Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of:	)	
	)	
Amendment of Parts 15 and 74 of the Rules for Wireless Microphones in the TV Bands, 600 MHz Guard Band, 600 MHz Duplex Gap, and 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	)	ET Docket No. 21-115 RM-11821

COMMENTS OF
THE NATIONAL ASSOCIATION OF BROADCASTERS

August 2, 2021

TABLE OF CONTENTS

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of:	)	
	)	
Amendment of Parts 15 and 74 of the Rules for Wireless Microphones in the TV Bands, 600 MHz Guard Band, 600 MHz Duplex Gap, and 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	)	ET Docket No. 21-115 RM-11821

COMMENTS OF
THE NATIONAL ASSOCIATION OF BROADCASTERS

I. INTRODUCTION AND SUMMARY

The National Association of Broadcasters (NAB)[1] hereby submits comments in response to the Commission's Notice of Proposed Rulemaking (NPRM) concerning the use of licensed and unlicensed wireless microphones in the broadcast television bands and other spectrum bands.[2] Broadcasters make substantial use of wireless microphones and other wireless audio systems in covering news, sports and in the production of content. As the spectrum available for television broadcasting has decreased following the broadcast spectrum incentive auction and the associated repack, the spectrum available for wireless

---

[1] The National Association of Broadcasters (NAB) is the nonprofit trade association that advocates on behalf of free local radio and television stations and broadcast networks before Congress, the Federal Communications Commission and other federal agencies, and the courts.

[2] *Amendment of Parts 15 and 74 of the Rules for Wireless Microphones in the TV Bands, 600 MHz Guard Band, 600 MHz Duplex Gap, and 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*, Notice of Proposed Rulemaking, ET Docket No. 21-115, FCC 21-46 (April 22, 2021) (NPRM).

microphones has also decreased. Accordingly, the need for increased cooperation between broadcasters and other wireless microphone users has never been greater.

The use of Wideband Multichannel Audio System (WMAS) technology on a secondary basis could help relieve spectrum congestion in situations where a large number of wireless microphones are needed. Because WMAS has a greater potential for interference and is not compatible with legacy narrowband wireless microphone deployments, however, the Commission should adopt prudent restrictions on WMAS operations to help reduce the potential for interference to primary spectrum users and to ensure that spectrum efficiency is actually improved. Subject to such restrictions, NAB supports the use of WMAS technology on a secondary basis.

II. THE COMMISSION SHOULD RESTRICT WMAS OPERATIONS TO USE CASES WHERE WMAS IMPROVES, RATHER THAN IMPAIRS, SPECTRUM EFFICIENCY

A. The Commission Should Limit WMAS Operations to Large Events

The overarching purpose of this NPRM is to "advance an important Commission goal of promoting efficient spectrum use."[3] Absent certain restrictions, however, WMAS technology could actually lead to *less* efficient use of spectrum and more conflict between users. This is because WMAS systems occupy more spectrum than traditional wireless microphone systems. As a result, the use of WMAS systems has a preclusive effect on traditional systems where spectrum is limited. For example, if there is only a single 6 MHz TV channel available for use at a breaking news event, one news crew using a WMAS system could occupy the entire channel and prevent coverage by other news organizations.

Breaking news events typically require one to four wireless audio channels (per broadcaster), including one or two wireless microphones and up to two interruptible foldback

---

[3] NPRM at ¶ 1.

channels which provide cuing and communications to on-air talent and technical support personnel. Broadcasters commonly pre-coordinate the RF channels used by their news crews to avoid conflict in situations where several stations may have crews covering the same event at the same time. As a result, the RF channels used by a broadcaster for breaking news are pre-programmed and may be difficult to change rapidly. A single WMAS deployment at a breaking news event, if uncoordinated, may interrupt the field news operations of several networks inhibiting the dissemination of emergency information to the public.

NAB believes that such obstruction is inevitable if the Commission does take reasonable precautions. First, the Commission should limit use of WMAS to situations where a large number of audio channels are needed and all channels are under control of a single entity. There is no reason to use a system designed for "wideband multichannel" use in situations where it is not needed. WMAS technology is, by definition, intended to be multichannel; that is, the spectrum efficiency improvements of this technology are realized only when *many* audio channels are being used by a single entity at a particular location. Examples of such deployments could include arena concerts, professional sporting events, television and movie production and major theatrical shows.

To ensure that WMAS is only used in situations where it will improve, rather than reduce, spectrum efficiency, the Commission should establish a minimum threshold for WMAS operations. NAB recommends that an appropriate threshold is ten audio channels in use by a single entity. Examples of a single entity could include a broadcast production company, theatrical troupe, musical group, venue owner or event frequency coordinator. The key point is that control of all RF transmitting facilities must be under a single entity with the ability and authority to rapidly reconfigure those facilities in the event of interference. As an

added measure, NAB suggests the Commission only authorize WMAS base stations that are designed to prevent transmission when fewer than ten paired audio devices are detected.

B. The Commission Should Require a Minimum Efficiency of Six Audio Channels Per Megahertz

Conventional, single channel analog FM wireless microphones are limited to a 200 kilohertz maximum bandwidth and can therefore operate with channel spacings of 200 kHz or less. This means that conventional technology can easily support up to five audio channels in one megahertz of RF bandwidth (5 ch/MHz).[4] Conventional digital wireless microphones have similar specifications.[5] In some cases conditions may limit actual efficiency to less than 5 ch/MHz, but NAB believes that common technical measures, including filtering and power control, can be used to achieve this efficiency under realistic conditions.

To justify its use, therefore, WMAS should improve on this baseline figure for spectrum efficiency. The Commission's proposal of at least three audio channels per megahertz (3 ch/MHz) appears to represent no meaningful efficiency improvement, particularly if the audio channels are not of broadcast or production/performance quality.[6] Consistent with the Commission's goal of improving spectrum efficiency, NAB recommends that 6 ch/MHz spectrum efficiency form the baseline by which WMAS is evaluated. Based upon marketing information from one of the petitioners, existing digital wireless microphone systems can support at least 47 audio channels in a six MHz RF channel, albeit with some restrictions, corresponding to a spectrum efficiency of 7.8 ch/MHz.[7] NAB understands that WMAS can

---

4 47 CFR § 861(e)(5).

5 See, *e.g.*, Sennheiser Model SK9000 Test Report (FCC ID: DMOSK9000).

6 NPRM at ¶ 22.

7 *See* "ULXD4Q Quad-Channel Digital Wireless Receiver," available at: https://www.shure.com/en-US/products/wireless-systems/ulx-d_digital_wireless/ulxd4q

support up to 64 audio channels in 6 MHz of RF bandwidth, corresponding to an efficiency of 10.7 channels/MHz. A baseline efficiency requirement for WMAS of 6 ch/MHz would thus represent an improvement upon what is available using existing technologies but be comfortably below the theoretical maximum efficiency of WMAS technology.

NAB observes that an "audio channel" could be a wireless microphone or direct box connection to a musical instrument, requiring high-fidelity, low-latency, high-dynamic range and phase-linearity over a wide-band audio circuit, or it could be an interruptible foldback or intercom connection with much lower bandwidth and dynamic range requirements. A musical performer, for example, will require greater effective bandwidth, likely achieving lesser spectral efficiency, while technical communications and cuing can be achieved with less bandwidth and greater efficiency.[8] It is not apparent, however, that such differences should be reflected in calculations of spectral efficiency. NAB expects that the effective bandwidths of a mix of performance-quality and technical-quality audio channels will be implemented by manufacturers using statistical multiplexing or other techniques.

III. THE COMMISSION SHOULD ADOPT RULES TO PREVENT INTERFERENCE TO BROADCAST OPERATIONS

The NPRM states that the Commission does not "intend to alter the existing spectrum rights – or expectations regarding access and availability of spectrum"[9] Accordingly, secondary users should continue to operate on a non-interference basis to primary users and unlicensed users may continue to operate only opportunistically and without spectrum or interference protection rights. NAB views the ability to register wireless microphone venues for protection in the TV White Spaces database as an essential component in the determination

---

[8] NPRM at ¶ 23.

[9] NPRM at ¶ 1.

of spectrum availability and access and urges the Commission to continue that requirement. We suggest additional specific protections below.

A. The Commission Should Limit WMAS Eligibility to Part 74 Licensees

As a practical matter, NAB expects WMAS devices to be more expensive than conventional wireless microphone systems for users needing only a small number of audio channels. Thus, cost alone may limit WMAS to professional applications. However, we are concerned that at least some small end-users may be tempted to "future-proof" their operations by investing in WMAS technology despite needing only a few audio channels. As described above, this could result in decreased spectrum efficiency that could limit broadcasters' ability to use wireless microphones to cover important events.

To prevent this, the Commission should limit WMAS eligibility to licensed operations. The Commission's regulations already distinguish between licensed and unlicensed users, allowing greater power, interference protection and flexibility for the former with the proviso that unlicensed users routinely employing 50 or more devices are eligible to apply for licensed status.[10] Because WMAS is intended to support large numbers of audio channels, it seems reasonable to assume that entities needing to employ WMAS technology will also be eligible for a license. The Commission acknowledges that wireless microphone manufacturers have not asked the FCC to authorize WMAS under Part 15 of the Commission's rules and NAB urges the Commission to limit WMAS to licensed users only.[11]

When interference problems arise, licensed users are far easier to identify and contact, generally more knowledgeable concerning technical issues and more professional

---

[10] See, *e.g.*, 47 CFR §§ 74.801, 15.713(j)(8).

[11] NPRM at ¶ 39.

and cooperative in reaching resolution. It is not uncommon for small wireless microphone users to simply leave their audio reinforcement systems on all the time. While this is less of an issue with unidirectional microphone systems, where a battery-operated transmitter will eventually run-down and the associated AC-powered receiver does not radiate, our understanding is that WMAS systems are designed to be bidirectional. An unattended AC-powered base station may transmit continuously for days or weeks, making the occupied spectrum unavailable for use by others. In such situations, the basic contact and location information afforded by the license record may be essential in getting the offending transmitter shut off quickly. If technological improvements eventually provide additional safeguards to ensure that WMAS systems are not inadvertently mis-configured or allowed to transmit unattended, the Commission can revisit this issue.

B. The Commission Should Limit WMAS to 6 MHz Bandwidth

NAB strongly supports the proposal to allow WMAS devices to use a 6 MHz maximum bandwidth.[12] Most wireless microphones and associated audio systems operate in the UHF television spectrum. The existing rules governing low-power auxiliary systems (LPAS) are designed to protect broadcast television stations which operate in defined 6 MHz channels. The selection of frequencies for LPAS is guided by the need to avoid interference to TV broadcast reception, and coordination schemes, including the TV White Space registration database, are designed around 6 MHz TV channels.[13] To avoid creating another set of protection requirements, WMAS should be limited to operation in 6 MHz channels and not be permitted to straddle multiple TV channels. Operation across larger bandwidths can be

---

[12] NPRM at ¶ 18.

[13] *See* 47 CFR §§ 74.803(b), 15.713(a)(2), 15.713(b)(2)(ii).

accomplished using two or more WMAS systems, each operating within a single 6 MHz TV channel. Conversely, WMAS operation should not be permitted at bandwidths of less than 1 MHz. This minimum bandwidth comports with NAB's proposal that a minimum of 10 audio channels be in use to operate WMAS with a minimum spectral efficiency of 6 ch/MHz.

In other spectrum bands, NAB recommends that the bandwidth of any WMAS operation be harmonized with standardized band plans. For example, in the bands 6875–6900 and 7100–7125 MHz, which are authorized for Broadcast Auxiliary Station (BAS) operations, 25 MHz channelization is specified.[14] Any operation in those bands should be confined to the specified channel boundaries but need not occupy an entire 25 MHz channel.

C. The Commission Should Limit WMAS Power to 250 Milliwatts EIRP

NAB agrees with the Commission's proposal to limit WMAS systems to 250 mW EIRP in the UHF television bands, regardless of the bandwidth of the WMAS operation.[15] For licensed users, conventional narrowband wireless microphones are permitted to operate with up to 250 mW in UHF television spectrum, although in most applications 50 mW or less is sufficient and helps to conserve battery life.[16] Most digital television systems are believed to be less susceptible to narrowband co-channel interference than wideband interference at the same power level.[17] Therefore, allowing wider bandwidths at the same power level as narrowband systems is likely to increase the potential for interference.[18]

---

[14] 47 CFR § 74.602(a).

[15] NPRM at 27

[16] 47 CFR § 74.861(e)(1)(ii).

[17] See, *e.g.*, ITU-R Recommendation BT.1368-13, "Planning criteria, including protection ratios, for digital terrestrial television services in the VHF/UHF bands" (2017).

[18] NPRM at ¶ 28.

NAB believes this 250 mW power level would be sufficient power to accommodate a large number of WMAS audio devices while reasonably limiting the co-channel interference potential to that of conventional wireless microphone deployments. An EIRP limit of 250 mW also maintains the necessary protection of WMAS to television stations operating on adjacent channels. Careful examination of the implications associated with the proposed adoption of ETSI Standard EN 300 422-1 (2017) indicates that the proposed WMAS emission mask would allow excessive levels of out-of-band energy to be radiated if the EIRP is not limited to 250 mW. For example, if WMAS is permitted to operate with 4.5 watts EIRP in 6 MHz as requested by Shure,[19] the interference power in an adjacent television channel is calculated to be at least 9.1 dB greater than for a single narrowband (FM analog) wireless microphone operating with 250 mW. As previously noted, narrowband wireless microphones are typically operated at lesser power levels, such as 50 mW, so this analysis may also be applied to the common situation of a large number of narrowband wireless microphones operating at lesser power than 250 mW in a single TV channel.

NAB calculated the amount of interference power in an adjacent television channel (TV Channel 15, 476–482 MHz) by graphically integrating the emission masks for digital and analog narrowband wireless microphones, and WMAS given in the ETSI standard, adjusting them for power levels of 250 mW for the narrowband devices and 4.5 watts for WMAS operating in Channel 14 (470–476 MHz). The results are shown in Figure 1. For this analysis, a narrowband device (analog or digital) was assumed to operate 100 kHz from the edge of the operating channel to simulate the worst-case condition. The WMAS was assumed to operate with 6 MHz bandwidth, with the emission centered in the operating channel.

---

[19] 750 mW/MHz times 6 MHz equal 4.5 watts EIRP.

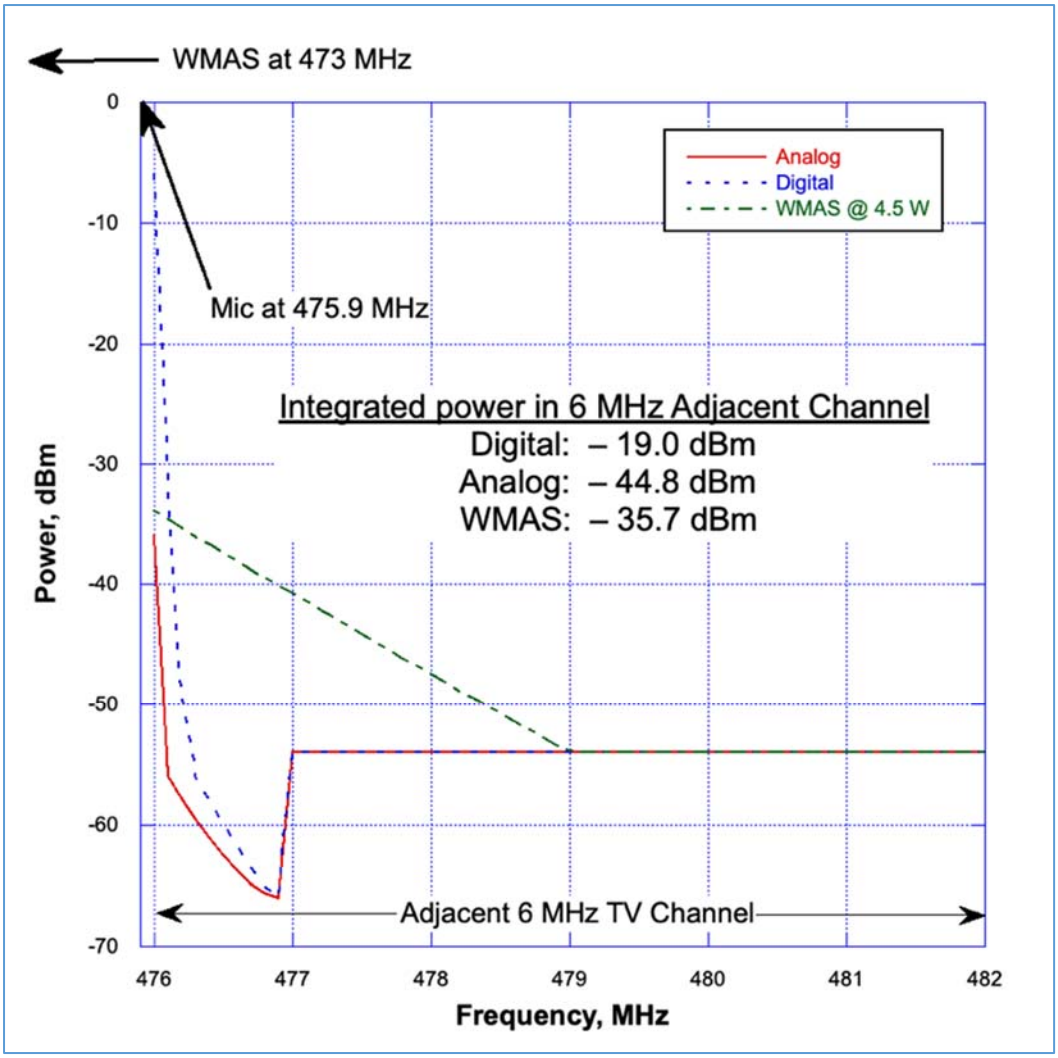

Figure 1. Illustration of out-of-band interference power from narrowband wireless microphones and WMAS.

Because wireless microphones often operate in unoccupied TV channels that are adjacent in frequency to operating TV stations, such an increase in out-of-band interference power substantially increases the risk of interference to television reception. A power limit for WMAS in a given channel regardless of bandwidth, rather than a power density limit, simplifies determining compliance with the emission mask and appears to be more consistent with the ETSI standard. The 2017 version of the ETSI standard appears to have little or no impact on requirements for narrowband equipment and NAB recommends its adoption in order to permit WMAS operation.

IV. CONCLUSION

NAB supports the Commission's efforts to increase spectrum efficiency for wireless microphone use through this proceeding. We believe that, with certain minimal restrictions in place, end users can operate WMAS technology without increased risk of interference to other spectrum users. We look forward to working with the Commission and other stakeholders in this proceeding to develop final rules that will facilitate the use of WMAS technology moving forward.

Respectfully submitted,

NATIONAL ASSOCIATION OF BROADCASTERS
1 M Street SE
Washington, DC 20003
(202) 429-5430

Rick Kaplan
Patrick McFadden
Alison Neplokh
Robert Weller

August 2, 2021