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September 29, 2017

Via Electronic Mail

Radio Spectrum Policy Group - Secretariat
DG CNET B4: Spectrum – Office: BU33 7/065
European Commission
B-1049 Brussels
Belgium

Ref: Comments on the Radio Spectrum Policy Group's Draft Opinion on a long-term strategy on future spectrum needs and use of wireless audio and video PMSE applications (DG CNET/B4/RSPG Secretariat)

Ladies and Gentlemen,

Shure Incorporated ("Shure") welcomes the opportunity to comment on the RPSG draft opinion.[1] For over 90 years, Shure has been a respected manufacturer of high-quality, innovative audio products. Today, Shure is a leading global manufacturer of audio electronics, including particularly wireless microphones, used in a wide range of PMSE applications in the professional audio industry as well as in high-quality consumer applications.[2] Shure has been instrumental in fueling advancements in wireless microphone technologies and is intensely involved in the development of PMSE policy and regulations via ITU, CEPT and ETSI to meet the current and future needs of the industry and a wide range of commercial and consumer applications that rely on PMSE.

As a pioneering innovator of PSME technology, Shure has participated in spectrum proceedings and worked closely with regulatory authorities in analogous proceedings in multiple countries, notably, the United States, the United Kingdom, Canada, Japan, Australia, as well as in proceedings at the European Commission ("EC"). Shure is committed to improving spectrum efficiency as is demonstrated by its many technical advances including the *Axient* System. As such, Shure supports efforts that facilitate long-term technical and policy solutions aimed at ensuring the current and continuing future availability of sufficient, clean spectrum for PMSE use.

Shure applauds the RSPG for developing a well-balanced and instructive document that reflects an appreciation for the critical role that PMSE plays today in many sectors of the global economy and national cultures. Long-term regulatory certainty and visibility on spectrum issues is strongly desired by PMSE manufac-

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[1] Radio Spectrum Policy Group: Draft Opinion on a long term strategy on future spectrum needs and use of wireless audio and video PMSE applications, dated August 4, 2017 ("Draft Opinion").

[2] PMSE wireless microphones as used herein includes a variety of audio devices that operate on a secondary basis on locally unoccupied televisions channels and in other authorized bands. In addition to wireless microphones, this equipment includes in-ear monitors, wireless intercoms, and wireless cueing ("IFB") systems.

tures and users alike to support ongoing investments in research and development and bolster user confidence in the long-term stability of the PMSE community. While Shure commends RSPG for opening this inquiry on the long-term strategy for PMSE, Shure believes much work needs to be done before RSPG can identify realistic and effective solutions to the problem of shrinking PMSE spectrum and growing PMSE use.

Shure herein offers its comments on:

- Possible solutions and options for meeting the expected future needs and use of audio and video PMSE applications after the year 2020, particularly at peak use large events.

- Technological developments and regulatory requirements related to spectrum use that meet PMSE demands.

- A common roadmap identifying principals and approaches for addressing spectrum availability for audio PMSE.

Shure suggests the following issues as action points which should be addressed in the RSPG's report and opinion for further action:

1) RSPG recognises that the 470-694 MHz band is vital to the industry as a core band; this band should be protected through an EC decision from disruptive technologies such as White Space Devices and Supplementary Downlinks;
2) RSPG should provide long term certainty for the PMSE industry by confirming access to the 470-694 MHz band until at least 2030; long-term reliable planning requires that new spectrum applications be considered as early as possible and announced at least five years in advance;
3) The RSPG report should encourage the EC to harmonise the 1350- 1400 and 1518-1525 MHz bands and work via the CEPT-ITU for these bands to be placed in the ITU Radio Regulations;
4) In the immediate future, a portion of the UHF band and a smaller portion of the VHF band should be dedicated to PMSE as a primary use;
5) The RSPG report should also encourage all member states to fully implement the EC decision 2014/641/EU harmonizing the 800 MHz duplex gap and 1800 MHz duplex gap;
6) In its section *Improvements in working practices* the report should clearly identify how PMSE spectrum management can be improved, or at a minimum should request CEPT to study the issue;
7) In view of the draft opinion identifying the VHF spectrum as an important resource, the report should send a clear message to the Member States that this band needs to be fully accessible to PMSE in a similar manner as the 470-694 MHz band;
8) As to the envisaged "monitoring of developments in the UHF spectrum", the report should specify how this monitoring will be achieved;
9) The RSPG should send a request to CEPT for compatibility studies in suitable sharing bands for PMSE (an initial study should consider the DECT and its adjacent band).

I. Solutions to Current and Future PMSE Needs

The RSPG report examines possible solutions and options for meeting the future need of audio PMSE applications after the year 2020. The RSPG correctly recognizes that this assessment must take into account current spectrum bands used by audio PMSE as well as ongoing and expected spectrum reallocations. In this regard, Shure emphasizes that UHF (470-694 MHz) spectrum is essential to existing audio PMSE technology and operations *and will remain so for the foreseeable future.* Accordingly, regardless of proposals to introduce new services into the UHF frequencies and discussions of evolving PMSE technologies to facilitate greater spectrum use, technical and policy solutions must ensure that some amount of clean UHF spectrum, preferably no less than 30 MHz, and some smaller portion in the VHF (174-216 MHz), remains available to support ongoing PMSE operations. Clear and unambiguous protection of the 470-694 MHz band from supplementary down links (SDL) and similar services must be required through an EC decision to provide the industry and users spectrum certainty until the next review.

At the outset, Shure points out the importance of PMSE and the need for forward looking and decisive policymaking to give manufacturers and users confidence in the future spectrum resources available to PMSE and time to adjust to any changes. PMSE use across a range of industry segments is integral to significant parts of the European and many member states' economies. PMSE also is essential to cultural and civic activities for which economic value is not an adequate measure.

A. The Role of RSPG

Shure thanks the EU Commission for extending the initial work of the *Lamy* report and for producing a well-balanced draft opinion for the industry. Shure strongly supports an ongoing proactive role for RSPG. RSPG's active leadership will be essential to addressing the expanding, and often conflicting, demands for spectrum by incumbent and new services. In this role, RSPG must account for the fact that the use of audio PMSE continues to grow as it becomes essential "infrastructure" to production technologies across a broad range of applications supporting content creation and transmissions in ever increasing demand. Indeed, Shure urges the RSPG to take an even more active approach to address the multiple challenging regulatory, policy and technical issues raised by ensuring that existing and future PMSE operations will have sufficient spectrum to support demand, including at large peak-demand events.

B. How to Characterize PMSE: Applications and Attributes

Shure commends the RSPG for its appreciation of PMSE's fundamental role in a broad range of events and activities – cultural, educational, business, entertainment, sporting, religious and civic events -- all with a common need for real-time presentation of audio and often video information. Today's wireless PMSE systems deliver excellent audio performance with very high reliability. This is critical because wireless microphones are at the front end of the audio chain and therefore they establish the quality for all downstream uses; for example, the capacity

and quality of PMSE operations affect the quality of live broadcast, live sound reinforcement, CD and DVD recordings, etc. according to the type of production. As the enabling technology to more and more content distribution, the regulatory and spectrum environment for PMSE has become critical to major industry and cultural sectors where content transmission is key, regardless of the technology platform used for distribution (broadcast TV, cable TV, film and music recording, Internet streaming, etc.)

In this examination of the technology trends and regulatory policies relevant to audio and video PMSE, any paths identified as long-term spectrum and regulatory solutions for PMSE must take into account the very distinct attributes and applications of PMSE. PMSE is quite different from other wireless services and the RSPG must be careful not to overlay technical and policy assumptions and judgments that may be reasonable to apply to other wireless services, such as 5G, but not appropriate for audio and video PMSE.

PMSE today involves a broad range of diverse applications including applications important for tourism, political leadership, cultural and civic engagement. PMSE is used extensively in everyday applications such as news gathering, business events, university seminars, local government, etc. PMSE is also integral to production of content that attracts a global audience and significant economic investment. A vast array of organizations rely on PMSE spectrum for the production of content relevant to:

- Performing Arts
- Concerts
- Sporting Events
- Broadcasting
- News Gathering
- Film and TV Production
- Corporate Events
- Entertainment Venues
- Educational Institutions
- Houses of Worship
- Government Activities

PMSE today can be viewed in three performance tiers based on the application:

- High: highest end professional quality PMSE systems used in large events,

- Medium: medium-sized events with professional performance demands comparable to large events, and

- Consumer: applications that support small events typically with no need for professional staff and where the content is not intended for recording or distribution.

PMSE users across all three tiers demand high-quality performance and reliability and professional users in the High and Medium tiers have zero tolerance for degradations in quality. Limited and/or unreliable spectrum availability, extraneous

noise, artefacts, dropouts due to interference, latency and throughput delays all undermine the essential value of PMSE for these segments. Unlike the relatively small impact of flaws in transmission quality in other wireless services, any of these flaws can destroy the essential value of the PMSE–supported performance or presentation. As the RSPG correctly observes, there is no opportunity to re-do live presentations or performances and therefore sufficient clean spectrum and interference protection for PMSE operations are essential.

The UHF television band within 470-694 MHz is the primary band for professional wireless audio PMSE operation globally. This band offers the most reliable operation due to a combination of good propagation, satisfactory antenna efficiency, and relatively low and predictable ambient noise and interference levels. Other bands that are used, where available, include the VHF television band in 174-216 MHz, 823-832 MHz, and 863-865 MHz. These bands are subject to high levels of interference in certain locations. The aeronautical DME band ("Air Band") in 960-1164 MHz is currently being studied for shared use by PMSE. A few administrations have allowed licensed PMSE systems to operate in portions of the 1350-1400 MHz and 1518-1525 MHz bands, but the long-term availability of these frequencies is uncertain, and the administration in charge of the allocation should be encouraged to make them available to help alleviate the loss of the 700 MHz band.

C. <u>Solutions for Peak Demand</u>

The RSPG draft report focuses on PMSE usage for large scale events and other situations in which it may be challenging to meet spectrum demand at any given time. Shure agrees with RSPG's observation that the ability to meet PMSE demand is "timing and location specific."[3] This is illustrated in areas of intensive use such as large events (e.g., concerts, sporting events, etc.) and concentrated areas of multiple PMSE users (e.g., London's West End and other theatre districts), or large events such as the Olympic Summer Games in London and Paris which present special challenges.

Overall demand for PMSE operations continues to rise for several reasons. First, the number of high-production events in public demand is growing. Today, live performance music concerts, live theatre, sporting events, corporate events, and Houses of Worship productions are increasingly popular. Second, providing PMSE support to meet peak demand has become more and more complex and challenging as the size and sophistication of production events has increased (e.g., Cirque du Soleil, award shows, etc.).[4] Third, demand for PSME support even in everyday uses has risen with the proliferation of access to content and programming from online sources, both pre-recorded and streaming. The rising trend in all of these factors is expected to continue and, accordingly, the RSPG is correct in assuming that demand for wireless PMSE will continue to increase.[5]

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[3] Draft Opinion at 7, 20.
[4] See Draft Opinion at 20.
[5] Same source.

Shure does not agree with the RSPG's prognosis that technology advances will make possible the continued deployment of peak demand events for both audio and video PMSE. We question the validity of this prognosis as manufacturers of equipment that already provides the highest number of audio links in a given swath of spectrum utilizing state-of-the-art technology. Manufacturers and users continue to face the difficult challenge of identifying sufficient interference-free spectrum necessary to meet growing performance requirements while PMSE spectrum is pressured by competing demands for spectrum from other services and users seeking new spectrum. In particular, the reassignment of TV in the UHF bands in favour of mobile wireless services and white space devices is a significant problem for PMSE that must be addressed.

PMSE support for peak demand events is particularly at risk. It is becoming increasingly more difficult to meet PMSE performance requirements at peak demand events, and Shure views the continuing increase in demand without a concomitant expansion of spectrum resources a concern of escalating urgency. In the next few years, if spectrum available to PMSE continues to be reduced, Shure expects that it may be impossible to meet the need for PMSE support to large scale events in certain locations.

In Section II below, Shure outlines the current state of technical advancement of PMSE technology and addresses the status, benefits, and challenges relevant to technical solutions strategies based on expanded digital transmissions, cognitive PMSE, 5G, and broad tuning ranges. Regardless of new PMSE technology developments and strategies, Shure emphasizes that none of these developments alone or in concert are expected to compensate for the loss of critical PMSE spectrum. In particular, UHF spectrum is essential to existing audio PMSE technology and operations *and will remain so for the foreseeable future.* Accordingly, regardless of proposals to introduce new services into the UHF frequencies and discussions of evolving PMSE technologies to facilitate greater spectrum use, the long term solution path(s) carved out for PMSE must ensure that some amount of clean UHF spectrum, preferably no less than 30 MHz, and some smaller portion of the VHF band, remains available to support ongoing PMSE operations. Shure accordingly urges the RSPG to include a recommendation in its report that some portion of both the UHF and VHF bands will need to be permanently designated to PMSE operations to accommodate current and long-term needs, along with other PMSE spectrum that can be made available.

II. <u>PMSE Technology Developments</u>

The RSPG draft report is correct in acknowledging the growth of wireless audio PMSE in the last decade and corresponding advancements in planning, coordination and technology promoting more efficient use of spectrum.[6]

RSPG recommends that the PMSE industry and academia continue research and development of advanced technologies to make better use of the available spectrum.[7] While the core of the RSPG's statement is accurate and Shure continues

[6] Draft Opinion at 8-12.
[7] Draft Opinion at 8.

to invest heavily in R&D, Shure cautions that anticipated technology developments described below cannot be counted on to make up for a lack of available PMSE spectrum. Intensive reuse of spectrum already takes place at large events where users can be assigned different time slots and/or locations. Furthermore, new high-density digital PMSE modes require clean spectrum for operation.

In fact, some of the technical developments discussed present so much uncertainty, the RSPG should simply commit to study their development without taking any action or offering any opinion regarding whether those technical strategies will ultimately bear fruit. One thing that is clear at this time is that none of the technology strategies identified by the RSPG -- standing alone -- present satisfactory and complete solutions in the foreseeable future for PMSE particularly if PMSE spectrum needs go unaddressed or the situation worsens. Both access to sufficient available, interference-free PMSE spectrum *and* continued advancements in PMSE technology will be required to ensure that peak demand events will be adequately supported in the future.

Shure agrees with RSPG's perception that the development of high end equipment for high density applications is "the preserve of top-end equipment which is usually used at peak demand scenarios …" but that could "trickle down" to users and technologies relevant to other tiers over the next few years.[8] Nonetheless, RSPG is correct in identifying several principle factors essential in the development of PMSE technology, namely the need for sufficient spectrum and a stable spectrum environment providing certainty over a longer term. Together, these attributes combine to provide incentives for manufacturers and users to continue to invest in PMSE technology.

A. <u>Current Digital Technologies</u>

As a leader in PMSE technology advances, Shure attests that PMSE manufacturers have undertaken substantial efforts to develop technology strategies to address a shrinking supply of spectrum available to PMSE and the greater risk of interference resulting from congested PMSE use and other spectrum entrants. Over a period of many years, the PMSE industry has developed and refined narrowband (i.e. 200 kHz) wireless transmission to an extremely high degree of performance, efficiency, and reliability. Users have come to expect and depend on this technology architecture to provide outstanding audio transmission capabilities. Currently, wideband digital systems are being studied by some manufacturers. Any new replacement technology will need to at least equal and preferably exceed the performance of current products.

Shure agrees with the RSPG that use of digital microphones will become more widespread, although analogue technology will continue to meet certain specific needs.[9] Much of the industry has transitioned to the use of digital transmission, which enables significant improvements in spectral efficiency. For example, in standard mode, Shure's *Axient* digital PMSE system enables up to 22 high quality audio channels to be transmitted in a single 8 MHz TV channel. In high density

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[8] Draft Opinion at 9.
[9] Draft Opinion at 21.

mode, it is possible to pack as many as 63 audio channels into 8 MHz with little to no perceived loss in audio quality, at the expense of a reduction in range due to lower transmitting power.

B. Development of Cognitive PMSE technologies

The RSPG states that cognitive PMSE systems may eventually enable a higher degree of automation in frequency use with greater flexibility perhaps enabling more users in the same frequency range resulting in increased spectral efficiency.[10] Shure agrees that some cognitive PMSE techniques are very promising, noting that basic cognitive techniques such as scanning have long been incorporated into PMSE technology and today are a standard part of coordination procedures. While there have been significant advances in cognitive PMSE technologies, these more advanced cognitive technologies are available and in use primarily by top tier professional users. Such technologies are on the high end of cost and complexity and are not appropriate for medium or low end use cases. Further, while cognitive PMSE systems are being studied within ETSI, there are a wide range of technology and licencing issues yet to be addressed to enable cognitive techniques to be considered a reasonable and realistic solution for PMSE. As such, although it is important to continue R&D investment in cognitive techniques, we do not expect advanced cognitive PMSE technologies to be in widespread use across all user tiers in the near future.

C. The Future of PMSE and 5G

Shure views with caution the assertions of the RSPG with respect to the potential applicability of 5G technology for PMSE applications. The RSPG draft states that "5G may be able to technically support PMSE use cases,"[11] noting that 5G features low latency and 'network slicing' making it possible to manage and prioritize traffic from individual users in order to offer the required level of QoS." The draft acknowledges that mobile operators would first need an "attractive business case" to address the PMSE market and also "acceptable prices and usage conditions for PMSE users."[12] Further, the RSPG draft notes that "the high cost of network investment and prioritization may affect service and performance of other customers especially in large events."[13]

At the present time, 5G technology and the use of the 5G technology platform is wholly unproven and undefined and therefore cannot be considered as a viable solution for PMSE. That said, Shure and other audio PMSE stakeholders are monitoring and actively exploring the potential development of PMSE technologies in 5G. While 5G is worthy of further study, there are very significant and fundamental technical, economic, and practical questions that need to be answered before an assessment can be made about the realistic potential for successful PMSE operations in 5G.

Currently, professional PMSE users have access to dedicated, licensed spectrum on which they can rely. The availability and cost of this spectrum is well-known,

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10 Draft Opinion at 10.
11 Draft Opinion at 21.
12 Draft Opinion at 10.
13 Same source.

enabling PMSE users to carefully and reliably plan events. If PMSE systems operate in 5G spectrum that is shared with mobile services, PMSE users cannot be assured that spectrum will be available where and when it is needed. The 5G-based technology will likely be unsuited for large events that currently rely on PMSE technologies. Often, large PMSE productions take place in locations where there is also high demand for mobile services, such as sports venues and theme parks. Mobile providers would need to commit to make sufficient spectrum available for PMSE operation under terms and conditions that address PMSE needs even if it meant limiting or denying service to mobile subscribers.

Other terms and conditions of PMSE use would need to be established including how spectrum access would work, whether PMSE systems would be able to operate on a "private node" basis or whether they would need to operate on a mobile provider's network, and how spectrum access would be priced. PMSE systems use hundreds of wireless microphones and sometimes operate for many hours at a time. The data cost for that scale of operation could potentially be prohibitive. Furthermore, in many cases, mobile networks are inaccessible or weak in areas where PMSE systems operate, such as inside large theatres and exhibition halls. Microcells would be needed in these areas, especially if 5G systems operate in multi-GHz frequency bands. The requirements would vary depending on whether PMSE systems were operated on a network or use private infrastructure and how frequency management was accomplished.

Other technical issues that need to be researched include latency, network reliability, and priority of access. For today's professional PMSE users, end-to-end latency of 2-3 milliseconds or less is expected for digital systems, dropped signals and unwanted noise are totally unacceptable, and priority over other uses for the duration of the program is mandatory.

Finally, PMSE manufacturers are acutely aware that PMSE users will not easily accept the risk of a completely new and unproven PMSE technology. Any movement away from existing successful and long-established PMSE technologies can only be accomplished when the technical, operational, and economic attributes of PMSE 5G transmission are demonstrated with certainty.

D. <u>Tuning Ranges</u>

Shure agrees generally with the RSPG that microphones will have even more flexibility to operate over a broad tuning range,[14] but cautions that the potential costs and benefits of adopting broad tuning ranges cannot be assessed unless and until specific tuning ranges are defined. Wide tuning ranges do allow for operation across fragmented spectrum, such as in different countries that have adopted generally similar yet disparate spectrum schemes. However, producing PMSE equipment with broad tuning ranges requires making trade-offs with respect to other technical considerations. In particular, equipment operating with much broader tuning ranges may be more vulnerable to receiver overload interference when relatively strong signals are present in adjacent bands. Harmonized spectrum allocations between countries, rather than increasingly wide tuning ranges, provide the greatest potential for compliant operation and maximiza-

[14] Draft Opinion at 4.

tion of return on equipment investment by PMSE users. Accordingly, Shure agrees with the RSPG that while deployment of PMSE equipment with wider tuning ranges can be beneficial it is by no means a complete solution to the spectrum challenges of PMSE operation at peak demand events today or in the future.

III. Common EU Roadmap For Future Spectrum Availability for Audio and Video PMSE

Shure agrees with the RSPG's view that a common roadmap identifying principles and approaches of spectrum availability for PMSE across EU member states could be an effective tool to ensure that sufficient PMSE spectrum continues to be available across the borders of the individual EU member states. Currently there is variation within the EU member states' spectrum bands for PMSE, and these disparate national allocations are problematic for PMSE users who operate internationally, both in terms of compliant operation and in equipment investment. National variations also create a cost penalty for manufacturers who bear the expense of creating and certifying multiple product variants to meet country-specific regulations.

This common goal of an EU-wide PMSE roadmap can only be achieved by the proactive work of the RSPG and should include the relevant ETSI groups and industry representatives. Planning for average use must aim for policies that have the potential for widespread adoption on a *global* level (in order to achieve economies of scale), while at the same time being sufficiently flexible and enabling the use of new technologies. On the national level, policies should encourage sufficient availability of peak-demand spectrum for large events based on the requirements of professional users who support these productions and who are intimately familiar with the capabilities of PMSE equipment. As large event productions become increasingly technically complex to attract larger audiences, the needs assessment from PMSE engineers "in the trenches" will become even more crucial in determining sufficient spectrum allocations to meet their needs now and in the future.

Shure applauds the work of the RSPG and will continue to support its efforts to secure sufficient access to spectrum for PMSE as a vital industry that provides a critical service to the European economy, society and culture.

Regards,

Mark Brunner
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Corporate and Government Relations