

Before the  
Federal Communications Commission  
Washington, D.C. 20554

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

**FIRST REPORT AND ORDER AND FURTHER NOTICE OF PROPOSED RULE MAKING**

Adopted: October 12, 2006

Released: October 18, 2006

Comment Date: (75 days after date of publication in the Federal Register)

Reply Comment Date: (105 days after date of publication in the Federal Register)

By the Commission: Chairman Martin and Commissioners Copps, Adelstein, Tate and McDowell issuing separate statements

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## 1. INTRODUCTION

1. By these actions the Commission is taking a number of important first steps towards allowing the introduction of new low power devices in the broadcast television spectrum (TV bands) on channels/frequencies that are not being used for authorized services (hereinafter referred to as "TV band devices").<sup>1</sup> Our goal in this proceeding is to allow such devices to operate on unused television channels in locations where such operations will not result in harmful interference to TV and other authorized services. We believe that this plan will provide for more efficient and effective use of the TV spectrum and will significantly benefit the public by allowing the development of new and innovative types of devices and services for businesses and consumers, without disrupting television and other authorized services using the TV bands. Because transmissions in the TV band are subject to less propagation attenuation than transmissions in other bands where lower power operations are permitted (such as unlicensed operations in the 2.4 GHz band), operations in the TV bands can benefit a wide range of service providers and consumers by improving the service range of wireless operations, thereby allowing operators to reach new customers. While there will be significant benefits to the public from our actions, we recognize that we must balance these benefits with the need to protect authorized services in the TV bands from harmful interference.<sup>2</sup>

2. We find that the record and information developed in response to the *Notice of Proposed Rulemaking* in this proceeding supports a conclusion that low power devices can generally be allowed to operate on TV channels in areas where those frequencies are not being used for TV or other incumbent licensed services if such devices comply with appropriate protective measures for ensuring that they do not cause interference to already authorized services.<sup>3</sup> Accordingly, in the First Report and Order herein we make initial decisions to permit fixed low power devices to operate on any permissible TV channel, but only at times and locations where the spectrum is not already being used by other authorized services. We will further consider whether appropriate provisions can be developed to permit low power personal/portable devices to operate in this spectrum without causing harmful interference. To minimize the risk of interference to certain authorized services in the TV bands, we will not permit operation of TV band devices on TV channel 37 that is used by radio astronomy and wireless medical telemetry services, and on TV channels 52-69, as that spectrum has been reallocated for other services and will no longer be part of the TV bands after the digital television (DTV) transition. We also will not permit operation of personal/portable TV band devices on TV channels 14-20 that are used by public safety services. In addition, the final rules we adopt will allow the marketing of TV band devices to commence on February 18, 2009, after the transition to DTV service is complete and all TV stations are in operation on their permanent DTV channels.

3. In the Further Notice portion of this action, we ask questions and set forth certain proposals with regard to the provisions necessary to implement complete and final rules. The process that we will follow in developing the final rules for devices in the TV bands will allow us to develop a thorough record on the various issues involved. While we continue to focus on devices operating on an unlicensed

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<sup>1</sup> The TV broadcast bands that are the subject of this proceeding include the following portions of the VHF and UHF radio spectrum: 54-72 MHz, 76-88 MHz, 174-216 MHz and 470-806 MHz.

<sup>2</sup> As defined in Section 2.1(c) of the Commission's rules and the international radio regulations, harmful interference is "interference which ... seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with these [international] Radio Regulations. (RR)." See 47 C.F.R. § 2.1(c).

<sup>3</sup> See *Notice of Proposed Rule Making* in ET Docket Nos. 02-380 and 04-186, 19 FCC Rcd 10018 (2004).

*basis, we also ask whether such devices should instead operate on a licensed or hybrid basis. We also describe our plans to conduct extensive testing to assess the potential interference from low power devices operating in the TV bands. We expect to complete this work and make final decisions in sufficient time for industry to design and produce new products by completion of the DTV transition. We are requesting additional comment on whether we should allow the operation of personal/portable devices and the means that such devices, both fixed and personal/portable, should be required to use to determine the availability of unused frequencies in the TV bands and the technical features and parameters of such capability to prevent interference to authorized services. We propose to require that TV band devices employ spectrum sensing to determine when TV channels are unused and to incorporate a dynamic frequency selection (DFS) mechanism to ensure that TV band devices operate only on vacant TV channels. We seek comment on whether TV band devices should be permitted to operate on TV channels 2-4, and whether fixed TV band devices should be permitted to operate on TV channels 14-20. We also seek additional comments on several issues relating to the geo-location/database and control signal approaches discussed in the Notice.*

## II. BACKGROUND

4. The Commission provides for the operation of unlicensed radio transmitters in Part 15 of its rules.<sup>4</sup> Under these rules, unlicensed devices generally operate on frequencies shared with authorized services and at relatively low power. 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.<sup>5</sup> The current Part 15 rules provide substantial flexibility in the types of unlicensed devices that can be operated. However, the rules prohibit the operation of unlicensed devices on certain frequencies, including the bands used for broadcast television service.<sup>6</sup>

5. The broadcast television service operates under Part 73 of the rules. TV stations generally operate on 6 megahertz channels designated channels 2 to 69 in the VHF and UHF portions of the radio spectrum (54-72 MHz, 76-88 MHz, 174-216 MHz and 470-806 MHz).<sup>7</sup> Television stations are now in the process of converting from analog to digital transmissions.<sup>8</sup> During the transition to digital transmissions, each full service television station that was authorized before 1997 is required to broadcast on two channels, one digital and one analog.<sup>9</sup> At the end of the transition on February 17, 2009, each TV

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<sup>4</sup> See 47 C.F.R. Part 15.

<sup>5</sup> See 47 C.F.R. § 15.5.

<sup>6</sup> See 47 C.F.R. §§ 15.205 and 15.209. Remote control and medical telemetry devices are the only unlicensed transmitters that are currently permitted to operate in the TV bands. See 47 C.F.R. §§ 15.231, 15.241 and 15.242.

<sup>7</sup> See 47 C.F.R. § 73.603(a).

<sup>8</sup> Advanced Television Systems and Their Impact upon the Existing Television Broadcast Service, MM Docket 87-268, *Sixth Report and Order*, 12 FCC Rcd 14588 (1997).

<sup>9</sup> The analog and digital channels currently used by full service TV stations are set forth in Sections 73.606 and 73.622 of the rules, respectively, see 47 C.F.R. §§ 73.606 and 73.622. In developing the initial table of allotments for digital TV stations, the channels were selected to minimize or prevent interference between digital stations and between analog and digital stations. Request for modification of stations on channels in the initial (1998) DTV Table of Allotments are evaluated for technical acceptability using minimum desired-to-undesired (D/U) signal ratios, see 47 C.F.R. § 73.623(c). New digital allotments added after the initial digital TV Table of Allotments must meet minimum separation distances to both digital and analog TV stations, see 47 C.F.R. § 73.623(d).

station must cease analog operation and operate on a single digital channel.<sup>10</sup> Because the new digital TV transmission system is more spectrally efficient than the analog TV transmission system, some current TV channel protection requirements were relaxed or eliminated for digital operation, and all existing television stations can be accommodated in less spectrum after the digital transition. Digital television stations will operate only on channels 2-51 after the transition, and television channels 52-69 have been reallocated for other uses.<sup>11</sup>

6. To avoid interference between TV stations, stations on the same and adjacent channels (and in the case of analog service certain other channel relationships) must comply with minimum separation distance requirements or other technical provisions. As a result of these provisions, there are geographic areas between stations of any given channel where TV service is not available. This situation will remain after the transition. After the digital television transition, there will be a number of TV channels in a given geographic area that are not being used by full service digital TV stations because such stations will not be able to operate without causing interference to co-channel or adjacent channel stations. The Commission's rules require minimum separation distances between stations based on the assumption that the stations will operate at maximum power.<sup>12</sup> However, a transmitter operating on a vacant TV channel (e.g., a channel not used by a high power TV station in a given geographic area due to interference concerns) at a lower power level than a TV station would not need as great a separation distance from co-channel and adjacent channel TV stations to avoid causing interference to such stations. Also, in some areas channels that would otherwise be available for television service are not being used.

7. In addition to full service analog and digital TV stations 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.<sup>13</sup> Low power TV stations, TV translator and TV booster stations are permitted to operate under Part 74 of the rules on a secondary basis to full service stations and on an equal basis to Class A TV stations, provided they meet technical rules to prevent interference to reception of such stations.<sup>14</sup> Part 74 also permits certain broadcast auxiliary operations on TV channels 14-69 on a secondary basis.<sup>15</sup> In addition, Part 74 permits certain entities to operate wireless microphones on vacant TV channels on a non-interference basis.<sup>16</sup> 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

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<sup>10</sup> See Title III of the Deficit Reduction Act of 2005, Pub. L. 109-171, 120 Stat. 4, 21 (Feb. 8, 2006).

<sup>11</sup> See *First Report and Order* in WT Docket No. 99-168, 15 FCC Rcd 476 (2000), *Report and Order* in ET Docket No. 97-157, 12 FCC Rcd 22953 (1998) and *Report and Order* in GN Docket No. 01-74, 17 FCC Rcd 1022 (2002).

<sup>12</sup> See *supra* footnote 7. The separations differ depending on the zone where the stations are located and whether the stations are in the VHF or UHF band.

<sup>13</sup> 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 not available to TV translator and low power stations.

<sup>14</sup> See 47 C.F.R. Part 74 Subpart G.

<sup>15</sup> See 47 C.F.R. § 74.602(h). This 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 subpart G of Part 74.

<sup>16</sup> See 47 C.F.R. § 74.861.

Service (PLMRS) under Part 90 of the rules and the Commercial Mobile Radio Service (CMRS) under Part 20 of the rules. In addition, medical telemetry equipment is permitted to operate on an unlicensed basis on vacant TV channels 7-46, and unlicensed remote control devices are allowed to operate on any TV channel above 70 MHz (channel 4), except for channel 37.<sup>17</sup> TV channel 37 is allocated for radio astronomy and the wireless medical telemetry service (WMTS) and is not used for TV broadcasting.

8. On May 13, 2004, the Commission adopted a *Notice of Proposed Rule Making (Notice)* in this proceeding in which it proposed to allow unlicensed operation in the TV bands at locations where frequencies are not in use by licensed services.<sup>18</sup> To ensure that no harmful interference to TV stations and other authorized users of the spectrum will occur, the Commission proposed to define when a TV channel is unused and to require unlicensed devices to incorporate "smart radio" features to identify the unused TV channels in the area where they are located. For the purpose of establishing a plan for minimizing interference, the Commission proposed to classify unlicensed broadband devices to be used in the TV bands into two general functional categories. The first category would consist of lower power "personal/portable" unlicensed devices, such as Wi-Fi like cards in laptop computers or wireless in-home local area networks (LANs). The second category would consist of higher power "fixed/access" unlicensed devices that are generally operated from a fixed location and may be used to provide a commercial service such as wireless broadband Internet access. The Commission proposed that fixed/access devices incorporate a geo-location method such as a Global Positioning System (GPS) receiver or be professionally installed, and that they must access a database to identify vacant channels at their location. It proposed to require that personal/portable devices operate only when they receive a control signal from a source such as an FM or TV station that identifies the vacant TV channels in that particular area. The Commission also sought comment on the use of spectrum sensing to identify vacant TV channels, but did not propose any specific technical criteria for spectrum sensing.

### III. REPORT AND ORDER

#### A. Background

9. The comments received in response to the *Notice* are divided between existing spectrum users of the TV bands, who are concerned about potential interference, and manufacturers and users of unlicensed devices who believe adequate safeguards can be put in place to prevent harmful interference to authorized services. Full service and low power broadcasters oppose allowing unlicensed operation in the TV bands. These parties express concern that unlicensed devices operating under the proposed rules would cause interference to TV reception, particularly in weak signal areas, and that the Commission should protect reception to a greater extent than proposed.<sup>19</sup> Several parties also express concern that

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<sup>17</sup> See 47 C.F.R. §§ 15.231, 15.241 and 15.242. Effective October 16, 2002, the Commission ceased granting certification 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 14 megahertz of spectrum in three blocks at 608-614 MHz (TV channel 37, which the WMTS now shares with radioastronomy), 1395-1499 MHz, and 1429-1432 MHz, see *Report and Order* in ET Docket No. 99-255, 15 FCC Rcd 11206 (2000).

<sup>18</sup> See *Notice of Proposed Rule Making* in ET Docket Nos. 02-380 and 04-186, 19 FCC Rcd 10018 (2004).

<sup>19</sup> For example, see National Cable and Telecommunications Association reply comments at 4, NAB/MSTV reply comments at 6, Society of Broadcast Engineers reply comments at 1, Community Broadcasters Association reply comments at 3, National Translator Association comments at 1, Entravision Holdings comments at 2, Southwest (continued....)

unlicensed devices operating in close proximity to TV receivers would cause direct pickup interference potentially affecting all channels.<sup>20</sup> Many parties state that if the Commission decides to allow unlicensed devices in the TV bands, it should wait until after the DTV transition when the bands will be less crowded.<sup>21</sup> Some of these parties also suggest that, if new wireless operations are allowed in the TV bands, they should be on a licensed, rather than an unlicensed, basis.<sup>22</sup>

10. Manufacturers and users of wireless microphones and other broadcast auxiliary services submit that unlicensed devices would cause harmful interference to those services. These parties recommend that the Commission take a number of steps to protect auxiliary services, including reducing power for portable unlicensed devices, reserving several TV channels in each market for wireless microphone use, requiring unlicensed devices to incorporate spectrum sensing to detect the presence of wireless microphones, and requiring unlicensed devices to recognize a "smart beacon" transmitted where wireless microphones are in use.<sup>23</sup> Land mobile interests express concern about allowing unlicensed operation on channels 14-20 in any part of the country because devices could be transported into areas where these channels are used by the PLMRS/CMRS.<sup>24</sup>

11. A number of equipment manufacturers, trade associations and other parties including Intel, Microsoft, CEA, Motorola, TIA, IEEE 802, Wi-Fi Alliance, New America Foundation and numerous WISPs support allowing unlicensed operation in the TV bands.<sup>25</sup> These parties generally state that unlicensed devices could operate in the TV bands without causing interference to authorized services, and that allowing operation in the TV bands could improve access to broadband communications by taking advantage of the favorable propagation characteristics of the TV spectrum and enable more efficient use of this spectrum.

(Continued from previous page)

Colorado TV Translator Association comments at 1, Syncom Media Group comments at 1, Cox Broadcasting comments at 8, Pappas Telecasting comments at 8, and Region 1 Translator Association comments at 2.

<sup>20</sup> See NAB and MSTV reply comments at 14, Consumer Electronics Association comments at 10, and National Cable and Telecommunications Association comments at 5.

<sup>21</sup> For example, see Pikes Peak Broadcasting Company comments at 1, NPG of Oregon, Inc. comments at 1, Association of Public Television Stations comments at 3, Pappas Telecasting Companies comments at 6, Cox Broadcasting, Inc. comments at 4, Entravision Holdings comments at 7, NAB and MSTV comments at 3, Qualcomm comments at 7, and Shure reply comments at 26.

<sup>22</sup> See NAB and MSTV comments at 24, National Translator Association comments at 4, Entravision Holdings comments at 7, Cox Broadcasting comments at 4, Community Broadcasters Association comments at 7, Region 1 Translator Association comments at 2, Paul Burkholder comments at 2, and Pikes Peak Broadcasting comments at 1.

<sup>23</sup> For example, see Shure comments at 9, Telex Communications comments at 2, ATK Audiotek comments at 2, Michael Mason comments at 2, Total RF Marketing comments at 6, Society of Broadcast Engineers at 2, Sennheiser Electronic Corporation comments at 2, National Systems Contractors Association comments at 3, and Profession Audio Manufacturers' Alliance comments at 3.

<sup>24</sup> See Motorola reply comments at 4, Land Mobile Communication Council reply comments at 3, Industrial Telecommunications Association comments at 1, County of Los Angeles comments at 2, and Association of Public Safety Communications Officials comments at 3.

<sup>25</sup> See Intel comments at 2, Microsoft comments at 3, CEA reply comments at 3, Motorola comments at 1, TIA comments at 4, IEEE 802 comments at 4, New America Foundation comments at 1, and Wireless Internet Service Provider's Association (WISPA) comments at 4.

12. Subsequent to the release of the *Notice*, the Institute of Electrical and Electronics Engineers (IEEE) formed Working Group 802.22 to develop a standard for unlicensed operation in the TV bands. The IEEE states that the standard this working group is developing will specify a cognitive air interface for fixed, point-to-multipoint, wireless regional area networks that operate on unused channels in the VHF/UHF TV bands between 54 and 862 MHz.<sup>26</sup> It further states that protocols in the standard will ensure that this new service does not cause harmful interference to the licensed incumbent services in the TV broadcast bands and that the standard will provide for broadband systems that choose portions of the spectrum by sensing for frequencies that are unoccupied. The IEEE 802.22 Working Group has broad participation from those in the TV broadcast sector and the public safety community who are licensed users of TV spectrum, as well as from chip vendors, wireless equipment suppliers, and firms from other countries.<sup>27</sup> It has developed a document of functional requirements that it will use as guidelines in developing an air interface standard and is now drafting the IEEE 802.22 standard.

### B. Discussion

13. We find that allowing low power devices to operate in the TV bands on frequencies that are not being used by authorized services could have significant benefits for the public by enabling the development and operation of new wireless communications devices and systems that would promote access to broadband internet and other services. Because of the favorable propagation characteristics of the TV spectrum, these new devices could provide more effective service at greater ranges than unlicensed devices that operate at higher frequency bands. These new devices and services could also have significant benefits for economic development and for consumers and businesses by providing additional competition in the broadband market. However, we also recognize that we must ensure that new devices operating in the TV bands do not cause harmful interference to TV stations<sup>28</sup> and other licensed services. Thus, as explained below, we are making further proposals and requesting additional information to enable us to ensure that such devices can operate in the TV bands without causing harmful interference. Our goal is to establish rules in this proceeding in a timeframe whereby we will allow the introduction of devices in the TV bands on spectrum that is not being used for authorized services when the DTV transition is completed on February 17, 2009.

14. As indicated above, comments were filed both in favor of and in opposition to the proposals in the *Notice*. Broadcasters and other TV spectrum users express concern about potential interference from unlicensed devices to the various services that operate in the TV bands. Although the record filed in response to the *Notice* provides a sufficient basis for the Commission to conclude that properly regulated devices could operate in the TV bands without causing harmful interference to incumbent operations, the record does not contain sufficient information to adopt final rules for their operation. For example, the *Notice* did not make any specific proposals regarding spectrum sensing, and there is no information in the record as to key criteria that would need to be specified to allow the use of that technique, such as the required levels for sensing, spectrum to be scanned, and durations for the sensing. In addition, we need further information regarding the beacon and geo-location approaches. Accordingly, we are making certain initial decisions toward allowing operation in the TV bands and setting forth specific technical

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<sup>26</sup> See IEEE announcement dated October 12, 2004 at [http://standards.ieee.org/announcements/pr\\_80222.html](http://standards.ieee.org/announcements/pr_80222.html).

<sup>27</sup> IEEE 802.22 participants include Qualcomm, Motorola, Phillips, Shure, and MSTV.

<sup>28</sup> The TV stations entitled to protection from unlicensed devices include full power, Class A, low power and TV translator stations, licensed now or in the future. The Further Notice seeks comment on what interference protections should be used if we allow licensed low power TV band devices (*see infra* para. 31).

proposals necessary to adopt complete and final rules. As discussed below, we will permit fixed devices to operate on spectrum in the TV bands that is not being used by authorized services, subject to the development of final technical rules that will prevent harmful interference to the authorized services. Fixed devices include those that generally operate from a fixed location, including outdoors, and may be used to provide a commercial service.<sup>29</sup> As we discuss in the Further Notice, the interference avoidance scheme and the technical rules that we develop will effectively define unused TV spectrum that can be used for such operation. Also, we do not conclude here whether TV band devices should operate on an unlicensed, licensed or hybrid basis, as some parties suggest, and we seek further comment on this issue in the Further Notice.

15. We recognize, as do many commenters responding to the *Notice*, the importance of conducting tests to ensure that whatever standards are ultimately adopted for such devices will protect incumbent radio services from harmful interference. Given the complex and novel sharing issues presented here, we intend to conduct several types of testing, and we also encourage interested parties to conduct tests and submit their results into the record of this proceeding. Interested parties that conduct their own tests for the record should design the tests to be consistent with the proposals in the Further Notice or, alternatively, provide a test plan that explains in detail the assumptions used and the reasons supporting them. The Commission's Laboratory is conducting a testing program to quantify the interference rejection capabilities of DTV receivers and intends to issue a report of the results of these measurements by March 2007. The Commission's Laboratory also will conduct a testing program, including field testing, to assess the potential for interference from low power devices operating in the TV bands and intends to issue a report of these test results by July 2007. The Commission's Laboratory also will test DTV converter boxes once they become available. Details regarding these interference testing plans will be announced by the Commission's Laboratory.

16. In order to provide sufficient time for the Commission and industry to develop appropriate technical standards for TV band products as well as lead time for industry to design and produce new products, we intend to adopt a Second Report and Order specifying final requirements for devices in the TV bands in the fall of 2007. This will allow the Commission's Laboratory to begin accepting applications for certification of these devices in the TV bands by late 2007. Certification will be granted if the application, upon review, is found to comply with the new technical rules and will allow the manufacture and shipment of products to distribution points. However, as we discuss further below, these devices will not be allowed to be available for sale at retail until after the DTV transition ends on February 17, 2009.

17. We are convinced based on the record in this proceeding that we can adopt rules to allow fixed low power operation on unused spectrum in the TV bands without causing harmful interference to authorized services. There are several factors supporting this conclusion. First, upon completion of the DTV transition, there will be significant unused TV spectrum available in many areas in the country, either because of the separations required between authorized stations to avoid interference or because available TV channels have not been assigned and other services are not using vacant channels.<sup>30</sup> Also, based on our experience in developing rules for U-NII devices, we believe it is reasonable to expect that existing technology, such as that used for spectrum sensing, can be adapted to allow devices to identify

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<sup>29</sup> See *Notice* at 10026.

<sup>30</sup> See Intel comments at 6, Intel reply comments at Appendix A and Adaptrum comments at 20. See *supra* para. 5.

*unused spectrum in a given geographic area and thus allow sharing of the TV bands.*<sup>31</sup> Further, we note that the IEEE 802.22 working group with broad based support is in the process of developing a standard to enable fixed devices to successfully share spectrum with authorized services in the TV bands. Finally, these devices will operate at relatively low power levels and, as several commenters noted, it is easier to protect incumbent operations in the TV bands, including wireless microphones, when devices are limited to fixed operation.<sup>32</sup>

18. Non-fixed devices (*e.g.*, personal/portable devices as discussed in the *Notice*)<sup>33</sup> generally pose a greater risk of harmful interference to authorized operations than fixed devices because such devices may have antennas that are less efficient and may be in a less advantageous position for sensing of incumbent transmissions (*e.g.*, in a room versus on a 10-meter mast), especially given that they will change location, thus making reliable identification of unused frequencies substantially more difficult. Also, it may be difficult for TV and other users to locate a non-fixed device that causes interference because it frequently changes location, whereas a fixed device that causes interference can be located more easily. Further, we note that the developing IEEE 802.22 standard is, at least at this time, limited to fixed point-to-point and point-to-multipoint operations and does not address the non-fixed personal/portable class of devices that the Commission proposed to allow in the *Notice*. We therefore find that additional information is needed on whether and how personal/portable devices can use spectrum sensing or other techniques to identify unused frequencies. More generally, we ask parties responding to the Further Notice to address whether and how non-fixed unlicensed devices could operate in the TV bands under the different sharing schemes under consideration in this proceeding.

19. *Permissible Channels for Operation.* In the *Notice*, the Commission proposed to exclude low power TV band devices from operating on TV channels 2-4 to avoid possible interference to TV interface devices such as VCRs, DVDs, satellite and cable boxes that operate on or adjacent to those channels. The Commission also proposed to exclude these devices from channel 37, which is used for radio astronomy and the WMTS, as well as channels 52-69, which have been reallocated for non-broadcast uses. In addition, it proposed to exclude low power devices from operating on channels 14-20 in parts of the country where those channels are used for the PLMRS/CMRS.

20. The commenting parties generally support excluding low power devices from channels 37 and 52-69 because those channels will not be used for TV band services and will therefore have different interference considerations than those at issue in this proceeding.<sup>34</sup> In addition, a number of parties support prohibiting low power operation on channels 14-20 in any part of the country because of possible interference to the PLMRS/CMRS.<sup>35</sup> These parties express concern that personal/portable devices could

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<sup>31</sup> See Intel comments at Appendix A, Shared Spectrum Company comments at Appendix, IEEE 802 comments at 12 and Adaptrum comments at 20.

<sup>32</sup> See Shure comments at 48.

<sup>33</sup> See *Notice* at 10026.

<sup>34</sup> See Telecommunication Industry Association comments at 4, National Academy of Sciences comments at 5 and 10, and National Radio Astronomy Observatory comments at 5.

<sup>35</sup> See Motorola reply comments at 4, Land Mobile Communication Council reply comments at 3, Industrial Telecommunications Association comments at 1, County of Los Angeles comments at 2, and Association of Public Safety Communications Officials comments at 3.

be transported into areas where channels 14-20 are used for the PLMRS/CMRS and cause interference to such operations.<sup>36</sup>

21. We will exclude low power devices from operating on TV channels 37 and 52-69 as proposed. This will prevent interference to radio astronomy operations and the WMTS on channel 37. In addition, channels 52-69 have been reallocated for services other than broadcast television and will no longer be part of the TV bands after the transition. As the commenting parties observe, that spectrum will be occupied by services that have different interference considerations than those at issue in this proceeding. We will also exclude personal/portable TV band devices from operating on channels 14-20 in all areas of the country to prevent possible interference to public safety and other operations in the PLMRS/CMRS. As discussed below, we are making specific proposals for low power devices to identify unused TV channels using spectrum sensing and other approaches. Identification of PLMRS/CMRS operations can be difficult because these types of operations are typically intermittent rather than continuous. Because personal/portable devices are easily transported and used anywhere, we believe that the most prudent approach to protecting public safety and other PLMRS/CMRS operations on channels 14-20 is to prohibit personal/portable low power TV band devices from operating on those channels in all areas of the country.<sup>37</sup> We are not making a determination at this time on whether fixed TV band devices should be permitted to use channels 14-20 at locations where those channels are not in use by the PLRMS/CMRS or other authorized services, nor whether TV band devices (fixed or personal/portable) should be permitted to use TV channels 2-4. Those issues are addressed in the Further Notice of Proposed Rule Making.

22. *Implementation Date.* We will allow low power TV band devices to be marketed immediately after the end of the DTV transition on February 17, 2009, but not before. We believe that this schedule is appropriate for several reasons. First, there are fewer vacant channels available during the DTV transition because most TV stations are currently broadcasting both an analog and a digital signal.<sup>38</sup> There are thus about twice as many TV channels in use now as there will be after the end of the transition when full service analog broadcasting ceases. Also, the TV band is in a state of flux as the Commission develops the final DTV table of allotments and some TV stations still must change channels. In this regard, there will be adjustments in DTV channels that affect the availability of channels in individual markets throughout the remainder of the transition. We also note the concerns of a number of parties about possible disruption to the DTV transition if unlicensed devices were permitted to operate in the TV bands prior to the end of the DTV transition.<sup>39</sup> We believe that the risk of creating uncertainty that would impede the DTV transition outweighs the benefit of allowing operation of low power devices at a slightly earlier date, especially given that some proponents of low power devices have indicated they would need

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<sup>36</sup> See County of Los Angeles comments at 2, Industrial Telecommunications Association comments at 2, and Association of Public Safety Communications Officials comments at 2.

<sup>37</sup> The Commission may find it appropriate to revisit this conclusion in the future as it develops familiarity with the technical challenges of operating in the white spaces.

<sup>38</sup> Some TV stations have voluntarily ceased broadcasting their analog signal. Also, full service TV stations that were first authorized after 1997 were assigned only a single channel.

<sup>39</sup> For example, see Pikes Peak Broadcasting Company comments at 1, NPG of Oregon, Inc. comments at 1, Association of Public Television Stations comments at 3, Pappas Telecasting Companies comments at 6, Cox Broadcasting, Inc. comments at 4, Entravision Holdings comments at 7, NAB and MSTV comments at 3, Qualcomm comments at 7, and Shure reply comments at 26.

up to 21 months after the adoption of final technical rules to bring such devices to market. For these reasons, we will allow TV band devices on the market only after the end of DTV transition.

#### IV. FURTHER NOTICE OF PROPOSED RULE MAKING

23. As indicated above, the purpose of this further rulemaking is to develop additional information concerning the rules that will be necessary to enable low power devices to operate in the TV bands without causing harmful interference to other authorized operations in those bands.<sup>40</sup> TV stations are generally protected from interference within defined signal contours, and the signal level that defines a TV station's protected contour varies depending on the type of station and the frequency band in which the station operates. Consequently, in the *Notice* the Commission proposed to use these service area criteria to define the areas that unlicensed devices must protect from harmful interference, *i.e.*, TV service within the contours defined by these criteria would have to be protected.<sup>41</sup> In the *Notice*, the Commission considered several different interference avoidance approaches for unlicensed operations for two functional categories of operations—fixed/access and personal/portable devices.<sup>42</sup> Fixed/access devices generally operate at higher power from a fixed location, including outdoors, and may be used to provide a commercial service.<sup>43</sup> Personal/portable devices, on the other hand, are those generally anticipated to operate at lower power, usually indoors or within a small localized area, and include devices such as computers or personal digital assistants (PDAs) that can be moved to operate at different locations.<sup>44</sup> The Commission proposed to require that fixed/access devices incorporate a geo-location method such as GPS or be professionally installed, and that they access a database to identify vacant channels at their location. The Commission proposed that personal/portable devices operate only when they receive a control signal from a source such as an FM or TV station that identifies the vacant TV channels in that particular area. Finally, it sought comment on the possibility of using spectrum sensing as an alternative to the geo-location/database and control signal approaches, but did not make any specific proposals on the use of this technique for identifying unused TV channels.

24. We note, as an initial matter, that a number of parties suggest that devices operating in the TV bands should operate on a licensed basis rather than an unlicensed basis. Since this matter was not raised in the *Notice*, we seek to explore it in this Further Notice. Given that the proposals in the *Notice* contemplated unlicensed operation, and that most of the focus of the commenters and industry activity has been on unlicensed operation, most of the specific proposals presented in this Further Notice (*see* Appendix B, Proposed Rules) are presented on the basis of unlicensed operation. We recognize, however, that many of these same proposals could be employed if the Commission were to instead provide for licensed operation, or a hybrid approach.

25. We do not believe there is sufficient information in the record to adopt rules for any of these interference avoidance approaches at this time. As discussed below, there are unresolved issues from the *Notice* with respect to both the geo-location/database approach and the control signal approach, and we

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<sup>40</sup> The Commission will consider all information on the record in developing final rules, including comments filed in response to all of the proposals and issues raised in the *Notice*.

<sup>41</sup> See *Notice* at 10031, 10032.

<sup>42</sup> See *Notice* at 10026.

<sup>43</sup> *Id.*

<sup>44</sup> *Id.*

are seeking further comment on ways to resolve those issues. Because we believe that the spectrum sensing approach holds promise, we are making specific proposals concerning this approach. Although the *Notice* included proposals that different interference avoidance schemes be used for fixed/access and personal/portable devices, commenters responding to this Further Notice should address whether and how one interference avoidance scheme could be used effectively for both types of TV band devices. Commenters also should address how an interference avoidance scheme would protect TV services within their defined contours.

#### A. Licensed vs. Unlicensed Operation

26. In the *Notice*, the Commission proposed to allow unlicensed operation in the TV bands, but did not address the possibility of instead providing for new low power operations on a licensed basis. A number of parties suggest that if new wireless operations are permitted in the TV bands, they should be on a licensed, rather than an unlicensed, basis. No party provided specific recommendations for how spectrum in the TV band could be assigned on a licensed basis for the devices contemplated in the *Notice*. In the interest of obtaining a further record on this issue, we seek comment on whether proposed low power operations in the TV bands should be allowed on an unlicensed, licensed, or hybrid basis.

27. The Commission has tried to strike a balance between the licensed model and the unlicensed model, determining which model to use based on all of the relevant circumstances. Both models have been successful. The licensed model is more efficient in many cases, and tends to work best when spectrum rights are (1) clearly defined, (2) exclusive, (3) flexible, and (4) transferable. When spectrum rights lack these attributes, potential licensees face uncertainty and may lack incentive to invest in a license or offer service. In those circumstances, the unlicensed model may better optimize spectrum access and utilization.

28. As an initial matter, we note that the frequencies and amount of unused television spectrum in the TV band will vary from location to location and, depending on the approach we ultimately adopt, could change over time as additional television stations are licensed or change frequency. For example, the assignment of low power television stations is not scheduled to be complete by the end of the DTV transition in February 2009. Also, under existing rules, currently authorized DTV stations would be permitted to seek to change frequencies after that date, which could complicate licensing of the white spaces spectrum, particularly if the Commission were to license the spectrum pursuant to auction. For example, if licensed wireless operations are required to protect other types of licensees in the TV bands, then wireless licensees in the TV bands could potentially lose their ability to operate on some, or even all, of their authorized frequencies when new operations with higher allocation status are authorized to operate in the same area. We also observe that, if protection of incumbents is required, devices operating in the TV bands would need to operate at lower power levels than are typical of many licensed services.

29. A majority of the commenters have expressed interest in operating low power devices in the TV bands on an unlicensed basis. Because unlicensed operations are not allowed to cause harmful interference,<sup>45</sup> if we proceed on an unlicensed basis, the interference protection status of existing services operating in this spectrum would not be affected. Unlicensed operations may also be better able to dynamically adapt to a shifting spectrum environment characterized by low power operation. The technical characteristics of the TV band spectrum may be suited for delivering wireless broadband service on an unlicensed basis to rural areas, where transaction costs may be higher. Finally, the unlicensed model may promote technological innovation.

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<sup>45</sup> See 47 C.F.R. § 15.5.

30. Commenters that support licensing generally state that licensing would provide an economic incentive for operators to ensure that they operate devices in a manner that does not cause interference to TV and other users in the band.<sup>46</sup> Qualcomm argues that the Commission should consider the need for additional licensed spectrum in addition to unlicensed spectrum, and that there is no reason to give away “prime” spectrum.<sup>47</sup> If the Commission were to provide for licensed operation of TV band devices, it may have the benefit of enabling policy makers and incumbent licensees to more rapidly and easily determine the source of any harmful interference that such devices may cause. It may also more effectively balance competing uses in markets where the amount of unused spectrum in the TV bands is low.

31. We note that licensing would require us to determine the rights and obligations of such licensees vis-à-vis other licensees. In contrast to unlicensed use, licensees would, by definition, have rights to transmit in this band with some interference protection. For instance, what would be the allocation status of such licensed operations? How would such services fit within the hierarchy of currently authorized TV and other services in the band? Should they have equal, superior, or secondary rights to existing services, and if so, which ones? Would TV band devices used by licensed services be required to incorporate the same type of interference avoidance mechanisms and low power limits that we have proposed for unlicensed devices? Would an exclusive licensing approach or a non-exclusive, shared approach better serve our spectrum policy objectives?<sup>48</sup> If we decide to license wireless services on an exclusive basis, we seek comment on what licensing areas should be used in this band – e.g., nationwide, regional, small geographic areas, or a site-specific approach? Should we divide the TV spectrum into different blocks of channels – e.g., Channels 5 and 6, Channels 7 through 13, Channels 21 through 36, and Channels 38 through 51 – and issue separate authorizations to operate on each of these blocks of channels in the relevant geographic area?

32. We seek comment on these and any other issues relevant to whether TV band devices should be allowed on an unlicensed, licensed, or hybrid basis. We ask commenters to discuss the technical, operational, legal, or economic advantages and costs associated with the various options. Commenters should also discuss the benefits and disadvantages associated with each of these approaches.

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<sup>46</sup> See NAB and MSTV comments at 24, National Translator Association comments at 4, Entravision Holdings comments at 7, Qualcomm comments at 11, Cox Broadcasting comments at 4, Community Broadcasters Association comments at 7, Region 1 Translator Association comments at 2, Paul Burkholder comments at 2, and Pikes Peak Broadcasting comments at 1.

<sup>47</sup> See Qualcomm comments at 11 and reply comments at 9.

<sup>48</sup> If we decide to adopt a licensing regime under which we would receive mutually exclusive applications for initial licenses in the TV band white space, we would be required under section 309(j) of the Communications Act to resolve such applications by competitive bidding. See 47 U.S.C. § 309(j); Implementation of Sections 309(j) and 337 of the Communications Act of 1934 as Amended, Report and Order and Further Notice of Proposed Rule Making, WT Docket No. 99-87, 15 FCC Rcd 22709 (1999) (establishing the analytical framework for the Commission’s exercise of its auction authority).

### B. Spectrum sensing and other technical requirements

33. A number of parties suggested that spectrum sensing could be used as a method to identify TV channels that may be used by TV band devices.<sup>49</sup> However, no party provided sufficient technical information for the Commission to adopt rules. We note that IEEE committee 802.22 is developing a draft standard for using sensing and other techniques to obtain access to the TV spectrum. We encourage the IEEE to continue its work. We recognize, however, that the Commission would need to adopt appropriate technical rules to ensure that equipment using sensing techniques will not cause harmful interference to TV broadcasting and other users of the TV spectrum. In this section we further explore the viability of spectrum sensing as a method for identifying TV channels that may be used by TV band devices and offer specific technical proposals for the sensing capabilities and parameters that would need to be included in the Commission's rules. We request additional comment on whether TV band devices should be allowed to use spectrum sensing as a means to determine the availability of unused frequencies in the TV bands and, if so, the technical features and parameters of the sensing capability to be required as discussed below.

34. Several commenters argue that spectrum sensing is a viable technique for detecting radio signals and point out that the Commission adopted a spectrum sensing requirement in its rules for unlicensed national information infrastructure (U-NII) devices at 5 GHz.<sup>50</sup> These rules include a requirement that U-NII devices employ dynamic frequency selection (DFS) to determine whether a radar signal is present before they can access the spectrum. We agree that the experience gained in developing the rules for 5 GHz U-NII devices is informative in considering the development of sensing techniques in the TV spectrum. We note, however, that there are many important differences between military radars and broadcast TV signals that affect the design of an acceptable plan for spectrum sensing and that the U-NII DFS requirements are specifically designed to detect military radars rather than TV stations and the other types of licensed operations in the TV bands. In this regard, operations in the TV bands have different technical characteristics than radars, particularly relative to power levels, modulation, required interference protection levels, propagation losses, antenna heights, and receiver locations. In addition, we observe that prototype U-NII systems with DFS were thoroughly tested to ensure that the DFS rules are adequate to prevent interference to radars. The Federal Government worked with industry to develop the necessary sensing standards and test procedures along with pass/fail criteria for these devices. There has not been any such sensing design work or extensive testing on TV band devices, so we do not know the exact technical parameters that would be necessary for any DFS requirements that might be used in the TV bands. Based on our experience in developing the spectrum sensing rules for 5 GHz U-NII devices, we do, however, believe that the DFS approach in those rules can, with appropriate modifications, be applied to TV band devices. Our specific proposals for spectrum sensing rules for TV band devices are discussed below.

35. *Detection Threshold.* The detection threshold is the sensitivity level that would be used to determine the presence of other signals. The minimum detection threshold for 5 GHz U-NII devices is -64 dBm for devices with an e.i.r.p. (effective isotropic radiated power) of 200 mW to 1 W and -62 dBm for devices using less than 200 mW.<sup>51</sup> The presence of signals above the threshold detection level does

<sup>49</sup> See IEEE 802 comments at 6 and 12, Motorola comments at 15, Tropos Networks comments at 5, CWLab comments at 3-4, Microsoft Corporation comments at 12-13, Wi-fi Alliance comments at 4, Intel Corporation comments at 15, Michael J. Marcus comments at 6, and Shared Spectrum reply comments at 7.

<sup>50</sup> The U-NII spectrum sensing requirements are set forth in Section 15.407(h) of the rules, 47 C.F.R. § 15.407(h).

<sup>51</sup> 47 C.F.R. § 15.407(h)(2).

not necessarily exclude access to the spectrum, but rather serves as a gating factor that is then followed by further processing to determine whether the signal may be a radar and therefore that spectrum cannot be used. An important consideration in developing this requirement was that relying solely on the detection threshold as the gating criteria for access to the spectrum would have led to increased detections of other unlicensed devices, preventing access to the spectrum even though these unlicensed devices could co-exist.

36. There are several important factors that must be considered in establishing an appropriate detection threshold for the TV spectrum. We recognize that the situation for detection in the TV bands is different from that of radar signals. While radars and TV transmitters both transmit high power signals, radar operation is different from TV service in that a single radar receive system is typically co-located with its associated transmitter while TV receivers are located throughout a station's service area. In the radar case, the co-location of transmitter and receiver allows the sensing level to be set so as to prevent unlicensed devices from operating within a specified distance of the radar site. This approach follows from the facts that a radio signal attenuates with distance from the transmitter in a predictable manner, that is, as the distance from the transmitter increases the signal becomes weaker, and the distance over which the radar and unlicensed signals propagate are the same, albeit in different directions. In the U-NII case, we set the sensing level at a value where the distance at which the specified level of radar signal will be present is far enough from the radar site that the radar receiver will not receive interference from an unlicensed device operating at its maximum allowed power. For example, if a U-NII device is located at a point where it receives a radar signal at or below the -64 dBm threshold level, the level of that U-NII device's signal that reaches back to the radar receiver will be below the level at which it would interfere with the radar's operation.

37. In the TV case, the spread out pattern of TV receiver locations produces a situation where the distance between the TV transmitter and a TV band device is generally different than the distance between a TV receiver and that TV band device. It is, in fact, reasonable to expect that a TV band device would operate quite close to a TV set, *i.e.*, in the same or adjacent residences/businesses, and both would be relatively far from the TV transmitter. Here, the TV set would be attempting to receive a relatively weak TV signal in the presence of a relatively strong unlicensed signal. This suggests that the detection threshold for TV band devices must be lower to account for their expected proximity to TV receivers. We observe that IEEE 802.22 is considering different threshold detection levels depending on the nature of the source signal, with levels as low as -116 dBm. We invite comment as to this value or alternative values for the detection threshold.

38. We appreciate that a variety of additional considerations need to be taken into account in developing the detection threshold for devices in the TV bands. For example, a lower detection threshold infers greater interference protection for services operating in the TV spectrum, but could also result in increased false positives as a response to spurious radio noise or other unlicensed devices, sharply reducing the usefulness of this spectrum for TV band devices. Also, the height of the TV band device transmitting antenna affects the distance that signals propagate, and therefore the distance at which interference could occur. We ask interested parties to address how these factors might be taken into account in developing the appropriate detection threshold.

39. A number of parties have asserted that sensing alone will not be effective in preventing harmful interference to TV broadcasting within its protected contour and to other authorized services in this spectrum due to the problem of the "hidden node." This situation results when there is an obstruction between the sensing receiver and the signal to be detected. In this case, the sensing receiver may fail to detect that a channel is occupied and begin transmitting, thus causing interference to other nearby parties attempting to receive that channel along an unobstructed path. We recognize that this is indeed a

potential problem and request views on its scope and how to deal with this phenomenon effectively. One approach would be to add further margin into the detection threshold, but that would increase the possibility of false detections, potentially increase the costs of unlicensed devices, and may have other detrimental effects on system performance. Another approach suggested in the record would be to use distributed sensing; that is, multiple antennas and sensing receivers at different locations that are able to share channel availability information with each other.<sup>52</sup> When multiple receivers that share information are used, the probability of missing a signal may be greatly reduced because only one receiver needs to detect a signal to ascertain that a particular channel is occupied, and the likelihood would seem low that every receiver in a system would be obstructed from receiving a signal. We invite further comment as to how we could ensure the viability of a distributed sensing approach for systems deployed on an unlicensed basis. For example, could this type of operation be achieved simply by requiring every device in a network to have sensing capability and to pass its sensing information on to other devices on the network? Another approach would be to use sensing in combination with other information, such as geolocation, under a set of policy rules that would serve as the gating criteria for access to the spectrum. We solicit comments on these and any other approaches that would deal effectively with the hidden node problem.

40. *Channel Availability Check Time, Move Time and Non-Occupancy Period.* In establishing the sensing provisions for unlicensed 5 GHz U-NII devices, the Commission specified various requirements for DFS relative to accessing the spectrum, how quickly the devices would have to vacate a channel once a radar signal is detected, and how long the channel could not be used again after such detection. Specifically, the Commission required that the 5 GHz U-NII DFS feature check for the presence of a radar before gaining access to the spectrum, perform in-service monitoring to detect the presence of a radar that may come on the air at any time, get off the channel within 10 seconds if a radar's presence is detected, and stay off the channel for at least 30 minutes thereafter.<sup>53</sup> These requirements took into account the nature and characteristics of the radar systems operating in the 5 GHz region of the spectrum, as well as the potential for interference from multiple devices and the technical feasibility of designing equipment with these capabilities. Radar systems may be operated at any time, for any duration, and at any location, but may also remain off-the-air for long periods of time. In contrast, the operating pattern in the TV spectrum typically does not change rapidly because TV stations rarely change their operating characteristics, such as hours of operation, antenna height, power, etc. Nevertheless, we recognize that operations in the TV spectrum can and do change over time. For example, certain TV broadcasting operations may be on most of the day, but not for brief periods during late night or early morning hours. New low power TV and translator operations could be authorized and come on the air at any time. Wireless microphone operations tend to be used for a period of hours at a particular location, but can also operate anywhere at any time and may not have a signal that is on the air continuously.

41. In light of these factors, we propose to require that TV band devices that use sensing to determine the availability of unused TV band frequencies perform sensing before accessing a channel and periodically thereafter to ensure that the channel is still available, *i.e.*, unoccupied. We ask commenters to indicate whether there is a need to specify the period of time over which sensing must occur before a channel may be accessed, and if so, what that should be. For example, would 30 seconds be a necessary or sufficient period of time for the initial channel availability check when a device is placed in operation, *i.e.*, turned-on. We also invite comment as to the appropriate period when the channel must be rechecked to determine that it continues to be available. Our initial proposal is to

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<sup>52</sup> See Shared Spectrum Company reply comments at 7 and Adaptrum comments at 20.

<sup>53</sup> See 47 C.F.R. § 15.407(h)(2).

require devices to recheck the channel at least every 10 seconds. This would ensure that devices are not on the air for extended periods of time causing harmful interference to authorized services in the TV spectrum that are not present during an initial sensing check. We would anticipate that this feature should be easy to implement from an equipment design standpoint. We do not propose to require devices to remain off the air for any prescribed period of time after a channel is first determined to be occupied. We believe the requirement to perform sensing before operating should ensure that devices will not cause harmful interference to authorized services that are already on the air.

42. *Channels Over Which Sensing Is Required.* In order to avoid co-channel interference to authorized services in the TV spectrum, sensing is clearly needed in the channel in which the device will operate. We also recognize that there is potential for TV band devices to interfere with TV and other authorized services operating on adjacent channels. In this regard, the Commission proposed in the *Notice* to prohibit fixed devices from operating on a channel adjacent to a TV station within that station's service area but to allow the lower power personal/portable devices to operate without adjacent channel restrictions. We request comment on the need for sensing in adjacent channels by fixed and personal/portable devices. We also request comment and information on the threshold levels at which protection should be invoked for sensed adjacent channel signals and whether protections other than simply requiring an unlicensed device to not transmit would be workable and appropriate. For example, if an adjacent channel signal were sensed, could interference be avoided by requiring the device to reduce power rather than cease operation? We further seek comment on whether any protection requirements are needed for services outside of the channels where TV band devices would be permitted to operate, and if so, what these would be.

43. *Bandwidth Considerations.* We recognize that there is a relationship between the sensing receiver bandwidth and ability of a device to detect weak signals. For example, we would not expect a device with a 6 megahertz sensing bandwidth to be able to detect as weak a signal as a device using a 200 kHz bandwidth. We seek comment on whether there is a need to specify a sensing bandwidth in addition to a detection threshold, or whether it is necessary to specify only the characteristics of the signals to be detected as discussed below and leave the sensing bandwidth to the manufacturer's discretion.

44. *Antenna Considerations.* The IEEE 802.22 working group is contemplating the use of an omnidirectional sensing antenna with a gain of 0 dBi. The purpose of this provision is to ensure that a TV band device is able to detect a TV signal irrespective of its direction in relation to the device. We invite comment about whether the Commission should require the use of an omnidirectional antenna with a 0 dBi gain for sensing. We also invite comment as to what considerations for sensing should be taken into account for devices that employ a gain antenna for transmission. For example, a TV band device with an omnidirectional sensing antenna may detect that TV signals on a channel are below the monitoring threshold and begin transmitting, but could conceivably cause interference if it uses a higher gain directional transmitting antenna aimed toward a TV receiver. What provisions would be necessary to avoid such a situation? Further, we invite comment on whether any requirements are necessary with respect to the transmit antenna height. As the transmit antenna height is increased, both the signal coverage and the distance at which interference to services in the TV bands could occur also increase. We seek comment on whether there is a need for a maximum antenna height requirement or other provisions, such as reduced power when a greater antenna height is used.

45. *Transmit power control.* The regulations the Commission adopted for DFS by U-NII devices at 5 GHz call for use of dynamic power control so that the device will automatically limit its emissions to a level 6 dB below the maximum permitted transmitter power if that is sufficient to accomplish the desired

communications.<sup>54</sup> Devices already operating 3 dB below the maximum permissible power were not required to include transmit power control. We propose to apply this same requirement for devices operating in the TV spectrum. We invite comment as to whether we should require a greater dynamic range for transmit power control, such as the ability to operate 9 or 12 dB below the limits if that is sufficient to achieve the desired communications. This approach could further reduce the potential for interference to services operating in the TV spectrum. In addition, we invite comment as to whether we should permit adjustments to any TV band device operating parameters, such as the detection threshold, if a TV band device operates at a power level substantially below the limit.

46. *Master/Client Operation.* We propose to allow fixed operations in the TV bands under a master/client model that is consistent with the model for U-NII devices.<sup>55</sup> That is, each system of TV band devices will have one master device and one or more client devices. We propose to define a master device as a device operating in a mode in which it has the capability to transmit without receiving an enabling signal. In this mode it would be able to select a channel and initiate a network by sending enabling signals to other devices. A network would always have one device operating in master mode. We propose to define a client device as a device operating in a mode in which the transmissions are under control of the master. A device in client mode would not be able to initiate a network. A network could have one or more client devices. We seek comment on this proposal. We also seek comment on any other approach that would be more appropriate.

47. *Spectrum Sharing.* The Commission's rules for unlicensed devices are designed not only to protect against harmful interference but also to facilitate spectrum sharing among unlicensed devices while minimizing constraints on product designs. For example, the Commission's rules allowing frequency hopping spread spectrum devices to operate at up to 4 W e.i.r.p. also require a minimum number of hopping channels using a random hopping sequence so that multiple devices and users can share the same spectrum.<sup>56</sup> Industry, within the framework of the Commission's rules, has developed voluntary standards such as the Wi-Fi and Bluetooth standards, for various types of unlicensed devices that further facilitate shared use of the spectrum. It is our intention to follow a similar course for unlicensed devices operating in the TV spectrum. We anticipate that industry will develop protocol standards that facilitate shared use of the spectrum. We are concerned, however, that in the absence of some minimal mandatory requirements, a single device or network of devices could conceivably monopolize use of a channel at a given location or area. We invite comment as to whether it may be necessary or appropriate for the Commission to establish minimal technical requirements to facilitate sharing by unlicensed TV band devices, or by TV band devices licensed under a non-exclusive model if the Commission chose to adopt such an approach. For example, such steps might include limitations on the duration of transmissions and repeating spectrum sensing at intervals more frequently than 10 seconds. Parties addressing this matter should make specific proposals. In addition, we ask that parties address the implications of their proposals for potential applications for TV band devices.

48. *Measurement procedures.* As we discuss in the Report and Order, we intend to conduct extensive testing as part of the process to develop technical rules for TV band devices. Further, we believe that compliance measurement procedures are critically important. However, it is premature to

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<sup>54</sup> See 47 C.F.R. § 15.407(h)(1).

<sup>55</sup> The U-NII definitions for "master" and "client" are in the U-NII compliance measurement procedures. See *Memorandum Opinion and Order* in ET Docket No. 03-122, 21 FCC Rcd 7672, 7682 (2006).

<sup>56</sup> See 47 C.F.R. § 15.247(a).

develop compliance measurement procedures at this juncture because the specific procedures used and tests to be conducted will depend in part on the final rules that are adopted. It is our intention to develop interim measurement procedures that will be provided when final rules are adopted. The procedures we use will draw on the measurement procedures for 5 GHz U-NII devices, to the extent those procedures are relevant to unlicensed devices in the TV bands and the rules we adopt for their operation, and our measurement procedures for unlicensed devices as specified in Section 15.31 of the rules.<sup>57</sup> We are presenting proposals and inviting comment on certain specific matters at this time. In performing the test for detection threshold, we propose to subject the sensing capabilities of unlicensed devices to an ATSC DTV signal, an NTSC signal and a 200 kHz FM signal with peak levels adjusted to the threshold level. We seek comment on whether this approach is appropriate or whether some other method should be used. The test procedure for 5 GHz U-NII devices calls for performing the detection tests a number of times and specifies pass/fail ratios. We do not believe such an approach is appropriate here because it should be simpler to detect signals from the types of devices operating in the TV spectrum than for radars, but invite comment in this regard. Parties suggesting approaches based on multiple tests and pass/fail ratios should offer specific proposals.

### C. Geo-location/database approach

49. In the *Notice*, the Commission proposed to require that fixed/access devices incorporate a geo-location method such as GPS or be professionally installed to determine their geographic coordinates. These coordinates would be used in conjunction with a database of incumbent TV band licensed stations and appropriate computational software to identify vacant channels at the unlicensed device's location. Several parties had concerns about the accuracy and maintenance of a database used to determine the location of TV and other transmitters.<sup>58</sup> Some parties expressed support for the proposed geo-location/database approach.<sup>59</sup> Other parties raised various concerns about this approach, such as whether GPS incorporated in an unlicensed device would be a reliable method for performing geo-location because it may not work indoors or at outdoor locations where the GPS signal is obstructed.<sup>60</sup> There were also concerns about the method that should be used (*e.g.*, the F(50,50) curves or the Longley-Rice propagation model) to calculate how far an unlicensed device must be from a TV or other station to avoid causing interference.<sup>61</sup>

50. The geo-location/database approach is one that may be used in some situations as the sole interference avoidance mechanism or in other cases used in conjunction with another interference avoidance mechanism, *e.g.*, a device could use this approach to identify vacant channels at its location as well as use spectrum sensing to verify that the channels are unused. We recognize though that there are a number of issues that would have to be resolved to make the proposed geo-location/database approach

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<sup>57</sup> See 47 C.F.R. § 15.31.

<sup>58</sup> See NAB and MSTV comments at 13, IEEE 802 comments at 8, and Syncom Media Group comments at 1

<sup>59</sup> See Motorola comments at 8, Microsoft comments at 9, Itron comments at 9, Harris Corporation comments at 6, and Intel comments at 19.

<sup>60</sup> See NAB and MSTV comments at 14, IEEE 802 comments at 8, and Society of Broadcast Engineers comments at 3.

<sup>61</sup> See National Translator Association comments at 1, Entravision Holdings comments at 2, Syncom Media Group comments at 1, Community Broadcasters Association at 5, Cohen, Dippell and Everist, P.C. comments at 4, and Pikes Peak Broadcasting Company comments at 1.

viable for interference avoidance. Most importantly, a complete database of all TV and other stations would have to be available in some form for users of unlicensed devices to access. The Commission does not maintain a database of all TV and other stations in the TV bands that could be accessed in real-time (or near real-time) by large numbers of unlicensed devices dispersed throughout the country. However, in other cases, the Commission has relied on private parties to develop and maintain databases of certain operations that others can access, and these databases are funded by the entities that use them. For example, the Commission selected the United Telecom Council (UTC) to maintain a database of broadband over power (BPL) systems,<sup>62</sup> and the American Society for Healthcare Engineering of the American Hospital Association (ASHE/AHA) to maintain a database of wireless medical telemetry service devices.<sup>63</sup> In these cases, the Commission developed basic regulations regarding the scope of the databases, solicited proposals from parties interested in developing and maintaining the database, and selected the database provider. We seek comment on relying on a similar approach here, particularly from parties who would be interested in developing and maintaining a database of operations in the TV bands. We also seek further comment on some issues regarding the content of and access to a TV band database. For example, what information about stations should be in a database, such as geographic coordinates, type and class of station, power level, antenna height and other antenna characteristics? What information about wireless microphones could be entered in a database so that their location can be ascertained because the Commission does not license them by geographic coordinates? How would an unlicensed device access a database, and how often would a database need to be updated?

51. Finally, we seek additional comment on some of the technical requirements for TV band devices relying on the geo-location/database approach. For example, what is the appropriate method of geo-location: GPS, professional installation, or some other method? Could devices incorporate Assisted GPS to help receive GPS signals in obstructed and indoor locations?<sup>64</sup> If a device is professionally installed, who should be permitted to install it? What is the appropriate method of determining the required

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<sup>62</sup> See *Public Notice OET Announces United Telecom Council to Serve as Database Manager for Access Broadband over Power Line Systems; Sets Deadline for Information Submissions*, DA 05-2701, 20 FCC Rcd 16289 (2005). The Commission required the BPL industry to establish a centralized publicly accessible Access BPL notification database with the database manager chosen by the BPL industry. The purpose of this database is to ensure that the location of Access BPL systems and their operating characteristics can be identified if harmful interference occurs and to facilitate the activation of interference mitigation and avoidance measures. The database includes the name of the BPL provider, frequencies of operation, ZIP codes served by the operation, type of equipment used, operator contact information, and dates of BPL system operation. See 47 C.F.R. § 15.615.

<sup>63</sup> See *Order* in ET Docket No. 99-255, 16 FCC Rcd 4543 (2001), which designated ASHE/AHA as the frequency coordinator for the WMTS. The Commission's rules require users of WMTS devices to register these devices with a designated frequency coordinator. The frequency coordinator maintains a database of these devices and uses the registration information to notify WMTS users of potential conflicts, coordinate WMTS operations with radio astronomy observatories and Federal Government Radar systems, and notify users of the need to comply with field strength limits in Part 90 or Part 27 if appropriate. The Commission's rules specify the information that must be included in the WMTS transmitter database, including frequencies used, modulation scheme, effective radiated power, number of transmitters in use, user name, transmitter location, and user contact information. See 47 C.F.R. §§ 95.1111 and 95.1113.

<sup>64</sup> Assisted GPS is used by CMRS licensees to acquire GPS signals in obstructed and indoor locations for complying with Enhanced 911 (E911) requirements. In an Assisted GPS system, the base station contains a GPS receiver which has an unobstructed view of the GPS satellites. The base station transmits data to the mobile unit that allows it to better correlate the signal being received from the satellite when the signal strength is low. Assisted GPS can result in greatly improved GPS receiver sensitivity and a more rapid determination of position.

separation from authorized users in the TV bands? How will the geo-location/database approach protect other authorized services, such as wireless microphones, the location of which may not be included in the databases? We seek comment on these and any other issues that need to be addressed to make this a viable interference avoidance scheme.

#### D. Control signal approach

52. In the *Notice*, the Commission proposed to require that personal/portable devices operate only when they receive a control signal from a fixed radio transmitter source such as an FM, TV or CMRS transmitter. The control signal would contain a listing of the TV channels that are vacant within the service area of the control signal. The TV band device would only be permitted to transmit on a vacant TV channel listed in the control signal; multiple control signals could be accessed. If no TV channels were vacant at that particular location, or if the TV band device could not receive a control signal, it would not be permitted to transmit. The list of vacant channels transmitted by the control signal would be determined by the use of a database and appropriate computational software, similar to the geo-location/database approach, but with one important difference. Instead of determining vacant channels at a single point (the TV band device transmitter), channels included in the vacant channel list must be vacant at every point within the service area of the station transmitting the control signal (e.g., within the noise limited coverage area of a DTV station).

53. Some parties express concerns about the effectiveness of the proposed control signal approach in preventing interference, stating that a TV band device may receive conflicting control signals, or may fail to confirm the presence of a valid control signal, and then transmit on an occupied TV channel.<sup>65</sup> Other parties object to allowing broadcasters to transmit or charge for information concerning vacant channels.<sup>66</sup> Still others noted that the locations with the greatest amount of vacant spectrum would be least likely to have a control signal available because there would be few broadcasters or other facilities around to transmit a control signal.<sup>67</sup> Only one party provided suggestions on the format for a control signal but did not provide detailed specifications.<sup>68</sup>

54. Because the control signal approach is essentially a variation of the geo-location/database approach, some of the same concerns apply to both methods, specifically, those about maintaining the database and the method used to calculate the required separation between unlicensed devices and authorized stations in the TV bands. As discussed in regards to a geo-location database, a control signal database could be developed and maintained by a private entity selected by the Commission, and the database could be funded by parties who use it. We seek comment on whether the Commission should develop basic regulations regarding the scope of a database to be used with a control signal approach, solicit proposals from parties interested in developing and maintaining a database, and select a database provider. We particularly seek comment from parties who would be interested in developing and maintaining a database for the control signal approach. We also seek further comment on some issues regarding the content of and access to a TV band database. For example, what information about vacant TV spectrum should be in a database and who should determine the list of vacant TV channels in a

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<sup>65</sup> See NAB and MSTV comments at 14 and Pappas Telecasting Comments at 11.

<sup>66</sup> See Tropos Networks comments at 5, Wireless Unleashed comments at 15, Raymond D. Merrideth Jr. comments at 1, Zachary C. Miller comments at 1, and Yoachi Benkler comments at 1.

<sup>67</sup> See Microsoft Corporation comments at 13, and Wireless Unleashed comments at 15.

<sup>68</sup> See Metropolitan Area Networks comments.

broadcaster's service area, e.g., the database manager, a designated frequency coordinator? Is there any inherent conflict of interest in permitting broadcasters to identify and to send information identifying channels not licensed to them as vacant and therefore available for use by unlicensed devices?

55. Regarding the technical requirements for unlicensed devices, we seek further comment on the format and content of the control signal. How will the control signal approach protect other authorized services, such as wireless microphones, the location of which may not be included in the databases? Also, can the control signal approach be relied upon as an interference avoidance mechanism in areas where no broadcast station or other facility sends a control signal?

#### E. Operation on channels 14-20 and 2-4

56. In the *Notice*, the Commission proposed to permit low power devices to operate on channels 14-20 in those parts of the country where they are not being used for the PLMRS/CMRS or other authorized services.<sup>69</sup> In the Report and Order, we prohibit personal/portable TV band devices from operating on those channels in all areas of the country. We seek additional comment in this *Further Notice* on whether fixed TV band devices should be allowed on channels 14-20 in those areas of the country where those channels are not used by public safety. We note that the PLMRS/CMRS is permitted to operate in only 13 metropolitan areas in the country, and on only one to three channels in each area. Further, PLMRS/CMRS operations are limited to a defined radius around geographic coordinates specified in the rules for each metropolitan area.<sup>70</sup> Thus, prohibiting operation of all fixed TV band devices (e.g., devices used for backhaul) on all channels in the range of 14-20 in all parts of the country could preclude operation of fixed low power devices in many areas where these channels are not in use by the PLMRS/CMRS or other authorized services. We seek comment on whether allowing fixed operation of TV band devices on channels 14-20 would cause harmful interference to public safety. If we were to allow such use, how would it be implemented? Would any of the proposals described above have to be modified to protect the PLMRS/CMRS? Should we define an "exclusion zone" around the specified coordinates of each of the 13 metropolitan areas where operation of low power devices would be prohibited? If so, what would be the appropriate size of the zone and how could it be enforced?

57. The Commission proposed to exclude low power TV band devices from operating on TV channels 2-4 to avoid possible interference to TV interface devices such as VCRs, DVDs, satellite and cable boxes that operate on or adjacent to those channels. While there was some support in the record for excluding channels 2-4 based on the potential for interference, other parties believe that operation should be permitted on those channels because TV interface devices are usually connected to a TV with shielded cable that should obviate the interference potential from unlicensed devices on channels 2-4.<sup>71</sup> We seek further comment on whether we should allow TV band devices to operate on channels 2-4. In particular, we seek comment on whether TV interface devices would be more susceptible to interference from low power TV band devices than other TV receivers. We also seek comment on whether the cabling between a TV interface device and a TV receiver typically provides adequate shielding from

<sup>69</sup> See *Notice* at 10035.

<sup>70</sup> See 47 C.F.R. § 90.305. Base stations may not be located more than 50 miles from the specified geographic coordinates, and mobile stations must be within 30 miles of their associated base station.

<sup>71</sup> The Telecommunications Industry Association supports excluding channels 2-4, while the New America Foundation and Microsoft believe unlicensed operation should be permitted on those channels. See Telecommunication Industry Association comments at 4, New America Foundation comments at 10 and Microsoft comments at 19.

unwanted signals on channels 2-4. We also seek information indicating the extent to which such signals may be picked up directly within the TV receiver. In addition, we note a trend toward devices that connect directly to a TV receiver without going through the tuner. We seek comment on how much longer consumers are expected to use TV interface devices that connect to a TV through the tuner rather than an alternative interface connection.

## F. Other Issues

58. *Types and Applications of Devices.* In the *Notice*, the Commission stated that permitting unlicensed devices to operate in the TV bands would allow the development of new and innovative types of unlicensed broadband devices and services for businesses and consumers.<sup>72</sup> It anticipated that fixed unlicensed devices would be used by WISPs and others as base stations to provide Internet access and other broadband data services to homes and businesses.<sup>73</sup> The Commission expected that fixed operations would be outdoors, might cover a substantial geographic area, and might be part of a commercial infrastructure.<sup>74</sup> In light of the passage of time since the *Notice* and the modified proposals made herein, we seek additional comment on the types and applications of unlicensed devices that parties expect to be developed to operate in the TV bands. In particular, we seek comment on the relationship between the technical requirements we are now proposing and the potential types of TV band devices that could be needed and developed. For example, how would a specific interference avoidance mechanism affect the types of potential applications? We also invite comment as to whether the applications would be different if the Commission were to provide for TV band devices on a licensed basis instead of an unlicensed basis.

59. *Out of Band Emission Limits.* The Commission proposed to require that emissions from an unlicensed device outside that device's channel of operation comply with the limits in Section 15.209 of the rules.<sup>75</sup> These are the same limits that apply to most intentional radiators operating under Part 15 of the rules, and at frequencies above 30 MHz are the same as the limits that apply to most unintentional radiators, including computers and radio and TV receivers.<sup>76</sup> Motorola, NAB, and MSTV argue that these emission limits are inadequate to protect against interference to TV reception because they will result in field strengths high enough to cause interference at the noise limited contour of DTV stations.<sup>77</sup> Intel disagrees with these parties' claim, stating that they incorrectly assume that 1) Part 15 devices transmit the maximum power permitted by Section 15.209 across all frequencies outside their band of operation all the time, 2) TV viewers in marginal signal strength areas typically attempt to receive TV signals via indoor antennae, and 3) TV viewers and their neighbors do not already operate electronic devices covered by Section 15.209(a), which would cause the same type of supposed harmful interference.<sup>78</sup> Microsoft believes that requiring emissions outside the unlicensed device's channel of

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<sup>72</sup> See *Notice* at 10019.

<sup>73</sup> See *Notice* at 10029.

<sup>74</sup> See *Notice* at 10026.

<sup>75</sup> See 47 C.F.R. § 15.209.

<sup>76</sup> The limits for unintentional radiators are in Section 15.109.

<sup>77</sup> See Motorola comments at Appendix A and NAB and MSTV reply comments at 12.

<sup>78</sup> See Intel reply comments at 11.

operation to comply with the Section 15.209 limits is unnecessarily strict, because the signal roll-off required to comply with the limit would leave little of a 6 MHz channel available for service.<sup>79</sup> Microsoft recommends that signals outside of an unlicensed devices channel of operation be attenuated 20 dB from the highest level of desired power, and that the Section 15.209 limits apply only in restricted bands of operation.<sup>80</sup>

60. The Section 15.209 limits have a long and successful history of controlling interference from a wide variety of devices operating under Part 15 of the rules, including radio transmitters, computers and TV receivers.<sup>81</sup> We are not aware of any significant interference problems from devices that comply with these limits. We note Microsoft's concern that the proposed rules in the *Notice* would require sharp filtering of emissions to meet the Section 15.209 limits outside the unlicensed device's channel of operation. However, we are concerned their recommend out-of-band emission limit of 20 dB below the highest level of desired power would be inadequate attenuation to prevent interference to authorized services in the TV bands.<sup>82</sup> We are proposing to require that emissions outside a TV band device's operating channel comply with the Section 15.209 limits, but seek comment on whether different emission limits would be more appropriate.<sup>83</sup> Parties that believe limits other than those in Section 15.209 are necessary to protect incumbent TV band operations against harmful interference may perform tests and submit the results into the record in this proceeding.

61. We also seek comment on how out-of-band limits should be specified. Radiated emission limits at TV band frequencies are based on measuring equipment employing CISPR quasi-peak detector function and related measurement bandwidths.<sup>84</sup> CISPR quasi-peak methods were developed, based on subjective listening tests, to provide a measure of the effects of various kinds of interference on AM radio listeners. We seek comment on whether there is a better measure available for quantifying effects of interference on incumbent services in the TV bands, *e.g.*, ATSC digital television signals. For example, should measurement bandwidth be larger than the 120 kHz used by CISPR quasi-peak detectors in this frequency range in order to more closely match DTV receiver bandwidths? Should interference effects be quantified by measurements of average power, peak power, or some other function within the

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<sup>79</sup> See Microsoft comments at 27.

<sup>80</sup> See Microsoft comments at 27. Only spurious emissions are permitted in designated restricted bands of operation, and these emissions must comply with the limits in Section 15.209. See 47 C.F.R. § 15.205.

<sup>81</sup> The radiated emission limits for unintentional radiators such as computers and TV receivers are specified in Section 15.109, but are the same at the Section 15.209 limits at frequencies above 30 MHz.

<sup>82</sup> An unlicensed TV band transmitter operating at the limits proposed herein, 1 watt of power into an antenna with a gain of 6 dBi, would produce a field strength of 4,472 millivolts per meter at a distance of three meters. If the out-of-band emissions were required to be attenuated by 20 dB (a factor of ten), then the maximum permitted out-of-band emission level would be 447.2 millivolts per meter (447,200 microvolts per meter) at a distance of three meters. This level would be over 2000 times higher than the Section 15.209 limit at UHF TV frequencies (200 microvolts per meter at a distance of three meters), and over 4000 times higher than the Section 15.209 limit at low VHF TV frequencies (100 microvolts per meter at a distance of three meters).

<sup>83</sup> We expect that the same out-of-band emission limits would be appropriate if the Commission were to adopt a licensed approach for TV band devices. In such case, the out-of-band emission limits would be specified in the appropriate rule part rather than Part 15.

<sup>84</sup> See 47 C.F.R. § 15.35(a). CISPR is an acronym for the French name for the Special International Committee on Radio Interference.

*recommended measurement bandwidth? We also seek input on the appropriate emission levels using the proposed measurements. Should the levels be set to be equivalent in some sense to the 15.209 limits or should they be set at a different level?*

62. *Direct Pickup Interference and Receiver Desensitization.* Several parties allege that TV band transmitters operating in close proximity to TV receivers could cause interference by direct signal pickup through the receiver chassis.<sup>85</sup> Some parties also claim that TV band devices will “desensitize” a TV receiver, resulting in interference on all channels.<sup>86</sup> Intel believes that direct pickup interference is highly improbable because newer TVs and set top boxes incorporate fully shielded tuners that are nearly invulnerable to direct pickup interference, and that operators of personal/portable devices that could cause direct pickup interference would be located in close proximity to affected receivers and could reconfigure, relocate or disable their equipment to avoid direct pickup interference.<sup>87</sup>

63. The concerns raised by commenters are that TV band devices operated in close proximity to TV receivers could have adverse effects on them. We note first that the concerns raised are theoretical because no parties have submitted test results showing actual direct pickup interference from TV band devices to TV receivers. We believe that fixed TV band devices will typically not be operated as close to TV receivers as some parties assume and should not generally cause interference problems. Although personal/portable TV band devices could be located in close proximity to TV receivers, such devices are typically under control of the same party who can increase the separation distance between them or cease operating a device to eliminate any interference that occurs. As discussed above, we are inviting parties to submit test results to evaluate the interference potential of low power devices to TV receivers. If any parties discover actual direct pickup interference or other adverse effects on TV receivers or other radio equipment in or adjacent to the TV bands during testing, they can submit results to us that we will consider in the rule making process.

64. *Certification by TCBs.* All unlicensed transmitters and most licensed transmitters are required to be certified by the Commission or a designated Telecommunication Certification Body (TCB) before they may be legally marketed within the United States.<sup>88</sup> In establishing the requirements for TCBs, the Commission stated that while it intended to allow TCBs to certify a broad range of equipment, certain functions should continue to be performed by the Commission.<sup>89</sup> These functions include certifying new or unique equipment for which the rules or requirements do not exist or for which the application of the rules is not clear.<sup>90</sup> Because TV band devices would contain new technologies and we are proposing new rules to accommodate them, we expect that many questions about the application of the rules would arise. We propose that TCBs not be permitted to certify TV band devices until the Commission has experience with

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<sup>85</sup> See NAB and MSTV reply comments at 14, Consumer Electronics Association reply comments at 6, Consumer Electronics Association comments at 10, and National Cable and Telecommunications Association comments at 5.

<sup>86</sup> See NAB and MSTV reply comments at 10, Qualcomm reply comments at 6

<sup>87</sup> See Intel comments at 14.

<sup>88</sup> The requirement to certify unlicensed transmitters is in Section 15.201(b) of the rules, and the requirements concerning TCBs are in Section 2.960 of the rules. The authorization requirements for transmitters used in licensed services are in the applicable rules for each service.

<sup>89</sup> See *Report and Order* in ET Docket No. 98-68, 13 FCC Rcd 24687 (1999).

<sup>90</sup> *Id.*

them and can properly advise the TCBs on how to apply the applicable rules.<sup>91</sup> The Commission's Laboratory maintains a list of types of devices that TCBs are excluded from certifying, and we propose to place TV band transmitters on this list until such time as we determine that TCBs are capable of certifying them. We seek comment on this proposal.

65. *Unlicensed Use in Border Areas near Canada and Mexico.* 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.<sup>92</sup> 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.<sup>93</sup> In keeping with the current agreements with Canada and Mexico, in the *Notice* we proposed to prohibit unlicensed TV band devices from operating less than these distances from the Canadian and Mexican borders until agreements are reached with those countries. In particular, we sought comment on how to ensure that unlicensed devices using vacant TV channels do not operate within the border areas, whether the methods used to ensure that these devices operate only on vacant TV channels could be adapted to preclude operation in the border areas. Two parties believe that unlicensed devices need not be excluded from operating in border areas because unlicensed devices would operate with a lower power than broadcast stations and are not likely to cause interference across the borders with Canada and Mexico.<sup>94</sup> No party suggested a means to keep unlicensed devices from operating in the border areas. We ask whether the agreements with Canada and Mexico would need to be modified before we allow unlicensed TV band devices to operate in the border areas. To the extent they would need to be modified, we seek further comment on the methods that could be used to ensure that unlicensed TV band devices do not operate in the border areas until such time as the appropriate agreements are concluded. We also seek comment on whether the answers to these questions would be different under a licensed approach, and if so, how. Would these matters be more easily addressed under a licensed approach rather than an unlicensed approach?

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<sup>91</sup> See *First Report and Order* in ET Docket No. 00-47, 16 FCC Rcd 17373 (2001).

<sup>92</sup> 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>.

<sup>93</sup> 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 agreement is available on the Commission's web site at <http://www.fcc.gov/ib/sand/agree/files/mex-bc/lpubfbc.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. The distances we specify are the minimums specified in the agreements because those distances would apply to a station with the proposed maximum unlicensed device power of 1 watt into a 6 dBi gain antenna (2.43 watts ERP).

<sup>94</sup> See New America Foundation comments at 13 and Microsoft comments at 28.

#### IV. PROCEDURAL MATTERS

66. *Initial Regulatory Flexibility Analysis.* As required by the Regulatory Flexibility Act, *see* 5 U.S.C. § 603, the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on small entities of the policies and rules proposed in this document. The IRFA is set forth in Appendix C. Written public comments are requested on the IRFA. These comments must be filed in accordance with the same filing deadlines as comments filed in response to this Further Notice of Proposed Rule Making as set forth in paragraph 0, and have a separate and distinct heading designating them as responses to the IRFA.

67. *Final Regulatory Flexibility Certification.* A Final Regulatory Flexibility Certification is set forth in Appendix D.

68. *Ex Parte Presentations.* This is a permit-but-disclose notice and comment rule making proceeding. *Ex parte* presentations are permitted, except during the Sunshine Agenda period, provided they are disclosed as provided in the Commission's rules. *See generally* 47 C.F.R. §§ 1.1202, 1.1203, and 1.2306(a).

69. Pursuant to sections 1.415 and 1.419 of the Commission's rules, 47 CFR §§ 1.415, 1.419, interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. Comments may be filed using: (1) the Commission's Electronic Comment Filing System (ECFS), (2) the Federal Government's eRulemaking Portal, or (3) by filing paper copies. *See Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- **Electronic Filers:** Comments may be filed electronically using the Internet by accessing the ECFS: <http://www.fcc.gov/cgb/ecfs/> or the Federal eRulemaking Portal: <http://www.regulations.gov>. Filers should follow the instructions provided on the website for submitting comments.
- **For ECFS filers,** if multiple docket or rulemaking numbers appear in the caption of this proceeding, filers must transmit one electronic copy of the comments for each docket or rulemaking number referenced in the caption. In completing the transmittal screen, filers should include their full name, U.S. Postal Service mailing address, and the applicable docket or rulemaking number. Parties may also submit an electronic comment by Internet e-mail. To get filing instructions, filers should send an e-mail to [ecfs@fcc.gov](mailto:ecfs@fcc.gov), and include the following words in the body of the message, "get form." A sample form and directions will be sent in response.
- **Paper Filers:** Parties who choose to file by paper must file an original and four copies of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number.

70. Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail (although we continue to experience delays in receiving U.S. Postal Service mail). All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.

- The Commission's contractor will receive hand-delivered or messenger-delivered paper filings for the Commission's Secretary at 236 Massachusetts Avenue, NE, Suite 110, Washington, DC 20002. The filing hours at this location are 8:00 a.m. to 7:00 p.m. All

hand deliveries must be held together with rubber bands or fasteners. Any envelopes must be disposed of before entering the building.

- Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9300 East Hampton Drive, Capitol Heights, MD 20743.
- U.S. Postal Service first-class, Express, and Priority mail must be addressed to 445 12<sup>th</sup> Street, SW, Washington DC 20554.

71. People with Disabilities: To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to [fcc504@fcc.gov](mailto:fcc504@fcc.gov) or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (tty).

72. This document does not contain proposed, new or modified information collection(s) subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. In addition, therefore, it does not contain any new or modified "information collection burden for small business concerns with fewer than 25 employees," pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, see 44 U.S.C. 3506(c)(4).

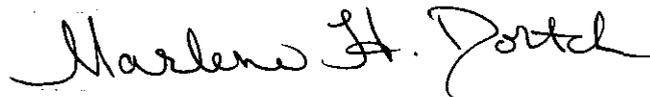
#### V. ORDERING CLAUSES

73. IT IS ORDERED that, pursuant to Sections 4(i), 302, 303(e), 303(f), 303(r) and 307 of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 302, 303(e), 303(f), 303(r) and 307, this First Report and Order and Further Notice of Proposed Rule Making IS HEREBY ADOPTED.

74. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this First Report and Order and Further Notice of Proposed Rule Making, including the Initial Regulatory Flexibility Analysis and Final Regulatory Flexibility Certification, to the Chief Counsel for Advocacy of the Small Business Administration.

75. For further information regarding this First Report and Order and Further Notice of Proposed Rule Making, contact Mr. Hugh L. Van Tuyl, Office of Engineering and Technology, (202) 418-7506, e-mail [Hugh.VanTuyl@fcc.gov](mailto:Hugh.VanTuyl@fcc.gov) or Mr. Alan Stillwell, Office of Engineering and Technology, (202) 418-2925, e-mail [Alan.Stillwell@fcc.gov](mailto:Alan.Stillwell@fcc.gov).

FEDERAL COMMUNICATIONS COMMISSION



Marlene H. Dortch  
Secretary

## APPENDIX A

## Parties Filing Comments

Comments

1. Adaptrum, Inc.
2. Alan Greagor
3. Association of Public Safety Communications Officials
4. Association of Public Television Stations
5. ATK Audiotek
6. Attron Networks, LLC
7. Audio-Technica U.S., Inc.
8. Chip Brown
9. Chuck Profito
10. Cohen, Dippell and Everist, P.C.
11. Commercial Broadcasting Corporation
12. Community Broadcasters Association
13. Consumer Electronics Association
14. County of Los Angeles
15. Cox Broadcasting, Inc.
16. CWLab
17. Dan Lubar
18. Dustin Goodwin
19. Entravision Holdings, LLC
20. Harris Corporation
21. IEEE 802
22. Industrial Telecommunications Association, Inc.
23. Intel Corporation
24. International Communications Industries Association, Inc.
25. Itron, Inc.
26. James M. McKinion
27. James Stoffo
28. John Laprise
29. John Notor
30. John Terrill
31. Jon M. Peha
32. Josephson Engineering, Inc.
33. Karl Winkler
34. Kenneth DiPietro
35. Kenneth Youngquist
36. KHEM Television
37. Lee Good, RTS
38. Mark Koskenmaki
39. Marlon K. Schafer
40. Metropolitan Area Networks, Inc.
41. Michael Falaschi
42. Michael J. Marcus
43. Michael Mason
44. Michiana Wireless
45. Microsoft Corporation
46. Motorola, Inc.
47. NAB and MSTV
48. NAMM, the International Music Products Association
49. National Academy of Sciences
50. National Cable & Telecommunications Association
51. National Radio Astronomy Observatory
52. National Systems Contractors Association
53. National Translator Association
54. New America Foundation, et al.
55. Noah Miller
56. NPG of Oregon, Inc.
57. NYCwireless.net
58. Old Colorado City Communications
59. OnlyInternet Broadband & Wireless, Inc.
60. Pappas Telecasting Companies
61. Paul Burkholder
62. Pikes Peak Broadcasting Company
63. Professional Audio Manufacturers' Alliance
64. PVT Networks, Inc.
65. QUALCOMM Incorporated
66. R. Kent Parsons
67. Raymond D. Meredith, Jr.
68. Rebekah Morris
69. Red River Broadcasting Co., LLC
70. Region 1 Translator Association
71. Ron Wallace
72. Ronald E. Wallace
73. Sascha D. Meinrath
74. Sennheiser Electronic Corporation
75. Shared Spectrum Company
76. Shure Incorporated
77. Society of Broadcast Engineers, Inc.
78. Southwest Colorado TV Translator Association
79. Stelios Valavanis
80. Symmetrical Networks, Inc.
81. Syncom Media Group, Inc.
82. Telecommunications Industry Association

83. Telex Communications, Inc.
  84. Tim Foster
  85. Tony Ray
  86. Total RF Marketing, Inc.
  87. Tropos Networks
  88. Vaxeo.com
  89. WDLP Broadcasting Co., LLC
  90. White Pine Television District No. 1
  91. Wi-Fi Alliance
  92. Wireless Broadband Operators Coalition
  93. Wireless Internet Service Providers Association
  94. Wireless Unleashed
  95. Yochai Benkler
  96. Zachary C. Miller
33. Webster Calhoun Cooperative Telephone Association

### **Reply Comments**

1. 700 MHz Advancement Coalition
2. Alan B. Greager
3. Allcom Communications, Inc.
4. BPS Networks
5. Brendan Geaney
6. Cameron Communications Corporation
7. Cohen, Dippell and Everist, P.C.
8. Community Broadcasters Association
9. Consumer Electronics Association
10. EarthLink, Inc.
11. Information Technology Industry Council
12. Intel Corporation
13. KBDI, Channel 12
14. Kennebec Telephone Company
15. Land Mobile Communications Council
16. Lanham Rattan
17. Motorola, Inc.
18. NAB and MSTV
19. NARTE
20. National Translator Association
21. New America Foundation, et al.
22. North Dakota Network Company
23. OnTarget Technologies, LLC
24. Pitkin County FM-TV Department
25. Ponderosa Telephone Company
26. PVT Networks, Inc.
27. QUALCOMM Incorporated
28. Red River Rural Telephone Association
29. Shared Spectrum Company
30. Shure Incorporated
31. Society of Broadcast Engineers, Inc.
32. Timothy X Brown

**APPENDIX B****Proposed Rules**

Part 15 of Title 47 of the Code of Federal Regulations is proposed to be amended as follows:

1. The authority citation of Part 15 continues to read as follows:

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

2. Section 15.209 is revised by amending the footnote to the table in paragraph (a) to read as follows:

**§ 15.209 Radiated emission limits, general requirements.**

(a) \* \* \*

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under Subpart H and under other sections of this Part, e.g., Sections 15.231, 15.241 and 15.242.

\* \* \* \* \*

3. A new Subpart H is added to read as follows:

**Subpart H – Unlicensed TV Band Devices**

**§ 15.701 Scope**

This subpart sets out the regulations for unlicensed TV band devices operating in the 76-88 MHz, 174-216 MHz, 512-608 MHz and 614-698 MHz bands.

**§ 15.703 Definitions.**

(a) Available Channel. A radio channel on which a *Channel Availability Check* has not identified the presence of a signal.

(b) Channel Availability Check. A check during which the TV band device listens on a particular radio channel to identify whether there is a station operating on that radio channel.

(c) Channel Move Time. The time needed by a TV band device to cease all transmissions on the current channel upon detection of a station above the DFS detection threshold.

(d) Dynamic Frequency Selection (DFS) is a mechanism that dynamically detects signals from other systems and avoids co-channel operation with these systems.

(e) DFS Detection Threshold. The required detection level defined by detecting a received signal strength that is greater than a threshold specified, within the TV band device channel bandwidth.

(f) In-Service Monitoring. A mechanism to check a channel in use by the TV band device for the presence of a station.

(g) **Operating Channel.** Once a TV band device starts to operate on an Available Channel then that channel becomes the *Operating Channel*.

(h) **Maximum Conducted Output Power.** The total transmit power 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.

(i) TV band devices. Intentional radiators operating in the frequency bands 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-698 MHz.

**§ 15.705 Cross reference.**

(a) The provisions of Subparts A, B, and C of this part apply to unlicensed TV band devices, except where specific provisions are contained in subpart H. Manufacturers should note that this includes the provisions of Sections 15.203 and 15.205.

(b) The requirements of subpart H apply only to the radio transmitter contained in the TV band device. Other aspects of the operation of a TV band device may be subject to requirements contained elsewhere in this chapter. In particular, a TV band device that includes digital circuitry not directly associated with the radio transmitter also is subject to the requirements for unintentional radiators in subpart B.

**§ 15.707 General technical requirements.**

(a) The maximum conducted output power is 1 watt. If a transmitting antenna of directional gain greater than 6 dBi is used, the peak output power shall be reduced by the amount in dB that the maximum directional gain of the antenna exceeds 6 dBi.

(b) Unwanted emissions shall comply with the following:

(1) Unwanted emissions outside the channel of operation must comply with the general field strength limits set forth in Section 15.209.

(2) The provisions of Section 15.205 of this part apply to intentional radiators operating under this section.

(3) Any devices using an AC power line are required to comply with the conducted limits set forth in Section 15.207.

(c) The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization a description of how this requirement is met.

(d) TV band devices are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these

requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(e) Manufacturers of TV band devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

(f) Dynamic Frequency Selection (DFS). TV band devices shall employ a DFS detection mechanism to detect the presence of authorized stations in the TV bands and to avoid co-channel operation with them. The detection threshold is referenced to a 0 dBi gain antenna. The minimum DFS detection threshold for TV band devices is -116 dBm.

(i) Channel Availability Check Time. A TV band device shall check if there is a station already operating on the channel before it may initiate a transmission on a channel and when it has to move to a new channel. The TV band device may start using the channel if no station with a power level greater than the detection threshold value listed above is detected within 30 seconds.

(ii) In-Service Monitoring. A TV band device shall perform in-service monitoring at intervals no greater than 10 seconds.

(iii) Channel Move Time. After a station's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the station's signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

(g) Transmit power control (TPC). TV band devices shall employ a TPC mechanism. The TV band device is required to have the capability to operate at least 6 dB below the maximum conducted output power limit of 1 watt. A TPC mechanism is not required for devices with a maximum conducted output power of less than 500 mW.

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**APPENDIX C****Initial Regulatory Flexibility Analysis**

As required by the Regulatory Flexibility Act of 1980, as amended (RFA),<sup>1</sup> the Commission has prepared this present Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities by the policies and rules proposed in this Notice of Proposed Rule Making (Notice). Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments on the Notice provided in paragraph 0 of the item. The Commission will send a copy of the Notice, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).<sup>2</sup> In addition, the Notice and IRFA (or summaries thereof) will be published in the Federal Register.<sup>3</sup>

**A. Need for, and Objectives of, the Proposed Rules**

1. This Further Notice would propose to allow low power transmitters to operate in the TV broadcast bands at locations where spectrum is not being used by authorized services without causing harmful interference to these services. The Further Notice seeks comment on whether these TV band devices should be authorized on a licensed, unlicensed or hybrid basis.<sup>4</sup> It would propose to require TV band devices to incorporate "smart radio" features to detect vacant TV channels and prevent harmful interference from TV band devices to authorized services operating in the TV bands. These features would include the abilities to 1) monitor spectrum prior to transmitting to ensure that it is not in use by authorized services, 2) switch frequencies or cease transmitting if an authorized service begins using a previously unused frequency, 3) adjust transmit power to the minimum needed to establish a link, 4) determine geographic location and access a database to determine which channels are in use, and/or 5) receive a control signal and select the operating frequency based on data in the control signal.

2. These proposals, if adopted, will prove beneficial to manufacturers and users of low power transmitters because they will provide for more efficient and effective use of the TV spectrum and allow the development of new and innovative types of wireless devices and communication services for businesses and consumers. The additional frequency bands where operation is proposed can provide an alternative last mile solution to cable or DSL services for delivering high speed Internet services, other data applications, or even video and voice services. This could particularly benefit underserved, rural, or isolated communities where cable and DSL services are not available. Also, because transmissions in the TV band have less signal attenuation through foliage and walls than frequencies above 900 MHz (such as unlicensed operations in the 2.4 GHz band), operations in the TV bands can improve the service range of wireless operations, thereby allowing operators to reach new customers and improve service to existing customers.

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<sup>1</sup> 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).

<sup>2</sup> See 5 U.S.C. § 603(a).

<sup>3</sup> See 5 U.S.C. § 603(a).

<sup>4</sup> Licensed operation requires the operator to obtain an authorization issued by the Commission to use a particular frequency band. Unlicensed operation may be done without a prior authorization from the Commission. Hybrid operation would be some mix of these two approaches but is not specifically defined in the Further Notice.

**B. Legal Basis**

3. The proposed action is authorized under Sections 4(i), 301, 302, 303(e), 303(f), 303(r), 304 and 307 of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 301, 302, 303(e), 303(f), 303(r), 304 and 307.

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

4. 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 proposed rules, if adopted.<sup>5</sup> The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."<sup>6</sup> In addition, the "small business" has the same meaning as the term "small business concern" under the Small Business Act.<sup>7</sup> A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operations; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).<sup>8</sup>

**5. Radio and Television Broadcasting and Wireless Communications Equipment Manufacturers.** The Commission has not developed a definition of small entities applicable to unlicensed communications devices manufacturers. Therefore, we will utilize the SBA definition application to manufacturers of Radio and Television Broadcasting and Communications Equipment. Under the SBA's regulations, a Radio and Television Broadcasting and Wireless Communications Equipment Manufacturer must have 750 or fewer employees in order to qualify as a small business concern.<sup>9</sup> Census Bureau data indicate that there are 1,215 U.S. establishments that manufacture radio and television broadcasting and wireless communications equipment, and that 1,150 of these establishments have fewer than 500 employees and would be classified as small entities.<sup>10</sup> The remaining 65 establishments have 500 or more employees; however, we are unable to determine how many of those have fewer than 750 employees and, therefore, also qualify as small entities under the SBA definition. We therefore conclude that there are at least 1,150 small manufacturers of radio and television broadcasting and wireless communications equipment, and possibly there are more that operate with more than 500 but fewer than 750 employees.

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<sup>5</sup> See 5 U.S.C. § 603(b)(3).

<sup>6</sup> 5 U.S.C. § 601(6).

<sup>7</sup> 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."

<sup>8</sup> 15 U.S.C. § 632.

<sup>9</sup> 13 C.F.R. § 121.201, NAICS code 334220.

<sup>10</sup> Economics and Statistics Administration, Bureau of Census, U.S. Department of Commerce, 1997 Economic Census, Industry Series - Manufacturing, Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing, Table 4 at 9 (1999). The amount of 500 employees was used to estimate the number of small business firms because the relevant Census categories stopped at 499 employees and began at 500 employees. No category for 750 employees existed. Thus, the number is as accurate as it is possible to calculate with the available information.

**6. Cellular and Other Wireless Telecommunications.** The SBA has developed a small business size standard for Cellular and Other Wireless Telecommunications, which consists of all such firms having 1,500 or fewer employees<sup>11</sup> According to Census Bureau data for 1997, in this category there were 977 firms that operated for the entire year.<sup>12</sup> Of this total, 965 firms had employment of 999 or fewer employees, and an additional twelve firms had employment of 1,000 employees or more.<sup>13</sup> Thus, under this size standard, the majority of firms can be considered small.

**D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements**

7. Most licensed and unlicensed transmitters are required to be authorized under the Commission's certification procedure as a prerequisite to marketing and importation, and the proposed new types of TV band devices would be subject to the same certification requirement. There are no proposed new recordkeeping or reporting requirements in the Further Notice. There are a number of proposed compliance requirements for TV band devices that are described below.

8. Transmitters capable of operating in the TV bands would have to incorporate the following features to ensure that they operate on only vacant TV channels. Specifically, a transmitter would have to incorporate a dynamic frequency selection (DFS) mechanism to monitor a TV channel before transmitting. If no signals on a channel were detected above a specified level within a specified period of time, the device would be allowed to transmit on that channel. Otherwise, the device would have to monitor other TV channels to find one that is vacant, or if no vacant TV channels were available, the device would not be allowed to transmit. A TV band device would have to periodically monitor the TV channel on which it transmits during operation, and if any new signals appear, the device would have to switch to another channel within a specified period of time or cease transmitting if no vacant channels are available. A TV band device would also have to incorporate a transmit power control mechanism to lower the output power by 6 dB (4 times lower) than the maximum permitted power of one watt if that level is sufficient to accomplish the desired communications.

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

9. The RFA requires an agency to describe any significant, specifically small business, alternatives that it has considered in reaching its proposed 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; (3) the use of performance, rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities."<sup>14</sup>

10. If the rules proposed in this notice are adopted, we believe they might have a significant economic impact on a substantial number of small entities. For an entity that chooses to manufacture or

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<sup>11</sup> 13 C.F.R. § 121.201, NAICS code 517211.

<sup>12</sup> U.S. Census Bureau, 1997 Economic Census, Subject Series: "Information," Table 5, Employment Size of Firms Subject to Federal Income Tax: 1997, NAICS code 513322 (issued October 2000).

<sup>13</sup> U.S. Census Bureau, 1997 Economic Census, Subject Series: "Information," Table 5, Employment Size of Firms Subject to Federal Income Tax: 1997, NAICS code 513322 (issued October 2000). 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 "Firms with 1000 employees or more."

<sup>14</sup> 5 U.S.C. § 603(c)(1) – (c)(4).

import equipment for the subject bands, the rules would impose costs for compliance with equipment *technical requirements, such as incorporating a DFS mechanism to detect vacant TV channels where the equipment can operate.* However, the burdens for complying with the proposed rules would be the same for both large and small entities. Therefore, no disproportionate burden of compliance would be sustained by small entities. Further, the proposals in this *Notice* are ultimately beneficial for both large and small entities because they will provide for more efficient and effective use of the TV spectrum and allow the development of new and innovative types of wireless devices and communication services for businesses and consumers. Also, because transmissions in the TV band are subject to less propagation attenuation than transmissions in other bands where lower power operations are permitted (such as unlicensed operations in the 2.4 GHz band), operations in the TV bands can improve the service range of wireless operations, thereby allowing operators to reach new customers.

11. The Further Notice seeks comment on alternatives to the proposed DFS mechanism for detecting vacant TV channels. Specifically, it seeks additional comment on how to implement the geo-location/database and control signal approaches for identifying vacant TV channels that was proposed in the original *Notice* in this proceeding. The geo-location/database method would require that a TV band device incorporate a Global Positioning System (GPS) receiver or be professionally installed to determine its location, and that the device would have to access a database to identify vacant channels at its location. The control signal approach would require that a TV band device operate only when it receives a control signal from a source such as an FM or TV station that identifies the vacant TV channels that could be used by the device in that particular area. We cannot find electrical engineering alternatives, such as exemptions from the requirements to include certain interference avoidance mechanisms into TV band devices that would achieve our goals while treating small entities differently. Nonetheless, we solicit comment on any alternatives commenters may wish to suggest for the purpose of facilitating the Commission's intention to minimize the compliance burden on smaller entities. As described above, the compliance burdens would include incorporating certain features into TV band devices to prevent interference to authorized services, such as DFS, transmit power control, geo-location/database access and/or the ability to receive and respond to a control signal.

**F. Federal Rules that May Duplicate, Overlap, or Conflict With the Proposed Rule**

None.

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**APPENDIX D****Final Regulatory Flexibility Certification**

*Final Regulatory Flexibility Certification.* The Regulatory Flexibility Act of 1980, as amended (RFA)<sup>1</sup> requires that a regulatory flexibility analysis be prepared for rulemaking proceedings, unless the agency certifies that "the rule will not have a significant economic impact on a substantial number of small entities."<sup>2</sup> The RFA generally defines "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."<sup>3</sup> In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.<sup>4</sup> 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).<sup>5</sup>

In this First Report and Order, the Commission decides to allow low power fixed devices to operate on unused spectrum on TV channels 5-13, and 21-51, excluding channel 37. Operation will not be permitted prior to further action by the Commission to develop technical rules that allow devices to operate on those channels without causing interference. Because the Report and Order does not adopt any rules or other compliance requirements, we certify that the actions in this First Report and Order will not have a significant economic impact on a substantial number of small entities. The Commission will send a copy of the First Report and Order including a copy of this final certification, in a report to Congress pursuant to the Small Business Regulatory Enforcement Fairness Act of 1996, *see* 5 U.S.C. § 801(a)(1)(A). In addition, the First Report and Order and this certification will be sent to the Chief Counsel for Advocacy of the Small Business Administration, and will be published in the Federal Register. *See* 5 U.S.C. § 605(b).

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<sup>1</sup> *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).

<sup>2</sup> 5 U.S.C. § 605(b).

<sup>3</sup> 5 U.S.C. § 601(6).

<sup>4</sup> 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in Small Business Act, 15 U.S.C. S § 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."

<sup>5</sup> Small Business Act, § 15 U.S.C. S 632.

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**STATEMENT OF  
CHAIRMAN KEVIN J. MARTIN**

Re: Unlicensed Operation in the TV Broadcast Bands; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, *First Report and Order and Further Notice of Proposed Rule Making*

Today, we take the next step in making unused broadcast spectrum available for new and innovative uses. Allowing low power wireless devices to operate in unused portions of the television bands could be an efficient and effective use of this unused spectrum.

In the past, I have expressed that our first priority is furthering the digital transition and minimizing the burden on viewers. Allowing the use of low power devices immediately could impede the progress of the DTV transition. The TV bands have been generally congested during the transition with TV stations operating on two channels each – an analog and a digital channel. Moreover, the final DTV channel selection and assignment process is still ongoing, which makes it more difficult to assess the amount of white space that might ultimately be available. Now that Congress has established a “hard date” for the DTV transition, however, the Commission should resolve outstanding technical issues so that low power devices designed to operate on unused TV frequencies may be placed on the market with the completion of the DTV transition.

**STATEMENT OF  
COMMISSIONER MICHAEL J. COPPS**

Re: Unlicensed Operation in the TV Broadcast Bands, Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, *First Report and Order and Further Notice of Proposed Rule Making*

I am very pleased to approve this item. It is an important step towards enabling a new generation of wireless devices that will enlarge broadband opportunities in cities and rural areas across the nation. For some time, I have hoped the Commission would move forward to enable this exciting new technology, so it is very encouraging that we are doing so today.

As my colleagues have heard me say, I am of the strong belief that our country is in the midst of a broadband crisis stemming from a lack of build-out in many areas and from grossly inadequate competitive choices in the rest. To take just one example, the International Telecommunications Union has concluded that our nation is 15<sup>th</sup> in the world in broadband penetration, and 21<sup>st</sup> in terms of “digital opportunity” (which measures additional factors like wireless technologies and broadband price). I think that the use of the TV white spaces is one of the truly promising opportunities before us in the near term to remedy this grave situation. And make no mistake about it – it is a *very* grave situation. There is simply no way that our country can remain in the forefront of the global economy without developing a broadband infrastructure that is up to the task.

The need for new broadband options is especially pressing in rural and high-cost areas, which may eventually be the greatest beneficiaries of white space technology. We must bring every part of this great nation with us as we move into the Digital Age. It is not just the right thing to do; it is an enlightened investment in our future that I am certain will pay for itself many times over.

So I am excited that we move forward today to embrace this promising technology. But we should not lose sight of the fact that many difficult choices remain before us as we approach the upcoming DTV transition date, when consumers and wireless ISPs can first begin to take advantage of these new broadband devices:

To begin with, we must develop technical standards that will maximize use of the TV white spaces while at the same time preventing inappropriate interference with free, over-the-air broadcasting. As with so much of the Commission’s work, the devil is in the details. I will be watching closely to make sure that we strike the appropriate balance between innovation and caution.

Then there is the question of whether the white spaces should be used on a licensed or unlicensed basis. The Commission’s assumption has always been unlicensed – indeed, the caption of our 2004 NPRM (and today’s item) is “Unlicensed Operation in the TV Broadcast Bands.” I have long supported freeing up additional unlicensed spectrum. In many contexts – as with the enormously successful bands that support today’s Wi-Fi networks – unlicensed uses most closely approach the ideal of the *people’s airwaves*, to be used in direct service of the public interest. With our recent AWS auction and the upcoming 700 Mhz auction, we are opening up a huge swath of prime spectrum to *licensed* use – and it seems to me, on the present record, that the appropriate balance is to open up the TV white spaces to *unlicensed* use. So while I am more than happy to give careful consideration to comments from those who favor licensed use of the white spaces, I would have preferred that today’s item announce a rebuttable presumption in favor of unlicensed use. I believe this approach would have provided greater clarity to innovators, entrepreneurs and the American people.

The final question is whether and how to permit operation on TV channels 14-20, which are used in some states for public safety operations. I would never approve any operation in the white spaces that

would compromise public safety. But at the same time, if it is technically feasible to use these channels for broadband in places where public safety officials do not use them, I think we ought to investigate such uses. I appreciate the Chairman's and my colleagues' willingness to work with me on the portions of this item that ensure the Commission will move forward to develop a full record on this issue. This keeps alive the encouraging possibility that one day these channels can be used to provide broadband in the large portions of the country where they are not being used by public safety operators.

I want to conclude by applauding the Office of Engineering and Technology for their great work on this item and thanking them in advance for continuing to work on the testing and technical rules stages of this process.

**STATEMENT OF  
COMMISSIONER JONATHAN S. ADELSTEIN**

Re: Unlicensed Operation in the TV Broadcast Bands; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band; *First Report and Order and Further Notice of Proposed Rule making*

I am pleased to support this decision that takes an important first step towards allowing unlicensed, low-power devices to operate in unused broadcast television spectrum bands. While our item is a conservative one, I think it strikes the right balance by promoting the development of new technologies while ensuring that over-the-air television is not subject to harmful interference.

The unlicensed, Wi-Fi movement has been one of the great telecommunications success stories over the past several years by enabling American consumers to offer and receive broadband services at the most local levels. Wherever I travel, I hear the calls for more unlicensed spectrum from operators who need more capacity to drive broadband deployment deeper and farther into all corners of the country. In this item, we are rightly exploring the latest and most exciting cognitive radio and spectrum sensing technologies that are available to see how they can enable spectrum facilitation in the television bands. Of course, broadcasters have used the public spectrum for many years to serve rural and urban areas alike in providing news, civic information, education and entertainment. I fully support our request for comment on how best to ensure that harmful interference is not caused by the operation of unlicensed devices. The American people care a lot about the quality of their television reception. We will hear an earful from consumers if this is not done right.

I am particularly pleased with our decision today to allow channels 14-20 and 2-4 to remain "on the table" for further testing to determine their suitability for possible unlicensed services in the future. Of course, our priority in evaluating this spectrum will be to protect existing operations in the bands, particularly public safety services that are licensed on channels 14-20 in thirteen major markets. So I support our decision to limit our inquiry with respect to these seven channels to fixed devices only. But I think the potential use of this spectrum for fixed wireless broadband services in rural areas is too great to take the spectrum completely out of consideration at this time, particularly as channels 14-20 are not in use across most of the country. So I want to thank my colleagues for agreeing to changes to the item that allow us to keep this spectrum "in play" pending the results of future tests.

Finally, while the item does provide a balanced view of the benefits and challenges of unlicensed versus licensed operations in the white spaces bands, I want to specifically express my preference for use of this spectrum on an unlicensed basis. Unlicensed services, with their low barriers to entry, present such a great opportunity for the deployment of broadband offerings in communities across the country no matter their size or financial status. Considering the favorable propagation characteristics for wireless broadband services in the 700 MHz band and the important obligation to protect existing television operations from harmful interference, I believe that unlicensed operations present the best use of the spectrum for this country.

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**STATEMENT OF  
COMMISSIONER DEBORAH TAYLOR TATE**

Re: Unlicensed Operation in the TV Broadcast Bands; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, *First Report and Order and Further Notice of Proposed Rule Making*

Today, we take a number of important first steps towards allowing the introduction of new low power devices to operate on unused broadcast television channels/frequencies not being used for authorized services. Hopefully, this plan will provide for more efficient and effective use of the TV spectrum and will significantly benefit the public, especially those Americans in rural areas, by allowing the development of new and innovative types of devices and services for businesses and consumers.

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**STATEMENT OF  
COMMISSIONER ROBERT M. McDOWELL**

RE: Unlicensed Operation in the TV Broadcast Bands, Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, *First Report and Order and Further Notice of Proposed Rulemaking*

I am excited about this item because it starts a chain of events that will lead to an explosion of entrepreneurial brilliance. I am also delighted that it provides tremendous opportunities for further unlicensed use of these slices of the spectrum. Like my fellow commissioners, I am committed to ensuring that the Commission takes advantage of all opportunities to spur technological innovation and increased access to broadband services. Additionally, I believe that permitting entrepreneurs to operate in the TV bands will benefit manufacturers, service providers and consumers by fostering the development of new delivery platforms and enhancing the range of existing platforms. At the end of this process, I am confident that the American economy will be strengthened and American consumers will reap the rewards.

I thank the Chairman for his strong leadership in handling the multiple conflicting interests at issue here in a deliberate, thoughtful manner. I am delighted that the Commission has laid down a timetable that will help ensure that consumer products will be available for sale at the conclusion of the DTV transition in February 2009. In the interim, we are proceeding mindful of the need to protect from harmful interference not only broadcasters, but all authorized commercial and public safety entities that operate in the TV bands as well. In this regard, I also want to thank the OET staff for their diligence and acknowledge the challenging work that faces them. I am pleased that the Commission's in-house experts will undertake a rigorous testing program, to include DTV converter boxes (once they become available), in order to quantify and analyze potential interference from unlicensed devices operating in the TV bands.

Given that we have a deadline, I look forward to working closely with my colleagues and all stakeholders to ensure that the process to make more efficient and effective use of the TV spectrum proceeds smoothly.