TV White Spaces – white space device requirements

Response by Vodafone to the Ofcom consultation

10 January 2013

1 Introduction

Vodafone welcomes the opportunity to respond to this consultation by Ofcom on requirements for TV white space 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 fulfill 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 is the latest in a series on the potential authorisation of white space devices. Following previous consultations, Ofcom has decided to concentrate its efforts on the geolocation (database) approach. Vodafone agrees with the decision of Ofcom to base its initial framework for authorisation of WSDs on geolocation. Indeed, we believe that Ofcom will find it impossible to develop a framework for WSDs based on sensing that would be consistent with its obligations in UK and EU legislation, in relation to technology neutrality for the primary services using the same spectrum.

However, in Ofcom's haste to authorise TV white space devices in the UK, it is planning implementation on a national basis while the European approach is still being developed, and it is developing its proposals on a piecemeal basis. In doing so, Ofcom is risking a repetition of the situation for the digital dividend; UK-specific decisions had to be modified in order to align with Europe; which has led to UK losing its lead in making the digital dividend spectrum available.

The geolocation approach to WSDs has two inter-related aspects, to ensure protection the primary users of the spectrum:

- the correct operation of the database and the coexistence criteria that it uses.
- the emission characteristics of the WSDs.

This consultation only addresses the second of these aspects, so it is impossible for stakeholders to fully assess the impact of the proposals in this consultation. It is therefore likely that Ofcom will need to revisit some of these proposals when it comes to consult on the database aspect.

2 Responses to specific questions

1: Do you agree with our approach to defining various categories of WSDs?

The approach adopted by Ofcom is certainly comprehensive and flexible, but it seems to be more complex than necessary for the initial introduction of white space devices (the VNS will be superseded by the ETSI Harmonised Standard within a short period). Some elements of this complexity are not fully defined and therefore cannot be implemented in the database, but the incomplete specification may prevent equipment being made that is compliant to the VNS.

As an example, the device parameter "Technology Identifier" is described as "mandatory" (para. 6.12.3). This will enable the database to calculate more technology-specific protection ratios, but in the absence of this information default values will be used. The technology-specific protection ratios will presumably need to be agreed by Ofcom (and possibly with other

stakeholders), which will require that the scope of "technology identifier" matches the range of devices for which Ofcom has agreed the technology-specific protection parameter. There is no information on how technology identifiers and technology-specific protection ratios will be defined and policed. However, if default values for protection ratio are used otherwise, there is no reason for this parameter to be mandatory.

2: Do you agree with our proposed sequence of operations for WSDs?

Yes, but see the responses to other questions for our comments on individual operations.

3: Do you agree with our proposed additional operational requirements for master WSDs?

3.1 Out-of-block emissions

The consultation document does not discuss the maximum transmit powers at which WSDs will be permitted to operate. This is presumably because Ofcom considers that this will be defined by the database based on coexistence criteria for incumbent services, on which it is yet to consult. However, the out-of-block emissions levels proposed in Tables 1 and 2 could have a major impact on the WSD power limits that would be applied around the UK.

The consultation document proposes four classes of out-of-block emission, which were apparently developed following discussions with stakeholders. The emission limits are defined in terms of adjacent frequency leakage ratios (AFLR), with three values for first adjacent DTT channel, second adjacent DTT channel, and any other channel in the 470-790MHz range. This means that the WSD transmit power will be limited by AFLR and the protection ratio for DTT.

The relationship between the AFLR and the maximum power limit for WSDs is analysed in Section 4 of this response, based on a paper submitted by Ofcom[1] to the ITU-R committee JTG 4-5-6-7 relating to emissions from mobile terminals in the proposed 700MHz band. The scenarios considered in this paper would also apply to WSDs. With the most favourable assumptions, this would result in a power limit of only a little above 12dBm/8MHz EIRP in substantial parts of the UK (DTT fringe reception areas); this might be reduced by up to 16dB, depending on WSD device class and the assumptions used.

Vodafone believes that the methodology used and assumptions made in the Ofcom paper are unduly conservative, as they are based on several unlikely circumstances occurring simultaneously (minimum coupling loss analysis). If the assumptions in this paper were applied to WSDs, it would render many TVWS applications technically unviable in substantial parts of the United Kingdom, which would make them commercially unviable in the UK as a whole.

It is incumbent upon Ofcom under its duties of technological neutrality and regulatory certainty that it applies consistent criteria for assessing coexistence of one wireless application with other wireless applications. Vodafone therefore urges Ofcom to undertake an analysis using more representative assumptions (Monte Carlo analysis), and to use the same assumptions for its work on both WSDs and mobile broadband devices in the 700MHz band. Noting that Ofcom expects to publish a consultation on co-existence with incumbent services "in the first half of 2013", Ofcom should also submit a paper to the next meeting of JTG 4-5-6-7 in July, applying the same criteria to mobile broadband 700MHz terminals.

This uncertainty about the maximum power at which WSDs can operate is likely to have a chilling effect on the development of WSDs for the UK market This uncertainty substantially

[1] ITU-R Document 4-5-6-7/91-E; Protection of digital terrestrial television reception from interference from mobile broadband terminals operating in adjacent spectrum; 16 November 2012.

reduces the value of Ofcom rushing to develop a VNS ahead of European standardisation – it is difficult to design a transmitter without knowing what its maximum transmit power should be.

3.2 Security

Vodafone welcomes the recognition by Ofcom that the communication between a master WSD and the website which contains Ofcom's list of qualifying WSDBs needs to be secure. In this consultation, Ofcom has proposed that this website is accessed using the HTTPS protocol.

The use of HTTPS protocol is a necessary but not sufficient condition for providing this security; it provides security once communication has been established with the website, but does not prevent the master WSD from accessing other websites. It would be quite easy to implement a "spoof" website that emulates the Ofcom one, together with a spoof website that emulates an open database. There could be a temptation to do this, to enable WSDs to operate without constraint in geographic areas where there is limited availability of spectrum or the maximum power is restricted.

Ofcom's approach to authorisation of WSDs is absolutely dependent on the security and integrity of the communication between master WSDs and the list of qualifying WSDBs. We therefore strongly urge Ofcom to seek expert advice on this aspect of its proposal.

4: Do you agree with our proposed additional operational requirements slave WSDs?

Out-of-block emissions

The comments in Q3 on out-of-block emissions also apply to slave WSDs.

5: Do you agree with the proposed device parameters, operational parameters and channel usage parameters?

Vodafone does not have comments on the substance of the proposed parameters.

However we have noted a number of inconsistencies in the terminology used to define the requirements, within and between the consultation document and the VNS; these could lead to ambiguity or contradiction. For example, the 8MHz blocks are defined both as n (where $21 \leq n \leq 60$) and as k (where $0 \leq k \leq 39$). In para. 5.35, the lower block is designated k and the upper block is designated m, whereas in para. 5.82 they are both designated k.

We recommend that Ofcom reviews these requirements carefully.

6: Do you agree with our approach of implementing the requirements in the example SI and the draft IR and VNS?

Ofcom needs to address the following aspects of the implementation:

6.1 Transmitter unwanted emissions outside the 470-790MHz band

Ofcom has proposed two categories of WSD:

- A 'Type A' device "is one whose antennas are permanently mounted on a non-moving outdoor platform".
- A 'Type B' device has antennas that are not permanently mounted, which must have an integral antenna.

The levels of unwanted emissions proposed by Ofcom in Table 2 (section 5.44 of the VNS) are typical of licence-exempt devices, which are typically portable. However, if a device is permanently mounted, these levels of unwanted emissions could cause a significant and continuous desensitisation to a mobile base station in the locality.

White space devices are expected to operate over a much wider percentage bandwidth than any previous transmitting device that has previously been authorised on a licence-exempt basis (certainly at the expected transmitted power levels). The assumptions that have been made previously about typical levels of unwanted emissions may therefore not be valid, because of differences in the transmitter architecture needed to support this wide bandwidth. Vodafone is concerned in particular about the desensitisation of base stations in the 1800MHz and 2.1GHz bands, due to the third and fifth harmonics of transmissions from WSDs.

The co-existence of base stations has been studied by 3GPP, and it has defined a limit of -61dBm/100kHz for this co-existence scenario[2]. Vodafone therefore proposes that the same limit should be applied in the VNS for mobile uplink bands. Meeting this limit will not impose any significant burden on competently designed WSD equipment intended to be permanently mounted.

This requirement can be implemented by adding the following text and table to section 5.4.4 of the VNS:

> For a Type A WSD, the level of unwanted emissions shall not exceed the limits given in Table 2bis.

Frequency range	Maximum permitted level	Measurement bandwidth
832 MHz to 862 MHz	-61 dBm	100 kHz
880 MHz to 915 MHz	-61 dBm	100 kHz
1710 MHz to 1785 MHz	-61 dBm	100 kHz
1920 MHz to 1980 MHz	-61 dBm	100 kHz
2500 MHz to 2620 MHz	-61 dBm	100 kHz

Table 2bis: Additional transmitter unwanted emissions limits for type A WDSs

6.2 Out-of-block emissions

There is contradiction and ambiguity in the definition of unwanted emissions.

The definition of “out-of-block emissions” in Section 4.1 of the VNS states: “Emissions are specified here as equivalent isotropic radiated power”. This exact term is only used in one other place in the VNS, in para. 6.142. However, the definition of this term as being equivalent isotropic radiated power is contradicted by para. 6.147 later in the same section, which states “The test method applies to conducted measurement”. Para 6.14 describes a method of deriving EIRP from conducted measurements, but this is only applicable for the requirements for transmit power, not emission mask (it also does not include the usual wording for rotating the measurement antenna to take account of the polarisation of the radiated signal).

It is therefore unclear which of the requirements for unwanted emissions are specified as conducted, and which are radiated (equivalent isotropic radiated power).

6.3 Definition of device type

The term ‘device type’ is not defined clearly enough to ensure that manufacturers declare this properly. A manufacturer cannot declare whether the antennas “are permanently mounted on a non-moving platform”, only whether they are intended to be so mounted. The meaning of “platform” and the status of a device with external antennas that are not intended to be

[2] 3GPP TS 36.104, Table 6.6.4.3.1-1: BS Spurious emissions limits for E-UTRA BS for co-existence with systems operating in other frequency bands (note that the limit for some bands is defined as -52dBm/1MHz, but this results in a very similar power spectral density to -61dBm/100kHz).

permanently mounted are also unclear. These points would be clarified if the definitions in the VNS are modified as follows:

Type A WSD – A WSD which has one or more external antennas or which is intended to be permanently mounted to a building or structure.

Type B WSD – A WSD which has an integral antenna and which is not intended to be permanently mounted to a building or structure.

These definitions need to be added to the IR, and corresponding changes needs to be made to clauses 5. (3) (e) and 6. (3) (d) of the SI.

Vodafone also proposes that the conformance of device type is assessed:

Device type

Definition

This confirms that WSD device declared to be a "Type B WSD" meets the requirements to be so declared. The definition of "Type B WSD" is given in Section 4.1 of the VNS.

Conformance

The following assessments shall be performed on a WSD that is declared to be type B:

a) Does the device have attachment points for permanent mounting on a building or structure?

b) Is the device supplied with accessories for mounting it on a building or structure?

c) Does the product literature describe optional accessories for mounting it on a building or structure?

d) Does the device have any antenna that is connected to the rest of the device by a cable?

e) Does the device have any connector for connection by the user of an external antenna?

If all of these assessments are negative, the device is confirmed as type B.

6.4 Validity of operational parameters

There is no requirement in the draft Statutory Instrument for a WSD to stop transmitting when the operational parameters cease to be valid. This could be added to Regulations 5. (5) and 6. (5).

There is no requirement in the draft Statutory Instrument or VNS relating to a WSD ceasing to transmit if it becomes unable to determine its latitude and longitude. Most WSDs are likely to determine their position using GPS; therefore, one case that may require special consideration in the VNS is when the GPS receiver is desensitised by third harmonic emissions from its transmissions on certain channels.

3 Representations on the impact assessment

The consultation document states that Sections 5, 6 and annex 5 are an impact assessment. The whole of this consultation response constitutes representations on the impact assessment in accordance with Section 7 (7) a) and b) of the Communications Act 2003, but we highlight particular issues below:

The policy objective of protection of incumbent users

Vodafone notes the policy objective stated in para. A5.10 of the impact assessment "to protect incumbent users". This protection is defined by the combination of the adjacent frequency

leakage ratios defined in Tables 1 and 2 and the maximum device power (which is not addressed by this consultation). However, the power limits applied by the database may not meet the legitimate expectations of stakeholders for some applications of WSDs, if the same criteria are applied as Ofcom has used in a contribution to ITU-R JTG 4-5-6-7 (see the response to Q3).

The consultation document has not considered the impact of the proposed levels of transmitter unwanted emissions from 'type A' WSDs on desensitisation of base stations and other wireless infrastructure (see the response to Q6).

Consumer benefits of TV white spaces

Paragraph A5.4 of the impact assessment describes the expectation of Ofcom that there will be citizen and consumer benefits from applications of TVWS including the short-range applications of wireless distribution around the home and local- or personal-area networks. However, this is based on a flawed analysis.

Paragraph 2.9 of the consultation document describes five possible use cases for TV White Space devices, including these applications. Paragraph 2.10 asserts that "in all the above cases, the main driver for the use of the TVWS frequencies is the favourable propagation characteristics of radio waves in the UHF TV band.

The radio propagation characteristics are indeed favourable in the UHF band. However, this is only significant when the application is limited by link budget, which is not the case for the short range applications. Indeed, when the application is capacity limited, a less favourable link budget is beneficial because this allows an increased frequency re-use, and therefore more efficient use of radio spectrum.

The current leading technologies for home, local and personal networks are WiFi and Bluetooth, which operate in the 2.4GHz and 5GHz bands. There is no evidence that these frequency bands are a constraint on their capabilities for these applications. Indeed, standards are under development for these applications at frequencies as high as 60GHz.

Security

The impact assessment assumes that the authorisation regime will work as expected, and does not consider the potential impact if it does not. The integrity of this regime is absolutely dependent on the integrity of the communications between a master WSD and the Ofcom list of qualifying WSDBs. It is therefore essential that Ofcom defines a secure protocol for this communication (see the response to Q3).

4 Emission masks and power limits

This consultation does not address the expected operational power limits for WSDs. These are defined by the database using coexistence criteria for DTT – both topics on which Ofcom has yet to consult. However, the out-of-block emissions levels proposed in Tables 1 and 2 could have a major impact on the WSD power limits that will be applied around the UK.

Tables 1 and 2 define out-of-block emissions for four classes of device as adjacent frequency leakage ratio (AFLR), for the first adjacent DTT channel, second adjacent DTT channel, and any other channel in the 470-790MHz range. The operation in the first and second adjacent channel can be limited by the database, but any restriction for all other channels will constrain operation throughout the UK. This scenario is therefore similar to the scenario for emission masks for mobile broadband terminals operating in the proposed 700MHz band.

Ofcom has submitted a paper to the ITU-R committee JTG 4-5-6-7 which analyses the impact of interference from mobile broadband terminals operating in the 700MHz band into DTT receivers operating at lower frequencies. This paper used a worst case (minimum coupling loss) analysis, but noted that other statistical methods (e.g. Monte Carlo) are available – these

would give results that are more representative of real-life situations. It concluded that the maximum out-of-band emission levels needed to protect fixed rooftop DTT reception (with the methodology and assumptions used) were:

- -52.9 dBm/ (8 MHz) for an I/N threshold of -6dB
- -58.6 dBm/ (8 MHz) for an I/N threshold of -10dB

If the most favourable combination is considered (WSD Class 1 or 3 and an I/N threshold of -6dB), this is equivalent to a maximum WSD transmit power P_{IB} of +12dBm/8MHz EIRP; this power would be reduced by 10dB for WSD Class 2 or 4, and by another 6dB for an I/N of -10dB. The results in the Ofcom paper apply for DTT signals on the edge of planned DTT reception. However, substantial parts of the UK are in 'fringe areas' for DTT reception, where the corresponding maximum WSD transmit power would not be much higher than the values calculated concluded in the paper.

Therefore, if the results of the Ofcom paper were applied to WSD devices, this would result in power limits that would render many WSD applications technically unviable in substantial parts of the UK.