

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington D.C. 20554**

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

COMMENTS OF ATK AUDIOTEK

INTRODUCTION

ATK AUDIOTEK (ATK) is one of the nation's largest providers of sound reinforcement equipment and services for broadcast special events, award shows, industrial conventions, permanent installations and concert events. A short list of some of the events we are involved in are as follows: The American Music Awards, The Billboard Music Awards, Miss America Pageant, Miss Teen USA, Miss Universe, The Academy of Country Music Awards, The Academy Awards, The Emmy Awards, Peter Gabriel US Tour, Radiohead US Tour, Sony Music Conventions, Microsoft Conventions, The Grammy Awards, The Opening and Closing Ceremonies of the 1996 and 2002 Olympics in Atlanta, GA and Salt lake, UT., both the Democratic and Republican National Conventions in 1996, 2000 and 2004, and NFL Super Bowls since 1998.

ATK understands the needs of the FCC to make available as much of the RF spectrum for public benefit as possible. Despite this, ATK has great concerns regarding the impact the rules change, as outlined in FCC 04-113 NPRM, will have on the use of low power wireless microphones, wireless in-ear monitor systems and wireless intercom systems which operate under Part 74.

DISCUSSION

Over the past decade or two, low power wireless microphones, wireless in-ear monitor systems and wireless intercom systems (“wireless microphone”) have become essential equipment in most sound reinforcement environments from community gatherings such as religious houses of worship to the largest of shows such as the NFL’s Super Bowl. Although the nation’s average, for a religious house of worship, is approximately 90 attendees, the majority of Americans attend religious gatherings greater than 250 attendees on a weekly basis. Further more, there are tens of thousands of these gatherings functioning weekly serving the American public numbering in the millions. Many of them have grown to rely upon wireless microphones out of convenience while some, due to their large size, have no option but to require them even for basic functionality. At the other end of the spectrum, the Super Bowl is often the most-watched TV program with over 135 million viewers each year. “Wireless microphone” equipment is used in such large quantities (over 1000 active frequencies) at this event mainly due to the demands of the national and international media, network TV and radio broadcasting, pregame-halftime-postgame entertainment and NFL team communications. In both of these extremes, all parties involved depend upon the predictable and reliable operation of their “wireless microphone” equipment. Should conditions arise which would regularly affect the reliable operation of this equipment, the impact on the American public and the financial ramifications would be immeasurable. It is ATK’s opinion that by allowing unlicensed radio transmitters to operate in the same unused TV spectrum along with “wireless microphone” equipment, a potential recipe for disaster will exist unless certain conditions are met.

Unlike some types of RF transmissions (i.e. WLAN/WISP, data, etc.), “wireless microphone equipment”, particularly performance microphones, cannot tolerate one single instance of interference without serious consequences. A minor consequence scenario would be a situation in which the interference causes dropouts, creating confusion to the performer and/or distracting the audience from the performance. A

major consequence scenario would be a situation in which the interference triggers a burst of noise, which in turn causes damage to speaker systems, the performer's ears or even to members of the audience. Modern concert sound systems today are capable of achieving momentary SPL peaks in excess of 145dB SPL. If a wireless microphone breaks squelch, the level of noise introduced into a sound system could easily drive the system to maximum SPL.

ATK appreciates the fact that the NPRM acknowledges the operation of wireless microphones in paragraph 38, but it states some oversimplified conclusions that are seriously flawed.

Specifically paragraph 38 states:

38. As noted above, manufacturers of wireless microphones express concern that operation of new unlicensed devices in the TV bands could cause interference to wireless microphones.⁵⁹ We believe that the operational characteristics of wireless microphones significantly reduce the likelihood of interference from unlicensed devices for several reasons. Wireless microphones are permitted relatively high output power given the range over which they are typically operate. The maximum permitted output power of these devices is 50 milliwatts in the VHF band and 250 milliwatts in the UHF band.⁶⁰ Wireless microphones are used in locations such as theaters and sports arenas where the operating range would typically be hundreds of feet at the most, so operation at the power levels permitted in the rules results in a significant signal level at the wireless microphone receiver. Further, the vast majority of wireless microphones are frequency modulated (FM). FM receivers exhibit a "capture effect" in which they respond to only the strongest signal received on a frequency and reject any weaker interfering signals. Because the desired signal at a wireless microphone receiver is relatively strong, we believe that the likelihood of interference from unlicensed device signals is therefore low such that unlicensed use should generally be compatible with wireless microphones. Nonetheless, we seek comment on whether other measures are needed to protect wireless microphone operation including the possibility of designating one or two unused TV channels in each market for use by only wireless microphones.

Although the above statement is true in part, it doesn't represent reality. In recent years, the need for wireless microphone equipment in television production has increased tenfold. Not too long ago, most of the "wireless microphone" equipment operated in the VHF TV band. A "big" show would have 6-8 channels of wireless performance microphones and another 8-12 frequencies used for production communications. As time progressed, demands for more "wireless microphone" equipment to operate in the same environment forced our industry to seek solutions in the UHF TV band. Soon we started

to see more and more events using 20 or 30 wireless performance microphones and 32-36 additional frequencies used for communications purposes. While that seemed a lot at the time, there was plenty of unused TV RF spectrum available in any given market across the country due to open adjacent channels and the ability to use “slot” frequencies on analog TV channels. Now we enter the present time where due to the DTV transitioning and the conversion of the upper UHF TV channels for emergency services, we are forced to operate in 25% of the spectrum we use to have. To add even more pressure to the situation, a typical TV special event like the Grammy Awards now require the function of 65 wireless performance microphones, another 20-24 channels of wireless in-ear monitors, 12-16 channels of wireless band equipment and 36-42 additional frequencies for production communications. That’s nearly 150 frequencies operating in a handful of unused TV channels. Because of this reality, advanced techniques are employed to cope with the ever-shrinking spectrum and the ever-increasing event production RF demands. One of these techniques is to manage the event’s RF noise floor. Most mass manufactured “wireless microphone” UHF equipment transmits only 30-100mW. This “reduced” power output helps to minimize increases of the event’s RF noise floor and allows us to operate 8-10 “wireless microphone” device frequencies per TV channel. The other reality is that most of the transmitting devices are battery powered. With current battery technology, a typical 50mW handheld UHF performance microphone will last only 4-6 hours before new batteries are needed. If we were to operate at the allowed 250mW, we would only get about 2 hours of reliable operation before we would need to change batteries. This would require an unreasonable level of battery management and/or battery replacement activity.

The second-to-last sentence of paragraph 38 is an amazingly bold conclusion. As outlined in the NPRM, these unlicensed devices will fall into two categories. “Personal/Portable” devices and “Fixed/Access” devices. As stated in paragraph 22 regarding transmission power output for “Personal/Portable”:

“...limit the maximum power output of these devices to 100 milliwatts (mW) and to require that such devices have a permanently attached integral antenna with a maximum permissible gain of 6 dBi.”

And for “Fixed/Access” devices, paragraph 25 states:

“...up to one watt and to employ higher gain directional antennas, with requirements for transmitter output reductions for antennas with gains above 6 dBi.”

Because it is unknown at this time what real products will come to the market due to the proposed rules change, it is unrealistic to believe that the likelihood of interference of these unlicensed devices with “wireless microphone” is low. What if a new sub culture develops because some clever company creates a personal PDA/iPOD like device that allows users a rich instant messaging/ peer-to-peer environment through a local wireless network created by all the devices within a certain range? What if it occurred at a night club or theater before or during intermission or worse yet, during the performance?

As stated in paragraph 30:

“...requirements needed to protect television service from digital unlicensed devices should be limited to... co-channel operations only for personal/portable operations.”

That’s probably true regarding “television service” but what about our 30-100mw low powered devices? A “Personal/Portable” device transmitting a full 100mw with a 6dBi fixed antenna, could wreak havoc on a live performance if it had a defect, software glitch or hardware problem that prevented it from “getting out of the way” of licensed devices such as the lead vocal microphone at that event. And while receiver squelching techniques like “tone code” can help reduce some of the negative effects of interference, what really matters for interference to occur is the D/U ratio at the “wireless microphone” receiver which is a function of both the desired and undesired powers and distances involved.

Another factor to consider is that unless these unlicensed devices incorporate technologies that are so advanced and full proof regarding the detection of unused spectrum, including effectively dealing with the “hidden node” condition and the relatively low power output from real world Part 74 “wireless microphone” devices, it will be impossible to effectively coordinate the RF spectrum for an event, be it large or small, with solid assurances to the event planners that interferences will not be a problem. What would be the proper technique in explaining, to the staff of George W. Bush, why his wireless microphone shut off, due to interference from unlicensed device(s) during that televised town hall meeting, at that poignant moment he had spent 10 minutes getting to? Never before has our industry had to contend with the large potential of unmanaged

RF transmission in the TV spectrum we operate in. It's one thing to know or be able to scan for active frequencies in the TV channels of interest, and build a RF plan around it, and it's entirely another thing to add the potential of random intermittent transmissions coming and going without warning or prediction. I would hate to see terms like "hit and run" and "Russian roulette" become standard "technical" statements in our industry.

Despite all these issues, as originally stated, ATK is aware of the need and duty of the FCC to make as much of the RF spectrum available for public benefit. There are some possible solutions that can eliminate or greatly reduce the chances of interference with "wireless microphone" equipment.

The first being the designation of TV channels in each market set aside for the exclusive use of Part 74 "wireless microphone" equipment. This of course would eliminate any possible interference for unlicensed wireless devices within these channels. This is suggested at the end of paragraph 38 but in order to have any real value, it must be a minimum of (6) channels per market. Preferably all UHF but (2) VHF (7-13) and (4) UHF will work too. The reason for this quantity was illustrated earlier. The quantities of frequencies required on most large scale entertainment events number now between 50 and 100 with some of the largest being nearly 150 (we won't even include the Super Bowl here with its 1000 or so frequencies used). These numbers are sure to increase with time. It is important to remember that although these types of events only number in the hundreds per year (TV award shows, TV special events, large scale national tours, large scale sporting events and major corporate conventions), these events touch and impact hundreds of millions of Americans each year. ATK believes that this alone justifies the allocation of TV channels for this purpose.

Next would be to require unlicensed devices to listen for control information from a "beacon signal". Due to the fact that the needs of an interference free environment for most events is a relatively small area as apposed to a whole city or county, these beacons could be programmed and deployed to create a "demarcation zone" signaling what TV channels are currently being used with "wireless microphone" or other protected

equipment. These beacons would be programmed and deployed by RF professionals responsible for the event, and transmit control information including other protected channels from other nearby beacons. A number of beacons would be deployed in a perimeter creating a “force field” of coverage around the area of interest. They would become a cost and management task of either the event venue, RF technical crew hired for the event or technical equipment provider of the event. Once the event is over, the beacons would be turned off and removed, ready to be reprogrammed and deployed to the next event. The key challenge here is the technology behind these beacons and the ability of the unlicensed devices to listen to them effectively. If proven effective and reliable, the additional cost and management load would easily be offset by the assurance offered by creating an interference free zone.

To further ensure that interference from unlicensed wireless equipment not be an issue and to cover the operating condition where deployment of “control beacons” are not possible, these devices need to engage in spectrum sensing. This would allow the unlicensed device not only the ability to search, on its own to find unused TV channels, but also allow it to verify a TV channel, that it’s about to jump to, is indeed clear of any protected transmitting devices. There are some large technological challenges here to solve. 1) How to deal with the “hidden node” condition. 2) Some communication equipment operates in a push to transmit mode. How will the unlicensed device deal with this intermitted condition? 3) How will the device continue to do background scans even on the TV channel it currently is cleared to be on? 4) Will all of these requirements make the device so expensive that its cost will out weigh its usefulness?

The last issue to facilitate the successful integration of unlicensed devices with “wireless microphone” devices is to limit the maximum transmitted power. ATK believes that the greatest interference problems will come from the “Personal/Portable” devices category. This category should be reduced from the recommended 100mW + 6dBi fixed antenna stated in the NPRM to 50mW + 0dBi fixed antenna. With regards to the other category “Fixed/Access” devices, ATK believe that even at the high power levels discussed in the NPRM, this category posses less of an interference threat. This is mainly

due to the restriction on these devices to not operate on co- or adjacent channels of a protected TV channel transmissions. ATK agrees with the power limitation discussed for “Fixed/Access” devices stated paragraph 25 of the NPRM.

CONCLUSIONS

ATK AUDIOTEK has been in the business of providing state-of-the-art sound reinforcement equipment and services for broadcast special events, award shows, industrial conventions, permanent installations and concert events for nearly 25 years. Our broad and vast experience allow us to have an “expert” opinion regarding the potential impact unlicensed devices operating in the “unused” TV channel spectrum. It is imperative that the FCC realize the ramifications regarding interference to Part 74 “wireless microphone” devices from the proposed rules change regarding unlicensed devices as outlined in the NPRM. Since most Americans regularly enjoy entertainment created for them via TV broadcasts or live experiences, the loss of reliable use of “wireless microphone” equipment would affect most of America. To ensure that this does not happen, the FCC must implement interference protection, which includes Part 74 devices, in the rules for regulating unlicensed devices in the TV RF spectrum.

Protection solution needed to ensure interference free environment are:

- 1) Designation of TV channels in each market set aside for the exclusive use of Part 74 “wireless microphone” equipment. A minimum of (6) channels would be needed.
- 2) Unlicensed devices are required to listen for a “beacon” signal that provides control information so it can easily determine a safe and clear channel for its operation.
- 3) Unlicensed devices need to engage in spectrum sensing. This will help to “police” the channels occupied by protected intermittent transmitting devices and manage the spectrum when “beacon” signaling devices are not deployed.
- 4) Limit the amount of transmission power allowed to unlicensed devices to 50mW + 0dBi fixed antenna for “Personal/Portable” device category and 1W + 6dBi antenna for “Fixed/Access” device category.

Respectfully submitted,

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