



Vodafone response to Ofcom consultation on the Digital Dividend: cognitive access - licence-exempting cognitive devices using interleaved spectrum (February 2009)

INTRODUCTION

The digital dividend in the UHF band is the most important spectrum to become available in the UK in at least the last decade, and probably for the decade to come. It falls in the “sweet spot” in the radio spectrum that is suitable for both capacity and coverage, and is therefore attractive for a wide range of applications. It is therefore imperative that all of Ofcom’s proposals in the digital dividend review consider the value of this spectrum over the long term.

The recent Ofcom consultation on clearing the 800MHz band contains an economic analysis that demonstrates the high value of spectrum in the UHF band for mobile services. Cognitive devices are inherently not capable of benefiting from the particular benefits of this frequency range, because of the power limit needed for a licence-exempt device to prevent interference to broadcast reception. Cognitive devices can therefore only be an optimal use of this spectrum if other mobile applications are not possible. Ofcom has already consulted on the future of DTV beyond digital switchover¹. Some potential developments (in particular, the introduction of single frequency networks – SFNs) might enable additional spectrum to be cleared in the future for new applications.

This consultation addresses the technical aspects of the implementation of one possible use of spectrum after digital switchover – cognitive devices. This is premature, because Ofcom has not yet properly considered whether cognitive devices will be the optimal use of this valuable spectrum - the information provided by Ofcom in the impact assessment suggests that the potential net present value (NPV) of other future applications in this spectrum is many billions of pounds. In order to fulfil its statutory duties², Ofcom must consider this point before proceeds towards licence-exemption of cognitive access in this band.

RESPONSES TO THE CONSULTATION QUESTIONS

General comments

The proposals in this consultation are heavily reliant on studies that Ofcom has undertaken or commissioned, especially from ERA. However, Ofcom has not included significant information about these studies in the consultation document, nor any

¹ The future of digital terrestrial television – enabling new services for viewers; 21 November 2007

² Section 7 of the Communications Act 2003

reference to where this information might be found. In particular, the conclusions of co-existence studies are heavily dependent on the assumptions, which are not described. It is therefore impossible to make meaningful comments on the consultation questions that are based on the results of these studies.

Some of the analysis in this consultation document is quite superficial. However, the coexistence scenarios for cognitive devices should be comparable to mobile terminals within the 790-862MHz band. The CEPT group SE42 has conducted thorough studies on this issue, in response to a mandate from the European Commission, and Ofcom has been an active contributor to this work. These studies have reached different conclusions to the proposals in this consultation.

The consultation document makes a number of references to the situation in the USA – in particular, the FCC and the White Spaces Coalition. However, as Ofcom will be aware, the ADTV standard for DTT transmission in USA is very different from DVB-T. Therefore, any studies and proposals for the US situation will not necessarily be valid for UK and for Europe (in particular, ATSC has a carrier, which makes it easy to sense). The White Spaces Coalition is a lobby group for the promotion of cognitive devices, so Ofcom needs to be cautious about relying on information from this source.

The consultation document does not consider the feasibility of developing conformity assessment procedures in accordance with EU law (specifically, the R&TTE Directive 1999/5/EC) that can ensure that cognitive devices perform as required. These are obviously essential before Ofcom could consider regulations for licence exemption.

Executive summary

Question 1 The executive summary sets out our proposals for licence-exempting cognitive devices using interleaved spectrum. Do you agree with these proposals?

No.

If cognitive access devices are authorised within the UHF television band, they will prevent any future changes in the use of parts of spectrum unless they can be subsequently removed from use. It is fundamentally impossible for a cognitive device to be designed with a sensing mechanism capable of detecting future systems, because this mechanism must employ correlation techniques to detect the presence of a system before causing interference to it. It is clearly impossible to design a technique to correlate signals from a system that is not yet designed, and whose characteristics therefore cannot be known.

However, the authorisation of cognitive devices could still frustrate future attempts by Ofcom to make more optimal use of the UHF spectrum, even if these devices have the mechanism to control the frequencies that they use. The users of these devices may have expectations to continue to be able to use them, preventing Ofcom from reallocating the spectrum for more valuable uses. There is a substantial body of

academic economics study^{3,4} which shows that allocating spectrum to licensed services (and especially to public mobile networks) creates more economic value than allocating it for licence-exempt systems.

Ofcom's would therefore be acting inconsistently with its principles for spectrum management in authorises cognitive radio devices without a geolocation capability and an updatable database.

Detection

Question 2 Do you agree that the sensitivity level for DTT should be -72 dBm?

Ofcom needs to be consistent in the protection criteria that it applies for the protection of DTT. Therefore if a criterion of 99.9% is considered sufficient for cognitive devices, the criterion in the protection clause that Ofcom has proposed for cleared spectrum should certainly not be higher.

Ofcom does not present the analysis that leads to the conclusion that 99.8% of viewers within a coverage area will receive a DTT signal above -70dBm and 99.9% of viewers will receive a signal above -72dBm. The received signal level for DTT is relevant for other aspects of the digital dividend review, particularly in relation to the proposed protection clause.

We therefore ask Ofcom to confirm that these received power levels are also appropriate for stakeholders to use in their assessment of the likely cost of complying with the proposed protection clause (we would not expect the values for channel 60 to differ significantly).

Question 3 Do you agree with an additional margin of 35 dB resulting in a sensitivity requirement for cognitive devices of -114 dBm?

The information in the consultation document on the work undertaken by ERA is insufficient to comment meaningfully on this proposal.

Question 4 Do you agree with a maximum transmit power level of 13 dBm EIRP on adjacent channels and 20 dBm on non-adjacent channels?

The analysis in this section is based on an incorrect assumption about the MCL between a cognitive device and an outdoor TV reception antenna. Ofcom has presented the correct analysis and the correct MCL value in its contribution to the

³ The Governing Regime of Spectrum; Gerald R Faulhaber, Professor of Business and Public Policy and Management, University of Pennsylvania; contained in Reforming Spectrum Policy, The Vodafone Public Policy Paper Series number 5, available at: http://www.vodafone.com/etc/medialib/public_policy_series.Par.58911.File.dat/public_policy_series_5.pdf

⁴ Towards an Evolutionary Regime for Spectrum Governance – *licensing or unrestricted entry*, William J Baumol and Dorothy Robyn; AEI-Brookings Joint Center for Regulatory studies, 2006, available at: <http://aei-brookings.org/admin/authorpdfs/redirect-safely.php?fname=../pdffiles/phpOl.pdf>

Both papers contain extensive references to the academic literature.

CEPT studies, SE42(09)069. This MCL value is lower, which would lead to lower EIRP limits.

Question 5 Would it be appropriate to expect DTT equipment manufacturers to improve their receiver specifications over time? If so, what is the best mechanism to influence this?

There is widespread agreement that the RF performance of DTT receivers is inadequate, and it is not improving with time⁵. It is apparent from the consultation document that Ofcom believes that this could prevent optimal use of the UHF spectrum by any service other than broadcasting. We agree with the EBU that this is a case where regulation has failed to protect consumers, and that the EU needs address this issue as a matter of urgency.

The immunity performance (ability to reject interference) of television receivers is regulated in EU by the EMC Directive (2004/108/EC). The appropriate mechanism to improve the RF performance of TV receivers is therefore to revise the Harmonised Standard for immunity of television receivers, EN 55020.

Question 6 Do you agree that the reference receive level for wireless microphones should be -67 dBm?

The information in the consultation document on the work undertaken by ERA is insufficient to comment meaningfully on this proposal.

Question 7 Do you agree with an additional margin of 59 dB for wireless microphones?

The information in the consultation document on the work undertaken by ERA is insufficient to comment meaningfully on this proposal.

Question 8 Do you agree with a sensitivity requirement for -126 dB (in a 200 kHz channel) for wireless microphones?

The information in the consultation document on the work undertaken by ERA is insufficient to comment meaningfully on this proposal.

Question 9 Do you agree with a maximum transmit power level in line with that for DTT? Are there likely to be any issues associated with front end overload?

No comment.

Question 10 Do you agree that the sensitivity level for mobile television receivers should be -86.5 dBm?

No.

⁵ See, for example, the presentation by Phil Laven of EBU at a Commission Hearing on the digital dividend, in Brussels on 6th March 2009.

The standard for DVB-H is complete and Mobile TV receivers are available, so Ofcom should have been able to obtain some evidence on which to base its proposal.

Question 11 Do you agree with an additional margin of 20 dB for mobile television?

No.

The analysis in the consultation document too superficial to justify a decision.

Question 12 Is it likely that mobile television will be deployed in the interleaved spectrum? If so, would it be proportionate to provide full protection from cognitive access?

No comment.

Question 13 Should we take cooperative detection into account now, or await further developments and consult further as the means for its deployment become clearer?

As Ofcom recognises, there is little understanding of the likely performance of cooperative detection. It is clearly not appropriate (and probably not possible) to take it into account at this time.

However, there are serious questions as to whether cooperative detection can ever be relied upon in defining regulatory conditions. The benefit of cooperative detection clearly depends on the probability of cognitive devices being in a location outside the shadow of the wanted signal but able to communicate with the other device. This is obviously dependent on the market penetration of cognitive devices, the number of different technologies for these devices, and many other factors.

Geolocation databases

Question 14 How could the database approach accommodate ENG and other similar applications?

No comment.

Question 15 What positional accuracy should be specified?

No positional accuracy should be specified.

This is not a parameter that is needed to meet the policy objective to prevent interference to other services in the same spectrum. It is sufficient for Ofcom to specify that cognitive devices do not operate in prohibited areas. Whether the cognitive system achieves this with a positional accuracy of 100m and by not transmitting within 100m of the boundary or with a positional accuracy of 5km and by not transmitting within 5km of the boundary is a matter for the designers of the system.

Question 16 How rapidly should the database be updated? What should its minimum availability be? What protocols should be used for database enquiries?

The cognitive system should be robust against the availability of the database, because there will be occasions when a cognitive device is unable to receive updates. Ofcom

therefore needs to specify an interval after which a device that has not received an update ceases to transmit.

Question 17 Is funding likely to be needed to enable the database approach to work? If so, where should this funding come from?

The funding should come from the beneficiaries of the cognitive system - manufacturers, users or service providers/operators, depending on the commercial model. This might be through some form of subscription or as a levy on the cost of equipment purchase.

Question 18 Should the capability to use the database for spectrum management purposes be retained? Under what circumstances might its use be appropriate?

Yes.

One purpose of this capability would be to restrict the operating frequency range of cognitive devices if part of the spectrum is reallocated for other purposes in the future.

Question 19 Should any special measures be taken to facilitate the deployment of cognitive base stations?

No.

As the consultation document recognises, the constraints on a basestation are likely to be greater than on a terminal in the same area, because of its greater antenna height. Therefore, if cognitive devices have geolocation capability, which needs to be mandatory, there is no benefit from special conditions for basestations; they would be no different (and potentially more restrictive) than the general conditions.

Beacon reception

Question 20 Where might the funding come from to cover the cost of provision of a beacon frequency?

There is no reason for the funding mechanism for the beacon frequency to be any different to the database – see the response to question 17.

The wording of the question implies that Ofcom has in mind only one “beacon frequency”. However, there is not policy reason why this needs to be the case. Different cognitive systems might have differing requirements for provision of information over the beacon frequency, and could make use of different existing or new radio systems to deliver it.

Question 21 Is a reliability of 99.99% in any one location appropriate? Does reliability need to be specified in any further detail?

There is no need for Ofcom to specify the reliability for the beacon frequency.

If the beacon system is provided as a commercial service, funded directly or indirectly by the users of cognitive devices, it is a commercial decision as to what reliability is needed. The one requirement that Ofcom should specify is the elapsed time after which

a cognitive device that has not received an update of information should cease to transmit.

Comparing the different options

Question 22 Do you agree with our proposal to enable both detection and geolocation as alternative approaches to cognitive access?

No.

Geolocation needs to be mandatory in order for Ofcom to comply with its stated principles for spectrum management, as discussed under question 1.

Other important parameters

Question 23 Should we restrict cognitive use of the interleaved spectrum at the edge of these bands? If so, what form should these restrictions take?

Any cognitive device operating at the edge of the bands should obviously comply with the requirements for protection of services in neighbouring bands. This will mean that it cannot operate in channel 60.

Question 24 Do you agree that there should be no limits on bandwidth?

No.

It is very unclear what applications might use cognitive access, and therefore how different applications will interact. The only reliable way to ensure that one application does not hog all the spectrum resource, preventing other applications from operating, is to limit the proportion of the total spectrum resource that can be used by a single device. The most effective way to do this is a limit on bandwidth.

Question 25 Do you agree that a maximum time between checks for channel availability should be 1s?

The analysis in the consultation document is insufficient to reach such a conclusion.

Both cognitive devices and indoor wireless microphones will operate in environments with strong multipath fading. It is unclear whether this has been taken into account in the additional margins proposed in questions 3 and 7.

If devices are permitted in vehicles, then Ofcom should take this into account in defining parameters that determine the ability of these cognitive devices to avoid causing interference. The interval would then obviously need to be shorter.

Question 26 Do you agree that the out-of-band performance should be -44 dBm?

No.

The analysis to derive this value is superficial, and is based on an incorrect assumption for MCL (see the response to question 4). The co-existence scenario for cognitive devices and mobile terminals are very similar, so the out-of-band requirements should also be similar (if anything, the limits for cognitive devices might be lower – the

applications of cognitive devices are very unclear, so a wider range of scenarios might need to be considered).

Ofcom has undertaken a thorough study of the co-existence between DTT reception and mobile terminal stations operating within the 790-862MHz band. This concluded that a block edge mask of -56.5dBm/8MHz would be needed to protect outdoor DTT reception. Ofcom has presented this analysis in its contributions to the CEPT studies, in SE42(09)061 and SE42(09)069, and this value was accepted as the working assumption in the CEPT work. It must be confirmed by ECC within a couple of months, to meet the timescale for delivery of a report to the Commission.

The limit for out-of-band emissions of cognitive devices should no higher than the block edge mask for mobile terminals operating within the 790-862MHz band. It may need to be lower, because the expected applications and corresponding terminal density for cognitive devices are very uncertain.

Question 27 Is a maximum transmission time of 400ms and a minimum silence time of 100ms appropriate?

The consultation document does not provide any technical justification for these values - the only explanation given is that they have been proposed by the White Spaces Coalition, which is a commercial lobby group in the USA. It is therefore possible that these values are only optimum for the technology and/or applications envisaged by this group. If Ofcom adopts these values without technical analysis, it could inadvertently skew the regulations in favour of certain applications and/or technologies. We note that other technologies with cognitive sensing capabilities (like DECT and WiFi) generally have shorter frame structures.

Question 28 Is it appropriate to allow “slave” operation where a “master” device has used a geolocation database to verify spectrum availability?

Yes, in general.

It is unlikely that the range of a cognitive device will be great enough for the uncertainty in location resulting from a master-slave relationship to be significant (provided that this is limited to one hop).

Impact assessment

The impact assessment appears to contain a number of serious shortcomings, and contains insufficient detail for respondents to make a full evaluation.

As mentioned in the introduction to this response, Ofcom has not considered the potential economic benefits of other potential uses of UHF spectrum, but the impact assessment contains information that indirectly indicates that this could be far higher than Ofcom’s assessment of the economic benefit of cognitive access:

The NPV of DTT and PMSE use in the UHF spectrum is estimated as £80bn over a 20 year period and £50bn over a 10 year period (see para. 5.18) – i.e. the NPV of DTT and PMSE use over the 10 to 20 year timeframe is £30bn. Ofcom only considers a 10 year timeframe for the impact assessment because of the possibility of other licensed

uses. Ofcom therefore presumably considers that these other possible uses would have a higher NPV than DTT and PMSE. If 100MHz of UHF spectrum could be released for other licensed applications in ten years time (out of around 300MHz for the six multiplexes after DSO), the NPV would be around £10bn. ***This is around two orders of magnitude higher than Ofcom's estimate of the NPV of cognitive access over the same period.***

The following statement (in para. 5.27) is not valid for cognitive access using detection:

“this potential value at risk would be low because new applications could be developed so as to be able to work within the protection being offered to existing DTT and wireless microphones”

The detection functionality in the cognitive devices must be designed to detect specific systems in order to be capable of avoiding interference to them, which is impossible for a new technology (see the response to questions 1 and 22). It is clear from the NPV analysis above that even a very short delay in the availability of released spectrum due to legacy cognitive devices would have a net substantial negative NPV.

The impact assessment also does not address the potential negative impact of cognitive devices on the feasibility of introducing technology enhancements for DTT. The potential need for DTT to maintain its existing “radio signature”, so that it can be detected by existing cognitive devices, could be a substantial constraint on its development. These enhancements would be likely to increase the spectrum efficiency of DTT, which could be a key enabler for the future release of spectrum for other uses.

Ofcom's estimate of the NPV of cognitive access seems to be unduly optimistic. It appears that Ofcom has not included the cost of adding cognitive functionality to devices in its analysis. All of the significant applications that Ofcom envisages for cognitive devices are substitutes for WiFi. The success of WiFi is founded on the low cost and convenience of a radio interface that is ubiquitously embedded in consumer and business products. Ofcom assumes that only a small proportion of users would benefit from the inclusion of cognitive access. It is therefore inconceivable that cognitive devices would ever be embedded into consumer products, especially for a UK-only market. The assumptions used by Ofcom's in its analysis for the NPV of cognitive access therefore seem to represent a market that would never materialise in practice.