

## **Qualcomm response to the Ofcom public consultation on licence-exempting cognitive devices using UHF interleaved spectrum**

Qualcomm believes that licensed spectrum is the best way to provide broadband services with sufficient quality of service at a reasonable cost. Past experience indicates that services based on unlicensed spectrum have largely been unsuccessful to provide wide area services, whereas mobile broadband access is flourishing in licensed bands. In addition, the award of UHF spectrum for licensed services brings considerably more value to the UK economy than authorizing its use on a license exempt basis.

Unlicensed devices have been, on the other hand, successful in providing short range services to consumers and companies. However, it should be noted that such services are intrinsically local services using high frequency bands which enable to reduce the risk of interference. Those services and their evolution can be accommodated in the existing large license-exempt spectrum. Operation at lower frequency bands could actually be counter-productive for such services, as interference would be propagated further away from the local service area. The UHF band and its favorable propagation condition should be reserved to licenced services which have proved to be very efficient in their use of the spectrum.

The UHF band provides very challenging sharing environment due to the favorable propagation environment as well as the number of systems deployed in the band. Regarding the protection of Digital Terrestrial TV (DTT), Qualcomm would like to highlight the studies of the SE42 with regards to the protection of DTT below 790MHz from mobile broadband devices above 790MHz. The Ofcom inputs to SE42 studies highlighted the following points:

- Document SE42(09)052 stated the DTT reference sensitivity (to be protected from interference) should be -77.17dBm/8MHz.
- Document SE42(09)069 stated that the terminal station emission below 790MHz should be kept below -56.5dBm/8MHz.

Given the similarities in emission power between mobile broadband terminal devices and proposed cognitive devices (20dBm in both cases), as well as expected user density, Qualcomm recommends Ofcom to adopt a single set of protection requirements of DTT. This

directly concerns questions 2 and 26 of the present consultation which introduces alternative values for the parameters presented above.

Not only should spectrum sensing devices detect current Digital Terrestrial TV and mobile TV standards (DVB-T, MediaFLO, DVB-H, T-DMB) but also all PMSE devices and future evolution of DTT and MTV standards. In addition, Qualcomm acknowledges Ofcom statement that the lower digital dividend should be auctioned on a technology neutral basis. Therefore, spectrum sensing cognitive devices should have the capacity to detect any new technology introduced in the band, including non broadcasting technologies. Extensive feasibility and compatibility studies are still required to understand the possibilities and limitations of spectrum sensing cognitive devices in this band.

Considering the strategic value of the UHF band, Qualcomm recommends performing all the appropriate studies before authorizing the use of cognitive radio devices in this spectrum.

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

Qualcomm disagrees with the sensitivity level of Table 1, due to the method selected by Ofcom which inherently assumes that the cognitive device and the TV receiver are geographically close to each other. Qualcomm believes that this hypothesis is not compatible with the proposed transmission power of 20dBm. More details can be found in our answer to question 3.

Qualcomm also disagrees that mobile TV in interleaved spectrum is an application that should not be protected from cognitive devices. Therefore, parameters from Table 1 should be modified to take into account protection of mobile TV. More details can be found in our answer to question 12.

Finally, Qualcomm believes that Out-of-band performance in Table 1 and 2 should be specified in dBm/8MHz or in dBm/MHz. The out-of-band performance should also be aligned with the out-of-band performance requested from mobile devices in 790-862MHz (-56.5dBm/8MHz).

**Detection**

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

The ECC SE42 working group has been studying the emission limits below 790MHz applicable to mobile devices introduced in the band 790-862MHz. Ofcom proposed for these studies to select a sensitivity level for DTT of -77.17dBm/8MHz (See document SE42(09)052). Qualcomm would like to highlight the necessity for the Ofcom to select a single value for this parameter and ensure the same level of DTT reception protection from cognitive devices as from mobile broadband devices.

Once a single sensitivity value for DTT is selected, Qualcomm recommends selecting this value as the DTT field strength that should be protected from interference from cognitive devices. In other words, if a DTT receiver receives such field strength; cognitive devices should be sensitive enough to avoid interference to this DTT receiver. Such clarification is required as will be shown in our response to question 3.

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

Qualcomm disagrees with the method introduced by the Ofcom.

Inherently, the method assumes that the TV receiver and the interfering cognitive device are located in the same geographic area. In such a case, as described by the Ofcom, the difference in received DTT field strength level can be estimated to a maximum 35dB.

The following example case highlights the most common interference case, which has not been considered by the Ofcom in this consultation: interference of a DTT receiver by a cognitive device located geographically far away from the DTT receiver.

Consider a DTT receiver, with -72dBm DTT received signal. Typical DTT C/N requirement can be around 20dB (see ETSI EN 300 744). Therefore, any interfering signal above -92dBm would create interference to the DTT receiver.

Considering a transmitted power of 20dBm, a DTT receiver antenna gain of 0dBm (corresponding to a case where the cognitive device is not at all in the main lobe of the DTT antenna), and a feeder loss of 5dB, any cognitive device would create interference to the DTT receiver when the path loss between the cognitive device antenna and the DTT receiver antenna is less than  $20 - (-92) - 5 = 107$ dB.

At 500MHz, a 107dB path loss corresponds to:

- more than 10km for a free-space path loss,
- 2.6km for the Hata rural path loss (Base station height:30m, cognitive device height:2m, frequency 500MHz),
- 813m for the Hata suburban path loss (same parameters as above),

- 375m for a Hata urban path loss (same parameters as above).

When considering such large distances, it is clear that though the DTT signal level at DTT receiver is 72dBm, it is potentially much lower where the cognitive device is located. It should be noticed that this analysis was carried without taking into account any hidden node margin and considering a very mild 0dBm for the DTT receiving antenna, which makes it a very optimistic case.

Qualcomm recommends Ofcom to take into account this analysis and abandon the assumption that the DTT receiver and the interfering cognitive device are located in the same geographical area.

Qualcomm considers that selection of a sensitivity level for cognitive devices of -114dBm is extremely likely to create interference to DTT receivers in areas adjacent to the cognitive device location.

**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?**

Qualcomm notes that the proposed transmit power level are related to DTT receivers adjacent channel C/I. Qualcomm wonders whether this C/I requirement depends on the type of interfering signal or not. As cognitive devices are likely to be based on channel bandwidth other than 8MHz, Qualcomm would recommend defining emission requirement on specific bandwidth, to be selected by Ofcom, rather than on the total power of the device. Block Edge Masks would adequately provide the theoretical framework for such definition.

Following our response to question 3, Qualcomm also notes that the proposed transmit power level are in very clear contradiction to the principle set in page 1 of the consultation paper: '1.5 In their simplest form, cognitive devices rely solely on spectrum-sensing capabilities to detect unused spectrum in which they can transmit. If they fail to detect licensed use of spectrum, harmful interference might occur. To prevent this, two key parameters must be set appropriately:

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- The device must transmit with relatively low power such that its signal does not travel far from its location.'

**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?**

NC

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

NC

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

NC

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

Qualcomm disagrees with the proposed Ofcom approach to derive the sensitivity level. As demonstrated in question 3, the relatively large power of cognitive devices associated with the extremely good propagation characteristics of UHF radio waves mean that a cognitive device may interfere wireless microphones located far away.

Qualcomm recommends upgrading its analysis by integrating a margin linked to the interference radius of a cognitive device.

**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?**

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- The device must transmit with relatively low power such that its signal does not travel far from its location.'

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

Qualcomm would disagree with the proposed levels.

Based on its extensive experience with regards to Mobile TV, Qualcomm expects commercial terminal with a connector level sensitivity of -98.6dBm and -94.5dBm over respectively Additive White Gaussian Noise channel (flat-fading) and TU-6 fading channel.

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

Qualcomm does not specifically challenge the proposed additional margin of 20dB.

However, Qualcomm notes, in line with the answers to previous questions 3, 4, 8 and 9, that the Ofcom's analysis only considers interfering cases where the mobile TV receiver and the cognitive device are located in the same area.

As demonstrated in the answer to question 2, cognitive devices are likely to create interference very far away from their geographic location. Ofcom's proposed sensitivity level for cognitive devices is very likely to create serious interference to mobile TV receivers in neighboring geographical areas.

**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?**

Mobile TV can potentially be deployed in the interleaved spectrum and is a licensed use of the spectrum. Qualcomm expects the Ofcom to fully protect mobile TV in the interleaved spectrum following Ofcom statement on the p1 of the present consultation:

'We concluded that we should allow cognitive access as long as we were satisfied that it would not cause harmful interference to licensed uses [].'

**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?**

Given the propagation characteristics of the UHF band and the power level proposed by Ofcom, Qualcomm believes that it is inadequate to consider that two collaborating cognitive devices are collocated. With 20dBm, cognitive device can potentially communicate over very large distances and therefore share information about essentially completely uncorrelated interference environment.

Furthermore, it cannot be assumed that cooperative detection will be effective as it requires a high density of collocated cognitive devices to work.

Taking into account cooperative detection in regulatory decisions would potentially result in serious interference to DTT receiver and PMSE users when an isolated cognitive device is operated.

**Geolocation databases**

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

NC

**Question 15. What positional accuracy should be specified?**

Qualcomm notes that, given the Ofcom proposed cognitive device emission level, it is likely that cognitive devices would create interference at more than one kilometer away from their geographical location. Therefore, Qualcomm concludes that the database should be carefully designed to only allow cognitive devices where DTT and PMSE are not in use in the current geographical location but also in neighboring geographical locations.

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

NC

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

NC

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

NC

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

NC

#### **Beacon reception**

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

NC

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

NC

#### **Comparing the different options**

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



Qualcomm disagrees with Ofcom proposal to enable detection as one approach to cognitive access. Qualcomm believes that careful consideration of likely interference scenario leads to very stringent detection level requirements for 20dBm cognitive devices. Therefore Qualcomm recommends that any feasibility of detection scheme be demonstrated before regulatory actions are taken to allow the deployment of such devices.

### **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?**

CEPT SE42 is conducting studies to define Block Edge Masks for PMSE equipment operating in adjacent band to the expected mobile FDD downlink band (likely to be included in the 790-822 MHz band). Cognitive devices deployed immediately below 790 should respect at least the same emission restriction as PMSE equipment.

Qualcomm notes that mobile devices cannot transmit more than -50dBm/MHz in FDD downlink band, according to 3GPP specifications. One approach may be to limit allowable emission in the band 790-832MHz to a comparable level.

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

NC

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

NC

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

The ECC SE42 working group has been studying the emission limits below 790MHz applicable to mobile devices introduced in the band 790-862MHz. Ofcom proposed for these studies to select an out-of-band emission level for mobile user equipment equal to -56.5dBm/8MHz (See document SE42(09)069). Qualcomm would like to highlight the

necessity for the Ofcom to select a single value for this parameter and ensure the same level of DTT reception protection from cognitive devices as from mobile broadband devices.

Qualcomm notes that the Ofcom analysis defined its proposed level on an 8MHz bandwidth. Given the proposed lack of restriction of cognitive devices bandwidth and the varying bandwidth of systems in adjacent bands (8MHz for DTT, 200kHz for PMSE, 5/10MHz for mobile devices), Qualcomm would propose to adopt an out-of-band emission restriction defined on a smaller bandwidth, e.g. dBm/MHz or dBm/200kHz.

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

NC

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

Qualcomm notes that the proposed emission level of 20dBm corresponds to device capable of communication over large distance (see answers to Q3, Q4, Q8, Q9, Q12 and Q13). Therefore, it is completely inappropriate to allow master/slave operation as two cognitive devices communicating with each other may be located in widely separated locations. As a result, the availability of the channel at the ‘master’ location provides no information on the availability of the channel at the ‘slave’ location.

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