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?	I am satisfied with the current system for booking licences. The turnaround time is effective, as we often secure spectrum in advance of arriving at the venue. On the rare occasions that changes are required to an existing licence, the process is typically handled quickly and efficiently by the PMSE booking team. Overall, communication with the PMSE booking team is good.
### 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?	
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?	

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?

Several converging forces have pushed both the number of systems in use and the peak channel counts at large events substantially upward in recent years.

The live events industry has grown significantly in both scale and technical sophistication. Festival headliner productions, arena tours, and large theatrical productions now routinely deploy wireless systems at a density that would have been considered exceptional a decade ago. West End and touring musical theatre in particular has seen RF channel counts climb sharply — a large musical may now use 40–60 wireless microphone channels for performers alone, before accounting for IEM systems. The artistic expectation of fully wireless, highly mobile performers has become the standard, not the exception.

In-ear monitor adoption has been prevalent in live music for some time, but we are seeing the demand grow dramatically in theatre as technology improves. Each IEM user requires at least one dedicated downlink channel, effectively doubling the spectrum demand per wireless-equipped performer or musician relative to a microphone-only setup.

Conference and corporate production has expanded enormously. Hybrid and large-scale corporate events, awards ceremonies, and presentations now routinely deploy multi-channel wireless systems that previously only broadcast and theatrical productions required. This has increased demand at the coordinated end of the market as these events seek protection from interference.

Digital wireless systems (using standards such as those developed by manufacturers like Shure, Sennheiser, and Sony) are more spectrally efficient than their analogue predecessors in some respects, but the sector has largely used that efficiency to fit *more systems* into the available spectrum rather than to reduce spectrum consumption. The result is that while individual systems may have a slightly smaller RF footprint, the aggregate demand has grown.

Many users who previously held national licences have migrated to coordinated site-specific or event-specific licensing, particularly as their events have grown in complexity or as they have become more aware of the benefits of coordination. The coordinated licence framework

Question	Your response
	provides interference protection that a national shared licence cannot guarantee, and as spectrum has become more congested, the value of that protection has increased. So some of the apparent decline in national licences may reflect a transfer of demand to coordinated licences rather than a genuine reduction in wireless microphone use. In recent times some users have found CH38 less reliable in certain geographic areas as the surrounding band environment changed and have sought alternatives. There is also uncertainty about the long-term status of interleaved spectrum that may discourage some users from investing in channel 38-specific equipment. The decline in VHF national licences is more straightforwardly a technology story. VHF wireless microphone systems are an older technology with characteristics larger antenna systems, less aesthetic integration, lower audio bandwidth in some implementations that have made them progressively less attractive compared to UHF systems. Manufacturers have largely ceased developing new VHF wireless microphone products for the professional market. Traditional RF talkback systems (operating in dedicated PMSE talkback bands) are facing direct substitution from IP-based intercom solutions. Systems built on platforms such as Dante, AES67, or proprietary IP intercom products (Riedel's MediorNet, Clear-Com) increasingly provide the functionality of RF talkback over wired or fibre infrastructure where that infrastructure exists. In permanent or semi-permanent venues, broadcast centres, large theatres, conference venues, the business case for maintaining dedicated RF talkback licences weakens as IP infrastructure matures. DECT-based beltpack systems operating in the 1.9 GHz band also provide a licence-exempt alternative removing some demand from the licensed talkback bands entirely. The overarching pattern across b) and c) is that licensed spectrum use in PMSE is concentrating at the high-complexity, high-value end large simultaneous wireless systems at major events while routine, lower-complexity spectrum use migrates toward IP, DECT, licence-exempt options, or simply disappears as technology changes the

Question	Your response
	underlying production workflow. This has important implications for how Ofcom thinks about future spectrum allocations for the sector: raw licence counts are an increasingly poor proxy for the actual spectrum dependence and economic value of PMSE activity.
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? b) national wireless microphone licences (UHF channel 38 and VHF)? c) talkback, fixed audio links and ADS licences?	The live events economy shows no structural sign of contraction. The broader trend of experiential spending audiences prioritising live experiences over recorded content continues to support investment in theatre and events. As production values escalate, the RF channel count per production tends to escalate with it. There is no artistic or technical ceiling in sight for what a major theatrical production will demand in terms of simultaneous wireless systems. IEM penetration has further to run. Adoption is still growing in segments regional and mid-scale touring, educational and amateur performance at the more professional end, theatrical production where IEMs were previously uncommon. As the technology becomes more affordable and as the expectation of wireless monitoring becomes universal, these segments will add materially to coordinated demand. Immersive and interactive content formats are an emerging driver. Immersive theatre, site-specific performance, and audience-participation formats all create RF complexity that traditional proscenium productions do not, performers moving unpredictably through spaces shared with audiences, requiring robust wireless links across geometrically challenging environments. These formats are growing as an artistic and commercial sector.
Question 6: Do you agree that, given the trends, we are right to focus on wireless microphones/IEMs?	The economic and cultural case for prioritising wireless microphones and IEMs is strong. This is where spectrum dependence is greatest, where no credible alternative technology exists at scale for professional applications, where demand is growing rather than declining, and

Question	Your response
	where the consequences of spectrum inadequacy are most immediately felt. The IEM dimension deserves particular emphasis within this focus. IEMs are sometimes treated as secondary to microphones in policy discussions because they are less visible to audiences, but in spectrum terms they are equal. Each IEM user requires downlink capacity just as each microphone user requires uplink capacity, and in many modern productions the IEM channel count exceeds the microphone channel count.

Question	Your response
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?	Propagation is a genuine technical driver of band preference, not merely a legacy artefact. UHF in the 470–694 MHz range offers a combination of manageable good penetration of soft tissue and clothing (important for body-worn transmitters), adequate range for most venue applications, and reasonable multipath behaviour that has proven well-suited to wireless microphone use. Higher bands offer more available spectrum and potentially more channels but worse propagation, more sensitivity to obstacles, and higher susceptibility to multipath in complex acoustic environments. The DME band is shared with other services, including aeronautical DME navigation aids. The coexistence requirements and geographic constraints this imposes on PMSE use of the band are complex, and the resulting coordination requirements are more demanding than for UHF PMSE. Users and manufacturers evaluating whether to invest in DME-capable equipment must assess not only whether the band works technically but whether the regulatory framework is stable and whether the coordination burden is manageable in practice. Where this assessment has been made, the conclusion has generally been that the combination of technical compromise and regulatory complexity makes DME a less attractive investment than continuing to optimise within UHF or exploring higher-band digital alternatives. DME is not harmonised globally leading to additional coordination when production move across boarders.
Question 8: What actions could enable greater take-up of the DME, DECT and licence exempt bands in the future?	The single most powerful thing Ofcom could do is provide unambiguous, long-term regulatory certainty for PMSE use of the DME band. This means publishing a clear framework that defines exactly where, under what conditions, and with what coordination requirements PMSE can operate in the band and committing to that framework for a defined period long enough to justify manufacturer investment decisions.

Question	Your response
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?	
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?	Latency is the most discriminating characteristic across audio PMSE applications, and the one where the consequences of getting it wrong are most immediately and viscerally apparent. When a performer hears their own voice through an IEM, any delay between the acoustic sound produced at their mouth and the monitored sound arriving at their ear creates a phenomenon known as the Sidetone Effect which unconsciously alters their vocal production in response to the delayed feedback, causing pitch instability, timing disruption, and vocal fatigue. Wireless microphones are somewhat more tolerant of latency than IEMs, because the performer is not monitoring their own voice in real time through the system — but latency still matters significantly.
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?	
Question 12: What technologies are currently available or are being developed which can improve audio spectrum efficiency in the future, particu-	The evolution of antenna system design has been at least as important as transmitter and receiver technology in enabling higher channel counts in dense RF environments.

Question	Your response
larly in the use of wireless microphones and IEMs at the largest events and venues?	
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?	The most fundamental technical barrier to adopting more spectrally efficient digital encoding in IEM applications is the latency constraint described earlier.
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?	
Question 15: 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 could industry do and what could Ofcom do to facilitate those efficiencies?	The absence of agreed technical standards for digital wireless audio interoperability equivalent to the role that standards like AES67 play in networked audio means that each manufacturer implements spectral efficiency improvements in proprietary ways that are not comparable.

Question	Your response
## 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? c) the bandwidth used at horse racing fixtures and other major sporting events?	Confidential? – Y / N

Question	Your response
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 24: What changes to working practices and spectrum planning could improve video spectrum efficiency in the future?	Confidential? – Y / N

Question	Your response
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? – Y / N Autograph is a specialist company working in the pro-audio industry. We mainly sell and hire out equipment and services to a wide range of clients across the UK. As a rental company supporting around 60–70% of West End productions, the PMSE sector, with all its variety, has been at the core of what we do for over 50 years. Over that time, the West End has evolved alongside advances in technology and now depends on companies like us (and our competitors) to deliver highly engineered, reliable systems that can handle 8 shows a week, 52 weeks a year without fail. Radio spectrum use in the PMSE world is essential to almost everything we supply. We hold one of the largest inventories of radio microphones in the world, and nearly every theatre production or event we work on uses radio mics and in-ear monitoring systems in some capacity. On the sales and installation side, we provide wireless microphone and IEM systems to a broad mix of clients, including education, regional theatre, the military, places of worship, live entertainment venues, sports venues, bars, clubs, and even the London Stock Exchange. We have a very large inventory of radio microphones and In-ear monitoring systems. The numbers below are not exact but a very close indication of how many devices are currently on hire. Total individually licensed devices currently operating within the 470-694 MHz range - 1240 x micro bodypack transmitters - 95 x handheld microphones - 160 x IEM transmitters with 180 x Bodypack receivers These devices are mostly used indoors in theatres, mainly in London's West End, but also in touring venues across the UK. The size of events can vary, from small 100-seat theatres right up to large venues with around 3,000 seats. Most productions run for long periods, West End shows can last anywhere from a few months to several years, sometimes even decades, while tours usually run between 6 months and 3 years.

Question	Your response
	Over time, we've noticed a steady rise in the number of individually licensed devices in use. That's partly because casts are getting bigger, but also because more performers are using wireless microphones on shows where they might not have before. Audience expectations are growing too, and that often means bringing in more technology to meet them. Productions are also adding extra layers of redundancy, with more cast members wearing two wireless microphones, one serving as a backup. We're also seeing more use of in-ear monitors (IEMs), as performers tend to prefer them for clearer, more personalised audio compared to traditional on-stage foldback speakers. IEMs are also often used for practical speakers, running wirelessly with IEM receivers and battery-powered amps, which is especially useful for effects speakers in situations where running cables just isn't practical. Equipment type and ranges below. *Shure Axient Digital – G56 band (470-636 MHz)* 450 x ADX1M micro bodypack transmitters on long term hire 60 x ADX2 handheld microphones on long term hire - In use over 18 Theatre shows in the West End and on tours throughout the UK. *Sennheiser 6000 series – A1-A4 band (470-550 MHz) & A5-A8 band (550-638 MHz)* 600 x SK6212 micro bodypack transmitters on long term hires 20 x SKM6000 handheld microphones on long term hires - In use over 24 Theatre shows in the West End and on tours throughout the UK *Sony DWX – (470-638 MHz)* 130 x Sony DWT B03R micro bodypack transmitters on long term hires 10 x DWM 02N handheld microphones on long term hires - In use over 3 Theatre shows in the West End and on tours throughout the UK *Sennheiser 5000 series - L Range (470-638 MHz)*

Question	Your response
	60 x SK5212 micro body pack transmitters on long term hires 5 x SKM5200 handheld microphones on long term hires *Sennheiser G4 IEMs – Range B 626-668 MHz* 50 x IEM transmitters with 50 x Bodypack receivers *Shure PSM1000 – Range L8E 626 – 694 MHz* 25x IEM dual channel transmitters 70 x Bodypack transmitter *Shure Axient PSM – Range G56 (470-636 MHz)* 10 x ADTQ 4 channel IEM transmitters 12 x ADTD dual channel IEM transmitters 60 x ADXR body pack receivers *Please find attached three case studies showing existing theatre productions, highlighting the planning processes and key parameters involved in delivering the event.* We currently provide wireless microphones to approximately 45 productions across London's West End and the wider UK. Because so many theatres and venues in the West End are packed into a relatively small area, we need access to a broad range of spectrum. This allows us to efficiently space out frequencies and TV channels to avoid interference with nearby venues. For touring productions, having access to a wide range of TV channels is just as important, as it helps us adapt to the different DTT usage across the country. Even with newer technologies such as WMAS being introduced in high-end equipment, we don't expect our spectrum needs to decrease. While WMAS can increase the number of channels within a single TV channel, top-tier productions still have strict requirements around audio quality, transmitter range, and latency, meaning we continue to need roughly the same amount of spectrum as with our standard digital radio mic systems. Our business depends on spectrum for the core deliverable of our work. Wireless microphones, in-ear monitors (IEMs), talkback systems are not optional add-ons; they are the product. Spectrum loss directly

Question	Your response
	threatens the ability to honour contracts: a theatre production relying on wireless performance cannot easily revert to wired, if the spectrum isn't available. The reputational damage flows downstream to hire companies, venues, and the UK's broader reputation as a destination for premier theatrical productions and live events. Cost implications Coordination costs would rise as usable spectrum shrinks. The more users competing for fewer channels means more intensive (and expensive) pre-event frequency planning, often requiring specialist RF consultants and longer periods of coordination. This adds significant cost to operating budgets and addition strain on human resources. Operational risks As spectrum contracts, the channel count available at any given theatre or event falls, and the risk of inter-system interference rises, particularly in high-density environments like the West End, stadia, or festival sites where hundreds of wireless systems may need to coexist simultaneously. The growing footprint of 5G in adjacent and guard bands creates an additional interference pressure that PMSE users have limited technical means to counter. Technologies such as WMAS which initially promised more efficient spectrum use have in reality made little difference to the Spectrum required to deliver high quality and reliable theatrical productions. Lost and reduced opportunities The UK has a globally significant live events, theatre, and broadcast production sector. Spectrum availability underpins the country's ability to be at the forefront of such productions. If the spectrum resource shrinks below what these events demand, organisers will face a choice between compromising production quality or relocating to jurisdictions with more spectrum headroom. There is also a longer-term skills and innovation risk: a sector squeezed out of RF technology by spectrum scarcity will lose the engineering talent and institutional knowledge that supports that work.

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