Your response

Question	Your response
Section 3 –Spectrum use by the PMSE sector in the UK **Question 1**: What are your views on how our processes work - for example our online booking system, turnaround times, and event coordination. Do you think the current approach works well? How could we improve it?	Confidential? – N Things generally work well if the online system allows the request. There are some odd things such as the requirement to have a shell license before making adhoc bookings, which seems like an unnecessary level of manual paperwork (especially for somebody who already has a shared license). The website could do with modernizing and improving (especially things like searching for a venue and pinpointing positions on maps). Phone calls to the support line to fix a problem are usually dealt with quickly and efficiently, but responses for other things can occasionally be slow over email. The one case where I've been involved in a more detailed issue (a conflict between two local venues), I found it easy to work with the Ofcom personnel who came to investigate.
Section 4 – PMSE historic trends **Question 2**: Do you have any comments on how we have analysed and characterised wireless microphone and IEM demand, or suggestions for alternative ways of characterising this demand?	Confidential? – N The analysis looks relatively good for the larger events. The assumption about fitting only 10x wireless microphones into a TV band is a little on the low side – if you try hard, you can generally get to 12 in most cases without issue.
Question 3: Do you have any comments on how we have analysed and characterised wireless video demand, or suggestions for alternative ways of characterising wireless video demand?	Confidential? – Y / N

Question	Your response
## Section 5 – Future trends and opportunities ## Wireless audio ### Drivers of demand **Question 4:** What factors have driven changes in the demand for audio PMSE applications, specifically for: a) the increased use of coordinated wireless microphones and IEMs, particularly the peak number of simultaneous assignments used at the largest events? b) the slight decline in the number of national wireless microphone licences (UHF channel 38 and VHF)? Has the extent of use of these licences changed, and if so why? c) the declines in talkback, fixed audio links and ADS licences?	Confidential? – N (a): I think an area that hasn't been considered a lot in the analysis is some of the smaller (e.g. amateur/semi pro) events, where demand for wireless appears to be constantly increasing, especially in the theatre, where the lower cost of good quality analogue radio microphones (e.g. Sennheiser's Evolution range) means that we are often running 40-50 channels to meet the needs of a production. Many productions are at a quality where everybody in a cast is radio mic'd, much like a professional production would, because good sound is seen as a distinguishing factor. As productions get more complex, and directors have less tolerance to microphone failures, we've also seen increases in the number of cast members wearing two microphones for failure tolerance (even in amateur/community productions). This will only increase, driven by a low tolerance by audience members for any technical issues during a production. (b): I found the data about the drop in the number of shared licenses interesting. I've noticed that many venues that used to have a shared license now no longer do, relying on the incoming productions to supply their own license instead. It's possible that this accounts for some of the drop. (c): No response.
Question 5: What factors could drive further changes in the demand for audio PMSE applications in the future, and what will this mean for future demand, specifically for: a) coordinated wireless microphones and IEMs, particularly the peak number of simultaneous assignments used at the largest events?	Confidential? – N (a): No response. (b): I've mentioned the historical increases in demand for radio mics in the theatre in the answer to Question 4, which I think will only continue to increase as productions get increasingly ambitious. (c): No response.

Question	Your response
b) national wireless microphone licences (UHF channel 38 and VHF)? c) talkback, fixed audio links and ADS licences?	
Question 6: Do you agree that, given the trends, we are right to focus on wireless microphones/IEMs?	Confidential? – N I agree.
Changes in the take-up of bands already available **Question 7:** What factors have driven the take-up of different bands for wireless audio? What are the barriers to greater use of the DME band?	Confidential? – N As was noted in the analysis, there are a couple of main problems here: 1. Availability of equipment that can tune to the required bands. It's worth noting here that the relatively narrow tuning band of most equipment means that hire companies would have to stock enough different ranges of the same equipment to be able to take advantage of the less well used bands, which for many is just cost prohibitive, so stocks tend to be focused on the more commonly used CH38/65/66/70 ranges. 2. Using multiple discrete bands on a single production may necessitate separate sets of antennas/antenna distribution, further increasing cost and complexity. This tends to mean companies stock a smaller set of more compatible ranges to keep things manageable – e.g. usually a single set of antennas/ADU can handle the full CH38-70 range. 3. Better performance/range of the lower frequency ranges (e.g. CH38-42). There's often a meaningful difference in range between devices using CH38-42 and devices using CH65-70. Going significantly higher than this (especially into the 1800+MHz ranges) makes a huge difference to their performance on a congested stage full of people, set and stage cloths.
Question 8: What actions could enable greater take-up of the DME, DECT and licence exempt bands in the future?	Confidential? – N I think that there are likely many cases where the higher frequency bands could work well, such as conferencing/corporate work and smaller stages, or cases where

Question	Your response
	transmitters and receivers are close together – for example instrumentalists using wireless to get from their instrument to an on-stage receiver (or vice-versa for IEM usage). But without availability of equipment for people to hire/test, encouraging people to take these up could be challenging. I'll note that Sennheiser has for a while had a 1.8GHz EW100 Evolution system available, but I've never seen one installed anywhere.
Changes in spectrum availability **Question 9:** Which potential additional bands might be suitable for wireless audio applications, particularly microphones and IEMs at the largest events and venues?	Confidential? – N As has been mentioned, the best frequencies for audio usage on busy stages are those that are most forgiving of obstacles and distance, e.g. the lower frequencies of the current UK shared license ranges of CH38 (and surrounding spectrum) and to a slightly lesser extent the CH65-70 ranges. Keeping more spectrum close together (coupled with equipment that has a wider tuning range if/where possible) would keep the need to maintain multiple sets of equipment across these ranges to a minimum. Equipment using spectrum with a lower effective range would increase the need for more complex antenna distribution, for which cost-effective equipment doesn't exist, and which is beyond the needs and technical know-how of smaller productions.
Question 10: To what extent do the characteristics of different audio applications drive their requirements for spectrum – for example particular requirements for latency, resilience or capacity?	Confidential? – N The convenience of using wireless mics and IEMs for any application - and the lower price points at which these can be obtained in recent years (especially analogue ones) are also a factor now, where historically these might have been out of reach for many smaller events. Additionally, a higher perceived/real risk of issues (e.g. range, signal levels, more likely to fail than equivalent wired devices) is driving the desire for backup microphones, meaning that in many cases, a single wired microphone/wired monitor speaker are replaced with up to 2 wireless microphones and a set of wireless IEMs, further driving increases in spectrum usage.

Question	Your response
Changes in efficiency of spectrum use **Question 11:** What changes in spectrum use (technology, working practices, different bands, etc) have enabled audio wireless growth to be accommodated to date, particularly the increased use of wireless microphones and IEMs at the largest events and venues in the context of reduced UHF spectrum availability?	Confidential? – N The availability and use of software like Wireless Workbench, and a better understanding of intermodulation and coordination by RF/Audio engineers has meant that more microphones have been able to be safely packed into the available spectrum, achieving better results than the manufacturer's fixed / recommended frequencies.
Question 12: What technologies are currently available or are being developed which can improve audio spectrum efficiency in the future, particularly in the use of wireless microphones and IEMs at the largest events and venues?	Confidential? – N The biggest enabler here are some of the recently released digital wireless systems, such as the Sennheiser EW-DX system, allowing more (intermod free) channels to be packed into the spectrum.
Question 13: Are there any barriers to adopting more efficient technologies for audio applications, particularly for wireless microphones and IEMs at the largest events and venues? What could industry do and what could Ofcom do to facilitate greater use of those technologies?	Confidential? – N Cost of adopting digital is the largest issue here for all but the largest events/venues that are less sensitive to this.
Question 14: What changes to working practices and spectrum planning could improve audio spectrum efficiency in the future, particularly in the use of wireless microphones and IEMs at the largest events and venues?	Confidential? – N Encouraging the use of software like Wireless Workbench instead of the auto-scan features of the products or using the manufacturer's recommended plot, and encouraging manufacturers to publish better information about recommended spacing and bandwidth requirements for their equipment – i.e. not just the "perfect" setup, but also publishing some "minimum" specs for people prepared to take more risks in squeezing more devices into the spectrum they have.
Question 15: Are there any barriers to adopting working practices that could enable more efficient use of spectrum by audio applications, particularly for	Confidential? – N

Question	Your response
wireless microphones and IEMs at the largest events and venues? What could industry do and what could Ofcom do to facilitate those efficiencies?	Training and available documentation. Nearly everyone I know who does this has been self-taught and/or learned on the job.
## Wireless video ### Drivers of demand **Question 16:** What factors (such as more complex events and use of higher resolution equipment) have driven the demand for wireless video bandwidth, in particular for: a) the increased bandwidth required for the largest sporting events such as Formula 1 at Silverstone and The Open Championship? b) the bandwidth required for nationally important state events such as The Coronation? c) the slow growth or decline in bandwidth used at horse racing fixtures?	Confidential? – Y / N
Question 17: What factors could drive further changes in the demand for wireless video bandwidth in the future, and what will this mean for future demand, in particular for: a) the bandwidth required for the largest sporting events like Formula 1 at Silverstone and The Open Championship? b) the bandwidth required for nationally important state events such as The Coronation?	Confidential? – Y / N

Question	Your response
c) the bandwidth used at horse racing fixtures and other major sporting events?	
Potential new bands **Question 18:** What factors have influenced the degree of take-up of existing bands used by wireless video applications, particularly the growth in take-up of the 7 GHz band?	Confidential? – Y / N
Question 19: Which potential additional bands might be suitable for video PMSE applications, particularly at the largest events and venues?	Confidential? – Y / N
Question 20: To what extent do the characteristics of different video applications drive their requirements for spectrum – for example particular requirements for resilience or capacity?	Confidential? – Y / N
Changes in efficiency of spectrum use **Question 21:** What technologies are currently available or are being developed which can improve wireless video spectrum efficiency in the future?	Confidential? – Y / N
Question 22: Are there any barriers to adopting more efficient technologies for wireless video? What could industry do and what could Ofcom do to facilitate greater use of those technologies?	Confidential? – Y / N
Question 23: What types of video demand could realistically be supported by private (for example 5G) networks?	Confidential? – Y / N

Question	Your response
Question 24: What changes to working practices and spectrum planning could improve video spectrum efficiency in the future?	Confidential? – Y / N
Question 25: Are there any barriers to adopting working practices that could enable more efficient use of spectrum by wireless video? What could industry do and what could Ofcom do to facilitate those efficiencies?	Confidential? – Y / N

Other comments

Question 26: Do you have any other comments or views on the issues raised in this document?

Confidential? – N

(i) License costs

The drive for more radio microphones (especially in the theatre) can lead to significant licensing costs, which are hard to explain given the structure of these costs.

Using the shared license (CH38/65/66) and the unlicensed CH70 band can coordinate approximately 30 channels for a cost of £135 over two years, which is cost-effective and easy to explain.

Getting to 40-50 means booking out 1-2 further TV channels, which have a rather oddly structured set of costs:

- One-year, fixed site, single TV channel - £168
- 48h temporary cost, single TV channel - £51

This means a typical week's production on a temporary license would cost £204, yet an entire year for the same spectrum would only cost the venue £168. In cases where venues are happy to acquire the site license, this works well, but otherwise the cost of these licenses can get significant for cost-constrained productions. The differences in these costs make very little sense, as all these licenses are automated via the website, leading to few differences in cost for Ofcom and the same overall outcome.

(ii) Increasing the number of channels in the shared license

Having more channels available in the standard shared license (e.g. perhaps as many as double the current allocation) would significantly improve the cost-constrained end of the sector, which are prepared to take a risk on the shared frequency bands.

(iii) Spectrum changes and impact on equipment stocks, costs and WEEE

Ofcom should bear in mind the logistics and costs for companies and organisations in migrating frequency bands.

Organisations operating in the PMSE sector have invested heavily in equipment, especially in the UK shared

Question	Your response
	license ranges. Costs per channel range from £500-1000+, which is a significant investment for many smaller companies, theatres, houses of worship, schools and other similar organisations. Simply replacing the equipment is just not possible in some cases due to lack of budget, especially in schools. Additionally, the last time this happened (loss of CH69) necessitated devices needing to be returned to manufacturers for retuning and/or replaced – this was manageable in most cases because the equipment in question was still in production. The situation now is more complex, because many companies (e.g. Sennheiser) are in the process of moving away from analogue over to digital. A change that happens in the next 5-10 years may mean that a similar retuning is not possible, due to manufacturers no longer producing any of the analogue versions. In the case of Sennheiser (and other manufacturers), there is an enormous price and feature difference meaning that the lower ends of these ranges are not equivalent, with the low-end digital product being inferior in quality and capabilities than the low-end analogue product it replaced (e.g. the EW100 analogue to the EW-D digital). All of this means that the more cost-sensitive end of the market would be left with a perfectly usable set of equipment that they can't use due to spectrum changes, can't retune, with manufacturer trade-in deals for "equivalent" equipment that just isn't suitable. This equipment would then just be waste, which seems hard to imagine in these waste-conscious times (especially for electronic items).

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