

techUK response to the Ofcom consultation on TV white spaces: approach to coexistence

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Introduction

About techUK

techUK represents the companies and technologies that are defining today the world that we will live in tomorrow. In a very real sense techUK represents the future.

At the heart of tech in the UK is an ecosystem of 270,000 companies producing digital technologies, products and services. From east to west, north and south, from enterprise class organisations to established medium-sized businesses, growing small businesses and an exciting generation of tech start-ups: the UK is a hotbed of tech talent and techUK exists to represent the sector in its entirety.

Our role as techUK is to ensure that we seize the potential for good and address the disruptive new challenges that change and innovation always present. We work to understand the opportunities that technology provides; to support the companies and innovators that can realise those opportunities.

This underpins our simple vision to ensure that tech is good for the UK, the UK is good for tech and that tech is good for people.

Preamble

techUK welcomes Ofcom's proposals for enabling licence exempt access to the TV white spaces and encourages it to progress them as quickly as possible, whilst ensuring that the sharing framework provides sufficient protection for the existing licensed services.

techUK believes that locally and temporarily unused spectrum in the terrestrial TV broadcast bands offers economic and social potential by helping to meet the growth in demand for wireless connectivity bandwidth. Sub-1 GHz spectrum is particularly valued by some White Space users for the cost-effective coverage that it can facilitate although coverage is limited by power and, as this is interleaved spectrum the powers will be constrained. This should translate into fewer 'not-spots' and better value for consumers.

techUK notes the increasingly important role that licence-exempt Wi-Fi plays in enabling mobile device access to the Internet, relieving the data burden that would otherwise congest wide area mobile networks. The licence exempt Wi-Fi model has enabled connectivity and fuelled data service demand far beyond what might have been possible if mobile operator networks had had to carry the mobile device data burden alone. Reports by economist Richard Thanki¹ and Tom Hazlett² illustrate the value that licence exempt and licensed spectrum access, respectively, has brought. At the same time, the concept of TWVS is a subset of cognitive radio as Ofcom defined in their Digital Dividend Review: "*Cognitive radio is a new technology that can detect spectrum that is otherwise unused and transmit without causing harmful interference*".³

techUK recognizes the need to take measures to guarantee protection of

¹ Richard Thanki – The Economic Significance of Licence-Exempt Spectrum to the Future of the Internet, June 2012

² Tom Hazlett – The Spectrum-allocation debate: An analysis. IEEE Internet Computing, September/October 2006.

³ Ofcom, "Digital dividend review: A statement on our approach to awarding the digital dividend", 13 December 2007, <http://stakeholders.ofcom.org.uk/consultations/dar/statement>

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DTT reception and PMSE. We believe that the success of TVWS is dependent on ensuring that no PMSE or DTT user is frustrated by interference issues which could result in a negative opinion towards a dynamic spectrum approach. Also it should be considered that DTT users being subjected to several processes associated with the introduction of mobile services in 800 MHz, and potentially in the future in 700 MHz, may limit their tolerance to further complications and issues with their existing DTT reception.

techUK recognises also that the TVWS usage, unlike usage in other licence exempt bands is subject to a number of constraints given the DTT, Local TV and PMSE applications and the challenging interference management conditions.

Given the planned discussions at WRC 2015 relating to the co-primary allocation of mobile services in the 700 MHz band and the associated UK developments, techUK believes that Ofcom should ensure that adjacencies and coexistence issues are properly considered at the outset with a view to providing industry with a clear roadmap and certainty on the future use of the band, as early as possible.

Specific points

techUK agree that the geolocation database approach enables regulators a dynamic process to respond to experience and to adapt to changes in consumer needs, market conditions and local frequency availability. The database content can be rapidly altered to deal with unforeseen problems – for example in specific locations.

Some techUK members believe that Ofcom should take advantage of the geolocation database to be more flexible in framing the allowance for the new TVWS services and applications than would have been appropriate had such sharing conditions needed to be pre-fixed, before experience had been gained.

However, other techUK members believe that Ofcom's precautionary approach is essential for the introduction of services on an unlicensed basis into interleaved spectrum in order to avoid the risk of harmful interference to the incumbent licensed user DTT and PMSE. TV viewers and industry have invested heavily in the DTT platform over the last 10 years and expect the same quality of service to be maintained. Ofcom is breaking new ground with its proposals for TVWS service deployment and some techUK members request that adequate trials are carried out for a number of reasons which are elaborated in Question 1. It should be noted that one of the key lessons from the 4G rollout is that it was very difficult to accurately estimate the effect of amplifier overload which has so far proven to be a significant cause of real 4G interference problems, but this is not addressed by the consultation.

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.

techUK has identified the following issues which should be taken into account in enabling TVWS systems.

Protection level of DTT:

Given the uncertainties at this stage associated with the impact of WSD interference, we support the cautious approach adopted so far of minimizing the potential for harmful interference. If the models prove to be unduly conservative after a certain period of operation, they can be evaluated to allow more WSD usage whilst preserving DTT from interference. Some members

believe that Ofcom should also explore the scope for using a guard channel either side of the DTT channel being used in a given location.

Impact of 700 MHz release:

Ofcom should actively take into account parallel international and national developments relating to the future use of the 700 MHz band and ensure that its enablement of TVWS systems do not conflict with its policy development for the potential use of the band by mobile services.

Security of WSDB:

Ofcom should ensure that the WSDB accesses are properly secured so that no "cyber attacks" could lead to malfunction. In particular, the interface between WSDs and Ofcom's list of qualifying WSDBs is directly under Ofcom's responsibility, and it is particularly vulnerable to attack because it must use an open protocol.

Different types of WSD:

Although we recognize that multiplying the TVWS device variants increases the database burden to manage the different data, we think that it may be necessary to further categorise the TVWS radio technologies in a more detailed way in order to represent the wide range of device characteristics on the WSD market including their evolution. Ofcom is also requested to clarify how the height is measured accurately on a type B device that is not fixed, particularly in an indoor situation where the propagation is less predictable.

Immediate reaction to Interference:

Ofcom should work with the Consumer Electronics industry, so that all parties are informed about the trial deployments and able to properly address any resultant consumer calls. Given the wide range of its membership covering DTT, PMSE, mobile and TVWS proponents, techUK is well placed to work with Ofcom on refinements to the interference management framework if the number of calls received by technical support teams becomes unduly significant. During the trial it is important to maximize the openness to feedback from DTT users in order to address all the interference cases. As the trials will be in pre-determined places, we believe that a proactive communication (similar to that performed by at800) programme would be judicious.

Interference and DTT Installations:

Not all DTT wiring installations in households will be shielded according to the latest standards. As the earlier digital switch over was largely based on reusing existing installations, this aspect needs to be taken into account when assessing the TVWS device maximum power. Ofcom should conduct an assessment about cable (including substandard cabling) and socket shielding in typical British households to validate reduction of the C/(N+I) margin currently enjoyed by DTT consumers in areas close to the DTT transmitters and with stronger DTT signals, such as the use of wideband masthead preamps.

Viewers using alternative transmitters:

Given the difference of coverage between commercial multiplexes and public services multiplexes, viewers may (deliberately or inadvertently) choose to align their aerial to an alternative transmitter in order to receive the 6 multiplexes. or to choose another local TV service. These scenarios should be taken into account when determining the availability of suitable channels for WSD.

Interference tolerance to signals:

Ofcom's approach considers that more WSD interference can be tolerated by DTT receivers with a higher level of wanted signal than at the coverage area edge. This is generally true with a constant level of interference. However, Ofcom should take account of the fact that some places cannot tolerate additional interference level, as the margin may already be absorbed by other interferers (eg. DTT, LTE800).

Interference criterion:

The approach of Ofcom involves the use of a number of approximations and assumptions that make it challenging to assess the final impact on reception quality for the viewer. We would encourage evaluation of the potential interference to DTT services to be based on resulting changes in coverage probability rather than interference probability. Only the former value will be indicative of the resulting quality of reception taking into account all factors (DTT wanted signals, LTE800 and WSD interference). Additionally, the overall coverage probability assessment while leading to a certain degradation in quality of reception, would ensure a harmonized interference scenario amongst all viewers and would also take into account the increased tolerance where a margin of reception is present. The (interference-based) approach proposed ensuring 10 % probability of interference with 7 % coverage probability loss would mean that a minority of viewers will see a stronger impact from interference and may be considered "not served". This may vary with time, but it may be critical due to the non graceful degradation of DTT signals and the fact that aerials have to receive 6 multiplexes with different coverages at one discrete location.

Aggregation of interference signals:

Ofcom will not consider aggregation of WSD signals amongst others because of the usage of mechanisms such as "listen before talk" (LBT) to avoid mutual interference. This may not always be the case:

- for latency critical applications.
- for access points which will transmit most of the time due to a number of connected clients

The overall reception quality results from the aggregation of various unwanted and wanted signals. Thus we consider that the aggregation of all interferers over the band (including WSDs interferers), taking account of the appropriate frequency separations of interferers, should be used in calculating the maximum transmit power of WSDs.

Protection ratio:

We consider that since WSD are intended to operate on a non interference basis, a higher percentile of receivers should be used instead of 70 %. This would ensure that almost all DTT households are protected sufficiently. Concerning the choice of representative signals for protection ratios, we consider that it is Ofcom's role and responsibility to ensure the choice adequately represents the expected usage of WSD. If necessary, the measurements should be revised with more representative radio access technologies, taking into account the range of protection ratios between different radio technologies. As we envisage a large application of WIFI technologies, the use of WIFI signals should be taken into consideration in order to ensure that the permitted WSD transmit power is appropriate.

International aspect:

techUK further notes that the line being taken by Ofcom in the international meetings studying the criteria for protection of DTT (ECCPT1, CPG PTD, WP5D and JTG 4-5-6-7) is incompatible with the proposals in this consultation. Ofcom will need to ensure that its positions in these meetings are aligned with its decisions for TVWS.

In advance of the completion of the planned trials, a number of techUK members believe that Ofcom's proposed cautious approach of enabling TVWS applications while placing limitations on its use to protect licensed usage such as DTT and PMSE is appropriate. TVWS should be accommodated without leading to undue constraints for incumbents, nor cause interference leading to new immunity requirements for DTT receivers.

It is difficult at this stage to evaluate what the constraints on WSD will mean for the viability of different applications.

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.

techUK believes that Ofcom's proposed overall framework should ensure a low probability of harmful interference to PMSE services. Some members are of the view that the received wanted signal power, $PS,0$, for wireless microphones should be $-95\text{dBm}/(200\text{ kHz})$ and not $-65\text{dBm}/(200\text{ kHz})$. However, other members point out that PMSE protection requirements are very localised such as around venues. In the future, they feel that there is scope to consider a higher received power at the PMSE receivers, given industry practice and other mitigating technical factors – such as PMSE receiver antenna diversity and directionality, as well as proximity to DTT channel edge. Given the flexibility offered by the database approach, and the rapid response required in the event of database changes, Ofcom has scope to relax the safe harbour constraints – e.g. in remote rural areas, where there would be a lower risk of interference to PMSE.

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.

Some members of techUK believe that the approach to use channel 60 as a guard band, for the protection of LTE services from WSDs, is appropriate.

Other techUK members question the need to reserve the channel as a guard band, but agree that 4G services should be properly protected. They believe that valuable spectrum capacity could be gained and the intended objective achieved by restricting WSD emission power, as is proposed in channels adjacent to DTT channels. However, further study would be needed on an appropriate power limit.

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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.

techUK broadly agrees with Ofcom's assessment, though cautions that licensed services both in-band and in adjacent bands should be afforded adequate protection from WSDs. We encourage Ofcom to urgently carry out coexistence studies to assess impact of interference below UHF so that the necessary protection criteria can be incorporated.

Question T1: Do you have any comments on our proposal to cap the maximum in-block EIRP of all WSDs at 36 dBm/(8 MHz)?

A number of techUK members see no reason to cap WSD powers, given Ofcom's chosen geolocation database approach. In their view, the main advantage of this approach is that much of the control of WSDs can be handled through the database, and varied as appropriate, rather than being fixed in regulations. Manufacturers may confine their devices to FCC limits, for cost reasons, but, for example, specialist rural broadband equipment suppliers might usefully offer higher power in remote areas, where this would not pose any greater risk to licensed users. However, it is worth noting that these powers could probably not be used in any 'pixel' (area of 100m square) containing a household that might receive DTT. As a result, the benefit from allowing higher WSD powers is likely to be limited. It is also worth noting that the UK channel width is greater than used in the US, and so appropriate adjustments should be made in translating the spectral power density from FCC defined limits.

Some techUK members encourage Ofcom to adopt a precautionary approach for the introduction of White Space services and hence endorse the use of power caps to protect incumbent licensed services as a general policy. In order to determine the appropriate level for that cap Ofcom should do further work and carry out trials. In exceptional cases, with a license in isolated low populated areas, higher power licenses can be delivered if the technical assessment shows no impact on the surrounding DTT households.

techUK requests that Ofcom clarifies the procedure for dealing with interference which might arise to households subsequently - for example, if a household currently receiving TV by Pay/satellite (and therefore unaffected by WSD interference) changes hands, and the new owner chooses to use DTT and is then affected by WSD interference. Clarification is also sought on Ofcom's proposed TV overload limit of 0 dBm, given that, as shown in Figure A4.124, many TV sets may overload at levels below this. This limit also does not take account of amplifiers, which will reduce the effective overload level of the TV set.

Question T2: 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?

The proposed approach has been calculated on the basis of the DVB-T mode being DTG option 3 = 64QAM 2/3 used by PSB Muxes. Given that other DTT modes, such as option 8=64QAM 3/4 used by the commercial Muxes, option 7= QPSK used for local TV, and the DVB-T2 option 6= 256QAM 2/3 – all have different protection ratios and C/N

⁴Ofcom, "TV white spaces: approach to coexistence. Technical analysis"

<http://stakeholders.ofcom.org.uk/binaries/consultations/white-space-coexistence/annexes/technical-report.pdf> 4 September 2013

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requirements, techUK seeks clarification from Ofcom as to whether the check will include all the applicable DTT modes in the receive area. techUK | #techUK

techUK would also be interested to hear whether any tests have been carried out involving DTT receiver protection ratios for option 7. The operating point of this mode is so different to the current option 3 that linear interpolation of 64QAM 2/3 protection ratios may not be sufficiently accurate.

Some techUK members are concerned that allowing an increased level of interference in stronger DTT signal areas may cause interference to consumers with sub standard amplifier/cabling setups which are currently working perfectly well due to the strong DTT signal and low interference levels, but will be problematic in the presence of strong WSD interference eroding the large $C/(I+N)$ margin. Typically DTT consumers at the edge of coverage will have been forced to invest in better quality antennas and cabling/amplifier setups in order to receive a reliable signal, but this might not be true in areas closer to the DTT transmitter. Thus techUK believes that targeted trials are necessary to verify the extent of this problem.

Question T3: 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?

Some techUK members think this is a practical approach. As experience is gained with the technology deployed in the field, Ofcom can make appropriate adjustment to the assumptions used as a basis for the calculations.

However other techUK members are concerned that the proposed approach, chosen with its assumptions, may result in challenges to interpret and predict the DTT reception quality. Additionally, there is a concern that this approach would lead to higher WSD powers than agreed within the Technical Working Group and result in a heightened risk of interference. To alleviate this concern, Ofcom could make a study of the number of antennas that are not pointing to the preferred transmitter to understand the extent of the problem and decide if this should be addressed via the database.

Question T4: 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?

Some techUK members believe that this is a practical approach to providing protection to reception of DTT services.

However others, as explained in Questions 1 and T3, believe that the various assumptions and approximations make it difficult to assess the overall resulting reception quality and request the following points and scenarios to be addressed in Ofcom's chosen approach. Given that a 1 dB desensitisation results in 7 % loss in coverage probability, following figure 4.7⁵, they consider that 10 % of households being impacted is critical, as it may result in no reception for some of them. They prefer a criteria which directly places a cap on the loss of coverage probability by a given percentage point anywhere in the coverage area. The splitting of the 10 % to two 30 % likelihoods for protection ratios (performance of receivers) and coupling gains does not consider cases where the combination of the two factors results in interference. The combinations of the two conditions met "(receiver below performance criterion) AND (coupling Gain above the reference level)" is only a subset of possible interference scenarios. In reality there will be cases where one or the other condition is met but the

⁵ Ofcom, "TV white spaces: approach to coexistence. Technical analysis"
<http://stakeholders.ofcom.org.uk/binaries/consultations/white-space-coexistence/annexes/technical-report.pdf> 4
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combination results into interference. Overall the percentage of households with coverage probability loss of 7 % will be much higher than 10 %. The given underestimate of impacted households is another reason considering the resulting coverage probability loss as end result as a criterion.

As discussed in Question 1 and Question T3, some members believe that the various assumptions of the proposed approach make it difficult to assess the overall resulting reception quality. Thus they are concerned that this approach may not afford adequate protection to incumbent licensed services, in particular those households that depend on set top aerial reception for both primary and secondary sets. The proposed approach could result in far higher White Space powers than had previously been developed within the TWG and lead to increased interference to incumbent licensed services. They encourage further work in the pilots to help evaluate the protection this provides. For example, it would be useful for the WSDB to gather statistics of the number of master and slave WSDs in use in a particular area over time, so that the effects of aggregated interference can be taken into account.

Question T5: 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?

Some members (as explained in Questions 1 and T3) are concerned that the approach chosen with a variety of assumptions may result in challenges to interpret and to predict the DTT reception quality which is the overall objective. Though, as experience is gained with the technology deployed in the field, Ofcom can make appropriate adjustment to the assumptions used as a basis for the calculations. In particular, techUK is concerned that Ofcom's approach is not representative of household separation in urban, sub-urban and rural environments – for example, whether the 5m minimum distance should only apply to urban situations. Some modern housing estates in suburban areas which have “mirror image” neighbouring houses with chimneys adjacent to each other which could be 5m apart. We are not sure of the definition of urban and suburban in this context to be able to comment further.

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?

By analysing the N+3 and N+9 protection ratio characteristics of the measured receivers in Annex 4, we estimate there are approximately 33 can tuner and 17 silicon tuners dating back to 2007 measured in this report. The can tuners represent older receiver designs and approximately 2/3 of the total by sales volume is more likely to be replaced than the more recent silicon tuner designs. Therefore the performance of the latter (which also provide an indication of future receiver performance) will become increasingly important over time. For some combinations of interference frequency offset and wanted signal level, the protection ratios of these two tuner categories are different by several dB – in some cases better performance on silicon tuners, and in some cases, the opposite.

Given these differences, techUK propose the WSD protection ratios used to protect the legacy population should not be based on the performance of all the tuner types collected together, but should consider the lower performing tuner type (can or silicon) in each case of wanted signal level, WSD class and frequency offset.

Ofcom's decision to use a Weightless pre-configured test sequence is not felt to be representative of real world characteristics of this technology in operation. As pointed

out in question 1, techUK believe that the 70 % percentile is restrictive for existing DTT market and we propose the 90 % percentile to guarantee a better DTT protection. The value of 90 % was also used in CEPT for establishing protection ratios. As experience is gained with the technology deployed in field-tests, Ofcom can make appropriate adjustment to the assumptions used as a basis for the calculations.

Regarding assumption of ACLR improvements vs frequency, A4.33 and table A4.5⁶ assume that the WSD ACLR improves by 10dB/8MHz. However this behaviour is not reflected in the ETSI EN 301 598 standard to which WSD will be designed and tested and so WSD manufacturers could use different design technique (such as envelope tracking) that might not conform to Ofcom's assumption of 10dB/8MHz roll-off, whilst still meeting the less demanding ETSI specification mask. techUK recommends that Ofcom's planning assumptions should follow the ETSI mask.

Question T7: Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of WSDs in relation to DTT calculations?

techUK believe that Ofcom's approach is appropriate, though with the caveat (as noted in response to Questions T3 and T5) that the variety of assumptions in the chosen approach is likely to result in challenges to interpret and predict the DTT reception quality. For example, the measurement of height on a type B device that is not fixed, particularly in an indoor situation where the propagation is less predictable and not possible to be specified by the installer could be problematic. As experience is gained in the field, Ofcom can make appropriate adjustment to the assumptions used as a basis for the calculations.

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?

techUK believes that this is a cautious, but practical approach. As experience is gained in the field, Ofcom can make appropriate adjustment to the assumptions used as a basis for the calculations.

Question T9: Do you have any comments on the PMSE wanted signal power levels that we propose in relation to coexistence calculations?

For coexistence calculations techUK believes that the PMSE wanted signal power level should be -95dBm/(200kHz).

Question T10: Do you have any comments on our proposed approach for calculating coupling gains in relation to PMSE calculations

techUK notes that the report assumes a PMSE antenna height of 5m which is reasonable for BC studio and theatre use. However, it should be taken into account that for ENG use, the PMSE receiver's antenna height is 1m - 1.5m.

Question T11: Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of WSDs in relation to PMSE calculations?

No

⁶ Ofcom, "TV white spaces: approach to coexistence. Technical analysis"
<http://stakeholders.ofcom.org.uk/binaries/consultations/white-space-coexistence/annexes/technical-report.pdf> 4 September 2013

Question T12: 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?

No

Question T13: 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?

No

Question T14: Do you have any comments on our proposed protection ratios in relation to PMSE calculations?

The proposed protection ratio is based on the PMSE wanted signal power levels is -65dBm/200KHz. techUK believes this should be changed to -95dBm/(200kHz).

Question T15: 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?

We agree with this approach, which avoids undue wastage of valuable spectrum capacity.

Question T16: Do you have any comments on our proposed WSD emission limits in relation to PMSE use in channel 38?

We support the provision of adequate protection arrangements for the incumbent licensed services and see merit in extending the proposed arrangement described for PMSE in channel 38 to DTT services and allow for ENG/mobile PMSE use with a receiving RF level of under -95dBm/(200kHz). However in exceptional circumstances, such as in rural areas where there is a lower risk of interference, it may be feasible to moderate nationwide restrictions in channels adjacent to 38.

Question T17: Do you have any comments on our proposal not to permit WSDs to operate in channel 60?

Some techUK members support the use of channel 60 as a guard band to protect LTE services in the 800 MHz band and see merit in extending this approach to the protection of DTT services below the 800 MHz band.

Alternatively, some techUK members believe that that Ofcom should apply power variation to match the risk of interference rather than precluding use of channel 60. This proposal would allow lower power applications to enjoy the benefits of additional capacity, in areas where this would not cause harmful interference to the licensed services in the 800 MHz band. However, further study would be needed to determine an appropriate power limit.

Question T18: 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?

On the understanding that licensed services both in-band and in adjacent bands should be afforded adequate protection from WSDs, techUK support a precautionary approach when introducing unlicensed services such as TVWS and where appropriate seek to develop its understanding of interference issues through trials prior to causing any disruption to commercial services. Out with this understanding, techUK agree that

there should be no further restrictions on the operation of WSDs in relation to protection of services below 470 MHz. techuk.org | [@techUK](https://twitter.com/techUK) | [#techUK](https://www.facebook.com/techUK)

Question T19: Do you have any comments on our proposal that, if unwanted emissions limit (over 230-470 MHz) in the draft ETSI standard (EN 301 598) is not changed, there should be restrictions on the in-block powers of WSDs in channels 21 to 23?

No, we do not believe that any additional restrictions should be imposed for WSDs operating in these channels. As with any other white space channels (noted in Question T18), we expect that the power reported by the database will take into account only the constraints needed to prevent harmful interference to adjacent licensed services whether DTT, PMSE or other (in the case of the bands below 470 MHz). Where appropriate, techUK encouraged Ofcom to develop its understanding of interference issues through trials prior to causing any disruption to commercial services.

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