Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title: **TV white spaces: approach to coexistence**

To (Ofcom contact): **Mark Binns**

Name of respondent: **DSA Regulatory co-chairs: Angelo Cuffaro, Aparna Sridhar**

Representing (self or organisation/s): **DSA (Dynamic Spectrum Alliance)**

Address (if not received by email):

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Please tick below what part of your response you consider is confidential, giving your reasons why

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Whole response		Organisation	
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Name: Angelo Cuffaro and Aparna Sridhar (DSA) Signed (if hard copy)

Ofcom Consultation: TV white spaces: approach to coexistence
Response of the Dynamic Spectrum Alliance

Details of the Consultation
Name: TV white spaces: approach to coexistence
Deadline: December 13, 2013.
Link: http://stakeholders.ofcom.org.uk/consultations/white-space-coexistence/

About the Dynamic Spectrum Alliance

The Dynamic Spectrum Alliance is a global, cross-industry alliance focused on increasing dynamic access to unused radio frequencies. The membership spans multinational companies, small-and-medium-sized enterprises, academic, research, and other organizations from around the world, all working to create innovative solutions that will increase the utilization of available spectrum to the benefit of consumers and businesses alike.[1]

General Response

The Dynamic Spectrum Alliance (DSA) welcome Ofcom's proposals for enabling licence exempt access to the TV white spaces. We congratulate Ofcom on its progress in defining a TV white spaces framework which can be used as the foundation for extending Dynamic Spectrum Access to bands beyond UHF.

We believe that making unused spectrum in the terrestrial TV broadcast bands available for licence-exempt use will have significant economic and social benefits. As it becomes more difficult to clear spectrum of older technologies, sharing spectrum will be an important tool in addressing substantial growth in demand for wireless connectivity bandwidth. Sub-1 GHz spectrum is particularly valued for its superior propagation characteristics.

The geolocation database approach set forth by Ofcom also enables regulators to respond to experience and to adapt to changes in consumer needs and market conditions. Ofcom should take advantage of this flexibility to frame the allowance for the new TVWS services and applications in a way that maximizes the utility of licence-exempt uses.

We further believe, that as a future step, the geolocation database may be augmented with sensing, either through a network of sensors which report real-time information back to the database, or through sensing in the White Space Devices (WSD) themselves. While we recognize that sensing is perhaps not yet commercially available, we believe the next logical step toward achieving optimum dynamism in channel allocations may be to complement the geolocation database with sensing information, so that the database can incorporate real world feedback experienced by the user's WSD.

[1] A full list of members is available at www.dynamicspectrumalliance.org/members.html.

We also believe that geolocation databases can be used in the future to manage other opportunistic services and other bands. For example, requiring PMSE devices to automatically register their location in the WSDB when technically and commercially feasible to do so would make management and the use of the spectrum much more efficient. In the meantime, we would encourage the JFMG to populate the WSDB with PMSE location information.

In conclusion, we believe that Ofcom has taken a positive first step in laying down the co-existence framework, and we hope that as we learn more from the pilot and initial deployments, we will be in a better position to comment on new rules that can fully optimize the use of the TVWS and shared bands. In addition, we hope that all the stakeholders use the initial TVWS regulation framework proposed as a springboard to develop mechanisms to facilitate co-existence between peer secondary devices.

Q1:Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to DTT services? Please state your reasons for your comments.

We think that Ofcom's proposed approach is practical and strikes a sensible balance between ensuring that there is a low probability of harmful interference to DTT services and enabling new TVWS applications and services. It is difficult at this stage to evaluate whether the constraints on white spaces devices (WSDs) will limit the viability of particular applications – though clearly wide area network applications (such as smart city applications and broadband gap filling) would likely be most significantly affected.

In reference to paragraph 5.14, we agree that OFCOM has made a practical and reasonable assumption in considering solely the degradation to external rooftop antennas (outdoor coverage) rather than also indoor coverage of DTT services.

In reference to paragraph 5.30, and paragraphs 3.2 and 3.3 of the technical report, we agree that considering the signal strength of the DTT signal, and the increase in the noise and interference floor (i.e. target noise rise) in measuring degradation is a more meaningful and reliable indication of the likelihood of harmful interference.

In reference to paragraph 3.7, the clearance of the 700 MHz band will be a concern to white spaces technology and service providers. However, we believe that Ofcom should explore mitigating the impact by seeking a framework that will allow WSDs to continue to operate in this band, and at a minimum permit the licence-exempt use until the repurposing of the band is completed.

In reference to Figure 13 which shows the number of TVWS channels available in any given pixel. We believe an additional figure showing the level of signal expected to be received from a DTT service in any given pixel could shed some light on the actual number of useable TVWS channels. i.e. those pixels that are very close to DTT transmitters in co or adjacent channels may suffer from extreme interference that would make it difficult for WSD devices to operate in those pixels.

In addition, it would be helpful to understand the contiguous availability (i.e. number of contiguous pixels) of each TVWS channel for WSD devices because of the potential capacity benefits for some applications. i.e. Is the availability generally limited to isolated pixels or are there generally large contiguous areas of TVWS channel availability?

Q2:Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to PMSE services? Please state your reasons for your comments.

We believe that Ofcom's approach to PMSE protection, is as with DTT protection, broadly sensible. However, we feel that there is scope to consider and test during the pilot a higher received interfering power at the PMSE receivers, given industry practice and other mitigating technical factors, such as PMSE receiver antenna directionality and proximity to DTT channel edge as explained in paragraph 6.9 a. Restrictions can then be relaxed to the extent that they are found to be unnecessary.

In reference to paragraph 6.15, we believe that the nationwide restrictions in channels adjacent to 38 should be tested during the pilot to determine whether they can be moderated to reflect a lower risk of interference, for example, in certain rural areas where the population density is much lower. As above, restrictions can then be relaxed to the extent that they are found to be unnecessary.

In reference to paragraph 6.17, we comment that the cost of the flexibility afforded to JFMG is a challenging update requirement on WSDs, which will in any case only apply in the vicinity of venues. We believe that if advanced cognitive radio technologies are to be introduced in the future some of the legacy issues should be solved first (e.g. illegal use of PMSE equipment and poorly performing systems). Consequentially, Ofcom should use the performance of professional PMSE solutions on which to base its protection arrangements. If necessary, Ofcom can allow for a transition period to account for the fact that some older equipment will still be in regular use. Ofcom should also step up its efforts to identify and eliminate un-licensed use of PMSE equipment and seek ways to encourage PMSE users to update their equipment. It is important that PMSE manufacturers and regulators help to solve the interference and deployment issues with improved processes and technology.

In reference to paragraph 6.6, given the flexibility offered by the database approach, and the rapid response required in the event of database changes, we believe that Ofcom has scope to consider relaxing the safe harbour constraints– e.g. in remote rural areas, where the risk of interference to PMSE would be negligible. We believe Ofcom should consider when it might be feasible to require PMSEs using channel 38 to register in the WSD database. This would give the database a more accurate picture of the channel/location use to permit the use of channel 38 in areas where licensed wireless microphone usage is not taking place.

In reference to Figure 13 (Availability of 8 MHz channels in Central London in relation to DTT - London scenario 2), we note that 15 TVWS channels with a transmission power limit of 35dBm are available for 90% of households. However, the additional constraint of coexistence with PMSE (Figure 16 – TVWS availability in Central London in relation to DTT and PMSE – London scenario 2), causes a reduction to just 5 channels. The combination of coexistence with both PMSE and DTT is thus very restrictive. We believe that the band manager for PMSE spectrum allocations (currently JFMG, an Arqiva company) should be required to make the allocation of reservation information (spectrum, location and date / time required) that will be entered into the WSD database available for review and should also be required to provide periodic, verifiable reports on actual usage of the allocated spectrum in order to ensure that the spectrum is being used efficiently. In addition, it will be beneficial if the WSD database in turn makes the PMSE information publicly available. Clearly, any reduction in PMSE allocations would greatly improve the availability of WSD channels in London and other PMSE intensive regions.

In reference to paragraph 6.9 c, we agree that using wanted power rather than sensitivity for calculating the protection ratio is a realistic assumption. However, assuming that the PMSE device is always at the edge of the frequency band and not taking into account the mitigating effects of directional antennas are both worst case assumptions which should be tested as part of the pilot to ensure that the WSD emission limits are not overly cautious. Restrictions can then be relaxed to the extent that they are found to be unnecessary as real world data is gathered.

In reference to paragraph 6.12, we believe that the pilot offers the opportunity to test whether the database can be used to provide calculated power allowances rather than completely prohibiting operation in white spaces around venue boundaries. This restriction can then be relaxed to the extent that it is found to be unnecessary by fine tuning the calculations.

Q3:Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to 4G services above the UHF TV band? Please state your reasons for your comments.

In reference to paragraphs 7.13 and 7.14, we question the need to reserve channel 60 as a guard band. We believe that the intended objective can be achieved by restricting WSD emission power as is proposed in channels adjacent to DTT transmissions and this can provide WSD with valuable spectrum capacity. We also believe that current high powered (20,000 Watts) incumbents using channel 60 (i.e. DTT Freeview[2]) will most likely cause more significant interference issues to 4G networks rather than low power WSDs. In addition, we believe that the rationale put forth by Ofcom (i.e. likelihood of a WSD in proximity to a 4G UE) will also apply in the future to 4G operators. With the proliferation of 4G small cells (i.e. femto-cells, pico-cells, etc), it will be difficult for operators to make sure that there are no small cell base stations transmitting in the vicinity of an adjacent channel 4G mobile device. Solutions will be required to mitigate the interference. Those same solutions can then be used to mitigate the much lower anticipated interference from WSD devices: the WSD power levels are significantly lower than the levels of an adjacent base station in the reference scenario.

Q4:Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to services below the UHF TV band? Please state your reasons for your comments.

DSA has no comment on this question.

QuestionT1:Do you have any comments on our proposal to cap the maximum in-block EIRP of all WSDs at 36 dBm/(8MHz)?

In reference to paragraph 4.24 of the technical report, we see no reason to cap WSD power in the way Ofcom has proposed, given Ofcom's chosen geolocation database implementation. The main advantage of Ofcom's approach is that as much of the control of WSDs as possible can be handled through the database, and varied as appropriate, rather than being fixed in regulations. Manufacturers may decide to harmonise maximum power on a global basis for example in line with FCC limits, to improve economies of scale in equipment and to enable a more uniform approach to planning and coverage projections, but specialist rural broadband applications for example might

[2] http://www.ukfree.tv/txdetail.php?a=SX857619

usefully offer higher power in remote areas, where this would not pose any greater risk to licensed users. It is worth noting that the UK channel width is greater than used in the US, so keeping the same spectral power density as the FCC allows would suggest a power limit of 5.3 Watts (EIRP).

However, we recognise that not having a cap on WSD power may create coexistence issues with other WSD devices in small cell urban/suburban environments, and we would favour a cap in those applications.

QuestionT2: Do you have any comments on our proposed approach for calculating WSD emission limits, as expressed in Equation(4.3),in relation to DTT coexistence calculations?

In reference to paragraph 3.41 of the technical report, we agree with Ofcom's conclusions that aggregated interference is not a significant issue. A study "Controlling Aggregate Interference under Adjacent Channel Interference Constraint in TV White Space" performed by Lei Shi et al of the KTH Royal Institute of Technology showed that the "Reference Geometry" proposed in ECC report 159 was extremely pessimistic. [3]

In reference to paragraph 4.37 of the technical report, we are in agreement in using target noise rise rather than location probability as it is a relevant and reliable measure of likelihood of perceptible impairment of the licensed service.

QuestionT3: Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of DTT receivers in relation to DTT calculations?

With reference to the proposed use of reference models with coupling gains, we see no immediate alternative but would remark that the choice of coupling gain will have a significant effect on the availability of spectrum for WSDs. Ofcom should therefore select coupling gains that are commensurate with Ofcom's stated aim of ensuring a low probability of harmful interference and not select worst case figures which apply in a very limited range of geometrical scenarios.

QuestionT4: Do you have any comments on our proposed target 1 dB rise in the noise-plus- interference floor at the edge of DTT coverage, and our approach for allowing greater rise in the noise plus interference floor in areas inside DTT coverage?

We believe that this is a cautious and sensible approach, providing more than sufficient protection to reception of DTT services. We believe that further work should be carried out in the pilot to help to evaluate the protection this provides to ensure that it provides a low probability of harmful interference to DTT whilst ensuring the most efficient use of spectrum by enabling WSD to reach their potential.

In reference to paragraph 4.62 of the technical report, we agree that the proposed target reduction should be relative to the sensitivity of the receiver and the strength of the DTT signal. This would allow for increased degradation in areas where the DTT signal is high and decreased degradation where the DTT signal is low.

In reference to paragraph 4.67 of the technical report, we believe that the presumption that angular discrimination is excluded from all WSD antennas severely underestimates the coupling loss. This

[3] http://web.ict.kth.se/~sungkw/files/shi_sung_zander_crowncom_2012_2.pdf

presumption will severely restrict point to point backhaul deployments in particular, which can take advantage of the angular discrimination.

QuestionT5: Do you have any comments on our proposed approach for calculating coupling gains in relation to DTT calculations, including the use of 70th percentile coupling gain values for same pixel, tier 1 pixel and tier 2 pixel scenarios, and the use of median coupling gains for tier 3 pixel (and beyond) scenarios?

We agree that OFCOM has made reasonable assumptions in the calculation of the coupling gain and encourage real word measurements to confirm these assumptions

In reference to paragraphs 4.82, and 4.88 of the technical report, we question the use of a default height of 30 meters for WSD (worst case) instead of 10 (average) as in the same-pixel and tier 1 pixel scenarios. This is likely to result in an underestimation of the coupling loss and therefore unnecessary constraint on WSD transmission power limits.

In reference to paragraph 4.94 of the technical report, the assumed indoor penetration loss of 7dB for type B devices (portable/mobile) should not be the only factor in assessing the coupling gains. An indoor device is very unlikely to create much interference to a DTT aerial receiver pointing outward towards a DTT tower, especially in urban environments. The indoor device is likely to be at different height than the aerial outdoor antenna, and as a result an elevation azimuth antenna discrimination factor should be assumed. In addition, we believe that the penalty (losing the 7dB indoor to outdoor factor and assuming that a type B device is outdoors at a height of 1.5 meters) of not reporting the height for portables/mobiles is pessimistic especially since most portables or mobiles do not currently have the capability to report height. As a possible solution, we would prefer that the assumption be made that that a Type B device is an indoor device unless explicitly indicated that it is outdoors.

Question T6: *Do you have any comments on our proposed protection ratios in relation to DTT calculations, including the use of 17 dB for co-channel protection ratio, and 70th percentile values for adjacent channel protection ratios?*

We agree that a reasonable approach has been taken but encourage Ofcom to perform additional measurements using 802.11af technology.

QuestionT7:DoyouhaveanycommentsonourproposedapproachfordealingwiththeuncertaintyinthelocationsofWSDsinrelationtoDTTcalculations?

In general, we believe that Ofcom has taken a reasonable approach. In the future, however, the uncertainty of WSD locations may be additionally mitigated through sensing technology. One such solution is the introduction of a network of sensors or sensing technology in the WSD themselves that identify possible interference and report back to the geolocation database. We believe that complementing the geolocation database with sensing information may provide an efficient approach to sharing spectrum between WSDs and DTTs, and other incumbents.

Question T8: Do you have any comments on our proposed approach for calculating WSD emission limits, as expressed in Equation (5.2), in relation to PMSE coexistence calculations?

In reference to paragraphs 5.31, and 5.40 of the technical report, we agree that a value of -65 dBm for the wanted signal power (in conjunction with other parameters) is much more realistic than using the minimum sensitivity, as microphones are typically operated at a higher SNIR to ensure good quality can be maintained.

QuestionT9:Do you have any comments on the PMSE wanted signal power levels that we propose in relation to coexistence calculations?

In reference to paragraph 5.45 of the technical report, we agree that a value of -65/73 dBm for the wanted signal power is much more realistic than using the minimum sensitivity.

QuestionT10:Do you have any comments on our proposed approach for calculating coupling gains in relation to PMSE calculations

In reference to paragraph 5.53 of the technical report, we believe that using a default height of 30 meters is pessimistic for those devices that do not report height.

In reference to paragraph 5.48, we believe that for Type B devices, the addition of an indoor/outdoor parameter for the WSD to indicate to the WSDB would be very beneficial as an indoor device is much less likely to degrade performance. As an alternative solution, the default assumption can be made that a Type B device is an indoor device unless explicitly indicated that it is outdoors. In addition, it would be beneficial to know the approximate height of the PMSE devices as well as the coupling gains can then be more accurately calculated.

QuestionT11:Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of WSDs in relation to PMSE calculations?

In general, we believe, Ofcom has taken a reasonable approach. The uncertainty of WSDs locations to wireless microphones and other types of PMSE may be improved in the future by complementing the database with sensing information. The WSDs would detect a PMSE signal and would choose another channel in that time at that location, the WSDs would also report back to the geolocation database, which could update its information and avoid assigning that channel at that time to another WSD, for example.

QuestionT12:Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of PMSE receivers in relation to PMSE calculations?

The approach is reasonable.

QuestionT13:Do you have any comments on our proposed approach for the derivation of WSD-PMSE coupling gains for non-geolocated slaves in relation to PMSE calculations?

In reference to paragraphs 5.69, and 5.70 of the technical report, we believe that this approach, although it allows a slave WSD to transmit at the edge of a PMSE area, can unnecessarily restrict operation of class 3, 4, and 5 devices in adjacent channels. In practice, the probability of such co-location is vanishingly small, as the slave WSD could be located anywhere within the coverage area of the master. We propose to increase the reference separation from 10 meters to a value such that class 3 devices with a height of 10 meters can operate with no restrictions in the first adjacent

channel (i.e. 36 dBm). We believe that there is significant margin here, as the scenario chosen to derive the restrictions is based on pessimistic assumptions: building penetration gain of 0 dB, and microphone receiver height of 10 m.

QuestionT14:Do you have any comments on our proposed protection ratios in relation to PMSE calculations?

DSA has no comment on this question.

QuestionT15:Do you have any comments on our assessment that a margin for uncertainties in radio propagation is not necessary given the proposed parameters for derivation of coupling gains in relation to PMSE coexistence calculations?

In reference to paragraph 5.80 of the technical report, we agree that an additional margin is not necessary because excluding the use of the angular and polarisation discrimination is already quite pessimistic.

QuestionT16:Do you have any comments on our proposed WSD emission limits in relation to PMSE use in channel 38?

In reference to paragraph 5.91, we believe the assumption that a WSD is always 10 meters away from a PMSE operating in channel 38 unnecessarily restricts operation in adjacent channels for device classes 3 (31 dBm), 4(21 dBm) and 5 (11 dBm). We propose to increase the reference separation from 10 meters to a value such that class 3 devices with a height of 10 meters can operate with no restrictions (i.e. 36 dBm). We believe that there is significant margin here as the scenario chosen to derive the restrictions is based on pessimistic assumptions: building penetration gain of 0 dB, microphone receiver height of 10 m.

We further point out that in the future a geolocation database augmented with sensing information may help to eliminate the need for fixed distance separation limits.

QuestionT17:Do you have any comments on our proposal not to permit WSDs to operate in channel 60?

We believe that WSD operations should not be restricted in channel 60. In addition, we also believe that current high powered (20,000 Watts) incumbents using channel 60 (i.e. DTT Freeview4) will most likely cause more significant interference issues to 4G networks rather than low power WSDs. With the proliferation of 4G small cells (i.e. femto-cells, pico-cells, etc), it will be difficult for operators to make sure that there are no small cell base stations transmitting in the vicinity of an adjacent channel 4G mobile device. Solutions will be required to mitigate the interference. Those same solutions can then be used to mitigate the much lower anticipated interference from WSD devices: the WSD power levels are significantly lower than the levels of an adjacent base station in the reference scenario. In addition, it is our opinion that the assumption that the mobile that is <10 meters away from a WSD using channel 60, and also operating in the Block A1 band is a low probability event.

[4] http://www.ukfree.tv/txdetail.php?a=SX857619

QuestionT18: Do you have any comments on our proposal that, if the unwanted emissions limit (over 230-470 MHz) in the draft ETSI standard (EN 301 598) is tightened by 8 dB, there should be no further restrictions on the operation of WSDs in relation to services below the UHF TV band?

DSA has no comment on this question.

Question T19: Do you have any comments on our proposal that, if the unwanted emissions limit (over 230-470 MHz) in the ETSI standard (EN 301 598) is not changed, there should be restrictions on the in-block powers of WSDs in channels 21 to 24.?

DSA has no comment on this question.