Your response

The DTG welcomes the opportunity to respond to Ofcom's call for input on PMSE. A DTG working group on PMSE was established in 2016 in response to industry concerns following decision on the UHF band spectrum at WRC-15. The co-primary allocation of mobile services in the band 694 – 862 MHz caused considerable disruption to the industry and resulted in work by the DTG and its members to clear the 700MHz band ready for mobile deployments following Ofcom's spectrum award in 2021.

The DTG PMSE working group comprises manufacturers, PMSE hire companies, broadcasters and other PMSE operators. We have worked with Ofcom to minimise disruption resulting from 700MHz, share information on compensation schemes and study the spectrum efficiency of PMSE deployments within the group.

We are pleased to see steady growth in the creative industries and a growing demand for wireless technologies for audio and video production that enhance productions and enable increasingly complex events. Creative industries contribute over 5% in Gross Value Added (GVA)[1] to the UK economy, driven by high value content underpinned by the PMSE sector. It is critical that this sector continues to be supported with suitable access to internationally harmonised spectrum.

Our members are increasingly alarmed by the impending threats to audio PMSE tabled for WRC 31. It should be noted that any spectrum re-assignment will carry considerable costs and there is no clear alternative spectrum that could accommodate equipment that currently uses the 600 MHz band. As such spectrum re-assignment discussions need to be pre-empted by suitable studies on alternative spectrum which would need to be harmonised. This situation is quite different from that following WRC-15 where Ofcom quickly identified the potential problems and enabled the licensed sharing of audio PMSE with DME equipment in the frequency range 960 – 1154 MHz.

1

Creative Industries: Growth, jobs and productivity, January 2025, House of Lords Library https://lordslibrary.parliament.uk/creative-industries-growth-jobs-and-productivity/

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 PMSE stakeholders appear broadly happy with the online booking system, but we note that the system was down at the end of 2024 and the platform is slow and potentially needs updating. Coordination activities at large events by Ofcom PMSE staff are welcomed by DTG members involved in production. More support will be necessary if spectrum changes result in denser deployments and the need to more carefully police the coordinated assignments. The decision not to support short term licensing of n40 spectrum for private 5G operations using the online tooling should be reviewed. An online system would clearly be more convenient than a paper system.

## 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 assumption that an assignment of 8MHz is equivalent to 10 radio microphone assignments or 4 IEMs is potentially quite conservative. This is likely to under-estimate the density of spectrum use at studio centres and theatres. The steady growth in assignments is clear from the analysis and is a consequence of growth in the creative industries and the desire to make more use of wireless microphones on PMSE events. Events are becoming increasingly complex, and this creates further demand. Improvements in the spectrum efficiency of PMSE kit following the 700MHz clearance and adoption of digital technology is facilitating more deployments. The addition of DME licensing has been a welcome addition to allow existing operations to be maintained and new applications to grow. The future demand analysis in the CFI concentrates on assignments relative to Glastonbury (wireless audio) and Silverstone (wireless video) which have been used to draw the conclusion that drivers of PMSE spectrum demands are concentrated on a small number of large events in specific locations for short periods of time. While there clearly is an increasing demand year on year at these locations, it would be misleading to conclude that other locations that use spectrum are not driving demand. There are many locations nationwide such as studios, theatres, music venues, which rely on spectrum to operate daily and are also seeing year on year growth. The fact that these assignments are relatively small compared to the specific events referenced in the CFI, does not mean that theses assignments are any less important for the creative industry. The CFI mentions that Talkback assignments in UHF spectrum have reduced by 5% annually over 2018-2024. The reason for this is due to the lack of spectrum for wireless mics and IEMs which has meant that talkback systems have been moved to DECT bands/technology. The CFI states that the DME spectrum is sparsely used (section 5.9): “As noted in Section 4, the newly available aeronautical DME band (960–1164 MHz) accounted for a small proportion of PMSE demand “

Question	Your response
	This analysis is based on Glastonbury but the DME band provides a vital resource for PMSE usage in the UK. We would expect DME deployments to increase in popularity as user awareness grows and equipment availability improves. However, this may take time as users will tend to use familiar bands for the life of the equipment and review this when necessary. Additionally, as the DME band is a UK only option for PMSE, there are only a small number of manufacturers that support this band meaning that this equipment is not commonplace in rental markets which is a huge part of the industry.
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? – N We note the licensing database information indicates 200% growth in video PMSE licensing which is not recognised in the analysis. News organisations and broadcasters tend to purchase annual assignments, and the intensity of use is not captured in the analysis. The assignment data shows strong growth in the 7GHz band which illustrates the delay between introduction of a new band, improvements in equipment supply and adoption by users. Adoption was initially slow after the band was introduced and its use was recommended by Ofcom in 2014 in preference to using 2GHz and 2.2GHz bands which is at capacity, but we now see good equipment availability and strong use. It is of concern that this band is now at risk from IMT with proposals under agenda item 1.7 at WRC-27.

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 DTG PMSE members report organic growth in demand for wireless microphones and IEMs which is reflected in the assignment data. Improvements in the spectrum efficiency of UHF equipment and the growth in the creative industries has driven this increase. Events are becoming increasingly ambitious and complex which further drives PMSE spectrum demand. Spectrum losses at 700MHz have been offset by licensing of the 960-1160MHz band to help sustain this growth in the creative industries. The factors driving the slight decline in channel 38 assignments are unclear, but it should be noted that these assignments do require local coordination with other users of this channel, so alternative UHF channels may be preferable for ad-hoc use. Channel 38 remains important for global news organisations and annual block assignments by such organisations are quite common. Another factor suggest by DTG PMSE group members was the use of free licence Bluetooth devices which are becoming more common place instead of channel 38 equipment. This is for quick small scale fast turnaround assignments e.g. live news where there is more reliance on smaller crews rather than trucks where the channel 38 equipment is located. The decline in talkback licensing is most likely a consequence of the trend toward the use of DECT equipment for these applications and the retirement of analogue talkback equipment as it reaches its natural end of life. For fixed audio links, IP connectivity via fixed or mobile broadband is often possible and preferable when available.
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	Confidential? – N Improvements in the performance, reliability and spectrum efficiency of radio microphone equipment have increased their popularity. The creative industries are also growing, which creates additional new demand. Events are becoming more complex and the appetite for wireless connectivity is increasing. At high density sites, such as large studio centres, it is quite common to find radio microphones planned on a 400kHz lattice in one studio

Question	Your response
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?	with an interleaved arrangement also at 400kHz spacing in adjacent production areas. Ofcom's data doesn't give sufficient insight into the operational processes, such as interleaving, being used. Such practices can achieve a spectrum efficiency of 40 microphones per 8 MHz channel. New WMAS equipment does not offer any significant improvement on this density. Podcasts are also a significant driver of PMSE spectrum demand using a wide range of locations and setups.
Question 6: Do you agree that, given the trends, we are right to focus on wireless microphones/IEMs?	Confidential? – N Wireless microphones and IEMs are vitally important for productions, and it is correct for Ofcom to focus on this. UHF spectrum re-assignments for ITU regions at WRC-31 may see a co-primary allocation of mobile in the 600 MHz band which would threaten mics / IEM at large productions and major public events. Previous experience following spectrum losses at 800MHz and 700MHz confirm that mobile cannot share spectrum with PMSE and expensive re-engineering of PMSE equipment has been necessary to sustain the requirements of the creative industries. The opportunities for further spectrum efficiency gains appear incremental rather than a step-change and we note Ofcom have not identified any new bands to mitigate the impact of future UHF losses. If new bands can be found, these need to be tested and adopted by vendors and subsequently users which will be a slow process.

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?	Confidential? – N Equipment availability is a key driver for UHF which is a harmonised band across region 1. The band is widely supported by all manufacturers and there is a mature equipment supply chain from multiple vendors. It therefore naturally remains the first choice for most audio PMSE use. European studies from CEPT (ECC 372) have shown that 83% of PMSE wireless audio assignments in Europe are in the UHF band (470-694 MHz). Given the scale and ecosystem in place to support this and that harmonisation is needed, barriers and take up of spectrum bands is decided at an international level. For example, the CFI suggests that greater support of the DME band in other European countries could lead to a larger potential market and lower costs. While this is acknowledged, it needs to be made clear that the PMSE industry and Ofcom have attempted to encourage uptake of the DME band in other European countries via CEPT and other forums since the UK started using it for PMSE. The blockers are well known, and the aeronautical industry have successfully discouraged PMSE adoption by other European administrations. Overall, this highlights the challenge faced by the PMSE industry in finding harmonised spectrum. The DME band is unique to the UK and only Shure, Sound Devices, and Wisycom are the only manufacturers that have shown interest in supporting this band. We note that Austria may be adopting this band for indoor use and we encourage Ofcom to share experiences of using this band with other European vendors in its international activities within CEPT and ITU. Growth in DME usage has been strongest in locations where UHF spectrum supply is limited. An example would be Elstree studios where operations would not be sustainable without extensive use of the DME band. However, as noted earlier, the PMSE sector heavily relies on the rental market who are less likely to stock DME band equipment given its limited UK-only use.

Question	Your response
Question 8: What actions could enable greater take-up of the DME, DECT and licence exempt bands in the future?	Confidential? – N DECT is not suitable for applications where latency is a concern but is appropriate for most professional talk-back applications. Equipment costs are generally quite high which limits demand in cost-conscious applications. DME band equipment is also quite expensive and only available from three vendors. Some vendors are reluctant to support this band given that its application is essentially limited to the UK. Ofcom should promote adoption of this band across region 1. Harmonisation of the DME band across region 1 for PMSE would drive support from new vendors and would increase take-up.

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?	Confidential? – N Ofcom's studies in 2016 on PMSE demand and the impact of 700 MHz closure identified 960-1164 MHz, 1525-1559 MHz, 1350-1400 MHz and 1660 – 1710 MHz as potentially viable band for PMSE. Only 960 -1164 MHz was considered viable, and we believe this remains the case. We understand the spectrum band 1350- 1400 MHz is a potential IMT band and is extensively used for fixed links in the UK. There is perhaps opportunity to develop 1785-1805 MHz as this is a harmonised band. Vendor support and equipment supply remain a major problem. To establish a new band for PMSE, harmonisation across a region is needed or manufacturers will be reluctant to invest in the development of equipment. PMSE spectrum is identified by CEPT FM 51 and documented in ERC recommendation 25-10. There appear to be no obvious new bands for audio PMSE identified by FM 51. The Ofcom shared access license band 3.8 – 4.2 GHz has been explored by some DTG members and research work was conducted by the Horizon project 5G-Records by Sennheiser. This work concluded that the frame structure of 5G NR cannot support low latency radio microphones. There is potential to provide talkback, but no terminal equipment is available and there is currently little motivation to move talkback out of the DECT band (1880 – 1900 MHz). The CFI references the use of the DAB band, but this would offer limited capacity. Also mentioned was the duplex gap but as this is owned by EE there would need to be arrangements made by Ofcom and it would potentially be a UK-only solution again. In terms of PMSE sharing spectrum with mobile users this was investigated in CEPT study (ECC 221) for 700 MHz, outlining power restrictions and separation distances which meant implementation was impractical. Overall, any new spectrum requires harmonisation to drive equipment development and uptake.

Question	Your response
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 High quality and low latency are key parameters for professional audio production. Productions may use a mixture of wired and wireless microphones and minimising the delay between different sources is essential. For musical performances, where the use of wireless IEMs is increasingly common, maintaining low latency between capture at the microphone and fold back to a musician in-ear monitor is crucial. A maximum latency budget of 5ms for the radio microphone, downstream processing and fold back to the in-ear monitor is considered the absolute maximum that can be tolerated. In TV studios, higher latency can be tolerated for presenter cue feeds and production talkback. DECT systems generally achieve a latency of 30 – 50 ms for beltpack-to-beltpack communication. The audio bandwidth requirement of talkback systems is typically 7kHz, which is considered adequate. Radio microphones systems require 20kHz audio bandwidth. Resilience is crucial as failures cannot be tolerated. It is quite common to double mic key presenters on TV productions to provide additional reliability against equipment failure.

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 move from analogue to digital radio microphones has improved spectrum efficiency and enabled increasing numbers of radio microphones on complex production. Spectrum efficiency has improved markedly and many legacy issues relating to transmitter intermodulation and the need for careful frequency planning has been relaxed. A transmitter intermodulation distortion target was added to the ETSI standard EN 300 422-1 V2 in September 2016 as part of the Radio Equipment Directive (2014/53/EU) and this standard is a requirement of Ofcom IR 2038. This initiative has significantly reduced the need for intermodulation free planning of radio microphones and improves the density of deployment. In general, the industry is mindful of the need to maximise efficient spectrum usage and has mitigated the loss of 800 and 700 MHz bands through a combination of utilising new technology, adoption of the DME band and DECT bands, and efficient operation practices. Radio planning is highly complex, and the industry employs sophisticated spectrum coordination and frequency planning to manage this. As noted in the CFI, there is a need at live events and productions for resilience and practicality as outages are not tolerable. As such the potential to extend operational complexity is limited and continued sufficient access to predictable spectrum for PMSE is key.
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 WMAS technology offers opportunities to deploy bidirectional systems offering both frequency and time-based coordination. The bidirectionality also means that an 8 MHz channel can be used for both microphones and IEMs rather than have microphones and IEMs operating in separate channels. For those events using both applications, this functionality allows for operational and spectrum efficiency benefits. It is important to highlight that gains will be gradual through improved flexibility and the ability to dynamically allocate resources, rather than being a step change in spectrum efficiency. As Ofcom notes, the compound annual growth rate in assignments for microphones and IEMs is 7.1% and shows

Question	Your response
	no sign of diminishing. In practice, therefore, when a technology enables easier deployment and efficiency gains, these gains are often reinvested into higher production ambition rather than lower spectrum use. In some WMAS, the 8 MHz channel resource can be dynamically allocated depending on the operational requirement. Users need to trade-off range, latency and audio quality depending on their requirements which affects the overall channel density .
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 The deployment of WMAS will require investment which must be funded by users or the supplying hire companies. Feedback from PMSE users in the DTG PMSE group was that equipment cycles cover long investment periods. The extent to which older, less efficient technologies are deployed is unclear and may be the subject of further studies and analysis by Ofcom.
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 Discussion within the DTG PMSE group highlights that the PMSE industry is maximising efficiencies at large events and venues through a combination of utilising new technology, adoption of the DME band and DECT bands, and efficient operation practices. The deployment of digital IEMs and mics using WMAS technology is perhaps the only area where improvements can be made but this is subject to the barriers of technology uptake as highlighted and is likely to provide incremental benefits rather than a step change in audio spectrum efficiency.
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?	Confidential? – N The successful planning of large PMSE events is a complex matter and it is unclear how Ofcom could influence this. We note that Ofcom have not participated in the drafting of EN 300 422 and efficiency improvements have been driven by the industry. It is unlikely that Ofcom have the resources to influence this.

Question	Your response
	There is an opportunity for Ofcom to engage more closely with industry via groups like the DTG PMSE Group.
## 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? – N There is a move to progressive HD and a desire for UHD for video production, particularly for content intended to be streamed on IP platforms. The convenience of deploying wireless cameras at complex events is another contributory factor. To achieve on-board coverage from F1 racing cars, wireless cameras are clearly a necessity. For national events, such as the Coronation, private 5G networks have shown promise for news gathering applications. UHD content tends to be carried by fibre-connected cameras when possible. DVB-T based radio cameras can achieve a maximum code bitrate of 32 Mb/s in 8MHz channels and 43Mb/s in 10 MHz channels; this gives acceptable quality for most HEVC-coded material.
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? – N

Question	Your response
c) the bandwidth used at horse racing fixtures and other major sporting events?	
Potential news 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 Ofcom have actively encouraged the licensing of 7GHz for wireless cameras and take up has grown as the availability of equipment has improved. For large events that cannot be contained within 2GHz and 2.2GHz bands, 7GHz is a logical choice if the link budget can be achieved.
Question 19: Which potential additional bands might be suitable for video PMSE applications, particularly at the largest events and venues?	Confidential? –N We welcome Ofcom's initiatives in licensing 2320-2340MHz and 3880 - 4200MHz for Private 5G deployments. The cost of P5G is steadily reducing and we would anticipate further growth in this area. We encourage Ofcom to develop online tools to support licensing of this spectrum for private 5G.
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? – N

Question	Your response
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 There are issues with obtaining satisfactory quality for UHD contribution within the 10 MHz channels licensed for video links. The best capacity that can be achieved would be 43 Mb/s for a 10 MHz channel, but link budget considerations can necessitate operation using lower capacity modulation modes requiring more video compression. This carries a risk that unwanted video artefacts will be introduced into the wireless camera content. Higher capacity is available in private 5G connections, but only by using the 3800-4200MHz band licensed under the Ofcom SAL. Such spectrum licenses require up to 42 days' notice, and this limits the application of high-bandwidth P5G deployments for PMSE.
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? – N Spectral efficiencies of the order of 1 bit/second per Hz are being achieved in WMAS and digital radio microphones, which suggests low order modulation (e.g. coded QPSK). Greater efficiency may be possible in the future at the expense of reduced reliability, but this requires technical developments by equipment vendors.
Question 23: What types of video demand could realistically be supported by private (for example 5G) networks?	Confidential? – N Private 5G networks are attractive for operations in studio centres and large outdoor events where Ofcom can license spectrum. The number of deployments is growing, and the technology is attractive where mobile spectrum is congested e.g. large public events. Low latency can be achieved but requires careful choice of camera back and P5G configuration. Equipment cost remains high, but harmonisation of this band in Europe is expected to improve this situation.
Question 24: What changes to working practices and spectrum planning could improve video spectrum efficiency in the future, particularly in the use of wireless microphones and IEMs at the largest events and venues?	Confidential? – N Spectrum re-use and refinement of propagation models used may deliver benefits. Ofcom work in this area to support improved tooling and planning may yield benefits.

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? – N The radio equipment directive delivered a revised draft of EN 302 064 V2.1.0 with enhanced transmitter ACLR and new receiver performance targets. The enhanced ACLR was subsequently rejected and removed in EN 302 064 V2.1.1. The extent to which transmitter out of block performance affects the density of deployment would require further study.
Other comments **Question 26:** Do you have any other comments or views on the issues raised in this document?	Confidential? – N

Please tell us how you came across about this consultation.

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