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EX PARTE OR LATE FILED

March 28, 2017

Ms. Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street SW
Washington DC 20554

Re: **Docket Nos. 14-166, 14-165, 12-268, 08-166, 08-167, 10-24, *Promoting Spectrum Access for Wireless Microphone Operation*, et al.**
Docket Nos. 15-146, 12-268, *Preservation of One Vacant Channel in the UHF Television Band for Use By White Space Devices and Wireless Microphones*, et al.
Docket No. 16-142, *Authorizing Permissive Use of the "Next Generation" Broadcast Television Standard*
***Ex Parte* Communications**

Dear Ms. Dortch:

On behalf of Sennheiser Electronic Corporation, pursuant to Section 1.1206(b)(2) of the Commission's Rules, I am electronically filing this notice of an oral *ex parte* communications in the above-referenced dockets.

On March 27, 2018, Joe Ciaudelli, Director, Spectrum Affairs, Sennheiser Electronic Corporation and I met with Joyce Bernstein, Stephen Buenzow, Mark Colombo, Jean Kiddoo, Julius Knapp, Barbara Kreisman, Paul Malmud, Paul Murray, Matthew Pearl, Rodney Small, and Hugh van Tuyl, all of the Commission staff.

We presented the information and positions in the attached slide deck, and distributed the attached manual titled "Guide to Wireless Microphone Operation Post FCC 600 MHz Incentive Auction." In addition, we asked about procedures for Part 74 licensing and coordination with AFTRCC for wireless microphones operating in the 1.4 GHz band.

Please do not hesitate to contact me with any questions.

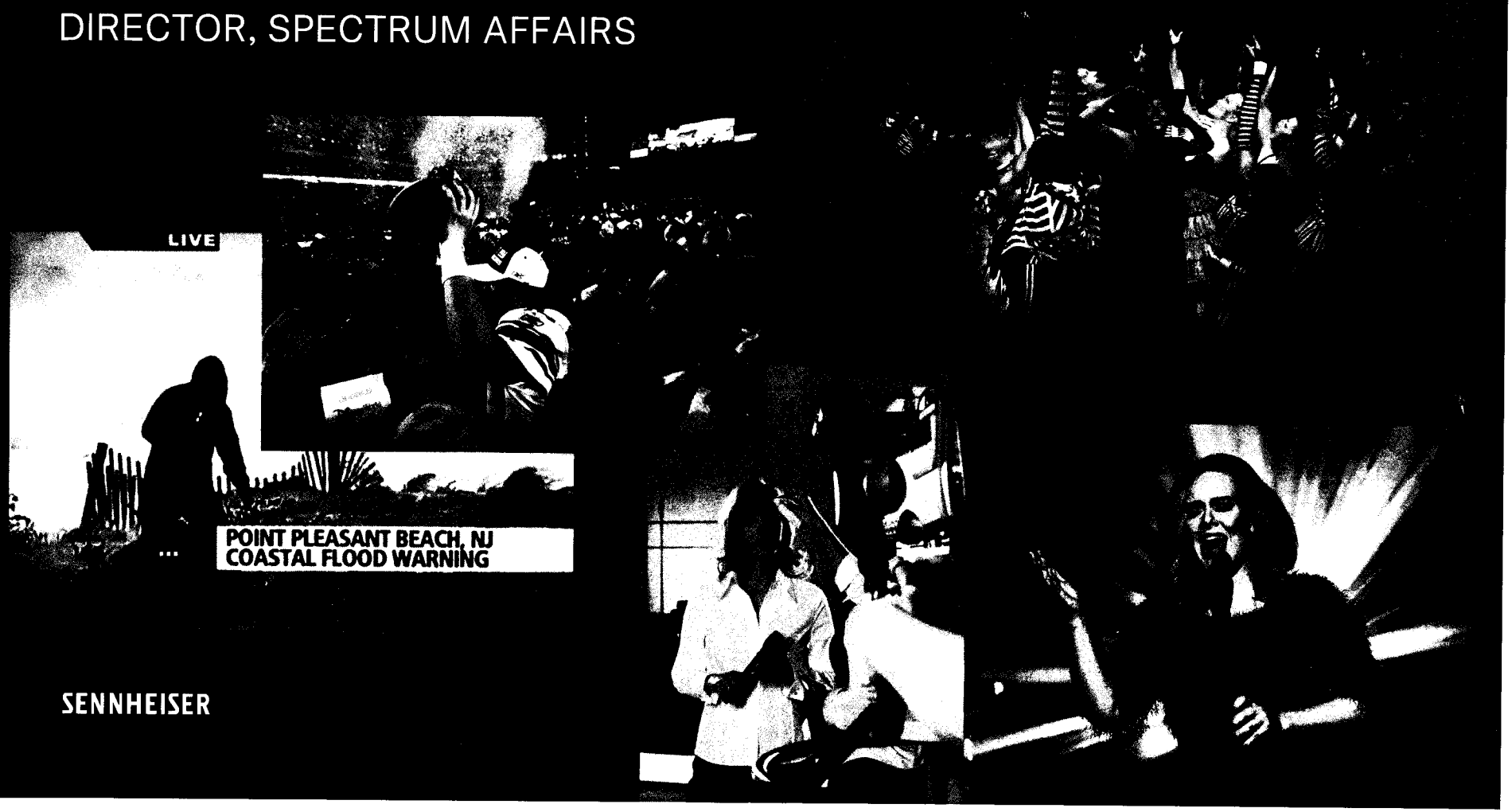
Respectfully submitted,

Mitchell Lazarus
Counsel for
Sennheiser Electronic Corporation

cc: Meeting participants

Critical Issues for Wireless Microphone Operations Post Incentive Auction

JOE CIAUDELLI
DIRECTOR, SPECTRUM AFFAIRS



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Topics

- Expand license eligibility to include legitimate professional productions that do not routinely use 50+ wireless microphones
  - GN Docket Nos. 14-166, 12-268, ET Docket Nos. 14-165, 10-24, WT Docket Nos. 08-166, 08-167
- Adopt a reserved channel for wireless microphones and white space use
  - MB Docket No. 15-146, GN Docket No. 12-268
- ATSC 3.0 adoption does not need simulcasting in vacant channels
  - GN Docket No. 16-142
- Amend the 200 kHz bandwidth limit in Part 74 to allow technology that improves spectrum efficiency
- Increase the separation requirements for white space devices commensurate to any change in their power output and antenna height

Sennheiser at a Glance

Global Headquarters

New Mexico Factory

- Founded in 1945
- Workforce of more than 2000 people all over the world
- Annual sales approx. $800 million
- Production sites in Germany, Ireland and the USA
- International network of subsidiaries and distribution partners
- Three U.S. Facilities:
  - Old Lyme, CT: Sales & Marketing
  - Palo Alto, CA: Advanced R&D
  - Albuquerque, NM: Factory
    - Primary plant for production of wireless microphones for Americas, Asia. Australia/NZ

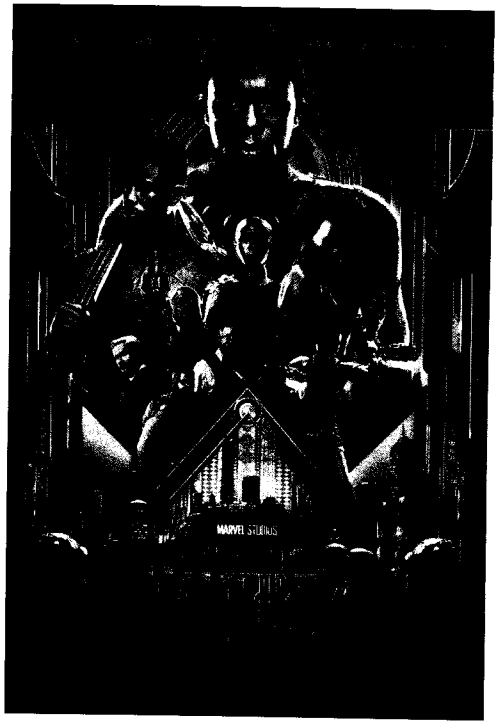
Awards

- Emmy Award
- Technical Grammy
- Academy Award

Sennheiser is the leading manufacturer in high end profesional wireless mics. More than 90% of mics used on Broadway are Sennheiser

Economics: Content Creation vs. Distribution

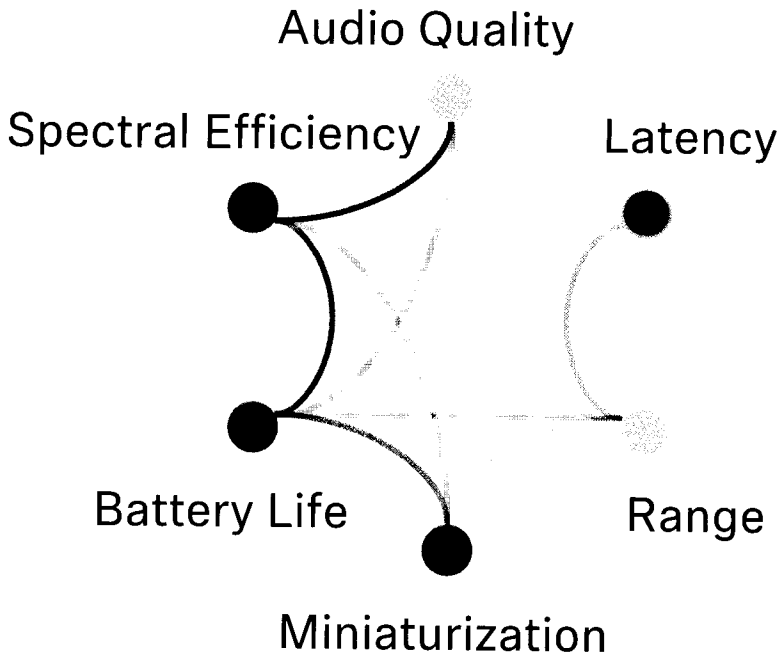
- Spectrum is essential for content creation
- U.S. produced news and entertainment is the best in the world and vital to our economy:
  - Nearly $1 Trillion to the economy = ~ 6.5% of the national GDP
  - 3-to-1 export to import ratio - the highest, by far, of any American made product or service



- Demand for content and wireless microphones is robust
- Productions continue to become more sophisticated

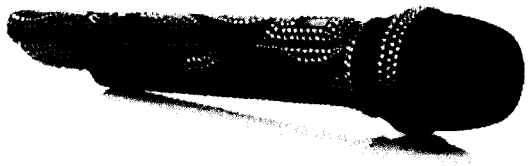
Mics Have High Technical Demands

- Mics must be free of drop-outs, have CD quality sound, negligible latency (audio delay), and fit in a tight spectrum mask. Any feature can be optimized but only at the expense of one or many of the others
- Some applications can tolerate compromise but critical ones cannot!



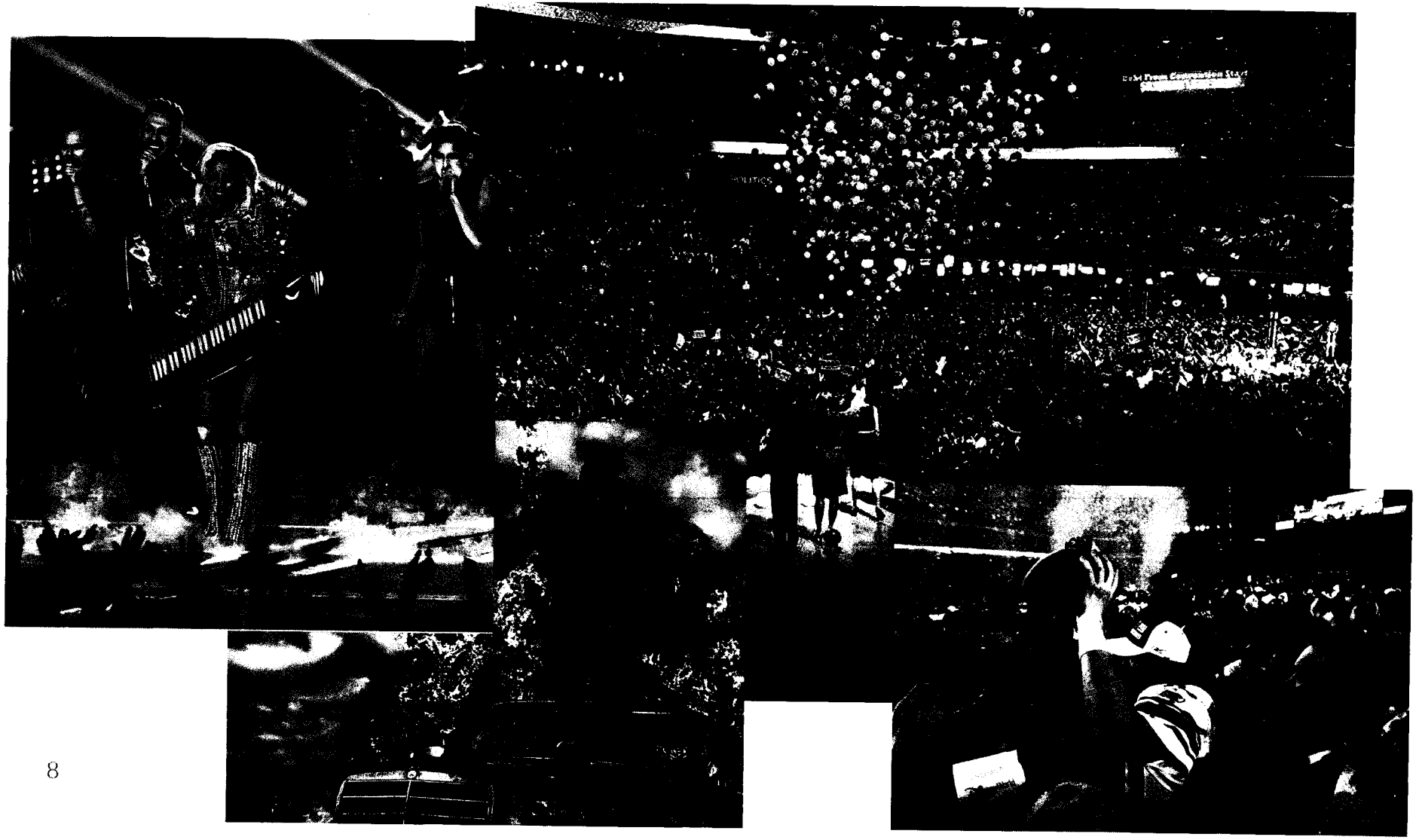
Essential Tools – Some Are Mission Critical

- Wireless microphones take many forms: handhelds, bodypack lapel mics, in-ear monitors, interruptible fold back (IFB) – cueing for on-air talent, intercom systems for backstage communications, coaching staff and crew in sporting events
- Networks and content creators routinely use 10 or more UHF channels for each of their daily productions
- Over 1600 coordinated frequencies (including lapel mics, intercoms, etc.) are used for Broadway theaters each night



- Major events often use hundreds of mics
- Over 1500 frequencies are coordinated and used for the Super Bowl.
- Many applications can use alternate frequency ranges, however...

Hypercritical Situations Require Low Band UHF Spectrum



Clean Suitable Spectrum

- **The Commission should adopt its Notice of Proposed Rulemaking to reserve one UHF channel for wireless microphones and white space use:**
  - Shared WS use with priority for licensed mic operators via registration for interference protection in the database system

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- **The forthcoming 600 MHz mid-band gap and guard bands do not fill the reliability criteria for hypercritical mics due to:**
  - High noise floor and/or spurious emissions from adjacent services
  - The low 20 mW output power limit when operating in these buffer zones.
- **Simulcasting in vacant channels is not needed for successful introduction of ATSC-3.0**

Licensing

- Sennheiser supports the Commission's proposal to expand Part 74 license eligibility to include legitimate professional productions that do not routinely use 50+ wireless microphones
  - We support the proposed language because it provides flexibility to accommodate the evolution of content creation and the performing arts
- Commission should update and simplify licensing process via FCC website.
- Part 90 licensing for 169-172 MHz
  - Should be easy for intended users: schools, houses-of-worship, local government agencies, commercial entities
  - Should be included automatically with an approved Part 74 license

Improve Spectral Efficiency

- The Commission's goal of promoting spectral efficiency can be supported by allowing multipurpose systems that use a full 6 MHz channel
- Spectrum within each 6 MHz channel can be optimally allocated for different applications:
  - High definition for musical performance
  - Stereo for in-ear monitors
  - Standard definition for speech presentation
  - Narrowband for lower fidelity communication (i.e., intercom) links

Adequate Protection

- White space device proponents have requested
  - Increase in output power
  - Increase in allowable antenna height
- Commission has already considered and ruled on these issues.
- White space devices have not demonstrated need for these changes
- Any changes in these parameters should also increase the separation requirements to protect incumbent services, specifically licensed wireless microphone operators

Thank you!

Contact:

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Mitchell Lazarus | 703-812-0440 | lazarus@fhhlaw.com

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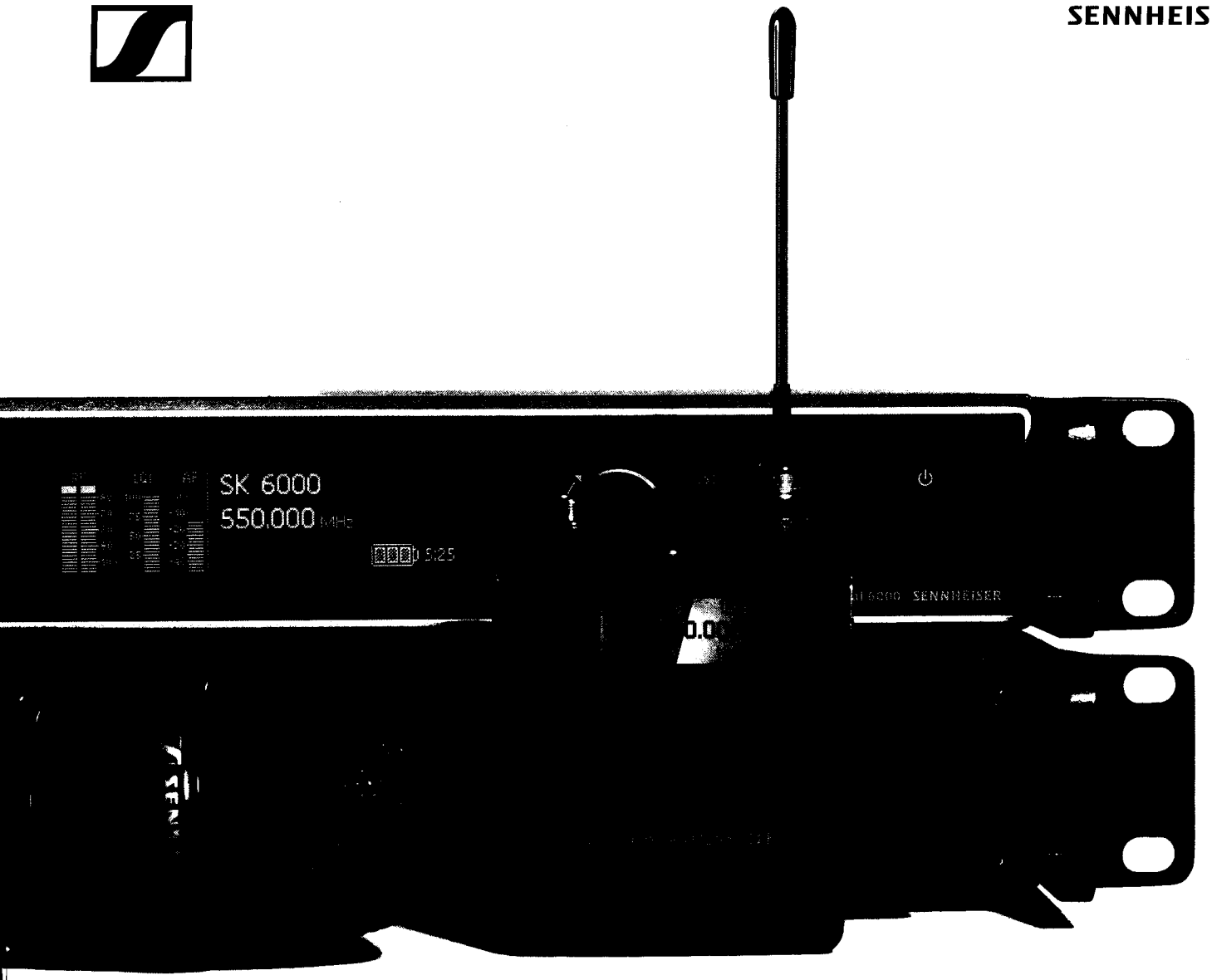


Guide to Wireless Microphone Operation

Post FCC 600 MHz Incentive Auction

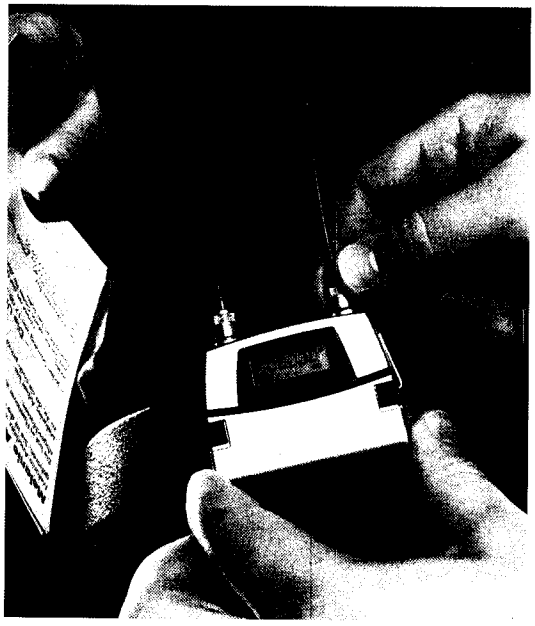
By Joe Ciaudelli
Sennheiser Electronic Corporation

Almost every venue and person using multiple wireless microphones in the United States will need to reconfigure their systems before July 13, 2020, or sooner in most areas, to comply with new federal regulations and avoid interference. Since the definition of wireless microphones includes in-ear monitors, intercom systems, and interruptible fold back ("IFB") systems, more devices will be impacted by the new federal regulations than most people realize.

Most wireless microphones, especially those of professional grade, transmit in locally-vacant TV channels, commonly referred to as white space channels, primarily in the Ultra High Frequency ("UHF") range. Legislation required the Federal Communications Commission ("FCC" or the "Commission") to conduct an "incentive auction" to repurpose a large portion of UHF TV band spectrum for mobile broadband. The auction impacts the 600 Megahertz ("MHz") band, specifically 614-698 MHz. For wireless microphone operators, this means that many UHF TV channels used today will not be available in the future.

FCC decisions concerning the incentive auction and the subsequent repacking of the TV band will significantly impact wireless microphones. Wireless microphone owners and operators should prepare for changes, including:

- 614-698 MHz will be repurposed, and will largely become unavailable to wireless microphones after a transition period that will end on July 13, 2020.
- There will be portions of the repurposed spectrum (e.g., the guard band and duplex gap) where wireless microphones will be allowed to operate, but under different rules (see below) including a 20 mW output power limit.
- Some TV stations currently broadcasting on channels in the 600 MHz band will be moved to lower TV channels, thereby increasing congestion in the remaining TV spectrum. This will further reduce the number of channels available to wireless microphones in the lower UHF and the VHF bands. However, the FCC's adoption of Sennheiser's proposal for co-channel operations (explained below) makes previously prohibited channels now available to wireless microphones.

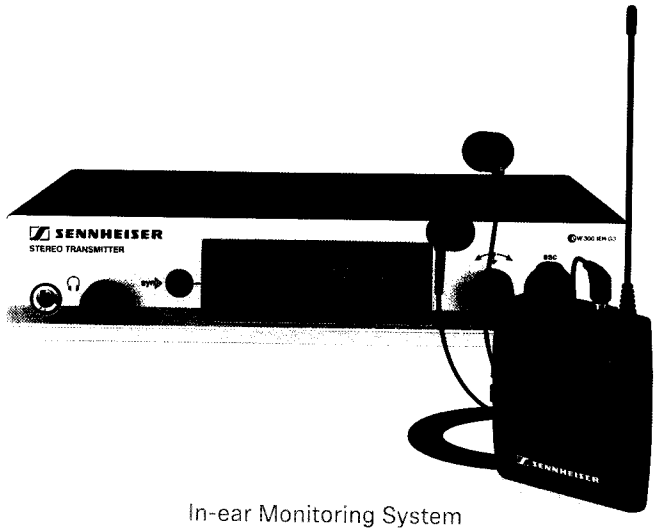


- About half of existing UHF wireless microphone equipment will likely be rendered obsolete, or will require modification. Basically, no later than July 13, 2020, any wireless microphone that can tune above 614 MHz will need to be taken out of service or modified to comply with the new band plan and FCC rules. More specifically, these rules apply to any wireless microphone that can tune to any frequencies within the broadband downlink block (617-652 MHz) or the uplink block (663-698 MHz), and all existing wireless microphones with output power greater than 20 mW that will be used in the guard band and duplex gap.
- Timing of the deployment of the new broadband services will vary by market area. Deployment in most areas is expected to occur well before 2020. A 600 MHz licensee is required to register use of its spectrum in the white space database system once it commences service in an area. Wireless microphone operators should check the database system, using the web portal of any of the FCC approved administrators (e.g., Spectrum Bridge, Key Bridge Global, Telecordia/iconectiv, etc.) for channels available to microphones in their locale. We generally recommend that wireless microphone owners and operators begin replacing 600 MHz equipment now and plan completion of their transition well before the final July 13, 2020 deadline.

- The two microphone reserved channels that currently exist in each geographic market are being eliminated. However, portions of the guard band and duplex gap will be available for the exclusive use of wireless microphones.
- The FCC has proposed that a reserved UHF TV white space channel exist in every market area, but a final decision is pending. This channel would be shared between wireless microphones and white space devices (explained below), but could be reserved by licensed microphone operators for eligible events.
- The FCC will require manufacturers, distributors, integrators, and retailers that sell or lease 600 MHz wireless microphone systems to post notices at the point-of-sale, on websites, on packaging, and in literature about vacating 600 MHz and the new operating rules.

New UHF Band Plan

The FCC's incentive auction had a multi-stage structure designed to repurpose up to 144 MHz of TV band spectrum, depending on various scenarios. Ultimately, only 84 MHz (614-698 MHz) will be repurposed. Although the auction poses big challenges for many wireless microphone owners and operators, this outcome repurposes less TV band spectrum than some observers within the audio industry had feared.



In-ear Monitoring System

UHF Channel 37 (608–614 MHz) has not been used for TV broadcast. Rather, it has been used for wireless medical telemetry ("WMTS") (e.g., monitoring a patient's vital statistics in a hospital). It has also been used in a few remote geographic areas for radio astronomy ("RAS") studies. Wireless microphones have never been permitted to operate on Channel 37, and this is not changing.

This leaves the majority of the UHF TV band (Channels 14-36) allocation unchanged. Accordingly, any locally-vacant (i.e., white space) channel within this range remains available to wireless microphones. This is important because the frequencies within this portion of the UHF TV band have very favorable characteristics, including: signals that can travel through walls, devices that achieve extended range from low transmitter power, and devices that utilize compact antennas. A prime message conveyed to the FCC by many audio industry leaders was that the UHF TV band must remain part of the spectrum portfolio available to wireless microphones – especially for hypercritical applications.

White Space Devices

In 2010, the FCC established rules for White Space Devices ("WSDs") – formerly known as TV White Space ("TVWS") or TV Band Devices ("TVBD") – which are unlicensed equipment also operating on unused TV channels, like wireless microphones do. WSD deployment thus far has been slow, but is expected to accelerate. The audio community has been concerned about this issue because of the increased potential for interference caused by more devices using the same frequency range. However, licensed operation of wireless microphones takes precedence over unlicensed devices, including WSDs. White space devices use location sensing in conjunction with a channel assignment database.

This database includes a list of channels reserved for wireless microphones used in registered events at protected areas, such as entertainment and sporting venues. WSDs must first access the database to obtain a list of permitted channels in the area before operating. A WSD lacking this capability can operate only under the direct control of another WSD that can access the database.

Reserved Channel

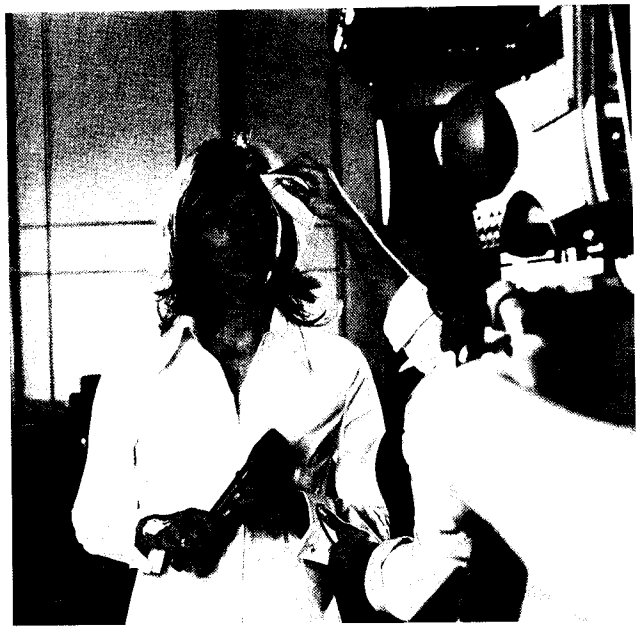
The FCC has issued a Notice of Proposed Rulemaking to reserve at least one UHF TV channel in every market for shared use by wireless microphones and WSDs, but has not yet made a final decision. The possibility exists that the new FCC leadership may reverse course on this issue. Regardless, many areas, particularly suburban and rural ones, are likely to have more than one white space channel. As noted above, eligible wireless microphone operators can reserve any locally-vacant TV channel for their event, preventing WSDs from operating on these channels during the production. This is done through any one of the FCC-approved white space database administrators. Once a reservation is entered, the information is automatically shared within minutes to all database administrators. Since the number of WSDs could increase significantly, registering for protection will become more critical in the future for wireless microphone operators.

Faster Database System

Currently, WSDs "pull" information by polling from the database once a day. In the future, white space database administrators will "push" information about changes in channel availability to WSDs operating in an area requiring protection of licensed wireless microphones – with the result that these channels can be reserved in about 20 minutes. This is a significant reduction in time compared to the current WSD polling method, which could take nearly 48 hours to ensure channel clearing. This greatly benefits news teams and other audio professionals covering late breaking events.

Co-Channel Operation with TV Stations

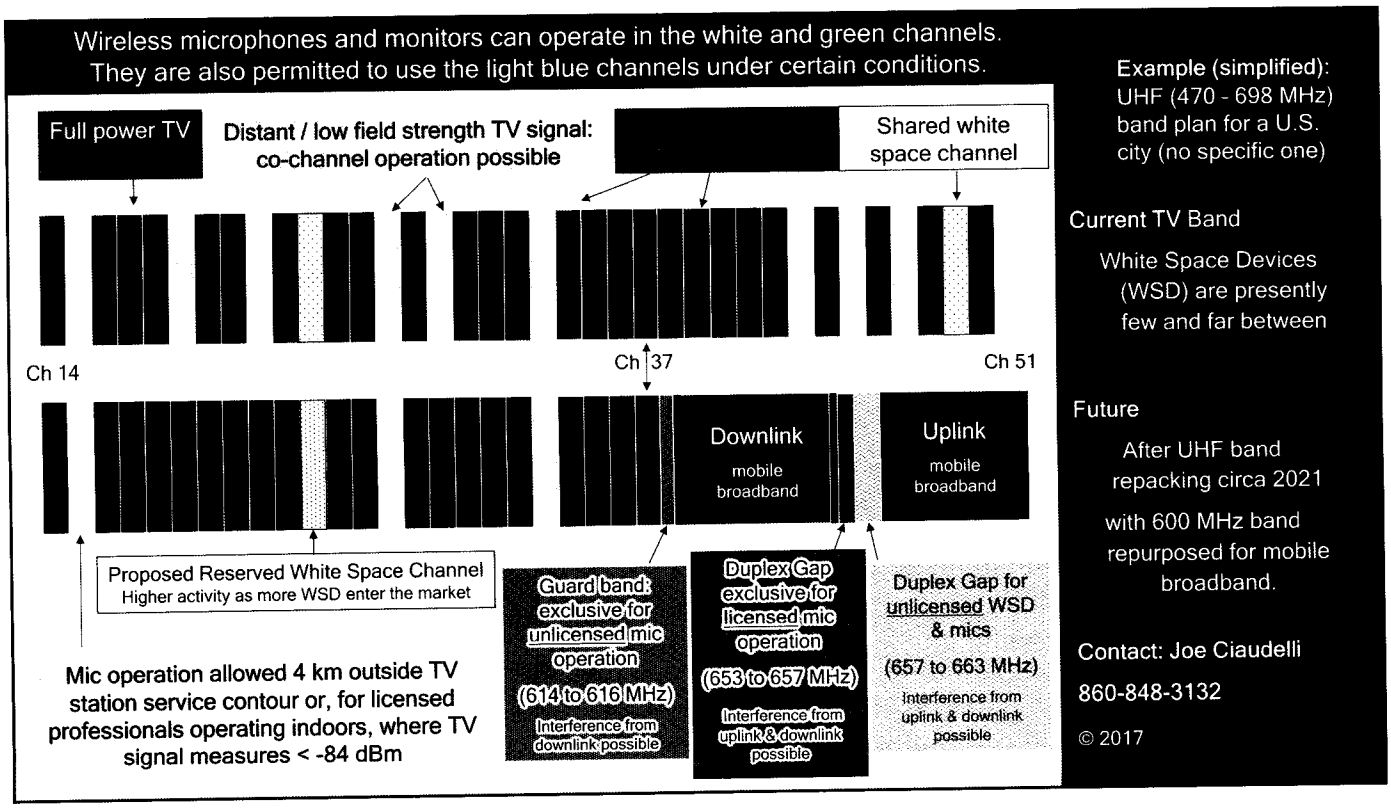
The Commission revised its rules for the operation of wireless microphones on the same channel used by a TV station (referred to as "co-channel operation"). Previously, wireless microphones were only permitted to operate on a TV channel with a minimum separation distance of 100 kilometers (approximately 70 miles) between the wireless microphones and the TV broadcast antenna. Now, wireless microphones can operate 4 kilometers outside the actual service contour of a TV station, regardless of the location of the TV antenna. Licensed wireless microphone professionals are permitted to operate closer, or even within the service contour if they are indoors, and the TV signal measures less than -84 dBm. This field strength benchmark, rather than the traditional geographic separation from TV transmit antennas, opened a number of UHF TV channels to wireless microphone operations that would otherwise not be permitted.



Operating in the Guard Band & Duplex Gap

An 11 MHz buffer band known as the duplex gap has been established between the forthcoming downlink and uplink 600 MHz mobile broadband blocks. No devices shall operate in the lowest 1 MHz adjacent to the downlink block. The next 4 MHz (653-657 MHz) are reserved for licensed wireless microphone operators, and will not be shared with white space devices. This will be particularly useful for electronic news gathering ("ENG") crews covering spontaneous events. In contrast, the upper 6 MHz (657-663 MHz) of the duplex gap will be shared between unlicensed wireless microphones and white space devices.

A 3 MHz lower guard band will exist, separating mobile broadband from Channel 37. No devices shall operate in the upper 1 MHz (616-617 MHz) adjacent to the downlink block. Wireless microphones will have exclusive use of the remaining 2 MHz (614-616 MHz), and will operate under FCC Part 15 unlicensed rules.



Power output of wireless microphone transmitters will be limited to 20 milliwatts (mW) effective isotropic radiated power ("EIRP") when operating in the guard band or duplex gap. This specification was traditionally measured as conducted power at the transmitter's antenna terminal. EIRP, a measurement based on use of a theoretical isotropic omnidirectional antenna, will yield slightly different results. Given that the guard band and duplex gap are buffers to control interference between adjacent services, there may be high out-of-band emissions (i.e., noise) from those services. Therefore, the possibility of interference to wireless microphones operating in these bands may be high, especially considering the low 20 mW microphone power limit. In comparison, permitted output power for wireless microphones in UHF TV white space channels is 50 mW and 250 mW for unlicensed and licensed operation, respectively.

Unlicensed wireless microphones operating in the guard band and the duplex gap will need to register with a database administrator. The administrator may assess a fee for such registrations, although that procedure has not been specified. Other than the 4 MHz within the duplex gap that is reserved for

users who do their homework, the UHF band is more predictable because its use is limited to specific devices and services. Therefore, UHF is still preferred for professional and many semi-professional applications. It is important to keep in mind that any wireless microphone with the ability to tune to any frequency within the repurposed spectrum will need to be taken out of service before the end of the transition period. Customers can confidently acquire any UHF system that does not have the ability to tune above TV Channel 36 (608 MHz). In the future, if you need to configure systems with a large number of wireless microphones requiring more spectrum than the UHF TV band can accommodate, it is important to determine if the operator qualifies for a Part 74 license. Licensed operators would be best served by first adding additional wireless microphones in the 941-960 MHz band, and then applying for use of 1.4 GHz for mega-installations. Unlicensed operators can add additional microphones in the guard band, duplex gap, and the various bands that are available to unlicensed devices.

Our Commitment Continues

Ever since the dawn of radio, policies regarding the use of spectrum have continually changed – that will not end with the outcome of this incentive auction. It is important to recognize that the incentive auction centered around how content is distributed. Adequate spectrum for wireless microphones is also essential for content creation. The United States is the undisputed global leader in news and entertainment content. U.S. core copyright material is a $1 Trillion industry (that's Trillion with a "T"), and has a 3-to-1 export-to-import ratio – the highest of any American-made product or service. Demand for recorded content and live events remains robust, and the trend for increasingly sophisticated productions will continue. Wireless microphones are not merely a convenience, they are indispensable tools fueling this ecosystem. Sennheiser is committed to work cooperatively with the FCC so that the Commission fully understands the importance and ubiquitous nature of wireless microphone operation in our society, and the challenges that spectrum repurposing poses. Our goals are to minimize the adversities that such changes could cause, and to ensure that wireless microphone use for live and recorded events will continue uninterrupted while meeting future demands. We thank all of our colleagues and customers who support our efforts – especially those who wrote to and/or even met with FCC staff, thus fortifying a fertile future for our industry.

About the Author:

Joe Ciaudelli is Director of U.S. Spectrum Affairs for Sennheiser Innovation & Research. He is a private sector advisor in the U.S. delegation to the International Telecommunications Union (ITU), the United Nations specialized agency on information and communications. He is also the founder of Rayvel, a corporation that specializes in electro-magnetic science, and holds three patents in holographic technology.