

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

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

**COMMENTS OF
SHURE INCORPORATED**

Shure Incorporated (“Shure”), by its undersigned counsel, hereby respectfully submits these brief Comments to the Commission’s recently released Initial Evaluation of the Performance of Prototype TV-Band White Spaces Devices, released July 31, 2007 (“Test Report”).¹ The Commission’s Test Report conclusively demonstrates that spectrum sensing is *not* a reliable means of protecting existing services, including wireless microphones, from interference caused by unlicensed TV band devices and that such devices will, in fact, interfere with existing services. The record in this proceeding now clearly dictates that portable TV band devices that rely on spectrum sensing to protect existing services from interference should not be allowed to operate in the TV band.

At the outset, Shure applauds the Commission’s dedication to developing hard data for use in analyzing the interference risks that unlicensed TV band devices present to wireless microphones,² TV reception and other devices. The Commission rightly honored its

¹ *Initial Evaluation of the Performance of Prototype TV-Band White Space Devices*, Technical Research Branch, Laboratory Division, Office of Engineering and Technology, Federal Communications Commission, OET Report, FCC/OET 07-TR-1006 (rel. July 31, 2007) (“*Test Report*”).

² “Wireless microphones” as used herein includes a variety of audio devices authorized under Part 74 of the Commission’s Rules as secondary users of locally unoccupied television channels. In addition to wireless

commitment to making a sound engineering assessment of the claims surrounding proposed unlicensed TV band devices.³ The implementation of the Commission's twin goals in this proceeding -- to explore how vacant TV frequencies could be used without causing interference to existing users -- can only be done by carefully crafted technical rules based on effective and objective testing of the technologies being offered to provide that protection. The stakes in this proceeding are too high to do anything less; wireless microphones are used extensively in high-quality audio systems for newsgathering, high-profile sporting and entertainment events, musical and theater productions, government, educational, religious and business meetings. Verbal assurances of interference protection and promises to develop solutions in the future should not - - and cannot -- be the basis upon which the Commission establishes technical rules to protect wireless microphones, TV stations and other incumbents against harmful interference. The Commission's Test Report reveals that these assurances and promises are not substantiated. In the interest of avoiding a waste of valuable administrative and industry resources, the Commission should scrutinize any further promises against the hard facts of the Test Report. Any purported technological advancements to improve interference detection and avoidance by proponents of unlicensed TV band devices or efforts to repudiate the Commission's Test Report must not be taken on faith but must be demonstrated and subjected to extensive and complete testing.

microphones, this equipment includes in-ear monitors, wireless intercoms, wireless assist video devices ("WAVDs") and wireless cueing ("IFB") systems.

³ See *Unlicensed Operation in the TV Broadcast Bands*, First Report and Order and Further Notice of Proposed Rulemaking, ET Docket Nos. 04-186, 02-380, 21 FCC Rcd 12266, at 48 (rel. Oct. 18, 2006) ("*FNPRM*") ("We [the FCC] intend to conduct extensive testing as part of the process to develop technical rules for TV band devices. Further, we believe that compliance measurement procedures are critically important.").

I. The Commission's Tests Reveal that Spectrum Sensing is not a Viable Means of Interference Protection in the TV Bands

The Test Report demonstrates that unlicensed portable devices, if permitted to operate in the TV band, cannot consistently and reliably sense or detect wireless microphone signals and will cause direct interference to incumbent wireless microphone operations.⁴ The results of the OET's testing confirmed Shure's assessment of the significant interference risk and concerns regarding the technical protections proposed. For nearly four years, Shure has analyzed claims by the proponent manufacturers and warned that the proposal to allow personal/portable unlicensed devices to operate in the TV band will result in significant harmful interference to existing users. Throughout this proceeding, Shure has prodded the proponents of TV band devices to submit evidence through analysis, test results and equipment to substantiate their claims that the Commission and those at risk of harmful interference can rely on their "smart radio" technology to protect incumbents and avoid interference.

Finally in March and May, 2007, devices were submitted by Microsoft Corporation and Philips Electronics for the purpose of demonstrating those interference protection capabilities. The proponent manufacturers submitted their equipment with confidence that the Commission's rigorous testing of their devices would prove the interference protection capabilities of the equipment.⁵ The Coalition said: it has "invested the time and resources to build prototype

⁴ See *Test Report* at 61-67.

⁵ "The Coalition has now backed up its words by building a prototype . . . and making arrangements to submit it to the Commission for testing. This device will confirm that incumbent licensees can be protected by unlicensed devices from harmful interference." See Reply Comments of Dell Inc., Google, Inc., The Hewlett-Packard Co., Intel, Corp., Microsoft Corp., and Philips Electronics North America Corp. filed in ET Docket Nos. 04-186, 02-380 on March 2, 2007, at 1-2 ("*Coalition Reply Comments*"). "Like the personal/portable prototype device previously submitted by Microsoft on the Coalition's behalf, the Philips prototype . . . will provide incumbent licensees in the television band with the interference protection to which they are entitled. Specifically, the Philips prototype successfully locates analog and digital televisions signals as well as wireless microphone signals using detection threshold of -114 dBm." See Ex Parte Letter of the White Spaces Coalition filed in ET Docket Nos. 04-186, 02-830 on May 21, 2007, at 1.

devices.”⁶ The Coalition assured that “[i]t has extensively tested and refined its design.”⁷ The Coalition went so far as to say that it “*guarantees* that incumbent licensees will be protected from harmful interference.... The Coalition is confident that the Commission’s independent and expert testing of its prototype will confirm the wisdom of the Coalition’s choice of operating parameters.”⁸

Unfortunately, the two devices tested by the OET, Prototypes A (Microsoft’s device) and B (Philips’ device), were both found to be deficient in their ability to sense wireless microphones and Prototype A, the only device submitted with a transmitter, was found to cause significant interference to wireless microphone operations.⁹ Prototype A was “tested with wireless microphone signals at various power levels and locations within a TV channel, and with and without the presence of a DTV signal on a different channel and at different power levels.”¹⁰ The results of these tests indicated that “Prototype A was generally unable to sense wireless microphones.”¹¹ In fact, the OET found that “in many cases, [Prototype A] incorrectly sensed the wireless microphone signal as a DTV signal.”¹² Since Prototype A’s performance in spectrum sensing tests proved to be “very poor,”¹³ OET found that “no additional insight” could be gained “from testing this device under other conditions....”¹⁴ The tests also revealed that the

⁶ *Coalition Reply Comments* at 5.

⁷ *Id.*

⁸ *Id.* (emphasis added).

⁹ Prototype B only has spectrum sensing capability and therefore was not tested for its potential to cause interference to wireless microphone operations.

¹⁰ *Test Report* at 63.

¹¹ *Id.*

¹² *Id.* at viii.

¹³ *See Peer Review of Prototype TV White Space Devices Study*, Memorandum, ET Docket No. 04-186, at 4 (Aug. 1, 2007) (“*Peer Review Report*”).

¹⁴ While the spectrum sensing testing for Prototype A represented the “best case” for sensing a wireless microphone, upon suggestion by the peer review panel, OET performed additional informal testing on the devices and found that Prototype A “still failed to sense the microphone signal.” *Id.* at 4.

transmitter in Prototype A “is capable of causing interference to TV broadcasting and wireless microphones.”¹⁵

Although Prototype B fared slightly better in its spectrum sensing tests, the OET still found that “it also incorrectly indicated the presence of a microphone on channel 24” and that it “incorrectly sensed wireless microphone signals on six additional channels.”¹⁶ The tendency of Prototype B to incorrectly sense wireless microphones on vacant channels suggests that the device lacks the ability to accurately detect occupied channels.¹⁷ In addition, the Test Report demonstrates that Prototype B’s ability to detect a wireless microphone signal was degraded in the presence of DTV signals, which raises significant concerns about interference in a real-world situation.¹⁸ In short, neither prototype was capable of reliably and accurately sensing other spectrum users. The Test Report revealed the failure on a fundamental basis for a spectrum sensing solution and confirms that spectrum sensing technologies are not a ripe technology ready for implementation in the TV bands.

In grappling with the complex technical issues raised by the proposal to introduce new devices in the TV frequencies, the Commission committed that it would not permit new devices, including portable devices, to operate in this band if incumbent operations could not be protected from interference.¹⁹ Based on the interference threat that the Commission’s own testing has revealed, the Commission must stand firmly behind its initial decision and restrict unlicensed operations in the “white spaces” to fixed applications.²⁰

¹⁵ *Test Report* at x.

¹⁶ *Id.* at 64.

¹⁷ *See id.* at 64.

¹⁸ *See id.* at 66.

¹⁹ *FNPRM* at 15 (“We recognize ... the importance of conducting tests to ensure that whatever standards are ultimately adopted for such devices will protect incumbent radio services from harmful interference.”).

²⁰ Although not the subject of these comments, Shure has proposed in this docket a number of technical and operational safeguards that will be necessary to prevent interference from fixed operations.

II. Even If The Tested Performance Could Be Improved, Other Device Capabilities Would Need To Be Tested And Confirmed Before Spectrum Sensing Could Be Viewed As A Viable Interference Protection Mechanism

The Commission -- and the proponents of unlicensed devices -- have focused attention on spectrum sensing as the principal means for protecting existing services from interference. However, the problem of determining which channels are in use is challenging with fixed systems and extremely difficult for portable devices. As Shure and the IEEE²¹ have previously advised, current spectrum sensing technology has not been shown to be a sufficient primary interference protection method for analog or DTV stations or wireless microphones in the TV band. The Test Report verifies this analysis.

The Commission must bear in mind that the equipment submitted as evidence of the interference protection capabilities of proposed TV band devices lacked several other key features that would be necessary for the proposed solutions to operate as described. Both prototypes submitted required manual control in order to perform certain tasks. The devices lacked the ability to perform intelligent tasks such as sensing for incumbent users, ceasing operations on a busy channel and moving to an open channel within critical, specified time periods. These critical capabilities were not incorporated in the test equipment and thus were not tested. Accordingly, the Test Report should *not* be read to mean that the proposed equipment would provide the necessary interference protection if only the detection threshold could be improved or out-of-band transmitted emissions reduced. In fact, there are numerous other features that a TV band device would need (and that would need to be tested) to demonstrate that it could provide the necessary interference protection.

²¹ See generally Reply Comments of Shure Incorporated filed in ET Docket Nos. 04-186, 02-380 on March 2, 2007, Comments of IEEE 802.18, filed in ET Docket Nos. 04-186 and 02-380 on January 31, 2007.

III. The Prototype Devices Failed to Perform in Best Case Scenarios; Further Testing in More Challenging Contexts Would be Futile

Shure supports the Commission's testing in this matter and concurs with the Commission's approach and conclusions. This is the case even though the Commission's testing did not include tests for all types of wireless microphone equipment or wireless microphone equipment in all contexts. The limits of the Commission's testing are not flaws in the methodology or approach but rather are limits that reflect the poor performance of the prototype devices in best case scenarios making testing in more challenging contexts futile.²² Thus, in drawing conclusions from the Commission's Test Report, it is important to understand that other tests conducted in more challenging contexts or configurations would reveal lower performance.

For example:

- The Commission did not include tests of prototype performance vis-a-vis wireless microphones operating in the VHF bands. The propagation of VHF radio waves and the ambient noise environment in VHF are very different than they are in the UHF band. Even if the performance of the prototypes could be improved in the UHF band, the Commission's testing does not provide a technical basis for allowing portable devices to operate in the VHF band.
- The out-of-band emissions of the prototype transmitter were unacceptably high absent any filtering. However, the narrow band filtering submitted to the Commission to address the out-of-band emissions for testing would likely be impractical for inclusion in consumer device based on excessive cost.
- All of the tests involving wireless microphones were performed in the laboratory on a static basis (no devices were moved around.) These tests therefore did not take into account the effects of multipath and "hidden node" problems. Even if the detection thresholds of the prototypes could be improved to the Commission's recommended value of -116 dBm (with 100% accuracy), wireless microphones would still experience interference unless the TV band devices were required to use network sensing (*i.e.*, each device must sense and report channel availability data to others).

²² It is noteworthy that the Peer Review Report issued to assess the appropriateness of the Test Report, *supra* note 1, observed that even though the OET tested a continuously modulated signal as the "best case" for sensing a wireless microphone signal, Prototype A exhibited virtually no capability to sense a "best case signal." Given the poor performance in a best case scenario, the report concluded that "there seemed to be no point in attempting to sense 'worst case' signals." See *Peer Review Report* at 3-4.

- The tests did not include Wireless Access Video Devices (“WAVDs”). WAVDs are authorized under the Part 74 Rules, specifically Section 74.870, and while Shure does not manufacture these devices, they are entitled to the same protection as wireless microphones under the proposed rules. WAVDs are routinely used in live sports broadcast and interference to WAVDs by unlicensed personal/portable devices will interrupt the video link from the wireless cameras.
- Wireless microphone testing was conducted in the laboratory only; no field tests were performed. As a result, the Commission’s tests did not generate any data on how a sensing device would perform in much more challenging real-world situations. In a real-world setting, both the prototype and wireless microphones would be constantly changing locations, multipath signals would complicate interference protection, and body absorption and other variables would reduce the power of wireless microphone transmissions. (Shure has previously outlined the important features of real-world field testing that would be relevant to determine whether and to what extent prototypes could sense and protect wireless microphones.²³) As the Test Report confirms, no party has yet demonstrated the ability to address these and other variables to ensure effective interference protection from portable devices.
- The sensing times for the tested TV band devices were impractically long. Even if these devices were able to detect a TV channel in use, the 14 minutes that Prototype A required to scan or even the 4 minutes that Prototype B required are wholly impractical for any real-world use.

IV. A Peer Review Panel Of Experts Found The OET’s Testing To Be “Well Done And Thorough”

While the poor performance of the tested prototypes is certainly disappointing, the Commission’s method and test implementation were entirely appropriate for assessing the “detect and avoid” techniques of the personal portable TV band equipment. The Commission’s testing methodology and conclusions came under the scrutiny of a rigorous peer review panel convened pursuant to the Office of Management and Budget’s requirements under the Information Improvement Act. This requirement mandates that all influential scientific assessments be subject to peer review to enhance the quality and credibility of the government’s scientific information.²⁴ This double layer of scientific scrutiny ensures the quality and

²³ See Shure Incorporated Ex Parte Comments, ET Docket Nos. 04-186, filed on July 26, 2007.

²⁴ See *Peer Review Report* at 2.

completeness of the OET tests and analysis and independently confirms that the Test Report is beyond reproach.

The Peer Review panel examined the OET's approach and conclusions in detail and issued its own report analyzing the OET's process. The Peer Review panel scrutinized the basis for and confirmed that the OET's scope of the testing,²⁵ the methodologies used in testing,²⁶ and the performance of the tests pursuant to those methodologies²⁷ all were appropriate. This independent "look" provided by the Peer Review panel corroborates the Commission's test process and Test Report. As such, the Test Report and the confirming independent Peer Review report firmly establish an indisputable record in this proceeding that does not support allowing portable devices to operate in the TV band.

CONCLUSION

The Commission's Test Report, as corroborated by an independent Peer Review panel, stands as informed and objective engineering confirmation that spectrum sensing is not a viable interference protection technique to protect existing users, including wireless microphone operations, from interference from new portable TV band devices. The Commission's testing is a fundamentally objective and factual analysis that must serve as the foundation for the Commission's technical rules in this proceeding.

²⁵ *Id.* at 2-3.

²⁶ *Id.* at 3-5.

²⁷ *Id.* at 6.

Respectfully submitted,

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