

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title: Digital Dividend: Cognitive Access, consultation on licence-exempting cognitive devices using interleaved spectrum

To (Ofcom contact): Professor William Webb

Name of respondent: Google

Representing (self or organisation/s): Self

Address (if not received by email):

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Name Iarla Flynn

Signed (if hard copy)



Google Response to Ofcom's Consultation

Digital Dividend: Cognitive Access

Licence-Exempting Cognitive Devices Using Interleaved Spectrum

Introduction

Google's belief in the importance of access to information throughout the world has driven us to build services and tools that make the Internet an easily searchable source of knowledge, as well as a platform for communication, expression, and creativity. Google believes in unfettered, ubiquitous access to the Internet, and supports policies that expand greater connectivity to more people in more places. Ofcom's Cognitive Access consultation represents an opportunity to develop such a policy and support continued growth in wireless access to the Internet.

The demand for wireless Internet usage carries with it a demand for spectrum. While billions are paid in the UK and elsewhere for this artificially scarce resource, there is much evidence to suggest that significant quantities of spectrum remain un-used or under-used. This was evidenced by a recent assessment which found that peak spectrum usage in a normal week in Dublin was only 13.6%¹. This data is similar to studies carried out in the US. Cognitive Radio provides a solution to enhancing spectral efficiency in these instances without harming incumbent services such as terrestrial broadcasting. It is vital that Ofcom works to bring such devices to market as quickly as possible using the well-suited UHF spectrum.

Across Europe there is more spectrum allocated for TV than is actually used to deliver television programming. This creates interleaved spectrum, which exists partially because television broadcasts in neighbouring markets typically cannot use the same spectrum and partially because fewer transmitters are needed in low-density population areas. Interleaved spectrum is thus a permanent attribute of the spectrum landscape.

¹ Shared Spectrum (p26) at http://www.sharespectrum.com/measurements/download/Ireland_Spectrum_Occupancy_Measurements_v2.pdf

Ofcom's analysis to date – which is supported by developments in the US - show us that pragmatic solutions for unlicensed access to TV spectrum can be developed based on detailed technical analysis.

Potential Service and Economic Benefits for the UK

Many potential uses of the Digital Dividend have been mooted for licence-exempt applications. These include home, business campus and community networks, as well as a wide variety of industrial or agricultural uses. While many such applications are already licence-exempt in the UK at other frequencies, the improved propagation characteristics of the UHF spectrum which forms the Digital Dividend are such that their benefits are greatly increased.

Unlicensed use of spectrum already has a big impact in the UK. The best example is WiFi, where the UK is a leader in Europe and is used by 20% of UK households². Unlicensed spectrum usage in the UHF band can serve UK consumers by providing last-mile connectivity, bridging the Digital Divide, and enabling new connectivity services such as community mesh networks.

The Digital Britain Interim Report (Section 2.2 Mobile Wireless Networks) highlights the massive potential and importance of mobile broadband services. The Interim Report (Section 4.1 Universal connectivity: Networks) also emphasises the importance of closing the Digital Divide and commits (Action 17) to developing plans for a digital Universal Service Commitment to be effective by 2012. This Universal Service Commitment will be delivered by a mixture of wired and wireless means. Google's belief is that facilitating access to White Spaces can make a significant contribution to the achievement of the objectives set in the Interim Report.

Google supports Ofcom's assessment that allowing licence-exempt access to interleaved spectrum will provide significant stimulus to the UK economy. Economic and social benefits running to hundreds of millions of pounds can be gained by users and business in the UK. Further impact can also be delivered through dynamic innovation and competition benefits that such a licence-exempt approach will encourage.

² Ofcom's International Communications Market 2008

A Clear Opportunity

Ofcom's modelling shows that there is a huge amount of interleaved spectrum available in the UK. This is clearly shown by Ofcom's finding that over 50% of locations are likely to have more than 150 MHz of interleaved spectrum.

Ofcom's detailed technical analysis of the potential for Cognitive Radio devices to operate in the unused TV spectrum has been echoed by similar research undertaken by the FCC in the US. Both regulators have reached the conclusion that cognitive devices will be able to enhance spectral efficiency by making use of this substantial and untapped resource.

The US Cognitive Radio process so far has shown the significant level of interest from major ICT players such as Microsoft, Motorola, Phillips and Dell. A number of devices were developed to assist the FCC in testing and activity in device development has increased since the FCC found in favour of their potential.

First Mover Opportunity

While the FCC has taken the first step in opening up White Spaces, the UK still has an opportunity to become the first market for such devices, as the US process could be delayed. As such there is a window of opportunity for the UK to take a lead in this emerging technology sector and take a global lead in this part of the digital economy.

By acting in the near term to authorise UHF-TV band devices under more flexible procedures, Ofcom can provide significant incentives for manufacturers to focus on the UK market, tailoring UHF-TV broadband technology to UK needs and available spectrum and ensuring the greatest benefits are seen by the UK consumer and economy. Waiting for the rest of Europe could delay the achievement of these benefits.

Technical Framework

Google welcomes Ofcom's proposals and commends the regulator on the direction it has taken. Google supports having rules that allow geolocation only devices as well as spectrum sensing only devices. If geolocation is used, spectrum sensing should not also be required. Conversely, if spectrum sensing is used geolocation should not be required. This provides opportunity for innovation in both areas and maximum flexibility.

In relation to geo-location databases, Google is a founder member of the White Space Database Group in the US, which will help ensure the safe operation of cognitive devices. We hope to use our expertise to support the work of Ofcom on database design and operation and look forward to discussing this matter in more detail with Ofcom in the near future to ensure the maximum benefits are realised from this exciting new technology.

Ofcom's desire to provide the maximum protection to incumbent users of the spectrum is understandable, but the set of parameters proposed for the operation of Cognitive Radio devices that rely only on spectrum sensing are overly restrictive and will create difficulties for manufacturers and service providers in bringing solutions to users.

Ofcom can achieve its aim of minimising the risk of harmful interference with a less prohibitive framework for control of sensing. In particular, the overall figure for the probability of harmful interference (0.04% or lower) from a cognitive device to a DTT receiver is excessively low and must be re-considered if any meaningful white space market is to be developed in the UK.

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?

Google welcomes Ofcom's proposal for licence-exempting cognitive devices accessing interleaved spectrum. This approach is consistent with the use of these devices for mass-market consumer broadband, and will go far in ensuring that the benefits of such services can be delivered quickly and inexpensively, consistent with consumer expectations and UK policy.

Google recognise the importance of ensuring that radio devices do not cause harmful interference to existing TV and PMSE services in the band. However, we believe that further work is required on the technical constraints to be imposed on cognitive devices as at current levels they may unnecessarily restrict their development. We hope that Ofcom will reconsider some of their assumptions and work with industry to ensure that UK consumers have access to innovative services and that spectrum efficiency is optimised.

DETECTION

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

Google agrees that from the probability analysis presented by Ofcom, 99.9% of UK viewers are likely to have DTT reception above -72 dBm. We therefore agree with this assertion given the information available.

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

Google recognises the value of the ERA measurement and modelling campaign and accepts that hidden node values of around 33dB may occur. However, we believe that 35dB is too high. According to ERA's report, a 35 dB margin results in a probability of interference of 0.04% which is excessively low. For example, in IEEE 802.22 this number was in the 1% to 10% range. We also believe that the margin in suburban areas which are not so close to transmitters would be significantly lower. In the areas where a 35dB margin could apply, close to transmitters, the minimum signal level would be much higher than -72 dBm.

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

No we do not agree. If we take the industry recognized DTG requirements for TV receivers as the reference then the minimum adjacent channel performance is 7 dB better than Ofcom has assumed. This would suggest that 20dBm would be a more appropriate limit on transmission power in adjacent channels. In non-adjacent channels, we believe there is scope for increasing the power limit without increasing the interference risk significantly.

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?

Yes, we believe that it is important to provide manufacturers with incentives to improve receiver performance, such that consumers can benefit from increased spectrum efficiency. Since receiver standards are typically developed for Europe as a whole, through ETSI for example, European regulators should work with industry in shaping standards for the future. Advantage should be taken of technology developments to increase standards in such a way that there are not damaging cost increases, which might inhibit market take-up of receivers having better performance. Another method might be mandatory labelling of interference susceptibility for new receivers.

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

Google considers that – 67 dBm is a good receive level reference for wireless microphones. Studies performed to date indicate that this level is appropriate to accommodate an environment that can support both devices.

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

Google considers an additional margin of 59 dB to be excessively high. The hidden node value to protect against interference in all cases, in addition to a worst-case body loss value of 20 dB is, in our view, already highly protective of wireless microphones. This proposal creates the risk that significant sections of the UK population would be needlessly denied access to broadband services delivered over cognitive devices. This, in turn, could retard or delay indefinitely the development of such devices for the UK market as a whole.

By contrast, Google would consider an additional margin value of not greater than -107 dB as the maximum tolerable interference level, and 10 dB for body loss, which is based on

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

Google considers, for the reasons explained in the previous questions, that a sensitivity requirement of -126 dB (in a 200 kHz channel) is excessively restrictive, and likely to curtail severely the delivery of broadband services to the UK citizen-consumer over cognitive devices. Recognising that the 200 kHz channel bandwidth represents a 16 dB reduction in noise over an 8 MHz DTT channel, it is still our view that the sensitivity requirement proposed by Ofcom (due to the additional detection margin) is too low.

As stated above, Google feels sensing for microphone signals at this level will likely result in false detection and lots of the valuable spectrum being left unused. As an alternative, Google would propose a limited number of safe harbour channels be used for microphones and then no-sensing or much higher sensing thresholds for the non-safe harbour channels.

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

No, we disagree. No additional protection should be afforded beyond that provided for DTT reception.

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

No, for the reason given in our answer to the preceding question.

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?

At this time, it is our understanding that there are several spectrum bands under consideration for mobile television. These are not entirely restricted to the interleaved spectrum in the 790 – 862 MHz band. Given that mobile operation in the interleaved spectrum will have to provide protection to DTT and PMSE services, we believe that mobile television, where commercially deployed, will operate in the cleared bands, or in non-UHF 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?

Google recognises the potential value in cooperative detection and believes that it should be taken into account. As there will always be at least 2 white-space devices, one transmitting and one receiving, it seems clear to us that cooperative sensing will be possible. Ofcom could provide support for this development by applying less restrictive sensing requirements for devices operating in such a mode.

GEOLOCATION DATABASES

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

Given the unpredictable nature of the requirements of ENG, Google believes that 'safe harbour' channels – marking certain channels as in the database as being permanently 'in use' at a given location – is the best method for ensuring ENG applications are protected.

Question 15. What positional accuracy should be specified?

Ofcom should set a minimum value for positional accuracy that does not set unnecessary constraints on the development of cognitive radio devices. Google therefore believes that accuracy within a region of 100m is appropriate. Beyond a limit of 100m, the radio environment can vary, and the cognitive device might have to take account of new available channels. This could create additional interference risks.

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

Google believes that it will be sufficient to update the database once a day (assuming that the requirements of ENG can be dealt with by the use of a 'safe harbour' channel). The database should achieve a very high level of availability, in the type of range suggested by Ofcom (i.e. 99.99%). The most efficient and effective means of making database inquiries are Internet-based protocols.

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

Over the long term, and with the deployment of mass-market cognitive devices, provision of the database will be able to stand alone as a commercial enterprise. However, in the initial phases of rollout, it would be possible for large data aggregators to provide the service as a means of enabling consumer access to cognitive devices. Google is prepared to consider providing such a service, but is equally prepared to support other providers of these data who are interested in creating a market for such information.

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

The capacity should only be retained if it does not unduly burden the database providers and lead to uncertainty as to which channels are available in a given location at a given time. Any use of the database for spectrum management purposes should be conducted in a transparent manner and with due caution.

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

Yes, we believe that special measures should be taken to facilitate cognitive base stations. By allowing the database to allow a higher power for white space devices, in locations where interference risk is lower.

BEACON RECEPTION

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

Google does not believe that beacons will be deployed in the UK. Any funding should, in any case, come entirely from commercial sources.

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, Google supports having rules that allow geolocation only devices as well as spectrum sensing only devices as alternative approaches. If geolocation and safe harbour channels for microphones is used spectrum sensing should not also be required. Conversely, if spectrum sensing is used geolocation should not be required.

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?

Cognitive access should not be restricted at the edge of these bands. The sensing technology will enable cognitive radio devices to sense not just television and PMSE services, but also users of other services. Therefore, the edge of the bands should not be treated differently to any other part of the band.

If any restrictions are deemed to be required once operation has begun, the database can be modified by Ofcom to implement this. We believe this is preferable to developing a set of unique rules to govern this use of spectrum.

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

Google agrees that there should be no limits on bandwidth. The benefits of these devices are derived in part from the unlimited bandwidth that they can provide through this efficient use of the radio spectrum. Only the technology will limit throughput, and this will improve with time.

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

No, this would unnecessarily restrict the operation of cognitive radio devices. We believe that the checking channel availability once every minute will be sufficient to ensure that cognitive radio devices do not cause any harmful interference. Current methods of channel sharing already exist, and we believe that similar methods should be employed here.

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

Google supports the results of the ERA report but believes that this requirement is too restrictive. We believe that performance can be improved through careful implementation of cognitive radio solutions, coupled with further studies to allow cognitive radio devices to operate at a level where the applications requested by consumers can be delivered. We look forward to working with Ofcom to ensure the most efficient use of spectrum, with the aim of providing consumers with innovative services which can adapt to their needs.

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

Google believes that Ofcom's proposals are fair, but suggests that if the necessary sharing conditions are put into place it may not be necessary to mandate maximum transmission time and silence time. We look forward to discussing this matter further with Ofcom

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

Google supports Ofcom's approach that the use of slave device operation should only be allowed when the master has performed database location.

ENDS