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28 April 2024

Shure's Comments to
Five-year spectrum outlook 2024–29 and 2024–25 work program Draft for consultation of ACMA

Shure Incorporated welcomes the opportunity to comment on ACMA's Five-Year Spectrum Outlook (FYSO).

Since 1925, Shure has been a leading manufacturer of high-quality, innovative audio products based in the United States. Shure products (www.shure.com) are utilized worldwide in applications known as audio Programme Making & Special Events (PMSE[1] also known as SAB/SAP[2]). PMSE equipment such as wireless microphone is playing an essential role in supporting productions in several facets of Australia life, culture, and economy. Beyond their traditional role in broadcasting and film production, wireless microphones support productions in a wide range of sectors including news reporting, theater, music, sports, worship, civic events, transportation infrastructure, and education.

ACMA notes that "The television broadcasting spectrum in Australia is also used by various forms of white space devices, most notably wireless audio devices, such as wireless microphones. Future planning decisions concerning the use of white space devices in the 600 MHz band will be guided by relevant government policy decisions."

Shure remains at the disposal of ACMA's and the Australian government to provide additional inputs to help guide any decisions that can impact the use of PMSE in the 470-694 MHz band.

Shure also welcomes ACMA recent decision on 1.9GHz proposing the inclusion of DECT 2020 Australia-wide in the 1880–1900 MHz frequency range and indoor only in the 1900–1920 MHz range, and rail mobile radio (RMR) along rail corridors in the 1900–1910 MHz frequency range. We will further comment on the dedicated consultation.

We therefore recommend ACMA to:

- Keep the 470-694 MHz band for PSME use. While there is an interest for potential use for IMT, we do not think that the demand will be there in the forthcoming decade;

- Assess other suitable bands such as 960-1164 MHz, 1240-1260MHz or 1350-1400MHz for wireless microphone;

[1] PMSE is the ITU's inclusive term consisting of radio microphones, in-ear monitors, wireless cameras, talkback systems, etc

[2] Services Ancillary to Broadcasting (SAB)/Services Ancillary to Programme making (SAP)

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- Modify the current bandwidth limit of 330 kHz to allow the deployment of WMAS products and the indoor limitation in certain scenario. Furthermore, WMAS technology should be allowed with 100 mW EIRP maximum for Wideband Multichannel Audio Systems (WMAS) with an occupied bandwidth of up to 6 MHz in the TV-UHF band and up to 20 MHz in other bands;

- Following the outcome of the consultation on LIPD[3] (in May 2023) , ACMA has considered to develop regulatory arrangements for WMAS in Australia. Shure is supporting ACMA to develop a more detailed proposal for consideration and possible inclusion of WMAS capabilties in a future update to the LIPD Class Licence.

Please contact the undersigned if you have any questions.

Respectfully submitted,
Guillaume Mascot
Head of Spectrum & Regulatory Affairs, Asia-Pacific
[redacted]

1. Audio PMSE enables content creation

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. Wireless microphones are ubiquitous to public life. They are widely used and relied upon in schools, houses of worship, government buildings, museums, and many other public places. The lives of most citizens are touched and enhanced by wireless microphones every day, whether in one of these places or by enjoying programs that were produced using wireless microphones. In all of these applications, wireless microphones must operate flawlessly. Interruptions, interference, and noise are not tolerated. This highlights the need for adequate amount of appropriate, clean spectrum.

During the Covid pandemic we have seen a transition driven by the resilience of the sector and the power of the human spirit that have found new ways of reaching not only that same audience as before but a more diverse, wider global audience as well. The demands for high-quality online content and meetings have dramatically increased worldwide.

2. Spectrum Requirements for PMSE

A typical event production today needs 40 – 80 wireless microphones and in-ear monitoring systems with high quality of service, which requires more than 60 MHz of clean

[3] https://www.acma.gov.au/sites/default/files/2023-05/lipd_class_licence_update_-_outcomes_paper.pdf

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spectrum in the TV-UHF band below 1 GHz. Studies such as the Lamy Report[4] in Europe concluded that approximately 96 MHz are sufficient for the daily use of audio PMSE in the UHF band below 1 GHz.

The 96 MHz requirement for daily use does not consider large events including events of national or global interest like the Olympics games. Those events do generate a very high "peak" demand, which might require more than 100 MHz of spectrum. We can even safely estimate that since the release of the Lamy report the demand has increased.

Required spectrum grows each year for medium and large events. A study[5] conducted by Swiss Radio and Television to determine the spectrum need for audio PMSE, categorizes daily spectrum requirement into; permanent use, events, and exceptional spectrum requirements. The study analyses data of 111 events over the past three relevant years.

PSME spectrum needs is increasing to satisfy the growing demand from physical end-users but will be even more as more immersive content with pristine sound caption (requiring more wireless equipment) will be developed.

Spectrum available for PMSE applications in the spectrum below 1 GHz has been shrinking over time, going to the mobile service for 3G, 4G and 5G deployments and as such, it is becoming harder and harder for the PMSE industry to support important cultural, sports and other events in the future.

Nevertheless, we observe that PSME spectrum needs is increasing to satisfy the growing demand from physical end-users and will be even more as more immersive content with pristine sound caption (requiring more wireless equipments) are developed to have new experience and content to bring value to digital networks such as 5G. Therefore Spectrum for PMSE is crucial for the whole digital and creative economy;

3. New possibilities for Audio PMSE

Wireless Multichannel Audio System (WMAS)

To overcome the shrinking access to TV-UHF band and cater to growing demands, the audio PMSE industry is continuously developing spectrally efficient and innovative products, but these advances cannot completely make up for any lack of spectrum.

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

[4] https://digital-strategy.ec.europa.eu/en/consultations/public-consultation-lamy-report-future-use-uhf-tv-broadcasting-band

[5] https://apwpt.org/wp-content/uploads/2022/03/Report-PMSE-Audio-spectrum-requirement.pdf

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- Very high audio quality
- High spectrum efficiency

A recent development is Wireless Multichannel Audio System (WMAS) technology which brings wideband transmission into the traditional narrow band PMSE domain. WMAS is a wideband system that provides multi-channel audio transmission capabilities by allocating one shared wideband RF channel for at least 3 audio channels per MHz RF bandwidth which increases the efficient use of spectrum compared to the traditional narrowband deployment. WMAS will not replace all narrow band devices, but it allows wider scalability and flexibility to meet user's needs. It also offers the possibility to provide higher data rates than narrow band equipment which is restricted there due to the 330 kHz bandwidth limitation or for indoor use only.

Shure as a global leader in the PMSE sector is looking to bring the latest technologies in the market such as WMAS and to ensure global harmonisation. We are observing a positive trend in decision and we can only recommend ACMA to also follow the same principles. Here are some examples:

- *United States: FCC regulation update (adopted on Feb 15th, 2024)* [6]

The U.S. Federal Communications Commission in the United States has just amended Parts 15 and 74 of its Rules for Wireless Microphones in the TV Bands and other bands and frequencies where they are authorized to operate in order to permit the use of newly developed Wideband Multi-Channel Audio System (WMAS) technology. This technology will enable further improvements in spectral efficiency beyond what has been achieved with narrowband digital systems, and it is well-suited for operation in the TV-UHF band.

Highlights from FCC's WMAS regulations:

- Permit licensed wireless microphone users to operate WMAS on frequencies already available for Part 74 licensed wireless microphones in the VHF-TV bands (54-72 MHz, 76-88 MHz, and 174-216 MHz), the UHF-TV band (470-608 MHz), the 653-657 MHz segment of the 600 MHz duplex gap, and in the 941.5-944 MHz, 944-952 MHz, 952.850-956.250 MHz, 956.45-959.85 MHz, 1435-1525 MHz , 6875-6900 MHz and 7100-7125 MHz bands.
- Permit WMAS operating under Part 74 to use up to 6 MHz channels in the TV bands, up to a 4 MHz channel in the 600 MHz duplex gap (653-657 MHz), and up to 20 MHz channels in other bands, but allow smaller channels when less spectrum is available in a band or is sufficient for an application.
- Permit unlicensed wireless microphone users to operate WMAS on frequencies already available for Part 15 unlicensed wireless microphones in the UHF and VHF TV bands and in the 657-663 MHz segment of the 600 MHz duplex gap with up to 6 MHz channels but allow smaller channels.

[6] https://docs.fcc.gov/public/attachments/FCC-24-22A1.pdf

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- Require WMAS to be capable of operating with at least three audio channels per MHz of spectrum to ensure that spectrum is used efficiently. This is aligned with ETSI's suggestion for WMAS to be capable of operating with three audio channels per MHz and FCC rules that this is more appropriate than their initial proposal to require WMAS to meet this efficiency requirement at all times.

Output power:

- Permit WMAS to operate on a licensed basis under the Part 74 rules at the same power levels currently permitted under these rules, i.e., 50 milliwatts EIRP in the VHF-TV bands, 250 milliwatts conducted power in the UHF band, 20 milliwatts EIRP in the 600 MHz duplex gap (653-657 MHz), 250 milliwatts conducted power in the 1435-1525 MHz band, and 1 watt conducted power in all other bands.
- Permit WMAS to operate on a unlicensed basis under Part 15 rules in the bands allocated and assigned for broadcast television:
- TV-VHF & TV-UHF
    - WMAS with a bandwidth up to 1 MHz: 50 mW EIRP.
    - WMAS with a bandwidth greater than 1 MHz: 100 mW EIRP.
- In the upper 6 MHz segment of the duplex gap (657-663 MHz): 20 mW EIRP limit consistent with the power level currently permitted for narrowband wireless microphones in this frequency band
- Unlicensed WMAS not allowed to operate in the 600 MHz guard band (614-616 MHz) that is allowed for narrowband unlicensed microphones since no party indicated that there is a need to do so.
- Require Part 15 and Part 74 WMAS to comply with the emission mask and spurious emission limits for WMAS specified in the 2021 ETSI wireless microphones standard.
- Update the existing Part 74 and Part 15 wireless microphone technical rules to reference relevant portions of the 2021 ETSI wireless microphone standard (current rules reference the 2011 version)

Table 1 below summarizes the licensing types with the respective allowed output powers in different bans for WMAS.

Table 1: Licensing types for WMAS and output power in allowed spectrum bands.

Licensing Type	Maximum Output Power
Unlicensed operation: in VHF and UHF TV bands	▪ 50 mW up to 1 MHz bandwidth, ▪ 100 mW for bandwidths greater than1 MHz up to 6 MHz

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Unlicensed operation: 653-657 MHz segment of the 600 MHz duplex gap	▪ 20 mW EIRP
Licensed operation: in most current wireless microphone bands	▪ 250 mW conducted in UHF TV band band (470-608 MHz), ▪ 50 mW EIRP in VHF TV band (54-72 MHz, 76-88 MHz, and 174-216 MHz), ▪ 20 mW EIRP in the 653-657 MHz segment of the 600 MHz duplex gap, ▪ 250 mW conducted in 1435-1525 MHz, ▪ 1W conducted in all other bands (941.5-944 MHz, 944-952 MHz, 952.850-956.250 MHz, 956.45-959.85 MHz, 6875-6900 MHz and 7100-7125 MHz bands)

The bandwidth limit for WMAS is summarized in table 2 below:

Table 2: Bandwidth limits for WMAS

BW Limit	WMAS Systems and available BW	Notes
Bandwidth up to 6 MHz permitted within a single TV channel and up to 20 MHz in other bands, or the available bandwidth if less.	If more than 20 MHz bandwidth is available, users may operate multiple WMAS systems. For example, in 1435-1525 MHz where up to 30 MHz is permitted, users could operate one 20 MHz WMAS system and one 10 MHz WMAS system, or two 15 MHz WMAS systems, etc.	• Equipment must be capable of 3 channels/MHz, but this is not an operating requirement. • FCC adopts references to 2021 ETSI EN 300 422-1 standard replacing 2017 version for both WMAS and narrowband analog and digital wireless microphones. • If ETSI revises the EN 300 422-1 standard in the future to allow more than 20 MHz, FCC would consider expanding the bandwidth limit.

- *The European Union*

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In Europe WMAS is standardized by ETSI and already specified in EN 300 422-1[7] "Wireless Microphones; Audio PMSE up to 3 GHz; Part 1", in which the WMAS transmit mask and its measurement routines are described. The EN limits the bandwidth of WMAS to 20 MHz without listing a minimum bandwidth.

WMAS is, in general, frequency neutral and designed to operate in all frequency ranges currently allowed by regulations for audio PMSE. The harmonised standard ETSI EN 300 422-1 already includes requirements for WMAS audio PMSE equipment.

ERC Recommendation 70-03, Annex 10[8], and ERC Recommendation 25-10[9] are the applicable recommendations in nearly all European countries. Both have already deleted the 200kHz bandwidth limitation for all relevant frequency bands and enable the operation of WMAS under the same output power restriction as for traditional audio PMSE devices.

In addition, a System Reference Document (SRDoc) ETSI TR 103 450 [10] has been approved and sent for discussion to CEPT ECC proposing the following changes:

- increasing the maximum radiated transmit power limit by 3 dB for WMAS Base Class 1 devices (see
-
- *Table* 3) by conducting studies as appropriate, and
- harmonization of national implementations and radio interface descriptions in the CEPT member states concerning WMAS operation.

The additional transmit power for WMAS Base class 1 is proposed to balance the needs of the various multiple access schemes and use cases. Exploiting the wideband property of the wireless radio channel might not always be possible.

A wideband channel has a bandwidth which is significantly larger than the coherence bandwidth. For the narrowband channel it is the other way around, i.e., the bandwidth is significantly smaller than the coherence bandwidth. See clause 7.2.8, Table 1.

In case of a narrowband channel, additional power may be needed. Increasing the WMAS maximum transmit output power by 3 dB compared to the maximum output power of narrowband devices will reduce the likelihood of reduced WMAS coverage relative to narrowband systems operating at maximum permissible power.

Depending on the implementation, WMAS can benefit from additional power, as operation over wider bandwidths may involve more susceptibility to environmental noise due to having less frequency agility to avoid it.

[7] https://www.etsi.org/deliver/etsi_en/300400_300499/30042201/02.01.02_60/en_30042201v020102p.pdf
[8] https://docdb.cept.org/download/2464
[9] https://docdb.cept.org/download/2431
[10] https://www.etsi.org/deliver/etsi_tr/103400_103499/103450/01.02.01_60/tr_103450v010201p.pdf

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The table 3 below provides a summary of the proposed power levels for WMAS where the WMAS Portables and WMAS Base Class 0 are in line with current ERC Recommendation 70-03. WMAS Base Class 1 power levels represent a 3 dB increase in operating power and are limited to devices that will remain stationary during operation and with a bandwidth (up to 20 MHz) that does not increase the PSD above that of legacy narrowband equipment.

Table 3: Proposed transmit power limits for WMAS Base and Portable equipment in ETSI TR 103 450

	Band [MHz]	**WMAS Portable Power**	**WMAS Base Class 0 Power**	**WMAS Base Class 1 Power (new proposed limit)**
e	174 - 216	50 mW ERP	50 mW ERP	100 mW ERP
f1	470 - 694	50 mW ERP	50 mW ERP	100 mW ERP
f3	821,5 - 826	20 / 100* mW EIRP	20 / 100* mW EIRP	40 mW EIRP
f4	826 - 832	100 mW EIRP	100 mW EIRP	100 mW EIRP
f5	694 - 703	50 mW ERP	50 mW ERP	100 mW ERP
f6	733 - 757,5	20 / 100* mW EIRP	20 / 100* mW EIRP	40 mW EIRP
h1	1 350 - 1 400	20 / 50* mW EIRP	20 / 50* mW EIRP	40 mW EIRP
h2	1 492 - 1 518	50 mW EIRP	50 mW EIRP	100 mW EIRP
h3	1 518 - 1 525	50 mW EIRP	50 mW EIRP	100 mW EIRP
j	1 785 - 1 805	20 / 50* mW EIRP	20 / 50* mW EIRP	40 mW EIRP
NOTE: * Restricted to body worn equipment or equipment with Spectrum Scanning Procedure (SSP), except in f3 (body worn equipment only).				

Shure recommends ACMA to modify the current bandwidth limit of 330 kHz to allow the deployment of WMAS products. Furthermore, WMAS technology should be allowed with 100 mW EIRP maximum for Wideband Multichannel Audio Systems (WMAS) with an occupied bandwidth of up to 6 MHz in the TV-UHF band.

Following the outcome of the consultation on LIPD (in May 2023), ACMA has considered to develop regulatory arrangements for WMAS in Australia. Shure is supported ACMA to develop a more detailed proposal for consideration and possible inclusion in a future update to the LIPD Class Licence.

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DECT-2020 NR

DECT-2020 NR (Digital Enhanced Cordless Telecommunication 2020 New Radio) is the world's first non-cellular IMT 2020 (5G) technology standard recently approved by ITU-R (M.2150-1) is fully specified by ETSI and Release 1 of the technical specification has already been published (ETSI TS 103 636, Part 1 to Part 5). In addition, ETSI is working on a harmonized standard EN 301 406-2 "Digital Enhanced Cordless Telecommunications (DECT); Harmonized Standard for access to radio spectrum; Part 2: DECT-2020 NR", which is part 2 of a multi-part deliverable covering the access to radio spectrum of the different DECT radio interfaces. The EN is currently in the ETSI approval process and is expected to be cited in the Official Journal in Q1 2024.

One envisaged use case supported by DECT-2020 NR is the Pro-audio / audio PMSE market. Therefore, DECT-2020 NR has been designed to deliver the high performance and low latency required for audio PMSE, such as wireless microphones, used by touring bands, recording studios, theatres and for broadcasting (including electronic news gathering).

DECT-2020 NR is not targeted to replace DECT but will be a technology bringing new capabilities, such as Ultra-Reliable Low-Latency Communication (URLLC) and Massive IoT or Massive Machine Communication (mMTC). It is designed to be 100% spectrum-compatible with DECT.

Shure is a member of the DECT Forum and we strongly believe that DECT and DECT-2020 NR are future proof technologies.

DECT-2020 New Radio (NR+) is a recognised IMT-2020 (5G) technology as referenced in Recommendation ITU-R M.2150-2.2 NR+ has been designed to meet the 5G requirements for massive Machine Type Communications (mMTC) and Ultra-Reliable and Low Latency Communications (URLLC). **This makes NR+ a technology option for local area connectivity for a wide range of vertical and enterprise communication requirements. Therefore, we recommend taking into account NR+ technology for having access to local private networks in 3.4-4.0 GHz.**

We can further detailed the possibilities if necessary and you can find more information here: https://www.dect.org/downloads.aspx

4. Comments to specific sections

- **600 MHz (617–698 MHz)**
  The PMSE industry needs to have continued access to the 600MHz band to cater for increasing demands. The UHF band is primary global spectrum band for wireless microphones, successfully shared with television broadcasting service for many years on a cooperative basis. For technical reasons, UHF spectrum is uniquely suited and vitally important to the operation of these devices. Countries that deployed the band for

mobile networks continued to provide PMSE access on special authorization. For example, in the USA, the Super Bowl, which is the biggest game in American football, takes place once every year. Technical and radio frequency planning for the Super Bowl begins months in advance and is dependent on available frequency bands. Mobile Network Operator T-Mobile and Dish Network have been building out its network on the 600 MHz band since the auction in 2017. Audio companies which relied on these frequencies to host large events had to apply for Special Temporary Authority licenses with the FCC to operate on the 600 MHz mobile band to accommodate the needs of the Super Bowl since there was not enough spectrum below the mobile band.

Since there is currently no PMSE equipment that operates outside of the 470-608 MHz, 600 MHz guard bands and duplex gap and to meet audio PMSE requirements at the Super Bowl, the FCC had to grant audio PMSE companies a special temporary authorization for the use in the spectrum blocks auctioned to mobile (617-652MHz downlink)/(663-698MHz uplink)for the event area in Los Angeles within one kilometre. Luckily, equipment from other regions, where this band is still available, e.g., EMEA, could be used for this event.

The available spectrum is not sufficient to meet PMSE needs, not only that but also, existing audio PMSE installations are already suffering interference from IMT in different bands. This causes extra costs for PMSE users to mitigate interference and increases challenges for audio PMSE companies to seamlessly enable such large and important events.
We do not see a strong demand for IMT in 600 MHz for the next decade and it is heavily used by several stakeholders such as PSME. It is important to consider PMSE usage in this band when conducting technical research.

- **1350-1400MHz (L-Band)**

PMSE sector needs secure access to spectrum in a clearly defined frequency range, where reliable, interference-free, operation can be confidently planned for, with long-term access guaranteed.

In the United States in 2017 when 70 MHz (in 600 MHz band) of spectrum was reallocated from use by broadcasters to use for 5G mobile networks, 90MHz of spectrum, between 1435 and 1525 MHz was made available for PMSE use.

PMSE users need replacement spectrum to be made available, with a similarly sized piece of spectrum that is predictably and reliably available for such use. Discussions are currently open in a number of other countries. The EU top-level group ECC has suggested this band for a national allocation in European countries. CEPT has finalized the compatibility studies, for example, ECC Report 245[11], dated 29 January, 2016, titled Compatibility studies between PMSE and other systems/services in the band 1350-1400

[11] https://docdb.cept.org/download/1242

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MHz. This band has already been added to ERC REC 25-10 and ERC REC 70-03 and will be allocated in Europe.
Consequently, **Shure kindly requests ACMA to consider 1350-1400MHz with power up to 50 mW EIRP for audio PMSE applications.** We expect this band to be a candidate for a possible worldwide harmonized tuning range for audio PMSE.

- **1.9 GHz (1880–1920 MHz)**
  Shure welcomes ACMA recent decision on 1.9GHz proposing the inclusion of DECT 2020 Australia-wide in the 1880–1900 MHz frequency range and indoor only in the 1900–1920 MHz range, and rail mobile radio (RMR) along rail corridors in the 1900–1910 MHz frequency range. We will further comment on the dedicated consultation.

- **Other bands (1240-1260 MHz)**
  We are encouraging regulators around the world to further assess the availability of spectrum for PMSE as there is a growing demand for this. As an example, the following bands have been implementing audio PMSE in some countries/regions worldwide:

Frequency Range (MHz)	Bandwidth Available (MHz)	Current Location
960 – 1164	204	UK
1240 – 1260	20	Japan
1350 – 1400	50	EMEA
1435 – 1525	90	USA

For 2024 Paris Olympic game in France, the regulator planned to allocate temporarily 2 new bands, which are 1240-1260 MHz and 1350-1400 MHz, to audio PMSE system beside UHF band as there will be a shortage of spectrum for this specific event. Nevertheless, Shure will further work with the French Administration to make this decision permanent.

In Japan, Wireless mics has been operating in 1240-1260MHz with license free for a long time without creating interference to other service nearby.

Due to the nature of our activities (e.g., localized) and technologies (e.g., low power), PSME is most of the time co-existing perfectly with other services such as: Miscellaneous radars, Earth exploration satellite, radio navigation satellite, TV program material transmission.

Shure therefore kindly asks ACMA to further assess the use of the 1240-1260MHz band or other suitable bands for wireless microphone applying both the narrow band (200KHz) and WMAS technology on a free-licensed basis for audio products by broadening the Interface.