

**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
)	

**REPLY COMMENTS OF SHURE INCORPORATED
TO THE INITIAL EVALUATION OF THE PERFORMANCE
OF PROTOTYPE TV-BAND WHITE SPACE DEVICES**

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SUMMARY

The Commission's Test Report stands as undeniable evidence that spectrum sensing technology does not provide interference protection to wireless microphones and other incumbent operations in the TV band. Without the surefire protection from interference promised by the proponents of portable white spaces devices ("WSDs"), important wireless microphone systems operating daily across the Nation in broadcasting, news, sports, entertainment, religious and educational events and programming will be at severe risk of disruption. Moreover, the results of the Commission's testing show that portable devices present a significant and intolerable interference risk to over-the-air TV viewing and cable TV operations. Interference to these incumbent operations will ultimately harm consumers who rely on wireless microphone technology for interference-free audio and will threaten a successful DTV transition.

The technical evidence demonstrates that portable WSDs should not be authorized in the TV band at this time. The proponents of introducing *en mass* new portable devices in the TV bands have had their chance -- indeed, many chances -- to substantiate how their sensing technology will effectively protect incumbents. To date, they have been unable to make that demonstration. The Commission must be guided by the technical engineering data generated in the test process. To do otherwise would lead the Commission down a dangerous path of ignoring the now extensive and specific record of evidence demonstrating that spectrum sensing is not able to serve as the core protection against interference.

Given the exceedingly poor performance of the sensing prototypes, Shure urges the Commission to focus its attention now on developing rules that enable *fixed* white spaces devices and to bring to a close any further deliberations in this proceeding over portable WSDs. This would allow the Commission to pursue its public interest objectives by promoting rural broadband services without causing harmful interference to incumbent operations. This sensible approach will also spare the Commission and industry from further uncertainty and the unnecessary commitment of additional time and resources.

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Shure Incorporated (“Shure”), by its undersigned counsel, hereby respectfully submits these brief Reply Comments in connection with 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 Test Report contains incontrovertible data that spectrum sensing technology does not protect wireless microphone and other incumbent operations in the TV band. The technical evidence demonstrates that portable white space devices (“WSDs”) should not be authorized in the TV band at this time. Given this unavoidable conclusion, Shure urges the Commission to focus its attention on developing rules that enable *fixed* WSDs and to bring to a close any further deliberations in this proceeding over portable WSDs thus sparing the Commission and industry from further uncertainty and the unnecessary commitment of additional time and resources. This approach will avoid significant crippling interference that will harm important incumbent operations and wreak havoc with the Nation’s DTV transition, while enabling the Commission to promote new fixed rural broadband services.

¹ Technical Research Branch, Laboratory Division, Office of Engineering and Technology, Federal Communications Commission , OET Report, FCC/OET 07-TR-1006 (released July 31, 2007) (“Test Report”).

I. A Broad Cross-Section of Stakeholders Agree Testing Revealed that Spectrum Sensing Does Not Provide Effective Interference Protection in the TV Bands

Many parties commenting on the Commission's Test Report echoed Shure's view that the test data plainly demonstrates the dismal failure of the "prototype" devices to reliably sense or detect incumbent operations and that proposed portable unlicensed devices incorporating the submitted technology will cause direct interference to incumbent operations.² Further, several parties agreed that the results of the wireless microphone tests are indisputable: the proposed sensing technology does not protect wireless microphones.³ Although Shure's principal interest in this proceeding is the protection of wireless microphone operations, the Commission should take note of the consensus of a broad cross-section of interested parties that the test data clearly reflects that proposed spectrum sensing technology does not work reliably and that mobile WSDs will, in fact, interfere with incumbent operations. These parties include broadcasters,

² See Comments of MSTV and NAB, ET Docket Nos. 04-186, 02-380, filed August 15, 2007, at 1 ("MSTV/NAB Comments") ("The Commission's findings in its recent report confirm MSTV and NAB's previously filed concerns about interference from personal/portable unlicensed devices and the studies demonstrating the inadequacy of spectrum sensing to protect television viewers and other users of the spectrum."); Comments of The Community Broadcasters Association, ET Docket Nos. 04-186, 02-380, filed August 15, 2007, at 1 ("CBA Comments") ("CBA is obviously alarmed at the OET findings that prototype White Spaces devices do not reliably detect the presence of [incumbents]."); Comments of DTV Manufacturers, ET Docket Nos. 04-186, 02-380, filed August 15, 2007, at 4 ("DTV Manufacturer Comments") ("the prototype devices not only fell short of a demonstration of non-interference, they instead demonstrated that personal/portable devices reliant upon the spectrum-sensing technique *will* interfere more often than not."); Comments of Sony Electronics, ET Docket Nos. 04-186, 02-380, filed August 15, 2007, at 1 ("Sony Comments") (noting that the Commission's tests "indicate that the prototypes failed to accurately detect and avoid the frequencies that were utilized."); Comments of Sprint Nextel Corporation, ET Docket Nos. 04-186, 02-380, filed August 15, 2007, at 2 ("Sprint Comments") (noting that the report "confirms that the prototype spectrum sensing devices simply cannot ensure that television viewers, as well as other current users of the television band, will not receive interference."); Comments of the National Cable & Telecommunications Association, ET Docket Nos. 04-186, 02-380, filed August 15, 2007, at 1-2 ("NCTA Comments") (stating that the Commission's report "validate[s] the concerns expressed by the cable industry and other parties regarding the substantial risks of wide-scale interference from unlicensed devices and the inadequacy of the signal sensing detection mechanism incorporated in prototype devices.").

³ See Comments of the Microphone Interests Coalition, ET Docket Nos. 04-186, 02-380, filed August 15, 2007, at 2 ("MIC Comments") ("As the Commission's test report demonstrates, unlicensed low power devices, if permitted to operate in the band, cannot consistently sense or detect wireless microphone signals, and could also cause direct interference to incumbent wireless microphones operations."); MSTV/NAB Comments at 10 ("[T]he FCC Report documents the harm that personal/portable devices will cause to licensed microphones relied upon by major sports leagues and other providers of news and entertainment programming throughout the country."); NCTA Comments at 8 ("In other words, wireless microphones operating in conjunction with unlicensed TV band devices, as currently proposed, would be rendered useless.").

established manufacturers of digital and other TV receivers, set top boxes, and other consumer electronic equipment, Class A and Low Power Television (“LPTV”) stations (many of which serve rural viewers), and the cable TV industry, which is concerned about direct pick up interference to TV sets and VCRs directly connected to cable TV systems as well interference to cable TV head end antennas.⁴ Based on the test results, the Commission cannot rely on spectrum sensing technology as the core protection against portable WSD interference to wireless microphones and other incumbent operations. As such, there is little justification for a Commission ruling entitling unlicensed portable WSDs to operate in the TV band.

II. The Test Data Does Not Support Introduction of Personal Portable Devices in the TV Bands

No party argued that the Commission’s test methodology led to the test failures.⁵ Faced with the incontrovertible truth revealed by the Commission’s testing -- that spectrum sensing technology does not protect incumbent operations in the TV band -- the Coalition and NAF, the two principal proponents of unlicensed TV band devices, resort to two incredible claims to urge the Commission nonetheless to allow personal/portable device operations in the TV band. First, it appears that the Coalition and NAF simply ask the Commission to ignore the reality of the evaluation data and to interpret the data as confirmation that “white spaces devices can effectively detect both digital television and wireless microphone signals.”⁶ NAF inexplicably

⁴ See MSTV/NAB Comments at 3 (“The results of the Commission’s initial tests on the prototype devices submitted by both Microsoft and Philips confirm that sensing will be ineffective at preventing interference to television services.”); DTV Manufacturer Comments at 2 (“To protect digital television reception, ... the Commission should not authorize any personal/portable device that depends upon spectrum sensing.”); CBA Comments at 1; NCTA Comments at 4 (noting that the Commission’s tests show that “direct pick up interference as measured by the FCC laboratory is as great, if not greater, than the potential interference [from co-channel or adjacent channel operations].”); Sony Comments at 1 (“In addition, the tests revealed the susceptibility of ‘direct pick up’ interference of televisions tuned to a cable signal.”).

⁵ See Comments of the White Space Coalition, ET Docket Nos. 04-186, 02-380, filed August 15, 2007, at 1 (“Coalition Comments”) (“These [test] results provide a useful basis from which the Commission can begin to craft final rules...”).

⁶ Coalition Comments at 1.

states that the Test Report “clearly confirms the feasibility, based on current technologies, . . . for WSDs to detect and operate on vacant TV channels without causing harmful interference to over-the-air television viewers or wireless microphone systems.⁷” This view is not borne out by the record. In wireless microphone laboratory testing, both prototype devices performed exceedingly poorly. Prototype “A” was unable to detect wireless microphone signals and often incorrectly categorized the signals as DTV transmissions. The poor performance of Prototype “A” in moderate conditions led the Commission to conclude that testing in more challenging environments would be futile.

Prototype “B” fared somewhat better when the microphone signal was located in the center of the TV channel, but performance decreased as the microphone signal was moved closer to the edge of the TV channel.⁸ Prototype B, at best, could only generate mixed results with respect to sensing because it could not accurately and reliably detect wireless microphone signals. These results cannot reasonably be read as proof or justification for an endorsement of spectrum sensing as a viable means of interference protection in the TV bands.

Second, the Coalition claims that Prototype “A” was “damaged” and that the Commission should completely disregard the Prototype “A” data demonstrating its failure to detect incumbent operations as well as the data demonstrating that the device causes direct interference to incumbent operations. As stated in Shure’s comments, given the many assurances, opportunities to provide data, and to demonstrate the efficacy of the proponents’ technology solution, the Commission should be deeply skeptical of such efforts to repudiate the

⁷ Comments of New America Foundation *et al*, ET Docket Nos. 04-186, 02-380, filed August 15, 2007, at 2 (“NAF Comments”). Similarly, according to Philips, the Test Report proves that WSDs “detect consistently and very robustly, and therefore effectively DTV broadcast or wireless microphone signals.” Comments of Philips Electronics North America Corporation, ET Docket Nos. 04-186, 02-380, filed August 15, 2007, at 3 (“Philips Comments”).

⁸ Test Report at viii.

Test Report.⁹ Looking at Prototype “B” test results, the Coalition states that the Test Report, demonstrates “once and for all the technical feasibility of spectrum sensing.”¹⁰ This conclusion is not supported by the highly mixed results of the actual test data. Moreover, Prototype “B” included even less functionality than Prototype “A,” (Prototype “B” did not contain a transmitter and, at the manufacturer’s instructions, was not able to be subject to field tests) which further calls into question the Coalition’s sweeping positive interpretation of the Prototype “B” test results.

The Commission should reject the Coalition’s bold recommendation urging the Commission to rely merely on the Coalition’s previously submitted “technical parameters” and proceed to adopt rules for personal/portable devices.¹¹ The Coalition seems to suggest that since the technical test data did not substantiate the viability of spectrum sensing, the Commission can and should dispense with the test process and data and permit personal/portables under previously suggested “parameters.” The Coalition’s suggestion defies logic and would not serve the public interest in preventing interference to important incumbent operations. To state the obvious, the Commission’s tests were intended to evaluate the technical claims raised in this proceeding regarding spectrum sensing technologies. They are not a process that can or should be ignored simply because the technical data generated does not match the outcome desired by some participants -- no matter how strong the desire. The Commission must be guided by the technical engineering data generated in the test process. To do otherwise would lead the Commission down a dangerous path of ignoring the now extensive and specific record of evidence demonstrating that spectrum sensing is not able to serve as the core protection against

⁹ For the purpose of developing rules, the Commission should not give weight to promises of future technology advancements to improve interference detection such as Philips’ assurances that “anomalies noted can easily be rectified in refined and improved versions of the Prototype.” Philips Comments at 4

¹⁰ Coalition Comments at 2.

¹¹ *Id.* at 2.

interference. The Commission is obligated to anchor its decision on the substantial record developed in this proceeding including its own test data. It is well-established that the Commission's decisions must be rational and may not run counter to the evidence before it.¹² The record in this proceeding clearly dictates that portable TV band devices which rely on spectrum sensing to protect existing services from interference should not be allowed to operate in the TV band.

III. The Coalition Wrongly Concludes That Unlicensed Operations On Adjacent Channels Will Not Create Harmful Interference

The Coalition also erroneously interprets the data in the Test Report's Over-the-Air ("OTA") test results to show that WSD operations on adjacent channels will not create significant interference. In particular, the Coalition wrongly concludes that the OTA test data supports a finding that WSD adjacent channel operations pose an interference risk extending for a "maximum of only two meters when the white space device transmission conformed to the Coalition's proposed mask."¹³ While Shure agrees that the OTA test data proves that adjacent channel operations will create harmful interference, a thorough analysis of the data demonstrates that such interference will have a far greater range than the Coalition admits. In the OTA tests, adjacent channel interference only extended for two meters because the DTV test signal was strong (20.5 dB above the threshold of visibility for the typical DTV receiver), and easily overcame the comparatively faint output power level of the Coalition prototype, which was restricted to roughly 6.6 mW due to the various external filters and attenuators required to make

¹² Under the "arbitrary and capricious" standard of review, the Commission's Rules will be set aside by a reviewing court where it finds that the agency has "failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise." *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43, 103 S.Ct. 2856, 77 L.Ed.2d 443 (1983) ("*State Farm*") (citing *SEC v. Chenery Corp.*, 332 U.S. 194, 196, 67 S.Ct. 1575, 91 L.Ed. 1995 (1947)); see also *Robert Wood Johnson Univ. Hosp. v. Thompson*, 297 F.3d 273, 280 (3d Cir.2002).

¹³ Coalition Comments at 5.

the prototype comply with the Coalition's own transmission mask.¹⁴ Were the DTV signal less robust, and the prototype's power level increased to the Coalition's recommended maximum output for personal/portable devices, Shure calculates that adjacent channel interference would likely be observed for in excess of 77 meters.¹⁵

Contrary to the Coalition's view, the OTA tests prove what Shure, the IEEE 802.22, NAB/MSTV and the DTV Manufacturers have already correctly asserted -- unlicensed operations within adjacent channels will create harmful interference that cannot be mitigated.¹⁶ In the OTA tests a prototype WSD in a controlled environment disrupted a nearby incumbent receiving a robust DTV signal despite having its output power restricted to roughly 6.6% of the proposed wattage limit for personal/portable devices while equipped with sophisticated external filters and pads intended to minimize spurious emissions. If a hand-built prototype enabled with sophisticated external hardware that shapes its RF emissions causes interference when operating within adjacent channels, it is difficult to conceive the interference threat mass produced devices will create when operating at full power. Now that the laboratory has confirmed Shure's assertion, we urge the Commission to uphold its commitment to the incumbents in the TV band and prohibit unlicensed operations within adjacent channels.

IV. Additional Technical Requirements and Parameters Are Required

Even if the Commission's testing had shown that the portable prototypes effectively sensed incumbent operations, which they did not, protection against interference can only be achieved if the Commission adopts additional technical requirements and parameters. While

¹⁴ See Test Report at 49-55.

¹⁵ Assumes a DTV signal strength of -83.5 dBm and unlicensed device output power of 100 mW.

¹⁶ See Comments of IEEE 802.18, ET Docket Nos. 04-186, 02-380, filed January 31, 2007, at 8 ("IEEE Comments") (noting that "co-channel operation within the noise limited protected contour of a DTV station is not feasible."); DTV Manufacturer Comments at 6 (stating that "the report shows that operation on the first lower and upper adjacent channels would cause interference at distances of 47 and 52 meters, respectively."); Comments of MSTV and NAB, ET Docket Nos. 04-186, 02-380, filed April 30, 2007, at 3-4 (urging that "all TV band devices must operate outside the protected contour of both co- and adjacent TV channels.").

Shure has previously outlined these requirements in its prior filings, Shure addresses below specific issues raised in the Comments to the Test Report.

(A) Some parties suggest that interference can be prevented by implementing a geolocation/database approach. Although the Commission may find that a geolocation/database requirement is necessary to protect certain incumbents, it does little to protect wireless microphones and should only be one part of a combination of interference protection requirements. Geolocation generally does not work indoors where many wireless microphone operations are used. Geolocation thus will not offer any meaningful protection to wireless microphones used in live TV studios, indoor concerts, theaters, and sports stadiums, for example. In addition, while this approach may be effective to avoid interference with stationary incumbent services, such as broadcast TV, it is not an effective interference protection solution for wireless microphones, which are highly mobile. The wireless microphone user's high degree of mobility makes it impractical to maintain continuous Internet access to the database and to continually update the database, both of which are necessary for a geolocation interference "solution" to be effective;

(B) Network sensing remains an important requirement that the proponents of WSDs have not yet fully addressed. 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) to compensate for the effects of multipath and “hidden node” problems;¹⁷

(C) In order for spectrum sensing to consistently detect signals of incumbent wireless microphone operations, the maximum output power must be reduced to a level comparable with the operations to be protected. In this case, most wireless microphones operate at 10-20 mW and therefore the Commission should adopt a 10 mW maximum WSD power limit. NCTA also supports a similar reduced power limit in order to protect against direct pick up interference.¹⁸

V. The Commission Should Close The Deliberations Regarding Personal/Portable Devices and Turn its Attention to Developing Rules for Fixed Applications

Commission testing over four months time and endorsed by an independent peer review panel revealed that spectrum sensing is not a technology sufficiently ripe to provide reliable interference protection against portable WSDs. In the face of this important technical data generated by the Commission’s own laboratory, the Commission should not at this time continue to entertain further deliberations in this proceeding regarding portable WSD proposals. Shure stands ready to participate constructively in the regulatory and technical process regarding the use of the TV band and in particular the protection of wireless microphone operations. As a part of that commitment, Shure is willing to work with the Commission and other interested parties in the future to develop rules and test procedures that will protect wireless microphone users from interference. However, given the extraordinary dedication of administrative and industry resources to the examination of proposed spectrum sensing technologies and the exceedingly

¹⁷ MSTV conducted field tests throughout the metropolitan Washington D.C. suburbs to evaluate the strength of operational DTV channels. On multiple occasions viewable DTV channels within a residence had less than -116 dBm signal strength. Without a network sensing feature, an isolated unlicensed device with a -116 dBm sensitivity threshold would not recognize these channels as occupied. *See* MSTV/NAB Comments, Attachment at 12-29.

¹⁸ *See* NCTA Comments at 2.

poor test results, it is time for the Commission to turn its attention away from personal/portables and focus on the fixed application that it has endorsed in the First Report and Order in this proceeding.¹⁹ The incumbent TV band operations in jeopardy of serious interference from new portable devices have labored under significant uncertainty for too long. Product developments and investments have been hampered by the continued threat of regulatory “eminent domain proceedings.”

The proponents of introducing *en mass* new portable devices in the TV bands have had their chance -- indeed, many chances -- to substantiate how their sensing technology will effectively protect incumbents. To date, they have been unable to make that demonstration. In the interest of avoiding waste of valuable administrative and industry resources, the Commission should bring to a close this chapter of its rulemaking proceedings regarding personal/portable devices.

VI. The IEEE Recommendation for Fixed Applications Must Be Codified in the Rules

Shure supports the IEEE 802.22 recommendation for fixed WSD applications previously outlined in comments in this proceeding.²⁰ It is imperative that the Commission’s Rules governing fixed devices include mandatory operational and technical protection requirements for incumbent services. Unless such requirements are codified into the Commission’s Rules, there will be little incentive for manufacturers to incorporate these protections with the undesired

¹⁹ *Unlicensed Operation in the TV Broadcast Bands*, First Report and Order and Further Notice of Proposed Rulemaking, ET Docket Nos. 04-186, 02-380, FCC 05-156, at ¶ 2 (released Oct. 18, 2006) (“Order”).

²⁰ IEEE has recommended a combination of interference avoidance techniques to protect incumbent devices in the TV bands. Specifically, the IEEE has recommended that the FCC (a) prevent unlicensed operations on adjacent TV channels, (b) require distributed sensing (*i.e.*, all devices within a given radius must sense and share the results of their spectrum scans), (c) require a “master” base station to manage channel usage, power and modulation characteristics of customer premise transmitters, (d) require the aforementioned base station to access a geolocation database to identify and avoid transmitting over known incumbents, and (e) restrict unlicensed operations to fixed devices pending future advances in technology that might facilitate other applications without threatening incumbent services. IEEE Comments at 6, 7, 16-19.

result being that consumers, the industry, and ultimately the Commission will likely have to deal with potentially serious and widespread interference problems on an *ad hoc* basis.

CONCLUSION

The Commission's overall goal in this proceeding is to allow new devices "to operate on unused television channels where such operations will not result in harmful interference to TV and other authorized services."²¹ The results of the Commission's own tests demonstrate that unlicensed *portable* devices present an enormous interference risk to wireless microphones and other incumbents in the TV band. 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. In light of these technical findings, the Commission should limit its action in this proceeding to "fixed" unlicensed devices for rural broadband services.

²¹ Order at ¶ 1.

Respectfully submitted,

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