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Shure's Response to TRAI's Consultation Paper on "Inputs for formulation of National Broadcasting Policy-2024"

April 26th, 2024

Shri Tejpal Singh
Advisor (B&CS)
Telecom Regulatory Authority of India

Dear Shri Tejpal Singh,

Shure Incorporated applauds the work of the TRAI and welcomes the opportunity to provide its response to the above-mentioned TRAI's public consultation. For 99 years, Shure has been a leading manufacturer of high-quality, innovative audio products. Shure's products are utilized worldwide in applications known as Programme Making and Special Events (PMSE), which is an ITU's inclusive term covering radio microphones, in-ear monitors, wireless cameras, talkback systems, etc.

In particular Shure wants to provide some comments to Q15.

> ***Q15. What policy and regulatory provisions would be required in the policy to enable and facilitate growth of digital terrestrial broadcasting in India. Stakeholders are requested to provide strategies for spectrum utilization, standards for terrestrial broadcasting, support required from the Government, timelines for implementation, changes to be brought in the current ecosystem and the international best practices. Please provide your comments with detailed justification and proper reasoning.***

TRAI noted in section 2.154 of the consultation that 526-582 MHz is being used for providing Terrestrial TV Broadcasting and is to be explored for the use of 5G terrestrial broadcast to replace Ministry of Information and Broadcasting (MIB) transmitters for use of the frequency range from 526-582 MHz.

We wanted to point out that PMSE is another important user in 526-582 MHz range that should be considered. In fact, 470-703 MHz is the most important frequency range for PMSE and the question of its long-term availability for PMSE to support content creation needs to be taken into account. Therefore, if 5G broadcast is to be introduced in the band, its compatibility with existing PMSE applications needs to be studied.

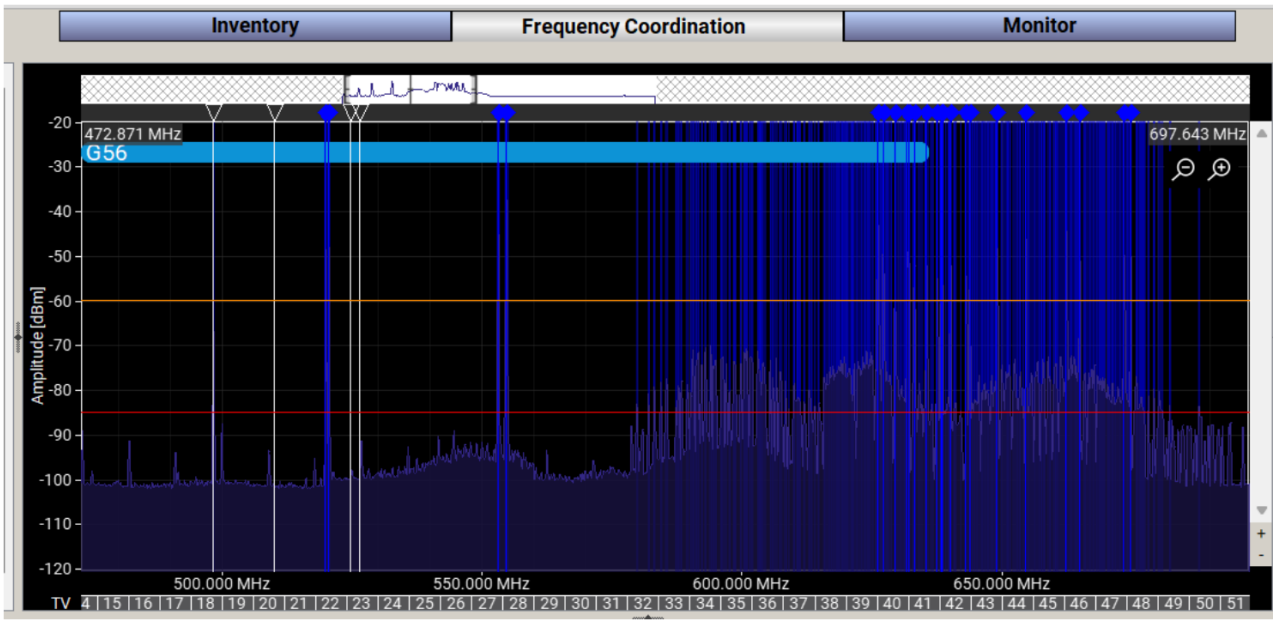
Indeed, PMSE can be considered the “pen and pencil” of the content production industry which includes web, theatre, adverts, films, sports, concerts and cultural events as emphasized in this video. Audio is of prime importance in the world of PMSE. Without the "audio" part of an event, CEOs, politicians, and entertainers cannot communicate with impact to their audience.

PMSE supports India’s very vibrant content creation industry with its film, music, theater and other sectors. This is recognized globally as noted in *The Hindu Businessline* :[1]

> *“As the recently concluded Cannes film festival celebrated India as the Country of Honour, it offered a great opportunity for us to display our potential to be the future content hub for the world”.*

The article even mentioned that *“India’s creative economy may drive the next wave of growth” and “For this to happen the right kind of policy framework needs to be evolved”.*

The limited availability of spectrum in the UHF band poses a unique challenge for PMSE, particularly regarding its allocation for mobile services. This issue impacts major events like the Navratri Festival in Bhuj, Gujarat, India where PMSE plays a vital role in delivering seamless audiovisual experiences. Despite its sensitive location near the Pakistani border, Bhuj continues to celebrate its cultural traditions, emphasizing unity and harmony. However, the unavailability of spectrum below 600MHz, potentially due to military's use, restricts access for PMSE applications, affecting performance quality and coverage. The following figure shows the frequency management plan generated with Shure’s Wireless Workbench Software at the Navratri Festival.



Spectrum for Navratri Celebration in Bhuj

The thin blue lines illustrated in the figure represent 200kHz audio channels. During planning of the event, it was observed that the spectrum below 580MHz appeared to be blocked, possibly for unknown reasons, which could include potential military usage, as it was not detected during the

[1] https://www.thehindubusinessline.com/opinion/indias-creative-economy-may-drive-the-next-wave-of-growth/article65487350.ece

scan. About 100MHz of spectrum was needed in the 600MHz band to support the requirements at the festival. Allocating 526-582 MHz to 5G broadcast and the 600MHz band (612-703 MHz) to IMT service would further diminish PMSE's access, necessitating a solution that balances spectrum scarcity and ensures uninterrupted audiovisual experiences, safeguarding the Navratri Festival's integrity and success in Bhuj.

Access to sufficient spectrum below 1 GHz to audio PMSE should be an important part of India's spectrum policy.

Deepika Padukone at the The 75th Cannes Film Festival - Closing ceremony - Cannes, France

Furthermore, platforms like Netflix, Disney, Amazon Prime, Apple+, etc are spending tens of billions of dollars on content creation. To support all of this, audio PMSE uses spectrum in the 470-698 MHz range globally. For example, we have been deploying the largest single wireless install of our top tier solutions in India at the Jio World Center for the Reliance Group in this frequency range.

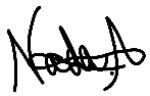
Like the mobile or satellite industry, PMSE's demand for spectrum is experiencing significant growth driven by both the traditional audiences and the new global audience realized by new

delivery platforms but as we know, this spectrum has been “eaten away” by the mobile industry in particular as the 700 MHz and the 600 MHz bands are opened for 4G and 5G worldwide. Innovations in audio PMSE technology are happening to make more efficient use of spectrum but these advances cannot completely make up for any lack of spectrum.

Therefore, as the TRAI develops a National Broadcasting Policy, we wanted to provide the comments hereafter to ensure that audio PMSE continues to get access to sufficient spectrum in the 470-703 MHz range (which can range from 60 MHz for some events to more than 100 MHz for major events like EXPO 2020 in Dubai or the Paris Olympic games or at the Jio World Center) to continue to support various events and contribute to the society and economy of India. It is essential for TRAI 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 spectrum loss.

Please do not hesitate to contact the undersigned if you have any questions or comments.

Respectfully submitted,



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PMSE 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. From primarily a film, theatre and TV industry content creation tool, PMSE is now important to every smartphone in the world as shown in this video. The PMSE 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.

India holds a dominant position in the world of content production with its film and other industries. For example, Shure has been deploying the largest single wireless install of our top tier solutions in India at the Jio World Center for the Reliance Group. The contribution of content production to the Indian economy has been growing as shown by the data hereafter:

India Music Industry[2]:
Summing up the revenues across the three main sub-industries (LIVE, Recording & Publishing), we estimate the scope of the Indian music market at **$443 million**.

Value of the live events market in India from 2016-2023[3]:

- In 2020, the live events market across India was valued at 27 billion Indian rupees ($380million).
- It was forecast to reach 95 billion rupees ($1.3bn) by 2023 and represents a 50% growth in 4 years (2016-2019).
- 70% growth is predicted over 7 years 2016-2023

India Film, TV and Online Video Services (OVS) sector - referred to as Creative industries[4]:

- The film, television, and OVS industries in India represent a combined revenue of around US $ 13.3 bn

[2] *Indian Music Industry Revenue by Source, 2018 - Sources: IFPI, PwC, VISION 2022, IPRS*
[3] *Published by Tanushree Basuroy*
[4] *Source: Deloitte India – Economic impact of the film, television and online video services industry in India 2019*

- Anticipated growth in creative industries of more than 10% over the next few years, and with appropriate support, a higher growth trajectory of 14–15% is possible.
- In 2017, OVS grew 50% from $37m to over $55m.
- By 2019, it generated over $600m with similar growth forecast.

Global content creation sector:

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.

- 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 has made $33 billion investment in content creation, $8 billion more than for 2021.

These wireless technologies are used extensively in the production of entertainment content, adding significant value to production. Figure 1 below illustrates the relation between PMSE and content consumption.

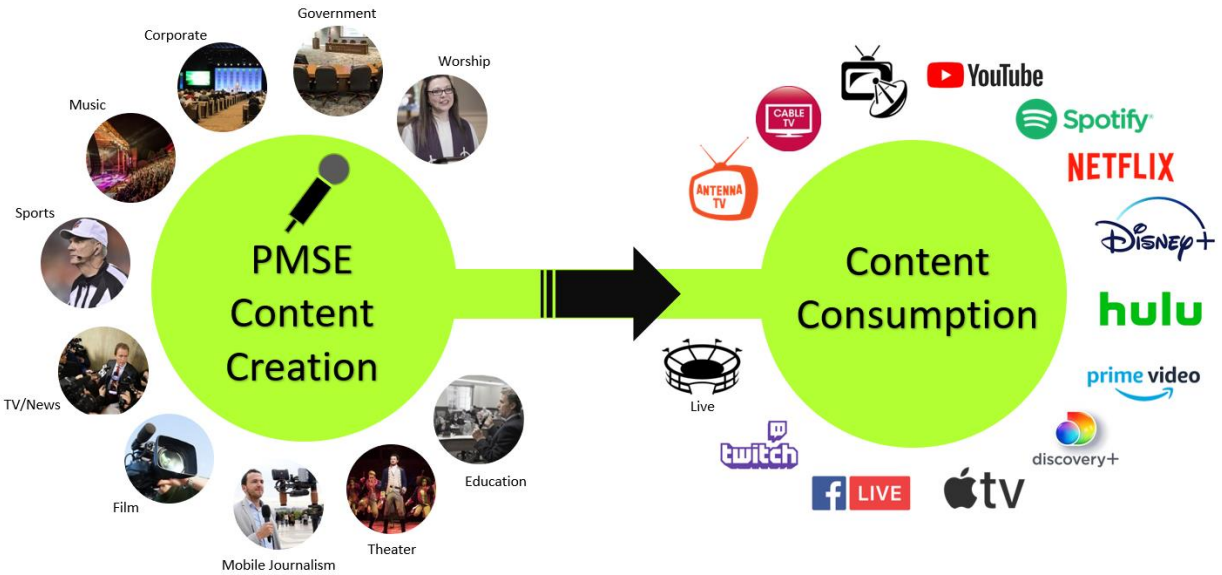

Figure 1: PMSE Enables Content Consumption.

2. Technical considerations of why audio PMSE needs access to spectrum in 470-698 MHz

The UHF band below 1 GHz is and will likely remain the primary global spectrum band for PMSE. PMSE has been successfully sharing this range 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.

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.

3. Continued access to spectrum in 470-698 MHz for audio PMSE is critical for its future

1. Audio PMSE Spectrum Requirements

Like all wireless communications technologies, audio PMSE needs spectrum. As India designs a policy and regulatory framework to support the development of new wireless technologies, they should ensure that audio PMSE continues to get access to a sufficient amount of usable spectrum. In particular, the UHF TV band within 470-698 MHz is the primary band for professional wireless audio PMSE operation globally, especially for touring productions. 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. The audio PMSE industry is very innovative, resourceful and embracing of new technologies to constantly improve spectral efficiency and end-user experience. However, we caution that anticipated technology developments cannot make up for a lack of suitable spectrum for audio PMSE operation. Intensive reuse of spectrum already takes place at large events where users are assigned different time slots and/or locations.

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][5].

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.
navra
Required spectrum grows each year for medium and large events. A study conducted by Swiss Radio and Television[6] 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.

The spectrum requirements for audio PMSE are summarized as follows:

a. Daily spectrum requirement:

Even, if the below examples are based on a PMSE database in Switzerland, the amount of needed PMSE devices and frequencies is very similar globally.

[5] https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=6721
[6] https://apwpt.org/wp-content/uploads/2022/03/Report-PMSE-Audio-spectrum-requirement.pdf

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

b. 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”
- Example international major event: Expo 2020 Dubai

2. 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. Jio World Center – Mumbai, India

Shure has deployed one of the largest single wireless installs of our top tier solutions in India with Reliance Group. In this particular case, the whole range from 470 – 703 MHz is available to support a major event at that indoor location at Jio World Center as no TV signal could be seen indoor that needed to be avoided. The picture below shows a spectrum scan of Shure's Wireless Workbench (WWB), a frequency management tool for high-tier multi-channel applications. With Shure's WWB, the user is able to develop a proper frequency management plan for the local event. The green lines show the wireless microphone channels. This Jio World Center frequency management plan considers several aspects for developing the most efficient frequency plan. This includes RF environment scans, considerations of RF attenuation of walls and between different rooms as well as antenna placement. Such an extensive frequency planning can be realized in such an installation with controllable RF environment to maximize the experience for the audience while mitigating any interference issues.

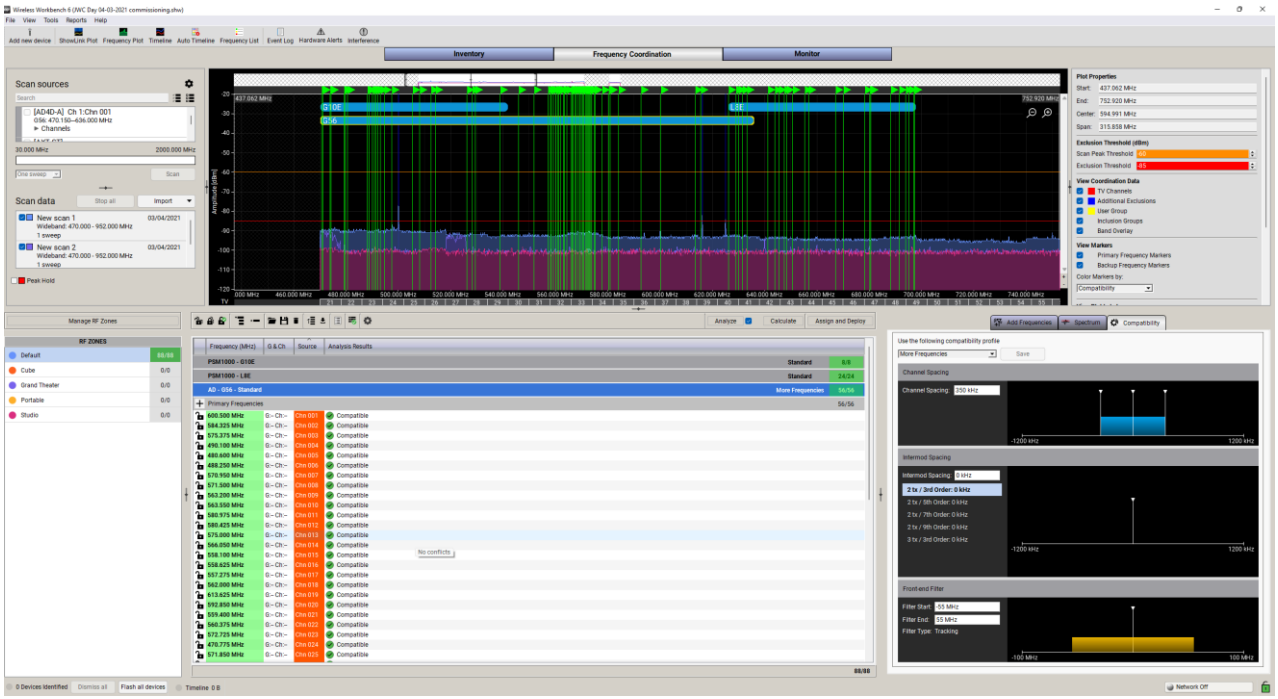

Figure 2: Spectrum for PMSE at Jio World Center.

b. EXPO 2020 – Dubai, United Arab Emirates

EXPO 2020[7] 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.

[7] https://www.youtube.com/watch?v=Rb5m8nT7meo

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

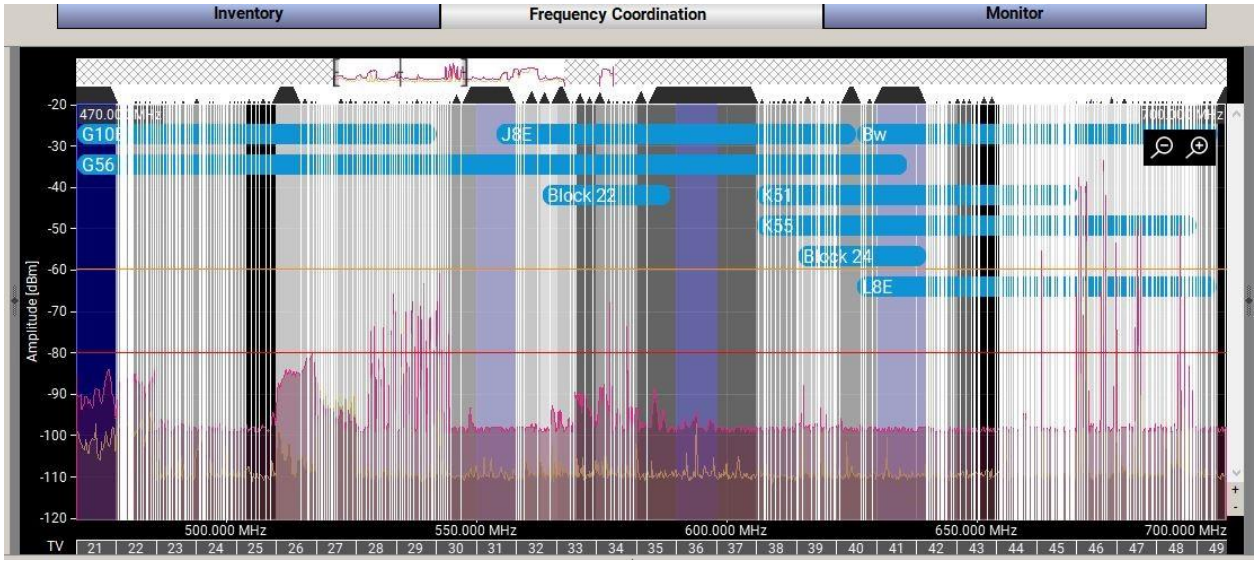

Figure 3: Frequency Management Plan at EXPO 2020

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.**

c. Super Bowl – USA[8]

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 since the auction in 2017. Audio companies and even organizers 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 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.

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

d. 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 4 shows frequency bands assigned to wireless microphones and In-Ear Monitoring (IEM) systems.

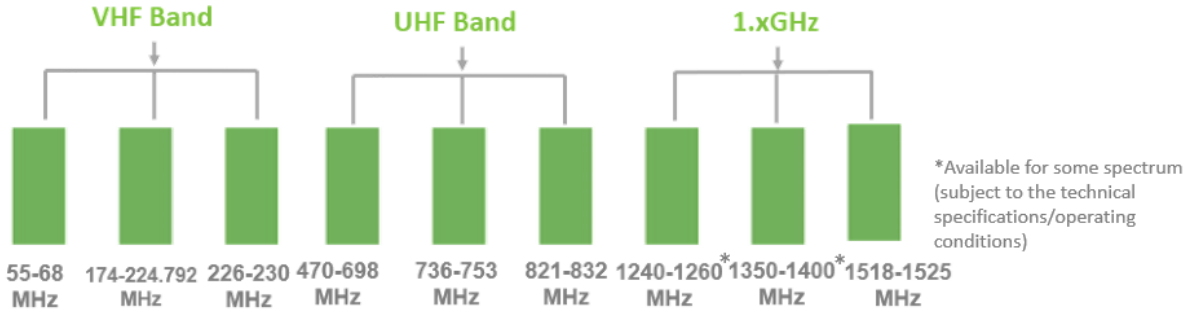

Figure 4: Spectrum for PMSE Use at Paris 2024 Olympics.

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 additional 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.

4. Potential Future Technology for Audio PMSE

To overcome the shrinking access to TV-UHF band and cater for 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
- Very high audio quality
- High spectrum efficiency

A recent development is Wireless Multichannel Audio System (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 the "next generation" wireless microphone system: technology that makes possible significantly more operating channels per megahertz through use of wideband. Technology neutral rules would also allow deployment of these technologies in various bands in addition to 3GPP-based or IEEE-based technologies.

(a) Example of USA

FCC released the regulations for WMAS (Wireless Multi-Channel Audio System)[9] on 15 February 2024 along with a statement from Chairwoman Rosenworcel[10]:

> *"Making sure all of these services can function at the same time without interference is a tall task. So when a new technology comes along with the potential to improve the efficiency of wireless microphone operations, it deserves attention. That is why a few years ago, we issued a rulemaking to explore a new wireless technology known as Wireless Multi-Channel Audio Systems, or WMAS. And it is why today we adopt new rules to fully support these systems. We do this because they significantly improve the efficiency of wireless microphone operations. In fact, under the rules we adopt here, three times as many microphones can operate while putting the same amount of power over the air as a single wireless microphone has under our past rules.* ***That is a spectrum win-win.*** *Because it means we can do more with our airwaves for all kinds of technologies, benefiting everything from special Super Bowl sized spectacles to the Wi-Fi routers we use in our homes every day."*

[9] https://docs.fcc.gov/public/attachments/FCC-24-22A1.pdf
[10] https://docs.fcc.gov/public/attachments/FCC-24-22A2.pdf

(b) Example of European Union

In Europe, WMAS is standardized by ETSI and already specified in EN 300 422-1[11] "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. In addition, ETSI TR 103 450 (SRDoc)[12] has increased the maximum radiated transmit power limit by 3 dB for WMAS Base Class 1 devices (compared to narrowband PMSE devices).
Furthermore, 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. Currently, the biggest challenge for 5G technology to meet is the latency requirement for professional live audio production. Beyond the technical challenge, the business case for PMSE on a 5G network is to be studied. It, therefore, cannot be considered as a viable solution for audio PMSE in the foreseeable future. That said, Shure and other audio PMSE stakeholders are exploring the potential development of audio PMSE technologies based on 5G and taking part in various industry efforts like, e.g., the 5G-Media Action Group (5G-MAG). PMSE is also being discussed as a potential application of IMT in the draft new IMT Applications report that is being drafted in ITU-R WP 5D.[13]

5. Conclusion

In summary, Shure will continue to support India's efforts to secure access to sufficient spectrum in the 470-703 MHz range for audio PMSE as a vital industry that provides a critical service to the economy, society and culture of India. If audio PMSE can no longer operate in the whole 526-703 MHz range because of 5G broadcast in 526-582 MHz or IMT in 612-703 MHz, we may not be able to support events at the Jio World Center or any major political, cultural or sports event that India would host for example.

Shure remains at TRAI's disposal to discuss regulations for audio PMSE.

[11] EN 300 422-1 - V2.1.2 - Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Class A Receivers; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU (etsi.org)
[12] https://www.etsi.org/deliver/etsi_tr/103400_103499/103450/01.02.01_60/tr_103450v010201p.pdf
[13] Draft new report ITU-R M.[IMT.Applications]. Applications of the terrestrial component of IMT for specific societal, industrial and enterprise usages.