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Shure's Response to New Zealand Radio Spectrum Management (RSM) Spectrum Outlook 2022-2026

1. Introduction

For almost 97 years, Shure has been a leading manufacturer of high-quality, innovative audio products. Shure's products (www.shure.com) are utilized worldwide in applications known as Programme Making and Special Events (PMSE), which is an ITU's inclusive term consisting of radio microphones, in-ear monitors, wireless cameras, talkback systems, etc. This includes deployments in industries such as broadcast and film production and other professional indoor and outdoor media content creation, in addition to a variety of other civic, business, and special event contexts. These applications continue to grow in scale and density worldwide to meet the needs of broadcast and event producers engaged in increasingly complex productions to meet audience expectations.

Audio is of prime importance in the world of PMSE. Without the "audio" part of an event, CEOs, politicians, and entertainers cannot communicate with impact to their audience. New Zealand holds a dominant position in the world of content production and this continues to grow.

During the Covid pandemic we have seen a transition driven by the resilience of the sector and the power of the human spirit that has found new ways of reaching not only that same audience as before but a more diverse, wider global audience as well.

- Facebook and Instagram report that 800 million people per day are watching live streams. The trend is projected to continue with 74% of live stream viewers saying they would continue to watch live streams even after concerts returned, and 70% would be willing to pay for live stream.
- In addition to the traditional live audiences, both recorded & live streams to cinemas globally opened a whole new audience. In the face of a pandemic, this has grown to include the online, on demand, live-streaming platforms – a new engagement that is here to stay. For example, globally, Netflix anticipated $17bn spend on Content Creation in 2020, rising to $26bn in 2026. Disney allocated $500m.

From primarily a film, theatre and TV industry PMSE is now important to every smartphone in the world.

Shure has actively participated for many years in various spectrum compatibility studies and consultations around the world, including in ITU and hereby, respectfully submits its comments to this RSM's document mostly to highlight an important matter that we believe is missing in the RSM's consultation:

- **Spectrum outlook for PMSE to ensure that PMSE continues to contribute to the society and economy of New Zealand.**

2. Continued access to spectrum in 470-694 MHz for PMSE is critical for its future

RSM does not explicitly address the important question of long-term availability of spectrum to support content creation in its document. Over the last decade we have seen PMSE spectrum reduce dramatically to go to the mobile service use while the demand for PMSE created content is experiencing significant growth driven by both the traditional audiences and the new global audience realized by new delivery platforms as explained above. It is essential to recognize the significance and social and economic value of PMSE and the efforts the PMSE industry has made to improve spectral efficiency to mitigate the losses.

Continued access to spectrum for PMSE, especially in the 470-694 MHz range, should be a top priority for RSM.

We further note the 470-694 MHz range, which is currently used by TV broadcasting and PMSE in many other countries worldwide, is being studied for mobile use in ITU-R Region 1 covering Europe, Russia, Middle East and Africa and a decision is expected at the next World Radiocommunication Conference of 2023 (WRC-23) in United Arab Emirates. A presentation was made on February 1st, 2022 to CEPT CPG PTD (the CEPT group dealing with this WRC-23 Agenda Item) noting the vitality of the PMSE industry and emphasizing the need to ensure long-term access to spectrum in the 470-694 MHz band by PMSE.[1]

We hereby provide some additional information that we hope would make RSM consider PMSE to be vital enough for it to be included in the proposed outlook.

1. Advances in PMSE Technologies

- ***Wireless Multi-Channel Audio System (WMAS)***

The PMSE industry is very innovative, resourceful and embracing of new technologies. It constantly seeks to improve and enhance both the spectrum and user aspect of the equipment.

A recent development is WMAS technology which brings wideband functionality into the PMSE domain, enabling centralized and automated controls for a diverse array of traffic types and client devices operating on a bi-directional basis. WMAS technology is one of the “next generation” wireless microphone systems: a technology that makes possible significantly more operating channels per megahertz through use of wideband.

[1] https://www.cept.org/ecc/groups/ecc/cpg/cpg-ptd/client/meeting-documents/file-history/?fid=68607

Significant increases in audio channel capacity are possible. For example, top tier professional microphone systems currently supporting 17-22 channels per 8 MHz could expand to support 30+ channels.

WMAS could operate in all frequencies currently available to PMSE, including frequencies in the 470 – 694 MHz. It is also critical that New Zealand also authorizes WMAS wideband technology for PMSE use.

Shure has also been active in developing the ETSI standard EN 300 422 for wireless microphones[2] that already supports WMAS with up to 20 MHz bandwidth.

In particular, WMAS will enable efficiency gains by using a bi-directional transceiver configuration to consolidate operations for professional [grade] performers in live events by combining wireless In-ear Monitor ("IEM") receiver and wireless microphone transmitter operations onto a single WMAS base unit.

However, WMAS is not a complete replacement for exisiting wireless microphone operations and deployments. Depending on the application, the necessary number of audio links and the RF environment, wideband or narrowband systems will be deployed or even a mixture of both.

- ***PMSE and 5G***

While Shure continues to invest heavily in R&D, we caution that anticipated technology developments, especially for the 5G platform, cannot be counted on to make up for a lack of suitable spectrum for PMSE operation. Intensive reuse of spectrum already takes place at large events where users are assigned different time slots and/or locations. Furthermore, new spectrally efficient high-density digital PMSE modes require clean spectrum for successful operation.

Shure is very careful when it comes to the assertions made about the potential applicability of 5G technology for PMSE applications as various publications on the subject show.[3] Indeed, at the present time, the feasibility of integrating audio PMSE applications into 5G is unproven and undefined on either a technology or economic basis. It, therefore, cannot be considered as a viable solution for audio PMSE in the foreseeable future.

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[2] https://www.etsi.org/deliver/etsi_en/300400_300499/30042201/02.01.02_60/en_30042201v020102p.pdf

[1]: Guirao M., Wilzeck A., Schmidt A., Septinus K., Thein C.: "Locally and Temporary Shared Spectrum as Opportunity for Vertical Sectors in 5G", IEEE Network (Volume 31, Issue 6, 2017)

[2]: Pilz J., Holfeld B., Schmidt A., Septinus K.: "Professional Live Audio Production – A highly synchronized 5G URLLC Use-Case", IEEE Network (Volume 32, Issue 2, 2018)

That said, Shure and other audio PMSE stakeholders are monitoring and actively exploring the potential development of audio PMSE technologies in 5G and take part in e.g., 5G-Media Action Group (5G-MAG).

The reason why most of today's audio PMSE devices are based on proprietary transmission schemes is the need to meet the following extensive requirements simultaneously and during the whole operating period:

- Ultra-low latency
- Very high transmission reliability
- Very high audio quality
- High spectrum efficiency

For example, latency of current equipment is in the range of 2-5 ms, the packet error rate between 10^{-4} and 10^{-6} and more than 15 wireless microphones can be deployed in 8 MHz bandwidth. So far, 5G has not yet shown or demonstrated equivalent performance.[3]

While 5G URLLC (Ultra-Reliable Low Latency Communications) seems to be a promising candidate for audio PMSE, the proof is still pending as to whether all requirements can be fulfilled.

Currently, professional PMSE users have access to interference free spectrum on which they can rely. The availability and cost of this spectrum are well-known, enabling PMSE users to carefully and reliably plan events.

PMSE systems cannot operate in spectrum that is co-channel with 5G services[4], and requires a guard band before PMSE users can be assured that interference free spectrum will be available where and when it is needed.

Often, large PMSE productions take place in locations where there is also high demand for 5G service, such as sports venues and theme parks, which will make co-channel operation problematic.

RSM should have technology neutral regulations to allow technologies like WMAS to be deployed in non-public network mobile spectrum currently under consideration.

2. Spectrum for PMSE

Like all wireless communications technologies, PMSE needs spectrum. As RSM designs a policy and regulatory framework to support the development of new wireless technologies, they should ensure that PMSE continues to get access to valuable and relevant spectrum. In particular, the UHF TV band within 470-694 MHz is the primary band for professional wireless audio PMSE operation globally, especially for touring productions. This band offers the most reliable

[4] https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-BT.2338-2014-PDF-E.pdf

operation due to a combination of good propagation, satisfactory antenna efficiency, and relatively low and predictable ambient noise and interference levels.

3. Innovative spectrum access approaches

We would respectfully suggest that Non-Public Network spectrum is essential in providing a base for other industries to develop new innovative systems and solutions. There are various approaches based on locally licensed, shared and unlicensed spectrum that can unlock spectrum that is free or affordable and can allow new innovative applications. Reuse of spectrum unused by mobile operators should also be actively pursued.

Examples include the following:

- USA FCC's Broadband Radio Service (CBRS) band in which new commercial operations are governed by a Spectrum Access System (SAS) which ensures that the new systems can coexist with the incumbent military radar systems.[6] The CBRS framework can be streamlined to something much simpler to satisfy the 3.8-4.2 GHz needs as the incumbents tend to be static Fixed Satellite Service (FSS) earth stations and not radars embarked on ships in USA. The CBRS specifications developed by the Wireless Innovation Forum (WInnForum) for the interactions of the SAS with the new commercial users can be adapted for the 3.8-4.2 GHz situation.[7]
- UK regulator Ofcom introduced a new licensing approach in the 3.8-4.2 GHz, through local licences (called Shared Access licences).[8] Potential users can apply to Ofcom for coordinated access to these bands in specific locations on a first-come-first-served basis. Longer term, Ofcom is studying the use of automated spectrum management tools that would allow adjustment of technical parameters of these new users over time. These tools could be an adaptation of the SAS developed in the USA for the CBRS band.
- Germany's regulator BNetzA assigned frequencies in the 3.7-3.8 GHz band for local networks. The bandwidth requested can be from 10 MHz to 100 MHz. The spectrum can be used in particular for industry 4.0, but also in the agricultural and forestry sector.[9]
- Unlicensed 6 GHz (5925-7125 MHz) band. Given that the extensive growth of Wi-Fi needs more spectrum, RSM should consider opening the whole frequency range from 5925 MHz to 7125 MHz ("6 GHz") for Wi-Fi use. While the use of the upper 6 GHz (6425-7125 MHz) for International Mobile Telecommunications (IMT) is under study for the World Radiocommunication Conference of 2023 (WRC-23), we note that no regulator has issued rules for IMT use of that band. While certain entities are asking to wait for WRC-23 decision before deciding on the use of the upper 6 GHz band, we are of the view that New Zealand should consider opening that band on an unlicensed basis so that its citizens can benefit from the 6 GHz Wi-Fi ecosystem enjoyed by the USA, Canada, Brazil and South Korea. In addition, technology neutral rules would also allow development of ecosystems in 6 GHz which are not based on Wi-Fi, like 3GPP NR-U or ETSI PMSE Wireless Multi-Channel Audio System (WMAS)[5].

[5] See https://www.etsi.org/deliver/etsi_en/300400_300499/30042201/02.01.02_60/en_30042201v020102p.pdf

Furthermore, to make more efficient use of the spectrum, enable new use cases and benefit from the unlicensed ecosystem emerging from the USA, RSM could consider the FCC's 6 GHz regulations as follows:[6]

- low power restricted to indoor use *without* an Automated Frequency Coordination (AFC) system across the whole 1.2 GHz of spectrum with:
  - Access Points at a Maximum Equivalent Isotropic Radiated Power (EIRP) of 30 dBm and EIRP Power Spectral Density (PSD) of 5 dBm/MHz.
  - Client Devices at EIRP of 24 dBm and EIRP PSD of -1 dBm/MHz to ensure that client devices remain in close proximity to the indoor access points.
- higher standard power indoor and outdoor operations controlled by an AFC[7] system that would prevent interference to any incumbent fixed systems with:
  - Access Points Power up to 36 dBm EIRP (EIRP PSD of 23 dBm/MHz).
  - Client Devices power up to 30 dBm EIRP (EIRP PSD of 17 dBm/MHz).
- The FCC's regulations could also be considered to protect any incumbent Fixed Satellite Service (FSS) uplink (earth stations to satellites direction) operation:
  - Standard power access points and fixed client devices located outdoors must limit their maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon to 21 dBm (125 mW) to protect fixed satellite services.

In summary, Shure will continue to support RSM's efforts to secure access to sufficient spectrum, including in the 470-694 MHz range, for PMSE as a vital industry that provides a critical service to the economy, society and culture of the New Zealand.

Please contact the undersigned if you have any questions.

Respectfully submitted,
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[6] https://docs.fcc.gov/public/attachments/FCC-20-51A1.pdf
[7] https://docs.fcc.gov/public/attachments/FCC-21-100A1.pdf