

Question	Your response
<p>Section 3 –Spectrum use by the PMSE sector in the UK</p> <p><b>Question 1:</b> What are your views on how our processes work - for example our online booking system, turn-around times, and event coordination. Do you think the current approach works well? How could we improve it?</p>	<p>Confidential? – N</p> <p>I feel the current licensing structure and coordination approach is well understood for frequent users of the portal when booking out frequencies for events. Compared to other platforms the Ofcom portal seems to be very reliably.</p> <p>However, for a first-time user or someone who lacks the knowledge in how RF is licensable by Ofcom it can be considered a bit of a maze on what license is best for them be it a 48-hour license, a fixed site license or a shared PMSE license. I have had to deal with this 1<sup>st</sup> hand with a client unsure whether to submit a fixed-site license or a shared PMSE license and how to apply. As well as take time teaching people how to book licenses themselves for jobs.</p> <p>With there being a lack of education tools and guidance offered by Ofcom there can be a reluctance to submit applications and therefore transmit illegally. For me personally during my time as a student at university studying technical theatre, finding out that Wireless mic systems required licensing was a unknown to me, up until when I self-taught myself RF for a show where I watched a seminar held by the Association for Sound Design and Production (ASDP) spoken by Tuomo Tolonen.</p> <p>This could result in OFCOM’s data in usage of spectrum to be inaccurate in what is being used. There is also the loss of revenue for the licenses being purchased. This all subsequently reduces the effect of licensing the spectrum.</p> <p>Providing a way to fill the current knowledge gap in surrounding PSME users within the industry would be beneficial for OFCOM by generating education and guidance around licensing, and how to navigate the portal for first-time users.</p> <p>Ways this could be done is by teaching at academic Levels such as the main conservatoires in the UK as well as other Performing arts facilities that provide technical education, or to the many groups in the UK like IPS, ADSP giving seminars and engaging with PMSE users.</p>

Question	Your response
<p>Section 4 – PMSE historic trends</p> <p><b>Question 2:</b> 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?</p>	<p>Confidential? –N</p> <p>Demand for wireless mics and IEM can differ for many scenarios some may be restricted by what they can use whereas the time I have spent at Terry Tew Sound and Light we are able to be flexible with spectrum with having a back up frequencies and systems or for any last-minute changes. However, when in university this was not the case, I was using kit that the industry would consider being outdated and inefficient. For the production that I was operating on I was required to hire more RF this subsequently meant using a different brand to the one owned by the university meaning I was going to have to space my kit out in the spectrum I had licensed. This goes for the rest of education in audio; RF equipment is highly expensive and considered low priority when it comes to budgets. So even if new digital ways of using RF or the rise in products implementing WMAS there is still a large usage of analogue RF being used and requiring the given spectrum we have.</p>
<p><b>Question 3:</b> 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?</p>	<p>Confidential? –N/A</p>

Question	Your response
<p>Section 5 – Future trends and opportunities</p> <p>Wireless audio</p> <p>Drivers of demand</p> <p><b>Question 4:</b> What factors have driven changes in the demand for audio PMSE applications, specifically for:</p> <ul style="list-style-type: none"> <li>a) the increased use of coordinated wireless microphones and IEMs, particularly the peak number of simultaneous assignments used at the largest events?</li> <li>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?</li> <li>c) the declines in talkback, fixed audio links and ADS licences?</li> </ul>	<p>Confidential? – N</p> <p>A)</p> <p>The increase in coordinated wireless microphones and IEMs, particularly at large events can be pointed to a drive for bigger creative expectations and in essence operational necessity. Productions are getting bigger, increasing expectations and are becoming more complex in many ways. With increase in need of moveability on stage and more contributors this brings an increased expectation for individual microphones and IEM's.</p> <p>IEM's used to be solely used by a few crew and the acts themselves whereas now its used for communication and cueing.</p> <p>With ticket Prices seeing a surge in price for events this has increased the publics expectations for flawless shows as the last thing the act wants is for videos to circulate online of an audio issue. This requires for complex systems to be put in place. Audio issues are easily the first thing to be noticed and be critiqued quickly on social media. This means there is a low tolerance for failure due to the repercussion of such failures.</p> <p>B)</p> <p>With there being a shift in manufactures providing equipment that can be used outside of VHF and channel 38 like in the duplex gap or 2.4GHz this should be considered as one of the reasons. For many they will hire equipment and that will be booked with a license outside this range.</p> <p>Again there could be a lack of knowledge and guidance that prevents someone from knowing the use they could have with VHF and channel 38.</p> <p>C) N/A</p>
<p><b>Question 5:</b> 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:</p> <ul style="list-style-type: none"> <li>a) coordinated wireless microphones and IEMs, particularly</li> </ul>	<p>Confidential? – N</p> <p>A) As the industry changes so will needs for PMSE more shows are becoming complex and immersive productions with audio being critical part in the experience. This requires a need and availability of higher channel counts especially for major events or shows. These systems are</p>

Question	Your response
<p>the peak number of simultaneous assignments used at the largest events?</p> <p>b) national wireless microphone licences (UHF channel 38 and VHF)?</p> <p>c) talkback, fixed audio links and ADS licences?</p>	<p>required to operate in reliably and where there is a high demand.</p> <p>B) demand for national wireless mics will definitely remain and having access to a known reliable channel is still vital to have.</p>
<p><b>Question 6:</b> Do you agree that, given the trends, we are right to focus on wireless microphones/IEMs?</p>	<p>Confidential? –N</p> <p>I totally agree there should be a right to focus on wireless microphones/IEMs as so many of us consume media that requires the use of this equipment. The UK music industry alone provides £8billion in gross value to the UK economy. This shows a rise in use of this equipment is vital for shows to be able to happen without being restricted in their technical needs.</p>
<p><b>Changes in the take-up of bands already available</b></p> <p><b>Question 7:</b> What factors have driven the take-up of different bands for wireless audio? What are the barriers to greater use of the DME band?</p>	<p>Confidential? –N</p> <p>Joining Terry Tew Sound and Light has provided me with first hand experience over the past 3 years in using DME. With its clean noise floor, it has been a great use to us allowing us to be able to Provide RF support and coverage for shows which we would not be able to without this spectrum. However, its knowledge and understanding of its use and manufacturers providing equipment at an affordable price is preventing it from being used more. By providing an equivalent format of kit that is in the UHF range would significantly increase its use. As well as educating people what it is.</p>
<p><b>Question 8:</b> What actions could enable greater take-up of the DME, DECT and licence exempt bands in the future?</p>	<p>Confidential? – N</p> <p>An issue with DME is harmonisation for many there is no reason to purchase kit that can only be used in the UK. True harmonisation in the EU would bring about a greater demand for it to be used circumventing investment by manufactures to make kit in that range. DECT band is heavily use by comms for wireless solutions however it would not be viable for Wireless mics and IEMs as the band is heavily congested with productions using</p>

Question	Your response
	<p>systems like Riedel Bolero becoming the industry go-to solution. This also goes for any license exempt bands with many users using Bluetooth devices and Wi-Fi there would be a low chance of using this for show related equipment. For this reason, there would be no benefit for DECT to be available for kit in the 470-698</p>
<p><b>Changes in spectrum availability</b></p> <p><b>Question 9:</b> Which potential additional bands might be suitable for wireless audio applications, particularly microphones and IEMs at the largest events and venues?</p>	<p>Confidential? – N</p> <p>During my Studies I based my dissertation of the changes the PMSE sector has seen and what its future holds. Part of my research was to investigate possible bands that may be suitable for PMSE to use. Higher bands were frequently looked into and everything pinned to having clear cons, be it reduced range, requiring clearer line of sight or being too complex to implement.</p> <p>There also needs to be a process for that band to have kit available to be used in it and to have it be easily implemented into existing workflows. Something which takes time to make and for people to have trust and understanding in using especially when scaled to large events. It can be a risk many would avoid.</p>
<p><b>Question 10:</b> To what extent do the characteristics of different audio applications drive their requirements for spectrum – for example particular requirements for latency, resilience or capacity?</p>	<p>Confidential? – N</p> <p>A system will always have latency the main requirements for systems like IEM's latency is critical for the system to work for an artist. Above 10ms and you will notice a timing disruption which can make performing an even greater challenge, something we wish to avoid.</p> <p>Systems are designed with a focus that there should always be redundancy, be that a spare frequency, spare transmitter, or a receiver. If something is to fall over it needs a back up to take over. This requires careful planning to implement what can be used as backup and if last minute changes are to get made the need for more spectrum is often required to maintain a reliable event.</p>

Question	Your response
<p data-bbox="204 286 660 320">Changes in efficiency of spectrum use</p> <p data-bbox="204 342 671 689"><b>Question 11:</b> 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?</p>	<p data-bbox="699 286 916 320">Confidential? – N</p> <p data-bbox="699 342 1382 533">The DME has significantly helped us deploy RF for shows without it venues such as television centre in white city would not be possible with well over 100+channels in use and any additional spectrum needed for shows requiring time to plan.</p>
<p data-bbox="204 728 667 996"><b>Question 12:</b> 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?</p>	<p data-bbox="699 739 916 772">Confidential? – N</p> <p data-bbox="699 851 1382 1904">3 manufacturers have created solutions using WMAS with each one having its own take on using this workflow. Shure has made a wideband mode for their IEM's which can achieve 28 channels per 6MHz with latency around 2.8ms. Though this mode is available many are sticking to what they know and choose to use its narrow band mode. It also requires the use of the IP protocol Dante which for some shows their systems do not use and instead are still on analogue XLR cable. Sennheiser on the other hand have gone with a different methodology using an 8MHz block and its system works on using time slots to determine the best signal in that window avoiding any unwanted RF noise. So far the IEM side to it has been heavily used but due to a lack of a handheld transmitter, plug on and a much-requested bodypack transmitter to differentiate it from the transceiver. This has caused many to not use the system. With the system it uses what it calls link modes this allows a user to select channels Audio, latency, and range using a range of presets. Though for critical major shows you can only get 4 low latency mic modes at 1ms this takes up a percentage of this 8MHz and only gets you so far that being 4 microphones and 2 stereo mixes for IEM'S. For most shows this is just not possible requiring the user to then choose modes with less audio quality and higher latency. Hopefully as this technology is developed this workflow becomes more efficient to use on a majority of shows.</p>

Question	Your response
	<p>Wisyscom have also just made an announcement as of writing this form, announcing that their recent IEM will be able to do 3 IFB audio channels in a 200KHz frequency block. As this has just been announced we are yet to know its practicality but shows a resilience that manufacturers are making workflows to be more spectrum efficient however this doesn't mean that these modes could possibly be suitable for large scale events and will require technicians to have the confidence that these new technologies are able to perform in show critical moments.</p>
<p><b>Question 13:</b> 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?</p>	<p>Confidential? – N</p> <p>As previously mentioned WMAS can work partially for large events. The downside is for possibly only a few mobile devices (IEM's/ Microphones) requiring to take up 8MHz can be very much considered spectrally inefficient. There is also an unwillingness to use the unknown equipment and sticking to what is tried and tested. Shure's IEM system allows this with different preset's allowing the user to decide what they transmit at be it narrow-band or wideband.</p> <p>The best way to continue bettering these technologies is getting first hand experience and collaboration between users of the equipment in their work practices with this equipment.</p>
<p><b>Question 14:</b> 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?</p>	<p>Confidential? – N</p> <p>Work practices are ever evolving and continued reiterating of antenna design, system separation will be key to this happening. Though there seems to be a plateau that we have already reached the peak of what can be done to improve audio spectrum efficiency.</p>
<p><b>Question 15:</b> Are there any barriers to adopting working practices that could enable more efficient use of spectrum by audio applications, particularly for wireless microphones and IEMs at the largest events and venues? What</p>	<p>Confidential? – N</p> <p>For major events as these are heavily coordinated by professionals specialising in this area efficiency is being used to the max. With regular use of RF by PMSE outside</p>

Question	Your response
<p>could industry do and what could Ofcom do to facilitate those efficiencies?</p>	<p>of major events this is less the case not necessarily because of knowledge but due to the lack of expertise.</p>
<p><b>Wireless video</b></p> <p><b>Drivers of demand</b></p> <p><b>Question 16:</b> What factors (such as more complex events and use of higher resolution equipment) have driven the demand for wireless video bandwidth, in particular for:</p> <ul style="list-style-type: none"> <li>a) the increased bandwidth required for the largest sporting events such as Formula 1 at Silverstone and The Open Championship?</li> <li>b) the bandwidth required for nationally important state events such as The Coronation?</li> <li>c) the slow growth or decline in bandwidth used at horse racing fixtures?</li> </ul>	<p>Confidential? –N</p> <p>N/A</p>
<p><b>Question 17:</b> 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:</p> <ul style="list-style-type: none"> <li>a) the bandwidth required for the largest sporting events like Formula 1 at Silverstone and The Open Championship?</li> <li>b) the bandwidth required for nationally important state events such as The Coronation?</li> </ul>	<p>Confidential? –N</p> <p>N/A</p>

Question	Your response
c) the bandwidth used at horse racing fixtures and other major sporting events?	
<p>Potential new bands</p> <p><b>Question 18:</b> 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?</p>	<p>Confidential? –N</p> <p>N/A</p>
<p><b>Question 19:</b> Which potential additional bands might be suitable for video PMSE applications, particularly at the largest events and venues?</p>	<p>Confidential? –N</p> <p>N/A</p>
<p><b>Question 20:</b> To what extent do the characteristics of different video applications drive their requirements for spectrum – for example particular requirements for resilience or capacity?</p>	<p>Confidential? –N</p> <p>N/A</p>
<p>Changes in efficiency of spectrum use</p> <p><b>Question 21:</b> What technologies are currently available or are being developed which can improve wireless video spectrum efficiency in the future?</p>	<p>Confidential? –N</p> <p>N/A</p>
<p><b>Question 22:</b> 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?</p>	<p>Confidential? –N</p> <p>N/A</p>
<p><b>Question 23:</b> What types of video demand could realistically be supported by private (for example 5G) networks?</p>	<p>Confidential? –N</p> <p>N/A</p>

Question	Your response
<b>Question 24:</b> What changes to working practices and spectrum planning could improve video spectrum efficiency in the future?	Confidential? –N N/A
<b>Question 25:</b> 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? –N N/A
<b>Other comments</b>  <b>Question 26:</b> Do you have any other comments or views on the issues raised in this document?	Confidential? – Y / N

**Please tell us how you came across about this consultation.**

- Email from Ofcom
- Saw it on social media
- Found it on Ofcom's website
- Found it on another website
- Heard about it on TV or radio
- Read about it in a newspaper or magazine
- Heard about it at an event
- Somebody told me or shared it with me
- Other (please specify)

Please complete this form in full and return to [liz.hall@ofcom.org.uk](mailto:liz.hall@ofcom.org.uk).