Joint response to Ofcom's consultation on cognitive access to the interleaved spectrum

1st May 2009

Introduction

This response presents the shared views of **Dell**, **Google**, **Microsoft** and **Philips**.

We welcome the opportunity to respond to Ofcom's landmark proposals[1] on permitting cognitive access to the interleaved spectrum. We broadly support these proposals and are providing this feedback in the spirit of continuing support for Ofcom's development of the regulatory framework. Our comments draw on insights and experience from our involvement with proceedings by the US communications regulator (FCC) on the same topic.

Surveys, conducted by Ofcom as part of its Spectrum Framework Review, have shown that much of the UK's spectrum lies unused for much of time. This applies even in the UHF band, which is in demand for its favourable coverage characteristics. Licence exemption provides a practical way to exploit this important but highly fragmented resource, in conjunction with cognitive access technology.

We expect considerable benefits to consumers from the opening up of white space, including innovative home network applications, improved hotspot coverage, and a socially important broadening of Internet connectivity. In addition, white space exploitation could bring economic benefits by providing UK industry with attractive new markets and export opportunities.

Ofcom's proposals represent a very significant step towards unlocking the benefits of this prime, but under-used spectrum. We agree with Ofcom that geolocation-based techniques for determining which channels are free provide a practical way forward for opening up the benefits of white space. We encourage Ofcom to establish an enabling framework for database operation as soon as possible.

We agree with Ofcom that devices should be allowed to use spectrum sensing (i.e. sensing-only without geolocation), for determining which channels are vacant. We understand that Ofcom feels the need to exercise caution in defining the requirements for devices which rely only on spectrum sensing. However we believe that existing spectrum sensing technology can provide more than sufficient protection for television reception and wireless microphone use. We therefore urge Ofcom to reconsider its proposed sensing requirements – particularly the threshold for sensing wireless microphones, which seems excessively stringent.

We think that the benefits to the UK are such that Ofcom should work to enact the required enabling legislation for cognitive access to interleaved spectrum this year, permitting both geolocation-based and spectrum-sensing alternatives.

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[1] http://www.ofcom.org.uk/consult/condocs/cognitive/cognitive.pdf

The UK should not wait for the rest of Europe in enacting the legislation

Although the FCC has already taken the first important step in securing the arrival of cognitive access, it is likely to take some time before devices reach the US market.

By bringing forward the necessary enabling regulation for cognitive access, rather than waiting for the rest of Europe, the UK can position itself at the forefront of this strategic area – to the benefit of consumers and industry.

Ofcom's proposals to allow geolocation and spectrum sensing provide a practical way forward

It makes sense to provide manufacturers with flexibility to prepare solutions that best meet the needs of particular applications. The market can then extract greater value from this opportunity.

Ofcom's proposals make clear the advantages of the geolocation approach and we agree that it makes sense to allow this technique as a substitute for spectrum sensing. This enables operating constraints to be more closely matched to interference risk and therefore promotes increased spectrum efficiency.

We agree with Ofcom that devices should be allowed to use spectrum sensing (i.e. sensing-only without geolocation) to determine which channels are vacant. We believe that such devices could deliver significant benefits, for example, where there are no existing networks through which to access a geolocation database and in applications where device cost is critical – such as distributed environmental sensing.

However, the proposed sensing requirements are over-cautious

Ofcom acknowledges that its proposals err on the side of caution, taking worst cases in general and assuming ultra-low interference tolerance for incumbent users. This may seem reassuring, but the proposed sensing requirements would be a strong disincentive to industry investment in developing technology in this strategic area.

We believe that there is scope for relaxing the requirements without adding any material interference risk. Apart from reducing the cost of the technology, this would also increase the effective white space capacity and improve spectrum efficiency by reducing the chance of mistaking spurious signals for those of protected services and applications.

Whilst we feel that licensees should be protected from harmful interference, we believe that the protection should be proportionate, leaving room for innovation. Virtually all previous advances in television technology have brought a small risk of impairment[2] and interference to some users, but in reality such initial concerns have been quickly forgotten. We should not let fear of innovation block the large potential benefits to consumers.

Adjacent Channel and Out of Band restrictions should be adjusted

We think that the restrictions that Ofcom has proposed on transmission from cognitive devices are unnecessarily tight, for reasons we present in our answers to Ofcom's questions 4 and 26. However,

[2] For example, the introduction of colour brought noticeable picture impairments to those using monochrome receivers

leaving that aside for now, we believe that use of geolocation should enable restrictions on both of these parameters to be modulated according to the protection requirements that prevail in each device's location. A blanket requirement would be wasteful of spectrum.

We think that white space has strong potential to enhance TV viewing

Far from spoiling TV, opening up white space has the potential to enhance viewers' enjoyment of television services. It can do this by facilitating more ubiquitous and affordable Internet connectivity for devices throughout the home. As viewing shifts from a passive/scheduled to a more interactive experience, the need for interactive network capacity grows[3]. White space technology could be integrated into TV receivers and related devices, benefiting viewers and offering broadcasters some exciting new business opportunities.

[3] The rapid rise of popularity of the BBC's iPlayer confirms the growing appeal of interactive content access, whose success has led service providers to complain about the strain such traffic places on their networks.

Our answers to questions in the consultation

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?

We agree in general with the proposals and welcome the flexibility which Ofcom proposes for devices using geolocation to determine vacant channels.

However, we think that Ofcom's proposals are over-cautious for devices which would use spectrum sensing to determine vacant channels. We believe that the proposed thresholds are unnecessarily low, discouraging industry investment in what promises to be a strategically important technology.

Detection

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

We agree with this.

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

We believe that 35dB is too high, particularly when subtracted from the weakest signal level.

a. ERA concluded that a 35dB margin applies in suburban areas, based on modelling and measurements in the Croydon area. However this area is close to a main transmitter and we believe this artificially enhances the difference between signal level observed at rooftop and street level. This high margin was accompanied by relatively high signal levels (typically between -50 and -60 dBm) even at 1.5m above the ground. This is well above the -72 dBm floor assumed in calculation of the required sensitivity for white space devices. In similar areas, close to transmitters, where a 35dB margin might apply, we would expect a similarly high minimum signal level.

b. In suburban areas which are not so close to transmitters, we would expect the peak margin to be significantly lower than 35dB. Table 3 in the consultation document indicates that 33dB was the highest margin observed in 99% of suburban locations.

We also expect typical roof-level antennae to provide lower gain than that suggested (12 dB) in areas, such as Croydon, where signal strengths are high overall. Previous surveys suggest that the installed antenna base is not much better than it needs to be. [*Reference: Digital Action Plan Task 5.14 Improving UK Aerial Installations: Review of Technical Performance, prepared by DTG for the UK Government (DTI), August 2003.*]

Finally, after switchover to digital television, we expect to find the reception levels boosted, as transmitter power is raised by 7 dB. This will provide further margin for relaxing the transmission power limit on cognitive devices.

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?

In answering this question, we assume that these limits would apply only to devices that rely on spectrum sensing to locate free channels. Using geolocation would avoid the need for a common 'worst-case' power limit by enabling a database to provide a maximum transmission power value that reflects the interference risks in the given channel and location.

We agree with the 20dBm limit for transmission power levels for non-adjacent channels. However, in our view, the proposed 13dBm limits for adjacent channels would constrain the reach and potential value of white space applications. Basing its analysis on a worst-case combination of adjacent channel TV receiver performance and cognitive device positioning has led Ofcom to propose a lower limit than is really needed.

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?

Receiver technology developments over time may well present opportunities for enhancing performance without significant cost penalties. Since receivers are typically built for Europe as a whole according to ETSI, CENELEC, E-book, and considering country specific requirements, like those defined by the DTG and NorDig for example, the UK should work with the industry and other European regulators to agree on a framework for ensuring that standards take spectrum efficiency into consideration.

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

Yes, we agree.

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

No, we believe that this is excessively high and not adequately supported by the evidence. The impact of such an unnecessarily demanding requirement would be to increase the cost of devices and increase the chance of false positives, reducing spectrum efficiency.

This margin was calculated using -117 dBm as the maximum tolerable interference level (at the wireless microphone receiver) and 20 dB body loss. In proceedings on this topic in the US, a leading standards work group and wireless microphone vendor have proposed more realistic values of -107 dBm and 10 dB, respectively. [*The IEEE 802 working group filed a Petition For Reconsideration to the FCC on 16th March and Shure filed Ex-Parte ET Docket 04-186 'Unlicensed Operation in the TV Broadcast Bands' on 13th June 2007.*]

The proposed 59dB margin assumes highly unlikely circumstances being taken in combination. We feel that a number of factors will act to reduce the margin requirement:

a. Arbitrary addition of worst-case body absorption[4] to the signal path between the wireless microphone transmitter and white space device, without any measurement in

[4] From free-field absorption measurements, which are unrepresentative of real applications

the example scenarios, artificially increases the sensing requirement. We believe that the absorption would be much lower in practice, due to the effect of multiple paths caused by reflection from walls, stage lights, props and other reflective structures which are likely to be found in vicinity of the wireless microphones when they are in operation

b. It is unlikely that white space devices would be in the areas suffering the worst hidden node margin during a performance – most public movement within venues occurs before and after performances (and during intervals)

c. The industry practice of leaving microphones turned on throughout performances maximises the chance of white space devices detecting their presence

d. The presence of multiple wireless microphones, at most major venues, further increases the chance of detecting at least one microphone

e. Ofcom's allowance for a deep fade (of the signal from the wireless microphone) at the wireless microphone receiver at the same time as the signal strength at a white space device falls to below the sensing threshold, leads to an excessively large exclusion zone for white space devices.

The plots[5] of microphone signal level from ERA's modelling and measurement data show that only in a relatively few confined places did the level fall below -100 dBm. These locations were all outside the auditorium and were unlikely places for members of the public to wait during a performance. Based on this, an appropriately cautious threshold for sensing wireless microphones could be -100 dBm or higher rather than the -126 dBm level proposed in the consultation document.

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

No, again, we believe that this requirement is excessively low and not adequately supported by the evidence, for the same reasons as given in our answer to the preceding question.

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?

We agree and we do not foresee any problems arising from front-end overload.

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

No, we disagree. It would be unreasonable to award greater protection than for DTT to an application which is unlikely to be viable in the interleaved spectrum. We have expanded on this in our answer to Question 12.

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

No, we do not agree, for the reason given in our answer to the preceding question.

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[5] Provided in the ERA report on the modelling and measurement programme: http://www.ofcom.org.uk/radiocomms/ddr/documents/eracog.pdf

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?

We believe that this is unlikely. To date, the demands from potential operators have been towards national or even Europe-wide channel allocations. The economics of mobile television are such that operators need to take every opportunity to reduce costs, of which coverage represents a major component. This favours the use of national single frequency networks and is a strong reason to prefer cleared spectrum.

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?

We think that this area does not need to be covered now, but would reward further study.

By definition, there will always be at least two white-space devices, one transmitting and one receiving. Ofcom could incentivise the development of cooperative approaches by offering a relaxation of sensing requirements on individual devices in proportion to the gain from operating in a collective mode.

Geolocation databases

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

Short notice applications, such as ENG, could be accommodated by requiring changes and/or notice of changes to be propagated quickly through database distribution systems. Synchronisation technology already exists, addressing this type of requirement. We understand that ENG organisations in the UK tend to book spectrum on an annual basis or at least the day before they need it. This considerably eases the time requirements on database distribution.

Question 15: What positional accuracy should be specified?

We believe that somewhere in the region of 100 metres would be sufficient for interference management purposes.

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

We think that the update and availability requirements should be determined in consultation with industry, as part of the overall framework for database operation.

In our view, the protocols and other database implementation details should be left to industry, working within any guiding principles that Ofcom may define.

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

In the longer term, the aim should be for the database operation to be self-funded through contributions from those who benefit. The regulator should facilitate multiple providers, as a means of increasing operating efficiency and reducing the cost to end users.

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

We have no comment to make on this.

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

In answering earlier questions we suggested that database should allow higher transmission power for white space devices in channels and locations where interference risk is lower. Such an approach would facilitate a range of applications and network topologies, including white space access points provided through higher power devices.

Beacon reception

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

Beacons should not be required. However, if they are needed then the costs should be borne by those deploying them.

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

We have no comment to make on this.

Comparing the different options

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

Yes, we agree that they should be considered as alternative approaches. It would not make sense to apply sensing requirements to devices that support geolocation nor vice versa.

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?

No, such restrictions could not be justified and would impair the economic viability of white space applications.

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

Yes, devices should be allowed to use as many free channels as they need. We believe that the only restrictions should be those required to prevent harmful interference.

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

No, such a short interval would unnecessarily restrict throughput, reducing the spectrum efficiency of white space applications.

The requirement is suggested as a means of protecting wireless microphone applications. However, given the industry practice of leaving wireless microphones switched on throughout performances, there will be plenty of opportunity to detect wireless microphones over much longer intervals. Thus, for example, relaxing the requirement to once per minute would radically increase spectrum efficiency, without significantly increasing the risk of interfering with a wireless microphone.

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

In our view the proposed ceiling is too low, with negative implications for the cost of the technology and therefore the potential benefits to consumers.

The value -44dBm is justified in the Ofcom's proposals on the basis of protecting wireless microphones as close as 1-2m. However, given the industry practice of locating wireless high up in studios and auditoriums, a separation of 10m should provide more than sufficient protection – as acknowledged in Ofcom's proposals [*Section 5.36 on p24*]. This more realistic assumption would provide nearly 20dB of additional attenuation, so that the out-of-band performance requirement could be relaxed to the same level as that needed for DTT, for example.

The above answer applies to devices that use spectrum sensing to locate free channels. The geolocation-based approach avoids the need for a common 'worst-case' out-of-band limit by enabling a database to provide a limit value that reflects the interference risks in the given location.

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

We recommend that secondary spectrum sharing rules should not be mandated, as this can lead to inefficiency and may inhibit innovation. However, we recognise that it is important to ensure that devices will not be able to monopolise channels.

The providers of licence-exempt wireless technologies have clear market incentives to ensure flexible, effective and fair mechanisms for channel sharing. Such mechanisms are already integrated in current wireless standards and are being developed for white space standards in the IEEE and Ecma-International.

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

Yes, this should be allowed.