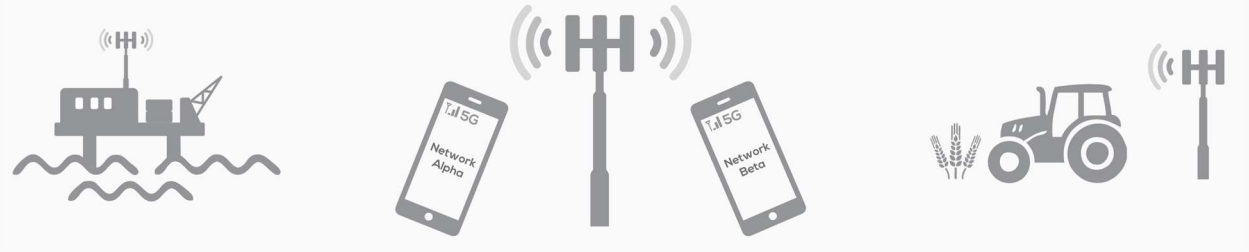

CALL FOR INPUT: SECTOR SPECTRUM REVIEW - PROGRAMME MAKING AND SPECIAL EVENTS (PMSE)

FROM

NEUTRAL WIRELESS

Submitted:	15/04/2026
Point of Contact:	**Dani Anderson**
	Senior Engineer
Mobile UK:	+44 7851287031
Email:	dani.anderson@neutralwireless.com
	spectrum@neutralwireless.com

Consultation Response Form

Complete this form in full and return to liz.hall@ofcom.org.uk.

Title	Call for input: Sector Spectrum Review - Programme Making and Special Events (PMSE)
Full name	Dani Anderson
Contact phone number	+44 7851287031
Representing (delete as appropriate)	Organisation
Organisation name	Neutral Wireless Ltd
Email address	dani.anderson@neutralwireless.com spectrum@neutralwireless.com

Confidentiality

We ask for your contact details along with your response so that we can engage with you on this consultation. For further information about how Ofcom handles your personal information and your corresponding rights, see Ofcom's General Privacy Statement.

Your details: We will keep your contact number and email address confidential. Is there anything else you want to keep confidential? Delete as appropriate.	Nothing
Your response: Please indicate how much of your response you want to keep confidential. Delete as appropriate.	None
For confidential responses, can Ofcom publish a reference to the contents of your response?	Yes

Table of Contents

Question 1

What are your views on how our processes work - for example our online booking system, turnaround times, & event coordination. Do you think the current approach works well? How could we improve it?

Is this response confidential? – N

N40, 2320-2340 MHz Short Notice Short Duration Booking and Licence

With respect to recent innovations from Ofcom, we welcome and strongly support the new Short Notice, Short Duration licence mechanism for temporary spectrum access to the 2320-2340 MHz n40 range that was launched earlier this year and which provides spectrum access for PMSE as well as live wireless video transport and other use cases. We recognise the consideration given to the industry production schedules, with regards to managing three-day turnaround times for new licence applications.

We have some suggestions on how the overall process for 'Short Notice Short Duration' licensing could be improved based on our initial experiences applying and deploying private 5G networks with this type of licence and thus further support PMSE use case uptake.

The current 'Short Notice Short Duration' application mechanism for n40 involves completing a PDF form and then submitting via email. We would encourage Ofcom to move towards an online application process, similar or identical to the existing one used for the *shared access licence (SAL)* mechanism. Ideally, this change would be combined with a migration to a future fully automated application process, which is already compatible with the existing simplified coexistence calculation mechanisms.

As there is, we understand, still an element of manual processing currently involved with applications for 'Short Notice Short Duration' n40 licences, there could be potential issues with regards to meeting the target licence turnaround time. For example, in scenarios where applications are submitted on a Friday or over the weekend, then the expected day to receive feedback on the licence would be no later than 3 calendar days from submission. However, if the licence mailbox is not processed 7 days a week, then the time available for Ofcom to turnaround the application in 3 calendar days is somewhat reduced.

Upper N77, 3800 to 4200 MHz Shared Access Licences

In addition, we welcome and strongly support the recent efforts that Ofcom have made with regards to improving the licence turnaround time for the 3800-4200 MHz *Shared Access Licence* (SAL) given the opportunity for PMSE use cases for audio and video on the upper n77 band. Our recent experienced reduction in time taken to receive and process an n77 licence is well received by all, particularly those looking to deploy temporary private 5G networks for the production industry and short timescales. For these production industry use cases, locations are often not known until a few weeks or sometimes just days before. The current n77 licencing timescales are invariably too short for n77 to be considered and licensed. We have a number of examples where n77 was sought for PMSE video use cases, but with only 2 or 3 weeks to the event/activity this would not be possible unless a special intervention requested.

We note that in Paragraph 3.40 of the PMSE Call for Input Ofcom document (12th March 2026), it states that because of technical coordination with 'incumbent users', issuing can take up to 40 days. Therefore as Ofcom are stating that it may be 40 days to then grant a licence, but also implicitly state that it may be 40 days to be told no licence is available. Hence applications then need to be perhaps 80 to 100 days in advance to leave 40 to 60 days to consider other solutions if the licence request is rejected. We believe that given the n77 and 3.8 to 4.2 GHz usage for SAL and other incumbent and legacy users is known across the UK, then the set up a 'rapid check' portal could be done. Or a method base on a check other users in a radius (like we understand is done for n40) could be adopted. Else the band, we believe, is not being used to its full potential, particularly for PMSE and other popup type events.

Question 9

Which potential additional bands might be suitable for wireless audio applications, particularly microphones and IEMs at the largest events and venues?

Is this response confidential? – N

We strongly believe there is the potential for audio applications, including microphones and IEMs, to be delivered through private 5G-enabled (P5G) workflows. This is an area of ongoing research, development, and trials that show very promising early results. When this workflow migration is completed, some of those technology deployments could then operate in the established P5G spectrum ranges.

We predict that upper n77 (3.8 to 4.2 GHz) solutions supporting low latency networks carrying uncompressed multichannel audio will be commercially available in the very near term using 100MHz or other bandwidths from n77. However the spectrum licensing time for events, venues and concerts (again noting from paragraph 3.40 of the PMSE Call for Input document (12th March 2026) could be up to 40 days to grant or reject) would benefit from being much shorter to grant or reject to encourage the future uptake for outdoor and indoor venues.

We realise that for fixed and always active venues (indoors and outdoors), then of course the n77 licensing can be in advance and secured for 12 months or more. But this option is not viable for all locations who may only require occasionally for special events. The strategy to have a 12 month licence and use for these occasions of course goes against the whole idea and premise of shared spectrum, as with a 12 month licence, but occasional use this means that others cannot use, and indeed may violate Ofcom licence if leaving 'off' for months at a time. Hence the migration to dynamic spectrum access (DSA) that is on-line and automatic remains the requirement now, and indeed as it was back in the early TV White Space times on the early 2010s.

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?

Is this response confidential? – N

The need for very low latency audio for live concerts is essential to performance (i.e. the performers need very low latency in earpieces or monitor speakers), and indeed any acoustic echo management that may be deployed (monitor speaker back to microphone) is more manageable with low latency.

It is well known that that the compression of audio to reduce the bit rate and hence requiring smaller channel capacities (less bits/sec) and therefore less spectrum bandwidth works very well with streaming and similar services; some of these services use 10:1 or more of compression (psychoacoustic mp3 or other) with minimal audio degradation. However for live performance audio, the additional latency added by doing the audio compression at the pickup microphone, and then more latency to audio decompress at the receiver, creates an overall latency that means compression is not viable. Hence the benefits of reducing spectrum requirements by audio compression in general cannot be realised (whether wireless or indeed wired).

However with the availability of channels of up to 100MHz on upper n77 SAL (3.8 to 4.2 GHz), creates opportunity for transmission of many uncompressed audio channels, and thus the only delay/latency is that of the transport delay of the private 5G network. Hence in common with some of our other answers to questions the viability of n77 for PMSE and audio becomes closer to reality using private 5G.

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?

Is this response confidential? – N

As noted in our response to Question 9 and 10, we believe there is a strong potential for audio applications to be delivered over private 5G (P5G) networks, in similar operating workflows as currently carried out for wireless video applications.

Latency requirements for some critical audio workflows may be difficult to achieve over P5G, but by enabling some microphone and IEMs to be connected over P5G, the number of devices contending for existing, or future, spectrum ranges would decrease. As in our answer to Question 10, given the spectrum available in the likes of n77, then a 100MHz channel can accommodate many high quality audio channels without using audio compression and decompression (used to save bandwidth).

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?

Is this response confidential? – N

We strongly believe that a large amount of wireless live video deployments should transition to use implementations of private 5G (P5G), for contribution links but also as an alternative to traditional wireless (COFDM) camera systems or to augment existing production with new, more dynamic and engaging content.

Broadcasters rely heavily on bonded-cellular devices to simultaneously transport video over multiple public operators. Acknowledging that they are unlikely to receive the uplink bandwidth required for a video link on a single operator, these devices allow them to contribute remote content for day-to-day newsgathering. However, the use of these devices consumes public network resources, impacting the performance of the network for other users (general public). In high demand density environments, public networks can become congested and unable to support broadcast workflows.

The ability to deploy temporary private 5G networks can deliver the capacity and reliability the broadcasters and production companies need while also removing the burden of their uplink video from the public networks.

As an IP-native technology, private 5G integrates into established production and enables local, remote and cloud-based workflows, as well as providing bi-directional support for auxiliary production services such as tally, remote camera control and talkback/intercom – services that usually require additional spectrum and licensing when using existing wireless systems.

With the proper frame structure implementation, discussed further in our answer to Question 23, the achievable throughput and latency performance is comparable to, or better than, other wireless camera systems.

Transition to P5G environments also enables new opportunities for capture and creation, where devices such as handsets, with built-in 5G capability and UHD cameras, can be used as content sources. This has been demonstrated already in industry at high-profile events such as the Paris 2024 Olympics, where such workflows were used for the Opening Ceremony and Sailing events.

Moreover, P5G connectivity also enables new options for content delivery, for remote monitoring or assistive technology to support those with disabilities at an event.

In addition to providing new opportunities, handset-based workflows have the potential to reduce the costs associated with production environments through reduction in equipment costs and staffing requirements.

As the opportunities enabled by P5G become more recognised and widely implemented, the overall spectrum utilisation for video applications may increase at a given event. However, more applications would be operating in the dedicated P5G spectrum range, reducing the number of devices contending for other operating frequencies.

Large sporting events face ever-increasing challenges to deliver new and engaging content, and the ability to capture video wirelessly is critical. Production demand will swell to fill available capacity, from moving to multiple cameras and data sources on each racing vehicle at Silverstone or competitors on a golf course, for example. There is no fixed capacity requirement for events like this. The Opening Ceremony of the Paris 2024 Games provided at least one live video feed from each of the 205 delegations as the boats made their way along the River Seine – this could not have been achieved using another technology. The network provided over 4.4 Gb/s of uplink connectivity not only for live

video but also for press photographer image upload, using 200 MHz of spectrum along the river.

The Coronation of H.M. King Charles III in May 2023 provided private 5G connectivity for the BBC and members of the Foreign Broadcast Service along the Mall. Over 60 devices from 20 international media outlets made use of the network. By the nature of the remote contributions to according to their production schedules to galleries around the world, all 60 devices were not live at the same time, but the network provided over 1 Gb/s of uplink capacity along the Mall, using 80 MHz of spectrum at a time when the public networks were saturated, allowing live content that could not have otherwise been broadcast.

Question 19

Which potential additional bands might be suitable for video PMSE applications, particularly at the largest events and venues?

Is this response confidential? – N

As discussed in our response to Question 17, we believe that the majority of wireless video PMSE applications should consider migrating to using deployments of private 5G in bands such as upper n77 (3.8 to 4.2GHz). This would allow for production companies and content creators to take advantages of the associated performance, flexibility, and integration benefits. When this workflow migration is completed, those applications can then operate in the established P5G spectrum ranges.

For established venues the licensing of n77 for PMSE can be efficiently progressed and a continuous and present licence then in place at the venue and managed by the venue and support use cases in video and audio use cases. Of course this assume the licence is in near continuous (weekly?) use, else if fallow for long periods of time this would violate the licence agreement (i.e. its not being used and others being denied opportunity to use).

However for popup, festival events, or short duration requirements the licence application for n77 would benefit from being a faster turnaround. As an example, if this turnaround was say 4 weeks, then it would take 4 weeks to apply and be granted, or indeed 4 weeks to know its been refused. Hence given refusal is a possibility the application would need to be at least 8 weeks in advance and perhaps 12, as alternative technologies would need to be planned if refused for n77. It is for this reason that events and festivals may not consider n77 and indeed some examples of this having happened, where n77 was considered, but licencing was the risk that meant alternatives selected.

For n77 and PMSE use we also propose a ‘rapid-check service’ would be very useful for PMSE use cases and users in n77. Perhaps along the lines of the n40 process, re checking on nearby licences and offering a short duration licence (likely with no QoS) from this rapid check.

Lastly, as Private 5G becomes more operable across a number of bands, including non-3GPP and/or in some MoD bands (that may be shared in future as per announcements over recent years), then with the availability of SDR based gNodeBs and SDR UEs, there is then considerable potential for PMSE, short term duration licensing in these bands in the future.

The key to this will be on-line dynamic spectrum access (DSA) and allocation tools, and we believe smart radios that can also sense spectrum usage in the bands in a specific location and feedback to an Ofcom managed or licenced database.

Lastly we also strongly believe that for DSA and therefore for PMSE licensing Ofcom should consider ‘type approving’ radios for their performance (e.g. with verifiable ACLR measurements and other performance figures submitted etc in their band of operation). If a radio is then type approved, then licences could potentially be released in minutes via a DSA online portal and process with a confidence that its not a ‘dirty’ leaky radio that will interfere with any neighbours.

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?

Is this response confidential? – N

In our experience operating and designing private 5G networks for wireless video applications, the overall production plan dictates the coverage and capacity requirements, which then dictate the corresponding spectrum requirements.

Generally, a single HD camera used for electronic news gathering (ENG) will require around 6-8 Mbps, but for coverage of a sporting event this could be up to 25 Mbps.

Working out how many cameras are needed and what the total throughput requirements are will inform whether a given P5G deployment requires 20 MHz, 40 MHz or 100 MHz carriers.

That is why it is crucial to appreciate the performance capabilities of P5G solutions, particularly when considering frame structure configurations as discussed further in our response to Question 23.

Question 21

What technologies are currently available or are being developed which can improve wireless video spectrum efficiency in the future?

Is this response confidential? – N

As discussed in our response to Question 17, we believe that the majority of wireless video PMSE applications should consider migrating to use deployments of private 5G.

This would allow for production environments to take advantage of the associated performance, flexibility, and integration benefits while also creating new opportunities for content capture through handset-based workflows.

As highlighted in our response to Question 23, the *frame structure* implemented by a P5G network can significantly impact the achievable performance. This is largely dictated by the hardware implemented in a given deployment.

To maximise the spectrum efficiency of such networks, it is imperative that the network configuration is optimised to suit the targeted application.

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?

Is this response confidential? – N

As discussed further in our response to Question 23, we believe that one of the issues currently associated with some implementations of private 5G technology for wireless video applications is the use of solutions that are not fully optimised for the use case requirements.

Specifically, the deployment of network infrastructure that cannot be configured to support sufficient uplink performance. When such devices are used, operators have to compensate for the achievable throughputs by over-subscribing on spectrum utilisation – i.e. using 100 MHz carrier bandwidths for a data throughput that could be achieved using 40 MHz or even less. For example equipment fixed to 7:2 downlink:uplink ratios needs a much wider bandwidth for the video uplink than equipment that can be configured to 2:7 downlink:uplink. Hence we suggest again that type approval for private 5G radios could be a good way forward in ensuring fair and efficient sharing of spectrum.

Therefore we again state that it is important for the industry to select and implement appropriate P5G solutions that are designed and optimised for the use case or application, rather than deploying generic solutions that are not fully fit for purpose.

Question 23

What types of video demand could realistically be supported by private (for example 5G) networks?

Is this response confidential? – N

For wireless video applications, the most critical traffic direction for video contribution and production links is in the '*uplink*' – from the capture camera to the receiver on a local user plane or in a cloud/remote production gallery.

The capacity and overall performance of a 5G network for video applications is dependent on a number of factors. This includes the channel bandwidth (e.g. 20 MHz or 100 MHz) and the receive sensitivity of the '*gNodeB*' or '*basestation*' units (antenna gain and radio performance), but also the transmit power (and antennas) of the *user equipment (UE)* device, and the frame structure used for the transmission.

As P5G is most commonly deployed as a *time division duplex (TDD)* technology (particularly in the frequency ranges 2320-2340 MHz and 3800-4200 MHz) all network elements will alternate in time between states of transmission and reception.

To maximise the uplink throughput or data capacity and make efficient use of spectrum to support multiple P5G-connected cameras, it is desirable to maximise the amount of uplink transmission and reduce time spent receiving downlink – data from the network to the camera.

This is achieved by changing the associated frame structure of carrier signals, which dictates how many timeslots are allocated to uplink or downlink in a given 5G TDD frame.

The implemented configuration in public 5G TDD networks is what is referred to as a *7:2* frame structure, where there are 7 downlink timeslots and 2 uplink timeslots (plus the flexible changeover slot) every millisecond. This arrangement is compatible with legacy LTE TDD patterns and is appropriate for the most common application of cellular technology by public networks – serving mobile broadband connectivity to consumers. This configuration, combined with massive MIMO arrays, is potentially capable of serving gigabits per second in the downlink. However, the uplink data rate is likely to be around *1 bit per second per Hz* – or 20 Mbps in a 20 MHz channel, or 100 Mbps in a 100 MHz channel.

This frame structure is often also commonly implemented in P5G solutions. Sometimes it is for spectrum licensing reasons, such as the coexistence requirements for the 2390-2400 MHz *Shared Access Licence (SAL)*. Unfortunately, it is often due to limitations of the selected basestation hardware. This significantly impacts the achievable performance and spectral efficiency, and can mean that some solutions are not appropriate for use in technically demanding wireless video applications.

The Neutral Wireless P5G solutions are capable of configuring the network resources to dedicate over 90% of timeslots to uplink traffic (there must be some downlink resources for control and uplink scheduling). This results in a practical real-world uplink data rate of over 3.5 bits per second per Hz – around 60-70 Mbps in a 20 MHz channel or 350-400 Mbps in a 100 MHz channel.

This highlights the importance of selecting and implementing appropriate P5G solutions that are designed and optimised for the use case or application, rather than deploying generic solutions that are not fit for purpose.

Question 24

What changes to working practices and spectrum planning could improve video spectrum efficiency in the future?

Is this response confidential? – N

As discussed in our response to Question 17, we strongly believe that a large number of wireless video deployments should be transitioning to use private 5G (P5G) workflows for contribution links and as an alternative to traditional wireless camera systems. This would allow for production environments to leverage the associated performance, flexibility, and integration benefits while also creating new opportunities for content capture through handset-based workflows.

Adopting these new workflows, combined with the new spectrum licence opportunities created by Ofcom, would be a significant change to the overall industry working practices.

For private 5G solutions for PMSE, we also believe that faster, online database driven licensing, and consideration of 'type or model approval' of 5G radios particularly in the upper n77 (3.8 to 4.2 GHz), can create solutions amenable to PMSE users for video and the "*we need it here and now*" scenario.

END OF DOCUMENT