

**BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
Washington D.C. 20554**

In the Matter of)	
)	
Unlicensed Operation in the TV Broadcast Bands)	ET Docket No. 04-186
)	
Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band)	ET Docket No. 02-380
)	
)	

**REPLY COMMENTS OF
SHURE INCORPORATED**

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SUMMARY

Shure Incorporated (“Shure”) supports the Commission’s commitment to prevent interference and disruption to incumbent authorized services, including wireless microphones and related audio devices, in the TV frequencies. The comments reflect that it is critical for the Commission to adhere to this commitment with respect to wireless microphones and other incumbent uses as it evaluates how new, additional services could be permitted in the TV bands and regardless of whether an unlicensed, licensed or hybrid regulatory regime is selected. Wireless microphones are integral to the production of “content” that Americans demand from all media and information outlets. Millions of Americans enjoy and rely on high-quality audio using wireless microphones in news-casting, entertainment, sports, religious, business and educational communications. As demonstrated in the comments, interference from new devices would cripple wireless microphone operations and disrupt these communications contrary to the public interest.

Shure joins with other parties in urging the Commission to anchor its decisions on real-world, proven and demonstrable interference solutions based on sound engineering and thorough testing. The comments revealed widespread concern that spectrum sensing has not yet been examined or proven to be effective in the TV bands and therefore cannot serve as adequate interference protection at this time. Further, although some progress has emerged with developing solutions for fixed access systems, numerous parties agree that little has been achieved with respect to interference avoidance solutions for personal/portable devices and the Commission should not authorize their operation in the TV bands at this time.

Given the extremely demanding quality requirements and specialized uses of wireless microphones, Shure proposes that the Commission adopt a combination of interference

protection measures to ensure that new TV band devices will not cause crippling interference to incumbent wireless microphone operations: 1) spectrum sensing, 2) reserve spectrum channels, 3) a smart beacon, and 4) specific implementation requirements. Several parties, including the IEEE, the principal engineering group that has intensively studied the complex interference issues raised by the Commission's proposals in this docket, support a combination of methods and techniques to protect incumbent operations. Whether these measures will be effective safeguards will turn on the details of their implementation. In that regard, Shure urges the Commission to ensure that interference protection thresholds discussed in the comments are coupled with requirements for distributed sensing and reduced power levels for unlicensed devices.

Finally, Shure strongly disagrees with the view of a few parties that wireless microphone uses are trivial and invalid. Further, Shure strongly opposes the "proposals" of some parties to eliminate wireless microphone operations in the TV bands altogether. Parties putting forth these "proposals" have little understanding of the extent and nature of authorized wireless microphone operations and do not understand wireless microphone technology. Their sole mission, apparently, is to co-opt TV band spectrum for their own purposes. These "proposals" are far outside the scope of this proceeding. They are contrary to the Commission's goal in this proceeding to protect incumbent operations, adverse to the public interest, and should be dismissed.

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Shure Incorporated (“Shure”), by its undersigned counsel, hereby submits these Reply Comments in response to the Commission’s Further Notice of Proposed Rulemaking (“FNPRM”) released October 18, 2006, in the above-captioned matter.¹

The Commission has made plain that unlicensed devices will be permitted to operate on unused television channels only as long as “such operations will not result in harmful interference to TV and other authorized services.”² It is critical that the Commission adhere to this commitment with respect to wireless microphones and other incumbent uses. Wireless microphones are integral to the production of “content” that Americans demand from all media and information outlets. Many commenting parties echoed Shure’s concern that spectrum sensing has not yet been examined or proven to be effective in the TV bands. Although some progress has emerged with respect to solutions for fixed access systems, numerous parties agree that little has been achieved and demonstrated with respect to interference avoidance solutions

¹ *Unlicensed Operation in the TV Broadcast Bands*, First Report and Order and Further Notice of Proposed Rulemaking, filed in ET Docket Nos. 04-186 and 02-380, FCC 06-156 (released Oct. 18, 2006) (“FNPRM”).

² *FNPRM* at ¶ 1. Indeed, the FNPRM is replete with clear statements that incumbent services in the TV bands must be protected from harmful interference.

for personal/portable devices. A number of parties supported measures similar to the solutions suggested by Shure to protect incumbents, including wireless microphones, and to the extent that the Commission proceeds in this docket, Shure urges the Commission to adopt these measures.

I. The Commission's Rules Must Protect Wireless Microphone Operations in the TV Bands

Wireless microphones³ are incumbent services operating in the TV frequencies that currently serve -- and for several decades have served -- important communications functions. Today, wireless microphones are an integral part of many high-profile uses that are critical to cultural, artistic, social, political, spiritual, and commercial aspects of our community, large and small. In addition, wireless microphones play a vital role in the distribution of emergency information to the public.⁴ Not only are wireless microphones integrated in many ways into our daily lives, they make possible the high-quality, advanced audio services that are a fundamental part of the content that consumers access through broadband services. In that respect, wireless microphones are on the front end of the "content" chain. Thus, it is disingenuous to argue that protection of wireless microphone operations is contrary to the Commission's objective to facilitate greater broadband access services.⁵ Indeed, wireless microphone use will become more -- not less -- important as our society continues to add broadband services as one more means of acquiring multimedia information. That said, numerous commenting parties, including proponents of new TV band devices, recognize the need to protect wireless microphones from

³ "Wireless microphones" as used herein includes a variety of audio devices authorized under Part 74 of the Commission's Rules as secondary users of locally unoccupied television channels. In addition to wireless microphones, this equipment includes in-ear monitors, wireless intercoms, wireless assist video devices ("WAVDs") and wireless cueing ("IFB") systems.

⁴ Comments of Radio-Television News Directors Association ("RTNDA"), filed in ET Docket Nos. 04-186 and 02-380 on January 31, 2007, at p. 2.

⁵ See Comments of New American Foundation, et al. ("NAF"), filed in ET Docket Nos. 04-186 and 02-380 on January 31, 2007, at p. 50.

interference, although there is significant disagreement on how best to accomplish that goal.⁶

This remains Shure's principal concern regardless of whether new devices in the TV bands will be authorized on a licensed, unlicensed or hybrid basis. Whatever regulatory model is selected for new devices in the TV bands, wireless microphones, as an enabler of modern content production for broadband, TV, or other media, must be protected from interference. Shure thus opposes a licensed or hybrid approach if it does not preserve interference-free continued reliable wireless microphone use.⁷ Similarly, Shure opposes an unlicensed approach if it fails to fully protect wireless microphone operations.

II. Shure Recommends a Combination of Methods and Specific Technical Requirements To Protect Incumbent Wireless Microphone Services in the TV Band

Specific technical parameters and requirements are necessary to govern any unlicensed device operation in the TV bands.⁸ Some commenting parties urge the Commission to allow unlicensed devices in the TV frequencies with a bare minimum of requirements.⁹ They argue that protective measures will impose costs and delays and will hinder the intended manufacturing process.¹⁰ Some urge the Commission to assess proposed technical and implementation requirements by virtue of whether they will "facilitate the creation of a mass market for

⁶ See generally Comments of Microphone Interests Coalition ("MIC"), filed in ET Docket Nos. 04-186 and 02-380 on February 2, 2007; Comments of Guitar Center, Inc. ("Guitar Center"), filed in ET Docket Nos. 04-186 and 02-380 on January 30, 2007; Comments of Professional Audio Manufacturers Alliance ("PAMA"), filed in ET Docket Nos. 04-186 and 02-380 on January 31, 2007; Joint Comments of The Association for Maximum Service Television, Inc. and the National Association of Broadcasters ("MSTV"), filed in ET Docket Nos. 04-186 and 02-380 on January 31, 2007; Comments of Dell Inc. et al. ("Dell"), filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007; Comments of Motorola, Inc. ("Motorola"), filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007; NAF; RTNDA.

⁷ See, e.g., QUALCOMM Incorporated ("QUALCOMM"), filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007, at p. 5; Comments of Charles L. Jackson and Dorothy Robyn ("QUALCOMM Consultants"), filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007, at pp. 54-55 (proposing licensed uses and removal of wireless microphone operations in TV bands.).

⁸ For convenience, throughout this document, Shure refers to the new devices proposed to operate in the TV bands as "unlicensed" devices even though the Commission has not yet determined whether such devices should be licensed or unlicensed.

⁹ Dell, at p. 21; Comments of Tropos Network ("Tropos"), filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007, at p. 10.

¹⁰ See Dell, at p. 10 (requirement for base station to communicate with devices and professional installation requirements will delay and add substantial costs).

devices”¹¹ and create a robust market with economies of scale and scope.¹² However, the public interests at stake in this proceeding are much broader than solely facilitating a “robust mass market of devices.” The Commission must consider the millions of American consumers who enjoy and rely on live real-time news, entertainment, sports, religious, political and educational programming that use wireless microphones.

Effective interference protection of wireless microphones is complex because wireless microphone operations are typically intermittent, rather than continuous, and itinerant, rather than stationary.¹³ Further, as the IEEE and others recognize in their comments, wireless microphones are designed to provide extremely high quality audio content, and as such, its producers and audience “cannot tolerate any disruptive interference during live audio feeds (once the moment is gone it is gone forever.)”¹⁴ Further, the types of uses vary widely and include, for example:

- Large fixed systems (using 20 to 200 channels) often seen in network television studios and theme parks;
- Small fixed systems (using 20 or fewer channels) often seen in movie making locations, Universities, Houses of Worship;
- Large itinerant (using 20 to 200 channels), such as political conventions, sporting events, touring music and theater shows; and
- Small itinerant (using 20 or fewer channels) such as electronic news gathering teams, press conferences.

Given these complexities, *even if TV band spectrum sensing can be developed as proposed* by several parties, it cannot be the sole means of providing protection to incumbent

¹¹ Dell, at p. 3.

¹² *Id.* at p. 15.

¹³ See *FNPRM*, at ¶ 40.

¹⁴ Comments of IEEE 802.18 (“IEEE”), filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007, at p. 10; see also Comments of The National Academy of Recording Arts and Sciences (“NARAS”), filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007, at p. 2; MIC, at p. 4; PAMA, at p. 4, Guitar Center, at p. 2.

wireless microphone operations. Several commenting parties recognize that a combination of interference protection measures are necessary to protect these incumbent operations while allowing other devices to operate in the locally unused TV channels. Significantly, the IEEE, the principal engineering group that has intensively studied the complex interference issues raised by the Commission's proposals in this docket, supports the adoption of a combination of methods and techniques to protect incumbent operations.¹⁵

To that end, Shure urges the Commission to adopt rules that incorporate (1) spectrum sensing requirements, (2) reserve spectrum channels in which new unlicensed devices are not permitted to operate, (3) a "smart" wireless microphone beacon that unlicensed devices can identify in order to avoid transmitting on specified channels during news-gathering or other production event, and (4) specific implementation requirements.¹⁶ None of these measures is infeasible or too burdensome or too costly *even in combination* for the incipient unlicensed TV band device industry to implement. Such measures do require some effort, cooperation and development on the part of the unlicensed TV band device community, but Shure believes that such modest steps are necessary and more than justified given the Commission's public interest objectives and the interests of the millions of American consumers and businesses at stake.

A. Shure Supports Recommendations for Specific TV Band Spectrum Sensing Parameters that Will Protect Wireless Microphones

The Comments confirmed that spectrum sensing is promising, but as yet unproven with respect to how it will work *in the TV bands to protect TV and other incumbents including wireless microphones devices*. The Commission accurately assessed in the FNPRM that the experience at 5 GHz is useful to the extent that it shows that spectrum sensing can be an effective

¹⁵ IEEE, at p. 6.

¹⁶ Shure proposed in its Comments that fixed base status 1) must be registered in a publicly accessible database, 2) professionally installed, and 3) required to transmit a unique identifier. Comments of Shure Incorporated ("Shure"), filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007, at pp. 21-22.

interference protection mechanism but that too little is known at this time about how sensing will operate to protect incumbents in the TV bands.¹⁷ In particular, required levels for sensing, power requirements, spectrum to be scanned, duration of the sensing, and other sensing design elements in the context of the unique operations present in the TV bands need to be determined.¹⁸

No party has yet supplied an actual, real-world TV band spectrum sensing device that can demonstrate how it will provide interference protection to incumbent services. As discussed below, Shure looks forward to laboratory and field testing of smart unlicensed devices to assess their ability to protect incumbent services from interference.

While smart technology is still under development, some helpful discussion of specific technical parameters emerged in the comments:

- Interference Protection Threshold: Shure identified a -107 dBm threshold in its comments that reflects recommendations of the IEEE that specified a threshold as one part of a combination of protection measures needed to safeguard Part 74 wireless microphones. (IEEE also identified a -116 dBm threshold for DTV broadcasting.)¹⁹ Dell proposed a -114 dBm interference detection threshold based on the Threshold of Visibility (“TOV”) for DTV receivers with a further reduction to account for variables of the relative position of the TV transmitter, the TV receiver antenna and the unlicensed device. Dell claims that its prototype will detect both analog and digital

¹⁷ *FNPRM*, at ¶ 34; *see, e.g.*, Comments of Consumer Electronics Association (“CEA”), filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007, at p. 4 (noting substantial differences between radar detection at 5 GHz and receiver protection in TV bands.).

¹⁸ Dell states that it has demonstrated the effectiveness of spectrum sensing to protect wireless microphones in theoretical and empirical studies. Dell, at p. 29-30. If Dell wants the Commission to give any weight to these representations, it should submit these studies in the public record making them accessible for public review and comment.

¹⁹ IEEE, at pp. 10-11.

signals and, together with this threshold, will protect wireless microphones.²⁰ Shure would support the -114 dBm threshold proposed by Dell, but it must be coupled with reduced power and distributed sensing requirements as outlined in Shure's comments.²¹

- Distributed Sensing Requirements: Distributed sensing of at least two (2) unlicensed devices should be required. Typically unlicensed device applications will involve two or more unlicensed devices in operation communicating with each other. If both of these devices are required to sense, it will immensely improve the ability of the unlicensed device system to detect wireless microphones and other incumbent services. Distributed sensing is critical to overcoming "hidden node" problems and the risk of interference to wireless microphones. Distributed sensing is the preferred approach to avoiding hidden node interference and superior even to the additional 7 dB of sensitivity in the interference detection threshold proposed by Dell.²²
- Maximum Power: Shure supports the dynamic power reduction proposal outlined by Dell²³ except that the maximum power should be reduced from 100 mW to 10 mW. In that case, the dynamic power circuitry need not reduce power below 1mW. That reduced power limit would reduce the dynamic range required from 20 dB to 10 dB. Shure also supports the proposal by Dell for a maximum of 0 dBi gain for receive and transmit antennas rather than the 6 dBi gain proposed by the Commission.²⁴

²⁰ Dell, at p. 6.

²¹ See Shure, at p. 14.

²² See *FNPRM*, at ¶ 39 (a more sensitive interference threshold may add costs, increase false detections and adversely affect system performance); see also IEEE, at pp. 6-7 (nothing that distributed sensing offers superior detection range relative to a signal sensing); MSTV, at p. 13.

²³ Dell, at p. 4.

²⁴ *Id.*, at p. 5.

- Non-Occupancy Time/Periodic Channel Sensing: Shure urges the Commission to require unlicensed devices to engage in frequent periodic channel sensing, e.g., every 10 seconds to protect wireless microphones.
- Other Parameters: Shure reiterates its recommendations made in its initial comments with respect to Channel Availability/Check Time/Recheck Time, Move Out Time, Non-occupancy Time/Periodic Channel Sensing, Transmit Power Control, Occupied Bandwidth, and Out Of Band Emissions.

B. The Commission Should Identify Several Channels of Clean Spectrum for Wireless Microphone Operations

Several parties recognized the merit of restricting unlicensed device operation in some TV band channels as a means of permitting wireless microphones to operate reliably without interference.²⁵ Shure fully supports that proposal and has suggested that the Commission identify six (6) channels in each market that will be exempt from unlicensed device operation: two (2) VHF High Band channels (7-13) and four (4) UHF channels.²⁶ If the Commission decides to adopt the adjacent channel plan proposed by the IEEE and MSTV²⁷ to protect TV operations, then the Commission should identify additional “clean” spectrum in rural areas where there are fewer TV stations operating and thus far fewer “adjacent channels” where wireless microphones could reliably operate free from unlicensed device interference.²⁸ Specifically, in that case, Shure urges the Commission to exempt six (6) channels in rural markets to ensure that incumbent wireless microphone operations have some spectrum free from unlicensed device interference.

²⁵ See generally IEEE, at pp.8-9, MSTV, at pp. 19-20, MIC, at p. 5, PAMA, at p. 6 (unlicensed devices should be prohibited from operating in certain channels).

²⁶ See Shure, at p. 13.

²⁷ IEEE, at pp. 8-9; MSTV, at pp. 19-20.

²⁸ In adjacent channels, wireless microphones would continue to carefully coordinate frequency usage as they do today to ensure that no interference is caused to broadcast stations.

C. Unlicensed Devices Should be Required to Recognize a Smart Beacon to Protect Wireless Microphones in Large Venues

Reserving relatively few TV channels would address the needs of many wireless microphone users, but it would not provide sufficient spectrum for large events requiring 50 or more channels. The Superbowl game, the Grammy Award Show, the Kennedy Center Awards, Grand Ole Opry Shows, Broadway Theaters, and the national political conventions are all examples of large events that have unique spectrum needs. Further, given the interference detection thresholds and power limits under discussion, it is still possible that an unlicensed device would have an interference range that significantly exceeds the range at which it could autonomously sense a low power Part 74 device, most of which operate at only 10-50 mW of power output. For body pack transmitters worn on the body, the actual radiated signal is typically 15 to 25 dB lower.

To address these needs -- and without imposing excessively large protection zones on TV bands -- the Commission should require unlicensed devices to recognize a "smart" beacon locally operated by a Part 74 user. This local beacon transmitter would operate in unoccupied TV channel and broadcast information to nearby unlicensed devices. Unlicensed devices would be required under the Commission's rules to scan for the beacon and avoid operating on TV channels marked as being in use by wireless microphones. Both fixed access and personal/portable devices, if and when authorized, must be able to receive and respond to the beacon. The Part 74 "smart" beacon system would be flexible enough to provide necessary protection to wireless microphone systems used in large venues without establishing a protection zone for longer and larger than what is necessary to cover the event. As such, the "smart" beacon system would protect incumbent wireless microphone operations in this use model in the

most spectrum efficient manner possible.²⁹ These beacons should be available for sale and use only by authorized Part 74 users.³⁰

III. The Comments Have Demonstrated the Importance of Testing

Numerous parties echoed Shure's position that it is critical for the Commission to evaluate technical and interference protection claims based on the results of laboratory and field testing.³¹ Many parties recognized that the interference protection measures being debated, especially spectrum sensing, still have not been subject to empirical testing in real-world situations. Further, the Commission's testing should be open, observable, repeatable and subject to public comment.³²

IV. Personal/Portable Operations Will Interfere With Incumbent Operations and Should Not be Authorized at This Time

The Comments demonstrate widespread concern about the interference that personal/portable operations will cause to incumbent operations. The enthusiasm of some parties for the prospect of mass sales and deployment of new devices cannot be allowed to overshadow the plain fact that no party has provided a real-world reliable solution to the complex interference issues raised by personal/portable operations. Neither the proponents of personal/portable devices nor the IEEE have been able to provide a detailed theoretical or empirical study of how personal/portable devices may share the TV band without interfering with incumbent operations. As Shure stated in its initial comments, it is critical that the Commission "anchor its decision in all respects on real-world, proven and demonstrable interference solutions based on sound

²⁹ Shure proposed additional detail of such a beacon system in its comments, and *ex parte* submission to the FCC dated January 25, 2007.

³⁰ To the extent necessary, Shure proposes that the Part 74 rules be amended to authorize the use of wireless microphone beacons under the circumstances outline above.

³¹ Comments of KJLA, LLC, filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007, at p. 4; Dell, at p. 18; QUALCOMM, at p. 4.

³² Comments of Media General, Inc., filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007, at p. 2; NAF, p. 71; MSTV, at p. 24; CEA, at p. 5.

engineering.”³³ Assurances of developments yet to come are not credible protections for important incumbent wireless microphone and other operations.³⁴ Likewise, assurances that the high-tech industry is capable of developing protections,³⁵ even assuming this could be true, simply do not justify Commission action at this time, well before such effective protections have been developed. Shure thus strongly disagrees with the view that the issue of personal/portable operations is “ripe” for a Commission decision.³⁶

If, and when, the Commission decides to review the parameters of personal/portable operations in detail, Shure urges the Commission to require much lower power levels than the 400 mW originally identified, and even the 100 mW proposed by Dell in its comments. Shure recommends that the output power be further reduced to 10 mW, thus placing wireless microphones and unlicensed devices on the same level.

The Commission should follow the sensible approach it set forth in the initial Notice in this proceeding and the FNPRM that committed to identifying ways to “enable low power devices to operate in the TV bands without causing harmful interference to other authorized operations in those bands.”³⁷

V. The Commission Should Reject Proposals to Oust Wireless Microphone Operations from the TV Band

At the outset, Shure reminds the Commission that the public interest considerations at stake place the burden on the parties proposing new uses of the TV band that would interfere with incumbent uses to show how this could be done without harming existing users. The Commission plainly stated in the FNPRM: “Our goal in this proceeding is to allow such devices

³³ Shure, at p. 3.

³⁴ NAF, at p. 62 (claiming that “[t]here are a variety of technical methods -- including technologies not yet invented -- that unlicensed device can use to avoid interference with television reception in the TV band.”).

³⁵ Dell, at p. 26; NAF, at p. 67.

³⁶ Dell, at p. 20.

³⁷ *FNPRM*, at ¶ 23.

to operate on unused television channels [at times and] in locations where such operation will not result in harmful interference to TV and other authorized services.”³⁸ Despite this clear mandate, some parties urge the Commission to eliminate wireless microphone operations in the TV band.³⁹

Shure strongly disagrees with the apparent view of a few parties that wireless microphone uses are trivial and invalid and should be removed from the TV band and/or lose all protections against interference.⁴⁰ NAF, Tropos and Qualcomm’s consultants attempt to discredit the entire wireless microphone user community by painting them as unauthorized spectrum “squatters.” They offer several uninformed “transition” plans that are no more than roadmaps to eliminate wireless microphone operations altogether, a goal that is clearly not aligned with this docket’s scope or the American public’s interests. Their comments reflect that they have little understanding of the extent and nature of authorized wireless microphone use and do not understand wireless microphone technology. While undoubtedly there are wireless microphone users that have not fully documented their license -- just as is the case in every wireless service licensed by the Commission -- the wireless microphone community has been careful to coordinate operations with primary broadcasters for many years. The absence of interference cases reflects the successful history of co-existence. The unlicensed device proponents should likewise prove that they can coexist with incumbent operations that have greater priority.

These “proposals” are nothing more than red herrings and should be dismissed. NAF declares that the Commission should migrate all wireless microphone uses out of the TV band and suggests that professional wireless microphone users buy spectrum access from other

³⁸ *FNPRM*, at ¶ 1. Indeed, the *FNPRM* is replete with clear statements that authorized services in the TV bands must be protected from harmful interference.

³⁹ NAF, at p. 50; QUALCOMM Consultants, p. 54-55.

⁴⁰ *See, e.g.*, NAF, at p. 55; QUALCOMM, at p. 54.

licensees in the spectrum, such as the Advanced Wireless Service (“AWS”) and 3G spectrum. NAF also speculates that there are only few other wireless microphone users and that they can be accommodated either as a Part 15 device or on Private Land Mobile Spectrum.⁴¹ Both of these suggestions are wholly unrealistic and unacceptable. The AWS band was purposely created for 3G communications services and as such was auctioned off for billions of dollars. Furthermore, AWS spectrum is not suited technically to wireless microphone operations, particularly given that wireless microphone operations are often intermittent and itinerant, cannot tolerate interference, and must operate in real-time.

NAF is also misguided in its suggestion that other wireless microphone uses could be accommodated as Part 15 or Part 90 PLMRS operations. Wireless microphones are sensitive precision instruments that deliver real-time, high-quality audio. Interference to a wireless microphone is devastating to a live broadcast production and renders the wireless microphone system completely unusable for its intended purpose. Thus, Part 15 operation, that is, by definition, intended for operations and uses that can and must tolerate interference, is unacceptable to the incumbent wireless microphone community using currently available technology.

Part 90 also cannot accommodate the quality audio that is required from wireless microphones. Part 90 specifies a total of eight (8) frequencies for wireless microphones in the VHF band. Only three (3) of these eight frequencies can be used together at one time due to intermodulation problems that relate to the way they were selected. These frequencies are shared with many other services and devices and are extremely prone to interference, rendering them unacceptable for wireless microphone operations. Shure previously manufactured equipment

⁴¹ Technical Comments of New American Foundation (“NAF Technical Comments”), filed in ET Dockets Nos. 04-186 and 02-380 on January 31, 2007, at p. 21.

using the Part 90 frequencies *but due to frequent and extensive user complaints, discontinued its product manufacturing in this spectrum*. Prototype testing revealed similar problems in the 450-470 MHz band.

The proposal to “transition” wireless microphones over 3-5 years out of the existing TV band frequencies is contrary to the public interest and should also be dismissed. Unlicensed device proponents are so eager to lay full claim over new “beachfront” spectrum that they cavalierly suggest that the Commission should simply eliminate interference-free wireless microphone operations in the TV bands.

Qualcomm’s consultants Jackson and Robyn argue that wireless microphone technology should be replaced and moved to other (unidentified) spectrum.⁴² Several parties have commented that analog FM transmissions are an older technology that is inefficient and not robust to interference.⁴³ Shure wishes to dispel the misguided idea that existing wireless microphone technology is outdated and inefficient. These statements reflect that wireless microphone technology is not widely understood. Analog FM today continues to provide the highest quality audio transmission achievable with no measurable delay. These attributes are critical for live sound reinforcement applications, especially for In-Ear Monitoring. This capability is currently not available from digital transmission systems. All digital transmission systems to date introduce delay in the signal path and thus are not well-suited for wireless microphone use. In addition, the notion that digital wireless microphones are less susceptible to interference than analog FM wireless microphones is also misguided. They are not. Shure has tested both technologies with a simulated Wi-Fi signal in the TV bands (operating under the authorization of its experimental license) and determined that digital transmissions are no less

⁴² QUALCOMM Consultants, at pp. 54-56.

⁴³ *Id.* at p. 54; NAF Technical Comments, at pp. 20-21.

affected by interference than analog FM. These results are documented in previously filed comments.

Further, the occupied bandwidth of an analog FM wireless microphone is spectrally efficient. It is not currently possible to transmit a high-quality (*i.e.*, 20 Hz-20 kHz) real-time audio signal in a 200 kHz bandwidth using digital transmission without introducing unacceptable delay for live sound applications. A broadband transmission is also inconsistent with the need to accommodate many links as wireless microphones are “many-to-many” systems where each individual performer or user represents a separate link.

Currently available alternative technologies are not suitable replacements for wireless microphones. Thus, these “suggestions” to replace wireless microphone technology have no basis in engineering and would cause significant hardship to the many users and people who rely on wireless microphones.

Shure fully recognizes the complexity of the technical and policy issues raised in this proceeding and has endeavored throughout this process to develop technical and regulatory solutions that can meet competing policy goals that raise technical conflict. While Shure appreciates the meaningful efforts by all parties to develop workable solutions, and is encouraged that NAF, Qualcomm and others are at least beginning to discuss the issues, the NAF and Qualcomm “proposals” fall far short of a workable or acceptable solution. In their rush to exploit the Commission’s laudable public policy goal of promoting rural broadband for their own spectrum agenda, these parties urge the Commission to adopt rules that would run roughshod over important incumbent wireless microphone uses. These suggestions are far outside the scope of this proceeding and contrary to the public interest.

The Commission has already clearly mandated that incumbent TV band operations must be protected from interference.⁴⁴ The Commission must not allow the proponents to convert this rulemaking proceeding into a spectrum eminent domain proceeding to suit their own purposes. The only relevant questions in this proceeding revolve around how best to permit additional uses of the TV bands while protecting incumbent uses.

Conclusion

The comments support the Commission's goal of ensuring that the potential introduction of new devices into the TV bands will not cause interference and disruption to existing authorized services, including wireless microphones. Millions of Americans enjoy and rely on high-quality audio using wireless microphones in newscasting, entertainment, sports, religious, business and educational communications. Shure joins with many other parties in urging the Commission to anchor its decisions in this proceeding on real-world, proven and demonstrable interference solutions based on sound engineering and thorough testing. Measured in those terms, it is premature for the Commission to permit personal/portable devices to operate in the TV bands. The Commission cannot rely solely on still unproven spectrum sensing technology to protect incumbents. Even if spectrum sensing can be developed to operate reliably in the TV bands, the Commission should adopt a combination of interference protection measures, including reserving some spectrum from unlicensed device operations and instituting a smart wireless microphone beacon. Finally, the Commission should summarily dismiss attempts by

⁴⁴ *FNPRM*, at p. 1.

some parties to simply terminate wireless microphone operations in the TV bands as this concept is well outside the scope of this proceeding and contrary to the public interest.

Respectfully submitted,

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