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| U.S. Radiocommunications SectorFact Sheet |
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| **Purpose/Objective:** This contribution proposes a draft liaison statement to WP 4C regarding AI 1.13 to assist WP 4C with its planning for sharing and compatibility studies.  |
| **Abstract:** Pursuant to Resolution **253 (WRC-23)**, in preparation for Agenda Item 1.13 (**WRC-27**), this contribution proposes a draft reply liaison statement to WP 4C with relevant technical information of aviation systems in the 960-1215 MHz and Radiolocation Service systems operating in the 2 360-2 390 MHz band. In addition, information is included for airborne AMT receivers in 1435-1525 and 1780-1850 MHz), and portions of the S-band (2.2 and 2.3 GHz). |

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|  **United States of America**  |
| proposed draft reply liaison statement to Working party 4C**Relevant technical information for sharing studies under WRC-27 Agenda Item 1.13** |
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**Introduction**

WRC-27 Agenda Item 1.13 considers possible new allocations to the mobile-satellite service for direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage, in accordance with Resolution 253 (WRC-23). In addition to the information provided in a previous liaison statement (4C/83), this contribution provides additional technical information of systems operating in-band and adjacent-band to the proposed frequency bands under WRC-27 AI 1.13.

Attachment: 1

ATTACHMENT

**Working Party 5B**

PROPOSAL DRAFT REPLY LIAISON STATEMENT TO WORKING PARTY 4C

**Relevant technical information for sharing studies under WRC-27 Agenda Item 1.13**

Working Party (WP) 5B thanks WP 4C for its liaison statement ([Document 5B/77](https://www.itu.int/md/R23-WP5B-C-0077/en)), requesting the characteristics and protection criteria of the systems operating in-bands and adjacent bands, as appropriate, to the proposed frequency bands under WRC-27 AI 1.13, for sharing and compatibility studies.

1. **Radiolocation service (RLS) in the frequency band 2 360-2 390 MHz**

In addition to the information provided in a previously liaison statement ([Document 4C/83](https://www.itu.int/md/R23-WP4C-C-0083/en)), WP 5B would also like to provide the technical characteristics of the radiolocation service (RLS) operating in the frequency band 2 360-2 390 MHz in Table 1 below.

Table 1 - Radiolocation Characteristics in the frequency band 2 360-2 390 MHz

|  |
| --- |
| Transmitter |
| Platform type (airborne, shipborne, etc) | Airborne | Ground |
| Frequency range (MHz) | 2360 – 2390 | 2360 – 2390 |
| Transmit Power (dBW) | 13 | 13 |
| Receiver |
| Platform type (airborne, shipborne, etc) | Airborne | Ground |
| Frequency range (MHz) | 2360 – 2390 | 2360 – 2390 |
| IF 3dB bandwidth (MHz)  | 4 | 4 |
| Receiver noise figure (dB) | 5 | 6 |
| Antenna |
| Antenna Radiation Pattern | Dipole/Omnidirectional | Dipole/Omnidirectional |
| Antenna gain (dBi) | 4 | 6 |
| Antenna azimuth beamwidth (Degrees) | 360 | 360 |
| Antenna elevation beamwidth (Degrees) | 24.6 | 21 |
| Protection Criteria, I/N (dB) | -6 | -6 |

1. **Aviation systems in the frequency band 960 - 1 215 MHz**

The frequency band 960-1 215 MHz is allocated to the aeronautical radionavigation service (ARNS) and the band 960-1 164 MHz is allocated to the aeronautical mobile (route) service (AM(R)S). The frequency band 1 087.7-1 092.3 MHz is allocated to the aeronautical mobile satellite (route) service (AMS(R)S) on a primary basis, limited to the space station reception of Automatic Dependent Surveillance – Broadcast (ADS-B). These allocations are heavily used by aviation safety-of-life systems.

Protection criteria for aviation systems

Aviation safety-of-life systems required the highest levels of availability, integrity, and continuity. For example, the Category I integrity is 1-1e-7 and Category II/III integrity is 1-1e-9. Such high levels of requirements are achieved by ensuring no harmful interference in extreme propagation anomalies and interference conditions.

WP5B recommends using I/N = -6 dB for aviation communication systems and I/N = -10 dB for aviation navigation and surveillance systems for sharing and compatibility studies conducted for 1.13… until relevant ITU-R recommendations are available for aviation systems in the frequency band 960 – 1 215 MHz. This represents the aggregate protection level if multiple interferers are present. WP5B recommends using I/N = -20 dB for interference from adjacent-band interferers.

Aviation safety margin

WP5B recommends an aviation safety margin of not less than 6 dB to be included in the sharing and compatibility studies.

DME technical parameters

Aviation safety-of-life systems, including ILS/DME installations, required the highest levels of availability, integrity, and continuity. For example, the integrity of a precision approach procedures (Category I) is 1-1e-7 and Category II/III integrity is 1-1e-9. Such high levels of requirements are achieved by ensuring no harmful interference in extreme propagation anomalies and interference conditions. Hence, a protection criterion of I/N = -10 dB should be used in the sharing studies. This represents the aggregate protection level if multiple interferers are present. A protection criteria of I/N = -20 dB should be used for compatibility studies with interference from adjacent-band interferers.

DME receiver performance and antenna parameters are in Table 1. The protection criteria provided should be considered for the aggregate of all possible interference sources.

Table 1

DME receiver performance and antenna parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameters | DME/N ground | DME/N airborne | DME/P ground | DME/P airborne |
| Frequency range of assignable channels, MHz | 1 025-1 150 | 9 62-1 213 | 1 025-1 150 | 962-1 213 |
| Bandwidth, MHz | 3.5 | 3.5 | 3.5 | 3.5 |
| Antenna gain, dBi  | 16 (directional),12 (omni-directional) | 5.4 | 16 | 5.4 |
| Noise figure, dB | 4 | 4 | 4 | 4 |
| Cable loss, dB  | < 2 | 4 | < 2 | 4 |
| Selectivity, attenuation (dB) @ freq offset (MHz) | 0 @ 010 @ 2.260 @ 9.6 | 6 @ 0.920 @ 1.0540 @ 1.360 @ 1.570 @ 3 | 0 @ 010 @ 2.260 @ 9.6 | 6 @ 0.920 @ 1.0540 @ 1.360 @ 1.570 @ 3 |
| Protection criteria (*I/N*), dB | -10 | −10 | −10 | −10 |
| Adjacent-band protection criteria (I/N), dB | -20 | -20 | -20 | -20 |

SSR technical parameters

Table 2 contains recommended characteristics and protection criteria for the SSR ground interrogator receiver and the SSR airborne transponder receiver.

Table 2

SSR system receiver performance and antenna assumptions

|  |  |  |
| --- | --- | --- |
| Parameters | SSR airborne transponder | SSR ground interrogator |
| Centre frequency, MHz | 1 030 | 1 090 |
| Bandwidth, MHz | 6 | 4.5 (Mode A and C)2.3 (Mode S) |
| Antenna gain, dBi | 2.8 / 5.4 | 27 |
| Antenna polarization | Vertical | Vertical |
| Cable loss, dB | 1 | 1 |
| Selectivity, attenuation (dB) @ freq offset (MHz) | 3 @ 324.6 @ 1040 @ 1560 @ 25 | 3 @ 324.6 @ 1040 @ 1560 @ 25 |
| Noise figure, dB | 5 | 5 |
| Interference criteria (I/N), dB | −10 | −10 |
| Adjacent-band protection criteria (I/N), dB | -20 | -20 |

ADS-B 1090ES technical parameters

Table 3 contains recommended characteristics and protection criteria for the ADS-B 1090ES airborne receiver.

Table 3

ADS-B 1090ES system receiver performance and antenna assumptions

| Parameters | ADS-B airborne |
| --- | --- |
| Centre frequency, MHz | 1 090 |
| Bandwidth, MHz | 11 |
| Antenna gain, dBi | 2-5 |
| Antenna polarization | Vertical |
| Cable loss, dB | 1 |
| Selectivity, attenuation (dB) @ freq offset (MHz) | 0 @ 03 @ 5.520 @ 1040 @ 1560 @ 25 |
| Noise figure, dB | 5 |
| Interference criteria (*I/N*), dB | −10 |
| Adjacent-band protection criteria (I/N), dB | -20 |

## UAT technical parameters

Table 4 contains recommended characteristics and protection criteria for the UAT receiver. The protection criteria provided should be considered for the aggregate of all possible interference sources.

Table 4

UAT receiver performance and antenna assumptions

|  |  |
| --- | --- |
| Parameters | UAT airborne |
| Centre frequency, MHz | 978 |
| Antenna gain, dBi | 0-4 |
| Cable loss, dB | 1-3 |
| Bandwidth, MHz | 1.3 |
| Noise figure, dB | 6 |
| Selectivity, attenuation (dB) @ freq offset (MHz) | 0 @ 03 @ 0.62515 @ 150 @ 260 @ 10 |
| Protection criteria (*I/N*), dB | −10 |
| Adjacent-band protection criteria (I/N), dB | -20 |

MLAT technical parameters

Until further analysis provides more detailed information, use the ADS-B 1090ES and UAT airborne receiver technical characteristics and protection criteria to represent the MLAT receiver on the ground. Also, while the SSR airborne transponder is the desired receiver in the MLAT interrogation path, its technical characteristics are already covered in the SSR technical parameters section.

ACAS technical parameters

Until further analysis provides more detailed information, use the ADS-B 1090ES airborne receiver technical characteristics and protection criteria to represent the ACAS receiver. Also, while the SSR airborne transponder is the desired receiver in the ACAS interrogation path, its technical characteristics are already covered in the SSR technical parameters section.

LDACS technical parameters

Table 5 contains recommended characteristics and protection criteria for the LDACS receiver. The protection criteria provided should be considered for the aggregate of all possible interference sources.

Table 5

LDACS receiver performance and antenna assumptions

|  |  |  |
| --- | --- | --- |
| Parameters | LDACS Rx airborne  | LDACS Rx ground |
| Frequency range, MHz | 1 110-1 146 | 964-1 000 |
| Antenna gain, dBi | 5.4 | 12 (typical) |
| Cable loss, dB | 3 | 2 (typical) |
| Duplexer loss, dB | 1 | − |
| Bandwidth, MHz | 0.5 | 0.5 |
| Noise figure, dB | 6 | 6 |
| Selectivity, attenuation (dB) @ freq offset (MHz) | 0 @ 0.256 @ 0.340 @ 0.470 @ 0.580 @ 0.7590 @ 1.5 | 0 @ 0.256 @ 0.340 @ 0.470 @ 0.580 @ 0.7590 @ 1.5 |
| Protection criteria (*I/N*), dB | −6/-10 | −6/-10 |
| Adjacent-band protection criteria (I/N), dB | -20 | -20 |

1. **Technical Characteristics for Airborne AMT receivers in L- and S-bands**

The Tables below contain technical characteristics for airborne telemetry relay receivers. The protection criteria provided should be considered for the aggregate of all possible interference sources. ITU-R Recommendation M.1459 sets forth the technical characteristics and protection criteria for AMT ground station receivers, but also includes antenna pattern information applicable to airborne receive systems.

Given the very large numbers of low earth orbit satellites anticipated, a minimum I/N of -6 dB is appropriate for protection of AMT airborne receivers.

(It may also be noted that, in some countries, including the U.S., use of the bands 1 435-1 525 MHz and 2 360-2 395 MHz by the aeronautical mobile service for telemetry has priority over other uses by the mobile service (See RR Nos. **5.343** and **5.394)).**

TABLE 6A

Characteristics of S-Band Telemetry Relay Link

|  |  |
| --- | --- |
| Parameters | Airborne Platform |
| Operating Frequency (S-band) | 2200-2290 MHz, 2310-2320 MHz, 2345-2360 MHz, and 2360-2395 MHz |
| Signal Bandwidth | 1-40 MHz (10 MHz typ.) |
| EIRP | 30-40 dBm |
| Antenna Pattern | Dipole (hemispherical, 360 degrees) |
| Polarization | Linear |
| Antenna System Performance |  G/T = 11dB/K |
| Receiver Noise Figure  | 6 dB |
|  S/N (normailized) | Eb/No = 13 dB (min.) |
|  Protection Criterion | I/N = -6 dB |
|  Protection Criterion (adjacent band) | I/N = -10 dB |

TABLE 6B

Characteristics of L-Band Telemetry Relay Links

|  |  |
| --- | --- |
| Parameters | Airborne Platform |
| Operating Frequency (L-band) | 1435 MHZ to 1535 MHz, 1780-1850 MHz  |
| Signal Bandwidth | 1-40 MHz (10 MHz typ.) |
| EIRP | 30-40 dBm |
| Antenna Pattern | Dipole (hemispherical, 360 degress) |
| Polarization | Linear |
| Antenna System Performance | G/T = 9 dB/K |
| Receiver Noise Figure  | 6 dB |
| S/N (normailized) | Eb/NO = 13 dB (min.) |
| Protection Criterion  | I/N = -6 dB |
| Protection Criterion(adjacent band) | I/N = -10 dB |

It may be noted that newer airborne relay technology operating in other bands (e.g. C-band) is expected to exhibit technical characteristics and protection criteria similar to those set forth in the Tables above (with the possible exception of values for antenna system performance in terms of G/T).