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ITU-APT Foundation of India (IAFI[1])

INFORMATION ON SPECTRUM NEEDS OF PROGRAMME MAKING & SPECIAL EVENTS (PMSE) TOWARDS WRC-23 AGENDA ITEM 1.5

1. Introduction

WRC-23 Agenda Item 1.5 calls upon the Administration to review the spectrum use and spectrum needs of existing services in the frequency band 470-960 MHz in Region 1 and consider possible regulatory actions in the frequency band 470-694 MHz in Region 1 on the basis of the review in accordance with Resolution **235 (WRC-15).**

Resolution **235 (Rev.WRC-15)** invited the ITU-R, to review the spectrum use and study the spectrum needs of existing services within the frequency band 470-960 MHz in Region 1, in particular the spectrum requirements of the broadcasting and mobile, except aeronautical mobile, services, taking into account the relevant ITU-R studies, Recommendations and Reports.
Programme Making & Special Events (PMSE[2] also known as SAB/SAP[3]). includes wireless applications used in professional audio/video productions such as concerts, musicals, or other staging of entertainment, meetings, conferences, cultural and educational activities, trade fairs, sport, religious, and other public or private events.

This contribution provides some background information on wireless applications of PMSE as to help APG administrations consider this agenda item.

Programme Making & Special Events (PMSE)

PMSE is defined as follows:

- Programme Making: the making of a programme for broadcast, the making of a film, presentation, advertisement or audio /video recording, and the staging or performance of an entertainment, sporting, social or other public or private events.
- Special Event: an occurrence of limited duration, typically from one day to a few weeks, which take place in specifically defined locations. Examples include culture, sport, entertainment, religious and other festivals, conferences, and trade fairs. In the entertainment industry, theatrical productions may run for considerably longer.

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 PMSE incudes equipment like wireless microphones, in-ear monitor systems (IEMs), etc. And audio is of prime importance in the world of PMSE. Without the "audio" part of an

[1] IAFI is an affiliate member of APT
[2] *PMSE is the ITU‘s inclusive term consisting of radio microphones, in-ear monitors, wireless cameras, talkback systems,* etcetera.
[3] *Services Ancillary to Broadcasting (SAB)/Services Ancillary to Programme making (SAP)*

Contact: ITU-APT Foundation of India, India Email: Info@itu-apt.org

event, politicians, CEOs, and entertainers cannot communicate with impact to their audience. Wireless microphones are ubiquitous to public life. They are widely used and relied upon in office building, government buildings, schools, houses of worship, 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. For these applications, the portion thereof, 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, 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. This 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 $26 billion in 2026. In 2022, Disney is making a $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.

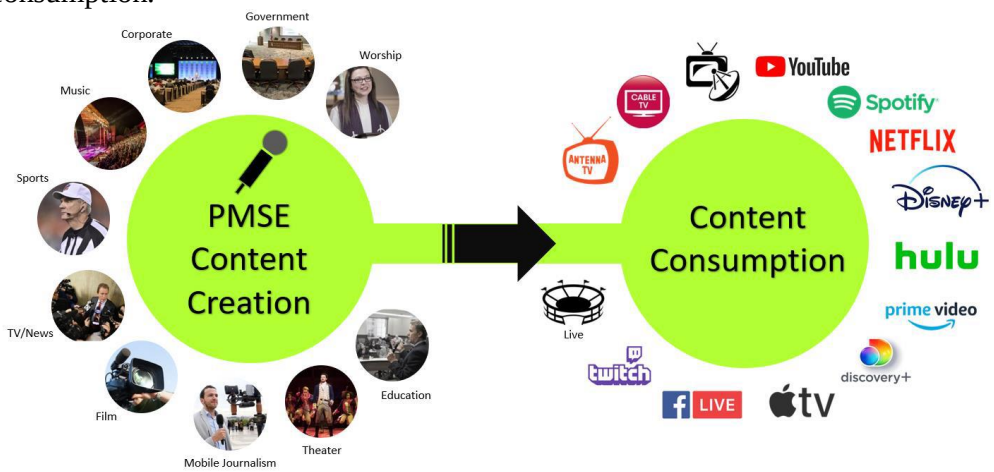

Figure 1: PMSE Enables Content Consumption

Spectrum needs of PMSE around 1 GHz for audio PMSE

Like all wireless communications technologies, audio PMSE needs spectrum. As NTIA[4] 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

[4] *The National Telecommunications and Information Administration, United States Department of Commerce.*

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.

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 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.

The spectrum requirements for audio PMSE are summarized as follows:
The example below is based on a PMSE database in one country as an example of the amount of needed PMSE devices and frequencies.

- **Permanent use**
  - Campus-Installations, which were considered in this analysis, require up to **110 MHz** spectrum in the UHF Band.
- **Events**
  - 82 **Small Events** (Events with less than 50 coordinated links) require **42 MHz** in the UHF Band:
  - 18 **Medium Events** (Events with 50-100 coordinated links) require **69 MHz** in the UHF Band
  - 11 **Large Events** (Events with 100-200 coordinated links) require **115 MHz** in the UHF Band.

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. These events include Ski World Championship St. Moritz, National wine festival "Fête de Vignerons", Dubai Expo 21-22

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

Jio World convention Centre is India's foremost venue for exhibitions, conventions, meetings, and social events. Its highly flexible and dynamic venues are equipped to simultaneously host physical, virtual and hybrid events. Such a space would need about 100 MHz of UHF spectrum according to a study.

Figure 2: Jio World convention Centre

b) Olympics and Paralympic Winter Games 2022 – Beijing, China

For Beijing 2022 Olympic and Paralympic Winter Games, to accommodate the spectrum needed for this event, Radio Administrations (MIIT) and Beijing Organizing Committee released the Spectrum Management Plan.

Wireless microphone users can apply for the frequency bands such as 470-510MHz, 630-698MHz and 798-806MHz but must avoid local broadcast frequencies. So, for bigger events spectrum management tools are used to protect the incumbents and to coordinate the wireless microphones.
In-ear monitor system can use the free resources in the frequency bands such as 470-566MHz and 606-702MHz.

Figure 3: Spectrum monitor (Left) and Spectrum coordinator (Right) for wireless microphone.

c) EXPO 2020 – Dubai, United Arab Emirates

EXPO 2020[5] in the United Arab Emirates (UAE) required 318 wireless microphone channels at the center 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 for high-tier multi-channel PMSE applications. As observed from the figure, each thin white line represents a 200kHz wireless RF channel for audio PMSE. Typically, such special events generate a very high "peak" demand, which might require much more than 100 MHz of spectrum.

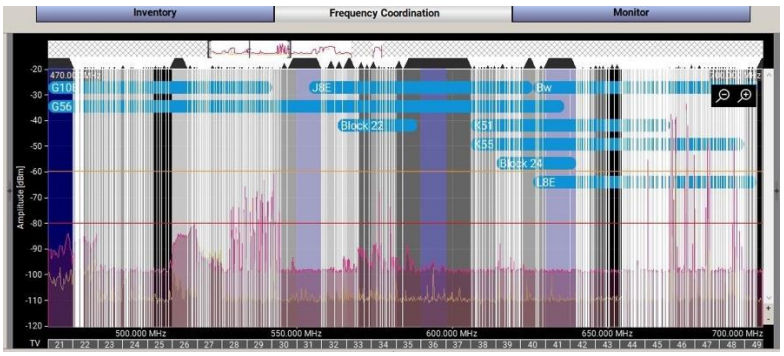

Figure 4: Frequency Management Plan at EXPO 2020

d) Olympics and Paralympic Games 2024 – Paris, France

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

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

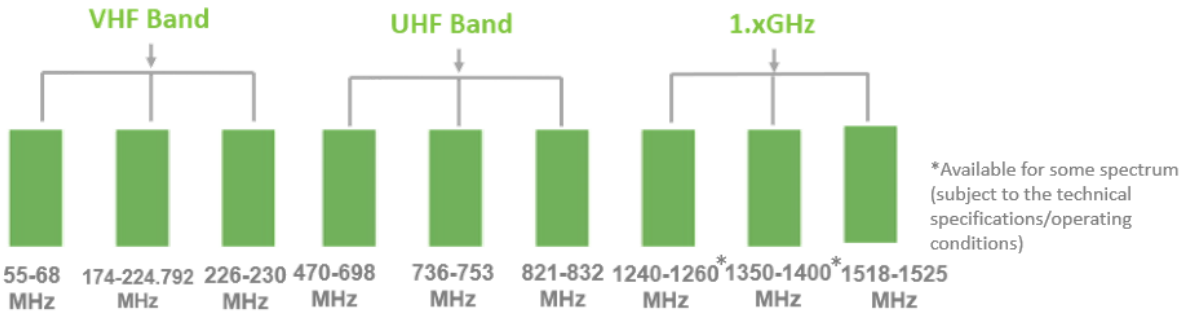

Figure 5: Spectrum for PMSE Use at Paris 2024 Olympics.

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.

2. Spectrum challenges faced by the PMSE industry worldwide.

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. While co-channel sharing of mobile with audio PMSE is impossible at the same location, audio PMSE has been sharing the TV UHF band (ex: 470-806MHz range mentioned in AWG PMSE questionnaire) with television in adjacent bands for more than 60 years successfully, without creating interference issues. Therefore, the band below 1 GHz is and keeps being the core band for audio-PMSE (wireless microphones).

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 and as spectrum available for PMSE continues to shrink in the TV-UHF band, it has been increasingly difficult to support major events.

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 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. To be able to support the 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 in Los Angeles within one kilometer. Luckily, equipment from other regions, where this band is still available, e.g., APAC. 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. It is important to consider PMSE usage in this band when conducting technical research.