angle of 5 degrees. The height of the antenna is about 10 m above the ground.

ANNEX 4

**Methodology for assessment of potential interference from IMT systems to the SRS in the frequency band 14.8 – 15.35 GHz**

**1 Introduction**

(Describe the Space Research Service (SRS) usage of the band, relevant characteristics of the SRS in this band)

**2 Standard methodology for assessment of aggregate interference from IMT systems into SRS space station uplinks**

(describe methodology)

 3 **Standard methodology for assessment of aggregate interference from IMT systems into SRS Data Relay Satellite (DRS) system (space-to-space) links**

(describe methodology)

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1. Interference analysis should assume 9 satellites at 50 degrees inclination and 9 satellites at 97.45 degrees inclination. [↑](#footnote-ref-1)
2. Interference analysis should assume 16 satellites at 53 degrees inclination and 16 satellites at 96.7 degrees inclination. [↑](#footnote-ref-2)
3. Interference analysis should assume 100 satellites at 45 degrees inclination and 48 satellites at 97.9 degrees inclination. [↑](#footnote-ref-3)