|  |  |
| --- | --- |
| **U.S. Radiocommunications Sector**  **Fact Sheet** | |
| **Working Party:** ITU-R WP 5B | **Document No:** USWP 5B XX-XX |
| **Ref:** Annex 20 to Document 5B/216-E Report on the thirty first meeting of Working Party 5B (Geneva, 19-28 November 2024) | **Date:** 3 March 2025 |
| Document Title: Preliminary Draft New Report “Technical characteristics, protection criteria, and compatibility and sharing studies for the modernization of the aeronautical mobile (OR) service allocated to that service between the frequency range 3.025 to 18.03 MHz”. | |
| **Author(s)/Contributors(s):**  Fumie Wingo  DON CIO  Robert Leck  ACES for DON CIO  Taylor King  ACES for DON CIO  Carmelo Rivera  ACES for DON CIO  Andre Tarpinian  HII for DON CIO | Phone: 703-697-0066  Email: [fumie.n.wingo.civ@us.navy.mil](mailto:fumie.n.wingo.civ@us.navy.mil)  Phone : 321-332-2111  Email : [robert.leck@aces-inc.com](mailto:robert.leck@aces-inc.com)  Phone : 443-966-0550  Email : [taylor.king@ACES-INC.COM](mailto:taylor.king@ACES-INC.COM)  Phone : 240-818-2766  Email : [carmelo.rivera@ACES-INC.COM](mailto:carmelo.rivera@ACES-INC.COM)  Phone : 267-210-0324  Email : [andre.a.tarpinian@hii.com](mailto:andre.a.tarpinian@hii.com) |
| **Purpose/Objective:** This contribution proposes continued work to edit Document Annex 20 to Document 5B/216-E of the chairman’s report. Edits include updating the document to a preliminary draft new report as discussed during the ITU-R WP5B conferences in November 2024 as well as updating the framework to combine technical characteristics and sharing studies into one document. | |
| **Abstract****:** An assessment of the technical characteristics, protection criteria and sharing considerations regarding the modernization of high-frequency spectrum for aeronautical mobile (OR) service within the 3.025 to 18.03 MHz frequency range under Agenda Item 1.9 are addressed along with the introduction of additional sections, dealing with study methodology and results. For the purpose of document development, comments in green are for the use of the authors and will be removed after they have been addressed before submission to ITU W5B. First draft updates are shown in yellow whereas second draft updates are shown in turquoise. | |

|  |  |
| --- | --- |
| **Radiocommunication Study Groups** | Logo  Description automatically generated |
|  |  |
|  |  |
| Source: Annex 20 to Document 5B/216-E Report on the thirty first meeting of Working Party 5B (Geneva, 19-28 November 2024)  Subject: Working Document Towards a PDNR | **Document 5B/XX-E** |
| **DD MM YYYY** |
| **Original: English** |
| **United States of America** | |
| WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT  NEW REPORT ITU-R  M.[MODERNIZATION OF HF AM(OR)S]  **Technical characteristics, protection criteria, and compatibility and sharing studies for the modernization of the aeronautical mobile (OR) service allocated to that service between the frequency range 3.025 to 18.03 MHz** | |
|  | |

**Introduction**

The United States proposes that ITU-R Working Party (WP) 5B consider the proposed report in support of AI 1.9.

Summary of the revisions

This revision addresses editors’ comments that were received at the thirty first meeting of Working Party 5B (Geneva, 19-28 November 2024) and includes additional content.

USA Modifications are highlighted in yellow also enabled with Tracking and identified as USA.

|  |  |
| --- | --- |
| **Radiocommunication Study Groups** |  |
|  |  |
|  |  |
| Received: Document 5B/216-E  Subject: WRC-27 agenda item 1.9 | **Annex 20 to Document 5B/216-E** |
| **28 November 2024** |
| **English only** |
| Annex 20 to Working Party 5B Chair’s Report | |
| WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT  NEW REPORT ITU-R  M.[MODERNIZATION OF HF AM(OR)S] | |
| Technical characteristics, protection criteria, and compatibility and sharing studies for the modernization of   the aeronautical mobile (OR) service allocated to that service between the 3.025 to 18.03 MHz | |

(202X)

Scope

This Report identifies technical characteristics, protection criteria, and compatibility and sharing studies for the modernization of high-frequency spectrum use in the aeronautical mobile (OR) service. It assesses compatibility with incumbent services that are allocated on a primary basis in band and adjacent band.

Abbreviations/Glossary

AM(R)S Aeronautical Mobile Route Service

AM(OR)S Aeronautical Mobile Off-Route Service

FSK Frequency Shift Keying

HF High Frequency

PSK Phase Shift Keying

QAM Quadrature Amplitude Modulation

RF Radio Frequency

RR Radio Regulations

WBHF Wide-band High Frequency

Definitions

AM(R)S: aeronautical mobile route (R) service:  An aeronautical mobile service reserved for communications relating to safety and regularity of flight, primarily along national or international civil air routes.

AM(OR)S: aeronautical mobile off-route (OR) service:  An aeronautical mobile service intended for communications, including those relating to flight coordination, primarily outside national or international civil air routes.

Skywave: The propagation of radio waves reflected or refracted back toward Earth from the ionosphere

Groundwave: Radio waves propagating parallel to and adjacent to the surface of the Earth, following the curvature of the Earth

Related ITU Recommendations and Reports

Recommendation [ITU-R BS.80](https://www.itu.int/rec/R-REC-BS.80/en) – Transmitting antennas in HF broadcasting

Recommendation [ITU-R BS.705](https://www.itu.int/rec/R-REC-BS.705/en) – HF transmitting and receiving antennas characteristics and diagrams

Recommendation [ITU-R F.240](https://www.itu.int/rec/R-REC-F.240/en) – Signal-to-interference protection ratios for various classes of emission in the fixed service below about 30 MHz

Recommendation [ITU-R F.1761](https://www.itu.int/rec/R-REC-F.1761/en) – Characteristics of HF fixed radiocommunication systems

Recommendation [ITU-R F.1762](https://www.itu.int/rec/R-REC-F.1762/en) – Characteristics of enhanced applications for high frequency (HF) radiocommunication systems

Recommendation [ITU-R F.1821](https://www.itu.int/rec/R-REC-F.1821/en) – Characteristics of advanced digital high frequency (HF) radiocommunication systems

Recommendation ITU-R SM.339 – Bandwidths, signal-to-noise ratios and fading allowances in complete systems

Report [ITU-R BS.458](https://www.itu.int/pub/R-REP-BS.458) – Characteristics of systems in LF, MF and HF broadcasting

Report [ITU-R F.2061](https://www.itu.int/pub/R-REP-F.2061) – HF fixed radiocommunications systems

Report [ITU-R F-2062](https://www.itu.int/pub/R-REP-F.2062) – Enhanced high frequency digital radiocommunication systems capable of providing enhanced applications

Report [ITU-R F.2087](https://www.itu.int/pub/R-REP-F.2087) – Requirements for high frequency (HF) radiocommunication systems in the fixed service

Editor’s Note: Add more Related ITU Recommendations and Reports as they become available from the incumbent services responsible Working Parties.

# Introduction

# The Aeronautical Mobile (OR) Service (AM(OR)S) utilizing the Appendix 26 frequency range between 3 025 kHz and 18 030 kHz has been a very important radio communication system for aircraft when communications is needed beyond the range of terrestrial radio systems operating at higher frequencies.[[1]](#footnote-2). Next generation Wide-band High Frequency (WBHF) technologies can accommodate digital technologies for aeronautical systems operating under Aeronautical Mobile Off-Route Service (AM(OR)S). The next generation of WBHF radio systems are expected to address the limitations of today’s HF (High Frequency) radio communications systems to enable broadband applications using standard waveforms and channel bandwidths and significantly improving HF data rate, voice clarity, and link availability. To support inclusion of WBHF systems, revision of the Appendix 26 is being studied to consider appropriate regulatory actions to support modernization of systems operating in the aeronautical mobile (OR) service within the frequency range defined in Appendix 26. In essence, this Report provides methods to modify the Appendix 26 (Rev.WRC-15) allotment plan without altering the current channelization.

# 2. Aeronautical Mobile (OR) Service Usage in the Appendix 26 Frequency Range

Unlike the AM(OR)S, which is dedicated to communications while on established air routes, the AM(OR)S is used for situations outside of normal flight paths. It is used specifically for aircraft communications when an aircraft is not flying on a standard published airway where line-of-sight radio is not possible and, due to range limitation to cover all portions of the routes flown, very HF coverage is insufficient. The use of HF frequencies is necessary because they facilitate long range communications coverage.

AM(OR)S is often used for air-to-ground voice communications, for the broadcast of air traffic service, meteorological information for situations like emergency diversions, search and rescue operations, or when an aircraft needs to communicate while in flight over remote areas.

WBHF technologies have been identified to improve performance requirements for the modernization of AM(OR)S operations. These technologies allow for improved data transmission capabilities compared to traditional narrowband HF, enabling faster and more reliable communication through implementation of wider channel bandwidths that are typically on the order of 6 to 48 kHz.

Implementation of wider channel bandwidths will result in improved voice quality, higher data rates, improved ground station monitoring and improved handover in the presence of signal degradation.

# 3. Appendix 26 Overview

Aircraft use specific HF frequencies allocated for AM(OR)S as defined in the ITU Radio Regulations, Appendix 26. Appendix 26 specifically refers to the "frequency allotment plan for the aeronautical mobile service," essentially outlining the designated frequency bands allocated for air traffic communication within the AM(OR)S. This includes details on channel usage and related information. It is primarily concerned with radio frequencies used by aircraft for communication, including both voice and data transmission when flying outside of established air routes. Unlike Aeronautical Mobile Route Service (AM(R)S), which is primarily used for safety-critical communications on established air routes, the off-route service is used for less critical communications when an aircraft deviates from its planned path. This service is typically used for coordinating flight changes, requesting information about weather conditions in an unexpected area, or communicating with ground stations outside of standard air traffic control zones.

Frequency allotments within Appendix 26 are based upon channel bandwidths that are limited to 3 kHz. Implementation of wider channel bandwidths will need to be accomplished within the scope of the current Appendix 26 allotment plan.

The AM(OR)S frequencies within Appendix 26 are listed below in Table 1.

TABLE 1

**Appendix 26 Frequency Ranges Exclusive to AM(OR)S (kHz)**

|  |  |
| --- | --- |
| 3 025-3 155 | 8 965-9 040 |
| 3 900-3 950 (Region 1 only) | 11 175-11 275 |
| 4 700-4 750 | 13 200-13 260 |
| 5 680-5 730 | 15 010-15 100 |
| 6 685-6 765 | 17 970-18 030 |

# 4. Adjacent Band Incumbent Services

Table 2 lists the adjacent band services that will need to be considered for this study.

TABLE 2

**Incumbent Services Adjacent to AM(OR)S Allocations**

|  |  |
| --- | --- |
| **Frequency band (kHz)** | **Adjacent Band Services** |
| 2850 - 3025 | AM(R)S |
| 3155 - 3200 | FIXED/MOBILE (except AM(R)) |
| 3800 - 3900 | FIXED  LAND MOBILE |
| 3950 – 4000 | FIXED  BROADCASTING |
| 4650 - 4700 | AM(R)S |
| 4750-4850 | FIXED  LAND MOBILE  BROADCASTING |
| 5480 – 5680 | AM(R)S |
| 5730 – 5900 | FIXED  LAND MOBILE |
| 6525 - 6685 | AM(R)S |
| 6765 – 7000 | FIXED  MOBILE (except AM(R)) |
| 8815 - 8965 | AM(R)S |
| 9040 – 9305 | FIXED |
| 10150 - 11175 | FIXED  Mobile (except AM(R)S) |
| 11275 – 11400 | AM(R)S |
| 12230 - 13200 | MARITIME MOBILE  **5.109** The frequencies 2 187.5 kHz, 4 207.5 kHz, 6 312 kHz, 8 414.5 kHz, 12 577 kHz and 16 804.5 kHz are international distress frequencies for digital selective calling. The conditions for the use of these frequencies are prescribed in Article **31**. |
| 13260 – 13360 | AM(R)S |
| 15005 - 15010 | STANDARD FREQUENCY AND TIME SIGNAL (15000 kHz) |
| 15100 - 15600 | BROADCASTING |
| 17900 - 17970 | AM(R)S |
| 18030 - 18052 | FIXED |

# 5. Technical Characteristics

## 5.1. AM(OR)S Legacy 3 kHz Channel Bandwidth Technical Parameters

An AM(OR)S HF transmitter is used for aircraft communications in areas beyond regular flight paths. Table 3-6 lists typical parameters for AM(OR)S aeronautical and aircraft station which can vary depending on the aircraft type and operating regions regulations.

A few additional technical parameters are listed below:

* The carrier frequencies of 3023 and 5680 kHz are intended for worldwide common use
* Aeronautical radio stations are limited to single-side-band emissions (J3E)
* The upper sideband shall be employed, and the assigned frequency shall be 1400 Hz higher than the carrier frequency
* Occupied bandwidth cannot exceed 2.800 kHz
* A channel bandwidth of up to 2.8 kHz contained within a given frequency channel power limits as defined in Table 3.

TABLE 3

|  |  |  |
| --- | --- | --- |
| **AM(OR)S Power Limits for Aeronautical and Aircraft StationsClass of emission** | **Power limit values**  **(peak envelope power supplied to the antenna)** | |
| **Aeronautical station** | **Aircraft stations** |
| J3E | 36 dBW | 23 dBW |
| A1A, A1B | 30 dBW | 17 dBW |
| F1B | 30 dBW | 17 dBW |
| A2A, A2B | 32 dBW | 19 dBW |
| H2A, H2B | 33 dBW | 20 dBW |
| (R, J) 2 (A, B, D) | 36 dBW | 23 dBW |
| J (7,9) (B, D, X) | 36 dBW | 23 dBW |

3 kHz channel bandwidth AM(OR)S transmitter and receiver parameters are included in Tables 4 and 6 below, along with emission and mask parameters that are included in Table 5.

TABLE 4

**AM(OR)S 3 kHz Channel Bandwidth Typical Transmitter Parameters**

|  |  |
| --- | --- |
| **Parameter** | **Aeronautical Ground and Aircraft Station** |
| Frequency Range (MHz) | 3.025-18.030 |
| Occupied Bandwidth (kHz) | 2.8 |
| Channel Separation (kHz) | 3 |
| Signal to Noise Ratio (dB) | 10 |
| Antenna Type | Directional |
| Power (Watts) | 1000 |
| Emission Type (Telephony) | J3E |
| Emission Type (Telegraphy) | A1A, A1B, F1B, (A, H) 2 (A, B)  (R, J) 2 (A, B, D), J (7, 9) (B, D, X) |
| Modulation Type | Upper Sideband  Amplitude Modulation |
| Propagation Mode | Skywave |
| Range (km) | Aeronautical Ground Stations: >1000  Aircraft Stations: <500 |
| Protection Criteria (dB) | 15 |



For aircraft station transmitters first installed after 1 February 1982 and for aeronautical stations transmitters in use after 1 February 1983:

TABLE 5

**AM(OR)S 3 kHz Channel Bandwidth Emission Mask**

|  |  |
| --- | --- |
| **Frequency separation Δ from the assigned frequency (kHz)** | **Minimum attenuation below peak envelope power (PX) (dB)** |
| 1.5 ≤ Δ < 4.5 | 30 |
| 4.5 ≤ Δ < 7.5 | 38 |
| 7.5 ≤ Δ | 43\* |
| \*For transmitter power up to and including 50W: 43+10log10 (PX) (W). For transmitter powers more than 50W, the attenuation shall be at least 60 dB. | |

FIGURE 1

**AM(OR)S 3 kHz Legacy Channel Bandwidth Emission Mask**

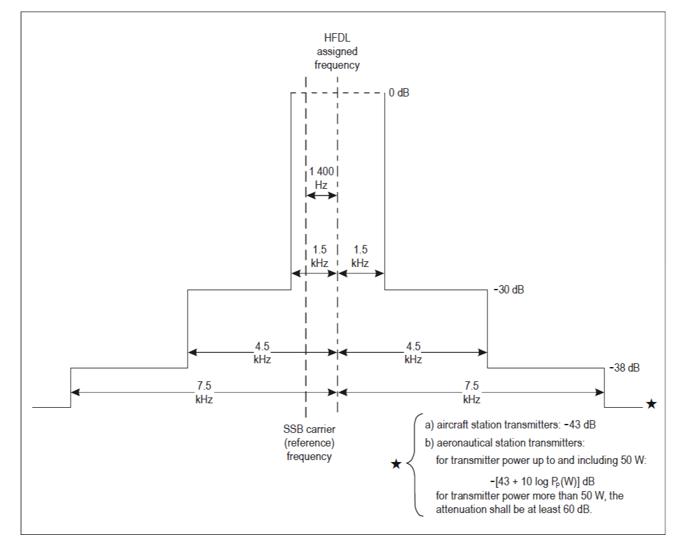


TABLE 6

**AM(OR)S 3 kHz Channel Bandwidth Typical Legacy Receiver Parameters**

|  |  |
| --- | --- |
| **Parameter** | **Aeronautical Ground and Aircraft Stations** |
| Frequency Range (MHz) | 3.025-18.030 |
| Receiver Bandwidth (kHz) | 2.8 |
| Receiver Sensitivity (dB) | 3 |
| Receiver Filter Response | [TBD] |
| Antenna Gain | [TBD] |
| Antenna Type | [TBD] |
| Antenna Polarization | [TBD] |
| Antenna Height | [TBD] |
| Antenna Height | [TBD] |
| Propagation Mode | Skywave |
| Range (kM) | Aeronautical Ground: >1000  Aircraft: <500 |
| Protection Criteria (dB) | 15 |

## 5.2. AM(OR)S Wide-band Channel Bandwidth Technical Parameters

AM(OR)S systems with wider channel bandwidths will utilize the existing 2.8 to 18.05 MHz AM(OR)S HF aeronautical frequency bands, so no additional spectrum will need to be allocated. New modulation waveforms consistent with the emission designators as defined in appendix 26 will be implemented.

Except for channel bandwidths, modulation types, and the emission mask, wide-band receiver and transmitter parameters are the same as those listed in Tables 3-6.

The following emission mask, Table 7, specifications are based upon the 3 kHz channel bandwidth emission masks as show in Figure 1 above. The primary difference between the mask in Figure 1 and the mask in Figure 2, below, is the channel bandwidth. The Figure 2 mask supports channel bandwidths of up to 48 kHz in 3 kHz increments. Adherence to this mask ensures non-interference with adjacent legacy HF services.

TABLE 7

**AM(OR)S Wide-band Emission Mask**

|  |  |
| --- | --- |
| **Frequency separation Δ from the assigned frequency (kHz)** | **Minimum attenuation below peak envelope power (PX) (dB)** |
| BW/2 ≤ Δ < BW/2 +3 | 30 |
| BW/2 +3 ≤ Δ < BW/2 +6 | 38 |
| BW/2 +6 ≤ Δ | 43\* |
| \*For transmitter power up to and including 50W: 43+10log10 (PX) (W). For transmitter powers more than 50W, the attenuation shall be at least 60 dB.  BW is the channel bandwidth (defined by Nx3 kHz, where N is the number of contiguous bonded 3 kHz channels) | |

FIGURE 2

**AM(OR)S Wide-band Emission Mask**

# 











## 5.3. Adjacent Band Incumbent Services Technical Parameters

Adjacent band incumbent services include AM(R)S, Fixed, Mobile (Except AM(R), Land Mobile, Broadcasting, Maritime Mobile and Standard Frequency and Time. The adjacent band technical parameters are listed in Table 8.

TABLE 8

**Adjacent Band Incumbent Services Receiver Technical Parameters**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Technical Parameters** | **AM(R)S** | **Fixed** | **Mobile (Except AM(R)** | **Land Mobile** | **Broadcasting** | **Maritime Mobile** | **Standard Frequency and Time** |
| Bandwidth (kHz) | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] |
| Modulation | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] |
| Antenna Type | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] |
| Antenna Gain | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] |
| Polarization | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] |
| Receiver Sensitivity | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] |
| Noise Environment | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] |
| [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] | [TBD] |

# 6. Protection Criteria

[TBD]

## 6.1. AM(OR)S Legacy 3 kHz Channel Bandwidth Systems

The in-band protection criteria for legacy AM(OR)S is [TBD].



**6.2. Adjacent Band Incumbent Services**

Table 9 lists the I/N protection criteria for adjacent band services. These I/N values were obtained from ITU-R reports and recommendations for oceanographic radar and radar sounders that are operating in the HF range.

TABLE 9

**Protection Criteria for Services that are Adjacent to the Allocated AM(OR)S Frequency Bands**

|  |  |
| --- | --- |
| **Service** | **I/N (dB)** |
| AM(R)S | -6 |
| Fixed | -6 |
| Land Mobile | -10 |
| Broadcasting | -20 |
| Maritime Mobile | -10 |
| Standard Frequency and Time | -20 |

**6.3. Derivation of Noise and Maximum Interference Levels**

The external noise is a combination of three components: man-made noise, galactic noise, and atmospheric noise.

Man-made noise depends on the frequency and the environment. Section 5 in Recommendation ITU-R P.372-10 details how to derive median values of man-made noise energy, , for several environments:

whereisthe operational frequency expressed in MHz and *c* and *d* , Table 10 are dependent on the environment.

TABLE 10

**Noise Calculation Factors**

|  |  |  |
| --- | --- | --- |
| **Environmental category** | ***c*** | ***d*** |
| Rural (curve C) | 67.2 | 27.7 |
| Quiet rural (curve D) | 53.6 | 28.6 |

Applying this formula for “rural” and “quiet rural” environments, one can then derive the resulting man-made noise level *.*

With regards to galactic noise and atmospheric noise, Figure 3 lists the noise energy contributions of noise sources across the 3-30 MHz band.

FIGURE 3

**Noise Energy vs. Frequency**



Galactic noise only depends on frequency. The galactic noise component will not be observed at frequencies below the ionospheric critical frequency of 10 MHz (Recommendation ITU-R P.372-10).

Atmospheric noise depends on frequency, time of day, and season. The Geneva 0 UT represents atmospheric noise energy during midnight hours vs. the 12 UT which represents atmospheric noise energy closer to noon.

**6.3.1. Maximum Interference Level for In-band Legacy 3kHz AM(OR)S and Adjacent Band Services**

Once the external noise, , is known, the maximum interference level, , into a given receivers’ bandwidth is shown in the formula below:

where:

= the maximum interference level in the incumbent service receiver (dB/W)

= I/N for a given service type (dB)

= the external noise valuein dBW/Hz as a function of the selected noise environment (dBW/Hz)

= Receiver Bandwidth (Hz)

The maximum interference level*, ,* is derived using the value of the lowest atmospheric noise level (quiet rural). The in-band legacy 3 kHz AM(OR)S and adjacent band services maximum interference levels calculation results are shown in tables 11 and 12 respectively.

TABLE 11

**Legacy 3 kHz AM(OR)S Maximum Interference Levels**

**(Quiet Rural)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Service** | **I/N (dB)** | **Receiver Bandwidth (kHz)** | **Maximum Interference Level (dBW/RBW)** |
| AM(OR)S | [TBD] | 2.8 | [TBD] |

TABLE 12

**Incumbent adjacent band Maximum Interference Levels**

**(Quiet Rural)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Service** | **I/N (dB)** | **Receiver Bandwidth (kHz)** | **Maximum Interference Level (dBW/RBW)** |
| AM(R)S | -6 | 2.8 | -117 |
| Fixed | -6 | 3 | -117 |
| Land Mobile | -10 | 12 | -115 |
| Broadcasting | -20 | 200 | -113 |
| Maritime Mobile | -10 | 2.8 | -121 |
| Standard Frequency and Time | -20 | 10 | -116 |

Note: The maximum interference level calculations used an average Maximum Noise level of -145.7 dBW/Hz. Receiver bandwidths were taken from NTIA Report 04-413.



# 7. Propagation Models

When considering scenarios involving aircraft, the propagation models contained in ITU-R Recommendations P.525-4 and P.528-3 are generally used for studies and simulations.

**[8. Compatibility and Sharing Studies**

Maintaining consistency with the operational factors as defined in Appendix 26 while maintaining legacy, except for channel width, system parameters will provide compliance with the HF spectral mask regarding adjacent channel power. Maintaining compliance with the HF emission mask will assure that WBHF AM(OR)S can coexist without conflict with legacy HF voice and data transmissions, as well as existing systems in frequency band that are adjacent to the Appendix 26 HF AM(OR)S allocations.

Given these conditions, no extensive interference and compatibility studies are required if it can be shown that WBHF AM(OR)S systems comply with the power limitations and emission masks of the legacy systems.

Should additional studies be required the protection criteria outlined in Section XX along with the methodologies outlined in Section XX would be used for analysis and/or simulations.

**8.1. Analysis Methodology**

**8.1.1. In Band**

The analysis consists of demonstrating that advanced or 4G Automatic Link Establishment (ALE) systems will provide a level protection that will assure that interference to legacy AM(OR)S 3 kHz transmissions will not be impacted in the presence of WBHF AM(OR)S transmissions.

**8.1.2. Adjacent Band**

Adjacent band analysis consists of demonstrating that typical aeronautical and aircraft station transmitters are in alignment with legacy system parameters and meet the requirements of legacy system emission masks. To accomplish this, spectrum analyser measurements of aeronautical and aircraft station transmitters will be measured over a range of various WBHF channel bandwidths (6, 12, 24 and 48 kHz). These measurements will then be compared to the emission mask requirements. Should the measured emission spectrum meet the emission mask requirements, no additional out of band analysis will be required. Figure 4 is a simplified block diagram of the measurement setup.

FIGURE 4

**Measurement configuration**

**9. Analysis and Results**

**9.1. In Band Analysis**

[TBD]

**9.1.1 In Band Analysis Results**

[this section will include an example of how ALE can be used to eliminate detailed/complex interference/compatibility studies]

**9.2 Adjacent Band Analysis**

[TBD]

**9.2.1. Legacy 2.8 kHz Analysis Results**

[will be used to show that spectrum behaviour in adjacent bands meets the mask- Pending measurements]

Figure 5. Legacy 2.8 kHz Measurement vs. Emission Mask

**9.2.2 WBHF AM(OR)S Analysis Results**

Tables XX to YY show the exceedance, if any, between the adjacent band measured emission and the maximum interference level as calculated for the following services: AM(R)S, Fixed, Land Mobile, Broadcasting, Maritime Mobile, and Standard Frequency and Time for low, mid, and high end center frequencies [actuals frequencies TBD from measurements] for QAM, PSK, and FSK modulation types.

Table 13. Adjacent Band AM(R)S Analysis Results



See Appendix 1, Figures 1 to 9 for AM(R)S for 6 kHz QAM (Low/Medium/High) measurement vs. emission mask results to correlate to results in Table 13 results.

See Appendix 1, Figures 10 to 18 for AM(R)S for 12 kHz QAM (Low/Medium/High) measurement vs. emission mask results to correlate to results in Table 13 results.

See Appendix 1, Figures 19 to 27 for AM(R)S for 24 kHz QAM (Low/Medium/High) measurement vs. emission mask results to correlate to results in Table 13 results.

See Appendix 1, Figures 28 to 36 for AM(R)S for 48 kHz QAM (Low/Medium/High) measurement vs. emission mask results to correlate to results in Table 13 results.

[repeat for Fixed, Land Mobile, Broadcasting, Maritime Mobile, and Standard Frequency and Time]

**10.0. Summary**

[TBD]

**APPENDIX**

Figures 1 to 9 for AM(R)S for 6 kHz QAM (Low/Medium/High) measurement vs. emission mask results to correlate to results in Table 13 results.

Figures 10 to 18 for AM(R)S for 12 kHz QAM (Low/Medium/High) measurement vs. emission mask results to correlate to results in Table 13 results.

Figures 19 to 27 for AM(R)S for 24 kHz QAM (Low/Medium/High) measurement vs. emission mask results to correlate to results in Table 13 results.

Figures 28 to 36 for AM(R)S for 48 kHz QAM (Low/Medium/High) measurement vs. emission mask results to correlate to results in Table 13 results.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. For the purposes of this document, the frequency range utilized by Appendix 26 (3 205 kHz to 18 030 kHz) will also be called the “HF” frequency range. This is done because the frequency range of Appendix 26 falls within the generally accepted “HF” frequency range which is between 3 MHz and 30 MHz. [↑](#footnote-ref-2)