

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 with and welcome the proposals for license-exempting cognitive devices using interleaved spectrum.

Cognitive devices have the potential to make highly efficient use of unused interleaved spectrum and to provide significant benefits for citizens and consumers in the form of new systems and services. By enabling these devices, Ofcom is taking a highly progressive approach to spectrum regulation which should be followed by other regulators around the world.

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

Yes, we agree with this sensitivity level in the context of DTT deployment in the UK.

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

Yes, we agree with the additional margin of 35 dB to overcome shadowing and the hidden node problem as examined in the ERA report number 2009-0011.

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?:

Yes, we agree with these maximum transmit power levels for mobile devices. However, we recommend that higher maximum transmit power levels be considered for fixed and/or expert installed devices. By permitting these higher power levels, valuable applications including wireless provision of broadband internet in rural areas can be enabled. Fixed and/or expert installed devices are typically installed at roof-top level and so can achieve much more reliable detection of licensed users than mobile devices. Further protection against harmful interference may be provided by requiring these fixed devices to obtain a list of unoccupied channels using database queries, rather than by sensing alone. This approach would be similar to that taken in the US (TV White Space Action FCC 08-260).

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, it is appropriate to expect DTT equipment manufacturers to improve their receiver specifications over time. We suggest a mechanism of equipment rating based upon out-of-band rejection performance. This mechanism could operate in a manner similar to that currently used for energy rating of domestic appliances within the EU. EU energy rating labels rate products from A++ to G based on their energy efficiency. A similar labelling system for wireless products would provide a strong incentive for

DTT equipment manufacturers to improve their receiver specifications and would provide the consumer with a transparent method for comparing the quality of competing products.

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

Yes, we agree with this reference receive level.

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

Yes, we agree with this additional margin.

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

Yes

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?:

Yes, we agree with maximum transmit power levels in line with that for DTT, with the exception of fixed and/or expert installed devices as indicated in our response to question 4 above. Regarding the issue of front-end overload, we recommend that independent tests be carried out in addition to consultation with manufacturers.

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

Yes

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

Yes

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 it is unlikely that mobile television will be deployed in the interleaved spectrum. If it is to be deployed, we recommend that equipment be subject to the same conditions associated with cognitive access and that no specific protection be provided. This approach would ensure a technology and service-neutral approach to regulation of interleaved 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 recommend that further developments be awaited in the context of cooperative detection. Cooperative detection by two or more devices has the potential to overcome shadowing effects and the hidden node issue. This is possible in the event that cooperating devices experience uncorrelated receive channels. However, the issue of whether the receive channels of cooperating devices are sufficiently uncorrelated to overcome the hidden node issue is an open research question. If it can be shown that a cooperative technique for detection can be guaranteed to overcome shadowing effects, then that technique may merit the use of a higher threshold for detection. Until such time, we believe that additional regulatory terms for cooperative sensing are not beneficial.

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

We recommend that a small number of safe-harbour channels be provided in every location for spectrum used on very short notice such as by ENG. Spectrum used with notice on the order of days can be easily supported within a database approach, requiring less frequent database updates and checks. The planned band manager award for PMSE spectrum uses would facilitate such a database-based approach.

Question 15: What positional accuracy should be specified?:

A positional accuracy of 100m should be sufficient. In the case that the database approach is adopted, the margin of error in positional accuracy can easily be incorporated within the database itself.

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

A 1-hour update requirement should be sufficient. As noted in response to question 14, the provision of safe-harbour channels for very short-notice use of spectrum would permit the update requirement to be relaxed as it would be possible for spectrum users to provide advance notice of operation. 99.99% availability should be provided. In the event that the database becomes unavailable, all deployed systems dependent upon it will experience a loss of service. Through the use of mature distributed database technology and redundant servers, this availability target should be achievable. Existing internet-based protocols for database queries should be adopted.

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

It is likely that funding will be needed to enable the database approach to work. A number of possible funding sources exist. One such source could be in the form of

a device license whereby a small charge is associated with each cognitive device sold with database querying capability. Another approach could involve the use of a micropayment made by a device each time the database is queried. As each approach has both advantages and possible drawbacks, we recommend that the issue be considered in detail.

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

Yes, this capability should be retained. In the case that devices are proven to be defective or to create harmful interference, the database would provide a powerful technique for device control. However, in the event that the regulator wishes to disable all cognitive devices so that it can license the interleaved spectrum to a new technology or service, a full process of informing and consulting stakeholders would be needed.

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

As outlined in response to question 4, we recommend that higher maximum transmit power levels be permitted for fixed and/or expert installed devices, including cognitive base stations. These power levels could be determined on a case-by-case basis using the database or could be prescribed in advance, taking worst-case interference scenarios into account. If power levels are prescribed in advance, the database could be used to return lists of channels which are available at each prescribed level.

We recommend that height limits for fixed and/or expert installed devices be adopted, rather than the consideration of device height within the database approach. By adopting a height limit, limits upon worst-case propagation can be achieved and the complexity of the database approach can be kept to a minimal level.

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

We do not believe that beacon reception is a viable technique for enabling use of interleaved spectrum by cognitive devices.

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

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

Yes, we agree with the proposal to enable both detection and geolocation as alternative approaches.

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?:

If restrictions are needed at band edges, we recommend that they be technology neutral. Such restrictions could take the form of Spectrum Usage Rights (SURs).

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

Yes.

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

Yes.

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

Yes.

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

We believe that caution should be taken in prescribing maximum transmission times and minimum silence times for cognitive devices accessing interleaved spectrum. By dictating a minimum silence time for all cognitive devices, the regulator dictates the minimum latency achievable by systems deployed using interleaved spectrum. A minimum latency of 100ms may limit or rule out the use of such systems for many applications such as videoconferencing and multiplayer gaming.

We recommend that mechanisms for ensuring fair access to interleaved spectrum be further researched and a range of appropriate mechanisms be assessed and compared, possibly by further consultation with stakeholders and interested parties.

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

Yes.