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| U.S. Radiocommunications Sector  Fact Sheet | |
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| **Document Title:** WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT NEW RECOMMENDATION ITU-R M.[TER\_AG\_CNPC\_CHAR] - **Characteristics of terrestrial, air-ground, unmanned aircraft system control and non-payload communications links operating in the AM(R)S allocation under No. 5.443C** | |
| **Author(s)/Contributors(s):**  Name: Don Nellis  Org: Federal Aviation Administration  Name: Michael Neale  Org: ACES Corporation for the FAA | Phone: (202) 267-9779  Email: [Donald.Nellis@faa.gov](mailto:Donald.Nellis@faa.gov)  Phone: (858) 705-8978  Email: michael.neale@aces-inc.com |
| **Purpose/Objective:** The purpose of this contribution is to capture and document the characteristics of terrestrial air-ground UAS CNPC links to enable any future sharing studies to use the correct values of the parameters of the characteristics of these system. | |
| **Abstract:** This contribution will provide values of a range of RF parameters associated with the CNPC links that operate in the AM(R)S allocation under No. 5.443C. The performance of these links has a direct relationship to the safe operation of these unmanned aircraft. Consequently, it is important to ensure their operation is correctly considered in any sharing and interference analysis that may be carried out in the future. | |

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| **Radiocommunication Study Groups** |  |
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| **English only** |
| **United Sates of America** | |
| WORKING DOCUMENT TOWARDS A PReliminary draft new RECOMMENDATION Itu-r m.[ter\_ag\_cnpc\_char]  **Characteristics and Protection Criteria of Terrestrial Air-Ground, Unmanned Aircraft System Control and Non-Payload Communications Links operating in the AM(R)S allocation under No. 5.443C**  **Introduction**  At WRC-2012 it was agreed, under No. 5.443C, that the frequency band 5 030-5 091MHz could be used by the aeronautical mobile (R) service limited to internationally standardized aeronautical systems. Industry, international standards development organizations and ICAO have been working since then to develop the technology and standards necessary to use that allocation. Consequently, it is now possible to provide characteristics and protection criteria for such systems for use in any future sharing studies within ITU-R.  **Proposal**  The United States of America proposes to assist in answering the above need by providing characteristics for such Control and Non-Payload Communications (CNPC) links operating in the AM(R)S allocation under No. 5443C and used in air-ground applications between Unmanned Aircraft (UA) and their Control Station (CS) where the Remote Pilot (RP) is located.  **Attachment:** | |

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| attachment  WORKING DOCUMENT TOWARDS A PReliminary draft new RECOMMENDATION Itu-r m.[ter\_ag\_cnpc\_char]  **Characteristics and Protection Criteria of Terrestrial Air-Ground, Unmanned Aircraft System Control and Non-Payload Communications Links operating in the AM(R)S allocation under No. 5.443C** |

**1 Introduction and Scope**

As described in Report ITU-R M.2171, Characteristics of Unmanned Aircraft Systems (UAS) and spectrum requirements to support their safe operation in non-segregated airspace, there is a strong and growing demand for the use of UAS (also known as Remote Pilot Aircraft (RPA) by ICAO) in civil applications. These UAS flights will share airspace with passenger carrying aircraft so their operation needs to be managed to safely allow the introduction of this new paradigm in aviation.

One aspect of the management of safe UAS operations is the management of the interference received by the Control and Non-Payload Communications (CNPC) receivers that link the Unmanned Aircraft (UA) and the Control Station (CS). Additionally, since the frequency band is shared with other Route Service systems, the interference caused by the UAS must also be managed to ensure that the levels of safety are appropriately maintained.

To enable this interference analysis to be undertaken the characteristics and protection criteria for these Terrestrial, Air-Ground CNPC links operating in the AM(R)S allocation under No. 5.443C are required. This report contains those characteristics and protection criteria based on systems that are being developed for international standardization by ICAO and which will be included within Annex 10, Volume VI, of their Standards and Recommended Practices.

**2 Characteristics of Terrestrial Air-Ground CNPC links**

**2.1 UA and CS Link Characteristics**

TABLE 1

**Transmission And Reception Characteristics**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Units** | **CNPC Link System Airborne Radios** | **CNPC Link System Ground Radios** |
| Frequency of Operation | MHz | 5 030 to 5 091 | 5 030 to 5 091 |
| Baseband Signal |  | Data | Data |
| User Data Rates | kbps | 7.04 to 34.8 | 7.04 to 34.8 |
| Duplexing |  | Time Division | Time Division |
| Transmit/Receive Duration  Up from CS  Down form UA | msec | 23 Up plus 1.3 Guard  23 Down plus 2.7 Guard | 23 Up plus 1.3 Guard  23 Down plus 2.7 Guard |
| Modulation |  | GMSK or QPSK | GMSK or QPSK |
| Symbol Rates | ksps | 34.5 to 138 including TDD, error correction/detection, guard times and synchronization overhead | 34.5 to 138 including TDD, error correction/detection, guard times and synchronization overhead |
| Occupied Bandwidth, C | kHz | Variable per application with a Maximum of 250 | Variable per application with a Maximum of 250 |
| Antenna Gain | dBi | 3 | 22.5 |
| Cable Loss | dB | 2 | 3 |
| Antenna Pattern |  | Constant Azimuth  Constant Elevation | Constant Azimuth  Tailored in Elevation  See Table 1 |
| Antenna Polarization |  | Vertical with aircraft flying straight and level | Vertical |
| Maximum Antenna Height | m | 22 860 (MSL)  Typical 8 000 | 2 to 50  Typical 10 |
| Service Range | km | 550  Typical 200 | 550  Typical 200 |
| Transmitter Conducted Power | dBm | 40 | 40 |
| Transmitter In Band Emission Limits | dBc/kHz | -96 at 2MHz offset  See Table 2 | -96 at 2MHz offset  See Table 2 |
| Receiver Noise Figure | dB | 6 | 6 |
| Receiver In Band Rejection – except the operating channel | dB | 44 | 44 |
| Protection Criteria I/N \* | dB | -10 | -10 |

\* Compatibility/sharing analyses could consider an aeronautical safety margin as recommended by ICAO. Values from 0 to 6 dB have been discussed.

TABLE 2

**Control Station Elevation Antenna Pattern**

**Pattern is constant in azimuth**

|  |  |
| --- | --- |
| **Elevation Degrees** | **Gain dBi** |
| 0.5 | 20.0 |
| 1 | 20.5 |
| 2 | 21.5 |
| 4 | 22.5 |
| 8 | 20.5 |
| 16 | 14.0 |
| 32 | 6.5 |
| 64 | 3.0 |
| >64 | 3.0 |

TABLE 3

**Transmitter In Band Emission Limits**

|  |  |
| --- | --- |
| **Offset from Carrier Frequency** | **dBc/kHz** |
| Channel Width ÷ 2 | -54 |
| 1.5 x Channel Width | -74 |
| 500 kHz | -90 |
| 2 000 kHz | -96 |

TABLE 4

**Transmitter Out Of Band Emission Limits**

|  |  |
| --- | --- |
| **Maximum CNPC Link System Power Spectral Density** | |
| **CNPC Link System Airborne Radios** | **CNPC Link System Ground Radios** |
| TBD | TBD |

**Editor’s Note:**  It is envisioned that the proposed Recommendation ITU-R M.[TER\_AG\_CNPC\_CHAR] will eventually include the out of band emission characteristics of AM(R)S transmissions into adjacent bands including those below 5 030 MHz that would be necessary for sharing studies to resolve the provisional nature of the -75 dBW/MHz protection value in **No. 5.443C**.