Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	)	
	)	
Promoting Spectrum Access for Wireless Microphone Operations	)	Docket No. 14-166
	)	Docket No. 12-268
Expanding the Economic and Innovative Opportunities of Spectrum Through Incentive Auctions	)	

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REPLY COMMENTS OF
SENNHEISER ELECTRONIC CORPORATION

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TABLE OF CONTENTS

Page

SUMMARY ii

DISCUSSION 1

A. Wireless Microphone Technology, User Requirements, and the 600 MHz Transition. 1

1. The Important and Exacting Needs of Wireless Microphone Users 1

2. Mandatory Technical Requirements 3

3. ETSI Masks 4

4. The Commission Must Resolve These Issues Quickly 4

5. Technical Rules Should be Uniform but Flexible 7

B. The Commission Must Act Promptly on Specific Spectrum Recommendations 7

1. VHF Spectrum 8

2. Enhanced TV Co-Channel Operations 10

3. 169-172 MHz 10

4. 941-960 MHz 11

5. 1435-1525 MHz 13

6. 1920-1930 MHz 16

7. 6875-7125 MHz 17

CONCLUSION 18

SUMMARY

The comments in this proceeding demonstrate the bind in which the wireless microphone industry finds itself: The demand for wireless microphone spectrum is growing while spectrum resources are diminishing.

Wireless microphone manufacturers show clearly that the solution is not to force the adoption of specific technologies, which in the foreseeable future at least will not create efficiencies but will result only in more costly and less usable devices for users. Rather, the solution is to craft uniform or near-uniform technical and service rules across several key spectrum bands – 169-172 MHz, VHF, 941-960 MHz, and 1435-1525 MHz – that will serve new wireless microphone uses and provide quasi-replacement spectrum for UHF. (Of course, there is no substitute for clear UHF channels for hyper-critical wireless microphone use, as issue that Sennheiser addresses in the Commission's concurrent proceeding on 600 MHz unlicensed operations.)

Sennheiser has outlined a regulatory approach based on three tiers of wireless microphone users – Class A licensed professional users; Class B other professionals and semi-professional users; and Class C hobbyist users. The impetus for this three-tiered approach is the existence of many renowned professional organizations that do not qualify for a Part 74 license because they do not operate fifty or more microphones. The record contains numerous filings from these organizations regarding their plight.

Three factors make wireless microphones good spectrum neighbors with incumbents: 1) their need to find and operate only on clear, clean spectrum; 2) their compliance with the very tight emission masks (such as ETSI), which produce nearly negligent out-of-band emissions; and 3) relatively low power.

If the Commission moves quickly to allocate new spectrum, and ensures that wireless microphones operating in 600 MHz maximize their time and use on that band, it will succeed in providing for best possible transition, given the circumstances.

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REPLY COMMENTS OF SENNHEISER ELECTRONIC CORPORATION

Sennheiser Electronic Corporation ("Sennheiser") hereby replies to comments filed in the above-captioned Federal Communications Commission's ("FCC" or "Commission") Notice of Proposed Rulemaking ("NPRM").[1] There is widespread agreement that the wireless microphone industry (manufacturers, users, and content creators) needs regulatory certainty that new, usable spectrum soon will be made available; that the 600 MHz transition period is not truncated but instead is designed to maximize the useful life of 600 MHz wireless microphones; and that unnecessary technical standards are not imposed.

DISCUSSION

A. Wireless Microphone Technology, User Requirements, and the 600 MHz Transition.

1. The Important and Exacting Needs of Wireless Microphone Users.

More than sixty local and professional performing arts organizations filed letters in this proceeding detailing their use of spectrum for wireless microphones and noting their interest in

[1] *In the Matter of Promoting Spectrum Access for Wireless Microphone Operations; Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Notice of Proposed Rulemaking, Docket Nos. 14-166 and 12-268 (rel. Sept. 30, 2014) ("NPRM").

the outcome of this and the related unlicensed 600 MHz proceeding.[2] Many of these users, which include renowned organizations such as the Steppenwolf Theater in Chicago and the Baltimore and Houston Symphonies, fall into the "Class B" user category because they employ fewer than fifty microphones and therefore do not qualify for a Part 74 license.[3] These parties express concern about their regulatory status and the transition from 600 MHz spectrum, a concern Sennheiser highlighted in its comments.[4] As the Commission moves forward, it should account for the needs of these important civic organizations.

Many parties echo Sennheiser's statements regarding the exacting needs of wireless microphone users.[5] For example, Lectrosonics discusses the importance of good range for wireless microphones that are used to produce television and movies or provide content from sports fields.[6] As it explains, "[f]actors such as antenna efficiency, receiver sensitivity and propagation characteristics also come into play in defining the maximum range of a wireless microphone system. These factors are determined by the physical properties of the frequency band used."[7] Shure explains that "wireless microphones provide a medium for multimedia or artistic content, and are evaluated by a wholly unique set of criteria relative to a basic

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2 *Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 60 MHz Guard Bands and Duplex Gap, and Channel 37, and Amendment of Part 74 of the Commission's Rules for Low Power Auxiliary Stations in the Repurposed 600 MHz Band and 60 MHz Duplex Gap; In the Matter of Promoting Spectrum Access for Wireless Microphone Operations; Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Notice of Proposed Rulemaking, Docket Nos. 14-165 and 12-268 (rel. Sept. 30, 2014) ("Part 15 NPRM").

3 *See* Comments of Steppenwolf Theater at 1; Comments of the Houston Symphony at 1; Comments of the Baltimore Symphony Orchestra at 1.

4 Comments of Sennheiser at 5-6.

5 Comments of Sennheiser at 4, 12-14.

6 Comments of Lectrosonics at 4.

7 *Id.*

communications device."[8] Broadcast Sports, Inc. details the "ever-increasing expectations of the public for enhanced broadcast coverage of news, emergency situations and sports and event coverage."[9] And the Society of Broadcast Engineers notes that wireless microphones play an important role in public safety by ensuring that breaking news regarding emergency situations is disseminated.[10]

2. Mandatory Technical Requirements.

The Commission made specific inquiries as to whether wireless microphones should or could be made more efficient or employ certain technologies.[11] Wireless microphone manufacturers agree that they must be able to design devices that meet the needs of their clients, and that mandatory technical requirements would impede their ability to do so. As Audio-Technica explains, it is "unnecessary to mandate efficiency" because inefficient products are not usable when large events demand the use of many microphones.[12] Shure concludes that "[e]nd users should be permitted to decide whether an analog or digital microphone is better for their particular application."[13] And Lectrosonics agrees that "proven analog products will remain in use and in demand for a long time to come while our digital products gradually evolve to meet the needs and earn the trust of professional users."[14] In sum, the Commission must refrain from imposing the use of certain technologies or modulation techniques.

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8 Comments of Shure at 25.

9 Comments of Broadcast Sports, Inc. at 5.

10 Comments of the Society of Broadcast Engineers at 3.

11 NPRM at ¶ ¶ 52-65.

12 Comments of Audio-Technica at 20-21.

13 Comments of Shure at ii.

14 Comments of Lectrosonics at 9.

3. ETSI Masks.

The Commission proposed the adoption of ETSI masks for wireless microphone operations, and there is widespread agreement in support of this proposal.[15] Most manufacturers already meet these masks, and have done so for decades.[16] Formally requiring the ETSI masks should reassure the Commission that wireless microphones will be able to successfully co-exist with incumbents in other frequency bands.

4. The Commission Must Resolve These Issues Quickly.

Wireless microphone users and manufacturers agree that the FCC must allocate new spectrum for wireless microphones in short order.[17] The demand for wireless microphones is growing while the available spectrum is shrinking.

The National Association of Broadcasters ("NAB") requests that the FCC authorize new spectrum for wireless microphone use before the commencement of the incentive auction.[18] Sennheiser agrees. The Commission must move quickly, given the enormous changes and challenges faced by the wireless microphone industry. NAB aptly summaries: "[N]o spectrum user has lost more and gained less in this proceeding than wireless microphones."[19] Indeed, the

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[15] Comments of Sennheiser at 11; Comments of Shure at 33; Comments of Audio-Technica at 22.

[16] *Id.* Sennheiser recognizes that Lectrosonics seeks to use a modified version of the existing Part 74 mask, which it states will have the same result at the ETSI masks. Comments of Lectrosonics at 15-18. Sennheiser takes no position on this request.

[17] Comments of Sennheiser at 16; Comments of Shure at 2-3; Comments of CP Communications at 5.

[18] Comments of the National Association of Broadcasters, Docket No. 14-166 (filed Feb. 4, 2015) ("NAB Comments").

[19] NAB Comments at 4.

Commission is now considering allowing television stations to operate in the duplex gap during the repacking process.[20]

NAB additionally requests that the Commission allow wireless microphones to operate on the 600 MHz spectrum until licensees are ready to commence operations and newly authorized spectrum for wireless microphones is identified.[21] Sennheiser supports this proposal for two reasons: it provides necessary spectrum resources during the transition period, and it also will allow users to maximize the useful life of 600 MHz equipment.

Shure similarly seeks to maximize the ability of wireless microphones to use 600 MHz spectrum, so that "viable wireless microphones are not unnecessarily stranded."[22] Shure specifically requests that: 1) new 600 MHz entrants who deploy and operate facilities prior to the end of the 39 month transition period register with a white spaces database; 2) the Commission automatically modify any 600 MHz Part 74 licenses to allow for operation in the guard band and duplex gap; and 3) wireless microphones that are certificated and operating in 600 MHz frequencies which cover any portion of the duplex gap or guard bands be allowed to continue to operate in those new bands under appropriate coordination procedures (*i.e.*, manual check of the geolocation database or manufacturer provided information based on the database).[23] Sennheiser agrees with this approach, as it will protect the investments made in 600 MHz equipment, something especially important to wireless microphone users who replaced 700 MHz equipment with 600 MHz equipment.

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20 *Id.*

21 NAB Comments at 3-4.

22 Comments of Shure at 17.

23 Comments of Shure at 17-18.

Some parties seek to expedite the transition of wireless microphones off 600 MHz spectrum.[24] These parties do not present compelling reasons for the Commission to impose a more rapid transition period. While Sennheiser and other manufacturers have agreed to meet the Commission's proposed deadlines, any decrease in the amount of time will greatly harm the industry. Wireless microphone users must be able to maximize the useful life of 600 MHz equipment, and wireless microphone manufacturers must have time to develop products for new frequency bands. The time to market for newly designed wireless microphones is at least several years, particularly for products that will operate on newly accessed bands. For these reasons, the suggested expedited timelines are unjust, unwarranted and infeasible.

The Commission sought comment on the education efforts concerning the transition. Sennheiser and Shure detail what the efforts they have and will take to educate wireless microphone users regarding the forthcoming transition.[25] Notably, since the time that it became clear that the 600 MHz band may be repurposed, Sennheiser has advised customers to not purchase equipment for this band.[26] Concerns that there will be many new purchases of such equipment are unfounded. And Mobile Future's suggestions that the Commission must require specific consumer education go too far, given the Herculean efforts that wireless microphone manufactures have taken to educate users regarding both the 700 MHz and 600 MHz transitions.[27]

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24 Comments of CTIA at 43-45; Comments of Mobile Future at 3.

25 Comments of Sennheiser at 19; Comments of Shure at 19.

26 Comments of Sennheiser at 19.

27 Comments of Mobile Future at 5-6.

5. Technical Rules Should be Uniform but Flexible.

Sennheiser recognizes that the Commission must grapple with fitting wireless microphone operations into many different frequency bands, each with a different set of incumbents and different operating rules. Nonetheless, simplicity must be the goal. Operations on these bands must be as uniform as possible to facilitate product development and ease the transition from the UHF band. Some parties, as detailed below, seek to impose a myriad of restrictions on wireless microphone use in the newly allocated spectrum bands. Efficient product planning and development requires that wireless microphones have the same or similar technical requirements across most bands.[28] Additionally, the Commission must keep in mind that as wireless microphone technology evolves the rules must retain enough flexibility to allow new innovative products into the market.[29]

B. The Commission Must Act Promptly on Specific Spectrum Recommendations.

Wireless microphone manufacturers essentially agree on which of the proposed spectrum bands will be most useful for wireless microphone operations. Many of the lower frequencies suggested in the NPRM (*i.e.* between 26 MHz and 172 MHz) are viewed as having limited use, either because of frequency characteristics or limited bandwidth, though manufacturers are more optimistic about potential though limited use of 169-172 MHz.[30] There is widespread support to make available 11 MHz of additional spectrum by broadening the current allowable range to 941-960 MHz.[31] And the industry additionally views use of the 1435-1525 MHz band as

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28 *See* Comments of Lectrosonics at 6.

29 Comments of Sennheiser at 14.

30 Comments of Sennheiser at 21-22; Comments of Shure at 10-11.

31 Comments of Audio-Technica at 23.

important, as this range is likely to be harmonized for wireless microphone use in many other countries.

1. VHF Spectrum.

Parties agree that VHF is not useful replacement spectrum for lost UHF spectrum, though they believe additional use can be made of it.[32] For example, Lectrosonics suggests that "IFB ('interruptible foldback') cueing and control systems could be made practical in the VHF band if the power limit was increased, releasing UHF spectrum for other wireless microphone operations."[33] Sennheiser requested that the FCC harmonize allowable power levels for UHF and VHF operations at 250 mW. Lectrosonics agrees that VHF should conform to UHF operations generally, and that specifically the power limit should be increased to 250 mW to compensate for antenna deficiency deficits.[34]

Shure has proposed that wireless microphones operate at 50 mW, but with output power to be measured on either a conducted or radiated ("EIRP") basis.[35] Shure additionally proposes that the "conducted limit to devices with detachable antennas, while the radiated limit would apply to devices with embedded or permanently affixed antennas," and that these rules apply through the entire VHF range and to licensed and unlicensed users.[36] Sennheiser believes these are reasonable suggestions, though harmonizing the UHF and VHF rules would promote regulatory simplicity.[37]

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[32] Comments of Sennheiser at 17; Comments of Broadcast Sports, Inc. at 13; Comments of Shure at 30 (explaining issues with ambient noise and loss of antenna efficiency).

[33] Comments of Lectrosonics at 14.

[34] Comments of Lectrosonics at 14.

[35] Comments of Shure at 31.

[36] Comments of Shure at 31.

[37] *See* Comments of Sennheiser at 17.

CEA expresses concern about the impact on VHF television if the power level for wireless microphones is increased and there is no corresponding change to the separation distance requirements, suggesting that rigorous technical analysis is needed.[38] These concerns are unfounded. The 4 km separation for wireless microphones was derived using an overly conservative methodology based on the operations of white space devices, which have an EIRP of 4000 mW with an antenna at 3 meters height above average terrain ("HAAT"). The Commission reasoned that operating sixteen 250 mW licensed wireless microphones within the same 6 MHz TV channel cumulatively equaled 4000 mW.[39] Although this measurement may have been convenient, it is not accurate, as the cumulative power from sixteen separate sources spaced apart is not the same power emitting from one source. Wireless microphones operating at 250 mW power are designed for licensed operation and are the exception, used in occasions such as golf tournament broadcasts, where they are geographically spread out.[40] Furthermore, the 3 meter antenna HAAT is not applicable to wireless microphones. The only standard model 250 mW transmitters sold are body packs, which typically sit at waist level, not 3 meters HAAT, and are subject to body absorption effects far more than handheld devices. For these reasons, the 4 km separation requirement is overly conservative.[41]

Sennheiser has suggested that meeting a threshold of -80 dBm over 200 kHz would be a more practical approach. In CEA's view, use of this threshold strength would produce emissions significantly higher than the minimum A/74 guideline for DTV receiver sensitivity, and is too

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38 CEA Comments at 4.

39 That is, 16 x 250 mW= 4000 mW.

40 It would be an extremely rare occasion that sixteen 250 mW wireless microphones would be operated within the same TV channel; Sennheiser has no knowledge of this ever occurring.

41 For this reason, a tiered separation requirement to protect VHF television is unnecessary, contrary to the Commission's suggestion.

uncertain.[42] The A/74 guideline designates a TV signal of -68 dBm as "weak." Nevertheless, Sennheiser does not object to the minor increase of the suggested benchmark to -84 dBm so that the required threshold exceeds the Threshold of Visibility of the ATSC guideline. Though given that over-the-air television is primarily viewed in home settings and wireless microphones designed for the UHF band are not uses in homes, this modification may not be necessary.

2. Enhanced TV Co-Channel Operations.

The Commission proposed that licensed wireless microphone users that register their sites and frequencies may operate co-channel with television stations on a secondary, non-interference basis.[43] Sennheiser supports allowing wireless microphones to operate in locations where the co-channel television signal measures below -80 dBm over 200 kHz.[44] Shure suggests that registration may be automated through either an FCC portal synchronized with white space database administrators or directly with white space database administrators.[45] In Sennheiser's view, licensed operators should not be encumbered by a registration process, and the threshold test that it proposes is more than sufficient to protect television.

3. 169-172 MHz.

As noted above, parties believe that limited additional use can be made of 169-172 MHz. Sennheiser suggests that the entire 169-172 MHz band be made available for wireless microphone use on a secondary basis by changing frequency assignments to allow more frequencies to operate simultaneously.[46] Audio-Technica agrees that the Part 90 rules are too

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42 Comments of CEA at 7-9.

43 Comments of Shure at 31.

44 Comments of Sennheiser at 18.

45 Comments of Shure at 32.

46 Comments of Sennheiser at 22.

inflexible and that a more flexible channelization scheme will allow for greater use of the band by wireless microphones.[47] Audio-Technica additionally supports adoption of an ETSI mask requirement,[48] which Sennheiser supports as its products already meet these masks.

Shure recommends that wireless microphones operate at a 50 mW power limit in this band, but with output power to be measured on either a conducted or radiated (EIRP) basis.[49] Shure additionally seeks 200 kHz emissions, dividing the band into 120 evenly spaced 25 kHz channels with upper and lower guard bands, and permitting operations under Parts 15 and 74 rather than Part 90.[50] Sennheiser generally supports these suggestions, though harmonizing VHF with existing UHF power regulations would promote regulatory simplicity. Allowing Part 15 and Part 74 use of the band would provide for regulatory ease.

4. 941-960 MHz.

The Commission sought comment as to the use of various discrete portions of this frequency range.[51] As the parties make clear, if this band is to serve as a suitable substitute for lost UHF spectrum, wireless microphones need access to the entire band under the same set of rules.

Sennheiser thus requested that this entire band be made available to all Part 74 license eligibles under the technical rules established for LPAS operations in the 944-952 MHz band, with the requirement that the ETSI masks be met.[52] Lectrosonics supports Sennheiser's request to make this band available on a secondary basis to all LPAS licensees, and notes that expanding

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47 Comments of Audio-Technica at 23.

48 *Id.*

49 Comments of Shure at 34.

50 *Id.* at 34-35.

51 NPRM at ¶ ¶ 134-156.

52 Comments of Sennheiser at 22.

wireless microphone use of this band "would yield new products quickly since we are already making products in this band."[53] Shure agrees that the Part 74 rules and the ETSI masks should apply.[54]

Broadcast Sports believes that there will be limited available spectrum in 941-960 MHz due to use by Part 74 Aural Studio to Transmitter links ("STL") and fixed Aural Intercity Relay Links ("ICR").[55] Aural carriers are only in use on a portion (944-952 MHz) of the band. With respect to the band as a whole, spectrum availability will depend on geographic location. This band is not well used in every market. The record on this and the related unlicensed 600 MHz proceeding is clear that wireless microphones require as much replacement and additional spectrum as possible, so even additional availability in some markets would be useful.[56] As Lectrosonics explains: "Operation requires careful frequency coordination to avoid conflicts with other uses such as STL (Studio Transmitter Link) stations, but the additional spectrum made available here has proven quite useful for licensed professional users."[57] When wireless microphones are operated indoors at lawful power levels, they will have a very little chance of interfering with an outdoor high elevation receive site using directional antennas. For these reasons, wireless microphones will fit well in this band.

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53 Comments of Lectrosonics at 4 and 7.

54 Comments of Shure at 36.

55 Comments of Broadcast Sports at 13.

56 *See* Comments of Shure at 3 (regulatory changes have "crowded wireless microphone operations into less and less spectrum raising the real possibility that some events simply will not be able to be supported in the future unless the Commission identifies sharing approaches and additional spectrum to supplement the available TV band spectrum suitable for low power microphone uses.").

57 Comments of Lectrosonics at 19.

The Society of Broadcast Engineers opposes the operation of unlicensed microphones on this band, and seeks required coordination through SBE.[58] In Sennheiser's view, the most appropriate coordinating body would be one familiar with all aspects of the wireless microphone industry.

Xcel Energy Service opposes LPAS operations on 941-944 MHz and 952-960 MHz, though it would be amendable to this if the Commission were to impose technical requirements including minimum separation distances, protection zones, limit power, and indoor use.[59] Sennheiser understands the investments made by MAS incumbents and the need to protect their operations, and Sennheiser stands ready to work with MAS licensees to ensure the wireless microphones will not impede MAS operations. Xcel does not explain why it believes that wireless microphones will interfere with MAS or why its interference mitigation suggestions are reasonable or effective, so Sennheiser cannot respond more specifically to its concerns.

5. 1435-1525 MHz.

The Commission proposed to make 1435-1525 MHz available for use by wireless microphones on a licensed secondary basis, at specific locations and times.[60] Sennheiser agreed that licensed Part 74 users should have access to this band on a secondary basis, and agreed to limit such use to certain times and locations after prior coordination.[61] Shure concurs, but additionally suggests that the ETSI mask be required and that a 25 kHz channel raster be

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58 Comments of the Society of Broadcast Engineers at 13.

59 Comments of Xcel Energy Service, Ltd. at 2-4.

60 NPRM at ¶ 177.

61 Comments of Sennheiser at 24.

implemented across the band.[62] While Sennheiser does not believe that the suggested channel raster necessary, it would not oppose this suggestion.

The Aerospace and Flight Test Radio Coordinating Council ("AFTRCC") raises the issue of protecting critical flight testing operations from harmful interference, especially in the event that non-professional users obtain microphones that can operate on these frequencies.[63] In AFTRCC's view, the FCC must require that wireless microphones operating in this band not only coordinate their operations but also contain "integrated control mechanism[s]" that would prohibit operations without prior coordination.[64] This is unnecessary and would increase cost and complexity.

Limiting operations to licensed wireless microphone users, and requiring prior coordination with the frequency coordinator, will provide sufficient protection to flight test telemetry. Professional wireless microphone users always seek channels that are clear.[65] AFTRCC suggests that:

> A request for AFTRCC coordination should include the specific frequencies to be used, if known, the type of wireless microphone device to be used, the location of the devices (provided by GPS or other reliable and suitable method), and point of contact information regarding the entity responsible for the proposed wireless microphone operations.[66]

These suggestions are reasonable, so long as coordinates can be manually inputted. Determining location via GPS is largely impractical, given that the majority of wireless microphone applications occur indoors where GPS signals may not be obtainable.

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62 Comments of Shure at 39.

63 Comments of AFTRCC at ii and 11.

64 *Id.* at 17-20.

65 Comments of Sennheiser at 4 and 9; Comments of Lectrosonics at 5; Comments of Shure at 7.

66 Comments of AFTRCC at n.42.

Sennheiser recognizes AFTRCC's concerns regarding the potential resale wireless microphones designed for 1435-1525 MHz.[67] Equipment designed for this band will be high-end and thus costly, so even on the resale market prices will be higher than new semi-professional or entry level equipment. There would not be a financial incentive for unlicensed, and especially hobbyist users, to purchase used equipment designed for this band. Nonetheless, Sennheiser would agree to provide information in its user manuals and on labels noting both the coordination requirement and stating that the user must be a Part 74 licensee. Section 15.216 of the Commission's rules already provides for similar disclosure requirements for microphones used in the TV bands.[68]

Additionally, an integrated control mechanism would increase the cost of equipment and render the band unusable for many years as manufacturers design equipment solely for the 1435-1525 MHz frequency range. Presently, there are no commercially-available wireless microphones designed for operations in this band; the microphones that do operate on 1435-1525 MHz are made by hand. To design commercial microphones with an electronic key, the typical time to market is typically four years.[69] This time would be reduced if manufacturers were allowed to use existing architecture.

Broadcast Sports opposes allowing wireless microphones on the 1435-1525 MHz band on the basis that any available spectrum must be preserved so that broadcasters may obtain Special Temporary Authority ("STA") to operate wide-bandwidth video equipment, though Broadcast Sports suggest that microphones could operate with certain limitations and

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67 Comments of AFTRCC at 16.

68 47 C.F.R. § 15.216.

69 Comments of Lectrosonics at 7.

safeguards.[70] Presently, event coordinators or directors determine which use (video or microphone) is given priority for special events, and often video receives priority. Individual entities obtaining STAs will also split the spectrum between video and microphone use. This system works well for special events, and the Commission should not choose one type of use over another, especially given the pressing need for additional spectrum for wireless microphones.

CTIA opposes allowing use of this band by wireless microphones because it would prefer that the band be allocated to mobile broadband use, asserting that spectrum for mobile broadband is becoming scarce.[71] As Sennheiser and many others have demonstrated in this and the related unlicensed 600 MHz proceeding,[72] given recent Congressional and Commission actions, spectrum for wireless microphone use is becoming even more scarce, while spectrum allocated for wireless broadband use has increased.[73] Given the importance of wireless microphones in producing content for some of the largest industries in the U.S., including the largest export industry, it would not be in the public interest for the Commission to pursue a policy of allocating additional spectrum solely for broadband applications.

6. 1920-1930 MHz.

Sennheiser supports allocating this band for Class B semi-professional users. Shure notes that the band is increasingly being used in corporate environments, and suggests that the

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70 Comments of Broadcast Sports at 14-15.

71 Comments of CTIA at 42-43.

72 Part 15 NPRM.

73 *See* Comments of Sennheiser Electronic Corporation, WT Docket No. 14-165, at 8 (filed Feb. 4, 2015). The Commission has recently allocated new spectrum for broadband and Wi-Fi in the 600 MHz, 3.5 GHz and 5 GHz bands, for example.

Commission issue a second NPRM to explore the possible pairing of this band with 2020-2025 MHz.[74] Sennheiser supports access to this additional band.

CTIA opposes the allocation of 1920-1930 MHz for wireless microphones, claiming that the spectrum is better suited for other uses, is not suited for unlicensed users, and may not offer an ideal operating environment for wireless microphones. Sennheiser agrees that the band is not suitable for critical professional wireless microphone use, but it can be suitable for unlicensed wireless microphones. CTIA does not detail other uses for which it believes the spectrum would be better suited; wireless microphone users clearly are in urgent need for new and replacement spectrum, so it is difficult to understand what other uses would be more important to the public interest.

The Society of Broadcast Engineers seeks to limit use of 1920-1930 MHz to electronic news gathering ("ENG"), professional broadcast and professional program production.[75] Given the critical need for additional spectrum for all wireless microphones, and the propagation characteristics of this frequency, the best use of this band would be for non-critical applications.

7. 6875-7125 MHz.

One party suggests that the 7 GHz band is ideal "replacement spectrum" for wireless microphones.[76] Sennheiser has detailed the technical needs of wireless microphones, demonstrating that this spectrum would be a very poor substitute for UHF and would be appropriate only for short-range (*e.g.* 10 feet) broadcast audio applications.[77] Such a short range would preclude uses such as a reporter carrying a wireless microphone onto an athletic field,

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[74] Comments of Shure at 42.

[75] Comments of the Society of Broadcast Engineers at 14.

[76] Comments of Broadcast Sports at 15-17.

[77] Comments of Sennheiser at 8-9 and 25.

Katy Perry singing at the Super Bowl, or the filming of many movie scenes. Shure agrees, and suggests that the band would be appropriate for "short-range Electronic News Gathering (ENG) applications and at certain high-profile sporting events (e.g., race car or race track mounted microphones intended to capture the sound of the cars, or microphones used at professional golf tournaments)."[78]

CONCLUSION

The Commission must act quickly to provide additional spectrum for the current and growing needs of the wireless microphone industry, through uniform technical rules and no unnecessary technical requirements, and it must ensure that the 600 MHz transition is not truncated.

Respectfully submitted,

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[78] Comments of Shure at 44.

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