

Consultation questions: response from Brian Copsey

Q1: Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to DTT services? Please state your reasons for your comments.

The first question is “what is a low probability”? the term is used a number of times without definition.

I do not believe that in introducing WSD into the broadcast bands Ofcom has ensured a *low probability of harmful interference to DTT services*.

- From information supplied to, and discussed in the technical Working Groups(TWGs) a very large percentage of viewers use either indoor aerials(including Loft) and or amplifiers or are on communal systems. Some 8% of the population use set top antennas for primary viewing and by an additional 20% for secondary viewing (e.g. in bedrooms). Ofcom has explicitly excluded all these viewers from protection.
- Broadcasters have spent considerable time and money designing the TV transmission reception for mobile reception, again Ofcom has explicitly excluded these viewers from protection.
- During the TWGs the issue of which TV Tx is used by viewers had been extensively discussed, the situation is that many viewers receive transmitters which are not the Ofcom designated Tx and channels for their area. This may be due to reception problems or choice (different News or programs). Again Ofcom has explicitly excluded these viewers from protection.
- The issue of interference to amplifiers used for TV reception has been ignored, in spite of reports showing their vulnerability to in band radio energy, a figure of 33% of viewers has been identified in this category. For example a 20dBm WSD operating at 5m from an active antenna develops a field of 110dBmV/m and would typically block adjacent channel DTT reception

Q2: Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to PMSE services? Please state your reasons for your comments.

- Within the documents the term “low Probability” of harmful interference is used without definition. The Radio Regulations defines harmful interference as: *harmful interference: Interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service* operating in accordance with Radio Regulations (CS). The use of this term which if interpreted in a PMSE sense would decimate a live performance with the undefined term of “Low probability” does not give industry confidence that their proposals will protect PMSE use.

- The PMSE industry representatives have spent considerable time and expense in examining all the issues involved by the introduction of WSD in the broadcast bands, first in CEPT (producing three reports since 2009) and the WSD Cambridge trials. Even after these excellent balanced reports and practical trials they worked almost every week with a Technical Working Group(TWGs) chaired by Ofcom. However Ofcom has chosen to ignore some 90% of this work and endangered the many users of PMSE from Broadcast to theatre and multimedia. Ofcom has ignored the facts and figures assembled in this work plus its own testing of PMSE equipment to arrive at a system which can only be described as “WSD must happen everywhere “at any cost to the general public and UK economy. Questions on “who pays” if an event is ruined by interference have yet to be answered by Ofcom
- Another major issue is that whilst much statistical work has been carried out, the largest number of real WSD actually tested in live compatibility work (Cambridge Trial) is **3 prototype units**. Therefore Ofcom is pressing ahead not with a “cautionary approach” but with a system which is designed to absolutely maximize the amount of white space spectrum in major conurbations at the expense of incumbent services
- All the CEPT and Cambridge trial work prior to this consultation has shown that to fully protect PMSE use an exclusion zone of some 400m around a venue or event was necessary to prevent interference. In order to maximize white space spectrum availability Ofcom proposals are 14m and it would appear allow WSD into the actual venue.
- Current proposals talk about a PMSE event being able to be allocated new spectrum if interference occurs this beggars belief: first an event is expected to contact JFMG (does JFMG work 24 hours a day?) then recalculate an intermodulation free set of frequencies then retune say 40 radio microphone (already fitted with costumes and on actors) and filters whilst the audience wait?
- From the Cambridge trial report the following link budget is shown below (similar to those within the CEPT Reports.

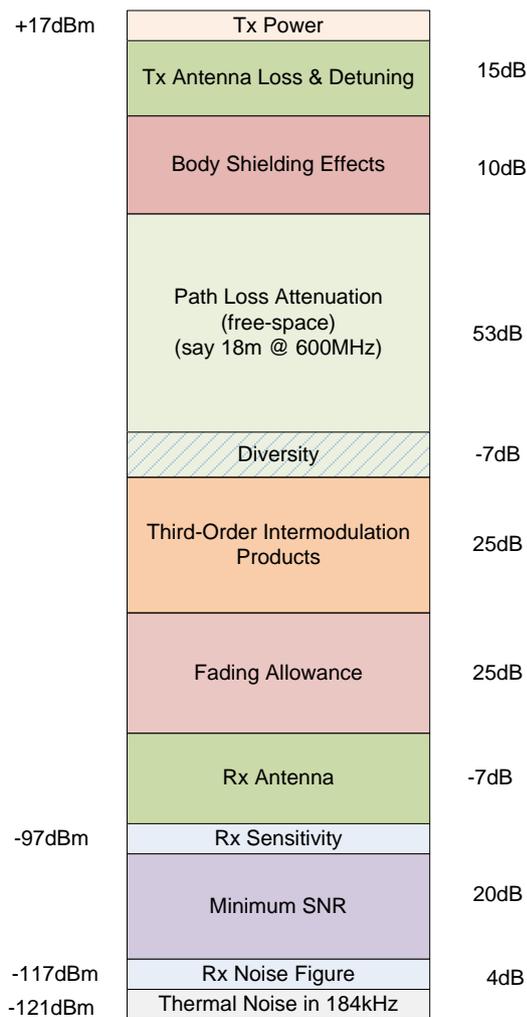


Figure 1: PMSE Link Budget

With an accompanying explanation:

Figure 3 attempts to show a typical PMSE link budget, transmit power is limited by regulation (and acceptable battery life) to a maximum of 50mW (+17dBm) but is usually configurable to 1mW/10mW/50mW. From the figure above on the right we can see that a body-worn RM antenna gain of -15dB and a further estimated 10dB lost when the body shields the signal path in a real indoor environment.

We can assume a free-space loss over, some 22metres (at 600MHz) of 55dB and a further 30dB fading allowance due to multipath propagation which will be present for indoor locations and especially with stage props and lighting gantries etc. Using receive diversity can help reduce the needed fading allowance^[1]. Furthermore, the multichannel tests performed herein will show that a further 25dB can be attributed to the raised 'noise-floor' due to a sea of third-order intermodulation products in band.

The receive antennas are usually mounted at the rear of the auditorium close to the receivers and audio desk and are usually high gain and directional, hence an assumed gain of 7dBi.

Thermal noise in a 184kHz bandwidth is -121dBm, add to this an optimistic receiver noise-figure of 4dB we get a receiver noise floor of -117dBm. A 20dB SNR will

provide the minimum audio quality required from the system and so we arrive at the Rx sensitivity of -97dBm .

The figure of -97dBm was also reflected in the Ofcom testing and has not been challenged during the TWGs discussions. It therefore came as a an unwelcome surprise that Ofcom without any discussion with the PMSE industry or users dragged up a figure of -65dBm , developed at a very late night discussion for the Chester Conference some 16 years ago. The only conclusion that can be drawn is that the actual figure of -97dBm *does not supply sufficient spectrum for WSD in major conurbations and PMSE venues.*

Ofcom states that the -65dBm figure is supported in the Cambridge trial report, having been personally involved and checked with others involved in preparing this report I can only say: NO it does not support the -65dBm figure. Nor is it mentioned.

Q3: Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to 4G services above the UHF TV band? Please state your reasons for your comments.

4G appears to be better protected then Broadcasting or PMSE!

Q4: Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to services below the UHF TV band? Please state your reasons for your comments.

No

Question T1: Do you have any comments on our proposal to cap the maximum in-block EIRP of all WSDs at $36\text{ dBm}/(8\text{ MHz})$?

This figure is too high for in block power within a co-channel situation, the SNR of users varies greatly in a given locality and even the UK PM does not have detailed data. Until more experience with “real equipment” is gained the power should be reduced to a maximum of 2W

Question T2: Do you have any comments on our proposed approach for calculating WSD emission limits, as expressed in Equation (4.3), in relation to DTT coexistence calculations?

It is not the equation but the factors inputted, please see response to Q1 the basis for the equation input should be reassessed.

Question T3: Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of DTT receivers in relation to DTT calculations?

“We propose to partially resolve this over-estimation by calculating the average (rather than the minimum) “

At the initial stage the minimum should be used, the safety margins built in by the TVWS WG and SE 43 are again being thrown away greatly increasing the probability of harmful interference on unsuspecting viewers

There is insufficient consideration of the viewer's using Loft antenna and amplifiers.

Question T4: Do you have any comments on our proposed target of a 10% likelihood of a 1 dB rise in the noise-plus-interference floor at the edge of DTT coverage?

we have given due consideration to recent evidence from LTE base station deployments in the 800 MHz band.

This is a dangerous assumption as the tests were not conducted under "real use" conditions ie only one frequency block in use and very very few handsets

The assumptions should return to the current rules for broadcast reception until real WSD equipment in a range of technologies and modulations is deployed in sufficient numbers to carry out real measurements in a working environment rather than lab or testing restricted to small numbers(<3) of WSD

This should be reduced by a safer figure of 1%

Question T5: Do you have any comments on our proposed approach for calculating coupling gains in relation to DTT calculations?

Please see answers to Q1, these factors should be included within the calculations

Question T6: Do you have any comments on our proposed protection ratios in relation to DTT calculations?

Please see answers to Q1, these factors should be included within the calculations

The Weightless WSD was a base station transmitting a QPSK modulated wideband (8 MHz) signal, consisting of bursts of duration 3.5 ms repeating every 10 ms. The signal was filtered to improve its adjacent channel leakage ratio (ACLR) prior to its application to the DTT receivers.

Again assumptions are made on a single WSD manufactures equipment using (from previous testing) a relatively begin modulations scheme (as opposed to say LTE) using a test sequence which does not reflect its real traffic.

Protection ratios should be much more conservative until real information is available or is Ofcom saying Weightless is the only modulation allowed?

Question T7: Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of WSDs in relation to DTT calculations?

These appear to maximise WSD spectrum accessibility rather than viewer protection

Question T8: Do you have any comments on our proposed approach for calculating WSD emission limits, as expressed in Equation (5.2), in relation to PMSE coexistence calculations?

These appear to maximise WSD spectrum accessibility rather than PMSE protection. Please see answers to Q2 and the figure of at least -97dBm should be used

Question T9: Do you have any comments on the PMSE wanted signal power levels that we propose in relation to coexistence calculations?

It's a great pity that Ofcom chose to put these figures in the proposals without any discussion at the TWGs and in conflict with the trial results and CEPT work.

5.40 The proposed -65 dBm/(200 kHz) is broadly in line with the received wireless microphone wanted signal powers reported in various trials^{27, 28} and is considerably higher than the typical wireless microphone minimum sensitivity of around -95 dBm/(200 kHz).

These appear to maximise WSD spectrum accessibility rather than PMSE protection. Please see answers to Q2 and the figure of at least -97dBm should be used

In-ear monitor

5.41 The proposed received wanted signal power, $P_{s,0}$, for in-ear monitors is -65 dBm/(200 kHz), and is the same as for wireless microphones

IEM are body worn receivers and as such:

- no body loss
- inefficient antenna factors
- fade margins

have been considered

Talkback

5.42 The proposed received wanted signal power, $P_{s,0}$, for talkback is -65 dBm/(200 kHz), and is the same as for wireless microphones

Talk back units are often body worn receivers and as such:

- no body loss
- inefficient antenna factors
- fade margins

have again been considered

Programme audio links

5.43 The proposed received wanted signal power, $P_{s,0}$, is -73 dBm/(200 kHz) for programme audio links. This figure is calculated from Chester '97 Annex 5 with reference to the studio transmitter link and Outside Broadcast (OB) link tables. We have chosen the lower default field strength to be protected of 60.5 dBµV/m @ 650 MHz²⁹. The nominal channel bandwidth is 200 kHz and an antenna gain of 0 dBi has been used in the conversion from field strength to power.

1. the Chester agreements 16 year old figures are not applicable to current use and equipment.
2. audio links can have a similar link budget to that shown in Q2

3. They are often bi directional and cover a number of miles

Therefore a figure of -97dBm at each location and along the path is realistic and should be used

Data links

5.44 We treat data links in the same manner as talkback since they use similar equipment

Same comments as Talkback

²⁷

5.45 In summary, we propose to use the values of received wanted PMSE signal power, $P_{s,0}$, described in Table 5.2 for the purposes of Equation (5.2). These are given for the various PMSE use cases.

Table 5.2 – Wanted signal power at the PMSE receiver. PMSE use case	$P_{s,0}$ (dBm/B)	PMSE channel bandwidth, B
Wireless microphones	-65	200 kHz
In-ear monitors	-65	200 kHz
Talkback	-65	200 kHz
Programme audio links	-73	200 kHz
Data links	-65	200 kHz

All figures should be changed to -97dbm or better, also bandwidth may be greater for digital systems

Question T10: Do you have any comments on our proposed approach for calculating coupling gains in relation to PMSE calculations

5.46 In deriving Equation (5.3) we have not accounted for any angular or polarisation discrimination at the transmitter or receiver antennas. This is because information regarding the orientations of the WSD and PMSE antennas will typically not be available. We acknowledge that ignoring antenna discrimination results in an over-estimation of the extent of interference. In practice, judicious positioning of PMSE receiver antennas can boost the PMSE signal by around 10 dB, while simultaneously suppressing the WSD signal by around 10 dB.

The statement:

In practice, judicious positioning of PMSE receiver antennas can boost the PMSE signal by around 10 dB, while simultaneously suppressing the WSD signal by around 10 dB.

Whilst technically true the ability to do this is rarely achievable due to the physical restrictions of scenery, space and the fact that such aerials should not be seen but the viewer or audience, therefore this statement must be disregarded for the majority of venues

5.47

We propose that WSDs use the parameter values in Table 5.3 for calculations of median coupling gain in Equation (5.3).

- The figures quoted are insufficient to provide protection for PMSE
- If as is suggested within the documents WSD are to be given permission to be present in the venue which figures will be used?

5.48 We have proposed a building penetration loss that is considered typical for the UHF band³². We generally have no information regarding the indoor/outdoor nature of a WSD. This is why we propose that all type A WSDs be treated as outdoor. We consider that a type B WSD with a height that is greater than 2 metres is likely to be indoor and should benefit from more relaxed emission limits through an added building penetration gain

The statement:

We consider that a type B WSD with a height that is greater than 2 metres is likely to be indoor and should benefit from more relaxed emission limits through an added building penetration gain

WHY? They could be on top of a building, initially all WSD should be treated as outdoor

Table 5.4 – Parameter for calculating WSD-PMSE path gain.

Height of PMSE receiver antenna.

This will be provided by Ofcom to the WSDs for each PMSE assignment. A default value of 5 metres will be assumed in the absence of available information.

From my work as a PMSE licensing organisation The whole approach of identifying aerial locations is fraught with problems, expense and inaccuracy. Antenna locations can be changed at short notice and will in many cases vary with each performance or activity or even during a performance. If this method is pursued detailed plans of each venue will be required, causing expense and difficulties for each user of that venue who cannot use the “designated” aerial position or wishes to use things such as extending gantries. In the case of outdoor events this system could not be used as the location of PMSE antenna which may be on a cordless camera will vary in position and height (think hydraulic hoist of 80m) A simpler system for all concerned is the 400m exclusion zone from the edge of the site or venue.

If this is pursued a more realistic default figure is 10-15 m given that antennas will often be in the highest point of a stage.

For type B WSDs, we propose to use a default outdoor height of 1.5 metres. This is broadly equivalent to an indoor height of 5 metres for a building penetration loss of 7 to 10 dB). This will account for the vast majority of type B use cases.

This is an unsafe presumption and should be the same as type A 30m

Question T11: Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of WSDs in relation to PMSE calculations?

The methods presumes conformity with a standardised receiver /transmitter parameters and does not consider a safety factor for production variations, this may mean large variation's in performance resulting in much close proximity to PMSE then the calculations suggest.

Question T12: Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of PMSE receivers in relation to PMSE calculations?

From my work as a PMSE licensing organisation The whole approach of identifying aerial locations is fraught with problems, expense and inaccuracy. Antenna locations can be changed at short notice and will in many cases vary with each performance or activity or even during a performance. If this methods is pursued detailed plans of each venue will be required, causing expense and difficulties for each user of that venue who cannot use the "designated" aerial position or wishes to use things such as extending gantries. In the case of outdoor events this system could not be used as the location of PMSE antenna which may be on a cordless camera will vary in position and height (think hydraulic hoist of 80m) A simpler system for all concerned is the 400m exclusion zone from the edge of the site or venue.

If this is pursued a more realistic default figure is 10-15 m given that antennas will often be in the highest point of a stage.

In addition if the Ofcom method is used a grid size of 10M is inaddaquate when a 14 m exclusion zone is proposed

Question T13: Do you have any comments on our proposed approach for the derivation of WSD-PMSE coupling gains for non-geolocated slaves in relation to PMSE calculations?

There are a very large number of assumptions within this section, coupled with a lack of knowledge on the nature and form of real WSD.

This section should assume a distance of 5M until such time real information becomes available

Question T14: Do you have any comments on our proposed protection ratios in relation to PMSE calculations?

5.72 We have undertaken a number of measurements to quantify the protection ratios relevant to different PMSE use cases. We have used a WSD signal based on the WiMAX standard for this purpose. The details of the measurement procedures and the post processing of the results are presented in Annex 5. We have characterised PMSE receiver failure as a 6 dB reduction in signal-to-noise and distortion ratio (SINAD).

If this figure is used massive interference to PMSE will be generated, again nor real equipment has been used and the generated signal will be much cleaner than real life, especially in low cost equipment. This figure needs real life testing before being used in any calculations.

5.74 The assumed WSD spectral leakage is based on the five spectrum emission masks of EN 301 598 (see Section 2) for channel separations $\Delta F = \pm 1, \pm 2$ and ± 3 . At increasing frequency separations, or low in-block EIRPs, WSDs will readily meet and exceed the EN 301 598 spectrum emission masks. As for the case of the WSD-DTT protection ratios, we have assumed a roll off in the emission masks (increase in AFLR) of 10 dB per 8 MHz beyond the third adjacent channel for the calculation of the WSD-PMSE protection ratios

The statement:

WSDs will readily meet and exceed the EN 301 598 spectrum emission masks.

How is this statement justified? No testing has taken place on real equipment, this assumption must be removed from Ofcom's proposals until they have proof.

5.75 Due to their narrowband nature, PMSE equipment have high adjacent channel selectivity, to the extent that the WSD-PMSE protection ratios are primarily lower bounded by the limited ACLR (non-zero out-of-block emissions) of the WSDs at low frequency separations. As such, the spectrum emission class of the WSD has a strong bearing on the values of the protection ratios.

No account is taken of the reverse intermodulation issues within this and similar statements and again it results in less protection for PMSE

5.76 all tables

The protection ratios for all devices must be reconsidered in light of the incorrect use of the -65dbm and other figures

Question T15: Do you have any comments on our assessment that a margin for uncertainties in radio propagation is not necessary given the proposed parameters for derivation of coupling gains in relation to PMSE coexistence calculations?

No, this needs further discussion and trial

Question T16: Do you have any comments on our proposed WSD emission limits in relation to PMSE use in channel 38?

The method proposed requires complex calculations which given that Ofcom will not be carrying them out have a possibility of going wrong. A simple exclusion of WSD from Ch 37-38 and 39 would be a more practical solution and give confidence to PMSE users

Question T17: Do you have any comments on our proposal not to permit WSDs to operate in channel 60?

Question T18: Do you have any comments on our proposal that, if the unwanted emissions limit (over 230-470 MHz) in the draft ETSI standard (EN 301 598) is tightened by 8 dB, there should be no further restrictions on the operation of WSDs in relation to services below the UHF TV band?

NO

Question T19: Do you have any comments on our proposal that, if unwanted emissions limit (over 230-470 MHz) in the draft ETSI standard (EN 301 598) is not changed, there should be restrictions on the in-block powers of WSDs in channels 21 to 23

Restrictions are required