



09.12.2023

Shure's reply to RSPG23-045 FINAL

RADIO SPECTRUM POLICY GROUP Work Programme for 2024 and beyond

For 98 years, Shure has been a leading manufacturer of high-quality, innovative audio products. The Headquarter for the European, African and Middle Eastern region is located in Germany. Shure products (www.shure.com) are utilized worldwide in applications known as audio-PMSE (also known as SAB/SAP)¹, which 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 annually in scale and density to meet the needs of broadcast (incl. streaming) and event producers engaged in increasingly complex productions to meet audience expectations.

Shure welcomes the opportunity to share our view on RSPG's Work Programme for 2024 and Beyond.

In particular, Shure agrees that:

„RSPG should also collect lessons from early initiatives from Member States introducing other usages than broadcasting to address audio PMSE long term developments in order to preserve sufficient spectrum for audio PMSE needs, taking also into account the transition of audio PMSE towards new spectrum efficient technologies. The RSPG also should gather information from industry stakeholders on expected technological developments in both mobile and broadcasting platforms.“

This reply provides some initial inputs for consideration for the RSPG Report/Opinion on the future usage of sub – 700 MHz band in the EU expected by October 2025. Shure looks forward to providing additional inputs as the RSPG gathers information from industry stakeholders on expected technological developments, spectrum needs and other aspects of audio PMSE.

Individual countries might see PMSE as a local use case, but please note that PMSE, despite that PMSE is used on local events, the whole production might be cross border. Example: Touring events are only possible, if the equipment can travel to all EU member states with similar rules.

Shure would kindly request that in any case, a long-term solution (harmonized, beyond 2030) for audio PMSE should be developed in the 470-694 MHz band, given the critical importance of this band for PMSE as explained in the following sections while identifying additional bands in the 1-2 GHz range.

This is aligned with the 2017 RSPG opinion that asked for retention of the core audio band of 470-694 MHz **and** identification of sub-2 GHz candidate spectrum for audio PMSE.¹ In particular, we agree with the following points from this 2017 RSPG report that:

- long-term regulatory certainty and visibility on spectrum access is desired by PMSE manufacturers and users.
- the Commission Implementing Decision for audio PMSE harmonises “at Union level the availability of a baseline of about 60 MHz of sustainable spectrum to meet recurring ordinary needs”. This may be insufficient in some cases, and Member States remain free to allow the use of more spectrum for PMSE if necessary.

¹ [RSPG17-037finalrev1_RSPG_opinion_PMSE.pdf_0.pdf \(europa.eu\)](#), Opinion on a long-term strategy on future spectrum needs and use of wireless audio and video PMSE applications, 21 November 2017



- “peak demand” is usually temporarily and locally limited but may appear in various situations like big musical or sport events, theatre districts, broadcasting facilities, or where several events are co-located at the same time.
- extraordinary events like Olympic Games need tailored national solutions which may be different from the regular approach.

We also agree with the following point in the 2017 RSPG report that:

- If considered necessary, a strategy to identify spectrum options below 2 GHz for audio PMSE may be needed, considering aspects such as the potential for widespread adoption on a global level (in order to achieve economies of scale), and the request from the PMSE community for long term stability and regulatory certainty.

1) Importance of audio PMSE to content creation

PMSE can be considered the “pen and pencil” of the content production industry which includes web, theatre, adverts, films, sports, concerts and cultural events as emphasized in this [video](#)². This is particularly relevant for Europe.

Today, it is virtually impossible to produce creative content without PMSE. 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. Ultra-High Definition (UHD) video would be of little interest without high quality sound to accompany it.

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.

- 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. To tackle this growing demand globally, there is mention of Netflix spending \$17 billion on content creation in 2020, rising to \$26bn in 2026. In 2022, Disney is making a \$33 billion investment in content creation, \$8 billion more than for 2021.



2) Audio PMSE spectrum requirements below 1 GHz

The continued availability of sufficient, interference-free spectrum is key to meet growing demand for wireless PMSE technologies (e.g., wireless microphones, In-Ear-Monitor Systems).

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 spectrum in the TV-UHF band below 1 GHz. Studies in Europe concluded that approximately 96 MHz are sufficient for the daily use of audio PMSE in the UHF band below 1 GHz [Lamy Report]³.

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.

Required spectrum grows each year for medium and large events. A study conducted by Swiss Radio and Television⁵ 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. Please note that even examples are from Switzerland they are valid for such events for CEPT region. The spectrum requirements for audio PMSE are summarized as follows:



Daily spectrum requirement:

Permanent use

- Campus-Installations, which were considered in this analysis, require up to **110 MHz** spectrum in the UHF Band:

Example: Campus SRF Leutschenbach Example: Seebecken in Zurich

Events

- Today the 82 analyzed **Small Events** (Events with less than 50 coordinated links) require prevailing **42 MHz** in the UHF Band:
 - Example sport: Engadiner Skimarathon, Fussball Super League
 - Example culture: Zürcher Sächsilüte, SRF bi de Lüt
- Today the 18 analyzed **Medium Events** (Events with 50-100 coordinated links) require prevailing **69 MHz** in the UHF Band:
 - Example politics: Local elections in Tessin
 - Example sport: Football national team games, Swiss Indoors Basel
 - Example culture: eidg. Jodlerfest, Film Festival Locarno
- Today the 11 analyzed **Large Events** (Events with 100-200 coordinated links) require prevailing **115 MHz** in the UHF Band:
 - Example politics: Federal council elections
 - Example sport: Ski races in Adelboden and Wengen (Lauberhorn)
 - Example culture: Gurtenfestival



Exceptional spectrum requirement:

- Major Events (events with more than 200 coordinated links) do not take place periodically. They have an exceptional cultural value and large media response at national and international level. There were 5 Major Events between 2016 and 2019 analyzed. They had together during **54 event days** (excl. setup & rehearsal) and average spectrum requirement of **174 MHz** in the UHF Band:
 - Example sport: Ski World Championship St. Moritz
 - Example culture: National wine festival “Fête de Vignerons”

Over the last decade we have seen audio PMSE spectrum reduce dramatically to go to the mobile service use while the demand for audio PMSE created content is experiencing significant growth driven by both the traditional audiences, mobile phone consumption 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 audio PMSE and the efforts the audio PMSE industry has made to improve spectral efficiency to mitigate the losses.

The spectrum range from 470 to 698 MHz below the 700 MHz band is critical for audio PMSE and the biggest possible amount of spectrum in that frequency range should be allowed for audio PMSE so that it can continue to support content creation⁶.

3) Case Studies from a PMSE perspective - Events Around the World

Hosting a global event can give many economic, social and cultural benefits to the host country including raising the profile of the host country in addition to social and economic

benefits. Such special events require a very detailed frequency planning from a local frequency coordinator. Organizing and planning large events may take several months in advance. Case studies from past and future (planned) events are summarized below.

a. EXPO 2020 – Dubai, United Arab Emirates

EXPO 2020^[1] in the United Arab Emirates (UAE) required 318 wireless microphone channels at the centre stage area and more than 1000 channels (each channel is 200 kHz wide typically) on the EXPO campus (ceremonies, pavilions, broadcaster including news gathering teams) amounting to much more than 100 MHz of spectrum.

The following figure shows the frequency management plan generated with Shure's Wireless Workbench Software at EXPO 2020 in UAE.

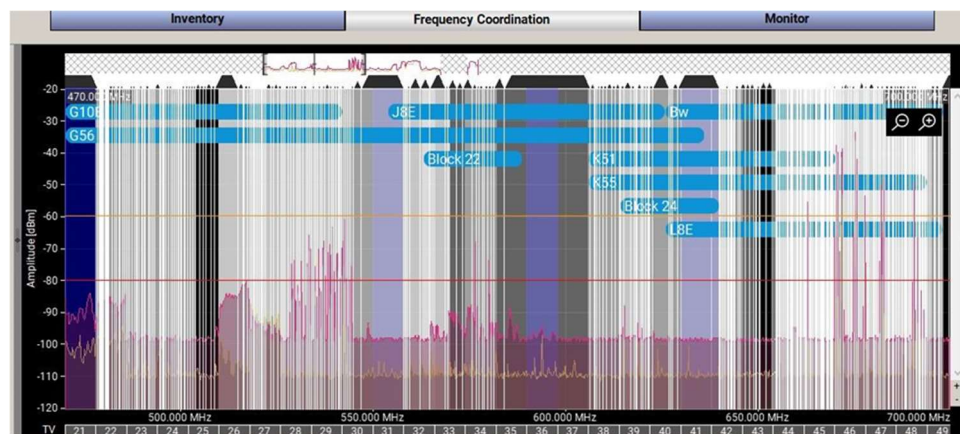


Figure 2: Frequency Management Plan at EXPO 2020

Picture legend:

- Scan from 470 – 700 MHz
- Blue vertical blocks (e.g., TV-channel 21 at 470 MHz and channel 36) indicate potential services, which need to be protected and therefore avoided.
- White lines show the planned and coordinated audio-PMSE devices

As observed from the figure, each thin white line represents a 200kHz wireless RF channel for audio PMSE. **Typically, special events do generate a very high “peak” demand, which might require more than 100 MHz of spectrum.**

b. Super Bowl – USA^[2]

In the USA, the Super Bowl, which is considered 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 has 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 operate out of the UHF band 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 of 614-673 MHz for the event area. Luckily, equipment from other regions, where this band is still available, e.g., Europe, Middle East & Africa, was used for this event.

c. Olympics and Paralympic Games 2024 – Paris, France

The summer Olympic and Paralympic Games (“the Paris 2024 Games”) will be held between July and September 2024 in Paris, France.

To anticipate the spectrum needed for the Paris 2024 Olympic and Paralympic Games (OPG), the national frequency agency (ANFR) and OPG organizing committee studied past OPG as well as other major international sport events, considering technological

evolutions. The ANFR and OPG committee released the [Spectrum Management Plan](#) and conditions for the Paris Olympics.

Figure 3 shows frequency bands assigned to wireless microphones and IEM systems.

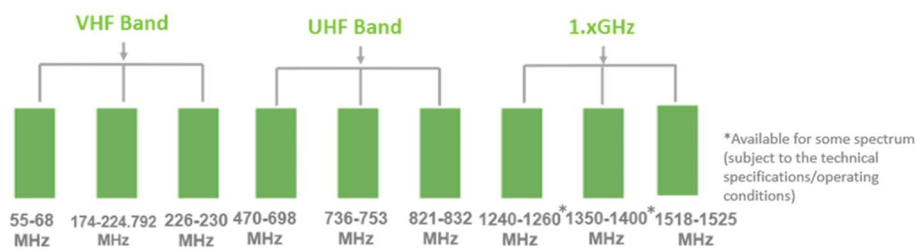


Figure 3: Spectrum for PMSE Use at Paris 2024 Olympics.

The host city, and its suburbs gather 16 % of the French population and most of the head offices of the main companies established in France, and there is accordingly already a very high use level of radio spectrum. Also, **5G deployments are reducing the bands historically allocated to the PMSE usages**. It is anticipated that the demand for spectrum for wireless microphones at music concerts or theatres in and around the Paris area will increase during the Games.

In addition to the 470-694 MHz band that is shared with TV and opening 3 bands in the 1.x GHz range, France recommends using wired communication systems for microphones whenever possible to accommodate the high PMSE demand. While we understand the recommendation for stakeholders to use wired microphones because of the spectrum crunch, it is clearly not aligned with the trend we are seeing with increasing demand for wireless microphones. It would be interesting to see how this recommendation is actually put in use by the users. Shure will continue to work with regulators worldwide to ensure that enough spectrum in the 470-698 MHz band is available for audio PMSE.

^[1] <https://www.youtube.com/watch?v=Rb5m8nT7meo>

^[2] <https://www.sportsvideo.org/2023/01/18/super-bowl-lvii-phoenix-state-farm-stadium-raise-rf-coordination-to-new-level/>



4) Technical considerations as to why audio PMSE needs access to the TV-UHF Band below 1 GHz

The TV-UHF band is and will likely remain the primary global spectrum band for wireless microphone operation. It has been successfully shared with television broadcasting services for many years on a cooperative basis. For technical reasons, UHF spectrum is uniquely suited and vitally important to the operation of these devices.

Wireless Microphones including In-Ear Monitors and Talkback Systems are highly portable devices that give users mobility, which is critical for many types of content production activities. As mobile devices, they are dependent on batteries, making power consumption, size, and weight important considerations. The characteristics of the spectrum in which wireless microphones operate are the single most important high-level determiner of power consumption and link reliability.

UHF spectrum below 1 GHz is ideal for wireless microphone applications from a technical standpoint.

One characteristic of the TV-UHF spectrum that makes it useful for wireless microphone operation is wavelength. Because wireless microphones are physically small devices, antenna size is an important consideration. In this UHF band, it is possible to obtain relatively good efficiency using antennas that fit inside the device or extend a short distance outside of it. Lower (e.g., VHF) frequencies require larger antennas for efficient operation. It is possible to use electrically short antennas, but this results in lower efficiency, narrower tuning range, or both. Lower efficiency causes higher power consumption and reduced transmission range.

Another characteristic of UHF spectrum that is relevant to wireless microphone operation is the ambient noise level. Electrical noise typically declines with frequency.



Thus, the amount of background noise present at UHF frequencies is lower than at VHF frequencies. The noise level is important because it determines how much power is required for a reliable radio link to be established. A higher noise level requires more transmitting power, which in turn means higher power drain and shorter operating time on batteries.

At frequencies above the 1 GHz range, both body absorption and path loss increase. Since wireless microphones are normally worn on the body or held in the hand, these losses have a negative impact on operation. Lab measurements indicate losses of 20 dB or more due to body absorption and shadowing. In addition, wireless microphone signals must often travel through obstructed paths like, e.g., the scenery on a theatre stage. Once again, this translates into a need for higher power, resulting in shorter battery life. UHF signals are better able to pass through such obstructions than higher frequency signals.

Reallocations and auctions of UHF television channels in some countries have dramatically reduced the amount of spectrum available for wireless microphones to use, particularly in cities where a great deal of content production takes place. In response, wireless microphone manufacturers have invested millions of dollars in developing spectrally efficient digital technologies. However, this technology requires clean spectrum in order to work properly.

5) Audio PMSE Technical Evolution

Shure is investing a lot into the research and evaluation of potential new technologies. Not all of them have a positive outlook, e.g., current 5G technology does not support high quality and low latency audio transmission and it is unsure, when such a 5G system might be available.



Please be aware that such a 5G system still needs its own frequency resource. Using and sharing of resources of a 5G base station of a typical mobile phone service provider is hardly achievable, as the business case of mobile phone service providers does not support our customer's needs.

Another technology called WMAS (Wideband Multichannel Audio System) is a much preferable solution. Therefore, Shure is driving the regulation to allow the deployment of audio-PMSE based on WMAS in the band 470 – 694 MHz. WMAS technology is already described in the harmonized standard EN 300 422-1.

Please note that even if WMAS technology will increase spectrum efficiency, it cannot completely make up for lack of spectrum. WMAS will not replace current systems but is an additional technology for applications where a large number of wireless microphones and In-Ear Monitor systems are required.

Shure is very active in different industry groups including 5G-MAG, DECT Forum and WInnForum.

6) Thoughts and summary on audio-PMSE spectrum management beyond 2030

For a range of practical and economic reasons and given the peripatetic nature of content production, universally available and harmonized tuning ranges are the best solution. The 470 - 698 MHz range is the core band of audio PMSE, available and in use worldwide, sharing spectrum with TV.

We ask kindly to consider the following proposal:

- Minimum of clean 80 MHz in the band 470 – 694 MHz, preferably harmonized and continuous. "Clean" spectrum means: no TV, no IMT use and no duplex centre gaps.



- The 80 MHz can be shared with other applications, examples to be studied are e.g., military ad-hoc systems, satellite up-link.
- Continue to allow sharing with whatever frequency range is still used by TV in 470 – 694 MHz.
- Minimum of supplemental 50 MHz in other bands below 2 GHz, such as 960-1164 MHz, 1240-1260 MHz, 1350-1400 MHz, harmonized across Europe.

In summary, we want to make sure that the spectrum needs for audio PMSE, especially in the bands below 1 GHz, are taken into account so that PMSE can continue to support various events and contribute to the society and economy of the European Union.

Please contact the undersigned if you have any questions.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'W. Bilz', is written on a light-colored, slightly textured background.

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