

Before the
Federal Communications Commission
Washington DC 20554

In the Matter of)	
)	
Amendment of Part 15 of the Commission's)	
Rules for Unlicensed Operations in the)	
Television Bands, Repurposed 600 MHz Band,)	
600 MHz Guard Bands and Duplex Gap, and)	Docket No. 14-165
Channel 37, and)	
)	
Amendment of Part 74 of the Commission's)	
Rules for Low Power Auxiliary Stations in the)	
Repurposed 600 MHz Band and 600 MHz)	Docket No. 12-268
Duplex Gap)	
)	
Expanding the Economic and Innovative)	
Opportunities of Spectrum Through Incentive)	
Auctions)	

COMMENTS OF SENNHEISER ELECTRONIC CORPORATION

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SUMMARY

Sennheiser is extremely concerned that the proposals in this proceeding perpetuate a problematic policy of making available more spectrum for the virtually non-existent white space industry, while further diminishing the spectrum resources available to the robust industries that rely on wireless microphones.

Many of the spectrum opportunities addressed here, including use of the 600 MHz guard bands and duplex gap, are poor options for wireless microphone users due to out-of-band emissions from wireless services and the exacting needs of professional wireless microphones. The majority of wireless microphones can be transitioned to operate outside of UHF. However, the hyper-critical links need for performances, when there is no second chance for a “re-take,” require highly reliable, clean UHF spectrum due to its favorable propagation and low noise floor.

Sennheiser proposes that two blocks of UHF spectrum be made available for wireless microphone use and not for white space device use. Specifically, the Commission should assign the one unassigned, or “naturally occurring,” UHF television channel solely for wireless microphone users. Additionally, Sennheiser proposes that wireless microphones rather than white space devices share Channel 37 with the incumbents. Adequate protection of incumbents can be accomplished in part by limiting this channel to Part 74 licensed (*i.e.* Class A) operators.

Sennheiser opposes changes to the Commission’s rules that will impact the ability of wireless microphones to access clear UHF channels. Specifically, Sennheiser opposes: 1) allowing portable white space devices to use Channels 14-20; 2) loosening the white space device rules for rural areas, especially when the definition of rural is based on occupied channels rather than population density; 3) relaxing the adjacent channel emission limits; and 4) relaxing the geolocation accuracy requirements, at least without correspondingly increasing the size of the exclusion zone protecting wireless microphones.

Finally, wireless microphones should not be regulated like white space devices. Wireless microphones are low power devices, susceptible to interference from others, with different operating needs, interference protection capabilities and technical characteristics. No wireless microphone, regardless of whether it is licensed or unlicensed, should be required to register with and be controlled by a white space database in order to operate; this is an unnecessary regulatory burden, one that does not seem to serve a useful purpose.

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COMMENTS OF SENNHEISER ELECTRONIC CORPORATION

Sennheiser Electronic Corporation (“Sennheiser”) hereby comments on the Federal Communications Commission’s (“FCC” or “Commission”) Notice of Proposed Rulemaking (“NPRM”) in the above-captioned proceeding.¹

The outcome of this proceeding, the Commission’s concurrent proceeding concerning wireless microphone opportunities,² and the forthcoming “preserved” television channel

¹ *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) (“NPRM”).

² *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) (“Microphone Opportunities NPRM”).

proceeding, are critical to the future of the wireless microphone industry in the U.S. As the Commission moves forward, it must carefully consider what would best serve the public interest: To push forward with opening additional spectrum to still-speculative white spaces technology, or to ensure that wireless microphone users involved in such robust and successful industries as entertainment and newsgathering continue to have access to sufficient spectrum. For these reasons, the Commission must re-think its proposed rules, and craft a regime that provides two blocks of UHF spectrum for wireless microphone use.

BACKGROUND

Sennheiser Electronic GmbH & Co. KG, headquartered in Germany, is a global leader in advanced microphone technology, RF-wireless and infrared sound transmission, headphone transducer technology, and active noise cancellation. Sennheiser Electronic Corporation is the main U.S. sales and marketing office, located in Old Lyme, Connecticut. Sennheiser also has a research center in San Francisco, California, and a manufacturing plant in Albuquerque, New Mexico that produces the majority of Sennheiser wireless microphones sold in North America, South America, Canada, and Asia.

Wireless microphones are more than a convenience. They are vital to a major component of the U.S. economy – essential to the entertainment and news industries – and support one of the United States’ major export sectors, *i.e.*, the film industry. Wireless microphones are ubiquitous in all aspects of the entertainment business, in news reporting, in sports, and in U.S. commercial, civic and religious life. They are essential to the production of virtually all non-studio broadcast events, and to nearly all studio-produced programs as well. These include team sports from local college broadcasts to the Super Bowl, the World Series, the Final Four, and the Stanley Cup; the Democratic and Republican political conventions; post-election national and

local coverage; the Oscar, Emmy, and Grammy Awards shows; events such as the Olympics, NASCAR races, the Kentucky Derby, and major golf and tennis tournaments; and on-the-scene news reporting of all kinds, both local and national. These broadcasts routinely attract millions of viewers, and often use more than 100 wireless microphones requiring use of all locally vacant UHF channels between 470-698 MHz (other than channel 37). Major events such as the Super Bowl, the Video Music Awards, and the Country Music Award Fanfare Festival, require up to 1000 wireless microphones operating on 350 MHz of spectrum, some of which is obtained through the use of special temporary authorizations.

Motion-picture production, from Hollywood blockbusters with nine-digit budgets to student work at the local community college, relies heavily on wireless microphones for clear, accurate audio. Live events, from Broadway productions to stadium-sized outdoor concerts, need wireless microphones to reach the back row, as well as provide input to ADA compliant hearing assist systems. Presenters in auditoriums, lecture halls, and houses of worship find them indispensable.

The U.S. public expects the very highest standards of production quality in all these forms of television, radio, film, and live entertainment. As a practical matter, this means “CD” sound quality rather than MP3, with no discernable latency (sound lag), for entertainment, news and sophisticated sound productions at concerts and Broadway productions.

The wireless microphone industry – manufacturers, owners, and users – has faced significant changes in recent years that have made operations much more complex and difficult. In 2010, the Commission required that wireless microphones transition off the 698-806 MHz

band, eliminating more than a third of available UHF spectrum.³ Given the pending incentive auction, the industry now must prepare for a second move off previously-available spectrum in a few years. The industry faces a great deal of uncertainty in terms of the amount and location of available spectrum after the auction and transition. Development of replacement products, before moving to the tooling and then manufacturing stages, cannot occur until regulatory details are finalized.

DISCUSSION

The Commission has proposed rules to provide for the operation of white space devices and wireless microphones in the post-incentive auction world. Wireless microphones and white space devices operate differently, with reserved and priority access spectrum needed for wireless microphone performance links; they cannot and should not be subject to the same operational and technical rules.

Sennheiser requests that the Commission set aside two blocks of UHF spectrum for wireless microphone use; retain rules for white space devices necessary to assure successful wireless microphone operations; and not impose white space database control requirements on wireless microphones.

A. Classes of Wireless Microphone Users.

In considering rules that impact wireless microphone operations, Sennheiser believes it is useful to classify wireless microphone users into three classes.

³ *Revisions to Rules Authorizing the Operation of Low Power Auxiliary Stations in the 698-806 MHz Band, WT Docket No. 08-166, Public Interest Spectrum Coalition, Petition for Rulemaking Regarding Low Power Auxiliary Stations, Including Wireless Microphones, and the Digital Television Transition, WT Docket No. 08-167, Amendment of Parts 15, 74 and 90 of the Commission's Rules Regarding Low Power Auxiliary Stations, Including Wireless Microphones, Report and Order and Further Notice of Proposed Rulemaking, 25 FCC Rcd 643, ¶ 87 (2010) ("2010 Wireless Microphone Order").*

The Class A user group would be licensed, professional users, specifically those eligible for Part 74 licensing.⁴ Class A uses include: TV broadcast, film production, news gathering, professional concert, theater, and historic political events. This group has the most demanding performance requirements, requiring extremely high fidelity and low latency links for critical on-air/on-stage wireless microphones and ear monitors to allow for a full audio response and dynamic range. Given the high standards required by performers and news media, and the expectations of audiences, for critical on-air/stage use, it is particularly important for Class A users to have access to clean blocks of UHF spectrum for hyper-critical applications that require high levels of reliability and the favorable propagation characteristics of UHF frequencies. Class A users often require priority access to channels shared with unlicensed devices. At times, Class A users employ higher power transmitters of up to 250 mW in the UHF band (up to 1W in other bands) for uses requiring longer ranges, such as broadcast coverage of large stadium games or golf tournaments.

Class B users are civic groups and other productive users of wireless microphones: regional and community theaters, churches and religious organizations not engaged in broadcast activities, schools, corporations, trade show and hotel conference centers, regional performance touring acts. This group requires the use of fewer microphones and channels than Class A users, and can operate adequately with transmitter power of 50 mW. There are times when Class B users stage professional level productions. For this reason, while Class B users do not routinely use fifty or more microphones, which would make them eligible for a Part 74 license, they often require use of a large number of microphones and better reliability than the products operating in

⁴ 47 C.F.R. Part 74.

the license-free ISM bands. These “mid-level” users will be severely affected by many of the Commission’s proposed changes.

Finally, Class C users are hobbyists using wireless microphones operating in unlicensed ISM bands, such as garage music groups, karaoke bars and small assemblies. Use of unlicensed ISM bands is sufficient for Class C use.

B. The Proposed Band Plan.

The Commission has proposed a frequency plan for white space and wireless microphone operations in the TV band.⁵ In the Incentive Auction proceeding, the Commission eliminated the designation of two unused TV channels for exclusive wireless microphone use.⁶ Additionally, the Commission proposed that white space devices and wireless microphones share the one unassigned television channel that will be available after the repacking process, the specifics of which has not yet been proposed.⁷ To protect wireless microphones from interference by white space devices, the Commission now proposes to increase the frequency that white space devices must recheck the database and decrease the time by which wireless microphones must register for protection.⁸

1. The Proposed Plan Fails to Meet Wireless Microphone Needs.

As discussed above, hyper-critical microphone applications require UHF spectrum with limited out-of-band emissions from adjacent services and that is dependable, without reliance on the proper functioning of all white space devices as well as the white space database system.

Although the database system has been in place for a few years, no portable white space devices

⁵ NPRM at ¶¶ 92-95.

⁶ NPRM at ¶¶ 24-25.

⁷ NPRM at ¶ 25.

⁸ NPRM at ¶ 25.

are in the market. Thus, real world experience is limited to the few, and more easily managed, fixed white space devices, and impact of portable white space devices on wireless microphone operations is unknown.

Live performances and many other situations involve the use of both microphones and in-ear monitors (also classified as wireless microphones), and these should operate on two blocks of spectrum, separated by at least several megahertz, in order to prevent interference.⁹

The Commission proposes sharing arrangements of TV band spectrum by wireless microphones and white space devices. Wireless microphones have a long history of spectrum sharing with TV broadcast and land mobile services in the UHF band. Sharing with white space devices can occur as well. However, the Commission proposes to allow portable white space devices access to channels 14-20 and to allow fixed white space devices to operate on adjacent channels. The Commission additionally proposes the relaxation of other white space device rules, such as geolocation accuracy, separation distance, and technical rules for use in “rural” areas.

These proposals, together with the elimination of the wireless microphone reserve channels,¹⁰ completely eliminate all “safe haven” UHF wireless microphone channels. Hyper-critical wireless microphone operations cannot reliably occur if wireless microphones need to compete for spectrum with white space devices on all of these channels. A breaking news story rarely leaves time for white space database registration and also can move quickly to another location. The proposed 4 MHz duplex gap is an insufficient replacement.

⁹ This is similar to how wireless base station and mobile frequencies must be separated.

¹⁰ *Expanding the Economic and Innovative Opportunities of Spectrum Through Incentive Auctions*, Report and Order, 29 FCC Rcd 6567 at ¶ 264 (2014).

Sennheiser proposes that the one unassigned, or “naturally occurring,” UHF television channel be assigned solely for wireless microphone use.¹¹ Additionally, Sennheiser proposes that Class A wireless microphone users be permitted use of Channel 37, and that white space devices be limited to the other spectrum that has been identified for white space device use (between 20 and 34 MHz of which is newly available).¹²

2. The Specific Spectrum Allocation Recommendations.

The Commission proposes to allocate a 6 MHz block of spectrum for white space device and unlicensed wireless microphone use in the 600 MHz duplex gap.¹³ As Sennheiser has noted previously, this spectrum will be useful only for some less critical wireless microphone operations. Sennheiser agrees that it is unnecessary to place a frequency separation between the six megahertz unlicensed segment and wireless uplink spectrum used for base stations.¹⁴ And, the one megahertz buffer should remain as proposed;¹⁵ moving the buffer to the upper end of the duplex gap would create greater interference potential to licensed wireless microphones, further diminishing any potential use of the duplex gap by these devices. Additionally, Sennheiser supports requiring a 3 MHz separation distance from the downlink block for white space devices.¹⁶

¹¹ Sennheiser realizes that the Commission will consider policies related to this unassigned channel in a subsequent proceeding. However, use of this channel is so interrelated to the proposals made in the two pending proceedings with regard to wireless microphones that the Commission must consider together all the issues raised in these three proceedings.

¹² See e.g. NPRM at ¶ 28 (proposing “an additional 12 MHz of contiguous spectrum for use by white space devices in areas where those channels are not used for authorized services.”).

¹³ NPRM at ¶ 92.

¹⁴ NPRM at ¶ 95.

¹⁵ *Id.*

¹⁶ NPRM at ¶¶ 87-90.

With regard to licensed microphone use in the 600 MHz duplex gap, the Commission proposes a single 4 MHz block for licensed microphone use.¹⁷ This is insufficient. While the Commission supposes that “manufacturers should still be able to get a substantial number of microphones to operate in it,” the reality is that the limited bandwidth, coupled with the likelihood of a high noise floor and out-of-band emissions from adjacent wireless services, will diminish likely use. This would impair the ability of many news services to cover the same event, for example.

Sennheiser does agree that a guard band between licensed wireless microphones and the unlicensed portion of the duplex gap is unnecessary and would only further limit the usefulness of the spectrum.¹⁸ And, Sennheiser supports the Commission’s proposal to not require use of a database access requirement for licensed wireless microphone operations in the duplex gap.¹⁹ As the Commission recognizes, licensed users are sophisticated and accustomed to working around other users, with a long-history of peaceful co-existence with other services. A database requirement is simply not necessary for wireless microphones.

Finally, the Commission proposes to allow white space devices to use Channel 37.²⁰ As indicated above, there is a greater and better-demonstrated need for additional spectrum for wireless microphone use, and in particular for hyper-critical Class A wireless microphone uses. Instead of allocating this spectrum to white space use, one that in ten years after approval still has not produced any significant deployment or a certified mobile device, the public interest would be better served by allowing licensed Class A users to share Channel 37 with RAS and

¹⁷ NPRM at ¶ 93.

¹⁸ NPRM at ¶ 94.

¹⁹ NPRM at ¶ 165.

²⁰ NPRM at ¶ ¶ 99-124.

WMTS. This would provide access to spectrum for hyper-critical wireless microphone applications, which as Sennheiser has shown are vital to the U.S. economy.

Wireless microphones have a demonstrated history of successfully avoiding protected television service contours, and in this same way will be able to avoid RAS and WMTS installations. Use will be limited to professional operators, who routinely and successfully avoid interference: manual databases, sensing functions found in the equipment, spectrum analysis software run through the equipment, and outboard spectrum analyzers. Because wireless microphones must function continuously and without interruption, such pre-planning is necessary to prevent incoming interference and protect other users.

3. Technical Recommendations for White Space Devices.

Some of the Commission's proposals with regard to the operation of white space devices will have a detrimental effect on the ability of wireless microphones to operate in whatever television channels remain available post-auction.

Sennheiser opposes the Commission's proposal to allow portable white space devices to operate on channels 14-20.²¹ After the auction and television repacking, wireless microphones will have fewer opportunities to find clear UHF channels on which to operate. Similarly, Sennheiser opposes the proposal to relax the current adjacent channel emission limits for white space devices.²² Less stringent adjacent channel emission limits will increase unwanted emissions into channels used by wireless microphones, thus decreasing the opportunities for wireless microphones to find much-needed available UHF spectrum.

²¹ NPRM at ¶ 29.

²² NPRM at ¶ 62.

Sennheiser is concerned with the Commission’s proposals regarding the operations of white space devices in “rural” areas.²³ First, the proposed definition of “rural” is inapt; the definition should focus on population density rather than the number of unused television channels. This is in-line with the Commission’s definition of rural for other purposes, and reflects the fact that in less populated areas the need for interference protection among devices operating co-channel or adjacent channel is reduced. Wireless microphones operate in many areas around the country; for example, ESPN makes use of many wireless microphones at major college football games in locations such as Lincoln, Nebraska and Lawrence, Kansas. Defining “rural” based unused television channels would not protect these operations (or, as another example, the operations of university and community theaters in such cities). For these reasons as well, Sennheiser opposes the proposal to allow for higher antenna height above ground for white space devices, as this would increase interference potential to wireless microphone operations.

Finally, Sennheiser opposes any decrease to the geolocation accuracy requirement for white space devices,²⁴ absent a concomitant increase in the required separation distance for white space devices operating near a registered wireless microphone. If geolocation accuracy is decreased without this protection, emissions from white space devices may interfere with protection of the exclusion zone required by wireless microphones.

C. Proposed Technical Rules for Wireless Microphones.

The Commission’s consideration of the appropriate technical rules for unlicensed wireless microphones should be framed by their technical requirements. A white space device provides casual digital connectivity to the Internet (much as Wi-Fi does) or to other distant

²³ NPRM at ¶¶ 44-53.

²⁴ NPRM at ¶ 77.

locations, connections that are subject to interruption and congestion delays under database control, with no assurance of immediate transmission. A wireless microphone, in contrast, needs immediate, high-bandwidth communication, but only over short distances, typically a few meters, or tens of meters at most.²⁵ During performance time wireless microphones need to operate without interruptions. The real-time, audio, fault intolerant requirements of wireless microphones does not allow for data buffering like white space devices. The performance criteria for wireless microphones are too demanding to be treated as white space devices, especially in the congested environments that are typical for wireless microphone operation.

1. TV Band Use by Unlicensed Wireless Microphones.

The Commission is proposing to codify rules for the operation of unlicensed wireless microphones in the TV bands, but in a way that differs from how they currently are allowed to operate under the terms of the waiver.²⁶ Sennheiser appreciates the Commission efforts to codify a regulatory framework for unlicensed wireless microphones.

The wireless microphone industry has been in the process of moving non-critical uses from the UHF band. But Class A and Class B users will require access to unlicensed UHF TV band spectrum, while Class C users can be accommodated with equipment operating in the ISM bands.²⁷

The Commission proposes to allow unlicensed wireless microphones to operate on the TV bands, up to the highest channel available after the auction.²⁸ The Commission additionally proposes that these microphones operate at least 4 km outside the protected service contours of a

²⁵ Football and golf broadcasts may require up to 100 meters.

²⁶ NPRM at ¶ 146.

²⁷ Sennheiser's comments in the Microphone Opportunities NPRM proceeding address the industry's efforts to move off of UHF and find new spectrum opportunities for non-critical uses.

²⁸ NPRM at ¶ 149.

TV station when operating microphones at 50 mW power, though it asks whether the rules should specify a maximum field strength or other emission limit in lieu of conducted power.²⁹

The Commission also proposes to require the same channelization, frequency stability, and bandwidth requirements that Part 74 wireless microphones must meet, and to require compliance with the ETSI emission mask.³⁰

As a general rule, the Commission should work to ensure that the technical rules that apply to licensed and unlicensed wireless microphones are the same (except for output power) so that manufacturers are not put in a position of designing multiple products for essentially the same use.³¹ This will assure better economies of scale and cost savings for consumers.

Sennheiser supports the Commission's proposed definition for "unlicensed wireless microphones in Part 15,"³² which appropriately establishes the parameters of use of these microphones on the TV band. In terms of the proposed 4 km protected contour rule, Sennheiser believes that it would more useful and effective to adopt its proposal to rely on a -80 dBm threshold. Specifically, wireless microphones should be allowed to operate in locations where the co-channel television signal measures below -80 dBm over 200 kHz. Sennheiser otherwise supports the proposal to adopt Part 74 technical rules (channelization, frequency stability, and bandwidth requirements). As well, Sennheiser devices meet the ETSI masks and Sennheiser supports adoption of those.

²⁹ NPRM at ¶ 150-151.

³⁰ NPRM at ¶¶ 152-155. The Commission would also apply the Section 15.209 emission limits for the frequency range outside of where the ETSI mask is defined.

³¹ This does not go to ISM devices, which must operate under separate technical rules.

³² NPRM at ¶ 148.

The Commission seeks comment on whether unlicensed wireless microphones can operate on Channels 14-20, where PLMS and CMRS services operate.³³ Wireless microphones are able to protect these services, which operate only in certain areas of the country.³⁴ Both licensed and unlicensed wireless microphones operate on these channels currently, and there is no reason to now prohibit such operations by unlicensed wireless microphones.

2. Unlicensed Wireless Microphones Operations in the Guard Band and Duplex Gap.

The Commission proposes the same definition and channelization, bandwidth, frequency stability and emission mask requirements for unlicensed wireless microphones operating on the 600 MHz guard band and duplex gap as the TV bands.³⁵ Sennheiser supports applying the same definition and technical rules for unlicensed wireless microphone operations in the TV, guard band, and duplex gap spectrum, as this will allow manufacturers to better achieve economies of scale in producing microphones for these frequencies.

In the guard band, the Commission proposes a one megahertz segment of frequency separation between the unlicensed wireless microphone and wireless downlink services.³⁶ As noted above, interference from wireless services will limit wireless microphone use of the guard bands. However, given the need for UHF spectrum by wireless microphone users, Sennheiser proposes this separation be reduced to 100 kHz for wireless microphones that meet the ETSI

³³ NPRM at ¶ 149.

³⁴ See 47 C.F.R. § 90.303(b).

³⁵ NPRM at ¶ 158.

³⁶ NPRM at ¶ 159.

masks, as these masks will ensure that the closer separation will not pose threat of interference to the new licensees.³⁷

The Commission proposes a maximum conducted power output of only 20 mW for unlicensed wireless microphones operating in the guard bands and duplex gap.³⁸ This power level will make wireless microphone operations, which generally operate at 50 mW, unreliable on these frequencies. The guard bands are likely to have high noise floors and out-of-band emissions from adjacent services.³⁹ A maximum power of 20 mW creates a low carrier-to-noise ratio and therefore impaired range, subjecting wireless microphones to much more interference compared to operating at 50 mW (or 20 mW on a clean channel). The Commission should allow a maximum conducted power output of 50 mW for wireless microphones that meet the ETSI masks, as out-of-band emissions are very low outside these masks.

3. Database Access Requirement for Unlicensed Wireless Microphones.

The Commission seeks comment on how to comply with the requirement of the Spectrum Act that unlicensed devices “rely on a database or other subsequent methodology.”⁴⁰ The Spectrum Act grants the FCC authority to determine how unlicensed users may operate in the guard bands, including whether they need to rely on a database and, if so, what type of database. The legislative history makes clear that Congress’ sole concern was that new licensees be

³⁷ In the Wireless Microphone Opportunities proceeding, the Commission has proposed that wireless microphones meet the ETSI masks, and Sennheiser supports this proposal.

³⁸ NPRM at ¶¶ 160-161.

³⁹ Sennheiser conducted a study in Europe that demonstrates the detrimental effects on wireless microphone operations by the high noise floor in the duplex gap. *See* Attached.

⁴⁰ NPRM at ¶¶ 162-164.

protected from interference by unlicensed users operating in the guard bands:

The FCC may permit unlicensed use in such guard bands. Unlicensed use shall rely on a database or subsequent methodology as determined by the FCC. The FCC may not permit any use of a guard band that would cause harmful interference to licensed services. Thus, this section makes clear that the FCC is free to create guard bands and allow secondary, unlicensed use in spectrum it has cleared with federal funds and auctioned under sections 6402 or 6403, so long as such guard bands are no larger than technically reasonable to prevent harmful interference between licensed services outside the guard bands and the use does not interfere with the licensed uses.⁴¹

Given this guidance from Congress, the Commission has broad discretion to interpret this section so long as the 600 MHz licensees receive adequate interference protection.

Wireless microphones have always been successful in protecting authorized services, and do so reliably. Wireless microphones rely upon sensing and/or manual database checks to find the clear frequencies. This is a necessary part of wireless microphone operations, and it is needed to ensure clean transmissions. Professional and most semi-professional wireless microphones have a built-in scan designed to sense (“look”) for open channels and frequencies and select which ones to use. Manufacturers have offered databases on their websites for years (and charts before the existence of websites) that allow operators to find clear spectrum. Manufacturers also offer analysis software tools using the microphone receivers as spectrum analyzers to scan for clean spectrum. Sophisticated users, particularly Class A licensed professionals, routinely use professional grade spectrum analyzers for even more detailed spectrum studies. These approaches have served as successful methods to prevent interference to

⁴¹ Conf. Rpt. on H.R. 3630, Middle Class Tax Relief and Job Creation Act of 2012, at E238-E239 (Speech of Hon. Fred Upton of Michigan in the House of Representatives) (Feb. 17, 2012); *see also id.* at E267 (Speech of Hon. Henry A. Waxman of California in the House of Representatives) (“Of course, any unlicensed use of the guard bands may not cause harmful interference with licensed uses of the spectrum that is auctioned.”).

authorized services. Taken together, they satisfy both the letter and the spirit of the statutory requirement for reliance on a database and/or subsequent methodology.

The absence of complaints indicates that the current system works. Indeed, licensed and unlicensed microphones have successfully co-existed on the same frequencies for years without the need for database control. The Commission need not, and should not, require an additional white space database control, which would serve only to unnecessarily increase the cost and complexity of wireless microphones. Moreover, a database control requirement would increase operating complexity, as it would impose a cumbersome regulatory burden on wireless microphone owners who would need to register and likely pay fees on an ongoing basis. Registration potentially could disrupt Class B users, many of which are non-profit theaters, houses of worship and schools that would find the additional costs and administration a heavy burden. Database sensing would require a whole new development process, one that would take several years and would add hundreds of thousands of dollars to development costs.

It would not be in the public interest, and is not required by the Spectrum Act, for the FCC to require that unlicensed wireless microphones to be controlled by the white spaces database.

4. Operation of Licensed Microphones in the Duplex Gap.

The Commission proposes that licensed wireless microphones operate on the duplex gap under the same technical requirements as unlicensed wireless microphones operating in the guard bands and duplex gap, except that they would be exempt from database requirements.⁴² In terms of the technical requirements, Sennheiser opposes limiting the maximum allowable power output of 20 mW to the antenna for licensed wireless microphones operating in the duplex gap

⁴² NPRM at ¶ 165.

for the same reason it opposes limiting power for unlicensed wireless microphones: this is an insufficient amount of power to overcome out-of-band emissions and noise from the wireless service. An output power of at least 50 mW is necessary to achieve useful wireless microphone operations, while the tight ETSI mask will protect adjacent channel operations.

For reasons explained herein, Sennheiser agrees that licensed microphones should not be required to be controlled by a database.

5. Operation of Licensed and Unlicensed Microphones in the Repurposed 600 MHz Band.

The Commission proposes that both licensed and unlicensed wireless microphones be allowed to operate on the repurposed 600 MHz band during the transition period.⁴³ Sennheiser agrees. Use of this spectrum will be vitally important to the wireless microphone industry as it prepares to transition off the repurposed spectrum and awaits the FCC's determination as to what other spectrum can be used, and subsequently begin product development for alternate bands. However, some carriers have expressed plans to start tests in the repurposed spectrum well before commencing their service. To the extent access to the repurposed 600 MHz band is not available for the entire period of 39 month transition period, wireless microphone operations will be harmed and this transition period will be less useful than the Commission envisioned. It would assist the wireless microphone industry if the 600 MHz licensees gave prior notice of the testing of their operations so that wireless microphone operators may plan around these tests.

Sennheiser supports the Commission's proposal that wireless microphones comply with a minimum separation distance requirement. However, the suggested method of determining that distance, equating a microphone or even a group of microphones to a 4,000 mW white space

⁴³ NPRM at ¶ 167.

device, yields an excessive and inaccurate result.⁴⁴ Even ten standard 50 mW microphones operating on a single channel do not generate nearly the same spectral density as one 4,000 mW white space device. Furthermore, because wireless microphones operate at body height, typically one meter, it is not appropriate to apply a separation distance at three meter antenna height above average terrain. Sennheiser proposes that the separation distance be calculated based on the -80 dBm threshold approach that it has proposed for separation from TV broadcast services.⁴⁵

Sennheiser reiterates that the general non-interference requirements set out in the Incentive Auction R&O are sufficient to protect wireless licensees, and opposes a database control requirement.⁴⁶

6. White Space Registration by Licensed and Unlicensed Wireless Microphones.

The Commission proposes to eliminate the ability of unlicensed wireless microphone operators to register for protection from white space devices in the white spaces database.⁴⁷ Sennheiser opposes this proposal. Unlicensed Class B users – civic groups (community theaters, non-broadcast churches, schools, corporations, trade show and hotel conference centers, regional performance touring acts) and other productive users of wireless microphones – may not routinely use 50 or more microphones, and therefore are ineligible for a Part 74 license. However, these groups do sometimes use several dozen microphones, and require greater reliability than Class C users. Some stage professional level productions and need the ability to

⁴⁴ NPRM at ¶¶ 167-169.

⁴⁵ That is, that wireless microphones be allowed to operate in locations where the signal of the protected service measures below -80 dBm over 200 kHz.

⁴⁶ See NPRM at ¶ 169.

⁴⁷ NPRM at ¶¶ 185-187.

obtain interference protection for their performances. As the available UHF spectrum decreases, registration protection will become more important.

The Commission also proposes improvements to the white space database use to ensure protection of wireless microphones operating in the TV channels, specifically that white space devices re-check the database at closer (no longer than twenty minute) time intervals and that database administrators share information within ten minutes.⁴⁸ Sennheiser supports these changes, which would assist wireless microphone users with critical needs in obtaining critical spectrum on short notice. However, hyper-critical wireless microphone applications still require UHF blocks that are free from white space devices and not reliant on the proper operation of the database system and the white space devices it governs.

The Commission suggests that unlicensed wireless microphone users pay a fee to access white spaces databases to identify available spectrum.⁴⁹ Sennheiser opposes this, as requiring database access fees would impose a cumbersome regulatory burden on wireless microphone owners who would need to register and pay. As mentioned above, fees would impose a particular hardship on the Class B users.

Additionally, the Commission proposes that a registered wireless microphone may be removed from a white spaces database if the device has not checked the database for three months.⁵⁰ Sennheiser strongly opposes this suggestion, as it is out-of-line with how many wireless microphone users function. For example, it is not uncommon for many performers to go on tour for a portion of the year, but spend the remaining time focused on recording and other activities, during which time they do not use their wireless microphones. The Commission's

⁴⁸ NPRM at ¶ 190.

⁴⁹ NPRM at ¶¶ 197-198.

⁵⁰ NPRM at ¶ 199.

proposal would create confusion and additional regulatory burdens for these and many other users.

D. Equipment Certification and Marketing.

The Commission has proposed cutoff dates for the certification, manufacturing and marketing of wireless microphones able to operate in the guard bands and repurposed 600 MHz band.⁵¹ Sennheiser agrees generally with the Commission's proposals. Sennheiser agrees especially that unlicensed wireless microphone users should be allowed to operate Part 74 wireless microphones in the TV bands until they are required to cease operations no later than 39 months after release of the Public Notice setting out new TV channel assignments;⁵² this will allow owners to maximize use of their devices before being required to discontinue their use.

Sennheiser is troubled by the proposal that wireless microphones certified to operate in any portion of the repurposed 600 MHz Band be required to cease operation after the cut off dates even if they can operate in other, permissible frequencies.⁵³ While this approach may be administratively efficient for the FCC, it will harm consumers who no longer will be allowed to use equipment that otherwise would have a long useful life. Today, many frequency agile wireless microphones are capable of operating on several TV channels, and are controlled by operators who tune them to the vacant channels. Wireless microphone users have successfully avoided operations on occupied channels for many years, ably preventing interference to the primary services (TV and land mobile). There is no reason that wireless microphones cannot operate on the allowable frequencies and successfully avoid the incoming 600 MHz licenses.

⁵¹ NPRM at ¶ 204.

⁵² NPRM at ¶ 206.

⁵³ NPRM at ¶ 208.

For this reason, the Commission should not require that wireless microphones that can operate on permissible frequencies be scrapped.

CONCLUSION

For the foregoing reasons, Sennheiser requests that the Commission allocate two blocks of separated, clean UHF spectrum for hyper-critical wireless microphone use. The Commission should not relax white space device rules when doing so will impede the operations of wireless microphones. Additionally, the Commission should regulate wireless microphones separately from white space devices, refraining from requiring white space database registration and control and other technical rules imposed on white space devices.

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