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
	)	
	)	ET Docket No. 02-380
Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band	)	

SECOND MEMORANDUM OPINION AND ORDER

Adopted: September 23, 2010 **Released: September 23, 2010**

By the Commission: Chairman Genachowski; Commissioners Copps, McDowell, Clyburn and Baker issuing separate statements.

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I. INTRODUCTION

1. By this action, we are finalizing rules to make the unused spectrum in the TV bands available for unlicensed broadband wireless devices. This particular spectrum has excellent propagation characteristics that allow signals to reach farther and penetrate walls and other structures. Access to this spectrum could enable more powerful public Internet connections - - super Wi-Fi hot spots - - with extended range, fewer dead spots, and improved individual speeds as a result of reduced congestion on existing networks. Many other applications are possible, such as broadband access to schools particularly in rural areas, campus networks that are better able to keep pace with user's increasing demands for bandwidth, home networks that are better able to support real time streaming video applications, remote sensing of water supplies by municipalities and support for the smart grid. The potential uses of this spectrum are limited only by the imagination. Although the particular unused TV channels vary from location to location, the devices will have the flexibility and agility to locate and operate on the unused channels, no matter where the devices are located. The devices will use geo-location technology to determine their location and a database look-up that identifies the unused channels that are available at their location. This type of "opportunistic use" of spectrum has great potential for enabling access to other spectrum bands and improving spectrum efficiency. Our actions here are expected to spur investment and innovation in applications and devices that will be used not only in the TV band but eventually in other frequency bands as well.

2. Specifically, we are resolving on reconsideration certain legal and technical issues in order to provide certainty concerning the rules for operation of unlicensed transmitting devices in the television broadcast frequency bands (unlicensed TV bands devices, or "TVBDs"). Resolution of these issues will allow manufacturers to begin marketing unlicensed communications devices and systems that operate on frequencies in the TV bands in areas where they are not used by licensed services ("TV white spaces"). The opening of these bands for unlicensed use, which represents the first significant increase in unlicensed spectrum below 5 GHz in over 20 years, will have significant benefits for both businesses and consumers and will promote more efficient spectrum use.

3. We are responding to seventeen petitions for reconsideration that were filed in response to the *Second Report and Order and Memorandum Opinion and Order* ("*Second*

Report and Order") in this proceeding.[1] These petitions collectively request numerous changes in the rules for TV bands devices. We are upholding the majority of the Commission's prior decisions on the issues raised therein. In this regard, we continue to believe that the approach the Commission followed in the *Second Report and Order* is desirable and appropriate for this first step in allowing unlicensed operations in the TV bands. We do, however, find merit in a number of the requests for changes to the rules for TVBDs and are granting those requests by modifying and clarifying the rules in four areas. Specifically, we are taking the following actions:

- Protection Criteria for Incumbent Services
  - Modifying the protection criteria for low power auxiliary stations such as wireless microphones to reduce the required separation between such devices and unlicensed personal/portable devices operating in Mode II.
  - Modifying the definition of the receive sites entitled to protection outside of a television station's service area to include all multi-channel video programming distributors as defined by our rules.
  - Reserving two vacant UHF channels for wireless microphones and other low power auxiliary service devices in all areas of the country.
  - Allowing operators of event and production/show venues that use large numbers of wireless microphones on an unlicensed basis that cannot be accommodated in the two reserved channels and any others available at that location to register the sites of those venues on TV bands databases to receive the same geographic spacing protections afforded licensed wireless microphones.
  - Restricting fixed TV bands devices from operating on locations where the ground level is more than 76 meters above the average terrain level in the area.

- TV Bands Devices
  - Eliminating the requirement that TV bands devices that incorporate geo-location and database access must also listen (sense) to detect the signals of TV stations and low power auxiliary service stations (wireless microphones). As part of that change we are also revising and amending the rules in several aspects to reflect use of that method as the only means for determining channel availability. While we are eliminating the sensing requirement for TVBDs, we are encouraging continued development of this capability because we believe it holds promise to further improvements in spectrum efficiency in the TV spectrum in the future and will be a vital tool for providing opportunistic access to other spectrum bands..
  - Adopting power spectral density limits for unlicensed TV bands devices.
  - Modifying the rules governing measurement of adjacent channel emissions.
  - Restricting fixed TV bands devices from operating at locations where the height above average terrain of the ground level is greater than 76 meters.

- TV Bands Database
  - Requiring that communications between TV bands devices and TV bands databases, and between multiple databases, are secure.

[1] We are addressing seventeen petitions for reconsideration that were filed in response to the *Second Report and Order and* Memorandum *Opinion and Order* ("*Second Report and Order*") in this proceeding. *See Second Report and Order and Memorandum Opinion and Order* in ET Docket Nos. 02-380 and 04-186, 23 FCC Rcd 16807 (2008).

- Requiring that all information that is required by the Commission's rules to be in the TV bands databases be publicly available.

- Use of TV Channels
  - Amending the rules to protect Canadian and Mexican stations in the border areas by including those stations in the TV bands database as protected services.
  - Changing the protection zone for the radio astronomy facility near Socorro, New Mexico to a rectangular area.
  - Declining to grant a request by FiberTower to set aside TV channels for fixed licensed backhaul use.

4. We are also making other minor changes and refinements to our rules for TV bands devices which are discussed below. With these changes and clarifications, our rules will better ensure that licensed services are protected from interference while retaining flexibility for unlicensed devices to share the TV bands with them.

II. BACKGROUND

5. The Commission provides for the operation of unlicensed radio transmitters in Part 15 of its rules.[2] Under these rules, unlicensed devices are allowed to operate on frequencies shared with authorized services at relatively low power, *i.e.*, at output power levels of 1 watt (W) or less. Operation under Part 15 is subject to the condition that a device does not cause harmful interference to authorized services, and that it must accept any interference received.[3] The rules adopted in the *Second Report and Order* permit unlicensed devices to operate on TV channels that are not in use in their vicinity, subject to specific technical requirements that are intended to prevent interference to TV broadcasting and other authorized users of the TV bands.

6. The broadcast television service operates under Part 73 of the Commission's rules. Full service TV stations operate on six-megahertz channels designated 2 to 51 in four bands of frequencies in the VHF and UHF regions of the radio spectrum (54-72 MHz, 76-88 MHz, 174-216 MHz and 470-698 MHz).[4] To avoid interference between TV stations, stations on the same and adjacent channels must comply with a number of technical provisions that effectively require that significant distances be maintained between co-channel and adjacent channel stations.[5] The service range of a TV station is shorter than its interference range, so there are areas between stations that are outside of TV station service areas where channels are unused. In addition, television stations operate with relatively high antennas and high power so that their signals can propagate to, and serve viewers at, significant distances. Such propagation distances also extend the range at which TV signals can cause interference and increase the area between them where channels are not used. There are typically a number of TV channels in a given area that are not being used by full service digital TV stations in order to avoid interference to co-channel or adjacent channel stations. A transmitter operating at a low antenna height and a low power level, *e.g.*, an unlicensed device, will have a much shorter service and

[2] *See* 47 C.F.R. Part 15.

[3] *See* 47 C.F.R. § 15.5.

[4] *See* 47 C.F.R. § 73.603(a).

[5] *See* 47 C.F.R. §§ 73.616, .622, .623, and .699.

interference range and can operate in these areas between TV station service areas without causing interference to TV services. There are also some areas where channels that could be used by a full service television station that are not being used for economic or other reasons. These channels can also be used by unlicensed devices without causing interference.

7. In addition to full service TV stations operating under Part 73 of the rules, certain other licensed services are permitted to operate on TV channels. Class A television stations operate under Subpart J of Part 73 of the rules.[6] Low power TV, TV translator and TV booster stations are permitted to operate under Part 74 of the rules on a secondary basis to full service TV stations and on an equal basis with Class A TV stations, provided they meet technical rules to prevent interference to reception of full service and Class A stations.[7] Class A and low power TV stations are permitted to broadcast in either analog or digital, and are permitted to operate on channels 2-51 and also on channels 52-69 (698-806 MHz), provided they will not cause interference to other licensed services on those channels. Part 74 also permits certain broadcast auxiliary operations on TV channels 14-69 on a secondary basis.[8] In addition, Part 74 permits certain entities to operate wireless microphones and other low power auxiliary station transmitters on vacant TV channels on a non-interference basis.[9]

8. Further, in 13 metropolitan areas, one to three channels in the range of channels 14-20 are used by licensees in the Private Land Mobile Radio Service (PLMRS) under Part 90 of the rules and the Commercial Mobile Radio Service (CMRS) under Part 22 of the rules.[10] In addition, medical telemetry equipment is permitted to operate on an unlicensed basis on any vacant TV channel in the range of channels 7-46, and unlicensed remote control devices are allowed to operate on any TV channel above 70 MHz (*i.e.*, above channel 4), except for channel 37.[11] TV channel 37 (608-614 MHz) is allocated for radio astronomy and the wireless medical telemetry service (WMTS) and is not used for TV broadcasting. The Offshore Radiotelephone

[6] *See* 47 C.F.R. Part 73 Subpart J. Class A TV stations operate at the power levels permitted for low power television stations under Part 74 of the rules, but have certain protection rights with respect to full service analog and digital TV stations that are not available to TV translator and low power stations.

[7] *See* 47 C.F.R. Part 74 Subpart G.

[8] *See* 47 C.F.R. § 74.602(h). This rule section permits TV studio-transmitter links, TV relay stations, and TV translator relay stations to be authorized to operate fixed point-to-point service on UHF TV channels 14-69 on a secondary basis, subject to the provisions in Part 74, subpart G.

[9] *See* 47 C.F.R. § 74.861.

[10] *See* 47 C.F.R. Part 90 Subpart L and 47 C.F.R. Part 22 Subpart E.

[11] *See* 47 C.F.R. §§ 15.231, 15.241 and 15.242. Effective October 16, 2002, the Commission ceased granting certifications for new medical telemetry equipment that operates on TV channels, but there is no cutoff on the sale or use of equipment that was certified before that date, *see* 47 C.F.R. § 15.37(i). To provide spectrum for wireless medical telemetry equipment, the Commission established the Wireless Medical Telemetry Service to operate on a primary basis in 13.5 megahertz of spectrum in three spectrum blocks at 608-614 MHz (TV channel 37, which the WMTS now shares with radio astronomy), 1395-1400 MHz, and 1427-1429.5 MHz. *See* Amendment of Parts 2 and 95 of the Commission's Rules to Create A Wireless Medical Telemetry Service, *Report and Order,* ET Docket No. 99-255, 15 FCC Rcd 11206 (2000). *See also,* Amendments to Parts 1, 2, 27, and 90 of the Commission's Rules to License Services in the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz, 1429-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands, WT Docket No. 02-8, *Memorandum Opinion and Order*, 18 FCC Rcd 16920 (2003).

Service uses channels 15-17 in certain regions along the Gulf of Mexico.[12] In Hawaii, channel 17 is reserved for inter-island communications but, no active licensees currently use this channel in Hawaii.[13] Unlicensed TV bands devices also need to protect these licensed uses.

9. On November 4, 2008, the Commission adopted a *Second Report and Order* in this proceeding in which it allowed unlicensed operation in the TV bands at locations where frequencies are not in use by licensed services. The Commission permitted both fixed and personal/portable unlicensed devices to operate in the TV bands. Fixed devices may operate at up to 4 Watts EIRP (effective isotropic radiated power). The Commission permitted fixed devices to operate on any channel between 2 and 51, except channels 3, 4 and 37, and subject to a number of other conditions such as a restriction against operation on the same channel (co-channel) as a TV station or on the first channel adjacent (adjacent channel) to such a station pending consideration of further information that may be submitted into the record in this proceeding. Personal/portable devices may operate either as Mode I devices (operates only on channels identified by either a fixed or Mode II personal/portable device) or as Mode II devices (relies on geo-location and database access to determine available channels at its location). Personal portable devices may operate on any unoccupied channel between 21 and 51, except channel 37, and may use up to 100 milliwatts EIRP, except that operation on the first adjacent channels to TV stations are limited to 40 milliwatts EIRP. All devices (fixed and personal/portable) must include adaptive power control so that they use the minimum power necessary to accomplish communications. Because channels in the range 2 and 5-20 will be restricted to fixed devices, many of these channels will remain available for wireless microphones that operate on an itinerant basis. In addition, in 13 major markets where certain channels between 14 and 20 are used for land mobile operations, two channels between 21 and 51 are being kept free of unlicensed devices and thus available for wireless microphones.

10. The Commission required that fixed and personal/portable devices must also have a capability to sense TV broadcast and low power auxiliary service station signals, *i.e.*, wireless microphones, as a means to minimize potential interference. The Commission also established additional requirements to further mitigate the potential for interference and to help remedy any interference that might occur. To prevent interference to authorized services in the TV bands, all unlicensed devices, except personal/portable devices operating in Mode I, must include a geo-location capability and provisions to access through the Internet a database containing information on protected radio services (*e.g.*, location and operating channels) and be capable of providing the channels that may be used by an unlicensed device at its location. All fixed devices must register their locations in the database and must transmit identifying information to make it easier to identify them if they are found to interfere. Furthermore, fixed and personal/portable devices operating independently must provide identifying information to the TV bands database. The unlicensed devices must first access the database to obtain a list of the permitted channels before operating and re-check the database at least once daily. This database will be established and administered by a third party, or parties, to be selected through a public notice process to solicit interested entities. The Commission released a Public Notice on

[12] See 47 C.F.R. § 2.106 NG66(b) and 47 C.F.R. § 22.1007.

[13] *See* 47 C.F.R. § 22.591.

November 25, 2009 inviting proposals from entities wishing to be designated as a TV bands device database manager.[14] Nine parties filed proposals in response to this notice.

11. In the *Second Report and Order*, the Commission also required all TV bands devices to be certified by the FCC Laboratory. The Laboratory will request samples of the devices for testing to ensure that they meet all the applicable requirements. The Commission also made provisions for the certification of devices that do not include the geo-location and database access capabilities, and instead rely on spectrum sensing to avoid causing harmful interference, subject to a much more rigorous set of tests by our Laboratory in a process that will be open to the public. These tests will include both laboratory and field tests to fully ensure that such devices meet a "Proof of Performance" standard so that they will not cause harmful interference. Under this procedure the Commission will issue a Public Notice seeking comment on the application, as well as test procedures and methodologies. The Commission will also issue a Public Notice seeking comment on its recommendations. The decision to grant such an application will then be made at the Commission level.

12. Seventeen parties filed petitions for reconsideration of requirements adopted in the *Second Report* and *Order*. Twenty parties filed oppositions to one or more of these petitions, and eleven parties filed replies to oppositions. A list of parties filing petitions is in Appendix A. Equipment authorization for the marketing of unlicensed TV bands devices has been held in abeyance pending the Commission's action on the petitions for reconsideration and its selection of one or more database managers.

13. On January 14, 2010, the Commission adopted a *Report and Order and Further Notice of Proposed Rule Making* (*Wireless Microphone R&O/FNPRM*) addressing the rules for wireless microphones and other low power auxiliary devices that operate in the TV bands.[15] In that action, the Commission prohibited the manufacture, import, sale, lease, offer for sale or lease, or shipment of wireless microphones and other low power auxiliary stations intended for use in the 700 MHz Band (TV channels 52-69) in the United States. The Commission also required that all low power auxiliary stations, including wireless microphones,[16] cease operations in the 700 MHz Band no later than June 12, 2010. In recognition of the fact that wireless microphones are used for important functions, but that many were being operated by parties ineligible for the required Part 74 license, the Commission waived the Part 15 rules for a limited period to permit unauthorized users of wireless microphones and other low power auxiliary stations to operate on an unlicensed basis under Part 15 pursuant to certain specified technical

[14] *See* "Office of Engineering and Technology Invites Proposals from Entities Seeking to be Designated TV Band Device Database Managers," Public Notice, DA 09-2497, ET Docket No. 04-186, rel. Nov. 25, 2009.

[15] *See Report and Order and Further Notice of Proposed Rule Making* in WT Docket Nos. 08-166 and 08-167 and ET Docket No. 10-24, 25 FCC Rcd 643 (2010).

[16] Low power auxiliary stations are intended to transmit over distances of approximately 100 meters for uses such as wireless microphones, cue and control communications, and synchronization of TV camera signals. 47 C.F.R. § 74.801. As a general matter, in this item the term "low power auxiliary station" is intended to include devices authorized under Part 74, Subpart H of our rules as well as devices operated on an unlicensed basis pursuant to the waiver in the Wireless Microphone R&O/FNPRM. *See Wireless Microphone R&O/FNPRM*, 25 FCC Rcd at 682-87 ¶¶ 81-90."

requirements -- in the 700 MHz Band until June 12, 2010, and in the core "TV bands" until the effective date of the Commission's actions in response to the Further Notice.[17]

14. A number of TV bands device applications are already operating on an experimental basis. The city of Wilmington North Carolina is trialing "Smart City" applications, including public "hot spots," low-cost broadband to a low-income housing development, and water level and water purity sensors for compliance with Environmental Protection Agency requirements and flood controls. In addition, a demonstration project in Claudville Virginia is bringing broadband access to a rural elementary school, as well as to consumers in their homes, and newly established public hot spots in the community. Plumas County California has undertaken a "Smart Grid" trial for electricity networks, which allows the electric cooperative to manage the electrical system, obtain data from substations, and manage power flow. The network in that trial also enables free energy monitoring tools that allow consumers to save energy and money, for example, by identifying appliances that are always on and using energy.

III. DISCUSSION

15. In this Second Memorandum Opinion and Order, we address on reconsideration a wide variety of issues relating to unlicensed use of the TV bands. These issues include protection criteria for incumbent authorized services, technical rules for TV bands devices, TV bands database requirements, the channels that can used by TV bands devices, and several miscellaneous issues. We are generally upholding the decisions the Commission made in the *Second Report and Order* with some specific revisions and clarifications. As indicated above, in this regard the actions we take here are consistent with and continue the approach towards authorization of unlicensed devices in the TV bands we enunciated in the *Second Report and Order* – our actions in this proceeding are to be a conservative first step that includes many safeguards to prevent harmful interference to incumbent communications services.[18] We do, however, agree with petitioners with regard to a number of the requested changes to the rules and are modifying and clarifying our rules as appropriate in granting those requests. We believe these changes and clarifications will provide for improved protection of licensed services in the TV bands, resolve certain uncertainties in the rules and provide manufacturers with greater flexibility in designing products to meet market demands. Our decisions denying and granting the various requests for changes to our rules for TV bands devices are discussed below.

16. With the issuance of this decision and the forthcoming decision by our Office of Engineering and Technology on selection of one or more database managers, manufacturers will be able to begin to make unlicensed TV bands devices and systems available to consumers, business and government users for general use.[19] We intend to closely oversee the introduction of these devices to the market and will take whatever actions may be necessary to avoid, and if necessary correct, any harmful interference that may occur. Further, we will consider in the future any changes to the rules that may be appropriate to provide greater flexibility for development of this technology and protect against harmful interference to incumbent communications services.

[17] The "core TV bands" consist of TV channels 2-51, excluding channel 37.

[18] *Second Report and Order*, 23 FCC Rcd 16808 (2008), ¶ 1.

[19] *Id*. at 16817, ¶10.

A. Protection Criteria for Incumbent Services

1. TV Stations

17. In the *Second Report and Order*, the Commission adopted technical criteria for determining when a TV channel is considered vacant for the purpose of allowing operation of an unlicensed device on that channel. It protected full service TV stations and Class A TV, low power TV, TV translator and TV booster stations from interference within defined signal contours.[20] The signal level defining a television station's protected contour varies depending on the type of station, *e.g.*, analog or digital TV, and the band in which a TV station operates, *e.g.*, VHF or UHF. The protected contours for analog TV stations are calculated in accordance with the F(50,50) curves specified in the Commission's rules, and the protected contours for digital TV stations are calculated in accordance with the F(50,90) curves. While Part 74 of the rules protects low power stations to a higher signal strength contour, and therefore to a shorter distance, than full service TV stations, the Commission decided to require TV bands devices to protect low power stations to the same contour as full service TV stations.[21]

18. To prevent interference to TV reception within these protected contours, the Commission required TV bands devices to comply with the same desired-to-undesired (D/U) signal ratios as digital TV stations.[22] Fixed TV bands devices and Mode II personal/portable TV bands devices operating with power levels greater than 40 milliwatts must operate outside the protected contours of both co-channel and adjacent channel TV stations at a sufficient separation distance to ensure that the D/U ratios are met within those TV stations' protected contours. Personal/portable devices operating with power levels of 40 milliwatts or less are permitted to operate within the protected contours of adjacent channel TV stations due to the lower risk of causing harmful interference at that power level.[23] The Commission adopted a table of minimum distance separations from the contours of co-channel and adjacent channel TV stations that fixed and Mode II personal/portable must meet.[24] The Commission determined these separation distances based on the power and antenna height of the TV bands device, the TV station protected contour, and the D/U ratio required to prevent interference. When a fixed or a Mode II personal/portable TV bands device contacts a TV bands device database and provides its geographic coordinates, the database will calculate which TV channels are vacant based upon the above criteria and provide a list of those vacant channels to the TV bands device.[25] The Commission also required that all TV bands devices include the ability to listen to the airwaves to sense analog and digital television stations as an additional measure of protection.[26]

19. *Petitions and Replies*. Adaptrum argues that the Commission should permit the use of more accurate TV propagation models than the FCC curves, and that if TV bands devices have both sensing and geo-location capabilities, the database administrator should be permitted

[20] *Id*. at 16865, ¶165.

[21] *Id*.

[22] *Id*. at 16866, ¶167.

[23] *Id*. at 16868, ¶176.

[24] *Id*. at 16871, ¶181.

[25] *Id*. at 16841, ¶85

[26] *Id*. at 16844, ¶95.

to use this information to improve the coverage predictions.[27] It states that the criteria described in the rules is a 1966 state of the art calculation appropriate for manual calculations and it is not clear whether terrain can be considered in predicting TV station coverage.[28] NCTA states that it does not oppose redefining the protected contours of TV stations to take local terrain features into account more precisely, but these measures are not yet ready to be deemed reliable.[29]

20. PISC argues that low power TV stations should not be protected to the same service contours as full power stations because this would preclude the use of valuable spectrum for expanding broadband access for the benefit of a very small minority of over-the-air viewers capable of receiving low power signals outside their limited service contours.[30] SBE and Community Broadcasters Association argue that the Commission failed to protect low power TV and TV translator operations because its analysis focused exclusively on digital operations while many low power TV stations will continue to operate in analog.[31] Community Broadcasters Association argues that the Commission should reduce the maximum power level of TV bands devices by 9 dB on upper adjacent channels, 14 dB on lower adjacent channels, and make any other appropriate adjustments to take into account the characteristics of analog TV receivers.[32] Rudman/Ericksen argue that use of the horizontal plane transmit antenna pattern in the Commission's database for calculating TV station protected contours will give incorrect results for stations employing antennas with mechanical beam tilt.[33] Cohen, Dippell and Everist state that the Commission should consider the interference problem that can result when a consumer uses a TV bands device in close proximity to an indoor TV antenna with amplification.[34]

21. *Decision*. We affirm our decisions regarding the protection contours for TV stations. First, we decline to change the method that must be used to calculate TV station protected contours. No party has described an alternative model that will provide more accurate calculations of TV station contours than the Commission's current method. The current method of calculating TV station contours in Section 73.684 of the rules using the FCC curves in Section 73.699 of the rules is straight forward, well understood and has proven sufficiently accurate over time. Given the lack of compelling information to the contrary, we believe that calculations of channel availability relying on that methodology will provide satisfactory protection of TV services. Further, with respect to Adaptrum's request that TV signal information be incorporated into the TV bands databases, as discussed below, we are removing the requirement that TV

[27] *See* Adaptrum petition at 7.

[28] *See* Adaptrum petition at 6. Motorola agrees with Adaptrum that other radio propagation software should be used in place of the R-6602 curves when calculating interference protection inside adjacent channel contours. *See* Motorola opposition at 13.

[29] *See* NCTA opposition at 13.

[30] *See* PISC petition at 24. PISC suggests that low power stations receive expanded protection in the database by demonstrating the number of viewers outside the protected contours that would be harmed by interference from TV bands devices. *Id.* at 25. Community Broadcasters questions whether low power TV stations would have the resources to prove where their viewers reside. *See* Community Broadcasters opposition at 2.

[31] *See* SBE petition at 11-12; Community Broadcasters petition at 2.

[32] *See* Community Broadcasters petition at 3.

[33] *See* Rudman/Ericksen petition at 11.

[34] *See* Cohen, Dippell and Everist petition at 4.

bands devices that include a geo-location capability and access to a database must sense television and low power auxiliary stations. Thus, sensing information on the location of TV signals would not be available to incorporate into the database. We agree with Rudman/Ericksen that the TV bands device database should include information on transmit antenna beam tilt to permit TV contour calculations to be made consistent with Part 73 of the rules and are modifying Section 15.713(h) the rules accordingly.[35]

22. We also affirm our decision to protect low power television stations to the same signal contour as full service TV stations. Low power stations may provide the only over-the-air broadcast services in rural areas, and we disagree that viewers of those stations should receive less protection than viewers of full service stations. Further, low power stations by their nature cover only a relatively small area, so a modest increase in the protected area beyond the defined Part 74 contour for these stations will not significantly impact the deployment of TV bands devices.

23. We disagree with SBE and Community Broadcasters that the rules fail to protect analog TV stations. While the D/U protection ratios for analog TV stations are higher than for digital stations, the protected service contours for analog stations are also higher than for digital stations. The net result is that the level of an undesired signal from a TVBD that will cause interference to an analog station is higher than the level that will cause interference to a digital station. Thus, the Commission's standards for protection of digital TV stations from interference caused by TVBDs when applied for protection of analog TV stations provide somewhat greater protection of analog TV stations than would standards produced from a similar analysis that specifically considered protection of analog TV stations. We also find that an analysis focusing on digital operation is appropriate for low power television stations because these stations will eventually convert to digital operation.

24. We decline to adopt any new requirements related to the use of TV bands devices in close proximity to amplified indoor antennas. A TV bands device and a TV receiver in close proximity would be under the control of the same party who could take steps to eliminate interference. The Commission previously adopted a requirement in the *Second Report and Order* requiring manufacturers to provide information to consumers on possible methods to resolve interference to television in the event it occurs, so we find no need to adopt any additional requirements.[36]

2. Wireless Microphones and other Low Power Auxiliary Stations

25. In the *Second Report and Order*, the Commission decided that the locations where licensed Part 74 low power auxiliary stations, including wireless microphones, are used can be registered in the TV bands device database and will be protected from interference from

[35] The Commission's TV station database specifies the amount of electrical and mechanical beam tilt in degrees, as well as the orientation of any mechanical beam tilt. The Commission's database does not contain vertical pattern information for stations employing beam tilt, so the Commission uses the assumed vertical transmit antenna patterns in Table 8 of OET Bulletin 69 in calculating TV station contours.

[36] *See* 47 C.F.R. § 15.706.

TV bands devices.[37] TV bands devices may not operate co-channel to a registered low power auxiliary station within a distance of 1 kilometer of the registered coordinates.[38]

26. *Petitions and Replies*. Adaptrum and Dell/Microsoft believe that only licensed wireless microphones should be entitled to interference protection.[39] Dell/Microsoft argue that parties that do not have a Part 74 license should not be permitted to register wireless microphones in the database, because allowing them to register could block white space access in many metropolitan areas.[40] Carlson Wireless suggests that unlicensed wireless microphones be required to access the spectrum on the same terms as white space devices and be allowed to register in the database.[41] Shure, Sennheiser and CWMU argue that all wireless microphone users should be able to register in the database and be afforded interference protection from TV bands devices.[42] However, Motorola, the Wi-Fi Alliance and PISC oppose this request.[43] In statements representative of the positions of these parties, the Wi-Fi Alliance argues that affording protection for all wireless microphones, including those operating without a license, undermines the Commission's attempts to establish a controlled environment for the white spaces.[44] It believes that non-licensed wireless microphones that do not operate under the appropriate operational restrictions in the TV bands device rules pose a serious interference threat to TV bands devices and that all unlicensed wireless microphone usage should fall under the same rules as TV bands devices.[45] CWMU requests that the Commission expand eligibility for wireless microphone licenses.[46] Carlson Wireless, Motorola and WISPA ask that two channels in each market be designated for non-exclusive use by wireless microphones that are not currently licensed.[47] Rudman/Ericksen argue that it is not necessary to reserve the first vacant channel above and below channel 37 for wireless microphones because the Commission can simply protect a point/radius for each wireless microphone in the ULS database.[48]

27. Several parties argue that wireless microphones should be protected at a distance greater than one kilometer. CWMU believes that if a table specifying protection distances for wireless microphones as a function of power and antenna height can not be added to Section 15.712(f)(1), then the protection distances specified in this section should be increased to 2 km

[37] *See Second Report and* Order, 23 FCC Rcd 16876 (2008) at ¶198.

[38] *Id*. at 16876, ¶199.

[39] *See* Adapatrum petition at 2 and Dell/Microsoft opposition at 7.

[40] *See* Dell/Microsoft opposition at 7.

[41] *See* Carlson Wireless opposition at 6.

[42] *See* Shure petition at 16, Sennheiser opposition at 4 and CWMU opposition at 6.

[43] *See* Motorola opposition at 20, Wi-Fi Alliance opposition at 2 and PISC opposition at 8.

[44] *See* Wi-Fi Alliance opposition at 2.

[45] *See* Wi-Fi Alliance opposition at 2.

[46] *See* CWMU opposition at 4-5.

[47] *See* Carlson Wireless opposition at 10, Motorola petition at 6 and WISPA petition at 6.

[48] *See* Rudman/Ericksen petition at 10. The Commission's Universal Licensing System can be accessed at http://wireless.fcc.gov/uls/index.htm?job=home.

for personal/portable devices and 4 km for fixed devices.[49] Shure argues that a two kilometer protective zone for fixed devices is required to offer meaningful protection, since the interference range of a four watt TV bands device is hugely disproportional to a wireless microphone's one kilometer protection zone and an increase to two kilometers will restore a reasonable level of proportionality.[50] SBE believes wireless microphones are entitled to protection anywhere within their operational area shown in the Commission's database, not just within a one or two kilometer radius.[51]

28. Other parties argue that the current protection radius should be maintained or even reduced. WISPA, Carlson Wireless, and Wi-FI Alliance support maintaining the current one kilometer protection radius for wireless microphones.[52] PISC contends that extending interference protection zones for registered wireless microphone venues to 2 km is excessive and an inefficient use of spectrum.[53] Dell/Microsoft argue that a one kilometer distance should apply only to 4 watt fixed devices, while a 160 meter separation distance from 100 mW devices and a 100 meter separation distance from 40 mW devices will provide the same level of protection for wireless microphones as a one kilometer separation distance from 4 watt devices.[54]

29. *Decision*. We continue to recognize that wireless microphones are currently used in many different venues where people gather for events large and small and many consumers and businesses have come to rely on these devices. We have previously limited use of channels 2 and 5-20 to communications between fixed TVBDs and reserved two channels in the range 14-51 in the 13 markets where PLMRS and CMRS systems operate to make sure that frequencies are available for wireless microphones.[55] As discussed below, we are herein expanding the reservation of two channels in the range 14-51 to all markets nationwide as suggested by several petitioners. This will provide frequencies where a limited but substantial number of wireless microphones can be operated on any basis without the potential for interference from TV bands devices. It will also ensure that frequencies are available everywhere for licensed wireless microphones used on a roving basis to operate without risk of receiving harmful interference from TVBDs. We have also provided for a nominal separation distance between TVBDs and sites of venues and events where large numbers of unlicensed wireless microphones are used by permitting such sites to be registered in the TV bands databases. Further, we note that at any particular location a number of TV channels will not be available for use by TVBDs due to the application of the various interference protection requirements under our rules. Thus, a significant amount of spectrum will be available on which wireless microphones can be operated as they have in the past without concern for interference from TVBDs. We believe that this

[49] *See* CWMU opposition at 9.

[50] *See* Shure petition at 13-14.

[51] *See* SBE opposition at 7-8.

[52] *See* WISPA opposition at 7, Carlson Wireless opposition at 6, and Wi-Fi Alliance opposition at 2.

[53] *See* PISC opposition at 14.

[54] *See* Dell/Microsoft opposition at 2.

[55] *See Second Report and Order*, 23 FCC Rcd 16860 (2089) at ¶ 151. With regard to channels 2 and 5-20, the Commission stated that restricting use of channels 2 and 5-20 to communications by fixed devices with other fixed devices would meet the needs of those desiring to provide service at a distance and also limit the number of TVBDs that could potentially conflict with wireless microphone use.

spectrum will provide sufficient frequencies to support wireless microphone operations at the great majority of events. We disagree with those who argue that more spectrum should be reserved for wireless microphones. We observe that wireless microphones generally have operated very inefficiently, perhaps in part due to the luxury of having access to a wealth of spectrum. While there may be users that believe they need access to more spectrum to accommodate more wireless microphones, we find that any such needs must be accommodated through improvements in spectrum efficiency. The Commission underscored this point in the currently pending wireless microphone proceeding and sought comment on solutions that could enable wireless microphones to operate more efficiently and/or improve their immunity to harmful interference.[56] We will continue to pursue this issue as the Commission considers possible repurposing of the TV spectrum.

30. We disagree with the petitioners that argue unlicensed wireless microphones should be subject to the same requirements as TVBDs under our rules. There are many important differences that make it impractical to apply the same rules to both types of devices. For example, TVBDs are expected to be data devices that will have access to the Internet. Wireless microphones do not typically include geo-location technology nor do they connect to the Internet, so requiring these devices to check for channel availability through a database would be impractical. Also, TVBDs generally should be able to tolerate some latency, whereas wireless microphones operate in real time and generally cannot tolerate significant latency. Most importantly, unlicensed wireless microphones have been operating for quite some time without causing harmful interference. Accordingly, we conclude that unlicensed wireless microphones should not be subject to the more confined approach we have applied to TVBDs.

31. With regard to registration of unlicensed devices in the TV bands databases, we first observe that unlicensed wireless microphones operate under the same general conditions of operation in Section 15.5 of the rules as TV bands devices, meaning they may not cause interference to authorized services and must accept any interference received, including interference from other non-licensed devices.[57] As a general matter, we therefore find that it would be inappropriate to protect unlicensed wireless microphones against harmful interference from other unlicensed devices, and in particular TV bands devices. We observe that there are a wide variety of applications for wireless microphones ranging from a single wireless microphone used by a performer or presenter, to small theatrical productions using perhaps 10 - 20 microphones, to large scale productions and events such as professional sports events and Broadway style productions that may use well over 100 wireless microphones. The overwhelming majority of such use does not merit registration in the TV bands database. In cases where the number of wireless microphones needed for an event is relatively low, the operator of unlicensed microphones can avoid receiving harmful interference from TVBDs by simply using the reserved channels or other channels in each market where TVBDs are not allowed to operate. The two reserved TV channels will accommodate a minimum of at least 16 wireless microphones and the additional channels that are not available for TVBDs at most locations will accommodate many additional wireless microphones.[58] On the other hand, we

[56] *See Report and Order and Further Notice of Proposed Rule Making* in WT Docket Nos. 08-166 and 08-167 and ET Docket No. 10-24, 25 FCC Rcd 643, 702 (2010).

[57] *See* 47 C.F.R. § 15.5.

[58] A 6 megahertz television channel can support the operation of 6-8 wireless microphones that operate with the current 200 kHz analog technology. *See ex parte* submission from Shure dated July 1, 2004 at page 4.

recognize that certain events, such as major sporting contests or live theatrical productions/shows, may use scores of wireless microphones and therefore may not be able to be accommodated in the two reserved channels and other channels that may be available for wireless microphones at that location.

32. Accordingly, we are addressing unlicensed wireless microphones and low power auxiliary devices in our rules for TV bands devices as follows. As the general rule, we are not allowing unlicensed wireless microphones and other low power auxiliary devices operating without a license to be registered in the database; these devices will not be afforded protection from interference from TV bands devices on channels where TV bands devices are allowed to operate.[59] Entities desiring to operate wireless microphones on an unlicensed basis without potential for interference from TVBDs may use the two channels in each market area where TVBDs are not allowed to operate, as well as other TV channels that will be available in the vast majority of locations. Such entities may consult with a TV bands database to identify the reserved channels at their location, as well as the TV channels that may not be available for TV bands devices.[60] Entities operating or otherwise responsible for the audio systems at major events where large numbers of wireless microphones will be used and cannot be accommodated in the available channels at that location may request registration of the site in the TV bands databases. The registration requests must be filed with the Commission. Entities filing registration requests will be required to certify that they are using the reserved channels and all other available channels from 7 – 51 (except channel 37) that are not available for use by TV bands devices and are practicable for use by wireless microphones.[61] The request to be registered must be filed with the Commission at least 30 days in advance and include the hours, dates or days of the week and specific weeks on which those microphones will be in actual use (on dates where events are not taking place those sites will not be protected) and other identifying information also required of low power auxiliary licensees. Unlicensed microphones at event sites qualifying for registration in TV bands databases will be afforded the same geographic spacing from TVBDs as licensed microphones. We also advise entities responsible for event sites qualifying for registration in TV bands databases that registration does not create or establish any form of right or assurance of continued use of the spectrum in the future.

33. To allow us to better identify registered wireless microphone licensed operations and unlicensed sites, we are adopting the following registration procedures. Operators of licensed wireless microphones may register sites directly with one of the designated database administrators and provide the information required by the rules, which we are amending to include the wireless microphone call sign.[62] As indicated above, operators of venues using

[59] Entities may, of course, also operate wireless microphones on channels other than those that are reserved but, except in cases where a large number of microphones are needed, will not be afforded protection from TVBDs on those other channels.

[60] We also anticipate that wireless microphone vendors will know the reserved channels in each area and will be able to assist their customers in selecting equipment that can operate on frequencies on those channels.

[61] Some channels that are not available for TVBDs may not be suitable for use by wireless microphones due to the potential for interference from licensed operations such as television stations or the need to protect public safety operations.

[62] Section 74.882 requires that, for transmitters used for voice transmissions and having a transmitter output power exceeding 50 mW, an announcement be made at the beginning and end of each period of operation at a single location identifying the transmitting unit's call sign and other information. 47 C.F.R. § 74.882

unlicensed wireless microphones will be required to register their sites with the Commission, which will transmit the information to the TV bands device database administrators. For the purpose of this registration, the Commission will develop a form that will allow the information to be filed through one of the Commission's electronic filing systems, such as the Universal Licensing System (ULS). The applicant will be required to certify that it complies with the requirements for registration of unlicensed wireless microphones, including that it will first make use of all TV channels not available for TV bands devices that are practicable for wireless microphone use, including channels 7-51 (except channel 37), and submit the information specified by the rules, which we are amending to include the name of the venue where the equipment is operated. As a benchmark, at least 6 - 8 wireless microphones must be operating in each channel that is being used for the event.[63] Registration requests that do not meet these criteria will not be registered in the TV bands databases. The Commission will take actions against parties that file inaccurate or incomplete information, such as denial of registration in the database, removal of information from the database pursuant to Section 15.713(i), or other sanctions as appropriate to ensure compliance with the rules. The Commission will make requests for registration of sites that use unlicensed wireless microphones public and will provide an opportunity for public comment or objections. We are delegating authority for administering this registration process jointly to our Office of Engineering and Technology and Wireless Telecommunications Bureaus.

34. Turning next to issues concerning the manner in which wireless microphones are protected, we are maintaining the requirement that fixed TV bands devices may not operate co-channel with low power auxiliary stations within 1 km of their coordinates registered in the TV bands databases. We recognize the arguments of Shure and CWMU about the difference in power levels between fixed TV bands devices and wireless microphones. However, whether harmful interference occurs in a particular situation depends on many factors, including the undesired signal power, antenna directivity and separation distance, as well as the level of the desired signal at the receiver, the receive antenna and receiver characteristics, and any intervening structures or terrain that could attenuate the undesired signal. Neither Shure nor CWMU provided an analysis with their petitions demonstrating that the 1 km separation distance adopted in the *Second Report and Order* is inadequate for fixed devices when taking all relevant factors into account. In cases where licensed low power auxiliary stations are being used at large outdoor venues, such as racetracks or golf courses, we will permit the party registering the devices to specify the coordinates of multiple locations within the site to ensure that protection is provided over the entire facility where microphones are being used.[64]

[63] We will continue to monitor technological progress in improving the spectrum efficiency of wireless microphones and could increase our benchmark for the number of wireless microphones on a channel.

[64] The coordinates of multiple locations at an event site could be specified in a TV bands database by either designating multiple locations in a single site record or by including a separate record in the database for each of the multiple locations. We allow the TV bands database managers to decide how to handle such cases. However, for purposes of determining the geographic areas around event sites in which TVBDs may not operate, in cases where multiple locations are specified for a site, the TV bands database administrators are to treat each of the multiple locations registered for a large site as a separate location, *i.e.*, each location registered for a site is to be treated as if it were a separately entered record independent of the other locations at the site (even though the geographic areas of the multiple locations overlap, and we expect them to do so in order to achieve contiguous geographic protection of an event site).

35. However, we agree with petitioners that argue that it is not necessary to provide low power auxiliary stations the same protection from personal/portable TV bands devices because the latter operate with power levels at least forty times lower than the maximum power permitted for fixed TV bands devices. Therefore, we are modifying our rules to require that Mode II (independent) personal/portable devices not operate co-channel with low power auxiliary stations within 400 meters (0.4 km) of their coordinates registered in the TV bands device database.[65] A 100 mW transmitter will produce a lower signal at 400 meters than a 4 watt transmitter at 1 km using a free space calculation, so this shorter distance will provide greater protection for low power auxiliary devices from 100 mW TV bands devices than a 1 km separation from 4 watt devices. We will use this same 400 meters distance for personal/portable devices that operate with less than 100 mW of power.[66]

36. We find that it is not practical to protect wireless microphones using information obtained from the ULS and decline to require that that information be used in defining such protection as suggested by Rudman/Ericksen. Some wireless microphones are licensed using specific coordinates, while others are licensed to a wide area such as the entire service area of a TV station, and a license may specify multiple operating channels. We also observe that wireless microphones can be operated intermittently at discrete locations, rather than continuously over a wide area. Thus, the use of ULS licensing data could preclude TV bands devices from operating on multiple channels and at locations where no wireless microphones are in operation.

3. Translators, Cable Headends and Multichannel Video Program Distributors

37. In the *Second Report and Order*, the Commission adopted rules to protect TV translator receive sites and cable TV headends that are located outside the protected contours of the TV stations being received. TV translator receive sites are often located on high towers or at high elevations and use high gain antennas to receive a full service station's signal well beyond the station's service area. Cable headends are facilities that acquire and distribute video service signals over a cable television system. Broadcast TV signals are often received off-the-air at a cable headend for retransmission over the cable system. In many cases, the cable headend will use an antenna with high gain antenna mounted high on a tower to receive a TV station's signals well beyond the station's service area in a manner similar to that used by TV translators. The Commission found that it is important to avoid disruption of TV service to viewers who are located beyond TV station service areas and able to receive those signals through retransmission

[65] Mode I personal/portable devices will use the same set of available channels as the fixed or Mode II device with which they communicate and our presumption under the rules is that the specific geographic location of these devices will not be known. Therefore, the distance between a Mode I device and a protected (registered) wireless microphone site cannot be identified with any more accuracy than the location of the fixed or Mode II device with which the Mode I device communicates. We will therefore treat Mode I devices the same as fixed and Mode II devices for purposes of protecting wireless microphones – in this respect the list of channels they obtain from their fixed or Mode II device will reflect at least a 1 km or 400 m separation from a protected wireless microphone site. However, Mode I devices will in fact as often as not be located closer to a protected site than their fixed or Mode II device.

[66] The relative difference in power between a personal/portable device operating at 100 mW and a personal/portable device operating at 40 mW is so small that there would be no significant difference in the separation distance values for these two power levels. We are therefore specifying the same 400 m separation for devices operating with 100 mW or 40 mW.

on TV translators and cable systems.[67] While those viewers are in fact located beyond the areas where the Commission normally protects TV services, in these cases TV services have *de facto* been extended and valuable service is being provided to a significant number of households. If a TV bands device were to be located between the TV translator/cable headend and TV station and then operate on one or more of the channels being received by those facilities in a manner that results in harmful interference, TV reception to the households and the cable system services could be disrupted.

38. To protect cable headends and TV translator receive sites which are not listed in Commission databases, the Commission allowed operators of TV translator receive sites and cable headends that are located within 80 km of the service contour of the received TV station to register their location and the channel(s) they receive in the TV bands device database. To prevent unnecessary entries into the database, the Commission permitted translator receive sites and cable headends to be registered only if they are outside the protected contour of the TV station being received.[68] The rules limit operation of TV bands devices co-channel and adjacent to the channel(s) being received over an arc of +/- 30 degrees from a line between the receive site and the TV station(s) being received.[69] Within this arc, TV bands devices operating co-channel to the received station may not operate within 80 km of the receive site, and TV bands devices on channels adjacent to the received station may not operate within 20 km of the receive site. The protection radius extends only as far as the protected contour of the station being received, so the co-channel protection distance would be less than 80 km for receive sites closer than this distance from a protected contour, and both the co-channel and adjacent channel protection distances would be less than 20 km for receive sites closer than this distance from a protected contour. In addition, to prevent interference to TV translators and cable headends from TV bands devices outside the main beam of the receive antenna, the Commission prohibited TV bands devices from operating co-channel to the channel(s) being received by these facilities within 8 kilometers and from operating on adjacent channels within 2 kilometers in all directions off the +/- 30 degree arc.

39. *Petitions and Replies*. SBE and MSTV/NAB requests that satellite receive sites receive the same protection as cable headends. DIRECTV/DISH Network similarly asks that the Commission clarify that the facilities of all multi-channel video programming distributors (MVPDs) receive the same protection as cable headends.[70] NCTA and DIRECTV request that cable headends more than 80 km outside a station's contour be made eligible for protection, that the protected wedge area be increased to +/- 50 degrees and that operators of fixed TV bands devices be required to coordinate with all operators of cable headends within 100 km who might be affected.[71] NCTA also states that the rules should define a clear process whereby cable operators can receive a greater protection area upon a showing of factors requiring greater protection distances than those provided in the rules.[72] Motorola supports allowing registration of

[67] *See Second Report and Order* 23 FCC Rcd 16872 (2008) at ¶185.

[68] *Id*. at 16872, ¶187.

[69] *Id*. at 16872, ¶186.

[70] *See* SBE petition at 15, MSTV/NAB opposition at 11 and DIRECTV/DISH Network petition at 3.

[71] *See* NCTA petition at 15-17 and DIRECTV opposition at 7.

[72] *See* NCTA petition at 15, 17. It also requests that the Commission correct a conflict between paragraph 186 of the text of the decision and Section 15.712(b) of the rules. Specifically, NCTA notes that paragraph 186 specifies (continued....)

headends beyond 80 km but opposes increasing the width of the protected arc and the co-channel protection distance in the radius outside the arc, arguing that the current protection specifications are adequate to protect the vast majority of headend receivers.[73] Adaptrum submits that the cable headend and translator receive site protection requirements are overly stringent and asks that the protection distance outside the main lobe of the antenna be made 100 meters rather than 2 km for adjacent channels.[74] Google and Motorola oppose requiring coordination of fixed devices with cable headend operators as an unnecessary burden.[75] Dell/Microsoft state that the cable headend protection provisions could unnecessarily restrict device operations and should be reduced or eliminated where practicable.[76]

40. DIRECTV/DISH Network, NCTA and SBE ask that the Commission allow the registration of headend facilities located within broadcast TV station protected contours.[77] DIRECTV/DISH Network and NCTA state this option is necessary to provide protection from portable TV bands devices using adjacent channels and because receive facilities located near a station's protected contour boundary could be at risk of interference from TV bands devices outside the contour. Dell/Microsoft oppose permitting such registration, stating that headends inside service contours already receive protection.[78] Dell/Microsoft, Motorola and PISC request that the Commission clarify that headends are entitled to register channels in the database only in instances where the headend is actually relying on an over-the-air signal, and Dell/Microsoft and PISC believe that channel registration in the TV bands database be limited to local channels, not out-of-market stations.[79]

41. *Decision*. As discussed below, we are modifying our rules to expand and more clearly define the types of receive facilities that may be registered in the TV bands database and are making certain changes to the protection criteria for these receive facilities. The purpose of permitting the registration of receive sites is to protect the reception of over-the-air TV signals that are redistributed through another means. Consistent with this intent, we will permit the registration of TV receive sites for other types of video service providers besides cable systems and will modify the rules in this regard to more clearly and completely define the types of facilities that may be registered. We are therefore specifying that receive sites of all multi-channel video programming distributors (MVPDs) as defined by Section 602(13) of the Communications Act may be voluntarily registered in the database, in addition to TV translator receive sites.[80]

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protection distances are to be determined from the protected contour of the TV station being received, while Section 15.712(b) specifies they are to be determined from the receive site.

[73] *See* Motorola opposition at 7-8.

[74] *See* Adaptrum petition at 10.

[75] *See* Google opposition at 19 and Motorola opposition at 8.

[76] *See* Dell/Microsoft petition at 7.

[77] *See* DIRECTV/DISH Network petition at 3-4, NCTA petition at 16 and SBE petition at 15.

[78] *See* Dell/Microsoft opposition at 13.

[79] *See* Dell/Microsoft petition at 8, Motorola opposition at 7 and PISC opposition at 18.

[80] The term "multichannel video programming distributor" is defined by Section 602(13) of the Communications Act as a person such as, but not limited to, a cable operator, a multichannel multipoint distribution service, a direct (continued....)

42. We recognize that there are cable headends that receive TV station signals located at distances beyond 80 km from the edge of a television station's protected service contour and understand NCTA's concern for possible disruption service to cable subscribers. These same considerations would apply to other MVPDs and to TV translator, low power TV and Class A TV stations that re-transmit programming from another TV station. We do not believe that the requested change would have significant impact on the availability of TV white space because these facilities are generally in remote areas where many channels will be available for white space devices. However, we also recognize that parties may wish to have an opportunity to review such requests to confirm the assessment. We are therefore providing that current MVPD operators, TV translator, low power TV and Class A TV stations with receive sites located beyond the 80 km co-channel protection distance in the rules may apply for a waiver of that distance during a period that will end 90 days after the effective date of the rules adopted herein. Such waiver requests would also involve shifting the 20 km adjacent channel protection distance so that it is measured from the actual receive site. We will then issue a public notice requesting comment on requests we receive and issue decisions. MVPD operators and TV translator, low power TV and class a TV stations that commence operation in the future with receive sites located beyond the co-channel and adjacent protection distances may apply for a waiver of those distances within 90 days of commencing operation. Following receipt of such request(s), we will then issue a public notice asking for comment on the request(s) and issue decision(s).

43. We decline to increase the width of the +/-30 degree protected arc as requested by NCTA. A receive site located outside the protected contour of a TV station would need to incorporate a high gain receive antenna, which has a narrow beamwidth. While we recognize NCTA's argument that an antenna has side lobes that will allow it to receive signals outside its main beam, this does not in itself demonstrate that the current protection requirement is inadequate or that a wider protected arc is necessary. Adaptrum provides no information to support its argument that the protection distance outside of the main lobe of the receive antenna should be significantly reduced and we therefore deny that request. We further decline to require operators of fixed TV bands devices to coordinate with operators of receive sites. The requirements we have adopted are extremely conservative and will adequately protect receive sites, so a coordination requirement is unnecessary and would be cumbersome to implement.

44. We find it unnecessary to provide for registration of receive sites within the protected contour of a TV station being received and thus decline to allow such registrations. Within a station's protected service contour, receive sites are protected from interference by the same provisions that protect reception by consumers. The rules require that TV bands devices be located outside the contour of a co-channel TV station, so a TV bands device located near a contour that is communicating with another TV bands device would not be directing its signal into the contour where the receive site is located. Further, a receive site inside, but near the edge of a protected contour, would have its receive antenna directed toward the TV station and not at the TV bands device outside the contour. Therefore, the orientation of the antennas in this situation makes interference highly unlikely. Additionally, a TV bands device operating on a channel adjacent to an occupied TV channel is permitted to operate within the service contour, but at a lower power level not to exceed 40 mW. This lower power level combined with the fact

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broadcast satellite service, or a television receive-only satellite program distributor, who makes available for purchase, by subscribers or customers, multiple channels of video programming. *See* 47 U.S.C. § 522(13).

that a receive site within a contour will receive a higher signal level than a receive site outside the contour makes adjacent channel interference from that source again unlikely. Furthermore, in the event that interference does occur, the operator of the TV bands device is required to cease operation.

45. Finally, we are modifying the text of the rules to clarify that registration for receive sites is limited to channels that are received over-the-air and are used as part of the service of the MVPD, TV translator, low power TV station or Class A TV station. We are not, however, limiting registration to local channels so as not to preclude the possibility that an MVPD or TV translator/low power television station may retransmit out-of-market channels if it is authorized to do so.

B. TV Bands Devices

1. Spectrum Sensing

46. In addition to requiring that TV bands devices access a database to determine available channels, the Commission decided in the *Second Report and Order* to require that TV bands devices be capable of sensing analog TV signals, digital TV signals and wireless microphone signals at a level of -114 dBm within defined receiver bandwidths.[81] This level is referenced to an omni-directional receive antenna with a gain of 0 dBi.[82] If a receive antenna with a minimum directional gain of less than 0 dBi is used, the detection threshold must be reduced by the amount in dB that the minimum directional gain of the antenna is less than 0 dBi.[83] Alternative approaches for the sensing antenna are permitted that provide at least the same performance as an omni-directional antenna with 0 dBi gain.[84] The Commission also required that the receive antenna used by fixed devices be located at least 10 meters above the ground to maximize the likelihood that its reception is not blocked from receiving signals originating from any direction.[85] It found that receive antenna height requirements are impractical for personal/portable devices and declined to impose such requirements on those devices.[86]

47. Under the rules adopted in the *Second Report and Order*, a TV bands device is permitted to begin operating on a TV channel if no wireless microphone or other low power auxiliary device signals above the detection threshold are detected within a minimum time interval of 30 seconds.[87] A TV bands device must also perform in-service monitoring of channels on which it operates a minimum of once every 60 seconds.[88] There is no minimum channel availability check time for in-service monitoring. If a device detects a wireless microphone or other low power auxiliary device signal on a channel it is using, the device must

[81] *See Second Report and Order* 23 FCC Rcd 16889, 16890 (2008) at ¶¶237, 240.

[82] *Id*. at 16890, ¶241.

[83] *Id.*

[84] *Id.*

[85] *Id.*

[86] *Id.*

[87] *Id*. at 16891, ¶245.

[88] *Id.*

cease all transmissions on that channel within two seconds.[89] If a TV signal is detected on a channel indicated as available for use by the database, the TV bands device must provide a notice of that detection to the operator of the device and provide a means for the operator to remove the channel from the device's list of available channels.[90] However, with respect to TV signals, the database is the controlling factor in determining whether a channel is available, and there is no requirement for a TV bands device to avoid operating on a channel where it detects a TV signal, since it is possible to detect a signal outside a station's protected service contour.

48. A personal/portable device operating in Mode I must identify (report) those TV channels on which it senses a wireless microphone or television signal above the detection threshold to the fixed or Mode II personal/portable device that provides it with a list of available channels. The fixed or Mode II device must respond as if it had detected the signal itself, *i.e*., it must not use the occupied channel if the Mode I device detects a wireless microphone and must report the TV signal detection to the operator of the device. In addition, TV bands devices communicating either directly with one another or linked through a base station must share information on channel occupancy determined by sensing. If any device in a local area group or network determines that a channel is occupied and notifies other devices with which it is linked, all the other linked devices will be required to respond as if they had detected the signal themselves.[91]

49. *Petitions and Replies*. A number of parties argue that there is no need for the spectrum sensing requirements and request that they be eliminated, particularly the requirement to sense wireless microphones. Adaptrum, Dell/Microsoft, PISC, Wi-Fi Alliance and others argue that the combination of the TV bands database and safe harbor channels 2-20, where personal/portable devices cannot operate, will be adequate to protect all wireless microphone use in the TV bands.[92] PISC and Google also argue that to the extent that the Commission imposes sensing requirements in addition to geo-location and database access, it protects unauthorized microphone users and compromises the underlying concept of the rules to protect authorized licensed use.[93] The Wi-Fi Alliance also argues that detecting low power auxiliary signals at extremely weak levels will add substantial TV bands device development time and expense.[94] Shure, on the other hand, argues that the spectrum sensing requirement should be retained and strengthened because it is necessary to protect those wireless microphones operating in a manner

[89] *Id.*

[90] *Id*. at 16843, 16844, ¶¶92, 96.

[91] *Id*. at 16892, 249.

[92] *See* Adaptrum petition at 2; Dell/Microsoft petition at 8; PISC petition at 5-8; Wi-Fi Alliance petition at 4-5; Motorola petition at 8; WISPA petition at 5 (argues that the Commission failed to consider the adverse effect that complying with sensing requirements would have on WISPs); IEEE 802 petition at 3 (argues that sensing to detect broadcast TV signals should be optional when reliable database access exists); Federation of Internet Solution Providers opposition at 2; Google opposition at 7-9.

[93] *See* PISC petition at 8; Google opposition at 7-9. *See also* Wi-Fi Alliance petition at 5.

[94] *See* Wi-Fi Alliance petition at 5. *See also* Federation of Internet Solution Providers opposition at 2 (also doubts the ability of spectrum sensing technology to perform as intended).

that makes registration in the database impractical.[95] Sennheiser and SBE also oppose the elimination or weakening of the sensing requirement for protecting wireless microphones.[96]

50. Several parties argue that, if the sensing requirement is retained, the -114 dBm detection threshold which applies to all incumbent operations is too low and should be increased. Dell/Microsoft and Google argue that the -114 dBm sensing level was recommended based on the assumption that sensing would be the only method for protecting incumbents, and this low level threshold is not necessary in light of the Commission's decision to require geo-location capability and database access.[97] Adaptrum contends that it is challenging or impossible to develop a device that can detect signals at a -114 dBm threshold and that such sensitivity can be achieved for wireless microphones only if the signal format and channel plan are known.[98] Dell/Microsoft, IEEE 802, Wi-Fi Alliance, Motorola and PISC contend that the wireless microphone sensing threshold should be increased to at least -107 dBm, arguing generally that a higher threshold will reduce the chance of false detections due to noise.[99] Sennheiser and Shure oppose requests to raise the TV bands device sensing threshold for wireless microphones,[100] and other parties argue that the detection threshold should be lowered. MSTV/NAB contends that there is no basis in the record for the -114 dBm sensing level, which would provide inadequate protection to roving wireless microphones that are not in the database.[101] SBE, Shure and CWMU argue that the sensing level should be lowered to -126 dBm as is required in the United Kingdom.[102]

51. Petitioners also request that other aspects of the sensing requirements be modified. IEEE 802, Motorola, WISPA, Carlson Wireless, Federation of Internet Solution Providers and Google believe that the 10 meter minimum receive antenna height for fixed stations is not necessary when a database is used.[103] Motorola, WISPA, Carlson Wireless and Google recommend a 3 meter antenna height as more practical and economically viable.[104] WISPA believes that the requirement that TV bands devices utilize an omnidirectional sensing antenna is overprotective and should be eliminated because it is only necessary for the sensing

[95] *See* Shure opposition at 5-6.

[96] *See* Sennheiser opposition at 5; SBE opposition at 6-7, 12.

[97] *See* Dell/Microsoft petition at 3 and Google opposition at 11.

[98] *See* Adaptrum petition at 2.

[99] *See* Dell/Microsoft petition at 4-5, IEEE 802 petition at 5, Wi-Fi Alliance petition at 5, Motorola petition at 12, and PISC opposition at 10.

[100] *See* Sennheiser opposition at 5; Shure opposition at 7. Shure argues that a 100 mW TV bands device will interfere far beyond its -107 dBm sensing range.

[101] *See* MSTV/NAB opposition at 19.

[102] *See* SBE petition at 24; Shure opposition at 7-8; CWMU opposition at 9. However Google argues that the tighter sensing requirement in the United Kingdom applies only when geo-location is not used. *See* Google opposition at 12.

[103] *See* IEEE 802 petition at 3, Motorola petition at 8, WISPA petition at 7, Carlson Wireless opposition at 2, Federation of Internet Solution Providers opposition at 3 and Google opposition at 13.

[104] *See* Motorola petition at 8, WISPA petition at 9, Carlson Wireless opposition at 2 and Google opposition at 13.

antenna to detect a protected signal in the path between the base station and the customer's equipment.[105]

52. Shure requests that the Commission decrease the channel re-check interval from 60 seconds to ten seconds to prevent prolonged incidents of co-channel interference, and that the Commission establish a non-occupancy period of 60 minutes after a wireless microphone is detected on a channel to prevent spectrum contention battles that result in disruptions of service.[106] SBE argues that the re-check interval should be decreased to once per second to prevent disruption of active newsgathering, live entertainment or sports.[107] Carlson Wireless, Dell/Microsoft, Google, Motorola, PISC and WISPA oppose requests to decrease the channel re-check interval.[108] Google argues that a 10 second interval for occupancy checking would render any use of TV bands devices impractical.[109] Dell/Microsoft argue that microphone users can reserve in advance channels where TV bands devices can not operate,[110] and PISC argues that given the specificity of the database, it is unnecessary to require a non-occupancy period for channels being used by wireless microphones.[111]

53. Motorola argues that the requirement to use distributed sensing will result in overly large areas in excess of 5 km where TV bands devices will have to vacate a channel used by a wireless microphone.[112] WISPA requests that the Commission eliminate the requirement for all fixed TV bands devices to take remedial action in the event one device in a network senses a protected signal because the detection of one signal by one TV bands device could result in an entire WISP network being shut down.[113] However, Shure contends that distributed sensing is a critical interference protection feature because networked devices will be more likely to identify signals hidden from a single TV bands device.[114]

54. *Decision.* We are eliminating the requirement for TV bands devices that rely on geo-location and database access to sense analog and digital TV signals and also wireless microphones and other low power auxiliary stations. Much of this proceeding has focused on the central question of whether spectrum sensing is a viable tool for providing access to spectrum. We have noted the benefits and limitations of spectrum sensing through testing conducted by our engineers and extensive discussion in the *Second Report and Order*. We continue to believe that spectrum sensing will continue to develop and improve. We anticipate that some form of

[105] *See* WISPA petition at 9.

[106] *See* Shure petition at 13.

[107] *See* SBE petition at 24.

[108] *See* Carlson Wireless opposition at 7, Dell/Microsoft opposition at 6, Google opposition at 12, Motorola opposition at 20, PISC opposition at 13 and WISPA opposition at 5 (a six-fold increase in the frequency of in-service monitoring and a 60 minute non-occupancy period would lead to more false positive detections and would be regulatory overkill).

[109] *See* Google opposition at 12.

[110] *See* Dell/Microsoft opposition at 6.

[111] *See* PISC opposition at 13.

[112] *See* Motorola petition at 13-14.

[113] *See* WISPA petition at 11.

[114] *See* Shure opposition at 8-9.

spectrum sensing may very well be included in TVBDs on a voluntary basis for purposes such as determining the quality of each channel relative to real and potential interference sources and enhancing spectrum sharing among TVBDs. However, at this juncture, we do not believe that a mandatory spectrum sensing requirement best serves the public interest. As petitioners and responding parties indicate, the geo-location and database access method and other provisions of the rules will provide adequate and reliable protection for television and low power broadcast auxiliary services, so that spectrum sensing is not necessary. With respect to protection of television services, we observe that the geo-location and database method is already the primary means for preventing interference to TV stations.[115] The sensing requirement adopted in the *Second Report and Order* only requires that a TV bands device inform the user when a TV signal above a threshold is detected and provide an opportunity for the user to change channel, but it does not preclude operation on a channel where a TV signal is detected. That is, the *Second Report and Order* essentially relied on geo-location and the TV bands data bases to protect over-the-air TV broadcasting, not spectrum sensing.

55. We also now conclude that inclusion of a spectrum sensing capability is not necessary to protect wireless microphone operations. Parties operating Part 74 licensed low power auxiliary stations at fixed locations are eligible to register those operations in the TV bands device database to obtain interference protection from TV bands devices. As indicated above, for parties ineligible for Part 74 licensing, the Commission, in its *Wireless Microphone R&O/FNPRM* permitted the operation of low power auxiliary service stations on an unlicensed basis under Part 15 of the rules pending a final decision on its proposals to expand eligibility for Part 74 licensing and to allow a new category of wireless audio devices to operate in the core TV bands under Part 15. Based on our informal observations of the marketing and uses of wireless microphones, it appears that the number of wireless microphones operating under the Part 15 waiver significantly outnumbers those operating as Part 74 licensed devices. As indicated above, unlicensed devices operate on a non-interference basis, meaning they may not cause interference to authorized services, and must accept any interference received, including interference from other un-licensed devices such as TV bands devices. Requiring TV bands devices to sense low power auxiliary stations such as wireless microphones would inappropriately give interference protection to a large number of other unlicensed, unprotected devices because there is no way for the sensing feature of a TV bands device to distinguish licensed from unlicensed devices.[116] We recognize that there will be some licensed low power auxiliary stations that can be used for roving applications for which the location can not be known in advance and therefore can not be registered in the TV bands device database. As discussed below, we have reserved two channels at all locations on which unlicensed TV bands devices will not be allowed to operate in order to ensure that there are frequencies on which licensed microphones used in roving applications such as electronic news gathering can operate. The availability of the frequencies in these channels will make it unnecessary to provide special protection from interference for such applications.

56. With the elimination of the spectrum sensing requirement for TV bands devices that use geo-location and database access, there is collaterally no longer a need for a minimum receive antenna height for fixed devices, and we are consequently removing that requirement from the rules. We are also revising and amending certain elements of the rules so that they

[115] *Second Report and Order*, 23 FCC Rcd 16841(2008) at para. 85.

[116] As discussed below, we are, however, extending protection to unlicensed devices used at venues where large numbers of wireless microphones are used.

continue to provide comparable assurance of protection against interference in the absence of sensing capabilities and to clarify and simplify the rules as they pertain to interference protection. In addition to revisions of the geo-location and database access rules, the changes include revision of certain terms used in the rules and elimination of the terms "client device," "client mode," "master device," and "master mode."

57. As part of these changes, we are eliminating the requirements for devices operating in Mode I to use distributed sensing. We also observe that some of the comments on this issue appear to reflect an understanding that the rules permit extensive networks of devices that would all be linked together using a commonly identified list of available channels. We wish to correct any misconceptions that, at least at this stage, the rules contemplate or permit such networks and sharing of channel availability information. Rather, as stated in the Second Report and Order, we will permit personal/ portable TVBDs to be used in the operation of networks only where a means is provided to ensure that each device is operating consistent with the channels available at its particular location.[117] The rules do not permit personal/portable devices operating in Mode I to relay channel availability information from one Mode I device to another Mode I device unless some means is used to ensure that each device is operating within the parameters for its particular location.

58. Our elimination of the general requirement that all TV bands devices perform spectrum sensing at least once per minute and report channel availability information to other devices in a network removes the only existing requirement in the rules for a Mode I device to maintain contact with a fixed or Mode II device. In reviewing this provision, we also observe that the rules currently do not require that a Mode I device periodically re-establish its list of available channels through either device that uses geo-location and database access; however, such re-checks for channel availability are necessary to ensure that a Mode I device does not continue to operate on a channel that becomes unavailable. To address these concerns, we are adding a requirement that a device operating in Mode I must either receive a special signal from the Mode II or fixed device that provided its current list of available channels to verify that it is still in reception range of that device or contact a Mode II or fixed device at least once per minute to re-verify/re-establish channel availability. This new requirement, including the special signal for verifying contact with the Mode II or fixed device that provided the Mode I device's list of available channels, is described in more detail in the section below on Re-check Procedures. This requirement is necessary because a Mode I device is not generally expected to be able to determine when it has moved, and it could possibly be moved to a location where the operating channel is occupied. Maintaining regular contact with a Mode II or fixed device will ensure that Mode I devices operate only on channels available at their location and that they cease operation when they move out of range of the device from which they obtained their list of available channels, in which case their list of available channels would no longer be valid. This requirement will also address situations where a Mode I device is no longer able to maintain contact with an operating fixed or Mode II device (for example, if the fixed or Mode II device with which the Mode I device has been communicating ceases operation and the Mode I device is not able to contact a replacement).

59. In reviewing the rules in this context, we also observe that Section 15.711(b)(3)(ii) of the rules requires that a Mode II personal/portable device access the database

[117] *Id*. at 16854, ¶132.

for a list of available channels each time it is activated from a power-off condition and re-check its location and the database for available channels if it changes location during operation. It is our intent that a Mode II device monitor its location regularly to determine if its location has changed under this requirement. We are therefore amending this section of the rules to clarify that a Mode II device must use its geo-location capability to check its location at least once every 60 seconds, except when in "sleep mode," *i.e.*, in a mode in which the device is inactive but is not powered-down. This clarification will ensure that Mode II devices re-check their list of available channels within a short interval if their location changes. It will also provide clarity with respect the re-check requirements for devices that operate on a mobile basis within a bounded geo-graphic area in which the same channels are available at all locations.

60. While we are eliminating spectrum sensing for TVBDs that use geo-location and database access, we continue to believe that this technology offers significant promise for improving spectrum access and efficiency both in the TV bands and in providing access to other spectrum. Spectrum sensing has come a long way and some have expressed the view that even today it is sufficiently developed that it can be relied upon for determining access to the TV bands and other spectrum. We are therefore leaving open the opportunity to submit applications for certification of sensing-only devices. We acknowledge that the process for approval of such devices is rigorous. However, we continue to believe that an open and transparent review as provided by that process is appropriate for sensing-only devices. Accordingly, we are retaining the provisions in our rules that permit the authorization and operation of personal/portable TV bands devices that rely on sensing alone under a "proof-of-performance" standard. We invite parties that submit such applications when they are ready to do so. We are taking this opportunity to clarify that devices that use sensing alone may initiate and participate in a network of TVBDs and may communicate with fixed, Mode I, Mode II and other sensing-only TVBDs but may not provide a Mode I device with a list of available channels. We are also re-locating the existing spectrum sensing technical provisions that previously applied to all TVBDs into the rule section on sensing-only devices.[118]

61. We are also increasing the minimum required detection threshold for wireless microphones and other LPAS stations of sensing-only devices from -114 dBm to -107 dBm. We are making this change for two reasons. First, sensing-only devices must operate with lower power than fixed or other personal/portable devices (except for personal/portable devices operating on channels adjacent to television stations), so a higher detection threshold would provide a level of protection that is approximately comparable to a lower threshold in a higher power device. Second, the rules for such devices specify that although compliance with the detection threshold for spectrum sensing is required, it is not necessarily sufficient for demonstrating reliable interference avoidance.[119] Thus, the required detection threshold we are adopting serves as a minimum performance criteria for a device.

62. Authorization of a sensing only TVBD under the proof-of-performance standard also requires that a manufacturer submit a prototype device that will be tested by the Commission to ensure that the device is capable of operating without interference prior to

[118] See 47 C.F.R. § 15.717. The spectrum sensing requirements include detection threshold levels, receive antenna characteristics (*e.g.,* gain and directionality), channel availability check time, in-service monitoring, and channel move time.

[119] *Id*.

certification. The decision on whether to certify a sensing-only device will be based on its performance, and in particular its ability to reliably detect the presence of authorized transmissions.[120] If the Commission determines through testing that a lower detection threshold is necessary to prevent interference then we would require the device to meet the lower threshold before it could be certified. We believe that these requirements for sensing-only devices are sufficiently conservative to prevent interference to TV reception and low power auxiliary stations. We see no basis for increasing the threshold for sensing of television signals.

2. Technical Requirements

a. Antenna Height

63. Because the range at which a TV bands device can cause interference increases as the height of the device's antenna increases, the Commission adopted a maximum antenna height limit of 30 meters above ground for fixed devices. This height limit was intended to balance unlicensed fixed TV bands device transmission range with the distance at which those operations could impact licensed services.[121] The Commission did not impose height restrictions on personal/portable devices because it found that it is not practical to administer an antenna height limit for those devices and the lower power and limited antenna gain of personal/portable devices would generally result in propagation over a shorter range than fixed devices.[122] Further, the Commission observed that personal/portable devices, unlike fixed devices which have gain antennas mounted outdoors to maximize the propagation range of their signals, will likely typically be used indoors where their signals will be attenuated by exterior walls. These factors will significantly reduce the range at which signals from a personal/portable device will be of sufficient field strength to cause interference.

64. *Petitions and Replies*. Several parties request that the Commission permit fixed devices to operate with transmit antenna heights greater than 30 meters to allow greater coverage from a single site, thus allowing the use of fewer towers.[123] However, MSTV/NAB and SBE oppose increasing the maximum allowable antenna height due to concerns about an increased potential for interference.[124] IEEE 802, SBE, and MSTV/NAB also supports defining the maximum antenna height as the height above average terrain (HAAT), rather the height above ground.[125] IEEE 802 and SBE believe that the current "height above ground" specification underestimates the protection distances needed from antennas located on a mountain.[126]

[120] *See Second Report and Order* 23 FCC Rcd 16895 at ¶261.

[121] *Id*. at 16886, ¶228.

[122] *Id.* at 16886, ¶229.

[123] *See* IEEE 802 petition at 3, WISPA petition at 13, Motorola petition at 6 and Federation of Internet Solution Providers opposition at 3. WISPA and Motorola request that the Commission revise the table of minimum required separation distances between TV station protected contours and fixed TV bands devices using antenna heights greater than 30 meters. *See* Motorola petition at 6 and WISPA petition at 14. MSTV/NAB disagrees with these parties' recommended separation distances, arguing that they are based on faulty assumptions. *See* MSTV/NAB opposition at 10.

[124] *See* MSTV/NAB opposition at 9 and SBE opposition at 7.

[125] *See* IEEE 802 petition at 3, SBE petition at 13, and MSTV/NAB opposition at 8. WISPA prefers using above ground measurement, but would not oppose HAAT if it allowed for increased base station height. *See* WISPA reply to oppositions at 10.

[126] *See* IEEE 802 petition at 3-4 and SBE petition at 13.

However, Google opposes specifying the antenna height as HAAT because the more sophisticated calculations required could impede prompt equipment deployments.[127] Rudman/Ericksen and SBE argue that the lack of a maximum transmit height for personal/portable devices will result in interference.[128]

65. *Decision.* We decline to increase the maximum permitted transmit antenna height above ground for fixed TV bands devices. As the Commission stated in the *Second Report and Order*, the 30 meters above ground limit was established as a balance between the benefits of increasing TV bands device transmission range and the need to minimize the impact on licensed services.[129] Consistent with the Commission's stated approach in the *Second Report and Order* of taking a conservative approach in protecting authorized services, we find the prudent course of action is to maintain the previously adopted height limit. If, in the future, experience with TV bands devices indicates that these devices could operate at higher transmit heights without causing interference, the Commission could revisit the height limit.

66. While we expect that specifying a limit on antenna height above ground rather than above average terrain is satisfactory for controlling interference to authorized services in the majority of cases, we also recognize petitioners' concerns about the increased potential for interference in instances where a fixed TV bands device antenna is located on a local geographic high point such as a hill or mountain.[130] In such cases, the distance at which a TV bands device signal could propagate would be significantly increased, thus increasing the potential for interference to authorized operations in the TV bands. We therefore conclude that it is necessary to modify our rules to limit the antenna HAAT of a fixed device as well as its antenna height above ground. In considering a limit for antenna HAAT, we need to balance the concerns for long range propagation from high points against the typical variability of ground height that occurs in areas where there are significant local high points – we do not want to preclude fixed devices from a large number of sites in areas where there are rolling hills or a large number of relatively high points that do not generally provide open, line-of-sight paths for propagation over long distances. We find that limiting the fixed device antenna HAAT to 106 meters (350 feet), as calculated by the TV bands database, provides an appropriate balance of these concerns. We will therefore restrict fixed TV bands devices from operating at locations where the HAAT of the ground is greater than 76 meters; this will allow use of an antenna at a height of up to 30 meters above ground level to provide an antenna HAAT of 106 meters. Accordingly, we are specifying that a fixed TV bands device antenna may not be located at a site where the ground HAAT is greater than 75 meters (246 feet). The ground HAAT is to be calculated by the TV bands database using computational software employing the methodology in Section 73.684(d) of the rules to ensure that fixed devices comply with this requirement.

[127] *See* Google opposition at 14.

[128] *See* Rudman/Ericksen petition at 13 and SBE opposition at 5.

[129] *See Second Report and Order* 23 FCC Rcd 16886 (2008), ¶228.

[130] The antenna height above ground is the distance from the antenna center of radiation to the actual ground directly below the antenna. To calculate the antenna height above average terrain (HAAT), the average elevation of the surrounding terrain above mean sea level must be determined along at least 8 evenly spaced radials at distances from 3 to 16 km from the transmitter site. The HAAT is the difference between the antenna height above mean sea level (the antenna height above ground plus the site elevation) and the average elevation of the surrounding terrain.

67. In reexamining this issue, we also note that the rules currently do not indicate that fixed device antenna heights must be provided to the database for use in determining available channels. It was clearly the Commission's intent that fixed devices include their height when querying the database because the available channels for fixed devices cannot be determined without this information.[131] We are therefore modifying Sections 15.711(b)(3) and 15.713(f)(3) to indicate that fixed devices must submit their antenna height above ground to the database.

68. We continue to decline to establish height limits for personal/portable devices. As the Commission stated in the *Second* Report *and Order*, there is no practical way to enforce such limits, and such limits are not necessary due to the different technical and operational characteristics of personal/portable devices.

b. Power and Power Spectral Density Limits

69. In the *Second Report and Order*, the Commission allowed fixed TV bands devices to operate with a peak transmitter output power of one watt with a maximum antenna gain of 6 dBi, and to require that the transmitter power be reduced by the same amount in dB that the maximum antenna gain exceeds 6 dBi.[132] This allows unlicensed TV bands fixed devices to operate with the equivalent of 4 watts EIRP. The Commission found that 4 watts EIRP is sufficient to allow fixed devices to communicate at ranges that will serve community and rural users while minimizing the potential for interference to broadcast television and other authorized services in the TV bands. Fixed TV bands devices were not permitted to operate adjacent to occupied TV channels, although the Commission decided to defer a final decision on this issue and to keep the record open pending the development of additional information demonstrating that a reliable method can be developed to allow adjacent channel operation while protecting authorized services.[133]

70. The Commission allowed personal/portable TV bands devices to operate with a peak transmitter output power of 100 mW with a maximum antenna gain of 0 dBi, and required that the transmitter power of such devices be reduced by the same amount in dB that the maximum antenna gain exceeds 0 dBi.[134] This allows personal/portable TV bands devices to operate with an equivalent of 100 mW EIRP. In cases where a personal/portable device is operating adjacent to an occupied TV channel, the maximum permitted EIRP is 40 mW.[135] Personal/portable devices that rely on spectrum sensing without the use of geo-location and a TV bands device database may be authorized at a power level up to 50 mW EIRP.[136] The Commission did not specify minimum bandwidth limits for transmissions by TV bands devices or power spectral density (PSD) limits in the *Second Report and Order*.

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[131] Section 15.713(a)(1) states that the TV bands device database will calculate available channels based on the interference requirements of Section 15.712, which contains a separation table that takes fixed device antenna height into account. The only way the database can perform this calculation is if the fixed device submits its antenna height along with its geographic coordinates to the database.

[132] *See Second Report and Order* 23 FCC Rcd 16846 at ¶105.

[133] *Id*. ¶178.

[134] *Id*. at 16852, 16853, ¶¶126-127.

[135] *Id*. at 16868, ¶176.

[136] *Id*. at 16895, ¶258.

71. *Petitions and Replies*. PISC states that the 4 watt limitation for fixed devices needlessly burdens the promotion of more affordable broadband deployment in rural areas, and requests that higher power be permitted for TV bands devices operating on channels separated by 12 megahertz or more from a digital TV station.[137] WISPA states that the limit for fixed devices could be increased to 20 watts of transmitter power to facilitate more efficient and economical use of the white spaces, and that the Commission should adopt protection criteria that permit operation of fixed devices at increased power as the distance from protected signals increases.[138] Motorola supports PISC's and WISPA's requests to increase the power of fixed devices, while MSTV/NAB opposes them.[139] Shure opposes WISPA's request, stating that devices at this power level would interfere with wireless microphones far beyond the 1 km protection radius.[140] SBE opposes higher power for fixed TV bands devices because of the increased potential for interference to low power licensed stations that are entitled to protection.[141] NCTA opposes to the requests of PISC and Motorola to increase the maximum allowable power of TV bands devices due to concerns about direct pickup interference.[142]

72. PISC believes that personal/portable devices that rely on geo-location/database lookup should be able to operate with power above 100 mW if the device is separated from a licensed service by two or more available channels.[143] Adaptrum argues that the power limit for personal/portable TV bands devices should be increased to 250 mW but does not provide a clear description or analysis of how devices could operate at this higher power level without posing increased potential for interference.[144] Shure opposes this request, arguing that a 250 mW TV bands device near the edge of a wireless microphone's protected zone could interfere with the microphone.[145] Motorola requests that a maximum power level of 4 watts EIRP be allowed for vehicle mounted mobile devices that are wirelessly tethered to a fixed device or that have access to a database, and suggests that marketing of devices could be limited to users defined in Part 90 of the rules.[146] SBE opposes requests for higher power, arguing that the rules adopted in the *Second Report and Order* are already inadequate to prevent interference.[147]

73. Adaptrum submits that sensing-only devices should be permitted to operate up to 100 mW instead of 50 mW, arguing that the 50 mW limit is arbitrary and was not explained in the *Second Report and Order*, and that a higher limit would provide an incentive for developers

[137] *See* PISC petition at 10.

[138] *See* WISPA petition at 15. Carlson Wireless and Federation of Internet Solution Providers support WISPA's request for higher power. *See* Carlson Wireless opposition at 3 and Federation of Internet Solution Providers opposition at 3.

[139] *See* Motorola opposition at 11 and MSTV/NAB opposition at 7.

[140] *See* Shure opposition at 10-12.

[141] *See* SBE opposition at 11.

[142] *See* NCTA opposition at 6-7.

[143] *See* PISC petition at 12.

[144] *See* Adaptrum petition at 5.

[145] *See* Shure opposition at 13.

[146] *See* Motorola petition at 16-18.

[147] *See* SBE opposition at 6-7.

to push the envelope in sensor performance.[148] PISC also requests a power increase to 100 mW for sensing-only devices, arguing that 50 mW is insufficient for spreading connectivity beyond a single room and would not allow mesh networking of devices.[149] Shure argues that a 100 mW TV bands device would interfere with wireless microphones located beyond the range at which a -114 dBm sensing capability could detect the signals of wireless microphones operating at their typical operating power levels.[150]

74. Some parties argue that the maximum permitted power for personal/portable devices operating on first adjacent channel should be reduced.[151] Shure argues that personal/portable TV bands device first adjacent channel operations will harm incumbent authorized services and should be limited to a maximum power level of 10 mW, which is comparable to the power used by wireless microphones.[152] SBE also argues that the 40 mW power limit for adjacent channel operation by personal/portable devices is too high and fails to provide an adequate level of protection for television viewers.[153] It further argues that the Commission's analysis used incorrect D/U ratios and made incorrect assumptions concerning antenna discrimination, interference distances and modulation types.[154] SBE argues that mobile DTV reception should be protected at a distance of 2 meters.[155] Rudman/Ericksen argue that the assumed 3 dB polarization discrimination factor between vertically polarized TV bands device antennas and DTV antennas is invalid because many DTV stations employ elliptical or circular polarization, back of TV set antenna loops that have vertical polarization are often used and the antennas of personal/portable TV bands devices can have any orientation.[156] MSTV/NAB claims that a personal/portable device operating at 1.5 mW on the first adjacent channel will not protect over-the-air broadcasts at the noise-limited contour level, and that the power levels adopted in the *Second Report and Order* are inadequate to protect reception of new mobile television services.[157] However, Dell/Microsoft argues that speculation about future broadcast service does not justify restrictions on adjacent channel power today.[158] Google and PISC believe that tighter restrictions on adjacent channel operation would make TV bands devices non-viable in major markets.[159] NCTA opposes the requests of Adaptrum, PISC and Motorola to increase the

[148] *See* Adaptrum petition at 9.

[149] *See* PISC petition at 23.

[150] *See* Shure opposition at 12-13.

[151] Some parties also argue that personal/portable devices should not operate on first adjacent channels; this issue is discussed below in the section "TV Channel Uses."

[152] *See* Shure petition at 7. Dell/Microsoft and Google oppose Shure's request. *See* Dell/Microsoft opposition at 5 and Google opposition at 15-16.

[153] *See* SBE petition at 2-3.

[154] *Id*. at 5-8.

[155] *Id*. at 11.

[156] *See* Rudman/Ericksen petition at 12 and SBE petition at 5.

[157] *See* MSTV/NAB opposition at 3.

[158] *See* Dell/Microsoft opposition at 19.

[159] *See* Google reply to oppositions at 7 and PISC opposition at 19-20.

maximum allowable power of TV bands devices as well as PISC's request to allow portable devices to operate on channels 5-13 due to concerns about direct pickup interference.[160]

75. Several parties request that we adopt a power spectral density (PSD) limit. IEEE 802 states there is a need to allow TV bands devices to operate with narrower bandwidths while maintaining the same level of protection to incumbents that would be provided if the transmitter power were spread over a wider channel. It recommends specifying a maximum power spectral density limit of 8 dBm (conducted) in a 3 kHz bandwidth, and requiring the minimum occupied bandwidth of a TVBD signal to be at least 500 kHz to differentiate between a Part 74 wireless microphone and a TVBD.[161] SBE believes that emissions from TV bands devices should be required to be wideband and noise-like with a minimum bandwidth of 4.5 megahertz and power measured over a 6 megahertz bandwidth.[162] MSTV/NAB argues that TV bands device emissions should be required either to have a minimum bandwidth of 4.5 megahertz or to comply with a maximum PSD limit in a narrower bandwidth.[163]

76. *Decision*. We are not convinced by the petitions for reconsideration that the power limits for unlicensed TV bands can be increased without also increasing the potential for interference to authorized services and therefore are affirming the power limits for fixed and personal/portable devices the Commission adopted in the *Second Report and Order*. In addition, as discussed below, we do not find that the power level of TV bands devices should be restricted to protect against direct pick-up interference to cable and satellite TV services. We do, however, recognize the need to address power considerations in TV bands device signals that occupy less than the full bandwidth of a TV channel and therefore are amending the rules to include power spectral density limits.

77. We decline to increase the 4 watt EIRP power limit for fixed devices and note that the Commission also considered and rejected a higher power limit for fixed devices in the *Second Report and Order*.[164] While the Commission previously observed that there are advantages to higher power levels for fixed devices, such as reduced infrastructure costs and increased service range, it did not adopt a higher power limit due to concerns about increased risk of interference in congested areas and a lack of experience with unlicensed wireless broadband operations in the TV bands. We also recognize the increased range provided by operation at higher power levels would be particularly desirable for some applications, including rural service and mobile operations as suggested by Motorola. We also understand that there may be situations where radio communications facilities could operate at higher power in TV white spaces without causing interference. However, we continue to conclude that because the extended range of such devices would significantly increase the potential for interference and also make it more difficult to identify sources of interference, it would not be appropriate allow higher power for unlicensed TV bands devices at this time. Indeed, such operation would be more appropriate under a licensed regime of regulation. We are therefore affirming the Commission's previous decision on fixed device power levels; we could re-visit the issue of

[160] *See* NCTA opposition at 6-7.

[161] *See* IEEE 802 petition at 5.

[162] *See* SBE petition at 13.

[163] *See* MSTV/NAB opposition at 8.

[164] *See Second Report and Order* 23 FCC Rcd 16847 (2008) at ¶106.

higher power levels for TV bands devices on a licensed or unlicensed bases at some point in the future as may be appropriate

78. We are retaining the current 100 mW maximum transmitter power limit for Mode I and Mode II personal/portable devices and decline to establish a new class of higher power vehicle mounted portable devices. As the Commission noted in the *Second Report and Order,* personal/portable devices generally pose a greater risk of harmful interference to authorized operations than fixed devices because these devices will change locations, making identification of both unused TV frequencies and the devices themselves, if interference occurs, more complex and difficult.[165] The Commission also noted the significant distances at which interference could occur from a personal/portable device operating at greater than 100 mW would make it very difficult to identify a device that is the source of interference.[166] We therefore decline to increase the power limit for personal/portable devices at this time.

79. Additionally, we are retaining the 50 mW power limit for sensing-only devices. The Commission stated in the *Second Report and Order* that the prototype TV bands devices it tested were able to sense the presence of signals from incumbent services under some conditions, but were unable to do so in others, such as in noisy environments or in the presence of strong adjacent channel signals.[167] It further stated that these factors made it difficult to fully validate the performance of sensing technology and develop standards to ensure that devices relying on sensing alone would not cause interference. While the Commission believed that these problems could be solved and decided to permit sensing-only devices, it decided to limit these devices to 50 mW rather than 100 mW as permitted for other personal/portable devices out of an abundance of caution with regard to their interference potential.[168] We find that the Commission provided an adequate rationale for the 50 mW power limit for sensing-only devices and decline to change the power limit for these devices at this time.

80. We also decline to reduce the maximum permitted power for personal/portable devices that operate adjacent to occupied TV channels. In the *Second Report and Order*, the Commission recognized that there is a potential for TV bands devices to interfere with TV reception on adjacent channels, but found that such interference is unlikely to occur in the majority of situations if the power level is kept low. As with any interference analysis, certain assumptions were made concerning factors such as the separation distance from the potential source of interference to the receive antenna, the characteristics of the receiver, the type of transmit and receive antennas and any intervening terrain or obstacles. The petitioners are essentially challenging the assumptions the Commission used in its analysis in the *Second Report and Order*. We find that the Commission made reasonable assumptions and are upholding the 40 mW adjacent channel power limit. Specifically, we observe that interference to TV reception from a transmitter on an adjacent channel would occur only when an adjacent channel signal level is substantially greater than the received TV signal level. Thus, adjacent channel interference would be most likely to occur in weak signal areas where an outdoor rooftop antenna is needed. In such situations, we find the Commission's assumed separation distance of

[165] *Id*. at 16849, ¶116.

[166] *Id*. at 16840, ¶84.

[167] *Id*. at 16895, ¶257.

[168] *Id*. at 16895, ¶258.

16 meters from a TV bands device to a rooftop TV antenna to be reasonable, as well as its assumption that the receive antenna will have horizontal polarization while the TV bands device has vertical polarization and that such a configuration will have a 3 dB polarization mismatch.

81. We find that assuming a TV receiver can reject adjacent channel signals at a -33 dB D/U ratio is reasonable because many receivers tested by the Commission have better performance than this, and because TV bands devices will comply with the stringent emission limits in the rules out-of-band emissions, which will limit *e*missions in the adjacent channel that could cause overload interference. Further, while SBE disputes the values the Commission used for TV antenna gain, it apparently considered only signals in the horizontal plane antenna pattern and not the additional attenuation resulting from the vertical difference in heights between the receive antenna and TV bands device. We note the arguments of SBE and MSTV that the Commission should assume a separation distance of two meters from TV bands devices to mobile DTV receivers. However, neither party provided an interference analysis or information about the characteristics of mobile DTV receivers, such as the sensitivity, adjacent channel D/U ratio that can be tolerated, antenna gain or directionality that could be used in an interference analysis.

82. With regard to Shure's request that we reduce the maximum power of TV bands devices operating adjacent to occupied channels, we note that wireless microphones operating under the Part 15 waiver are permitted to transmit with up to 50 mW, while Part 74 licensed microphones are permitted to transmit with up to 250 mW. Also, TV bands devices must use transmit power control to operate with the minimum power necessary for reliable communications and will therefore often operate at power levels below 40 mW. Thus, there is no significant power disparity between wireless microphones and TV bands devices. Further, as discussed below we are requiring TV bands devices to comply with power spectral density limits and to spread their energy to some degree within the TV channel of operation, while wireless microphones operate with a relatively narrow bandwidth. The fact that wireless microphones use narrow bandwidths compared to TV bands devices means that the interference potential from TV bands devices is reduced because a wireless microphone receiver will receive only a portion of the energy transmitted by a TV bands device.

83. We agree that a PSD limit would help protect authorized services in the TV bands and are therefore requiring that the conducted output power of fixed and personal/portable TV bands devices comply with PSD limits. In the absence of a PSD limit, multiple devices with transmit bandwidths of significantly less than 6 megahertz could share a single channel, resulting in a total transmitted power within a channel significantly greater than the power limits for fixed or personal/portable devices. A PSD limit will prohibit high power concentrations in a single channel, which will reduce the interference potential to TV stations and other services in the TV bands. We are basing the PSD limit on the maximum permissible conducted output power spread across a transmit bandwidth of 6.0 megahertz, the full bandwidth of a TV channel. The resulting conducted PSD limits in a 100 kilohertz bandwidth are 16.7 mW (12.2 dBm) for fixed devices, 1.67 mW (2.2 dBm) for personal/portable devices, 0.83 mW (-0.8 dBm) for sensing-only personal/portable devices and 0.7 mW (-1.8 dBm) for personal/portable devices operating adjacent to occupied channels. We are adopting these PSD limits. We decline, however, to adopt minimum bandwidth requirements as requested by IEEE 802 and SBE. We find that a minimum bandwidth requirement could unnecessarily constrain the types of modulation that could be used with TV bands devices and is not necessary because the PSD limit has the same effect of preventing high power levels in a TV channel. We are also clarifying that a device that

operates across more than one 6 MHz TV channel is still subject to the maximum power limits in Sections 15.709(a)(1) and (a)(2) of the rules per channel – the allowable power per channel does not increase with use of additional bandwidth beyond 6 megahertz.[169]

c. Out of Band Emission (OOBE) Limits

84. In the *Second Report and Order*, the Commission required that TV bands device emissions in channels adjacent to the occupied channel be attenuated at least 55 dB below the highest average power in the occupied channel. Emission measurements in both the occupied channel and the adjacent channels are to be made with a minimum resolution bandwidth of 100 kHz and an average detector.[170]

85. *Petitions and Replies*. Several parties request that the Commission modify the adjacent channel emission limits. IEEE 802 believes that the adjacent channel emission limits should be defined relative to the maximum allowable power in a 6 megahertz bandwidth, and that adjacent channel emissions should be measured in a 100 kHz bandwidth.[171] It recommends that the required attenuation in the adjacent channel be increased from 55 dB to 72.8 dB to compensate for the differing bandwidths it recommends for measuring in-band and out-of-band power. IEEE 802 argues that without these changes, the maximum permitted adjacent channel emissions would be higher when a transmit bandwidth of less than 6 megahertz is used, because the power of adjacent channel emissions would increase by the same amount that the power of the transmitted signal increases within the 100 kHz measurement bandwidth. Motorola requests that the Commission clarify that the limit is 55 dB attenuation from the total in-band power transmitted by the TV bands device, and that out-of-band power should be measured in a 100 kilohertz bandwidth.[172] Motorola also requests that if the Commission maintains the current emission measurement procedure, the minimum required attenuation should be reduced from 55 dB to 35 dB because an attenuation of 55 dB in adjacent channels is difficult to meet in consumer equipment operating at the power levels permitted by the Commission.

86. The Wi-Fi Alliance requests that the Commission specify the attenuation in channels adjacent to the operating channel referenced to the average total power over the operating bandwidth, and that emissions measured in a 100 kHz bandwidth should be at least 39 dB below the average total power over the operating bandwidth.[173] MSTV/NAB argues that adjacent channel emissions should be measured relative to the maximum allowable power in the 6 megahertz operating channel and oppose the requests of Motorola and Wi-Fi Alliance because they would allow higher adjacent channel emissions than the current rules.[174] Rudman/Erickson claim that the emission mask is inadequate for VHF TV bands device operation because the Commission did not consider the protected contour values for VHF DTV stations, but they did not recommend an alternative.[175]

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[169] *See* 47 C.F.R. § 15.709(a)(1) and (a)(2).

[170] *See* 47 C.F.R. § 15.709(c).

[171] *See* IEEE 802 petition at 5.

[172] *See* Motorola petition at 23.

[173] *See* Wi-Fi Alliance petition at 5.

[174] *See* MSTV/NAB opposition at 8.

[175] *See* Rudman/Erickson petition at 10.

87. *Decision*. We are modifying the rule for adjacent channel emissions to require that emissions be measured relative to the total in-band power in a 6 megahertz bandwidth, rather than in a 100 kHz bandwidth. This change will address the concerns raised by petitioners that the measured in-band power in a narrow bandwidth will vary depending upon the bandwidth of the transmitted signal. We will continue to require that the adjacent channel emissions be measured with a 100 kHz bandwidth, because a wider bandwidth would not be able to resolve emissions located just outside the channel of operation without being affected by the in-band power. The use of a 6 megahertz bandwidth for measuring the in-band power means that a higher reading will be obtained as compared to using a 100 kHz bandwidth, because the wider bandwidth will capture all the energy in a channel rather than only a portion of that energy. The 55 dB attenuation that the Commission adopted for adjacent channel emissions was based on the assumption that identical bandwidths would be used to measure both in-band and adjacent channel power, so we agree with IEEE that the currently required 55 dB attenuation should be increased to reflect the increased in-band measuring bandwidth while providing the same level of adjacent channel protection. As noted above, we will assume the maximum transmit bandwidth used to be the full 6 MHz channel. We will therefore base the increase in adjacent channel attenuation on a bandwidth ratio of 6.0 megahertz/100 kHz or 17.8 dB. Thus, we are revising the required adjacent channel attenuation to be 72.8 dB.

88. We decline to reduce the required adjacent channel attenuation as requested by Motorola and the Wi-Fi Alliance. Adjacent channel emissions from a TV bands device appear as co-channel emissions in an adjacent channel used by a TV station or other authorized service. Personal/portable TV bands devices are permitted to operate within the protected contours of adjacent channel TV stations, and fixed TV bands devices can operate as close as 0.1 kilometers outside the contours of adjacent channel stations and at significantly higher power than personal/portable TV bands devices. For these reasons, we find it necessary to limit adjacent channel emissions to the extent practicable to prevent interference to adjacent channel TV stations and other authorized services. We decline to modify the adjacent channel emissions limits for the VHF band as requested by Rudman/Erickson because they failed to describe or provide a justification for any specific changes to the rules.

d. Direct Pickup Interference

89. In the *Second Report and Order*, the Commission recognized the concerns of cable interests regarding the potential for direct pickup interference and their position that power levels should be limited to a lesser value.[176] It noted that FCC staff tests of three digital cable ready receivers, and anecdotal tests performed by the FCC staff in the laboratory and field, indicated that there is some potential for direct pickup interference to cable service from TV bands devices. The Commission observed that this direct pickup interference occurred at relatively close distances within the user's premises and could be corrected by removing consumer-installed splitters and wiring that effectively reduce the shielding of interfering signals as well as reduce the desired signal levels available at the user's TV receiver. It also observed that in the FCC staff tests when just a cable converter box was used to connect directly to the TV receiver, interference declined dramatically and was virtually non-existent on the digital tier of channels. The Commission further observed in tests by the staff with a 10 meter separation between devices on separate sides of a wall, such as in a townhouse, interference did not occur at

[176] *See Second Report and Order* 23 FCC Rcd 16852 (2008) at ¶126.

undesired signal levels below 100 mW for two receivers and slightly under 50 mW for a third. Based upon these observations and the fact the TV bands devices must incorporate transmit power control to limit their operating power to the minimum necessary for successful communications, the Commission decided that the risk of direct pickup interference is not sufficiently great to warrant a reduction in power that could impede the viability of certain TV bands device applications.[177]

90. *Petitions and Replies*. NCTA argues that tests it commissioned in support of its petition for reconsideration show that TV bands devices will cause harmful direct pickup interference to cable services.[178] It claims that personal/portable devices operating at 100 mW will cause interference to television receivers up to 80 feet away through a wall.[179] NCTA states that many television receivers do not meet the Part 15 shielding requirements for cable ready receivers and that consumer in-home wiring is wholly inadequate to guard against signal ingress from 100 mW devices.[180] It disagrees that interference can generally be eliminated by removing consumer installed splitters and wiring or that dynamic power control is a solution because there are no parameters or specifications for the power level, and because devices may tend to operate at maximum power indoors.[181] NCTA believes that maximum power for personal/portable devices should be 5 mW, but states that it would compromise on a level of 50 mW.[182] It also claims that fixed TV bands devices operating on VHF channels can cause interference at a distance of 1,000 feet through a wall.[183] NCTA requests that the Commission adopt a minimum separation requirement for TV bands devices of 400 feet from 4 watt ERP fixed transmitters to buildings served by cable and limit fixed device power to 1 watt in urban areas where there is a difficulty in maintaining this separation distance.[184] DIRECTV states that satellite TV in-home architecture is susceptible to direct pickup interference and supports NCTA's requests to limit personal/portable device power to 50 mW and require minimum distance separations between fixed devices and buildings served by cable and asks that this protection also be extended to satellite TV service.[185]

91. Several parties object to the requests by NCTA and DIRECTV to limit TV bands device power and establish minimum distance separations. Dell/Microsoft argue that NCTA did not test digital cable signals at the UHF frequencies on which personal/portable devices will operate, and that all TV receivers tested by NCTA appear to be able to withstand a 100 dBu field

[177] *Id*. at 16853, ¶126.

[178] *See* NCTA petition at 6.

[179] *Id*. at 7.

[180] NCTA petition at 7-8. Section 15.118(c) of the Commission's rules provide shielding requirements for analog cable ready consumer electronics products, 47 C.F.R. § 15.118(c).

[181] NCTA Petition at 10-11.

[182] *Id*. at 13.

[183] *Id*. at 13.

[184] *Id*. at 13.

[185] *See* DIRECTV opposition at 3.

when tuned to digital signals.[186] In its reply to opposition, NCTA disagrees that direct pickup interference is not a problem with digital cable systems.[187] Google opposes a reduction in personal/portable device transmit power, arguing that dynamic power reduction, equipment suppliers' efforts and consumers' own corrective measures should be sufficient to alleviate the risk of direct pickup interference.[188] Motorola opposes NCTA's request for a 400 foot separation between buildings with cable TV service at 4 watt EIRP devices or a reduction in power to one watt, arguing that the limit was adopted after an exhaustive analysis by the Commission and industry and should not be decreased.[189] WISPA argues that NCTA's indoor test results are flawed by use of an inadequately characterized unshielded test area and leaky cables and that their indoor-to-outdoor extrapolation is flawed by invalid assumptions concerning antenna aim and wall attenuation.[190]

92. *Decision*. We decline to reduce the maximum permissible power for personal/portable devices or to impose power and separation limits for fixed devices as requested by NCTA and DIRECTV. We first note that direct pickup interference is different from interference that can be received at the antenna of licensed over-the-air radio services such as broadcast television, low power auxiliary services or the PLRMS/CMRS. Interference can be caused to off-air reception of these services when an undesired signal on the same frequency as the transmitted signal exceeds some threshold at a receiver. By contrast, a cable system or satellite in-home wiring is a closed system in which the operator is not licensed to transmit on the frequencies used. No signal is transmitted over-the-air in those applications, rather direct pickup interference occurs when an undesired signal leaks into some part of the otherwise closed system, such as the cable, connectors, set top box or TV set. Thus, direct pickup interference results from a lack of immunity to undesired signals at some point(s) in the closed system of wiring and equipment. As noted above, the Commission has standards for regarding the ability of analog cable ready TV receivers to reject direct pickup interference.[191] However, there are no rules regarding the ability of other components in a system to reject direct pickup interference, and selection of appropriate system components is the owner or cable/satellite TV operator's responsibility. In this regard, we generally do not believe it is appropriate to protect the operations of closed systems that use radiofrequency (RF) signaling from interference from radio services and operations that use the airways. In this regard, we observe that the operators/users of such systems have full discretion to design their equipment to be immune to ambient RF energy transmitted by radio systems that use the airways.

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[186] *See* Dell/Microsoft opposition at 10. They further argue that there will be few legacy analog system components remaining by the time white space devices are available to consumers, that many or most cable and DBS systems are not susceptible to the interference that concerns NCTA and DIRECTV, and that other devices such as 800 MHz cell phones operate with higher power than TV bands devices and do not cause interference. *See* Dell/Microsoft opposition at 10 and reply to oppositions at 6-7. NCTA claims there is no significant use of the 800 MHz band by cable systems and that little frequency overlap is expected with new services in the 700 MHz band. *See* NCTA reply to oppositions at 2, 4.

[187] *See* NCTA reply to oppositions at 2, 4.

[188] *See* Google opposition at 16.

[189] *See* Motorola opposition at 12.

[190] *See* WISPA opposition at 12-15.

[191] *See* 47 C.F.R. § 15.118(c).

93. We also are not persuaded that direct pickup interference is a significant problem as NCTA states. Its testing revealed many of the same characteristics of direct pickup interference that the Commission's staff discovered during its testing. Specifically, NCTA determined that that the cables in a system are a significant source of direct pickup and that low quality (inadequately shielded) cables and connectors can result in substantially increased signal ingress. It also determined that analog systems are significantly more sensitive to direct pickup interference than digital systems. The Commission previously considered these factors when it established the power limits for TV bands devices in the *Second Report and Order*.[192] We note that the NCTA tests assumed a worst case scenario in which the cable signal level to a home is at the minimum level required by the rules, the TV bands device operates at the maximum power permitted by the rules and the maximum signal level is directed towards a TV receiver. In real world situations, the cable signal level may be greater than the minimum required, the TV bands device may operate at less than the maximum power due to the requirement to incorporate transmit power control, and the maximum TV bands device signal may not be directed toward a TV receiver, depending on the antenna directivity and orientation. These factors can have a greater impact on the potential for direct pickup interference than the power reductions requested by NCTA. We also note that NCTA's testing showed that some TV receivers can withstand signals levels greater than 100 mW without interference on digital channels, even assuming minimum cable signal input levels.[193] We further note that NCTA did not perform any tests using a cable converter box, which our testing showed, and which it agrees, could further reduce the potential for direct pickup interference.[194] In any event, notwithstanding NCTA's concerns for direct pickup interference and the possible mitigation of those concerns by elements in rules for TV bands devices, we find it inappropriate to limit the utility of TV bands devices by limiting their power to protect cable installations with inadequately shielded wiring or TV receivers that do not comply with the Part 15 shielding requirements.

C. TV Bands Database

94. In the *Second Report and Order*, the Commission required all fixed and Mode II TV bands devices to access a database to obtain information on the available channels at their location and required all unlicensed fixed TV bands devices to register their operations in this database.[195] The Commission stated that it will designate one or more entities to create and operate the TV bands database(s) and, as discussed above, has invited interested parties to apply for selection as database administrators.[196] The database(s) will be a privately owned and operated service that unlicensed TV bands devices must contact to obtain information on channel availability at the locations where they are operated and, in the case of fixed devices, to register their operation at those locations. In the case that multiple database administrators are selected, each device must contact a database service that the user or the manufacturer of the device selects. Database administrators are permitted to charge fees for registering fixed devices and

[192] *Id*. at 16852, ¶126.

[193] *See* NCTA petition at Appendix 3, Tables 2 and 3. For example, three of the five TV receivers tested on cable channel 36 were able to reject signals greater than 100 mW in all orientations, and a fourth was able to reject signals greater than 100 mW in three out of four orientations.

[194] *See Second Report and Order* 23 FCC Rcd 16852 (2008) at ¶126 and NCTA petition at 10.

[195] *Id*. at 16877, ¶201.

[196] *Id*. at 16878, ¶204.

providing lists of available channels to fixed devices and personal/portable devices. A TV bands database will be required to contain information on: 1) all of the authorized services that operate in the TV bands using fixed transmitters with designated service areas, including full service and low power TV stations, 2) the service paths of broadcast auxiliary point-to-point facilities, 3) the geographic regions served by PLMRS/CMRS operations on channels 14-20, 4) regions served by the Offshore Radiotelephone Service, and 5) the locations of cable headends and low power TV receive sites that are outside the protected contours of the TV stations whose signals they receive. In addition, a TV bands database will be required to contain the locations of registered sites where wireless microphones and other low power auxiliary devices are used on a regular or scheduled basis. The Commission did not establish any specific security requirements or protocols for communications between TV bands devices and the TV bands database.

95. The Commission required fixed and Mode II TV bands devices to re-check the database, at a minimum, on a daily basis to provide for timely protection of wireless microphones and other new or modified licensed facilities.[197] If a device fails to make contact with its database on any given day, it will be required to cease operating at 11:59 PM on the following day. Mode II devices are also required to re-establish their location coordinates and to access a TV bands database for a list of available channels each time they are activated or moved. The Commission further required that, if multiple database administrators are authorized, the database administrators are to cooperate to develop a standardized process for sharing data on a daily basis or more often, as appropriate, to ensure consistency in the records of protected facilities.[198] Finally, the Commission required that a database administrator make its services available to all unlicensed TV bands device users on a non-discriminatory basis.

1. Security

96. *Petitions and Replies*. Key Bridge argues that the Commission did not adequately address security risks with the geo-location/database approach and request that it require "strong counter party authentication" between databases and TV bands devices without specifying particular technologies or system architecture.[199] Other parties, including CWMU, MSTV/NAB and SBE, also argue that the Commission needs to adopt database security requirements.[200] MSTV/NAB submits that the absence of security requirements for databases or communications between a database and devices will leave the database system open to hackers to falsely list certain channels as available.[201] It also expresses concern that because the Commission's decision allows database administrators to agree on a protocol, the Commission retains no authority to approve those protocols.[202] Google opposes Key Bridge's request, arguing that the Commission adequately addresses the issue of authentication by relying on database administrators to correct inaccurate data and by reserving the Commission's right to remove inaccurate or non-compliant information.[203] Google also argues that each database administrator

[197] *Id*. at 16879, ¶206.

[198] *Id*. at 16884, ¶222.

[199] *See* Key Bridge petition at 3.

[200] *See* CWMU opposition at 7 and SBE petition at 22.

[201] *See* MSTV/NAB opposition at 15.

[202] *Id*. at 14.

[203] *See* Google opposition at 18.

will implement appropriate security features without the need to require such features in the rules.[204]

97. *Decision.* On reconsideration, we find that it is important and necessary for TV bands devices and TV bands databases to incorporate reasonable and reliable security measures to minimize the possibility that TV bands devices will operate on occupied channels and cause interference to licensed services and to protect the operation of the databases and the devices they serve from outside manipulation. While the Commission did not explicitly require the incorporation of security measures in the *Second Report and Order*, we note that virtually all online transactions involving financial or other confidential information currently use security measures to protect against unauthorized viewing and/or alteration of information being sent and to ensure that only authorized users have access to information. We therefore expect that device manufacturers and database administrators will have access to and be able to incorporate the reliability and security measures needed to protect the contents of databases and communications between databases and TV bands devices or other databases. We are concerned that if a device uses channels provided through other than legitimate contact with a TV bands database or if a database administrator does not include appropriate security to avoid serving unauthorized devices or to prevent outside parties from altering its processing system and data records, there could be interference consequences ranging from mild to severe.

98. To achieve the necessary protection of databases and connections between devices and databases regarding channel availability, we are requiring that TV bands devices and database systems employ security measures as follows. First, we are requiring that, for purposes of obtaining a list of available channels and related matters, fixed and Mode II TVBDs only be capable of contacting databases operated by administrators designated by the Commission. This will prevent TV bands devices from obtaining channel lists from unauthorized databases which may be invalid or inaccurate – we are particularly concerned about potential cases where a database would indicate as available channels that are used by authorized services. We also are specifying that TV bands databases must not provide lists of available channels to uncertified TV bands devices for purposes of operation (it is acceptable for a TV bands database to distribute lists of available channels by means other than contact with TVBDs) in order to avoid facilitating the operation of unapproved and non-compliant devices. To facilitate these restrictions, we are requiring that database(s) verify that the FCC identification number (FCC ID) supplied by a fixed or personal/portable TV bands device is for a certified device. To implement this provision, we are also requiring that database administrators obtain a list of certified TVBDs from our Equipment Authorization System.[205]

99. We are further requiring that communications between TV bands devices and databases be transmitted using secure methods to prevent corruption or unauthorized modification of data. This requirement includes communications of channel availability and other spectrum access information between fixed and Mode II devices (it is not necessary for TVBDs to apply security coding to channel availability and channel access information that they

[204] *Id*. at 18.

[205] Our Laboratory Division will provide a means for database administrators to obtain a list of certified TVBDs from the database maintained in our Equipment Authorization System.

simply pass through as such information will already be protected by the sending device).[206] We are requiring that when Mode I devices communicate with fixed or Mode II devices for purposes of obtaining a list of available channels, they are to use a secure method that ensures against corruption or unauthorized modification of the data. In addition, a fixed or Mode II device must check with its database that the Mode I device has a valid FCC Identifier before providing a list of available channels.[207] Also, we are requiring that contact verification signals transmitted for Mode I devices be encoded with encryption to secure the identity of the transmitting device and that Mode I devices using such signals accept as valid for authorization only the signals of the device from which they obtained their list of available channels. Finally, we are requiring that databases be protected from unauthorized data input or alteration of stored data. In order to accomplish this goal, the data base administrator is to establish communications authentication procedures that allow the fixed or Mode II devices to be assured that the data they receive is from an authorized source.

100. We are not requiring the use of specific technologies to meet these requirements, as we believe that database administrators and device manufacturers are in the best position to determine the appropriate methods to ensure compliance. Rather, we will require that applications for certification of TV bands device include a high level operational description of the technologies and measures that are incorporated in the device to comply with the security requirements. In addition, we are requiring that applications for certification of fixed and Mode II devices identify at least one of the designated TV bands databases that the device will have the ability to access for channel availability information and affirm that the device will conform to the communications security methods used by that database. With regard to MSTV/NAB's concerns about the possible problems with protocols developed after a database administrator is selected, there is no practical way the Commission could review a communication protocol in advance to provide absolute assurance that there are no security flaws with it. We will, however, take all reasonable steps in our examination of applications for certification to ensure that communications protocols are secure. In the event that flaws are discovered in a TVBD's security measures, the Commission will take steps to ensure that those measures are quickly corrected by device manufacturers and database administrators or to withhold or withdraw the authorization for operation of any affected devices.

2. Database Administrators

101. *Petitions and Replies*. SBE, CMWU and MSTV/NAB argue that that the Commission should designate a single database manager to perform all database functions.[208] CWMU believes that the database operator should function under close supervision of the Commission with an advisory panel consisting of representatives of all stakeholders to ensure that control of its development and/or operation is not assumed by one faction, and that

[206] MSTV/NAB also express concern about the security of communications between client devices and a master or fixed device that provides their channel assignments. They suggest that, at a minimum, client devices should be required to transmit a unique identifier to minimize the risk that they receive information from an unreliable source. *See* MSTV/NAB opposition at 15-16. This issue is addressed below in the section on "Transmitter IDs."

[207] As discussed above, we note that the rules do not permit personal/portable devices operating on a client basis to relay channel availability information from one client device to another client device unless some means is used to ensure that each device is operating within the parameters for its particular location.

[208] *See* SBE petition at 20, CWMU opposition at 6 and MSTV/NAB opposition at 13.

management is not hindered by an inability to reach agreements or compromises.[209] SBE argues that multiple database operators would complicate device designs and the ability to prevent and control rogue database operators.[210]

102. PISC argues that the Commission should permit the functions of a database to be split among multiple entities rather than requiring a single database provider to perform all functions.[211] It believes that the database could consist of a repository service that would be responsible for creating, updating and maintaining a database, a separate query service for providing available channel information based on data in the repository, and a registration service for fixed TV bands devices.[212] PISC requests that the Commission state its preference for a private but nonprofit database service.[213]

103. Key Bridge believes that the Commission should proceed with its original intent to authorize multiple database administrators that cooperate to ensure data integrity and synchronization.[214] It disagrees with SBE that multiple databases will impose a burden on TV stations to ensure databases are accurate and cites the Internet Domain Name System as an example of a globally distributed public information service with multiple, privately operated database servers.[215] Key Bridge argues that there are significant risks with a monopoly administrator, including proprietary database access formats, poor operational performance and prohibitive pricing and fees.[216] It disagrees with PISC that the database administrator function should be deconstructed or that a non-profit organization should be preferred.[217] Key Bridge supports the Commission's original intent to permit more than one database administrator but does not want this to create a situation with potentially functionally overlapping but only partially competent service providers.[218]

104. *Decision.* We are upholding the Commission's decision to allow the designation of multiple database administrators and will rely on market forces to shape the structure of the database administration functions and service offerings, subject to the various requirements set forth in the rules. Under this approach, some providers may choose to provide a full panoply of services and others may choose to provide only a repository function or "look-up" service. As the Commission stated in the *Second Report and Order*, multiple database administrators could offer services on a competitive basis.[219] This would prevent a single party from obtaining monopoly control over the database, could provide an incentive for database operators to provide

[209] *See* CWMU opposition at 7 and reply to oppositions at 5.

[210] *See* SBE petition at 20.

[211] *See* PISC petition at 12, 14.

[212] *See* PISC petition at 13.

[213] *See* PISC petition at 15.

[214] *See* Key Bridge opposition at 3.

[215] *See* Key Bridge opposition at 2-3.

[216] *See* Key Bridge reply to oppositions at 3.

[217] *See* Key Bridge opposition at 5.

[218] *See* Key Bridge opposition at 6.

[219] *See Second Report and Order* 23 FCC Rcd 16878 (2008) at ¶204.

additional services beyond those required by the rules and could result in lower costs to consumers. We will permit the database functions, such as a data repository, registration and query services, to be split among multiple entities. This approach will allow for competition between providers of specific elements of the database function and encourage the provision of enhanced services not specifically required by the rules. We recognize Key Bridge's concerns about creating a situation in which some parties engaged in the process do not have full competency in all aspects of database administration, but no parties would provide all the necessary database functions. We therefore are requiring that entities selected as database administrators will be held accountable for all aspects of database administration, including any functions performed by third parties. The nine proposals received in response to the Commission's November 25, 2009 public notice indicate that there are multiple parties seeking to be designated as TV bands device database managers, some as full-service operations and others as partial service providers. We are confident that market forces will result in the necessary and appropriate mix of database providers and third party entities that perform some aspect of the database function.

105. We disagree with SBE that designating multiple database administrators would complicate equipment design or limit the Commission's ability to control unauthorized database operators. Manufacturers would only have to design equipment to communicate with a single database, although they could design equipment to communicate with multiple databases if they choose. Further, designating only a single database administrator would not prevent unscrupulous parties from attempting to establish an unauthorized and inaccurate database, as parties could attempt this whether the Commission designates a single or multiple database administrators. Rather, the requirement to incorporate security in communications between TV bands devices and the databases will thwart unauthorized database operators.

106. We recognize that a complication of designating multiple database administrators is the need to synchronize licensing and registration information between databases. However, the rules already require this, and no party has shown that it is impractical to share information between TV bands device databases. We decline to establish an advisory panel to oversee the database as requested by CWMU. We find that this approach is unnecessary given that the Commission has already started the process for selecting the database administrators, and we are concerned that disagreements between panel members could potentially slow the development of the database. Rather, we will expect entities selected as a database administrator to cooperate in complying with the requirements for database coordination. We also decline to state a preference for a non-profit organization to run the database, as there is no evidence that a non-profit organization would administer a database better than a for-profit company.

107. In the *Second Report and Order*, the Commission stated that the database manager or managers would be selected by our Office of Engineering and Technology.[220] Once the selection of a database manager or managers is completed there will need to be Commission oversight and management of the database administrator(s) and their functions. We are delegating authority for this oversight to the Chief of our Office and Technology under Part 0 of the rules, as set forth in Appendix B.

[220] *Id.* at 16812.

3. Re-check Procedures

108. *Petitions and Replies*. Shure asks that the Commission require TV bands devices to access frequency availability information in real time, near real time, or at a minimum of once every hour, and that the Commission reduce the time period when TV bands devices must stop transmitting if they cannot contact the database from 48 hours to four hours.[221] Sennheiser, MSTV/NAB, SBE and CWMU also support increasing the frequency of database contact.[222] MSTV/NAB argues that if TV bands devices check the database only once per day, they will fail to protect many wireless microphone operations.[223] PISC and Google contends that requiring database look-up to protect registered microphone users in real time or substantially less than daily is unnecessary, possibly unworkable and would impose undue costs.[224] PISC argues that microphone venues know well in advance when they will be operating.[225]

109. IEEE 802 and Wi-Fi Alliance recommend as an alternative to a daily database check by TV bands devices that each such device provide an Internet contact address to allow the database to push changes in channel availability information to affected devices in near real time.[226] Wi-Fi Alliance also suggests the alternative of allowing each fixed or Mode II device to receive a certificate for time-limited operation in the TV bands.[227] Key Bridge states that an active channel management concept as proposed by IEEE 802 and WiFi Alliance could be accommodated without creating an undue burden on database administrators, but would require significantly expanded operational authority.[228] SBE opposes Wi-Fi Alliance's recommendation because it would not require daily database checks for fixed TV bands devices.[229]

110. Motorola requests that Mode II devices be permitted to contact the database and download channel availability information for multiple locations that surround its current location and that it contact the database again only when it has moved beyond the range where the downloaded information is valid.[230] It recommends that channel availability information be valid until 11:59 PM of the day after it was downloaded.[231]

111. *Decision.* We are affirming the current requirement that fixed and Mode II personal/portable TV bands device check the database at least once per day. The majority of entries in the database will be fixed services, such as TV stations, TV translator receive sites, cable and satellite headends, fixed BAS links, and the PLMRS/CMRS facilities. These fixed

[221] *See* Shure petition at 15-16.

[222] *See* Sennheiser opposition at 4, MSTV/NAB opposition at 12, SBE petition at 21 and CWMU opposition at 7.

[223] *See* MSTV/NAB opposition at 12-13 (itinerant wireless microphone incumbents cannot predict their spectrum needs or precise location 24 hours in advance).

[224] *See* PISC opposition at 12 and Google reply to oppositions at 9.

[225] *See* PISC opposition at 12.

[226] *See* IEEE 802 petition at 6 and Wi-Fi Alliance petition at 2.

[227] *See* Wi-Fi Alliance petition at 3.

[228] *See* Key Bridge opposition at 3.

[229] *See* SBE opposition at 7.

[230] *See* Motorola petition at 19-20.

[231] *Id*. at 19-20.

services change channels or service areas infrequently, so we find that requiring a daily database check by TV bands devices is quite adequate to protect these services. The concerns expressed in the record about the need to increase the frequency of database contact relate primarily to protecting LPAS stations, and wireless microphones in particular. Even in the case of wireless microphones, most events for which users can register wireless microphones in the database occur at fixed locations where the required registration information will be known more than a day in advance. Thus, the main concern appears to be how to protect licensed wireless microphones that are used in applications where the location and/or channel are not known at least a day in advance, such as electronic news gathering. As discussed above, we are taking steps to ensure that some channels remain available for wireless microphones by prohibiting personal/portable devices from operating below channel 21, designating two channels in each market from among channels 14-51 where TV bands devices cannot operate, and prohibiting fixed devices from operating adjacent to occupied TV bands channels. We find that these measures will ensure that adequate spectrum is available for licensed itinerant wireless microphone users in the vast majority of situations. In this context, we also must consider that in most locations many channels will be available for wireless microphone use that are not available for TVBD use. Those channels can be used by wireless microphones for unscheduled events. We also observe that in the case of a major unplanned news event, broadcasters already coordinate their use of frequencies for wireless microphones and that at a site can share frequencies by avoiding operation of wireless microphones at the same time. We therefore decline to require more frequent database checks by TV bands devices which would substantially increase the amount of database traffic without significant benefit.

112. In re-affirming the daily re-check requirement, we also observe that the rules currently do not specify that a database provide the TVBD with information on changes in channel availability that occur over the course of the 24 hours before the next re-check. For example, if a database were to provide a TVBD with only a list of the channels that are available at 9:00 a.m. and there is a scheduled use of wireless microphones on one or more of those channels during the period 3:00 p.m. to midnight, the TVBD would not cease operating on the channels that became unavailable later in the day. It is our intention that a database provide TVBDs with information on the full schedule of channel availability over the course of the 24 hour re-check period plus the additional period of up to 24 hours that a device may continue to operate if it is not able to contact its database at the end of the re-check period. This is necessary to ensure that TVBDs do not cause interference to protected operations that use channels during part of a 24 hour period. Accordingly, we are amending our rules to provide that 1) a database must provide fixed and Mode II TVBDs with channel availability information that includes scheduled changes in channel availability over the course of the 48 hour period beginning at the time the TVBDs make a re-check contact and 2) fixed and Mode II TVBDs must adjust their use of channels in accordance with channel availability schedule information provided by their database.

113. As indicated above, because they have no geo-location capability to identify their location, we are requiring Mode I personal/portable devices to either receive a signal to verify contact from the Mode II or fixed device that provided its current list of available channels or contact a Mode II or fixed device at least once per minute to re-verify/re-establish channel availability. Under the new contact verification option, a "contact verification signal" will be an encoded identification signal that may be broadcast by a fixed or Mode II device for reception by Mode I devices to which the fixed or Mode II device has provided a list of available channels for operation. Such signal will be for the purpose of establishing that a Mode I device is still within

the reception range of the fixed or Mode II device from which it received a list of available channels; reception of a contact verification signal will be presumed to verify that the list of available channels used by the Mode I device remains valid for purposes of the once per minute re-check requirement. We expect that this feature will be especially useful for improving efficiency in cases where several Mode I devices receive lists of available channels from the same fixed or Mode II device. We are not requiring that Mode II and fixed devices transmit contact verification signals in support of Mode I devices they serve; however, use of this option is strongly suggested. We are requiring that contact verification signals be encoded to ensure that they originate from the TV bands device that provided the list of available channels; the fixed or Mode II device transmitting a contact verification signal would need to provide a Mode I device it serves with decoding information at the time it makes an exchange contact with the Mode I device to provide a list of available channels. Mode I devices that receive contact verification signals will still be required to re-check with a fixed of Mode II device at least once a day. In addition, Mode II devices will be required to re-check/reestablish contact to obtain a list of available channels if they lose power. Collaterally, if a Mode II device loses power and obtains a new channel list, it must signal all Mode I devices it is serving to acquire new channel list. We are also clarifying the requirement that Mode II devices re-check with their database when they move to specify that such devices must re-check only when they are moved more than 100 meters from the location at which they performed their last re-check. This will avoid the need for re-checking when a device is moved very short distances that would have a *de minimis* impact on potential interference and reduce the burden of the re-check function on the database and the Mode II TVBD.

114. We will permit database administrators and device manufacturers to develop a system to "push" channel availability changes and other information to TV bands devices if they choose. This capability could, for example, be used in the development of standards that allow more efficient sharing of TV spectrum by networks of TV bands devices. We will not, however, require that databases or devices incorporate this capability. To guard against the possibility that a device may miss updates pushed by the database and continue transmitting on a channel that becomes unavailable, devices that incorporate this capability must still function in the same manner as other TV bands devices and validate their channel at least once per day and cease operation no later than 11:59 PM the following day if they cannot validate the operating channel. The operation of such an information "push" system must be described in the application for certification. Any other clearing of channels, such as marking particular channels as unavailable in the database, may only be done under authorization by the Commission.

115. We also will permit Mode II personal/portable devices to load available channel information for locations beyond their current position and use that information in their operation. Mode II devices will be allowed to use such additional available channel information to define a geographic area within which they could operate on the same available channels at all locations. Allowing channel lists to be stored for more than a single location will allow for more efficient operation of portable devices by reducing the number of queries to the database and to support mobile operation. For example a Mode II TVBD could calculate a bounded area in which a channel or channels are available at all locations within the area and operate on a mobile basis within that area. Mode II TVBDs that use such an approach must contact the database when they have moved beyond the boundary of the area where their channel availability data is valid, and must re-check the database at least once each day like other Mode II devices even if

they have not moved beyond the range where the data is valid.[232] Parties that incorporate the ability to load channel lists for multiple locations and operate within an area bounded into a device must describe in the application for certification how they will ensure the device operates only on available channels within the bounded area.[233]

4. Additional Service Features

116. *Petition and Replies.* PISC requests that the Commission require the TV bands database to be capable of reporting estimated signal strength data on adjacent TV channels in addition to available TV channels.[234] Key Bridge requests that the Commission require TV bands devices to report in-service monitoring and active channel data to the database system.[235] Motorola believes that more precise TV service area prediction models should be incorporated into the database to permit expanded adjacent channel use by fixed devices without the need for rulemaking delay.[236]

117. *Decision*. Database administrators may perform additional functions besides those required by the rules, such as tracking active channel use if reported by the TV bands device, or sending additional information to a TV bands device to enable it to determine the "best" available channel to use. Such functions are not prohibited by the rules, and the ability to add additional functionality could allow multiple database operators to distinguish their services and could be useful in the development of industry standards to enable more efficient spectrum sharing. However, in the interest of keeping the rules simple and avoiding the imposition of unnecessary requirements that could hamper innovation, we decline to require TV bands devices to report additional information to the database beyond what the rules currently require. We also decline to require the incorporation of different (and currently unspecified) TV service area prediction models into the database as requested by Motorola. The rules currently prohibit adjacent channel operations by fixed devices, and there is insufficient record to change that requirement at this time.

5. Database Information

118. *Petitions and Replies.* PISC requests that the Commission require that all information in the TV bands database repository be made fully transparent and available to the general public online and a matter of public record.[237] CWMU recommends that wireless microphone users be able to check and correct data, and Rudman/Ericksen recommends that all protected users be entitled to verify their TV bands device database entries free of charge.[238]

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[232] CWMU recommends that personal/portable devices be required to re-check the database if they move more than 50 meters. *See* CWMU opposition at 7. Because the rules require a TV bands device to determine its location with an accuracy of 50 meters, and because the rules require the database to be re-checked when a personal/portable device moves, the rules already address CWMU's request.

[233] We note that is possible that the available channels within a bounded area will be different at different locations in that area. In such cases, the device would only be allowed to operate on those channels that are available at all locations within the bounded area.

[234] *See* PISC petition at 16.

[235] *See* Key Bridge petition at 5.

[236] *See* Motorola petition at 20-21.

[237] *See* PISC petition at 14.

[238] *See* CWMU opposition at 7 and Rudman/Ericksen petition at 15.

However, Key Bridge believes that requiring public disclosure of voluntary registration information could compromise business security and pose a competitive risk to the cable, satellite and WISP industries.[239] It recommends that the requirement for database administrators to provide or delete information from the database be limited to publicly available data provided by the Commission or other government sources that is required for the fields specified in Section 15.713.[240] WISPA requests that the Commission require fixed TV bands device operators to access and review the geo-location database prior to network deployment and choose an available channel that does not cause interference to nearby fixed TV bands device networks.[241]

119. Decision. We will require that all information that is required by the Commission's rules to be in a TV bands device database be publicly available, including fixed TV bands device registration and voluntarily submitted protected entity (*e.g.*, cable head ends) information. We will not require the public disclosure of information that a database manager may collect to support additional services (*see* discussion supra), provided that this information also is not required to be provided by our rules. We note that the registration of a protected entity in the database will preclude operation of TV bands devices on one or more channels over specific areas, and that there is the possibility of errors in the registration information. Although much of the data will come from Commission databases that already are public sources, errors could result from the inadvertent entry of incorrect data, or as a result of a party deliberately entering false data. We therefore find that it is appropriate to permit public examination of protected entity registration information to allow the detection and correction of errors. We also find that making fixed TV bands device registration information publicly available could assist parties in locating the source of any interference that occurs and contacting the device operator to correct it. With regard to Key Bridge's request concerning the Commission's requirement to provide or delete information from the database, we are clarifying that this requirement applies only to the information that the Commission requires to be placed in the database and not any other information that a database administrator collects beyond what the rules require.

120. We decline to require fixed TV bands device operators to access and review the database prior to network deployment and to select a channel that is not in use, because one of the general conditions of operation for Part 15 is that a party's use of a particular frequency does not give it rights over other parties to continued use of that frequency.[242] In addition, a TV bands device may need to operate on more than one available channel and may do so. However, we will permit database administrators to allow prospective operators of TV bands devices to query the database to verify whether there are vacant channels at a site where they wish to operate, and operators of TV bands devices may use information from the database to voluntarily coordinate their channel usage to avoid conflicts.

121. In reviewing the rules for the information to included in a TV bands database, we observe that in the case of full power TV, Class A TV, low power TV and TV translator stations the Commission's Consolidated Broadcast Data Base System (CDBS) from which the TV station

[239] *See* Key Bridge opposition at 5.

[240] *See* Key Bridge petition at 7.

[241] *See* WISPA petition at 16.

[242] *See* 47 C.F.R. § 15.5(a).

database records will be extracted in many cases includes multiple types of records for each station. For example, the database may include license, license application, special temporary authorization and construction permit applications for the same station and may also include more than one of each of these types of records for the same station.[243] These multiple records can pose confusion in administering a TV bands database with respect to which records to extract for the database. It is our intention that the records in a TV bands database only reflect stations that are serving viewers. In the CDBS, only records for licenses and license applications imply that a station is providing service to viewers. We therefore are clarifying that a TV bands database is to include only TV station information from license or license application records. Given that a license application implies a change that is to the station's ongoing operations, we find that in cases where a station has records for both a license application and a license, a TV bands database should include the information from the license application rather than the license.[244] We are amending our rules to add these clarifications.

6. Database Fees

122. *Petitions and Replies*. PISC recommends that the Commission ensure to the extent feasible that database fees are limited to a modest, one-time charge that can be easily incorporated into the retail price of a device.[245] Key Bridge, on the other hand, believes that database operators and their clients should be allowed to freely negotiate among themselves to establish mutually acceptable price levels and fee structures.[246] It also requests that database administrators and TV bands device manufacturers be permitted to negotiate commercial relationships for the registration of Mode II devices.[247] SBE argues that the Commission did not consider the impact and cost on licensees of inputting data into the database, and that the cost of database maintenance should be calculated and the costs paid by new entrants benefiting from it, such as unlicensed equipment manufacturers.[248] Dell/Microsoft disagrees with SBE that costs incurred when registering with the database should be billed to equipment manufacturers.[249]

123. *Decision.* We decline to establish a particular fee structure for database administrators. We find that database administrators are in the best position to manage their costs and fees. We disagree with SBE that registering protected entities with the database will have a significant impact on licensees or others. Many of the registrations will be for services at fixed locations such as fixed BAS links or satellite, MVPD or TV translator receive sites, and these only need to be registered once, and in the case of receive sites, only if they are located outside the protected contour of the TV station being received. Information for licensed services will come from Commission databases. Further, all such registrations are voluntary, so a party may choose not to register sites where it believes that interference from TV bands devices is

[243] *See* 47 C.F.R. §§ 73.1635, .3533 and .3536.

[244] Upon completion of construction a broadcast station may begin operations in accordance with its construction permit. The license application must be filed within 10 days thereafter. *See* 47 C.F.R § 73.1620.

[245] *See* PISC petition at 15.

[246] *See* Key Bridge opposition at 6.

[247] *See* Key Bridge petition at 6.

[248] *See* SBE petition at 22.

[249] *See* Dell/Microsoft opposition at 17.

unlikely to occur. We are, however, modifying Section 15.714(a) to remove the provision that database administrators may charge to register temporary BAS links. The Commission did not state in the *Second Report and Order* that database administrators could charge for registering temporary BAS links, and a provision stating that they could was inadvertently added to the rules.

7. Other Database Issues

124. *Petitions and Replies*. SBE requests that the Commission clarify that every TV bands device, including Mode II personal/portable devices, is required to contact the database before being allowed to transmit unless it is a Mode I device that is in contact with a fixed or Mode II device that has contacted the database and uses the list of channels provided by the fixed or Mode II device. SBE believes that such database contact is needed to prevent "daisy chains" of devices that obtain authorization through other devices that did not contact the database themselves.[250] Key Bridge also requests that Mode II personal/portable devices be required to register with the database.[251] Dell/Microsoft opposes requiring registration of personal/portable devices and prohibiting conveying database information through multiple devices.[252] CWMU requests that we require that locations of wireless microphone venues and TV bands devices be accurate to +/-5 meters.[253]

125. *Decision.* Fixed and Mode II TV bands devices are allowed to contact a database for a list of available channels through other TV bands devices, provided they follow the rules and connect to an authorized database using the appropriate protocol, send their geographic coordinates and other required information and operate only on channels that the database indicates are available. The rules already permit this practice but do not allow the formation of "chains" of devices that did not access the database but merely pass-on a list of available channels.[254] Therefore, no rule changes are necessary in this regard. We will not require Mode II personal/portable devices to register in the database, because this would substantially increase the number of registrations in the database, and each of these registrations would have to be updated as device changes locations, thus substantially increasing the database traffic. We also see no need for registration of these devices as a means to help identify a source of interference, as the interference range of personal/portable devices is in general relatively short. In this regard, we are correcting an error in Section 15.713(e)(4) of the rules which incorrectly states that Mode II devices must register on initialization. We will not require devices to provide coordinates accurate to +/- 5 meters because that is a higher degree of precision than necessary, and such accuracy may not be readily achievable by most devices.

[250] *See* SBE petition at 21.

[251] *See* Key Bridge petition at 4.

[252] *See* Dell/Microsoft opposition at 17.

[253] *See* CWMU opposition at 8.

[254] *See* 47 C.F.R. § 15.711(g).

D. Use of TV Channels

1. TV bands Devices, Wireless Microphones and Low Power Auxiliary Stations

126. In the *Second Report and Order*, the Commission prohibited fixed TV bands devices from operating adjacent to occupied TV channels at this time, although it deferred a final decision on this issue and kept the record open pending the development of additional information demonstrating that a reliable method can be developed to allow adjacent channel operation.[255] The Commission decided to allow both fixed and personal/portable unlicensed TV bands devices to operate on channels 21-36 and 38-51. In addition, the Commission allowed only fixed TV bands devices to operate on channels 2 and 5-13 and on channels 14-20 outside of areas where PLMRS/CMRS services operate.[256] The Commission stated that allowing only fixed TV bands devices to operate below channel 20 would ensure that some channels remain available for use by wireless microphones and eliminate the possibility of interference from TV bands devices to public safety and other important communications operations in the PLMRS. While it believed that the geo-location/database and Mode I operation provisions of the rules would provide a high degree of assurance that PLMRS/CMRS, Offshore Radiotelephone Service and other authorized services on channels 14-20 are protected, the Commission chose a more conservative approach to protect the PLMRS/CMRS services from expected high numbers of nomadic personal/portable devices and affirmed its decision from the *First Report and Order and Further Notice of Proposed Rule Making* in this proceeding to prohibit personal/portable devices from operating on channels 14-20.[257] In addition, in 13 major markets where certain channels between 14 and 20 are allocated for land mobile operations, the Commission designated two channels between 21 and 51 - *i.e.*, the first vacant channels above and below channel 37 - where personal/portable TV bands devices could not operate, leaving those two channels available for low power auxiliary stations.[258]

127. *Petitions and Replies*. Adaptrum and Motorola ask that fixed devices be permitted to operate adjacent to occupied TV channels. Adaptrum submits several possible approaches for reducing interference power to TV receivers, including lowering TV bands device in-band transmission power, narrowing TV bands device transmission bandwidth, and lowering the out-of-band emissions limit for TV bands devices. Motorola argues that the adjacent channel prohibition for fixed TV bands devices could be eliminated if the rules allow for highly detailed terrain modeling that accurately predicts TV field strength.[259]

128. Dell/Microsoft, Motorola and PISC argue that prohibiting personal/portable devices below channel 21 is not necessary because the Commission has imposed rigorous geo-location and database querying on Mode II personal/portable devices and Mode I personal/portable devices are under control of a fixed or Mode II device.[260] However, APCO,

[255] *See Second Report and Order* 23 FCC Rcd 16869 (2008) at ¶178.

[256] *Id*. at 16859, ¶148.

[257] *See First Report and Order and Further Notice of Proposed Rule Making* in ET Docket Nos. 02-380 and 04-186, 21 FCC Rcd 12266, 12275 (2006) and *Second Report and Order* 23 FCC Rcd 16859 (2008) at ¶148.

[258] *See Second Report and Order* 23 FCC Rcd 16862 (2008) at ¶157.

[259] *See* Adaptrum petition at 3-5 and Motorola petition at 21.

[260] *See* Dell/Microsoft petition at 5, Motorola petition at 11 and PISC petition at 25.

County of Los Angeles and LMCC express concern that interference protection relying on geo-location may not work as anticipated and thus oppose allowing personal/portable devices to operate on channels 14-20.[261] Shure opposes permitting personal/portable devices to operate below channel 21, arguing that TV bands devices would be less effective sensing at frequencies below channel 21and that, if the integrity of the TV bands database is disrupted, devices that rely on it will pose the same interference threat as sensing-only devices.[262] NCTA opposes PISC's request to allow portable devices to operate on channels 5-13 due to concerns about direct pickup interference.[263]

129. PISC requests that the Commission eliminate the rule provision reserving two channels above 21 for wireless microphones in markets with PLMRS/CMRS operations. PISC argues that this reservation is needlessly wasteful in that the Commission already provides wireless microphones with more than enough spectrum and protection by excluding personal/portable devices on channels 5-20.[264] Rudman/Ericksen argues that it is not necessary to reserve the first vacant channel above and below channel 37 for wireless microphones because the Commission can simply protect a point/radius for each wireless microphone in the ULS database.[265] Sennheiser opposes elimination of the reserved channels, arguing that this would provide an advantage for TVBDs over wireless microphones.[266]

130. Other parties support increasing the number of TV channels on which TV bands devices may not operate to leave more channels available for wireless microphone use. Carlson Wireless, Motorola and WISPA recommend designating two channels in each market for use by wireless microphones.[267] CWMU states that it is impossible to protect wireless microphone use for many television productions using only a few safe harbor channels,[268] but it supports designating one channel in each metropolitan area for use by electronic news gathering for situations when it is impossible to register wireless microphone locations in advance.[269] NAB/MSTV requests that the Commission expand the current set-aside of two channels in 13

[261] *See* APCO opposition at 3, County of Los Angeles opposition at 3 and LMCC opposition at 5. Motorola states that concerns about operation on channels 14-20 could be addressed by removing the general prohibition on personal/portable devices operating on channels 5-13. *See* Motorola opposition at 15.

[262] *See* Shure opposition at 18-19.

[263] *See* NCTA opposition at 6-7.

[264] *See* PISC petition at 17.

[265] *See* Rudman/Ericksen petition at 10.

[266] *See* Sennheiser opposition at 4-5.

[267] *See* Carlson Wireless opposition at 6, Motorola petition at 10 and WISPA opposition at 7-8 (wireless microphones should register in the TV bands database, access the database on the same terms as TV bands devices, and have co-equal, secondary status with them).

[268] *See* CWMU opposition at 10. CWMU contends that the typical number of wireless microphones needed for various events is as follows: 50 for an average Broadway musical, 155 for a Monday Night Football telecast with an additional 40 for the National Football League, 1,000 for the Super Bowl, and 250-800 for a political convention.

[269] *See* CWMU opposition at 12. PISC argues that blocking off TV channels exclusively for intermittent wireless microphone use such as electronic news gathering is a highly inefficient use of spectrum. *See* PISC petition at 18.

markets to all markets and set aside additional safe harbor channels.[270] Shure argues that six channels centered around channel 37 is the minimum amount of spectrum needed to support itinerant users.[271] Google opposes Shure's request to prohibit adjacent channel operation above channel 21, arguing that Shure's proposal would result in no available channels for TV bands devices in many or all urban markets and no economies of scale to make a nationwide network viable.[272] Google further argues that adequate channels for wireless microphones are available below channel 21 and that restricting availability above channel 21 would serve only to protect wireless microphones operating illegally.[273]

131. *Decision*. We affirm our initial decision to prohibit fixed devices from operating on channels adjacent to occupied TV channels. While Adaptrum and Motorola provided general information on possible ways that fixed devices could operate adjacent to occupied TV channels, neither party provided sufficiently detailed information on the technical requirements that would be necessary to allow adjacent channel operation without interference and still permit operation of TVBDs. We also decline to change the designated channels where TV bands devices are prohibited from operating and, in this regard we also affirm our decision to prohibit personal/portable devices from operating below channel 21. As the Commission noted in both the *First Report and Order* and *Second Report and Order*, there is some potential for interference to PLMRS/CMRS services on channels 14-20 due to the nomadic nature of personal/portable devices, and we are taking a conservative approach to protect these services from interference and prohibit operation of personal/portable devices on these channels. In addition, we are affirming the prohibition on personal/portable devices on channels below 14 as well to help ensure that unused channels remain available for wireless microphones and other LPAS devices.

132. We are revising our rules to reserve two channels nationwide where TV devices are not permitted to operate to ensure that some spectrum remains available for wireless microphones and other LPAS stations. Reserving two channels nationwide will ensure that at least two channels remain available for wireless microphones in all markets. These channels will be the first channels on either side of channel 37 that are unoccupied by broadcast television stations or, if no channels are available on one side of channel 37, the first two channels nearest to channel 37.[274] These reservations will provide channels to accommodate LPAS operations that are not at fixed locations that would have been protected under the spectrum sensing provisions we are eliminating herein. Such LPAS operations include electronic news gathering and other temporary on-site applications, where the operating channels and locations are not known sufficiently far in advance to register them in the database. We believe that the reservation of two channels nationwide, along with the additional channels will be available at

[270] *See* NAB/MSTV opposition at 20 (the number of set-aside channels could be reduced over time as more spectrally efficient digital microphone equipment is deployed).

[271] *See* Shure opposition at 16.

[272] *See* Google opposition at 15.

[273] *Id*.

[274] To clarify this provision, the two reserved channels at a location are to be the same for all types of TVBD operations, i.e., fixed devices at any height and personal/portable Mode I and personal/portable Mode II at both power levels. Thus, if the first two unoccupied channels are adjacent to occupied channels, only 40 mW personal/portable devices would be affected by the reservations.

the vast majority of locations that cannot be used by TVBDs, will provide more than sufficient spectrum to accommodate the vast majority of wireless microphone usage. This will allow protected operation of a minimum of 12-16 wireless microphones and other LPAS stations in a small geographic area.[275] Further, the relatively low power of these stations limits their operating range to about 100 meters, allowing each vacant TV channel to be used at many locations in a TV market. We note that in many areas more than two channels will likely remain available for LPAS stations because fixed TV bands devices are not permitted to operate adjacent to occupied TV channels and personal/portable devices are not permitted to operate below channel 21.

133. Recently the Broadband Action Agenda announced an intention for the Commission to initiate rule making proceedings to increase spectrum efficiency and innovation in various frequency bands, including broadcast TV spectrum.[276] In addition, the Commission has initiated a proceeding to consider changes in the rules for wireless microphones that operate in the TV bands.[277] If the Commission makes changes to the rules concerning the channels available for operation for TV and other authorized services, the channels available for use by unlicensed TV bands devices and wireless microphones could change, and any TV bands device or wireless microphone that operates on a channel that is later designated for another use would have to cease operation on that channel. Depending on the tuning range of the TV bands device, particularly personal/portable devices, or wireless microphone these radios could have a reduced operating range. We recognize that the anticipated Commission proceedings introduce some uncertainty for manufacturers of TV bands devices and could delay their deployment. To avoid this problem, manufacturers can design devices that have the capability to tune over a wider range of frequencies than the rules currently permit, but that incorporate measures to limit operation to the frequency range over which the device is certified.[278] Manufacturers would therefore not have to redesign their equipment if the Commission modifies the permitted operating frequency range and could modify their equipment certification through a streamlined procedure.[279] We also observe that manufacturers are contemplating that devices that connect to CMRS services, mobile and personal/portable devices, whole-home wireless networks and other

[275] As discussed above, we are also providing for registration in TV bands databases of the channels used for wireless microphones at large performance venues where more than 12 microphones are used in order to protect the wireless audio operations at such facilities from interference caused by TVBDs.

[276] *See* "FCC Announces Broadband Action Agenda", News Release, rel. April 8, 2010; *see also* http://www.broadband.gov/plan/broadband-action-agenda.html

[277] *See supra* para. 11.

[278] This may occur, for example, when a radio operates on frequencies in the U.S. that differ from the frequencies that the radio operates on in other countries where it is marketed.

[279] Manufacturers could certify a TV bands device as a software defined radio, which is defined as a transmitter in which the operating parameters including the frequency range can be modified through a software change. *See* 47 C.F.R. § 2.1. A transmitter in which the software is designed or expected to be modified by a party other than the manufacturer must be certified as a software defined radio and must incorporate measures to ensure that only software that has been approved with the transmitter can be loaded into it. *See* 47 C.F.R. § 2.944. A manufacturer can obtain approval to expand the frequency range of a previously approved software defined radio through a Class III permissive change, which is a modification to an existing certification. *See* 47 C.F.R. § 2.1043(b).

wireless data systems that will use TV white space spectrum will also include Wi-Fi and Bluetooth communications technologies.[280]

2. Fixed Licensed Point-to-Point Backhaul Use

134. In the *Second Report and Order,* the Commission decided that it would not be practicable to authorize the use of TV white spaces on a licensed basis.[281] It concluded that the attributes supporting successful use of licensing - spectrum rights that are clearly defined, exclusive, flexible and transferable - would be difficult to accomplish in the TV bands if we were to maintain our goal of not affecting the interference protection status of existing services. The frequencies and amount of unused TV bands spectrum will vary at each location and could change as other primary users enter the band.[282] Instead, the Commission decided to allow low power unlicensed devices to operate on the TV white spaces at power levels no greater than 4 watts EIRP. First, it was concerned that operation at higher power levels would increase the risk of interference in congested areas and thus could make sharing spectrum between TV bands device users more difficult. Second, because the Commission did not have experience with unlicensed wireless broadband operations in the TV bands, it decided to take a cautious approach in setting power limits to minimize the risk of interference to authorized users of the TV bands.[283]

135. *Petitions and Replies*. FiberTower, Sprint Nextel, COMPTEL and RTG ("FiberTower et. al.") argue that the Commission erred in failing to dedicate a portion of the TV white spaces for fixed, licensed use. It states that all mobile broadband networks need wireless backhaul and that there is a critical shortage of spectrum available for that purpose.[284] FiberTower et. al. claim that the propagation characteristics of the white spaces are ideal for long range wireless backhaul, particularly in unserved and underserved areas, and that because fixed point-to-point backhaul equipment is available now, fixed licensed operations would spur immediate broadband deployment to unserved and underserved areas.[285] It further states that the Commission should have set aside six channels in the white spaces for fixed, licensed use in rural areas and authorized fixed, licensed operations in the white spaces in the third or greater adjacent channels existing in any market.[286] FiberTower et. al. states that given the ubiquitous, nomadic nature of existing and proposed unlicensed devices, it will essentially be impossible for the Commission to authorize licensed use effectively after unlicensed devices already occupy the

[280] *See ex parte* letter of July 19, 2010 to Julius Knapp, Chief of the Commission's Office of Engineering and Technology from Atheros Communications, Broadcom Corporation, Comsearch and others (19 companies and organizations) at 3.

[281] *See Second Report and Order* 23 FCC Rcd 16825 (2008) at ¶ 44.

[282] *Id*. at ¶ 46.

[283] *Id*. at 16847, ¶106.

[284] *See* FiberTower petition at 2.

[285] *Id*. at 5.

[286] *Id.* at 8.

same frequencies.[287] It requests that the Commission reconsider its decision before unlicensed devices are marketed to consumers.[288]

136. A number of parties oppose the petition of FiberTower, et. al.[289] Dell/Microsoft, Google and PISC argue that backhaul is not an efficient use of the white spaces, the white spaces should not be licensed and the petition is repetitious.[290] SBE does not believe that there are sufficient vacant TV channels to permit backhaul use. Community Broadcasters opposes FiberTower's request to reserve channels for backhaul use until after the Class A and low power television digital transition.[291]

137. *Decision*. We decline to set aside TV channels for fixed licensed backhaul use as requested by FiberTower at this time. As indicated above, the Broadband Action Agenda recently indicated an intention that the Commission initiate rule making proceedings to increase spectrum efficiency and innovation in various frequency bands[292] including the broadcast TV spectrum.[293] We intend to consider FiberTower's requests for spectrum for fixed licensed backhaul to support broadband services in the broader context of these future proceedings in order to better ensure a comprehensive approach to wireless rural backhaul in these bands. We disagree with FiberTower's contention that we should not delay in addressing its request for access to the TV bands because it would be impossible for the Commission to authorize licensed uses after unlicensed devices occupy the TV bands. Both fixed and personal/portable devices are to rely on a TV bands device database as their primary method for determining available channels. If the Commission makes changes to the rules concerning permissible channels of operation, imposes geographic area restrictions or makes other changes to the technical parameters for TV bands devices, these will be taken into account by the database administrator in determining available channels for TV bands devices. Therefore, any TV bands device that operates on a channel that is later designated for another use would cease operation on that channel after it performs its daily database check and the database indicates that the channel is no longer available for use. As we move forward, however, we are interested in pursuing the question of whether we can accommodate licensed rural backhaul in the white spaces within the UHF bands. Therefore, Commission staff will evaluate this possibility over the coming months, and will formulate and submit a recommendation on next steps to the Commissioners by the end of 2010.

[287] *Id*. at 9.

[288] *Id*. at 10.

[289] For example, *see* Community Broadcasters opposition at 3, Dell/Microsoft opposition at 18, Google opposition at 19, PISC opposition at 2, and SBE opposition at 12. WISPA believes that wireless backhaul could be implemented in the white spaces by allowing 20 watts transmitter power in rural areas rather than reserving 36 megahertz of spectrum as requested by FiberTower and others. WISPA opposition at 12. As discussed above, we decline to increase the power limit for fixed TV bands devices.

[290] *See* Dell/Microsoft opposition at 18, Google opposition at 20 and PISC opposition at 2.

[291] *See* Community Broadcaster's opposition at 3.

[292] *See* "FCC Announces Broadband Action Agenda", News Release, rel. April 8, 2010.

[293] http://www.broadband.gov/plan/broadband-action-agenda.html

E. Other Issues

1. Canada/Mexico Border Areas

138. The allotment and assignment of TV channels in the border areas with Canada and Mexico are subject to agreements with each of those countries. Low power TV assignments within 32 kilometers (20 miles) of the Canadian border must be referred to the Canadian authorities for approval.[294] In addition, low power UHF TV stations that are located less than 40 kilometers (25 miles) from the Mexican border, and low power VHF TV stations that are less than 60 kilometers (37 miles) from the Mexican border, must be referred to the Mexican government for approval.[295]

139. In the *Second Report and Order*, the Commission decided that fixed TV bands devices should not be permitted to operate within the border areas specified in the Canadian and Mexican agreements until it has an opportunity "to negotiate any necessary changes to those agreements with Canada and Mexico."[296] The Commission stated that fixed TV bands devices that operate with outdoor antennas at an EIRP of up to 4 watts "will be somewhat similar in operation to low power TV stations," and thus decided "in keeping with the low power broadcasting agreements with Canada and Mexico" that TV bands devices must comply with the distance separations from the border specified in the agreements.[297] The Commission also applied the same distance restrictions on the use of lower powered unlicensed personal/portable TV bands devices within the border areas "to avoid any uncertainty in administering the agreements with Canada and Mexico."[298] These border distance restrictions will be enforced for fixed devices and Mode II personal/portable devices through the use of their geo-location and database access capabilities. Devices operating in Mode I without a geo-location/database access capability will be prevented from operating in the border areas in that they will operate relatively close to an associated base station (fixed or personal/portable) that uses a geo-location/database access capability that will keep it from operating in the border areas.

140. *Petitions and Replies*. Tribal Digital Village (TDV) asks that the Commission reconsider its decision to ban the use of TV bands devices in the border areas with Mexico pending conclusion of negotiations with Mexico under the TV broadcast agreement with the

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[294] *See Working Arrangement for Allotment and Assignment of VHF and UHF Television Broadcasting Channels under the Agreement between the Government of the United States of America and the Government of Canada Relating to the TV* Broadcasting *Service,* dated March 1, 1989. This agreement is available on the Commission's web site at http://www.fcc.gov/ib/sand/agree/files/can-bc/can-tv.pdf.

[295] *See Agreement Amending the Agreement Relating to Assignments and Usage of Television Broadcasting Channels in the Frequency Range 470-806 MHz (Channels 14-69) along the United States-Mexico Border,* dated November 21, 1988. This international agreement is available on the Commission's web site at http://www.fcc.gov/ib/sand/agree/files/mex-bc/lpuhfbc.pdf. *See also*, the untitled amendment to the United States-Mexican agreement on VHF stations dated September 14-26, 1988, available on the Commission's web site at http://www.fcc.gov/ib/sand/agree/files/mex-bc/lpvhfbc.pdf. The agreements may require coordination at greater distances from the border depending on the ERP and HAAT of the LPTV station.

[296] *See Second Report and Order* 23 FCC Rcd 16897 (2008) at ¶ 265.

[297] *Id.*

[298] *Id.* at 16897, ¶ 266.

U.S., which could delay the introduction of new services to their communities.[299] TDB argues that the Commission offers no reasoned support for its decision.[300] It argues that the Commission did not explain why it rejected arguments that the TV broadcast agreement with Mexico does not apply to unlicensed TV bands devices, nor why it concluded that the TV bands devices would be "somewhat similar in operation to low power TV stations" as a basis for its decision. TDV asks that, if the Commission determines that the existing agreement requires coordination with Mexico, the Commission should consider whether it can address its concerns by entering information on Mexican stations in the TV bands database, thereby satisfying the purpose of the agreement to avoid interference, or by decreasing the size of the exclusion zones in the border areas for unlicensed devices using variable power.[301] PISC believes that the Commission should re-examine the border exclusion zone because TV bands devices are unlicensed devices, not broadcast stations covered by those agreements.[302]

141. *Decision.* We are modifying our requirement for the operation of TV bands devices in border areas with Canada and Mexico, as discussed below. At the outset, we clarify that unlicensed devices are not covered by the TV broadcast agreements with Canada and Mexico, and thus we do not need to negotiate changes to those agreements as we stated in the *Second Report and Order*. We have historically applied these agreements to licensed operations which are well-defined and readily identified under our rules and in our databases, characteristics which do not apply to unlicensed devices. Nonetheless, because TV bands devices will operate in the same frequency bands and on the same channels as TV stations in those countries as well as in the U.S., albeit at lower power than licensed stations, we are sensitive to the need to avoid causing interference to TV broadcast operations in Canada and Mexico. We find merit in Tribal Digital Village's suggested option to protect Canadian and Mexican stations in the border areas by including information on the Canadian and Mexican stations in the TV bands database as protected services within those countries.[303] We will do so, thereby ensuring that stations in those countries will be protected to the same level as stations in the U.S.[304] We will discuss our decision with Canada and Mexico to ensure that information on their operations in the database will be timely and accurate.

[299] *See* Tribal Digital Village petition at 1-2. Tribal Digital Village (TDV) is a consortium of 19 federally recognized American Indian tribes located in San Diego County, CA. TDV operates an extensive communications network supporting Tribal municipal buildings and programs and is interested in using TV bands devices for community networking. Parts of TDV's network lie within the exclusion zones along the Mexican border under the Commission's rules.

[300] *Id*. at 3-4.

[301] *Id*. at 5-6.

[302] *See* PISC opposition at 23.

[303] The requirement that TV bands devices operate beyond a minimum distance of the protected contour of co-channel or adjacent channel TV stations would not apply to Canadian or Mexican signals received within the U.S.; those stations are only to be protected from interference within their national borders.

[304] Because we are modifying our rules on this issue, we do not address TDV's argument that we did not explain how TV bands devices are somewhat similar to low power TV stations as a basis for our earlier decision not to allow TV bands devices to operate in the border areas.

2. Transmitter IDs

142. In the *Second Report and Order*, the Commission required fixed TV bands devices to transmit identifying information to ensure that they can be identified if interference occurs.[305] It required the identification signal to conform to a standard established by a recognized industry standards setting organization and stated that it expects the identification signal to carry sufficient information to identify the device and its location.

143. *Petitions and Replies*. Motorola requests that the requirement for fixed TV bands devices to transmit an identification signal conforming to a yet-to-be developed industry standard be eliminated because the requirement could constrain systems to support a particular modulation and delay TV bands devices entering the marketplace due to the time required for the development of a standard.[306] Adaptrum is also concerned about delays in developing and standard and requests that manufacturers be permitted to specify their own transmitter identification signal.[307] It believes that the current rule creates an incentive for delaying the market adoption of TV bands devices through the standardization process and violates the Administrative Procedure Act by delegating the Commission's powers to a non-government group.[308] NCTA objects to removing the requirement that fixed devices emit standardized identifying information, stating that the absence of that identifier this would make it even more difficult to diagnose white space interference problems.[309] MSTV/NAB believes that adding a requirement that devices operating in Mode I transmit a unique identifier could reduce the risk of interference by creating a mechanism to assist in locating devices that are not operating properly.[310]

144. *Decision*. We affirm our decision to require fixed TV bands devices to transmit an identification signal to identify the specific device and its location. We concluded previously that an identification signal will provide a useful means to help locate a specific device in the event that it causes interference. Although we have not specified the type of information that should be transmitted, we anticipate that, because fixed devices also have to register in the TV bands database, the transmitted identification information will be correlated, perhaps identical, with the database information to facilitate the location of a specific device.

145. We recognize the concerns of Motorola and Adaptrum about possible delays in development of a standard for the identification signal. Although our rules require that the signal conform to a standard established by a "recognized industry standards setting organization,"[311] we do not specify beyond this general criterion the type of organization that could develop such a standard, nor limit the number of organizations that might participate in the development of the standard. If necessary, we will work with industry groups to ensure development of a standard in

[305] *See Second Report and Order* 23 FCC Rcd 16847 (2008) at ¶108.

[306] *See* Motorola petition at 22.

[307] *See* Adaptrum petition at 8.

[308] *Id*. at 7.

[309] *See* NCTA opposition at 12.

[310] *See* NAB/MSTV opposition at 16. We note that NAB/MSTV did not file a petition for reconsideration; nonetheless, we address this issue to provide a complete record.

[311] 47 C.F.R. § 15.711(e).

a timely fashion. Accordingly, we anticipate that the development of a standard, at worst, will result in relatively little delay in the entry into the market of new TV bands devices. This slight potential downside is more than outweighed by the benefits of standardizing the delivery of the identification information.

146. Adaptrum is mistaken in asserting that the Commission's reliance on a non-governmental group for developing a standard for the identification signal constitutes an improper delegation of authority. The Commission established minimum requirements for the identification information in the *Second Report and Order*, and it retained authority to determine whether fixed TV bands device operators comply with this requirement. The referral to an industry standards-setting organization in the *Second Report and Order* of the task to develop a standard for the identification signal only involves issues related to the details of the identifying information to be transmitted, such as format. To the extent the standard fails to facilitate the intended use of the identification information that the device operators are required to provide, the Commission can easily address this failing by revisiting the sufficiency of the device operators' compliance with the underlying identification requirements and the framework for ensuring such compliance. Under these circumstances, the Commission's instruction that the device operators conform their identification signals to an industry standard established by a non-governmental standards-setting group does not come close to crossing the line drawn by the courts against improper delegations of agency authority.[312]

147. We decline to require that personal/portable devices operating in Mode I transmit an identification signal. Personal/portable devices operate at lower power than fixed devices and have a lower interference potential so there is less need for them to transmit identification information. Also, a personal/portable device operating in Mode I will not "know," and therefore cannot transmit, its geographic coordinates, making an identification signal from such a device significantly less useful.

3. Professional Installation

148. The geographic coordinates of a fixed TV bands device are to be determined by either an incorporated geo-location capability or a professional installer.[313] In the case of professional installation, the party who registers the device in the database will be responsible for assuring the accuracy of the entered coordinates.

149. *Petitions and Replies*. PISC argues that the Commission should not create a category of professional installer for equipment.[314] Rudman/Ericksen claim that because the Commission did not define professionally installed, it now needs to issue a Further Notice of Proposed Rule Making to define it.[315]

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[312] *See* Fund for Animals v. Kempthorne, 538 F.3d 124, 133 (D.C. Cir., 2008), *quoting* U.S. Telecommunications Ass'n v. FCC, 359 F.3d 554, 567 (D.C. Cir., 2004), *cert. denied*, 543 U.S. 925 (2004); Nat'l Park & Conservation Ass'n. v. Stanton, 54 F.Supp. 7, 19 (D.D.C. 1999) (An agency delegates its authority when it shifts to another party almost the entire determination of whether a statutory requirement has been satisfied, or where it abdicates its final reviewing authority.)

[313] 47 C.F.R. § 15.711(b)(1).

[314] *See* PISC petition at 27.

[315] *See* Rudman/Ericksen petition at 10.

150. *Decision*. We see is no need to modify the rules concerning the requirements for professional installation. The rules provide professional installation as an alternative to including a geo-location capability in the devices, and the intended purpose is to ensure that the geographic coordinates are correctly ascertained. We generally intend that a "professional installer" mean an entity consisting of an individual or team of individuals with experience in installing radio communications equipment and that provides service on a fee basis – such an individual or team can generally be expected to be capable of ascertaining the geographic coordinates of a site and entering them into the device for communication to a database. The task of ascertaining geographic coordinates and entering them into a device is not particularly difficult or complex and we therefore do not believe it is necessary to define the qualifications of a professional installer in the rules. In this context, we find it adequate to simply provide that a professional installer may be responsible for assuring the accuracy of the entered coordinates. Further, the rules already recognize professional installation for certain categories of Part 15 transmitters,[316] and if professional installation is deemed appropriate for a device, the grant of certification is conditioned accordingly.

4. Section 301 Licensing

151. *Petitions and Replies*. SBE argues that Section 301 of the Communications Act requires licensing for any apparatus that transmits enough energy to have a significant potential for causing interference.[317] It claims that the rules do not protect Part 74 licensed facilities against interference from Part 15 device and that this is arbitrary, capricious and beyond the Commission's authority under Section 301.[318] Rudman/Ericksen argue that Section 15.5(c) of the rules should be amended to allow private legal action against TV bands device users that cause interference.[319]

152. *Decision*. In this Order above, we considered and rejected SBE's contention that the rules that the Commission adopted in the *Second Report and Order* do not provide adequate protection against interference.[320] Accordingly, we need not address SBE's assertion that Section 301 of the Act requires licensing in this case.[321] In addition, we decline to modify our rules to provide a private right of action if interference occurs. The Commission's statutory authority

[316] 47 C.F.R. §§ 15.203 and 15.212.

[317] *See* SBE opposition at 9.

[318] *Id*. at 11.

[319] *See* Rudman/Ericksen petition at 14.

[320] *See* paras. 19-22, *supra*.

[321] *See also* Amendment of Part 15 of the Commission's Rules to Allow Certification of Equipment in the 24.05-24.25 GHz Band at Field Strengths Up to 2500 mV/m, *Memorandum Opinion and Order*, 18 FCC Rcd 15944, 15948 ¶ 11 (2003). In that Order, the Commission adopted rules allowing unlicensed operation of certain transmitters under certain conditions. A party filing a petition for reconsideration claimed that the Commission's rules failed to provide adequate protection against interference to other licensed operations, and therefore the transmitters at issues were required to be licensed under Section 301. The Commission found that the petitioner failed to demonstrate that the rules might permit harmful interference, and concluded therefore that it need not reach the petitioner's Section 301 argument.

and its rules provide for a range of enforcement actions that could be relied upon to eliminate and prevent interference.

5. Radio Astronomy

153. In the *Second Report and Order*, the Commission prohibited both fixed and personal/portable TV bands devices from operating on any channel within 2.4 kilometers (1.5 miles) of certain radio astronomy receive sites, including the Very Large Array (VLA) observatory located approximately 50 miles west of Socorro, New Mexico.[322] This observatory consists of 27 moveable antennas laid out in a Y-shaped configuration. The Commission's rules list the coordinates of the center of the array, but each segment of the array is 13 miles long, so the protection zone of 2.4 kilometers around the center point does not encompass large portions of the array.[323] The National Telecommunications and Information Administration (NTIA) requests that we change the protected coordinates from a single point to a rectangular area that encompasses the entire VLA.[324] To ensure that this facility is protected from interference from TV bands devices, we are adopting the change requested by NTIA. The rectangular area recommended by NTIA is approximately 19 miles by 22.5 miles, but because the observatory is in a generally unpopulated area, this change will affect few potential users of TV bands devices.

6. Other Rule Clarifications

154. Upon review of the rules adopted in the *Second Report and Order*, we discovered a number of minor inconsistencies between the text of the *Second Report and Order* and the rules. In addition, we noted a number of cases where we believe it is appropriate to clarify the rules, consistent with the *Second Report and Order*. Because these changes are not substantive, we may make them on our own motion without prior notice and comment.[325] A summary of the changes is provided below.

- Changes to definitions:
  - We are correcting an erroneous cross-reference in the definition of available channel and removing text that is not necessary as part of this definition; we are also clarifying the definition of a television channel.
  - We are removing the specific definitions of client mode, client device, master mode and master device and revising the text of other portions of the TV white space rules to reflect these changes.
  - We are incorporating the concepts of master and client in the definitions of fixed, Mode I and Mode II personal/portable devices.
  - We are indicating that a TV receive site may be used to provide signals to a Multiple Video Program Distributor (MVPD) and making minor wording edits to the definition of receive site.
  - We are indicating in the definition of TV bands devices that they operate on an unlicensed basis.

[322] *See Second Report and Order* 23 FCC Rcd 16861 (2008) at ¶156.

[323] *See* 47 C.F.R. § 15.712(h)(3).

[324] *See* NTIA letter dated August 4, 2009.

[325] *See* 5 U.S.C. § 553(b)(3)(B).

- We are indicating that TV bands device databases used by TV bands devices to obtain lists of available channels must be authorized by the Commission.

- Clarifications of the requirements for Mode I TV bands devices.
  - We are specifying that the list of channels provided to a Mode I device must be the same as the list of channels that are available to the fixed or Mode II device that provides the list.
  - We are clarifying that a Mode I device may operate only on channels that are permissible for its use, even if there are available channels outside the permitted range for Mode I devices, *e.g.,* channels below 21, where only fixed devices may operate.
  - We are clarifying that a fixed device or a Mode II device has the option to provide a supplemental list of available channels to Mode I devices (*i.e.*, a list of available channels in addition to the list of channels available to the fixed or Mode II device) that includes channels that are adjacent occupied TV channels and therefore not available to the fixed or Mode II device.

IV. PROCEDURAL MATTERS

A. Final Regulatory Flexibility Analysis

155. The Final Regulatory Flexibility Analysis, required by the Regulatory Flexibility Act, *see* 5 U.S.C. § 604, is contained in Appendix C.

B. Final Paperwork Reduction Act of 1995 Analysis

156. This Second Memorandum Opinion and Order contains new or modified information collections subject to the Paperwork Reduction Act of 1995 (PRA) and will be submitted to the Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA, Public Law 104-13. A modification is required to the Form 731 (OMB 3060-0057). OMB, the general public, and other Federal agencies are invited to comment on the new or modified information collection requirements contained in this proceeding. In addition, we note that pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, see 44 U.S.C. 3506(c)(4), we previously sought specific comment on how the Commission might further reduce the information collection burden for small business concerns with fewer than 25 employees.

C. Contact Persons

157. For additional information concerning this Second Memorandum Opinion and Order, please contact Mr. Hugh L. Van Tuyl at (202) 418-7506 or Mr. Alan Stillwell at (202) 418-2925, or via the Internet at Hugh.VanTuyl@fcc.gov or Alan.Stillwell@fcc.gov.

V. ORDERING CLAUSES

158. Accordingly, **IT IS** ORDERED that, pursuant to the authority contained in Sections 4(i), 302, 303(e), 303(f), and 307 of the Communications Act of 1934, as amended, 47 USC Sections 154(i), 302, 303(c), 303(f), and 307 this Second Memorandum Opinion and Order **IS HEREBY ADOPTED**.

159. **IT IS FURTHER ORDERED** that, pursuant to Sections 4(i), 302, 303(e) 303(f), 303(g), 303(r) and 405 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 302, 303(e), 303(f), 303(g), 303(r) and 405, the petitions for reconsideration addressed herein

ARE GRANTED to the extent discussed above and the remainder of requests in the petitions for reconsideration **ARE DENIED** as discussed above.

160. **IT IS FURTHER ORDERED** that Part 15 of the Commission's rules **IS AMENDED** as specified in Appendix B, and such rule amendments shall be EFFECTIVE 30 days after the date of publication in the Federal Register, except for Sections 15.713, 15.714, 15.715 and 15.717, which contains new information collection requirements that require approval by the Office of Management and Budget (OMB) under the PRA. The Federal Communications Commission will publish a document in the Federal Register announcing such approval and the relevant effective date.

161. **IT IS FURTHER ORDERED** that, pursuant to Sections 4(i), 302, 303(e) 303(f), 303(g), 303(r) and 405 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 302, 303(e), 303(f), 303(g), 303(r) and 405, the remainder of requests in the petitions for reconsideration addressed herein **ARE DENIED**.

162. **IT IS FURTHER ORDERED** that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, **SHALL SEND** a copy of the Second Memorandum Opinion and Order, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the U.S. Small Business Administration.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

Parties Filing Petitions

Petitions for Reconsideration

1. Adaptrum, Inc.
2. Cohen, Dippell and Everist, P.C.
3. Community Broadcasters Association
4. Dell, Inc. and Microsoft Corp.
5. DIRECTV and DISH Network
6. FiberTower, Sprint Nextel, COMPTEL, and RTG
7. IEEE 802 Local and Metropolitan Area Networks Standards Committee
8. Key Bridge Global, LLC
9. Motorola, Inc.
10. National Cable and Telecommunications Association
11. Public Interest Spectrum Coalition
12. Richard A. Rudman
13. Shure Incorporated
14. Society of Broadcast Engineers, Inc.
15. Tribal Digital Village
16. Wi-Fi Alliance
17. Wireless Internet Service Providers Association

Oppositions to Petitions for Reconsideration

1. APCO
2. Carlson Wireless Technologies, Inc.
3. Coalition of Wireless Microphone Users
4. Community Broadcasters Association
5. County of Los Angeles
6. Dell, Inc. and Microsoft Corp.
7. DIRECTV, Inc.
8. Federation of Internet Solution Providers of the Americas
9. Google, Inc.
10. Key Bridge Global, LLC
11. Land Mobile Communications Council
12. Motorola, Inc.
13. The Association for Maximum Service Television and the National Association of Broadcasters (MSTV/NAB)
14. National Cable and Telecommunications Association
15. Public Interest Spectrum Coalition
16. Sennheiser Electronic Corporation
17. Shure Incorporated
18. Society of Broadcast Engineers, Inc.
19. Wi-Fi Alliance
20. Wireless Internet Service Providers Association

Replies to Oppositions to Petitions for Reconsideration

1. Coalition of Wireless Microphone Users
2. Cohen, Dippell and Everist, P.C.
3. Dell, Inc. and Microsoft Corp.
4. FiberTower Corp., the Rural Telecommunications Group, Inc., COMPTEL and Sprint Nextel Corp.
5. Google, Inc.
6. Key Bridge Global, LLC
7. MSTV/NAB
8. National Cable and Telecommunications Association
9. Shure Incorporated
10. Society of Broadcast Engineers, Inc.
11. Wireless Internet Service Providers Association

APPENDIX B

Final Rules

Parts 0 and 15 of Title 47 of the Code of Federal Regulations is amended as follows:

PART 0 COMMISSION ORGANIZATION

1. The authority citation for Part 0 continues to read as follows:

   AUTHORITY: Secs. 5, 48 Stat. 1068, as amended; 47 U.S.C. 155

2. Section 0.241 is amended by re-designating the existing paragraph (h) as paragraph (i) and adding new paragraph (h) to read as follows:

§ 0.241 Authority delegated.

* * * * *

(h) The Chief of the Office of Engineering and Technology is delegated authority to administer the database functions for unlicensed devices operating in the television broadcast bands (TV bands) as set forth in Subpart H of Part 15 of this chapter. The Chief is delegated authority to develop specific methods that will be used to designate TV bands database managers, to designate these database managers; to develop procedures that these database managers will use to ensure compliance with the requirements for database operations; to make determinations regarding the continued acceptability of individual database managers; and to perform other functions as needed for the administration of the TV bands databases. The Chief is also delegated authority jointly with the Chief of the Wireless Telecommunications Bureau to administer provisions of § 15.713(h)(8) of this chapter pertaining to the registration of event sites where large numbers of wireless microphones that operate on frequencies specified in § 74.802 of this chapter are used.

3. Section 0.331 is amended by revising the introductory paragraph and adding new paragraph (e) to read as follows:

§ 0.241 Authority delegated.

The Chief, Wireless Telecommunications Bureau, is hereby delegated authority to perform all functions of the Bureau, described in § 0.131, subject to the exceptions and limitations in paragraphs (a) through (d), and also the functions described in paragraph (e).

* * * * *

(e) The Chief of the Wireless Telecommunications Bureau is delegated authority jointly with the Chief of the Office of Engineering and Technology to administer provisions of § 15.713(h)(8) of this chapter pertaining to the registration of event sites where large numbers of wireless microphones that operate on frequencies specified in Section 74.802 of this chapter are used.

PART 15 RADIO FREQUENCY DEVICES

4. The authority citation for Part 15 continues to read as follows:

AUTHORITY: 47 U.S.C. 154, 302a, 303, 304, 307, 336, and 544a

5. Section 15.701 is revised to read as follows:

§ 15.701 Scope.

This subpart sets forth the regulations for unlicensed Television Band Devices (TVBDs). These devices are unlicensed intentional radiators that operate on available TV channels in the broadcast television frequency bands at 54-60 MHz (TV channel 2), 76-88 MHz (TV channels 5 and 6), 174-216 MHz (TV channels 7-13), 470-608 MHz (TV channels 14-36) and 614-698 MHz (TV channels 38-51).

6. Section 15.703 is revised to read as follows:

§ 15.703 Definitions.

(a) Available channel. A six-megahertz television channel, as specified in § 73.603 of this chapter, which is not being used by an authorized service at or near the same geographic location as the TVBD and is acceptable for use by an unlicensed device under the provisions of this subpart.

(b) *Contact verification signal*. An encoded signal broadcast by a fixed or Mode II device for reception by Mode I devices to which the fixed or Mode II device has provided a list of available channels for operation. Such signal is for the purpose of establishing that the Mode I device is still within the reception range of the fixed or Mode II device for purposes of validating the list of available channels used by the Mode I device and shall be encoded to ensure that the signal originates from the device that provided the list of available channels. A Mode I device may respond only to a contact verification signal from the fixed or Mode II device that provided the list of available channels on which it operates. A fixed or Mode II device shall provide the information needed by a Mode I device to decode the contact verification signal at the same time it provides the list of available channels.

(c) *Fixed device*. A TVBD that transmits and/or receives radiocommunication signals at a specified fixed location. A fixed TVBD may select channels for operation itself from a list of available channels provided by a TV bands database, initiate and operate a network by sending enabling signals to one or more fixed TVBDs and/or personal/portable TVBDs. Fixed devices may provide to a Mode I personal/portable device a list of available channels on which the Mode I device may operate under the rules, including available channels above 512 MHz (above TV channel 20) on which the fixed TVBD also may operate and a supplemental list of available channels above 512 MHz (above TV channel 20) that are adjacent to occupied TV channels on which the Mode I device, but not the fixed device, may operate.

(d) *Geo-location capability*. The capability of a TVBD to determine its geographic coordinates within the level of accuracy specified in section 15.711(b)(1), *i.e.* 50 meters. This capability is used with a TV bands database approved by the FCC to determine the availability of TV channels at a TVBD's location.

(e) *Mode I personal/portable device*. A personal/portable TVBD that does not use an internal geo-location capability and access to a TV bands database to obtain a list of available channels. A Mode I device must obtain a list of available channels on which it may operate from either a fixed TVBD or Mode II personal/portable TVBD. A Mode I device may not initiate a network of fixed and/or personal/portable TVBDs nor may it provide a list of available channels to another Mode I device for operation by such device.

(f) *Mode II personal/portable device*. A personal/portable TVBD that uses an internal geo-location capability and access to a TV bands database, either through a direct connection to the Internet or through an indirect connection to the Internet by way of fixed TVBD or another Mode II TVBD, to obtain a list of available channels. A Mode II device may select a channel itself and initiate and operate as part of a network of TVBDs, transmitting to and receiving from one or more fixed TVBDs or personal/portable TVBDs. A Mode II personal/portable device may provide its list of available channels to a Mode I personal/portable device for operation on by the Mode I device.

(g) *Network initiation*. The process by which a fixed or Mode II TVBD sends control signals to one or more fixed TVBDs or personal/portable TVBDs and allows them to begin communications.

(h) *Operating channel*. An available channel used by a TVBD for transmission and/or reception.

(i) *Personal/portable device*. A TVBD that transmits and/or receives radiocommunication signals at unspecified locations that may change. Personal/portable devices may only transmit on available channels in the frequency bands 512-608 MHz (TV channels 21-36) and 614-698 MHz (TV channels 38-51).

(j) *Receive site*. The location where the signal of a full service television station is received for rebroadcast by a television translator or low power TV station, including a Class A TV station, or for distribution by a Multiple Video Program Distributor (MVPD) as defined in 47 U.S.C. 602(13).

(k) *Sensing only device*. A personal/portable TVBD that uses spectrum sensing to determine a list of available channels. Sensing only devices may transmit on any available channels in the frequency bands 512-608 MHz (TV channels 21-36) and 614-698 MHz (TV channels 38-51).

(l) *Spectrum sensing*. A process whereby a TVBD monitors a television channel to detect whether the channel is occupied by a radio signal or signals from authorized services.

(m) *Television band device (TVBD)*. Intentional radiators that operate on an unlicensed basis on available channels in the broadcast television frequency bands at 54-60 MHz (TV channel 2), 76-88 MHz (TV channels 5 and 6), 174-216 MHz (TV channels 7-13), 470-608 MHz (TV channels 14-36) and 614-698 MHz (TV channels 38-51).

(n) *TV bands database*. A database system that maintains records of all authorized services in the TV frequency bands, is capable of determining the available channels as a specific geographic location and provides lists of available channels to TVBDs that have been certified

under the Commission's equipment authorization procedures. TV bands databases that provide lists of available channels to TVBDs must receive approval by the Commission.

7. Section 15.706 is amended by revising paragraphs (a), (b), (c), (c)(1), (c)(2), and (c)(3) to read as follows:

15.706 Information to the user.

(a) In addition to the labeling requirements contained in § 15.19, the instructions furnished to the user of a TVBD shall include the following statement, placed in a prominent location in the text of the manual:

> This equipment has been tested and found to comply with the rules for TV bands devices, pursuant to Part 15 of the FCC Rules. These rules are designed to provide reasonable protection against harmful interference. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
>
> 1. Reorient or relocate the receiving antenna.
> 2. Increase the separation between the equipment and receiver.
> 3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
> 4. Consult the manufacturer, dealer or an experienced radio/ TV technician for help.

* * * * *

5. Section 15.707 is amended by revising paragraphs (a), (b), (c) and (d) to read as follows:

§ 15.707 Permissible channels of operation.

(a) All TVBDs are permitted to operate available channels in the frequency bands 512-608 MHz (TV channels 21-36) and 614-698 MHz (TV channels 38-51), subject to the interference protection requirements in §§ 15.711 and 15.712, except that operation of TVBDs is prohibited on the first channel above and the first channel below TV channel 37 (608-614 MHz) that are available, *i.e.,* not occupied by an authorized service. If a channel is not available both above and below channel 37, operation is prohibited on the first two channels nearest to channel 37. These channels will be identified and protected in the TV bands database(s).

(b) Operation on available channels in the bands 54-60 MHz (TV channel 2), 76-88 MHz (TV channels 5 and 6), 174-216 MHz (TV channels 7-13) and 470-512 MHz (TV channels 14-20), subject to the interference protection requirements in §§ 15.711 and 15.712, is permitted only for fixed TVBDs that communicate only with other fixed TVBDs.

(c) Fixed and Mode II TVBDs shall operate only on available channels as identified in paragraphs (a) and (b) of this section and as determined by a TV bands database in accordance with the interference avoidance mechanisms of §§ 15.711 and 15.712.

(d) Mode I TVBDs shall operate only on available channels as identified in paragraphs (a) and (b) of this section and provided from a fixed or Mode II TVBD in accordance with § 15.711(b)(3)(iv).

6. Section 15.709 is amended by adding new paragraphs (a)(5) and (a)(6) and modifying paragraphs (a)(1), (a)(2), (a)(3), (b), and (c) to read as follows:

§ 15.709 General technical requirements.

(a) *Power limits for TVBDs.*
(1) For fixed TVBDs, the maximum power delivered to the transmitting antenna shall not exceed one watt per 6 megahertz of bandwidth on which the device operates. The power delivered to the transmitting antenna is the maximum conducted output power reduced by the signal loss experienced in the cable used to connect the transmitter to the transmit antenna. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
(2) For personal/portable TVBDs, the maximum EIRP shall not exceed 100 milliwatts (20 dBm) per 6 megahertz of bandwidth on which the device operates with the following exceptions; Mode II personal/portable TVBDs that do not meet the adjacent channel separation requirements in § 15.712(a) and Mode I personal/portable TVBDs that operate on available channels (provided by a Mode II TVBD) that do not meet the adjacent channel separation requirements of § 15.712(a) are limited to a maximum EIRP of 40 milliwatts (16 dBm) per 6 megahertz of bandwidth on which the device operates. (3) TVBDs shall incorporate transmit power control to limit their operating power to the minimum necessary for successful communication. Applicants for equipment certification shall include a description of a device's transmit power control feature mechanism.
(4) Maximum conducted output power is the total transmit power over the occupied bandwidth delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.
(5) The power spectral density conducted from the TVBD to the antenna shall not be greater than the following values when measured in any 100 kHz band during any time interval of continuous transmission:
(i) Fixed devices: 12.2 dBm
(ii) Personal/portable devices operating adjacent to occupied TV channels: -1.8 dBm
(iii) Sensing-only devices: -0.8 dBm
(iii) All other personal/portable devices: 2.2 dBm
(6) TVBDs shall incorporate adequate security measures to prevent the TVBD from accessing databases not approved by the FCC and to ensure that unauthorized parties can not modify the TVBD or configure its control features to operate inconsistent with the rules and protection criteria set forth in this subpart.

(b) *Antenna requirements*.
(1)All transmit and receive antenna(s) of personal/portable devices shall be permanently attached.
(2) The transmit antenna used with fixed devices may not be more than 30 meters above the ground. In addition, fixed devices may not be located at sites where the height above average terrain (HAAT) at

ground level is more than 76 meters. The ground level HAAT is to be calculated by the TV bands database that the device contacts for available channels using computational software employing the methodology in section 73.684(d) of this chapter.(3) For personal/portable TVBDs operating under § 15.717, the provisions of § 15.204(c)(4) do not apply to an antenna used for transmission and reception/spectrum sensing.
(4) For personal/portable TVBDs operating under § 15.717 that incorporate a separate sensing antenna, compliance testing shall be performed using the lowest gain antenna for each type of antenna to be certified.

(c) *Emission limits for TVBDs*.
(1) In the television channels immediately adjacent to the channel in which a TVBD is operating, emissions from the TVBD shall be at least 72.8 dB below the highest average power in the TV channel in which the device is operating.
(2) Emission measurements in the channel of operation shall be performed over a reference bandwidth of 6 megahertz with an average detector. Emission measurements in the adjacent channels shall be performed using a minimum resolution bandwidth of 100 kHz with an average detector. A narrower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 100 kHz.
(3) At frequencies beyond the television channels immediately adjacent to the channel in which the TVBD is operating, the radiated emissions from TVBDs shall meet the requirements of §15.209.

* * * * *

7. Section 15.711 is amended by revising the section heading and introductory text and by revising paragraphs (a) through (f) to read as follows:

§ 15.711 Interference avoidance methods.

Except as provided in § 15.717, television channel availability for a TVBD is determined based on the geo-location and database access method described in paragraphs (a) and (b) of this section.

(a) *Geo-location and database access*. A TVBD shall rely on the geo-location and database access mechanism to identify available television channels consistent with the interference protection requirements of § 15.712. Such protection will be provided for the following authorized and unlicensed services: digital television stations, digital and analog Class A, low power, translator and booster stations; translator receive operations; fixed broadcast auxiliary service links; private land mobile service/ commercial radio service (PLMRS/CMRS) operations; offshore radiotelephone service; low power auxiliary services authorized pursuant to §§ 74.801-74.882 of this chapter, including wireless microphones and MVPD receive sites; and unlicensed wireless microphones used by venues of large events and productions/shows as provided under section 15.713(h)(8). In addition, protection shall be provided in border areas near Canada and Mexico in accordance with § 15.712(g).

(b) *Geo-location and database access requirements*.
(1) The geographic coordinates of a fixed TVBD shall be determined to an accuracy of +/- 50 meters by either an incorporated geo-location capability or a professional installer. In the case of professional installation, the party who registers the fixed TVBD in the database will be responsible for assuring the accuracy of the entered coordinates. The geographic coordinates of a fixed TVBD shall be determined at the time of installation and first activation from a power-off condition, and this information may be stored internally in the TVBD. If the fixed TVBD is moved to another location or if its stored coordinates become altered, the operator shall re-establish the device's:
(i) Geographic location and store this information in the TVBD either by means of the device's incorporated geo-location capability or through the services of a professional installer; and

(ii) Registration with the database based on the device's new coordinates.
(2) A Mode II personal/portable device shall incorporate a geo-location capability to determine its geographic coordinates to an accuracy of +/- 50 meters. A Mode II device must also re-establish its position each time it is activated from a power-off condition and use its geo-location capability to check its location at least once every 60 seconds while in operation, except while in sleep mode, *i.e.*, in a mode in which the device is inactive but is not powered-down.
(3)(i) Fixed devices must access a TV bands database over the Internet to determine the TV channels that are available at their geographic coordinates, taking into consideration the fixed device's antenna height, prior to their initial service transmission at a given location. Operation is permitted only on channels that are indicated in the database as being available for such TVBDs. Fixed TVBDs shall access the database at least once a day to verify that the operating channels continue to remain available. Operation on a channel must cease immediately if the database indicates that the channel is no longer available. Fixed TVBD must adjust their use of channels in accordance with channel availability schedule information provided by their database for the 48 hour period beginning at the time of the device last accessed the database for a list of available channels.
(ii) Mode II personal/portable devices must access a TV bands database over the Internet to determine the TV channels that are available at their geographic coordinates prior to their initial service transmission at a given location. Operation is permitted only on channels that are indicated in the database as being available for personal/portable TVBDs. A Mode II personal/portable device must access the database for a list of available channels each time it is activated from a power-off condition and re-check its location and the database for available channels if it changes location during operation by more than 100 meters from the location at which it last accessed the database. A Mode II personal/portable device that has been in a powered state shall re-check its location and access the database daily to verify that the operating channel(s) continue to be available. Mode II personal/portable devices must adjust their use of channels in accordance with channel availability schedule information provided by their database for the 48 hour period beginning at the time of the device last accessed the database for a list of available channels. A Mode II personal/portable device may load channel availability information for multiple locations around, *i.e.*, in the vicinity of, its current location and use that information in its operation. A Mode II TVBD may use such available channel information to define a geographic area within which it can operate on the same available channels at all locations, for example a Mode II TVBD could calculate a bounded area in which a channel or channels are available at all locations within the area and operate on a mobile basis within that area. A Mode II TVBD using such channel availability information for multiple locations must contact the database again if/when it moves beyond the boundary of the area where the channel availability data is valid, and must access the database daily even if it has not moved beyond that range to verify that the operating channel(s) continue to be available. Operation must cease immediately if the database indicates that the channel is no longer available.
(iii) If a fixed or Mode II personal/portable TVBD fails to successfully contact the TV bands database during any given day, it may continue to operate until 11:59 PM of the following day at which time it must cease operations until it re-establishes contact with the TV bands database and re-verifies its list of available channels.
(iv) A Mode I personal/portable TVBD may only transmit upon receiving a list of available channels from a fixed or Mode II TVBD that has contacted a database and verified that the FCC identifier (FCC ID) of the Mode I device is valid. The list of channels provided to the Mode I device must be the same as the list of channels that are available to the fixed or Mode II device, except that a Mode I device may operate only on channels that are permissible for its use under §15.707. A fixed device may also obtain from a database a separate list of available channels that includes adjacent channels that would be available to a Mode I personal/portable device and provide that list to the Mode I device. A fixed or Mode II device may provide a Mode I device with a list of available channels only after it contacts its database, provides the database the FCC Identifier (FCC ID) of the Mode I device requesting available channels, and receives verification that the FCC ID is valid for operation. To initiate contact with a fixed or Mode II device, a Mode I device may transmit on an available channel used by the fixed or Mode II TVBD or on a channel the fixed or Mode II TVBD indicates is available for use by a Mode I device on a signal seeking

such contacts. At least once every 60 seconds, except when in sleep mode, *i.e.*, a mode in which the device is inactive but is not powered-down, a Mode I device must either receive a contact verification signal from the Mode II or fixed device that provided its current list of available channels or contact a Mode II or fixed device to re-verify/re-establish channel availability. A Mode I device must cease operation immediately if it does not receive a contact verification signal or is not able to re-establish a list of available channels through contact with a fixed or Mode II device on this schedule. In addition, a Mode II device must re-check/reestablish contact with a fixed or Mode II device to obtain a list of available channels if they lose power. Collaterally, if a Mode II device loses power and obtains a new channel list, it must signal all Mode I devices it is serving to acquire new channel list.

(v) Device manufacturers and database administrators may implement a system that pushes updated channel availability information from the database to TVBDs. However, the use of such systems is not mandatory, and the requirements for TVBDs to validate the operating channel at least daily and to cease operation in accordance with paragraph (b)(3)(iii) of this section continue to apply if such a system is used.

(vi) TV bands devices shall incorporate adequate security measures to ensure that they are capable of communicating for purposes of obtaining lists of available channels only with databases operated by administrators authorized by the Commission, and to ensure that communications between TV bands devices and databases between TV bands devices are secure to prevent corruption or unauthorized interception of data. This requirement includes implementing security for communications between Mode I personal portable devices and fixed or Mode II devices for purposes of providing lists of available channels.

* * * * *

(c) *Display of available channels*. A TVBD must incorporate the capability to display a list of identified available channels and its operating channels.

(d) Identifying information. Fixed TVBDs shall transmit identifying information. The identification signal must conform to a standard established by a recognized industry standards setting organization. The identification signal shall carry sufficient information to identify the device and its geographic coordinates.

(e) *Fixed devices without a direct connection to the Internet*. If a fixed TVBD does not have a direct connection to the Internet and has not yet been initialized and registered with the TV bands database consistent with § 15.713, but can receive the transmissions of another fixed TVBD, the fixed TVBD needing initialization may transmit to that other fixed TVBD on either a channel that the other TVBD has transmitted on or on a channel which the other TVBD indicates is available for use to access the database to register its location and receive a list of channels that are available for it to use. Subsequently, the newly registered TVBD must only use the television channels that the database indicates are available for it to use. A fixed device may not obtain lists of available channels from another fixed device as provided by a TV bands database for such other device, *i.e.*, a fixed device may not simply operate on the list of available channels provided by a TV bands database for another fixed device with which it communicates but must contact a database to obtain a list of available channels on which it may operate.

(f) *Security*.

(i) For purposes of obtaining a list of available channels and related matters, fixed and Mode II TVBDs shall only be capable of contacting databases operated by FCC designated administrators.

(ii) Communications between TV bands devices and TV bands databases are to be transmitted using secure methods that ensure against corruption or unauthorized modification of the data; this requirement applies to communications of channel availability and other spectrum access

information between fixed and Mode II devices (it is not necessary for TVBDs to apply security coding to channel availability and channel access information where they are not the originating or terminating device and that they simply pass through).
(iii) Communications between a Mode I device and a fixed or Mode II device for purposes of obtaining a list of available channels shall employ secure methods that ensure against corruption or unauthorized modification of the data. When a Mode I device makes a request to a fixed or Mode II device for a list of available channels the receiving device shall check with the TV bands database that the Mode I device has a valid FCC Identifier before providing a list of available channels. Contact verification signals transmitted for Mode I devices are to be encoded with encryption to secure the identity of the transmitting device. Mode I devices using contact verification signals shall accept as valid for authorization only the signals of the device from which they obtained their list of available channels.
(iv) A TV bands database shall be protected from unauthorized data input or alteration of stored data. To provide this protection, the administrator of the TV bands database administrator shall establish communications authentication procedures that allow the fixed or Mode II devices to be assured that the data they receive is from an authorized source.
(v) Applications for certification of TV bands devices are to include a high level operational description of the technologies and measures that are incorporated in the device to comply with the security requirements of this section. In addition, applications for certification of fixed and Mode II devices are to identify at least one of the TV bands databases operated by a designated TV bands database administrator that the device will access for channel availability and affirm that the device will conform to the communications security methods used by that database.

* * * * *

8. Section 15.712 is amended by revising paragraphs a(1), a(2), (b), (d), (f), (g) and (h)(3) to read as follows:

§ 15.712 Interference protection requirements.

(a) * * *

(1) Protected contour. TVBDs must protect digital and analog TV services within the contours shown in the following table. These contours are calculated using the methodology in § 73.684 of this chapter and the R-6602 curves contained in § 73.699 of this chapter.

Type of station	Protected contour		
	Channel	Contour (dBu)	Propagation curve
Analog: Class A TV, LPTV, translator and booster	Low VHF (2-6)	47	F(50,50)
	High VHF (7-13)	56	F(50,50)
	UHF (14-69)	64	F(50,50)
Digital: Full service TV, Class A TV, LPTV, translator and booster	Low VHF (2-6)	28	F(50,90)
	High VHF (7-13)	36	F(50,90)
	UHF (14-51)	41	F(50,90)

(2) Required separation distance. TVBDs must be located outside the contours indicated in paragraph (1) of this section of co-channel and adjacent channel stations by at least the minimum distances specified in the following table. Personal/portable TVBDs operating in Mode II must comply with the separation distances specified for an unlicensed device with an antenna height of less than 3 meters. Alternatively, Mode II personal/portable TVBDs may operate at closer separation distances, including inside the contour of adjacent channel stations, provided the power level is reduced to 40 mW or less as specified in § 15.709(a)(2).

Antenna Height of Unlicensed Device	Required Separation (km) From Digital or Analog TV (Full Service or Low Power) Protected Contour	
	Co-channel	Adjacent Channel
Less than 3 meters	6.0 km	0.1 km
3 – Less than 10 meters	8.0 km	0.1 km
10 – 30 meters	14.4 km	0.74 km

(b) *TV translator, Low Power TV (including Class A) and Multi-channel Video Programming Distributor (MVPD) receive sites*. MVPD, TV translator station and low power TV (including Class A) station receive sites located outside the protected contour of the TV station(s) being received may be registered in the TV bands database if they are no farther than 80 km outside the nearest edge of the relevant contour(s). Only channels received over the air and used by the MVPD, TV translator station or low power/Class A TV station may be registered. TVBDs may not operate within an arc of +/-30 degrees from a line between a registered receive site and the contour of the TV station being received in the direction of the station's transmitter at a distance of up to 80 km from the edge of the protected contour of the received TV station for co-channel operation and up to 20 km from the registered receive site for adjacent channel operation, except that the protection distance shall not exceed the distance from the receive site to the protected contour. Outside of this +/-30 degree arc, TVBDs may not operate within 8 km from the receive site for co-channel operation and 2 km from the receive site for adjacent channel operation. For purposes of this section, a TV station being received may include a full power TV station, TV translator station or low power TV/Class A TV station.

* * * * *

(d) *PLMRS/CMRS operations*: TVBDs may not operate at distances less than 134 km for co-channel operations and 131 km for adjacent channel operations from the coordinates of the metropolitan areas and on the channels listed in § 90.303(a) of this chapter. For PLMRS/CMRS operations authorized by waiver outside of the metropolitan areas listed in § 90.303(a) of this chapter, co-channel and adjacent channel TVBDs may not operate closer than 54 km and 51 km, respectively from a base station.

(f) *Low power auxiliary services, including wireless microphones*:
(1) Fixed TVBDs are not permitted to operate within 1 km, and personal/portable TVBDs will not be permitted to operate within 400 meters, of the coordinates of registered low power auxiliary station sites on the registered channels during the designated times they are used by low power auxiliary stations.
(2) TVBDs are not permitted to operate on the first channel on each side of TV channel 37 (608-614 MHz) that is not occupied by a licensed service.

(g) *Border areas near Canada and Mexico*: Fixed and personal/portable TVBDs shall comply with the required separation distances in §15.712(a)(2) from the protected contours of TV stations in Canada and Mexico. TVBDs are not required to comply with these separation distances from portions of the protected contours of Canadian or Mexican TV stations that fall within the United States.

(h) *Radio astronomy services:* Operation of fixed and personal/portable TVBDs is prohibited on all channels within 2.4 kilometers at the following locations.
(1) * * *
(2) * * *
(3) The following facilities.

Observatory	**Longitude (Deg/Min/Sec)**	**Latitude (Deg/Min/Sec)**
Allen Telescope Array	121 28 24 W	40 49 04 N
Arecibo Observatory	066 45 11 W	18 20 46 N
Green Bank Telescope (GBT)	079 50 24 W	38 25 59 N
Very Large Array (VLA)	Rectangle between latitudes 33 58 22 N and 34 14 56 N, and longitudes 107 24 40 W and 107 48 22 W	
Very Long Baseline Array (VLBA) Stations		
Pie Town, AZ	108 07 07 W	34 18 04 N
Kitt Peak, AZ	111 36 42 W	31 57 22 N
Los Alamos, NM	106 14 42 W	35 46 30 N
Ft. Davis, TX	103 56 39 W	30 38 06 N
N. Liberty, IA	091 34 26 W	41 46 17 N
Brewster, WA	119 40 55 W	48 07 53 N
Owens Valley, CA	118 16 34 W	37 13 54 N

St. Croix, VI	064 35 03 W	17 45 31 N
Hancock, NH	071 59 12 W	42 56 01 N
Mauna Kea, HI	155 27 29 W	19 48 16 N

9. Section 15.713 is amended by revising paragraphs (a)(1), (b)(2)(i), (c)(2), (d), (e), (f)(3), (h)(1), (h)(6), (h)(7) and (h)(8) and adding new paragraph (j) to read as follows:

§ 15.713 TV bands database.

(a) * * *
(1) To determine and provide to a TVBD, upon request, the available TV channels at the TVBD's location. Available channels are determined based on the interference protection requirements in § 15.712. A database must provide fixed and Mode II personal portable TVBDs with channel availability information that includes scheduled changes in channel availability over the course of the 48 hour period beginning at the time the TVBDs make a re-check contact. In making lists of available channels available to a TVBD, the TV bands database shall ensure that all communications and interactions between the TV bands database and the TVBD include adequate security measures such that unauthorized parties cannot access or alter the TV bands database or the list of available channels sent to TVBDs or otherwise affect the database system or TVBDs in performing their intended functions or in providing adequate interference protections to authorized services operating in the TV bands. In addition, a TV bands database must also verify that the FCC identifier (FCC ID) of a device seeking access to its services is valid; under this requirement the TV bands database must also verify that the FCC ID of a Mode I device provided by a fixed or Mode II device is valid. A list of devices with valid FCC IDs and the FCC IDs of those devices is to be obtained from the Commission's Equipment Authorization System.

* * * * *

(b) * * *
(1) * * *
(2) * * *
(i) MVPD receive sites

* * * * *

(c) *Restrictions on registration*.
(1) Television translator, low power TV and Class A TV station receive sites within the protected contour or more than 80 kilometers from the nearest edge of the protected contour of the station being received are not eligible for registration in the database.
(2) MVPD receive sites within the protected contour or more than 80 kilometers from the nearest edge of the protected contour of a television station being received are not eligible to register that station's channel in the database.

(d) *Determination of available channels*. The TV bands database will determine the available channels at a location using the interference protection requirements of § 15.712, the location information supplied by a TVBD, and the data for protected stations/locations in the database.

(e) *TVBD initialization*.
(1) Fixed and Mode II TVBDs must provide their location and required identifying information to the TV bands database in accordance with the provisions of this subpart.

(2) Fixed and Mode II TVBDs shall not transmit unless they receive, from the TV bands database, a list of available channels and may only transmit on the available channels on the list provided by the database.
(3) Fixed TVBDs register and receive a list of available channels from the database by connecting to the iInternet, either directly or through another fixed TVBD that has a direct connection to the Internet.
(4) Mode II TVBDs receive a list of available channels from the database by connecting to the Internet, either directly or through a fixed or Mode II TVBD that has a direct connection to the Internet.
(5) A fixed or Mode II TVBD that provides a list of available channels to a Mode I device shall notify the database of the FCC identifier of such Mode I device and receive verification that that FCC identifier is valid before providing the list of available channels to the Mode I device.
(6) A fixed device located at a site where the ground level height above average terrain (HAAT) is greater than 76 meters shall not be provided a list of available channels. The ground level HAAT of sites occupied by fixed TVBDs is to be calculated using computational software employing the methodology in section 73.684(d) of this chapter.
(f) * * *
(1) * * *
(2) * * *
(3) The TVBD registration database shall contain the following information for fixed TVBDs:
(i) FCC identifier (FCC ID) of the device
(ii) manufacturer's serial number of the device
(iii) device's geographic coordinates (latitude and longitude (NAD 83) accurate to +/- 50 m)
(iv) device's antenna height above ground level (meters)
(v) name of the individual or business that owns the device
(vi) name of a contact person responsible for the device's operation
(vii) address for the contact person
(viii) e-mail address for the contact person
(ix) phone number for the contact person.

** * * *

(h) *TV bands database information*. The TV bands database shall contain the listed information for each of the following:
(1) Digital television stations, digital and analog Class A, low power, translator and booster stations, including stations in Canada and Mexico that are within the border coordination areas as specified in § 73.1650 of this chapter (a TV bands database is to include only TV station information from station license or license application records. In cases where a station has records for both a license application and a license, a TV bands database should include the information from the license application rather than the license. In cases where there are multiple license application records or license records for the same station, the database is to include the most recent records, and again with license applications taking precedence over licenses.):
(i) transmitter coordinates (latitude and longitude in NAD 83)
(ii) effective radiated power (ERP)
(iii) height above average terrain of the transmitting antenna (HAAT)
(iv) horizontal transmit antenna pattern (if the antenna is directional)

(v) amount of electrical and mechanical beam tilt (degrees depression below horizontal) and orientation of mechanical beam tilt (degrees azimuth clockwise from true north)
(vi) channel number
(vii) station call sign

* * * * *

(6) MVPD receive sites. Registration for receive sites is limited to channels that are received over-the-air and are used as part of the MVPD service.
(i) name and address of MVPD company
(ii) location of the MVPD receive site (latitude and longitude in NAD 83, accurate to +/- 50 m)
(iii) channel number of each television channel received, subject to the following condition: channels for which the MVPD receive site is located within the protected contour of that channel's transmitting station are not eligible for registration in the database
(iv) call sign of each television channel received and eligible for registration
(v) location (latitude and longitude) of the transmitter of each television channel received
(7) Television translator, low power TV and Class A TV station receive sites. Registration for television translator, low power TV and Class A receive sites is limited to channels that are received over-the-air and are used as part of the station's service.
(i) call sign of the TV translator station
(ii) location of the TV translator receive site (latitude and longitude in NAD 83, accurate to +/- 50 m)
(iii) channel number of the re-transmitted television station, subject to the following condition: a channel for which the television translator receive site is located within the protected contour of that channel's transmitting station is not eligible for registration in the database
(iv) call sign of the retransmitted television station
(v) location (latitude and longitude) of the transmitter of the retransmitted television station
(8) Licensed low power auxiliary stations, including wireless microphones and wireless assist video devices. Use of licensed low power auxiliary stations at well defined times and locations may be registered in the database. Multiple registrations that specify more than one point in the facility may be entered for very large sites. Registrations will be valid for no more than one year, after which they may be renewed. Registrations must include the following information.
(i) name of the individual or business responsible for the low power auxiliary device(s)
(ii) an address for the contact person
(iii) an email address for the contact person (optional)
(iv) a phone number for the contact person
(v) coordinates where the device(s) are used (latitude and longitude in NAD 83, accurate to +/- 50 m)
(vi) channels used by the low power auxiliary devices operated at the site
(vii) specific months, weeks, days of the week and times when the device(s) are used (on dates when microphones are not used the site will not be protected)
(viii) the stations call sign.
(9) Unlicensed wireless microphones at venues of events and productions/shows that use large numbers of wireless microphones that cannot be accommodated in the two reserved channels and other channels that are not available for use by TVBDs at that location. Such sites of large events and productions/shows with significant wireless microphone use at well defined times and locations may be registered in the database. Entities responsible for eligible event venues registering their site with a TV bands data base are required to first make use of the two reserved

channels and other channels that are not available for use by TVBDs at that location. As a benchmark, at least 6 – 8 wireless microphones should be operating in each channel used at such venues (both licensed and unlicensed wireless microphones used at the event may be counted to comply with this benchmark). Multiple registrations that specify more than one point in the facility may be entered for very large sites. Sites of eligible event venues using unlicensed wireless microphones must be registered with the Commission at least 30 days in advance and the Commission will provide this information to the data base managers. Parties responsible for eligible event venues filing registration requests must certify that they are making use of all TV channels not available to TV bands devices and on which wireless microphones can practicably be used, including channels 7-51 (except channel 37). The Commission will make requests for registration of sites that use unlicensed wireless microphones public and will provide an opportunity for public comment or objections. Registrations will be valid for one year, after which they may be renewed. The Commission will take actions against parties that file inaccurate or incomplete information, such as denial of registration in the database, removal of information from the database pursuant to Section 15.713(i), or other sanctions as appropriate to ensure compliance with the rules. Registrations must include the following information.

(i) name of the individual or business that owns the unlicensed wireless microphones

(ii) an address for the contact person

(iii) an email address for the contact person (optional)

(iv) a phone number for the contact person

(v) coordinates where the device(s) are used (latitude and longitude in NAD 83, accurate to +/- 50 m)

(vi) channels used by the wireless microphones operated at the site and the number of wireless microphones used in each channel. As a benchmark, least 6 – 8 wireless microphones must be used in each channel. Registration requests that do not meet this criteria will not be registered in the TV bands data bases.

(vii) specific months, weeks, days of the week and times when the device(s) are used (on dates when microphones are not used the site will not be protected)

(viii) the name of the venue.

* * * * *

(j) *Security*. The TV bands database shall employ protocols and procedures to ensure that all communications and interactions between the TV bands database and TVBDs are accurate and secure and that unauthorized parties cannot access or alter the database or the list of available channels sent to a TVBD.

(i) Communications between TV bands devices and TV bands databases, and between different TV bands databases, shall be secure to prevent corruption or unauthorized interception of data. A TV bands database shall be protected from unauthorized data input or alteration of stored data.

(ii) A TV bands database shall verify that the FCC identification number supplied by a fixed or personal/portable TV bands device is for a certified device and may not provide service to an uncertified device.

(iii) A TV bands database must not provide lists of available channels to uncertified TV bands devices for purposes of operation (it is acceptable for a TV bands database to distribute lists of available channels by means other than contact with TVBDs to provide list of channels for operation). To implement this provision, a TV bands database administrator shall obtain a list of certified TVBDs from the FCC Equipment Authorization System.

10. Section 15.714 is amended by revising paragraph (a) to read as follows:

§ 15.714 TV bands database administration fees.

(a) A TV bands database administrator may charge a fee for provision of lists of available channels to fixed and personal/portable TVBDs and for registering fixed TVBDs.

* * * * *

11. Section 15.715 is amended by revising the introductory text, revising paragraphs (c), (d), (e) and (g) and by adding new paragraph (f) and re-designating the existing paragraphs (f) through and (k) as paragraphs (g) through (l) to read as follows:

§ 15.715 TV bands database administrator.

The Commission will designate one or more entities to administer the TV bands database(s). The Commission may, at its discretion, permit the functions of a TV bands database, such as a data repository, registration, and query services, to be divided among multiple entities; however, it will designate specific entities to be a database administrator responsible for coordination of the overall functioning of a database and providing services to TVBDs. Each database administrator designated by the Commission shall:

* * * * *

(c) Establish a process for registering fixed TVBDs and registering and including in the database facilities entitled to protection but not contained in a Commission database, including MVPD and TV translator receive sites.

(d) Establish a process for registering facilities where Part 74 low power auxiliary stations are used on a regular basis.

(e) Provide accurate lists of available channels to fixed and personal/portable TVBDs that submit to it the information required under §§ 15.713(e), (f), and (g) based on their geographic location and provide accurate lists of available channels to fixed and Mode II devices requesting lists of available channels for Mode I devices. Database administrators may allow prospective operators of TV bands devices to query the database and determine whether there are vacant channels at a particular location.

(f) Establish protocols and procedures to ensure that all communications and interactions between the TV bands database and TVBDs are accurate and secure and that unauthorized parties cannot access or alter the database or the list of available channels sent to a TVBD consistent with the provisions of Section 15.713(i).

(g) Make its services available to all unlicensed TV bands device users on a non-discriminatory basis.

(h) Provide service for a five-year term. This term can be renewed at the Commission's discretion.

(i) Respond in a timely manner to verify, correct and/or remove, as appropriate, data in the event that the Commission or a party brings claim of inaccuracies in the database to its attention. This requirement applies only to information that the Commission requires to be stored in the database.

(j) Transfer its database along with the IP addresses and URLs used to access the database and list of registered Fixed TVBDs, to another designated entity in the event it does not continue as the database administrator at the end of its term. It may charge a reasonable price for such conveyance.

(k) The database must have functionality such that upon request from the Commission it can indicate that no channels are available when queried by a specific TVBD or model of TVBDs.

(l) If more than one database is developed, the database administrators shall cooperate to develop a standardized process for providing on a daily basis or more often, as appropriate, the data collected for the facilities listed in § 15.713(b)(2) to all other TV bands databases to ensure consistency in the records of protected facilities.

12. Section 15.717 is amended by revising paragraphs (a) and (b) and adding a new paragraph (c) to read as follows:

§ 15.717 TVBDs that rely on spectrum sensing.

(a) *Applications for Certification*. Parties may submit applications for certification of TVBDs that rely solely on spectrum sensing to identify available channels. Devices authorized under this section must demonstrate with an extremely high degree of confidence that they will not cause harmful interference to incumbent radio services.
(1) In addition to the procedures in Subpart J of Part 2 of this chapter, applicants shall comply with the following.
(i) The application must include a full explanation of how the device will protect incumbent authorized services against interference.
(ii) Applicants must submit a pre-production device, identical to the device expected to be marketed.
(2) The Commission will follow the procedures below for processing applications pursuant to this section.
(i) Applications will be placed on Public Notice for a minimum of 30 days for comments and 15 days for reply comments. Applicants may request that portions of their application remain confidential in accordance with § 0.459 of this chapter. This Public Notice will include proposed test procedures and methodologies.
(ii) The Commission will conduct laboratory and field tests of the pre-production device. This testing will be conducted to evaluate proof of performance of the device, including characterization of its sensing capability and its interference potential. The testing will be open to the public.
(iii) Subsequent to the completion of testing, the Commission will issue by Public Notice, a test report including recommendations. The Public Notice will specify a minimum of 30 days for comments and, if any objections are received, an additional 15 days for reply comments.

(b) *Power limit for devices that rely on sensing*. The TVBD shall meet the requirements for personal/portable devices in this subpart except that it will be limited to a maximum EIRP of 50 mW per 6 megahertz of bandwidth on which the device operates and it does not have to comply with the requirements for geo-location and database access in § 15.711(b). Compliance with the detection threshold for spectrum sensing in § 15.717(c), although required, is not necessarily sufficient for demonstrating reliable interference avoidance. Once a device is certified, additional devices that are

identical in electrical characteristics and antenna systems may be certified under the procedures of Part 2, Subpart J of this chapter.

(c) *Sensing requirements*.
(1) *Detection threshold.*
(i) The required detection thresholds are:
(A) ATSC digital TV signals: -114 dBm, averaged over a 6 MHz bandwidth;
(B) NTSC analog TV signals: -114 dBm, averaged over a 100 kHz bandwidth;
(C) Low power auxiliary, including wireless microphone, signals: -107 dBm, averaged over a 200 kHz bandwidth.
(ii) The detection thresholds are referenced to an omnidirectional receive antenna with a gain of 0 dBi. If a receive antenna with a minimum directional gain of less than 0 dBi is used, the detection threshold shall be reduced by the amount in dB that the minimum directional gain of the antenna is less than 0 dBi. Minimum directional gain shall be defined as the antenna gain in the direction and at the frequency that exhibits the least gain. Alternative approaches for the sensing antenna are permitted, *e.g.,* electronically rotatable antennas, provided the applicant for equipment authorization can demonstrate that its sensing antenna provides at least the same performance as an omnidirectional antenna with 0 dBi gain.
(2) *Channel availability check time*. A TVBD may start operating on a TV channel if no TV, wireless microphone or other low power auxiliary device signals above the detection threshold are detected within a minimum time interval of 30 seconds.
(3) *In-service monitoring*. A TVBD must perform in-service monitoring of an operating channel at least once every 60 seconds. There is no minimum channel availability check time for in-service monitoring.
(4) *Channel move time*. After a TV, wireless microphone or other low power auxiliary device signal is detected on a TVBD operating channel, all transmissions by the TVBD must cease within two seconds.

APPENDIX C

Final Regulatory Flexibility Analysis

1. As required by the Regulatory Flexibility Act (RFA),[1] an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Notice of Propose Rule Making* (*NPRM*) in ET Docket No. 04-186[2] and an additional IRFA was incorporated in the *First Report and Order and Further Notice of Proposed Rule Making* (*Further Notice*) in ET Docket No. 04-186.[3] The Commission sought written public comment on the proposals in the *NPRM* and in the *Further Notice*, including comment on the IRFAs. No comments were received in response to either IRFA. This Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.[4]

A. Need for, and Objectives of, the Second Memorandum Opinion and Order

2. This Second Memorandum Opinion and Order responds to seventeen petitions for reconsideration that were filed in response to the *Second Report and Order and Memorandum Opinion and Order* ("*Second Report and Order*") in this proceeding.[5] It upholds the majority of the Commission's prior decisions permitting unlicensed broadband operations in the TV bands and also makes other minor changes and refinements to the rules for TV bands devices. The Commission believes that these changes and clarifications to the rules will better ensure that licensed services are protected from interference while retaining flexibility for unlicensed devices to share spectrum with new services or to change frequencies if TV spectrum is reallocated for other purposes.

3. In the Second Memorandum Opinion and Order, the Commission is taking steps to provide access to unused TV spectrum that will fuel innovation and investment in new unlicensed wireless technologies, much as Wi-Fi and Bluetooth have changed the landscape of communications in recent years. It is resolving on reconsideration certain legal and technical issues in order to provide certainty concerning the rules for operation of unlicensed transmitting devices in the television broadcast frequency bands (unlicensed TV bands devices, or "TVBDs"). The steps being taken will make a significant amount of currently unused spectrum with very desirable propagation characteristics available for new and innovative products and services, particularly broadband data and other services for businesses and consumers. Resolution of these issues will allow manufacturers to begin marketing unlicensed communications devices and systems that operate on frequencies in the TV bands in areas where they are not used by licensed services ("TV white spaces"). The opening of these bands for unlicensed use, which represents the first significant increase in unlicensed spectrum below 5 GHz in over 20 years,

[1] *See* 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. § 601-612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

[2] *NPRM*, 19 FCC Rcd at 10018.

[3] *Further Notice*, 21 FCC Rcd at 12299.

[4] *See* 5 U.S.C. 604.

[5] We are addressing seventeen petitions for reconsideration that were filed in response to the *Second Report and Order and Memorandum Opinion and Order* ("*Second Report and Order*") in this proceeding. *See Second Report and Order and Memorandum Opinion and Order* in ET Docket Nos. 02-380 and 04-186, 23 FCC Rcd 16807 (2008).

will spur manufacturers to develop new radio technologies that will have wide ranging applicability for spectrum sharing in many frequency bands, will have significant benefits for both businesses and consumers and will promote more efficient spectrum use. The technology that enables access to TV white spaces will also serve as a foundation for a model that can be extended to provide opportunistic access to other spectrum bands.

B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA

4. Richard A. Rudman and Dane E. Ericksen ("Rudman/Ericksen) argue that the Final Regulatory Flexibility Analysis (FRFA) in the *Second Report and Order* is deficient because it did not address certain burdens on industry.[6] Specifically, they argue that the FRFA failed to consider the burden of every one of the 6,635 cable television systems in the United States having to register with the TV bands device database to protect the multiple TV receivers typically installed at a cable headend. Rudman/Ericksen state that because the rules permit the registration of receive sites only if they are outside the protected contour of the station being received, and only at distances up to 80 km from the protected contour, a cable system operator will have to calculate the contour for each station being received to determine if the receive site is eligible for registration. They state that there are 8,126 cable headends in the United States, and that if each headend receives ten stations, then over 80,000 contour calculations must be performed. Similarly, Rudman/Ericksen argue that thousands of TV translator licensees will have to perform contour calculations to determine whether their receive sites are at locations that are eligible for registration in the TV bands device database.

5. We disagree with Rudman/Ericksen that voluntary registration of receive sites for cable headends and TV translators poses a significant burden. As the Commission noted in the *Second Report and Order*, the receive sites that may be registered in the TV bands device database are located in areas where TV services are normally not protected, but the Commission decided to provide parties the option of registering sites if they choose to minimize the potential for interference from TV bands devices. However, there is no requirement to register a site. Further, operators of cable systems or other multi-channel video programming distributors (MVPDs) typically already have information on the location of the protected contours of TV stations in their service areas, so they can quickly determine whether a particular receive site is eligible for registration. Even if the operator of a receive site does not know its location with respect to the protected contour of the station being received, such information can be readily obtained. We note that we received petitions for reconsideration from the cable and TV translator industries and two MVPDs, and none of these parties claimed that registration of receive sites is unduly burdensome as Rudman/Ericksen allege.[7]

C. Description and Estimate of the Number of Small Entities To Which Rules Will Apply

6. The RFA directs agencies to provide a description of, and, where feasible, an estimate of, the number of small entities that may be affected by the rules adopted herein.[8] The

[6] *See* Rudman/Ericksen petition at 7.

[7] *See* petitions of the National Cable and Telecommunications Association (March 19, 2009), Community Broadcasters Association (March 19, 2009) and DirecTV and Dish Network (March 19, 2009).

[8] 5 U.S.C. § 604(a)(3).

RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[9] In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.[10] A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).[11]

7. *Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing*. The Census Bureau defines this category as follows: "This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment."[12] The SBA has developed a small business size standard for Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing, which is: all such firms having 750 or fewer employees.[13] According to Census Bureau data for 2002, there were a total of 1,041 establishments in this category that operated for the entire year.[14] Of this total, 1,010 had employment of under 500, and an additional 13 had employment of 500 to 999.15 Thus, under this size standard, the majority of firms can be considered small.

8. *Wireless Telecommunications Carriers (except Satellite)*. Since 2007, the Census Bureau has placed wireless firms within this new, broad, economic census category.[16] Prior to that time, such firms were within the now-superseded categories of "Paging" and "Cellular and

[9] 5 U.S.C. § 601(6).

[10] 5 U.S.C. § 601(3) (incorporating by reference the definition of "small-business concern" in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

[11] 15 U.S.C. § 632.

[12] U.S. Census Bureau, 2002 NAICS Definitions, "334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing"; http://www.census.gov/epcd/naics02/def/NDEF334.HTM#N3342.

[13] 13 C.F.R. § 121.201, NAICS code 334220.

[14] U.S. Census Bureau, American FactFinder, 2002 Economic Census, Industry Series, Industry Statistics by Employment Size, NAICS code 334220 (released May 26, 2005); http://factfinder.census.gov. The number of "establishments" is a less helpful indicator of small business prevalence in this context than would be the number of "firms" or "companies," because the latter take into account the concept of common ownership or control. Any single physical location for an entity is an establishment, even though that location may be owned by a different establishment. Thus, the numbers given may reflect inflated numbers of businesses in this category, including the numbers of small businesses. In this category, the Census breaks-out data for firms or companies only to give the total number of such entities for 2002, which was 929.

[15] *Id*. An additional 18 establishments had employment of 1,000 or more.

[16] U.S. Census Bureau, 2007 NAICS Definitions, "517210 Wireless Telecommunications Categories (Except Satellite)"; http://www.census.gov/naics/2007/def/ND517210.HTM#N517210.

Other Wireless Telecommunications."[17] Under the present and prior categories, the SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.[18] Because Census Bureau data are not yet available for the new category, we will estimate small business prevalence using the prior categories and associated data. For the category of Paging, data for 2002 show that there were 807 firms that operated for the entire year.[19] Of this total, 804 firms had employment of 999 or fewer employees, and three firms had employment of 1,000 employees or more.[20] For the category of Cellular and Other Wireless Telecommunications, data for 2002 show that there were 1,397 firms that operated for the entire year.[21] Of this total, 1,378 firms had employment of 999 or fewer employees, and 19 firms had employment of 1,000 employees or more.[22] Thus, we estimate that the majority of wireless firms are small.

D. Description of Projected Reporting, Record Keeping, and Other Compliance Requirements

9. TV bands devices are required to be authorized under the Commission's certification procedure as a prerequisite to marketing and importation, and the Second Memorandum Opinion and Order makes no change to that requirement. However, it makes certain changes to the technical requirements for TV bands devices, which are discussed below. In addition, the Second Memorandum Opinion and Order makes certain changes to the requirements for TV bands device databases, which are also discussed below.

E. Steps Taken to Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered

10. The RFA requires an agency to describe any significant alternatives that it has considered in developing its approach, which may include the following four alternatives (among others): "(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities;

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[17] U.S. Census Bureau, 2002 NAICS Definitions, "517211 Paging"; http://www.census.gov/epcd/naics02/def/NDEF517.HTM.; U.S. Census Bureau, 2002 NAICS Definitions, "517212 Cellular and Other Wireless Telecommunications"; http://www.census.gov/epcd/naics02/def/NDEF517.HTM.

[18] 13 C.F.R. § 121.201, NAICS code 517210 (2007 NAICS). The now-superseded, pre-2007 C.F.R. citations were 13 C.F.R. § 121.201, NAICS codes 517211 and 517212 (referring to the 2002 NAICS).

[19] U.S. Census Bureau, 2002 Economic Census, Subject Series: Information, "Establishment and Firm Size (Including Legal Form of Organization," Table 5, NAICS code 517211 (issued Nov. 2005).

[20] *Id.* The census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

[21] U.S. Census Bureau, 2002 Economic Census, Subject Series: Information, "Establishment and Firm Size (Including Legal Form of Organization," Table 5, NAICS code 517212 (issued Nov. 2005).

[22] *Id.* The census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

(3) the use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities."[23]

11. The Second Memorandum Opinion and Order generally upholds the rules adopted in the *Second Report and Order*. However, the Commission agreed with petitioners with regard to a number of the requested changes to the rules and modified and clarified the rules as appropriate in granting those requests. It believed those changes and clarifications will provide for improved protection of licensed services in the TV bands, resolve certain uncertainties in the rules and provide manufacturers with greater flexibility in designing products to meet market demands.

12. The Commission eliminated the requirement for TV bands devices that rely on geo-location and database access to sense analog and digital TV signals and also wireless microphones and other low power auxiliary stations. In reaching this decision, it considered the competing views from various parties on whether spectrum sensing is a viable tool for providing access to spectrum. The Commission believes that spectrum sensing will continue to develop and improve and anticipates that some form of spectrum sensing may very well be included in TVBDs on a voluntary basis for purposes such as determining the quality of each channel and enhancing spectrum sharing among TVBDs. However, the Commission did not believe that a mandatory spectrum sensing requirement best serves the public interest. It found that the geo-location and database access method and other provisions of the rules will provide adequate and reliable protection for television and low power broadcast auxiliary services, so that spectrum sensing is not necessary. These other rule provisions include: 1) reserving two vacant UHF channels for wireless microphones and other low power auxiliary service devices in all areas of the country, and 2) allowing operators of the venues of large events and productions/shows that use large numbers of wireless microphones on an unlicensed basis to register the sites of those venues with the Commission to receive the same geographic spacing protections afforded licensed wireless microphones.

13. The Commission also adopted changes to the requirements for the databases that TV bands devices must contact to contain lists of available channels. Specifically, it required that communications between TV bands devices and TV bands databases, and between multiple databases, are secure. The Commission found that it is important and necessary for TV bands devices and TV bands databases to incorporate reasonable and reliable security measures to minimize the possibility that TV bands devices will operate on occupied channels and cause interference to licensed services and to protect the operation of the databases and the devices they serve from outside manipulation. The Commission noted that virtually all online transactions involving financial or other confidential information currently use security measures to protect against unauthorized viewing and/or alteration of information being sent and to ensure that only authorized users have access to information. It therefore expects that device manufacturers and database administrators will have access to and be able to incorporate the reliability and security measures needed to protect the contents of databases and communications between databases and TV bands devices or other databases. In addition, the Commission required that all information that is required by the Commission's rules to be in a TV bands device database be publicly available, including fixed TV bands device registration and voluntarily submitted protected entity (*e.g.*, cable head ends) information. Although much of

[23] 5 U.S.C. § 603(c)(1) – (c)(4).

the data will come from Commission databases that already are public sources, errors could result from the inadvertent entry of incorrect data, or as a result of a party deliberately entering false data. The Commission found it is appropriate to permit public examination of protected entity registration information to allow the detection and correction of errors.

14. The Commission made certain changes to the technical requirements for TV bands devices. It adopted a power spectral density (PSD) limit, which is a measure of transmitter power per unit of bandwidth. In the absence of a PSD limit, multiple devices with transmit bandwidths of significantly less than the width of a TV channel (6 megahertz) could share a single channel, resulting in a total transmitted power within a channel significantly greater than the power limits for fixed or personal/portable devices. A PSD limit will prohibit high power concentrations in a single channel, which will reduce the interference potential to TV stations and other services in the TV bands. The Commission also adopted changes to the measurement procedure for TV bands device emissions that fall into a TV channel adjacent to the operating channel to ensure that consistent measurement results are obtained regardless of the bandwidth of the transmitted signal.

15. The Commission also removed the prohibition on TV bands devices operating within the border areas near Canada and Mexico. It found that TV stations in Canada and Mexico could be protected by including them in the TV bands device database rather than by a blanket exclusion on TV bands device operation within the border areas.

F. Report to Congress

16. The Commission will send a copy of the Second Memorandum Opinion and Order, including this FRFA, in a report to be sent to Congress and the Government Accountability Office pursuant to the Congressional Review Act.[24] A copy of the Second Memorandum Opinion and Order and FRFA (or summaries thereof) will also be published in the Federal Register.[25]

STATEMENT OF CHAIRMAN JULIUS GENACHOWSKI

Re: 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, Second Memorandum Opinion and Order, ET Docket No. 02-380

As President Obama recently said, "our nation's success depends on strengthening America's role as the world's engine of discovery and innovation." Today, the Commission takes a big step to open a new platform for American innovation. This is important. It will enhance our economy and strengthen our global competitiveness, lead to billions of dollars in private investment and to valuable new products and services – some we can imagine, and many we can't.

[24] *See* 5 U.S.C. § 801(a)(1)(A).

[25] *See* 5 U.S.C. § 604(b).

It is another implementation of an important recommendation of the National Broadband Plan, which emphasized the vital role of spectrum to our economic future and the need for spectrum efficiency, spectrum recovery, and smart spectrum policy. As the National Broadband Plan explained, both licensed and unlicensed spectrum are important for a vibrant mobile ecosystem.

Today's focus is on unlicensed spectrum, which offers unique opportunities to innovators and entrepreneurs. Today's Order marks the Commission's first significant release of unlicensed spectrum in 25 years.

This new unlicensed spectrum will be a powerful platform for innovation. And as we've seen time and again, when we unleash American ingenuity, great things happen.

We know from experience that unlicensed spectrum can trigger unexpected but hugely beneficial innovation. For example, years ago, there was a band of low-quality spectrum that was lying fallow. Nobody could figure out what to do with this so-called "junk band," so the FCC decided to free it up as unlicensed spectrum.

The result was a wave of new technologies – baby monitors, cordless phones, and eventually a real game changer: Wi-Fi. Today, Wi-Fi is a multi-billion industry and an essential part of the mobile ecosystem.

As compared to the airwaves we released for unlicensed use in 1985, this "white spaces" spectrum is far more robust – traveling longer distances and through walls, making the potential for this unlicensed spectrum much greater.

One analyst estimates white spaces applications could generate more than $7 billion in economic value annually.

We know what the first major application will be: super Wi-Fi. Super Wi-Fi is what it sounds like: Wi-Fi, but with longer range, faster speeds, and more reliable connections.

We can also expect, as we've seen now with Wi-Fi, enhanced performance from the mobile devices using licensed spectrum that we've come to rely on so heavily.

The FCC has already granted experimental licenses to a handful of cities, giving us an idea of the myriad ways super Wi-Fi will be put to use.

In Claudeville, Virginia, they are providing broadband access to a remotely located elementary school. In Wilmington, North Carolina, they are trialing "smart city" applications to manage traffic and monitor water quality at nearby wetlands. In Logan, Ohio they are using the white space to deliver Telemedicine to health care providers. Plumas County, California is utilizing "Smart Grid" technologies for its electricity network.

We're seeing "machine-to-machine" Internet uses of this spectrum that could be its own harbinger of benefits to come.

These are just some of the applications we know about. But again what may be even more exciting are the applications that American innovators and entrepreneurs will invent.

One last point. Today's Order is important not only for the innovation, investment and economic benefit it will unleash, but because of the competitive edge it will offer.

U.S. companies have already invested in research and development of super Wi-Fi technologies. Now they can take this technology out of the labs and onto the market.

Other countries have been looking at Super Wi-Fi. By giving the green light now, the United States will be the first nation to deploy this technology. We can have the investment here, the intellectual property developed and the products launched here, and then export our products globally – all contributing to U.S. job creation and economic growth.

STATEMENT OF
COMMISSIONER MICHAEL J. COPPS

Re: 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, Second Memorandum Opinion and Order, ET Docket No. 02-380

It's been a long time coming, but it looks like white spaces' time has indeed come. This is a truly major step to make more spectrum available for wireless broadband. I have long advocated the full-scale development of white spaces technology to maximize the spectrum resource. In the absence of innovative technological solutions, too much spectrum—and prime spectrum below 1 GHz, at that—will lie fallow. When we last addressed white spaces on November 4, 2008, a momentous day in many ways, we left too many questions unresolved about the use of white spaces within the broadcasting spectrum. A lot has changed since then, including a focused commitment to ensuring that every American has access to affordable, value-laden, opportunity-creating broadband. Now we finally resolve the difficult questions and set ourselves on a course to unleash the tremendous potential of the white spaces.

Throughout the implementation of the National Broadband Plan, I have emphasized the countless ways that transformative broadband technology intersects with nearly all aspects of our everyday lives. The opportunities created by white space technologies are endless: whether it's increasing the reach of broadband to unserved and underserved populations, including Tribal Lands; whether it's giving local governments tools for implementing smart city, eco-friendly wireless applications; whether it's providing robust wireless coverage for school children, inside and outside the classroom. The possibilities are just about limitless.

We began our work on white spaces mindful of these opportunities, but with a focus on how to address the needling challenges of avoiding potential interference with other occupants of the TV spectrum—including broadcasters, cable headends and wireless microphone users, licensed and unlicensed. I am proud of our Office of Engineering and Technology staff for confronting the hard questions head on, and bringing us an item that provides a technologically-sound way forward. Here again, hero status goes to Julie Knapp and his team for persevering, asking all the right questions, doing the rigorous testing and analysis, and bringing us an item that is both visionary and balanced. Unlicensed spectrum is no longer just about garage door openers, and it is the type of clever, outside-the-box thinking demonstrated here that is exactly the kind of thinking that the United States needs to encourage if it is to continue to lead in technology innovation.

Recognizing the importance of licensed wireless microphones to electronic news gathering and the reality that many venues—Broadway theaters, sports arena, churches and schools—have come to rely on unlicensed wireless microphones, we have gone to great lengths to accommodate their needs. In fact, we take the bold step of setting aside two reserve channels nationwide, where wireless microphones can operate without the potential of interference from white spaces devices. In addition to the reserve channels, wireless microphones have other channels available in the TV bands that are not available for white spaces devices. For large events that need more than the channels available in a given area for wireless microphones, we will allow users to register the time, place and duration in the TV Bands Database. The

Commission will ensure transparency in this process, and—in order to register—will require large users to demonstrate that all other spectrum above Channel 7 is unavailable for wireless microphone use. I believe that this approach will not only ensure adequate spectrum for both wireless microphones and white spaces devices, but also encourage wireless microphone manufacturers to make much-needed improvements to equipment efficiency and interference resistance.

One of the great lessons that I quickly learned here at the FCC is the power of technology to turn scarcity into abundance. Now is the time for us to implement a framework that allows innovators and entrepreneurs to use technology to bring the promise of under-used white spaces spectrum from the test mode to widespread use. We are providing that golden opportunity today, and I look forward to seeing new devices widely-available in consumer markets next year.

A great example of white spaces potential was demonstrated last week when the Hocking Valley Community Hospital in Ohio—working with Google and Spectrum Bridge—became the first hospital to utilize white spaces for the purposes of telemedicine. Down in Wilmington, North Carolina, using an 18-month experimental license from the FCC, Mayor Bill Saffo has unveiled a municipal wireless white spaces network that transmits video of traffic along highways, monitors water level and quality, saves energy by remotely turning off lights at ball parks and provides public Wi-Fi in some areas. I hope and expect to see examples like these popping up all over the country.

Again, thanks to Julie Knapp and his team for their tireless work in bringing us today's Order. They have given us a workable balance that promotes wireless broadband use of the white spaces, allows venues to continue to use wireless microphones and protects the operations of broadcasters. The American people will reap real benefits from your work here. Of course, your work is not yet done. We have wisely delegated the technical issues surrounding the creation of the TV Bands Database administrators to OET. I hope this will move expeditiously and that we can get that Database management up-and-running within the next two months. Thanks to the Chairman for his leadership here and to all my colleagues who have supported this step, asked great questions and made good suggestions to improve the item. Finally, let's recognize the vast stakeholder input we have enjoyed here—although to say we always "enjoyed it" might be just a tad of a stretch. Absent the robust dialogue and input we have had from so many stakeholders, this would be a lesser item.

STATEMENT OF
COMMISSIONER ROBERT M. McDOWELL

Re: 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, Second Memorandum Opinion and Order, ET Docket No. 02-380

I am pleased to support today's order resolving the petitions for reconsideration of our historic – and unanimous – November 2008 vote to make a portion of the unused spectrum in the TV bands available for unlicensed wireless devices. This proceeding started under the leadership of Chairman Michael Powell in 2002. Foreseeing the wonderful consumer benefits and the huge opportunity for job growth associated with this spectrum, many of us, including me, for years have been strong advocates for unlicensed use of the TV "white spaces." And, it's no secret that, for some time now, I have emphasized the importance of concluding this proceeding as soon as possible. Although our work is not entirely complete, we have taken another important step.

The potential uses for this spectrum are limitless. Moreover, the protocol developed in this proceeding for "smart use" of this spectrum has great potential for enabling access to and improving efficiency in other frequency bands. The white spaces formula – unlicensed spectrum distribution, limitless potential applications and a path for continued development of advanced smart technologies – illustrates another reason why neither open access nor net neutrality rules need be mandated. The ubiquitous availability of white spaces provides consumers a competitive alternative to existing broadband providers, an additional check against potential anti-competitive mischief, and a means to relieve spectrum congestion in licensed bands. Furthermore, as with Wi-Fi, the *unlicensed* nature of white spaces use will accelerate its deployment and adoption much faster than if this spectrum was auctioned (if that were even practical to begin with). Our action thus helps to bring more broadband to consumers as quickly as innovation, rather than the government, will allow.

Although we have eliminated the *requirement* that TV band devices that incorporate geo-location and database access must listen and adjust for other signals, I am pleased that we emphasize the importance of the continued development of this sensing capability. Because sensing holds great promise to improve spectral efficiency and provide "smart" access to other bands, I thank the entrepreneurs that are investing in the costly research and development to continue to improve this technology.

In addition, I look forward to coordinating closely with our talented colleagues in the Office of Engineering and Technology on completing our next task: getting the TV bands geo-location databases up and running. Certainly it is important that we proceed to this next step as quickly as possible, which will bring greater certainty to the entities that tell us they are standing ready to build the technologies for this spectrum band. Given that we have eliminated the sensing requirement, however, it will be just as important to proceed with great care. We all agree that we have a duty to create an effective tool, as well as to ensure that we "do no harm" to incumbent users or, ultimately, consumers.

Finally, as the use of mobile data increases, providers will need to increase their backhaul capacity, including microwave backhaul, to accommodate the expected exponential increase in traffic. Increasing the availability of microwave will serve as an additional choice for backhaul

services. This, too, is an issue that I've been speaking about for some time now, most recently at last month's open meeting. Therefore, I appreciate today's express commitment to pursue the question of whether we can accommodate licensed rural backhaul in the white spaces. Specifically, Commission staff will evaluate this possibility and will formulate and submit a recommendation to the Commissioners by the end of the year. I will continue to stay engaged on this issue, and look forward to learning more.

First, I thank the commissioners and chairmen who worked on these ideas years ago. I also applaud Chairman Genachowski's leadership and the contributions of my fellow commissioners here today. These issues are complicated, yet they were easier to grasp and resolve because the process was collegial and consensus-based. Thank you also to Julie Knapp, Alan Stillwell, and all of our colleagues in the Office of Engineering and Technology and Ruth Milkman and her team in the Wireless Telecommunications Bureau. We are grateful for your guidance, insights and creativity.

STATEMENT OF
COMMISSIONER MIGNON L. CLYBURN

Re: 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, Second Memorandum Opinion and Order, ET Docket No. 02-380

Today, I join the chorus of support that every Commissioner, who has voted during the history of this proceeding, has expressed for permitting the development of unlicensed services in the TV White Spaces. The National Broadband Plan, and the 14th Mobile Services Report, made it clear that licensed communications companies, find it difficult to develop a profitable business plan, to serve the communications needs of many sparsely populated rural areas. As pilot programs in Claudville, Virginia and Wilmington, North Carolina demonstrate, when unlicensed services are allowed to take advantage of the enhanced propagation characteristics of the TV spectrum, these services can successfully bring affordable wireless broadband services, to both sparsely populated rural areas and low-income communities in urban areas. I am excited to see that companies such as Dell, Google, Microsoft, Motorola, and Nokia, have expressed such optimism about developing products and services for the TV White Spaces.

I was pleased to see that we revisited the Commission's decision, from 2008, to prohibit the operation of TV White Space devices in geographic areas near the borders of Canada and Mexico. Many tribal communities are located near these borders, in rural areas, that are the most difficult for commercial wireless firms to serve. Consequently, these tribal communities are among those that stand to benefit the most from the wireless broadband services that the TV White Space device manufacturers plan to deliver. As the 2008 Order pointed out, we should be concerned about Canadian and Mexican licensed operations. But, as the Tribal Digital Village persuasively demonstrated, the straightforward solution, which is consistent with the rules we adopt today, is to include information on the Canadian and Mexican stations in the TV White Space database as protected services.

As you know, there were a number of contentious issues in this proceeding. Julie Knapp, and the talented staff in the Office of Engineering and Technology, took a thoughtful and measured approach to strike the proper balance, between the interests of the TV White Space advocates, public safety agencies, and wireless microphone users. I am confident that this agency will continue to take approaches that promote the development of TV White Space devices and services.

STATEMENT OF
COMMISSIONER MEREDITH A. BAKER

Re: 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, Second Memorandum Opinion and Order, ET Docket No. 02-380

I am excited about today's TV White Spaces item. I believe it represents real progress in enabling and empowering innovation and entrepreneurship in cutting edge technologies. Today's item is a solid building block for spectrum policy. It is a win for American leadership in the wireless space that has the potential to transform the way we use congested spectrum, to take the "mobile revolution" to new levels. I hope that the pioneering work that has been done to engineer TV Band devices will lead to similar approaches for other spectrum bands. There are "white spaces" in all parts of the spectrum and we need to use them more effectively.

Today, we clarify the conditions under which unlicensed devices can use TV white spaces. It is a defining step in a process that began many years ago. The ample record reflects the wide range of views in this complicated area. I take them all very seriously. The item before us reflects the staff's hard and careful analysis and strikes an appropriate balance.

There is still work ahead of us. I hope other users of the TV Bands, like wireless mics, will make every effort to ensure that the technology solutions they develop and deploy use the spectrum, which is necessarily constrained in certain parts of the country, as efficiently as possible. In this regard, in particular, I believe there is much that can and should be done.

There are three areas in this item where I hope we will take additional action in the near future to advance our spectrum policy and ensure its alignment with the needs and requirements of the millions of people across the country that use wireless technologies every day.

First, I support the approach we are taking today with respect to the development of a TV Band geolocation database. A robust, reliable and secure database is critical to the successful deployment of TV Band devices. We are giving appropriate latitude to the Office of Engineering and Technology to develop the regulations and requirements that will govern the TV Band Database. I hope Julie and his team can complete their work on a timely basis. I look forward to working on the details with them. It is important to define an approach that includes adequate safeguards to ensure that the database is as accurate, user-friendly and accessible as possible. Setting appropriate standards for database maintenance while leaving the database architecture open for customization and advanced services fosters the twin goals of empowering innovation and ensuring that novel uses of white spaces don't harmfully interfere with incumbent users.

In this regard I reiterate my view that for this and any form of dynamic spectrum access to work, our guiding principle must always be that we do not harm legitimate incumbent operations. Broadcasters' rights, in particular, must be respected and protected. We must ensure oversight and enforcement of our rules applicable to the band, including the rules governing the operation of the database.

Second, I hope that equipment developers and device manufacturers will continue their work on sensing technologies and take advantage of the flexible approach outlined in the item. I appreciate the well-articulated concern that requiring *both* sensing and database consultation could have a chilling effect on the initial deployment of white space devices. However, I am hopeful that the widespread commercial deployment of sensing technologies will play a critical role in increasing access to spectrum not only in the TV white spaces but in other spectrum that from time-to-time or in certain locations lies fallow. Sensing technologies have shown great promise in other contexts, including Department of Defense research, and I look forward to finding ways to encourage and advance their deployment for commercial purposes.

Finally, it is important that we address additional proposals to set aside TV channels in rural areas for fixed licensed backhaul in the very near future. The ability of both new and incumbent wireless providers to provide 4G wireless services ubiquitously is dependent upon a robust wireless infrastructure that is too often lacking in rural areas. The prospect of fixed licensed backhaul in the TV bands holds great merit and I would hope that we could move forward along the lines that have been proposed as soon as we have completed our official analysis of TV spectrum availability.

I would like to add my thanks to Julie and Ruth and their teams who have been working on this item for so many years. Today we have taken a real step forward.