Additional comments:

Adrian Pickering is an academic engineer in Electronics and Computer Science, University of Southampton. He is an associate of the Institute of Broadcast Sound and is Sound Supervisor for Highfield Church, Southampton. He is particularly concerned that the community sector (e.g. churches, universities) can benefit from access to interleaved spectrum in order to carry out their social obligations. Cognitive access technologies have the potential to benefit such sectors of society, but not as framed in this consultation. Currently, they pose a threat to such PMSE-like users, which must be addressed.

There must be fast acceptance that cognitive-device self-detection of spectrum use by other licensed users is NOT PRACTICAL in consumer-grade products. Cognitive devices will be a potentially popular, global product and it is a matter of global spectrum-user self-interest that non-compliant devices are never manufactured or ?get into the field?. (Response to an unput question in section ?International harmonization?).

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

No. They pose too much of a threat to licensed use of interleaved spectrum both to existing technologies and future (digital) technologies. Further, they are too specific to latency tolerant applications. Notably, it would not be possible to use cognitive technology for radio microphones. Cognitive-based radio microphones could considerably benefit the community and cognitive technologies should not preclude that at this stage.

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

The focus of this response is on its impact on PMSE-type of use. Unlike DTT and other types of users of interleaved spectrum, it is regularly used in ?live? situations where interference can permanently lose data and impact on many, notably if being broadcast. The type of interference that DTT users may experience if a cognitive malfunctions would be similar to an ignition-unsuppressed car passing by. It would affect a few viewers for a short time and would be tolerable.

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

See answer to Q2.

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?:

This is clearly DTT focused. What impact does it have on PMSE-type equipment?

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 clearly desireable that applications are as resilient to other spectrum users as is economically achievable, thereby achieving best spectrum utilisation. The fairest way to achieve this is to set out a standards strategy as early as possible and in advance of current equipment replacement cycles. Those manufacturers that choose to ignore it will lose market share.

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

No. Further work is required to ensure that this is realistic and that it is practical for wireless microphones that have different spectral envelopes (notably digital wireless microphones). Even answering this question is lending acceptance to the principle that detection is possible. Physics shows that it is not. Should cognitive devices be made that attempt to detect licensed users (using whatever technology) licensed users will develop matching techniques to defend their spectrum, which would not necessarily be ?good neighbourly?. The simple way of avoiding this ?guerilla war? is to accept that detection is NOT PRACTICAL. Alternative means of using the spectrum are possible and discussed below.

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

See answer to Q6. Also note that, assuming cognitive devices become popular, they will be as pervasive as mobile phones. This means that ? whether theatres like it or not ? they will be in use at all parts of a theatre, not just outside.

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

All would agree that this figure is challenging ? too challenging for consumer electronics to achieve. Accordingly, detection should not be part of a strategy for spectrum (re)use.

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?:

Every attempt must be made to ensure device interworking (see answer to Q5). However, it is simply not acceptable that a licence-free device can be permitted to legally transmit on top of a licenced, incumbant user albeit for a short period. If the detection strategy is used, this is what it implies. This is NOT ACCEPTABLE in a standard and will lead to mitigating behaviour (see answer to Q6).

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

Mobile television has the same consumer characteristics as DTT. See above responses.

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

See answer to Q10.

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?:

The protection should be no fuller than for wireless microphones. It would be ironic if the consumers of PMSE-generated product had a higher level of protection than its originators.

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?:

See answer to Q12.

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

A database of licensed users needs to be kept by the band manager and will exist anyway. Such data can often be ?streamed? in a data channel, as it is by subscription television services. Thus there is the possibility of a hybrid approach where local spectrum information is available from a locally receivable data stream (which would change across cells or regions). Again, the question tends to assume a solution and perhaps not all solutions have been explored yet.

Question 15: What positional accuracy should be specified?:

This assumes that positional accuracy is required. If the device is able to receive the data channel (the ?beacon? approach) then it will be receiving local spectrum use information (be it from a local base station or, perhaps, a DTT transmitter).

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

If the data is streamed and, possibly, interpreted by a local base station which generates a pilot beacon, then some local storage and intelligence can be used to produce conservative spectrum use data to client cognitive devices.

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 recognised that, though the client cognitive devices are licence-free, the services they may be using will be at a price (cf mobile phones). Those that are collecting the revenue need to pay whatever is required in order to make their revenue-generating service function.

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

Yes. The band manager maintains the database on behalf of Ofcom and Ofcom should be able to use it in the national interest.

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

Yes. Since this respondee favours a beacon approach, it would be sensible that these are subject to standards in the same way as the client cognitive devices themselves (i.e. licence-free, type-approved and can interwork). Some spectrum needs to be set aside for their use, possibly within the DSO-freed spectrum.

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

The funding should come from the licensees of the services that generate revenue from cognitive devices and/or their means of working e.g. access to the beacon data.

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

If a beacon cannot be received then there should be some acceptable default behaviour, such as availability of an internationally-agreed ?fall-back? spectrum block. As with mobile phone networks, provision of a beacon will be in service operators? interests since it will increase revenue. What is absolutely VITAL is that licensed users (such as PMSE) get the highest chance of interference-free use of spectrum. This suggests that the fall-back cognitive spectrum and licensed users? spectrum must be mutually exclusive. Since this could be within the DSO-freed spectrum, this is an issue that needs to be addressed now.

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

No. The solution favoured by this respondee is conservative and would follow the same patterns of growth as cellular mobile. The detection a cognitive device would need to do is beacon pilot identification and any further necessary to interwork with similar devices. If it cannot find a beacon to tell it what part of the spectrum to use

next, then it will use spectrum dedicated for such devices to use. Since this would be at higher powers, it is important that it is clear of other services that could be affected. There will be a natural incentive to be able to use interleaved spectrum which will lead to more beacon pilot installations.

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?:

It is suggested that cognitive devices need some non-interleaved spectrum of their own in order to make them successful and robust and not cause interference to other users. When using interleaved spectrum it must work to standards that respect other (licensed) users.

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

There should be limits on bandwidth. There must be some incentive not to ?hog? bandwidth without penalty. Interleaved spectrum is not a free resource ? licensed users pay for it.

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

The answer to Q6 made the point that to engage in such a question lends acceptance to the principle of sensing. This respondee does not believe that this approach is practical. Further, it precludes use of cognitive techniques for low-latency applications, notably radio microphones. The technique should at this stage allow negotiated, temporary use of interleaved spectrum by any application, known or unknown, which respects EXISTING users.

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

See answers to Q25 and Q9.

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

See answer to Q25.

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

Something like this is very attractive. In the responses above, it is suggested that a master device could collect its data in a number of ways e.g. extracting a data stream from a local DTT multiplex. Once it has its own spectrum-use database then it uses

that to either forward to other base stations or negotiate with local, client cognitive devices.