New spectrum for audio PMSE

Further details on approach to modelling and sharing in the band 960-1164 MHz

Consultation update

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About this document

In response to our consultation on new spectrum for audio PMSE (Programme Making and Special Events) some stakeholders have requested additional information on the coexistence modelling in the aeronautical band 960 MHz to 1164 MHz. This document provides the additional information requested.

We have reopened our consultation period and stakeholders who wish to comment further in view of this information should do so by 22 January 2016.

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Section 1

Introduction

1.1 In our consultation on new spectrum for audio PMSE[1], published on 23 October 2015, we summarised our approach to coexistence modelling between PMSE and Distance Measuring Equipment (DME) in the band 960 MHz to 1164 MHz. In response some stakeholders requested more detail on the modelling approach which we have subsequently set out in this document.

1.2 We are not extending the scope of the original consultation by the provision of this additional information. However, in the event that interested parties wish to comment again having read it, we have provided a further two weeks in which to do so. Any further responses should be submitted by 22 January 2016.

[1] http://stakeholders.ofcom.org.uk/consultations/new-spectrum-audio-PMSE/

Section 2

Sharing analysis in the band 960-1164 MHz

Our approach to coexistence modelling between PMSE and DME

2.1 As we noted in the October consultation, in order to determine the coexistence potential we modelled four interference scenarios. These were:

1. Protecting the ground transponder receiver from PMSE
2. Protecting the airborne interrogator receiver from PMSE
3. Protecting the PMSE receiver from the DME transponder
4. Protecting the PMSE receiver from the DME airborne interrogator

2.2 For the terrestrial components i.e. scenarios 1 and 3, ITU-R Recommendation P.452 was used, and for the airborne paths, scenarios 2 and 4, the general path propagation model ITU-R Recommendation P.528 (IF77) was used. We applied this approach to the four locations listed in the consultation to provide indicative spectrum availability at key PMSE points throughout the UK.

2.3 At Seven Dials, London; Media City, Salford and Scottish Exhibition & Conference Centre, Glasgow analysis was carried out for both indoor and outdoor PMSE use with building entry loss applied. For Glastonbury only outdoor PMSE was considered i.e. no additional building entry loss was applied.

2.4 Clutter loss has been applied for the terrestrial scenarios at the PMSE end only. For both airborne and terrestrial scenarios interference has been modelled for 1% time.

2.5 Below we provide additional detail on the parameters and values used in our coexistence testing. These were agreed between the Civil Aviation Authority (CAA) and Ofcom.

Interference thresholds from JCSys Ltd measurements

2.6 The interference thresholds for DME and PMSE are those derived from the work by JCSys Ltd. In all cases the most restrictive threshold for each frequency offset was used to provide the most limiting envelope for coexistence. Table 1 gives the interference thresholds for DME ground transponders and Table 2 gives the interference thresholds for DME airborne interrogators.

Table 1: DME ground transponder maximum interference threshold

Delta F (MHz)	X-mode Interference threshold (dBm)	Y-mode interference threshold (dBm)
-8	-56	-50
-7	-56	-50
-6	-56	-50
-5	-64	-55
-4	-66	-70
-3	-70	-75
-2	-89	-87
-1	-100	-102
0	-111	-115
1	-100	-100
2	-87	-89
3	-74	-82
4	-60	-77
5	-47	-74
6	-45	-68
7	-45	-63
8	-45	-63

Table 2: DME airborne interrogator maximum interference threshold

Delta F (MHz)	X-mode interference threshold (dBm)	Y-mode interference threshold (dBm)
-6	-20	-32
-5	-20	-35
-4	-29	-41
-3	-38	-48
-2	-47	-58
-1	-61	-75
0	-95	-98
1	-61	-69
2	-46	-55
3	-37	-48
4	-29	-40
5	-20	-36
6	-20	-29

2.7 When measuring the maximum interference thresholds provided above, the methodology included the effect of JTIDS in the signal environment in accordance with the UK Any Point In Space (APIS) 70NM radius Geo Area at 60% Time Slot Duty Factor (TSDF), known as 70/60. This forms the basis of the Frequency Clearance Agreement between the CAA and Ministry of Defence.

2.8 For PMSE the interference threshold was set to -65 dBm for the case when the PMSE channel sits across the centre frequency of the DME channel. When the PMSE channel is ±300 kHz from the DME centre frequency an additional 25 dB of isolation was incorporated. Testing showed a quick reduction in the effect of interference from DME into PMSE with increasing frequency offset such that interference from DME in an adjacent channel was negligible and therefore we have not modelled the adjacent channel scenario.

Parameters used for the terrestrial scenarios (ITU-R Recommendation P.452)

2.9 When modelling the terrestrial paths, PMSE into DME ground transponder and ground transponder into PMSE, we used the following parameter values.

Table 3: PMSE parameter values

PMSE	
Maximum EIRP	17.0 dBm
Antenna height	1.5 m
Clutter loss urban	22.9 dB
Clutter loss rural	17.9 dB
Building entry loss	11.0 dB
Reference frequency	960 MHz

2.10 It is widely recognised that when transmitters are used close to the body it absorbs some of the radiated power. Consequently in coexistence studies a factor is usually included to account for this reduction in radiated power. However, in order to provide additional margin we have not included it in our analysis.

2.11 When considering indoor PMSE we have included a building entry loss. While there is a broad range of building entry loss values our view is that 11 dB is conservative. In addition the reference frequency has been chosen to represent the worst propagation condition i.e. propagation losses at 960 MHz are less than at 1164 MHz.

2.12 The clutter loss is only applied at the PMSE end on the assumption that the DME transponder is generally free of clutter. These values are taken from the propagation model ITU-R Recommendation P.1812.

2.13 Table 4 provides the parameter values assumed for the DME transponder. Note we consider the DME transponder to be free of clutter therefore no clutter losses are applied.

Table 4: DME transponder parameter values

DME transponder	
Maximum EIRP	From ICAO COM3 (1 July 2015)[2]
Antenna height	10 m
Antenna gain (dB Systems 5100A-D/7)	6 dBi (at 0° to the horizon)
Reference frequency	960 MHz

2.14 The ITU-R P.452-15 model was configured for 1% time using refractivity parameters appropriate to the given path being modelled as per ITU methods and maps.

2.15 No additional safety margin has been applied. Given that the measurements carried out by JCSys Ltd incorporated the full pulse environment from JTIDS, and the other conservative assumptions that were made, e.g. using the most stringent thresholds for each frequency offset, low reference frequency and no additional loss to account for body absorption effects, we saw no need to include any additional margin.

Parameters used for the airborne scenarios (ITU-R Recommendation P.528)

2.16 The PMSE parameters used are the same as for the terrestrial path. The DME interrogator parameters are given in Table 6. In the airborne scenarios no clutter is applied to either PMSE or DME.

Table 6: DME interrogator parameter values

DME interrogator	
Maximum EIRP	62.4 dBm
Antenna height	From 0 to 98,425 ft (30 km)
Antenna gain (as per ITU Rec M.1642)	5.4 dBi (maximum)
Reference frequency	960 MHz

2.17 For PMSE interference into the DME interrogator our approach is to protect the airborne interrogator at any location within the Designated Operational Coverage area. This approach is very conservative as it assumes that an aircraft can be at zero feet throughout the DOC and so no vertical separation distances are applied. Given this extremely conservative approach, alongside the conservative assumptions noted above, we have not included any additional safety margin.

2.18 It is noted that some DOCs are sectored, i.e. are defined with shorter ranges on some bearings, however we have ignored these sectors and apply the largest range defined for the DOC across the whole volume. For example a DOC may be defined

[2] International Civil Aviation Organization Table COM3 - International and National Frequency Assignments to Radio Navigation Aids In the bands 108-118, 960-1215 and 5031-5091 MHz

with a range of 200 NM with a sector range of 150 NM or defined with a range of 150 NM with a sector at 200 NM and in either case we apply the 200 NM range.

Method for evaluating a candidate DME channel

2.19 Below we provide a summary of our approach to evaluating whether a DME channel (DME channels are 1 MHz wide) is usable by PMSE in accordance with the thresholds and modelling parameters detailed above. Spectrum availability is the sum of all four interference scenarios across all the frequency offsets provided in the measurement data.

2.20 The method is a ‘two step’ process. Firstly we consider the terrestrial scenarios and then move to consideration of the airborne scenarios.

- Identify all DME facilities within 500 km (270 NM) of the PMSE venue and compute distance;
- Compute the path losses to the DME ground transponders in accordance with the parameters detailed above, including height gain, building entry and clutter losses as appropriate;
- Check the path loss against the interference threshold and exclude DME channel if this is exceeded;
- Subtract the DOC range from the distance between the PMSE venue to DME ground transponder;
- Compute the coupling gain at limit of interrogator threshold and add height gain and building loss for PMSE as appropriate;
- Look up the coordination distance from IF77 modelling; and
- Compare the coordination distance with the DOC and exclude as necessary.