



April 14th, 2023

Stephanie Weiner,
Acting Chief Counsel, National Telecommunications and Information Administration.

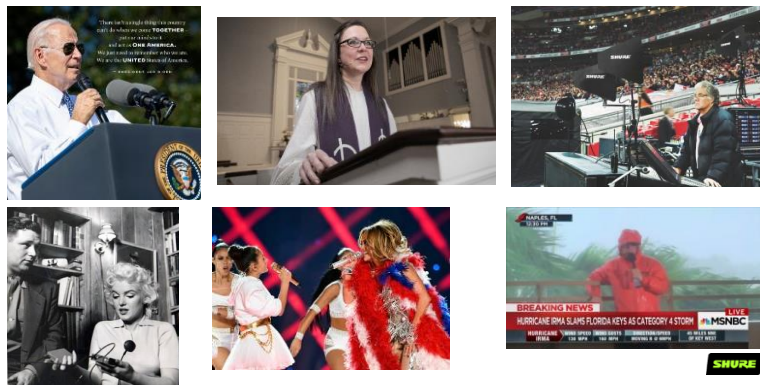
Re: Shure Incorporated Comments to NTIA’s docket number NTIA–2023–0003 on Development of a National Spectrum Strategy

[Shure Incorporated](#) applauds the work of the NTIA and welcomes the opportunity to provide its response to the above-mentioned NTIA’s Docket.

For more than 97 years, Shure, a U.S. based audio products manufacturer, 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 a term used in ITU to cover radio microphones, in-ear monitors, wireless cameras, talkback systems, etc.

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.

Some PMSE use cases



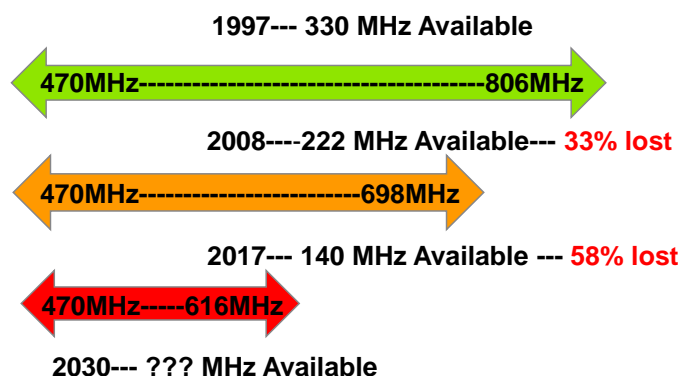
PMSE supports the very vibrant U.S. Creative Sector and like the mobile or satellite industry, PMSE’s demand for spectrum is experiencing significant growth driven by both the traditional audiences and the new global audience realized by new delivery platforms but as we know, this spectrum has been “eaten away” by the mobile industry in particular as the 700 MHz and the 600 MHz bands are opened for 4G and 5G worldwide.

In fact, spectrum available to PMSE in the core band of 470-806 MHz in the U.S. (shared with TV) has shrunk by ~58% (and ~ 43% in Europe which has not auctioned 600MHz yet to 5G).¹

¹Notes:

- 6 MHz is subtracted for the Radio Astronomy channel 608-614 MHz which has never been available to PMSE.

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.



We note there is no clear item on the importance and future of PMSE in NTIA’s Spectrum Strategy. This input seeks to highlight the PMSE situation and have PMSE introduced into NTIA’s spectrum strategy, **especially as PMSE can share spectrum with other systems, including in bands managed by NTIA, given the localized use, low transmit power and spectrum use for a certain duration by PMSE. This is aligned with our message to the FCC:**²

Shure emphasized that Commission spectrum policy should address the important needs of PMSE operations which supports content creation sectors representing more than an estimated trillion dollars in economic value. Notwithstanding the continuing expansion in demand for PMSE operations to support U.S. broadcasting, U.S. streaming services, theater, music, sports, Houses of Worship, business gatherings, and education, among other uses, U.S. PMSE operations have been constrained by a material reduction in available spectrum as a result of changes in Commission rules regarding spectrum that has been core to PMSE operations for years. We discussed spectrum strategies for the future including options for sharing as spectrum rules change to reflect the evolution of preferences in content consumption, changes in content distribution channels, and to accommodate 5G, 6G and beyond.

We also want to bring to NTIA’s attention that Shure led a collaborative work in [ETSI](#) and the [WinnForum](#), two standardization bodies known for developing innovative utilization of spectrum and wireless communications systems, to study sharing frameworks to allow temporary and flexible access for PMSE.

- The ETSI technical report ETSI TR 103 885 is available [here](#)
- WinnForum technical report WINNF-TR-2011 is available here [here](#)

- 616-617 MHz is a guard band-- not available for PMSE use (or any use) so subtracted that as well.
- This does not include the 653-663 MHz duplex gap.

² <https://www.fcc.gov/ecfs/document/10209049636290/1>

The ETSI TR in particular is more complete than the WInnForum TR and analyzed various spectrum sharing frameworks as applied to PMSE. Examples include the Spectrum Access System (SAS) in the Citizens Broadband Radio Service (CBRS) band, the Automated Frequency Coordination (AFC) system used in the 6 GHz band and Licensed Shared Access/enhanced Licensed Shared Access (LSA/eLSA) developed in Europe. The next step is to develop a joint paper between the WInnForum and ETSI that would also identify the adjustments needed to these sharing frameworks to meet the requirements of PMSE applications.

Therefore, we respectfully request that NTIA also recognizes the significance, social and economic value of audio PMSE and considers the spectrum needs for audio PMSE in its Spectrum Strategy. Otherwise, it could be hard for U.S. to host any major event like an Olympic game in the future. Spectrum bands like 1240-1260 MHz, 1300-1350 MHz, 1435-1525 MHz, 3.1-3.45 GHz are all interesting bands that could be explored for different PMSE applications via sharing with the incumbents.

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

Respectfully submitted,
/s/ Prakash Moorut

Prakash Moorut
Global Head of Spectrum & Regulatory Affairs
Shure Incorporated, USA

Contents

1. Programme Making & Special Events (PMSE) is of critical importance to the U.S. economy.....	3
2. Continued access to spectrum around 1 GHz for audio PMSE is critical for its long-term future.....	5
3. Potential Future Technology for Audio PMSE	9
4. Shure supports spectrum Sharing.....	10
5. Conclusion.....	11

1. Programme Making & Special Events (PMSE) is of critical importance to the U.S. economy

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.

U.S. holds a dominant position in the world of content production with its film and other industries as shown by the data hereafter:³

- U.S. Streaming services - Subscription Video-On-Demand (SVOD) revenue has doubled in the 3 years since 2018, reaching \$25.3 bn in 2020 and is expected to reach \$54bn by 2027 – growing at annual rate of 8.63%
- Theater - 2018 Broadway generated \$3bn in ticket sales which led to a further \$8bn spend on ancillary activities such as hotels restaurants, shopping and other (non-Broadway) entertainment.
- U.S. Media & Entertainment generates \$717bn (6.9% total GDP) with projected annual growth rate of 8.9% through to 2030.
- In 2019, Live music nationwide had an economic impact of \$132 bn. Every \$100.00 spent on a concert ticket drives a further local economy spend of \$334.92 (per out-of-town visitor)
- Film sector - As of 2020, the U.S. Movie industry is worth \$91.83 billion and is forecast to have a CAGR of 4.1% from 2018 to 2025.
- The U.S. TV Broadcasting industry has a market size of \$63.2bn.

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.

³ Sources: Statista & <https://www.zippia.com/advice/media-and-entertainment-industry-statistics/>

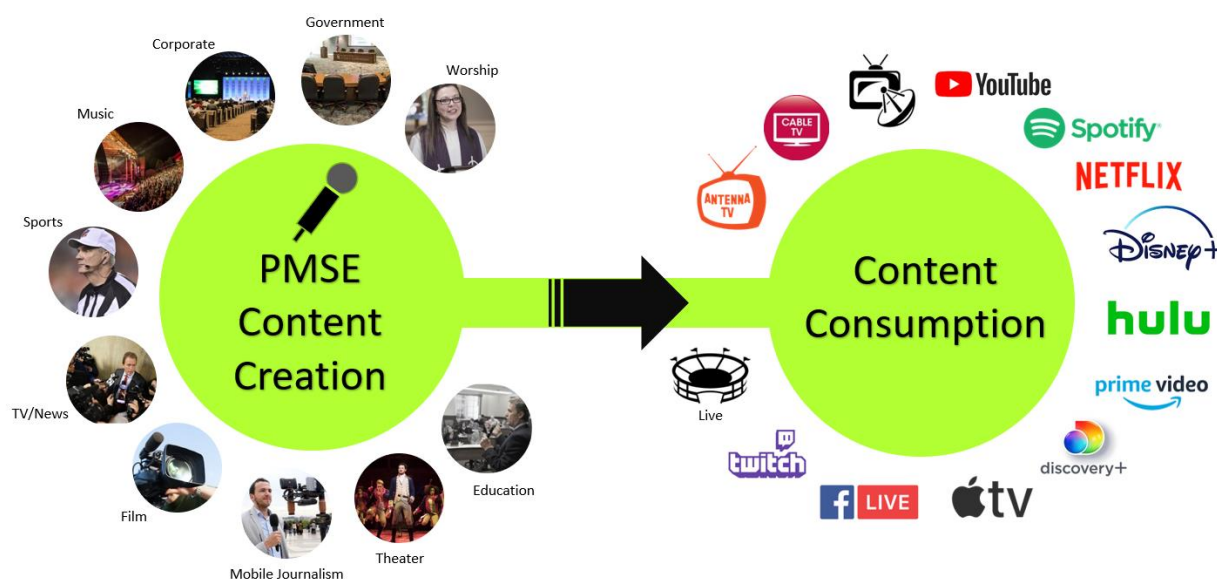


Figure 1: PMSE Enables Content Consumption.

2. Continued access to spectrum around 1 GHz for audio PMSE is critical for its long-term future

1. Audio PMSE Spectrum Requirements

Like all wireless communications technologies, audio PMSE needs spectrum. As NTIA develops a spectrum strategy 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 TV-UHF 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]⁴.

⁴ https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=6721

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.

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.

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.

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

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. EXPO 2020 – Dubai, United Arab Emirates

EXPO 2020⁶ 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 (WBB) Software at EXPO 2020 in UAE. With Shure’s Wireless Workbench, a frequency management tool for high-tier multi-channel PMSE applications, the user is able to develop a proper frequency management plan for the local event.

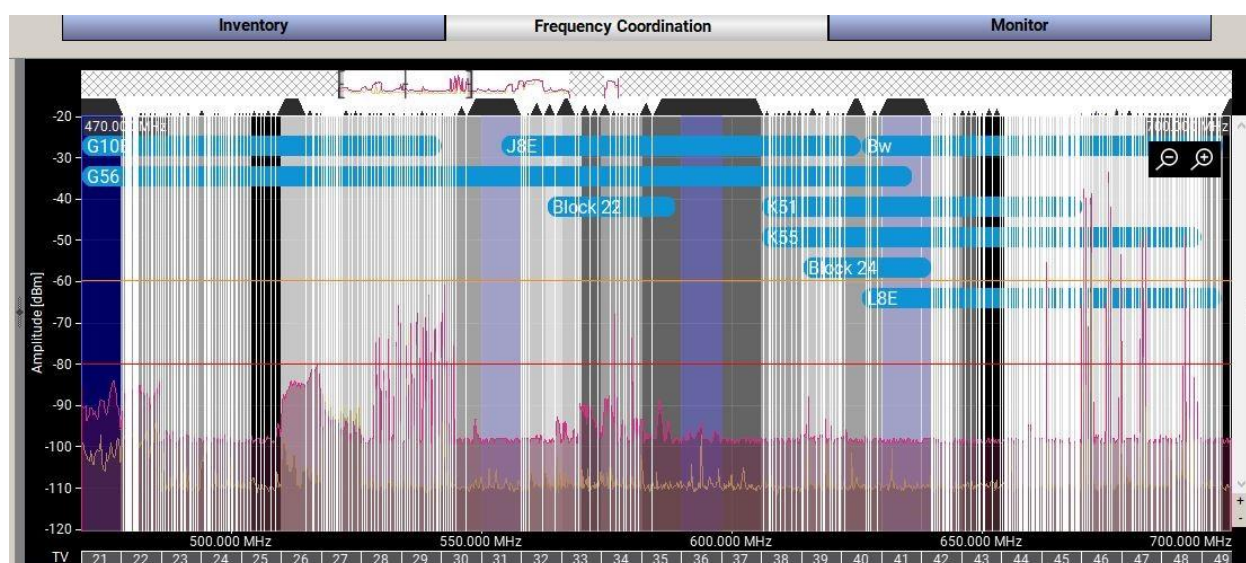


Figure 2: Frequency Management Plan at EXPO 2020

⁶ <https://www.youtube.com/watch?v=Rb5m8nT7meo>

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 much more than 100 MHz of spectrum.**

b. Super Bowl – U.S.⁷

In the U.S., 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. 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.

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 In-Ear Monitoring (IEM) systems.

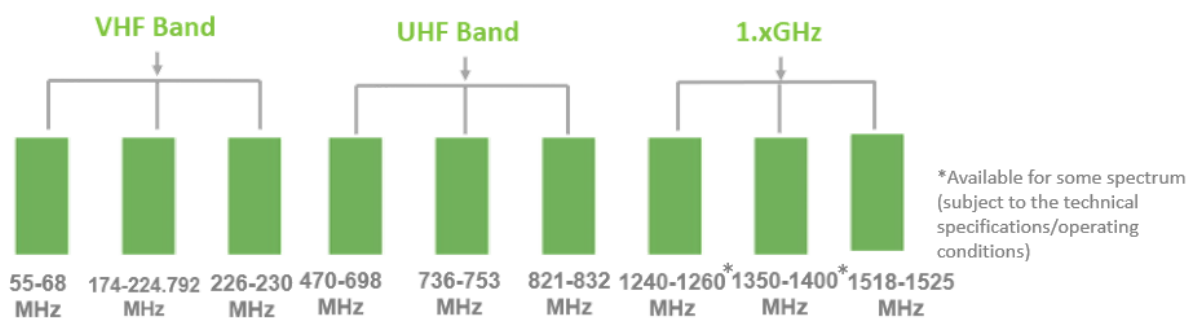


Figure 3: Spectrum for PMSE Use at Paris 2024 Olympics.

⁷ <https://www.sportsvideo.org/2023/01/18/super-bowl-lvii-phoenix-state-farm-stadium-raise-rf-coordination-to-new-level/>

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.

3. 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 U.S.

The U.S. Federal Communications Commission in the United States has opened a Notice of Proposed Rule Making (NPRM)⁸ to consider amending 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.

(b) Example of European Union

The wireless microphone standard EN 300 422⁹ describes test procedure for WMAS. Although WMAS systems are not available in the market yet, regulation has prepared for its future implementation by deleting the maximum bandwidth limitation of 200 kHz, which was part of ERC Recommendation 70-03.

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.¹⁰ 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 preliminary draft new IMT Applications report that is being drafted in ITU-R WP 5D.¹¹

4. Shure supports spectrum Sharing

PMSE has been sharing spectrum successfully with TV for decades. We are part of the Spectrum for the future [coalition](#) that supports spectrum sharing as a viable approach to make spectrum available to various industries, including PMSE. While there's certainly room for improvement in shared spectrum frameworks, they at least allow various sectors, ranging from real estate to health care to utilities to media content production to get access to free/affordable spectrum as explained in a November 17th, 2022 [letter](#), addressed to FCC and NTIA explaining how spectrum sharing is driving innovative uses of spectrum.

⁸ <https://docs.fcc.gov/public/attachments/DOC-371281A1.pdf>

⁹ 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)

¹⁰ [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)

¹¹ Preliminary draft new report ITU-R M.[IMT.Applications]. Applications of the terrestrial component of IMT for specific societal, industrial and enterprise usages.

In addition we are very active in WINNForum, ETSI and with various regulatory bodies to develop spectrum sharing solutions. In particular, we led the joint work between ETSI and WINNForum on the analysis of existing spectrum sharing frameworks for temporary and flexible spectrum access by PMSE.¹² A white paper will be developed jointly between these 2 organizations that will provide some recommendations on how to adapt these frameworks to meet PMSE requirements.

5. Conclusion

In summary, we want to make sure that the spectrum needs for audio PMSE, especially around 1 GHz, are considered so that PMSE can continue to support events and content creation, thereby contributing to the society and economy of the U.S. Moreover, we support the use of spectrum sharing to unlock spectrum for use by the PMSE.

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 and the new global audience realized by new delivery platforms. We have asked the FCC not to auction any additional spectrum below 614 MHz to mobile service as PMSE needs that spectrum.¹³ Shure was therefore relieved when the T-band (470 MHz to 512 MHz) auction was cancelled in the U.S.¹⁴

While co-channel sharing of mobile with audio PMSE is problematic, audio PMSE has been sharing the 470-698 MHz band with TV stations for more than 60 years successfully, without creating interference issues. We view that some of the more recent spectrum techniques can be successfully adapted for various spectrum bands, including those managed by NTIA to allow PMSE applications while keeping the government incumbents in the bands so that they can continue to perform their important missions using the spectrum. Clearing and auctioning spectrum to mobile operators cannot be the only answer to spectrum management. The U.S. needs to continue to be a leader on spectrum sharing which is allowing so many applications to flourish and PMSE is one of them.

¹² See ETSI TR 103 885 ([TR 103 885](#)) & WINNF-TR-2011 ([WINNF-TR-2011](#))

¹³ <https://www.fcc.gov/ecfs/document/10209049636290/1>

¹⁴ <https://www.rrmediagroup.com/News/NewsDetails/NewsID/20384>