



Vodafone's response to Ofcom Consultation

TV white spaces: approach to coexistence (and Addendum)

November 2013

TV White Spaces: approach to coexistence

1. Introduction

Vodafone welcomes the opportunity to respond to this consultation by Ofcom on its approach to coexistence for TV white space (TVWS) devices. The UHF spectrum in which these devices are proposed to operate falls in the “sweet spot” for many wireless applications, including mobile broadband. Vodafone therefore has interest in helping Ofcom to fulfil its statutory duty to secure the optimal use of the radio spectrum, and that it does not take decisions that will sterilise spectrum from being used for more valuable applications in the future.

This consultation follows one in November 2012 on the emission characteristics of TVWS devices¹. The coexistence of TVWS depends on the emission characteristics of the devices themselves and the operation of the database that manages the powers, frequencies and locations at which they transmit. It is apparent that Ofcom had not, at that time, considered relationship between these characteristics, the number of channels available for TVWS use and the associated transmit power, and the criterion for coexistence with digital terrestrial television (DTT) coexistence.

TVWS is not the only development in the UHF band that has the potential to cause interference to DTT reception; Ofcom is also heavily involved in studies in CEPT and ITU on the 700MHz band. However, the approach to protection of DTT reception that Ofcom has proposed in those studies is totally at odds with the approach that Ofcom proposes for TVWS in this consultation. The scenarios for deployment of 700MHz band are almost identical, so there is no reason for the approach for protection of DTT to be different - stakeholders have a legitimate expectation that Ofcom will be consistent in the criteria that it applies.

Following the publication of the consultation document, a stakeholder found an important error in the analysis underlying its proposals, which has required an addendum and an extension of the consultation period. This appears to be the result of (perhaps needlessly) complex proposals and the haste in which they have been developed. We are also conscious that the resources in Ofcom to develop complex analysis of this nature are finite and potentially overloaded. The addendum has the feel of a justification for the conclusions of the original consultation document, rather than a genuine review of them in the light of the error, and we would have been more comfortable if a more measured approach had been adopted, even if this had resulted in a short delay to the trial.

¹ TV White spaces: A consultation on white space device requirements; 22 November 2012.

2. Responses to questions

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?

(taking into account the addendum)

It is incumbent on Ofcom to take a consistent approach for possible interference to DTT from TVWS devices and 700MHz band terminals. However, the current approach taken by Ofcom on 700MHz band in the international meetings preparing for WRC-15 is fundamentally at odds with the proposals in this consultation:

- In the original consultation, Ofcom proposed a criterion equivalent to a reduction in location probability of 7%. The additional information in the addendum indicates that the true figure will be higher, but Ofcom avoids giving a revised value.
- For 700MHz band², Ofcom uses minimum coupling loss (MCL) analysis, which is equivalent to **zero** reduction in location probability.

In paragraph 2.19 of the Addendum, Ofcom states:

“These particular judgements regarding parameter values must be seen within the broader context of firstly all the various modelling assumptions and parameter values used, and secondly the emerging evidence that existing modelling tools, such as that used by Ofcom in this case, may be likely to underestimate the robustness of the DTT reception compared to what will be seen in practice.”

If Ofcom has this view of the robustness of DTT reception, it **must** also apply this to its work on the 700MHz band.

Q2: Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to PMSE services?

No comment.

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?

Vodafone agrees with Ofcom that it is essential to ensure a low probability of harmful interference to 4G services. Vodafone does not object in principle to WSDs operating in channel 60. However, it is difficult to predict what types of WSD might become commercially successful, and therefore what the scenarios for interference with 800MHz terminals might be.

Vodafone therefore supports Ofcom's proposal that WSDs should not operate in channel 60. However, the analysis in the technical report is based on incorrect assumptions on the performance of 800MHz band terminals. Ofcom therefore needs to review whether some restriction of operation of WSDs is needed in channel 59, in order to avoid harmful interference to 800MHz band terminals. See the answer to question T17 for further discussion of this issue.

² Protection of digital terrestrial television reception from interference from mobile broadband terminals operating in adjacent spectrum; Document 4-5-6-7/218-E; Figure 4

In the early stages of deployment of WSDs, there will not be a scarcity of TVWS spectrum in channel 59 and below, so this would not have any impact on the viability of TVWS applications. If/when TVWS becomes successful, then Ofcom could review this decision, and any change could be implemented very simply through a change in the database algorithm.

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?

No comment.

3. Responses to specific technical questions

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

This proposed cap is substantially higher than any current class of licence-exempt device operating in shared spectrum. This is surprising, given that the density of TV receivers is quite high in areas where WSDs might be deployed, and RF filtering is not possible to provide additional protection of DTT receiver front ends.

TV Receiver overload

The technical report concludes that the minimum coupling gain between a WSD and DTT rooftop antenna is in the range of -32 to -52dB at 474MHz (45dB for a WSD height of 1.5m), which is consistent with the value of 48dB from previous Ofcom studies at 690MHz³. However, this does not take account of RF amplifiers in the DTT reception system, which will increase the coupling gain significantly.

The latest version of the D Book defines requirements for RF immunity of DTT receivers to LTE interference⁴, which is based on an LTE signal level of -15dBm. For a WSD with +36dBm/8MHz output power, this would be exceeded if the coupling gain is greater than -51dB, or -57dB if the reception system includes an RF amplifier with a gain of 6dB. According to figure 4.10 c) (the most conservative of the three graphs), these values correspond to the 87th and 75th percentile respectively.

Therefore, up to 13% of DTT receivers that meet the latest D Book requirements might suffer overload in this scenario, or around a quarter of receivers in installations in DTT reception installations with RF amplifiers. We must emphasise that at800 has found that the majority of 800MHz interference cases occur in DTT reception installations that include an RF amplifier.

Interference between WSDs and optimal use of spectrum

While individual TVWS devices may not receive protection from interference, Ofcom still has a general duty to ensure that the conditions for use of TVWS devices secure the optimal use of the spectrum. When wireless devices with substantially different characteristics are deployed in the

³ Protection of digital terrestrial television reception from interference from mobile broadband terminals operating in adjacent spectrum; Document 4-5-6-7/218-E; Figure 4. The 3dB difference for device height of 1.5m is probably due to different assumptions on antenna characteristics between 474 MHz and 690MHz.

⁴ D Book 7 Part A v2, section 9.14.2.1

same band, there is a risk that the higher power device will 'squeeze' the lower power device out of the spectrum. A maximum transmit power of 36dBm/8MHz seems high for coexistence with other TVWS applications. This issue is unlikely to be explored in the pilots, because each pilot is likely to trial only one TVWS application.

Q 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 calculation?

One benefit of TVWS using a database approach is that the algorithm for defining the conditions under WSDs can transmit can be refined at any time, even after the devices have entered the market. This would allow the introductory period to use a straightforward algorithm, which could be conservative and which could be refined with the benefit of experience. The introductory algorithm would probably not make the maximum possible bandwidth of spectrum available for WSD operation - but this should not have any impact during the introductory period, when there would only be a small number of WSDs.

However, Ofcom has missed this opportunity and chosen to try to define the final algorithm from the outset. This algorithm attempts to make the maximum possible bandwidth available for WSDs. As a result, the algorithm is complex and difficult to evaluate. Indeed, it is so complicated that Ofcom was not able to spot a major error in its proposals before the consultation started⁵.

Q T4: Do you have any comments on our proposed target 1 dB rise in the noise-plus-interference floor at the edge of DTT coverage, and our approach for allowing greater rise in the noise plus interference floor in areas inside DTT coverage?

As discussed in the response to Q1, Ofcom should use the same target for interference from WSDs as it has proposed for 700MHz terminals.

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

(note: this response does not address the extra information in the addendum)

As discussed under Q1, Ofcom needs to use a consistent approach for WSDs and 700MHz terminals.

We note that the curves for 'WSD height = 1.5m' in figure 4.10 is equivalent to the scenario used by Ofcom for 700MHz band³. In this consultation Ofcom proposes to use the coupling gain values which correspond to 30% exceedance probability (70th percentile). However, for 700MHz band, Ofcom has proposed to use minimum coupling loss, which corresponds to 0% exceedance probability. As can be seen from the graphs in figure 4.10, this corresponds to a difference of 8-15dB in coupling gain.

⁵ Powerpoint presentation for TV White Spaces Coexistence Workshop, 10 October 2013; Slide 26 "Error in the consultation"; http://stakeholders.ofcom.org.uk/binaries/spectrum/whitespaces/1124340/TVWS_Coex_Workshop_presentation_FINAL.pdf

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

(note: this response does not address the extra information in the addendum)

The protection ratios seem to be based on the performance of TV receivers alone, without considering the impact of external RF amplifiers. As Ofcom will be aware, for the 800MHz band, at800 has found that almost all of the interference cases involve reception systems that include an RF amplifier. For the 800MHz band, these cases can be solved by fitting a low-pass filter between the antenna and the RF amplifier, but this is not possible for interference from WSDs.

Ofcom therefore needs to consider the impact of RF amplifiers on the necessary protection ratios, in a similar way to what it has already done for the 800MHz band.

It is likely that the worst interference to DTT reception will be caused by applications of TVWS with infrastructure-like deployment. However, unlike the 800MHz band, there will be no means to identify the source of the interference, and no organisation like at800 to provide the remedy.

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

As stated in our response to Question 3, we agree with Ofcom's conclusion not to permit WSDs to operate in channel 60 at present. However, the analysis in section 6 of the technical report is based on incorrect assumptions and, for this reason, Ofcom also needs to consider whether restrictions might need to be placed on the operation of WSDs in channel 59.

The analysis in the second bullet of para 6.17 is incorrect⁶; the achievable stop-band attenuation of a duplex filter in a terminal is substantially less than the value of 50dB quoted in this paragraph and para 6.11c). The analysis assumes that the duplexer achieves this attenuation by 782MHz (the boundary between channels 59 and 60), as illustrated in Figure 6.2. However, there is no evidence in the consultation to support this assumption, and this is not consistent with specifications for commercially available duplex filters. The 800MHz bandplan requires a rapid roll-off in the centre gap; in a duplex filter design this is usually traded off against a less rapid roll-off for the outer edges. In future studies, Ofcom needs to use representative characteristics for these devices⁷.

4 Representations on the impact assessment

The consultation document states (para 2.30) that sections 4 to 7 constitute an assessment of the impact of the coexistence proposals with DTT and other services. Therefore, this response as a whole should be considered to constitute representations on the impact assessment in accordance with Section 7 (7) a) and b) of section 7 of the Communications Act 2003 (this includes responses to the questions in the technical report, because these provide justification to sections 4 to 7).

⁶ It appears that Ofcom has incorrectly inferred the duplex filter rejection from the terminal emission mask.

⁷ We understand that Ofcom has commissioned two studies on the performance of terminals, in relation to WRC-15 agenda items 1.1 and 1.2. These anticipate that these will provide information on performance of duplex filters that Ofcom can use in any further studies on this topic.

Prima facie, the scenarios for use of 700MHz band terminals are the same as for TVWS devices⁸. Therefore, it is reasonable to expect that the technical characteristics of emissions from TVWS devices and 700MHz terminals should be equivalent, in order to achieve the same degree of coexistence with DTT. If anything, given that TVWS devices operate on a secondary basis, the criteria for coexistence might be expected to be more stringent than for 700MHz band terminals.

When Ofcom publishes its statement on the authorisation of TVWS devices (expected in the summer of 2014), Vodafone expects that this will explain and justify any differences between its approach for coexistence of TVWS devices and the one that it has taken in CEPT and ITU meetings for the 700MHz band, particularly as Ofcom has not undertaken any impact assessment for the 700MHz band. Unduly stringent requirements for 700MHz band terminals in Europe will threaten global roaming and economies of scale, which will be to the detriment of citizens and consumers.

Prior to the publication of this statement, Ofcom should not promote a view for the 700MHz band that diverges from the analysis in this consultation – because only this analysis has been subject to an impact assessment.

⁸ Though there may be additional scenarios for some types of TVWS devices that are not relevant for 700MHz band terminals e.g. in-home multimedia distribution.