

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

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

THIRD MEMORANDUM OPINION AND ORDER

Adopted: April 4, 2012

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By the Commission:

TABLE OF CONTENTS

Heading	Paragraph #
I. INTRODUCTION.....	1
II. BACKGROUND.....	3
III. DISCUSSION.....	6
A. Height above average terrain (HAAT) limit	7
B. Out-of-band emissions	21
C. Protection of wireless services on channel 52.....	36
D. New class of TV bands devices	48
E. Confidentiality of database information.....	53
F. Other Matters	58
1. TV translator, low power TV and Class A TV station receive sites.....	59
2. Protection of radio astronomy	61
IV. PROCEDURAL MATTERS.....	62
A. Final Regulatory Flexibility Analysis	62
B. Final Paperwork Reduction Act of 1995 Analysis.....	63
C. Contact Persons.....	64
V. ORDERING CLAUSES.....	65
APPENDIX A – List of Parties Filing Petitions	
APPENDIX B – Final Rules	
APPENDIX C – Final Regulatory Flexibility Analysis	

I. INTRODUCTION

1. Unlicensed TV bands devices, or “TVBDs,” will operate on frequencies in the TV bands in areas where they are not used by licensed services (“TV white spaces”). Although the particular unused TV channels vary from location to location, the devices will have the flexibility and agility to locate and operate on the unused channels, no matter where the devices are located. This type of “opportunistic use” of spectrum has great potential as a model for enabling access to other spectrum bands and improving spectrum efficiency.

2. In this Order, we are addressing five petitions for reconsideration of our decisions in the *Second Memorandum Opinion and Order* (“*Second MO&O*”) in this proceeding¹ and modifying our rules in certain respects. In particular, we are: (1) increasing the maximum height above average terrain (HAAT) for sites where fixed devices may operate; (2) modifying the adjacent channel emission limits to specify fixed rather than relative levels; and (3) slightly increasing the maximum permissible power spectral density (PSD) for each category of TV bands device. These changes will result in decreased operating costs for fixed TVBDs and allow them to provide greater coverage, thus increasing the availability of wireless broadband services in rural and underserved areas without increasing the risk of interference to incumbent services. We also are revising and amending several of our rules to better effectuate the Commission’s earlier decisions in this docket and to remove ambiguities.

II. BACKGROUND

3. In the *Second Report and Order and Memorandum Opinion and Order* (“*Second Report and Order*”) in this proceeding, the Commission adopted rules that allow unlicensed devices to operate in the TV bands at locations where frequencies are not in use by licensed services.² The TV bands consist of six-megahertz channels designated 2 to 51 in four bands of frequencies in the VHF and UHF regions of the radio spectrum (54-72 MHz, 76-88 MHz, 174-216 MHz, and 470-698 MHz).³ The Commission permitted two categories of unlicensed devices, fixed and personal/portable unlicensed, to operate in the TV bands.⁴ Fixed devices must incorporate a geo-location capability and a means to access a database that provides a list of available TV channels that may be used at their location.⁵ Such devices must contact a database to obtain a channel list before operating and re-check the database at least once daily.⁶ Fixed devices are permitted to operate with up to one watt transmitter power output and may use an antenna that provides up to 6 dBi of gain.⁷ Portable devices can operate either as “Mode I” or “Mode II”.⁸ A Mode II device must incorporate similar geo-location and database access capabilities to fixed devices.⁹

¹ See *Second Memorandum Opinion and Order* in ET Docket Nos. 02-380 and 04-186, 25 FCC Rcd 18661 (2010) (“*Second MO&O*”). A list of parties filing petitions for reconsideration is included in Appendix A, which also includes parties filing oppositions to those petitions and replies to the oppositions.

² See *Second Report and Order and Memorandum Opinion and Order* in ET Docket Nos. 02-380 and 04-186, 23 FCC Rcd 16807 (2008). In the *First Report and Order and Further Notice of Proposed Rule Making* in this proceeding, 21 FCC Rcd 12266 (2006), the Commission allowed fixed unlicensed devices to operate on vacant TV channels, excluding channel 37, and prohibited personal/portable devices from operating on channels 14-20 that are used by public safety operations in some cities. However, it did not adopt final technical rules at that time. In the *Second Report and Order*, the Commission allowed portable devices to operate on channels 21-51, excluding channel 37, and adopted technical rules for both fixed and portable devices. In the *Second Memorandum Opinion and Order* in this proceeding, 25 FCC Rcd 18661 (2010), the Commission responded to seventeen petitions for reconsideration of the *Second Report and Order*. It upheld the majority of the Commission’s previous decisions but made a number of minor revisions to the rules.

³ See 47 C.F.R. § 73.603(a).

⁴ See 47 C.F.R. §§ 15.703(c) and 15.703(i).

⁵ As an alternative, fixed devices may have their geographic coordinates determined and programmed by a professional installer. See 47 C.F.R. § 15.711(b)(1).

⁶ See 47 C.F.R. § 15.711(b)(3)(i).

⁷ See 47 C.F.R. § 15.709(a).

⁸ See 47 C.F.R. §§ 15.703(e) and 15.703(f).

A Mode I device is not required to incorporate geo-location or database access capabilities but instead obtains the list of available channels on which it can operate from either a fixed or Mode II device that has database access.¹⁰ Personal/portable devices are permitted to operate with up to 100 mW EIRP except when operating on channels adjacent to a TV service, in which case they may operate with up to 40 mW EIRP.¹¹ The databases used by TV bands devices are established and administered by parties selected by the Commission.¹²

4. In the *Second MO&O* in this proceeding, the Commission upheld the majority of its prior decisions but made the following changes to the rules that are at issue in one or more of the five petitions for reconsideration that we address in this order:

- Restricted fixed TV bands devices from operating at locations where the ground level is more than 76 meters above the average terrain level in the area.¹³
- Eliminated the requirement that TV bands devices that incorporate geo-location and database access must also listen (sense) to detect the signals of TV stations and low power auxiliary service stations (wireless microphones).¹⁴ As part of that change, the Commission also revised the rules in several respects to reflect use of that method as the only means for determining channel availability.¹⁵ These changes include requiring Mode I devices to verify channel availability and Mode II devices to verify their operating location at regular time intervals.¹⁶
- Modified the rules governing the measurement of adjacent channel emissions.¹⁷
- Required that information in the TV bands databases be publicly available.¹⁸

5. The petitions for reconsideration raise the following issues: (1) the height above average terrain (HAAT) limit for TV bands devices; (2) out-of-band emission limits; (3) protection of wireless services on TV channel 52; (4) establishment of a new category of fixed indoor TV bands devices; and (5)

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⁹ See 47 C.F.R. §§ 15.711(b)(2) and 15.711(b)(3)(ii). Unlike fixed devices, there is no option for a Mode II personal/portable device to be professionally installed as an alternative to incorporation of a geo-location capability. Additionally, a personal/portable device must re-check its location at least once every 60 seconds except when in a sleep mode.

¹⁰ See 47 C.F.R. §§ 15.703(e) and 15.711(b)(3)(iv).

¹¹ See 47 C.F.R. § 15.709(a)(2).

¹² See 47 C.F.R. § 15.715. The Office of Engineering and Technology designated ten entities to administer TV bands device databases by two separate Orders. The ten designated database administrators are: Airity, Inc. (formerly WSdb LLC); Comsearch; Frequency Finder, Inc.; Google, Inc.; LS Telcom; Key Bridge Global LLC; NeuStar, Inc.; Spectrum Bridge, Inc.; Telcordia Technologies, Inc.; and Microsoft Corporation. See *Order* in ET Docket Nos. 02-380 and 04-186, 26 FCC Rcd 554 (2011) (designating the first nine of these listed parties as database administrators) and *Order* in ET Docket Nos. 02-380 and 04-186, 26 FCC Rcd 10599 (2011) (designating Microsoft Corporation as the tenth database administrator). At this time, Spectrum Bridge has received approval to operate its database system to serve devices and Telcordia has run a public trial of its database system.

¹³ See *Second MO&O*, 25 FCC Rcd 18661, 18689 (2010) at ¶ 66 and 47 C.F.R. § 15.709(b)(2).

¹⁴ See *Second MO&O*, 25 FCC Rcd 18661, 18684 (2010) at ¶ 54.

¹⁵ See *Second MO&O*, 25 FCC Rcd 18661, 18685 (2010) at ¶¶ 56-59.

¹⁶ See 47 C.F.R. §§ 15.711(b)(3)(iv) and 15.711(b)(2).

¹⁷ See *Second MO&O*, 25 FCC Rcd 18661, 18697 (2010) at ¶ 87 and 47 C.F.R. § 15.709(c).

¹⁸ See *Second MO&O*, 25 FCC Rcd 18661, 18710 (2010) at ¶ 119. This requirement does not apply to any information that the database administrators collect that is not required by our rules to be in the database.

the confidentiality of certain information in the TV bands database.

III. DISCUSSION

6. We find that in the Second MO&O, the Commission generally established the appropriate balance between providing for operation of TV bands devices that will make new broadband services available to the public while protecting incumbent services in the TV bands from interference. Thus, we are upholding the majority of the Commission's decisions in the *Second MO&O* that are addressed in the petitions for reconsideration. We do, however, find merit in some of these requests and are therefore modifying certain rules to enhance TVBD operations, particularly in rural and underserved areas. In particular, we are increasing the maximum height above average terrain (HAAT) of sites where fixed devices may operate, modifying the adjacent channel (out-of-band) emission limits to specify fixed levels, and slightly increasing the maximum permissible power spectral density (PSD) for each category of TV bands device. These changes will result in decreased operating costs and greater coverage from fixed TV bands devices that we expect will increase the availability of wireless broadband services in rural and underserved areas. We also find that these changes will not increase the risk of interference to incumbent services. We also are correcting several of our rules to better effectuate the Commission's earlier decisions in this docket and to remove ambiguities.

A. Height above average terrain (HAAT) limit

7. Because the range at which a TV bands device can cause interference to authorized users increases as the height of the device's antenna increases, the Commission adopted a maximum antenna height limit of 30 meters above ground level (AGL) for fixed devices in the *Second Report and Order*.¹⁹ The Commission also adopted a table of separation distances between fixed TV bands devices and the service contours of co-channel and adjacent channel TV stations for three different ranges of antenna height: 0 to 3 meters, 3 to 10 meters, and 10 to 30 meters.²⁰ This table specifies the greatest separation distances at the highest antenna height and shorter separation distances at lower antenna heights.

8. In the *Second MO&O*, the Commission declined to increase the maximum permitted transmit antenna height above ground for fixed TV bands devices, stating that the 30 meters AGL was established as a balance between the benefits of increasing TV bands device transmission range and the need to minimize the impact on licensed services.²¹ However, while the Commission found that specifying a limit on antenna height AGL rather than above average terrain would be satisfactory for controlling interference to authorized services in the majority of cases, it also recognized that the potential for interference increased in instances where a fixed TV bands device antenna is located on a high point such as a hill or mountain.²² In such cases, the antenna height above the surrounding terrain would be significantly greater than if the antenna were located on flat terrain, thus substantially increasing both the distance at which signals would propagate and the potential for interference to authorized operations in the TV bands. The Commission concluded that a limit on antenna height above average terrain (HAAT)

¹⁹ See *Second Report and Order*, 23 FCC Rcd 16807, 16886 (2008) at ¶ 228. The Commission did not impose height restrictions on personal/portable devices because it found that it is not practical to administer an antenna height limit for those devices and the lower power and limited antenna gain of personal/portable devices would generally result in propagation over a shorter range than fixed devices.

²⁰ See 47 C.F.R. § 15.712(a)(2).

²¹ See *Second MO&O*, 25 FCC Rcd 18661, 18689 (2010) at ¶ 65.

²² The antenna height above ground is the distance from the antenna center of radiation to the actual ground directly below the antenna. To calculate the antenna height above average terrain (HAAT), the average elevation of the surrounding terrain above mean sea level must be determined along at least 8 evenly spaced radials at distances from 3 to 16 km from the transmitter site. The HAAT is the difference between the antenna height above mean sea level (the antenna height above ground plus the site elevation) and the average elevation of the surrounding terrain.

was necessary to limit the interference potential of fixed TV bands devices. To accomplish this, the Commission prohibited fixed TV bands devices from operating at sites that are more than 76 meters (249 feet) above the average height of the surrounding terrain.²³ Therefore, the maximum permissible HAAT for fixed device antennas is the 76 meter site HAAT limit plus the 30 meter maximum antenna height AGL, or 106 meters (348 feet). To ensure that fixed devices operate only at sites that comply with the 76 meter HAAT limit, the Commission required that the TV bands database compute the site HAAT at a fixed device's location and not provide a list of available channels to the device if the computed HAAT exceeds the limit.²⁴

9. *Petitions and Comments.* The Wireless Internet Service Providers Association, Federation of Internet Solution Providers of the Americas, Native American Broadband Association, Spectrum Bridge, Inc., Comsearch, Carlson Wireless Technologies Inc., and Wireless Strategies, Inc. ("Joint Petitioners") request that the Commission eliminate the 76 meter ground HAAT limit for fixed sites.²⁵ The Joint Petitioners request that the Commission instead allow antenna heights of up to 250 meters (820 feet) HAAT. To offset the increased interference potential from fixed devices operating with higher antenna heights, they request that the Commission amend the table of separation distances in Section 15.712(a)(2) of the rules to provide increased separation distances from the protected contour of co-channel and adjacent channel TV stations for fixed devices operating with antenna heights greater than 30 meters up to a maximum of 250 meters HAAT.²⁶ The Joint Petitioners argue that there are significant areas of the country where fixed devices cannot be deployed solely because the 76 meter ground HAAT limit is too low to allow fixed stations to be installed.²⁷ It states that these areas are in rural, mountainous, and hilly areas where broadband service to the public is already lacking and where white space spectrum would provide an affordable and viable broadband access solution.

10. In their comments, Stratus Wave, Google, Motorola, PISC, and WCAI support eliminating the 76-meter site HAAT limit, arguing that this limit is unnecessarily restrictive.²⁸ Stratus Wave states that the current height restrictions foreclose white space operation in the majority of the State of West Virginia and that its costs would be reduced by a factor of three if the Commission relaxed these restrictions.²⁹ Stratus Wave, Motorola, and WCAI believe fixed devices should be permitted to operate with a maximum HAAT of 250 meters.³⁰ WCAI states that this higher limit would benefit ISPs and consumers in hilly and mountainous areas and would not harm incumbents if they are protected to the same level as afforded by the current table in the rules.³¹ Google recommends that the Commission eliminate the use of HAAT altogether and simply specify a 30-meter antenna height above ground limit, but it states that it would support an increase in the maximum HAAT to 250 meters if the Commission chooses not to set a height above ground limit.³²

²³ See *Second MO&O*, 25 FCC Rcd 18661, 18689 (2010) at ¶ 66.

²⁴ See 47 C.F.R. § 15.713(e)(6).

²⁵ See Joint Petitioners petition at 1.

²⁶ *Id.*, at 12.

²⁷ *Id.* at 3.

²⁸ See Stratus Wave opposition at 1, Google opposition at 3, Motorola opposition at 5, PISC opposition at 9 and WCAI reply to oppositions at 2.

²⁹ See Stratus Wave opposition at 2.

³⁰ See Stratus Wave opposition at 1, Motorola opposition at 5, and WCAI reply to oppositions at 2.

³¹ See WCAI reply to oppositions at 2.

³² See Google opposition at 3-4.

11. NAB does not object to a maximum HAAT of 250 meters but believes that the Commission should maintain the 30-meter limit on antenna height above ground level.³³ Cellular South opposes increasing the allowable antenna height for fixed TV bands devices to 250 meters but does not oppose allowing an antenna height AGL of no more than 30 meters where the site HAAT exceeds 76 meters.³⁴ However, Motorola, the Joint Petitioners, and WCAI believe that a 30-meter AGL limit is too low. Motorola argues that the limit unnecessarily penalizes users in flat, rural areas, and the Joint Petitioners and WCAI believe the antenna height limit should be raised to 75 meters AGL.³⁵

12. Shure argues that the Joint Petitioner's proposal to more than triple the limit for fixed TV bands device HAAT creates a dramatic imbalance between TVBD transmission range and incumbent protections and that for the Joint Petitioner's proposal to be viable, increased separation distances would have to apply to all protected incumbent services.³⁶ Shure did not, however, provide any information on what it believes to be the appropriate separation distances. The Joint Petitioners and Motorola state that the Commission should make corresponding increases in the required separation distances to co-channel and adjacent channel facilities to compensate for higher HAAT.³⁷ NAB argues that if the Commission permits higher HAAT, it should not allow fixed devices at this height to provide channel lists to Mode I devices because there may be a greater distance between the fixed and Mode I devices.³⁸

13. *Decision.* We are modifying our rules to establish a maximum HAAT for a fixed device antenna of 250 meters and maintaining the limit for fixed device antenna height AGL at 30 meters. We take this action because we find that the current rule, which limits fixed TV bands devices to sites where the ground HAAT is no greater than 76 meters, unnecessarily precludes the operation of fixed TV bands devices at many locations in the country, particularly in rural and other areas that are currently underserved by broadband services. Under the modification we adopt herein, a site with an elevation of up to 220 meters above average terrain could be used with a 30-meter antenna, or a site with a higher elevation above average terrain could be used with a shorter antenna, provided the sum of the site elevation above average terrain and antenna height above ground does not exceed 250 meters. These changes will result in lower costs and greater flexibility for fixed device operators by allowing the use of sites that were previously precluded by the rules and permitting greater coverage from each site. This will increase the availability of wireless broadband services, particularly in rural and underserved areas.

14. We decline to raise the limit for fixed device antenna height AGL to 75 meters as the Joint Petitioners request. The Commission previously considered and rejected requests to raise this limit in the *Second MO&O*, noting that the 30-meter height above ground limit was established as a balance between increasing the TV bands device transmission range and the need to minimize the impact on licensed services.³⁹ While we recognize the Joint Petitioners' argument that an increased antenna height above ground limit could improve TV bands device range in certain circumstances, we find that the Commission appropriately took a conservative approach to minimize the potential for interference to authorized services by limiting the antenna height AGL to 30 meters. We therefore decline to increase this limit at this time. As the Commission previously stated, we could revisit this height limit in the

³³ See NAB opposition at 9.

³⁴ See Cellular South opposition at 7.

³⁵ See Motorola reply to oppositions at 9-10, Joint Petitioners reply to oppositions at 6 and WCAI reply to oppositions at 3.

³⁶ See Shure opposition at 13-14.

³⁷ See Motorola opposition at 5 and Joint Petitioners reply to oppositions at 3.

³⁸ See NAB opposition at 10.

³⁹ See *Second MO&O*, 25 FCC Rcd 18661, 18689 (2010) at ¶ 65.

future if experience with TV bands devices indicates they could operate at higher antenna heights without causing interference.⁴⁰ Also, as discussed above, the changes we are making by removing the 76-meter site HAAT limit and permitting an antenna HAAT of up to 250 meters will serve to increase the coverage of TV bands devices in many instances.

15. Because the range at which interference occurs increases as the antenna height is raised, we are making additional changes to offset the increased potential for harmful interference at the higher antenna heights we are permitting. As recommended by the Joint Petitioners, we are revising the table of minimum required separation distances between fixed devices and the contours of co-channel and adjacent channel TV stations to specify separation distances for HAAT ranging from less than three meters to a maximum of 250 meters.⁴¹ We find, however, that the Joint Petitioners' recommended separation distances are greater than necessary to provide the level of protection to TV services that the Commission decided to provide.⁴² We are therefore modifying the table as shown and described below.

Antenna height above average terrain of unlicensed device	Required separation (km) from digital or analog TV (full service or low power) protected contour	
	Co-channel (km)	Adjacent channel (km)
Less than 3 meters	4.0	0.4
3-Less than 10 meters	7.3	0.7
10-Less than 30 meters	11.1	1.2
30-Less than 50 meters	14.3	1.8
50-Less than 75 meters	18.0	2.0
75-Less than 100 meters	21.1	2.1
100-Less than 150 meters	25.3	2.2
150-Less than 200 meters	28.5	2.3
200-250 meters	31.2	2.4

16. The methodology used by the Joint Petitioners to calculate the required separation distances between TV bands devices and co-channel and adjacent channel TV contours is generally consistent with the methodology described in the *Second Report and Order*. The Joint Petitioners calculated separation distances from fixed devices with an antenna HAAT of 30 meters and greater in the same manner as the Commission by using the F(50,10) propagation curves in the rules.⁴³ The Joint Petitioners used the OET TM-91-1 method to calculate separation distances for fixed device antenna heights below 30 meters HAAT because the Commission's propagation curves are undefined for HAAT

⁴⁰ *Id.*

⁴¹ See Joint Petitioners petition at 12.

⁴² See 47 C.F.R. § 15.712 (a).

⁴³ See 47 C.F.R. § 73.699, Figures 9, 9a, 10, 10a, 10b and 10c. Interfering signal contours are generally calculated using the F(50,10) curves. However, the F(50,10) curves are undefined at distances less than 15 km, so the F(50,50) curves are used to compute interfering contours at distances less than 15 km. The F(50,50) curves are undefined at distances less than 1.5 km, so other methods such as OET TM-91-1 must be used at very short distances.

values below 30 meters.⁴⁴ OET TM-91-1 is a model that the Commission uses for calculating signal levels at short distances and low antenna heights above ground.⁴⁵ While the Commission used a different propagation model to calculate the separation distances at low antenna heights in the *Second Report and Order* (the Okumura model), it used the TM-91-1 model in the *Second Report and Order* to calculate the impact of personal/portable TV bands devices on TV reception at short distances, e.g., up to approximately 1.5 km.⁴⁶ Based on our comparison of these models, we find that TM-91-1 is appropriate for calculating signal levels at distances less than 1 km (as well as longer distances), whereas the Okumura model was not designed for use at distances less than 1 km. Thus, we agree with the Joint Petitioners' suggestion to use the TM-91-1 model to calculate the required separation distances from TV bands devices at antenna heights below 30 meters HAAT where the Commission's propagation curves are undefined.

17. While we agree with the Joint Petitioner's general methodology for determining separation distances, we disagree with certain assumptions it used in its calculations. First, in determining the recommended adjacent channel separation distances, the Joint Petitioners assumed a significant increase in the current adjacent channel emission limits which would require substantially greater adjacent channel separation distances. As discussed in more detail below, we decline to substantially increase the adjacent channel emission limits. Second, the Joint Petitioners assumed a -26 dB D/U adjacent channel protection ratio, whereas the Commission used a -33 dB protection ratio in the *Second Report and Order*.⁴⁷ As the Commission noted in the *Second Report and Order*, DTV receivers can operate with adjacent channel D/U ratios of -33 dB or even less.⁴⁸ Therefore, the Joint Petitioners' recommended D/U ratio would overprotect adjacent channel TV service. We therefore used -33 dB in our adjacent channel distance separation calculations. Third, with regard to co-channel protection, the Joint Petitioners assumed a 16 dB D/U protection ratio, whereas the Commission used a 23 dB ratio in the *Second Report and Order*.⁴⁹ The 23 dB ratio is necessary to protect co-channel DTV service at the edge of a TV station's service contour where the signal-to-noise ratio is low, so we find the Joint Petitioners' recommended co-channel D/U ratio of 16 dB inappropriate.⁵⁰ Finally, in calculating both the co-channel and adjacent channel separation distances, the Joint Petitioners assumed a 3 dB factor for polarization mismatch and no correction factor for the TV receive antenna front-to-back ratio, whereas the Commission's calculations did not consider polarization mismatch but assumed a 14 dB antenna front-to-back ratio as specified in the DTV planning factors.⁵¹ We disagree with both of the Joint Petitioners'

⁴⁴ See Joint Petitioners petition at 17.

⁴⁵ See *Propagation in Suburban Areas at Distances Less than Ten Miles*, FCC/OET TM-91-1, January 25, 1991, available at <http://transition.fcc.gov/oet/info/documents/technical/tm91-1.pdf>.

⁴⁶ See *Second Report and Order*, 23 FCC Rcd 16807, 16840, 16870 (2008) at footnote 147 and ¶ 181. Footnote 147 erroneously refers to OET TM-91-1 as TM90.

⁴⁷ See *Second Report and Order*, 23 FCC Rcd 16807, 16869 (2008) at ¶ 177.

⁴⁸ *Id.*

⁴⁹ See *Second Report and Order*, 23 FCC Rcd 16807, 16866 (2008) at ¶ 167.

⁵⁰ See 47 C.F.R. § 73.623(c)(3).

⁵¹ See *Second Report and Order*, 23 FCC Rcd 16807, 16867, 16869 (2008) at ¶¶ 172 and 177. The Commission stated that it expected the polarization mismatch between a vertically polarized TV bands device antenna and a horizontally polarized TV receive antenna to reduce the potential for interference from TV bands devices. However, it did not include a polarization mismatch factor in its calculations of the separation distances between TV bands devices and TV service contours. The 14 dB front-to-back ratio for a TV receive antenna is specified in the DTV planning factors that the Commission used for its analysis in the *Second Report and Order*. See *OET Bulletin No. 69, Longley-Rice Methodology for Evaluating TV Coverage and Interference*, February 6, 2004 at 10.

assumptions in this regard. We find that it is appropriate for us to consider the antenna front-to-back ratio in the calculation because a TV receive antenna near the edge of a service contour will be pointed at the TV station being received, so the back of the antenna will be pointing toward a TV bands device located outside the service contour. We do not agree that use of a polarization mismatch factor is appropriate for determining fixed device separation distances because manufacturers have the freedom to design systems that use either horizontally or vertically polarized antennas, so we cannot assume or rely upon a polarization mismatch between TV bands devices and TV receive antennas.

18. We recalculated both the co-channel and adjacent channel separation distances in the Joint Petitioners' table using the TM-91-1 model and methodology described above, assuming a DTV protected contour of 41 dBu. In calculating the revised separation distances, we discovered an error in the co-channel separation distances in the current rules. While the *Second Report and Order* stated that the separation distances were determined using the maximum fixed device EIRP of 4 watts, we had inadvertently calculated the distances using an effective radiated power (ERP) of 4 watts, which is equivalent to 6.56 watts EIRP. The use of this higher power in the calculations resulted in the determination of co-channel separation distances that are greater than necessary to provide the degree of protection to TV service that the Commission decided to provide.⁵² Using the methodology described above and the correct EIRP to calculate the required separation distances, at antenna heights up to 30 meters the required co-channel separation distances are reduced by approximately 2 to 3 kilometers as compared to the current rules, while the required adjacent channel separation distances increase by approximately 300 to 500 meters as compared to the current rules.

19. We are prohibiting fixed devices with an HAAT greater than the current maximum of 106 meters from providing channel lists to Mode I personal/portable devices. This action is necessary because a Mode I device, which does not incorporate a geo-location capability, obtains a list of available channels from a fixed or Mode II device that is determined by the geographic coordinates of those devices. Under the current 106 meter limitation, the communication distance between a Mode I device and the fixed or Mode II device that provides a channel list is relatively short, and thus there is a low probability that a Mode I device will operate at a location where its channel list is not valid, *i.e.*, does not meet the minimum separation distances from co-channel and adjacent channels TV stations or other protected services. However, if the fixed device that obtains the channel list for a Mode I device operates with greater HAAT than the current rules permit, the Mode I device could operate at a greater distance from the coordinates of the fixed device where the available channel list was calculated. This will increase the chance that the Mode I device could operate at a location where the channel list is not valid. We will therefore require that the TV bands database not provide channel lists for Mode I devices through fixed devices with an antenna HAAT of greater than 106 meters.⁵³

20. We are not increasing the minimum required separation of one kilometer between wireless microphones and fixed devices operating at a higher HAAT than the current rules allow, because the higher HAAT will not increase fixed device signal strength at a one kilometer distance. The OET TM-91-1 model that we use to calculate signal strength at that distance takes into account radiated power, separation distance, and the antenna height AGL, but is independent of the HAAT.⁵⁴ Because we are not

⁵² See 47 C.F.R. § 15.712(a)(1).

⁵³ A Mode I device requests a list of available channels through either a fixed or a Mode II personal/portable device. The fixed or Mode II personal/portable device sends the Mode I FCC identification number to the database for verification and requests a list of available channels. The database will enforce the height limit we are adopting by not providing a list of available channels to a Mode I device if the request comes through a fixed device with an HAAT greater than 106 meters. The database calculates the HAAT of all fixed devices, so it has the information necessary to determine compliance with this height limit.

⁵⁴ See [OET TM-91-1](#) at 6.

increasing the maximum fixed device antenna height AGL or radiated power, there will be no increase in signal level at one kilometer. We also are not increasing the size of the exclusion zones around receive sites for MVPDs, low power TV or BAS links, because we have no information demonstrating that the existing requirements are insufficient to provide adequate protection at the higher antenna HAAT that we are permitting for fixed devices.

B. Out-of-band emissions

21. In the *Second Report and Order*, the Commission adopted out-of-band emission limits for TV bands devices to protect other authorized services both inside and outside the TV bands. For emissions that fall in a TV channel adjacent to the operating channel of a TV bands device, the Commission required that these emissions be at least 55 dB below the highest emission in the operating channel, with both the in-band and out-of-band emissions measured with a 100 kHz bandwidth.⁵⁵ Emissions that are more than one channel removed from the operating channel must comply with the limits specified in Section 15.209 of the rules.⁵⁶ These field strength limits, measured at a distance of 3 meters, are 100 microvolts per meter (30-88 MHz), 150 microvolts per meter (88-216 MHz), 200 microvolts per meter (216-960 MHz), and 500 microvolts per meter (above 960 MHz).

22. In the *Second MO&O*, the Commission modified the limits for emissions that fall in TV channels adjacent to the operating channel. Specifically, it required that in-band emissions be measured within a 6 MHz bandwidth instead of within a 100 kHz bandwidth, and it revised the required level of attenuation from 55 dB to 72.8 dB to compensate for the difference in measurement bandwidths while providing the same level of interference protection.⁵⁷ The Commission made these changes to ensure consistency in emission measurements, because the in-band power measured within a 100 kHz bandwidth could vary depending on the bandwidth of the transmitted signal, whereas the total power measured within a 6 MHz bandwidth will be the same regardless of whether the signal fills the entire channel or just part.⁵⁸

23. *Petitions and Comments.* The Joint Petitioners, Motorola, and Wi-Fi Alliance request that the Commission relax the emissions limit in the channel immediately adjacent to the TV bands device operating channel. Motorola recommends relaxing the limit by 25 dB for frequencies +/-3 MHz outside the channel where a fixed TV bands device operates and increasing the adjacent channel separation distances by a sufficient amount to introduce an additional 25 dB of path loss.⁵⁹ It states that the relaxed emission mask could apply to all fixed devices or alternatively to a new class of fixed device that would have to meet increased adjacent channel separation distances. Motorola argues that the emission mask for devices operating in the TV bands is 30-40 dB more stringent than the industry standards for Wi-Fi and WIMAX technologies.⁶⁰ It states that this results in equipment costs for fixed customer premises equipment that are 65% higher compared to comparable equipment operating in other frequency bands. Motorola further argues that the emission limits impact network capacity and data throughput because

⁵⁵ See *Second Report and Order*, 23 FCC Rcd 16807, 16889 (2008) at ¶ 236.

⁵⁶ *Id.*

⁵⁷ See *Second MO&O*, 25 FCC Rcd 18661, 18697 (2010) at ¶ 87. An increase in the in-band measurement bandwidth to 6 MHz will result in a measured level that is 17.8 dB greater than the level measured in a 100 kHz bandwidth if the TV band device power is uniformly distributed across a channel. Therefore, required attenuation in the adjacent channel was changed from 55 dB to 72.8 dB (17.8 dB greater) to provide the same level of interference protection.

⁵⁸ See *Second MO&O*, 25 FCC Rcd 18661, 18697 (2010) at ¶ 87.

⁵⁹ See Motorola petition at 7.

⁶⁰ *Id.* at 4.

part of a 6 MHz channel will need to be used as a transition band to meet the required level of suppression at the channel edge.⁶¹ It states that a relaxed emission mask for fixed devices, coupled with a greater distance separation from adjacent channel TV stations, can provide equivalent protection to incumbent services. The Joint Petitioners state in their petition that they agree with the changes requested by Motorola.⁶² The Wi-Fi Alliance recommends that the Commission adopt a fixed adjacent channel emission limit of -25.8 dBm/100 kHz for devices with a transmitted power of 100 mW EIRP or less.⁶³ It argues that expensive and complex filtering must be added to devices to meet the out-of-band emission limits, although it does not quantify the claimed increase in equipment cost.

24. Google and PISC support the petitioners' request to modify the adjacent channel emission limits. Google contends that adjusting the out-of-band emission limits could speed deployment of white spaces products and services by making it easier for manufacturers to build products and bring them to market.⁶⁴ PISC agrees that the Commission should modify the emission mask for fixed TV bands devices, which it claims is overly restrictive.⁶⁵

25. Several parties argue that relaxation of the adjacent channel emission limits will result in interference to authorized services. NCTA states that the Commission should reject the petitions to relax the limits, arguing that the proposed higher limits are not sufficient to protect over-the-air reception.⁶⁶ Cellular South argues that the Commission should decline to relax the out-of-band emission mask for TV bands devices without ensuring protection for Lower Block A wireless systems (which occupy former TV channel 52).⁶⁷ NAB and Shure state that the requested relaxation of the limits would cause interference to TV reception and wireless microphones, and Shure further argues that increased separation distances from adjacent channel TV stations will not prevent interference to wireless microphones.⁶⁸ Motorola counters that the requested changes would not cause interference if separation distances are increased and that Shure grossly overstates the concern for interference to wireless microphones which can operate adjacent to TV stations, which operate at much higher power than fixed TVBDs.⁶⁹ The Joint Petitioners state that the Commission could increase the 1 km zone for wireless microphones, enlarge the protected area for cable headends, or retain the current out-of-band emission limit at channel 51.⁷⁰

26. NAB argues that claims that compliance with the emissions mask would be difficult and costly are undermined by Adaptrum's March 8, 2011 *ex parte* filing demonstrating that it can comply with the mask.⁷¹ It also argues that compliance with the emission mask is easier for fixed devices than portable devices because they have few physical restrictions regarding size and weight.⁷² NAB and Shure

⁶¹ Id. at 5.

⁶² See Joint Petitioners petition at 8.

⁶³ See Wi-Fi Alliance petition at 2 and 4. The Wi-Fi Alliance recommendation is for a fixed, rather than a relative, adjacent channel emission limit. It is 27 dB greater than the current limit for a 100 milliwatt device.

⁶⁴ See Google opposition at 6.

⁶⁵ See PISC opposition at 10.

⁶⁶ See NCTA opposition at 7.

⁶⁷ See Cellular South opposition at 4.

⁶⁸ See NAB opposition at 7, Shure opposition at 11 and Shure reply to oppositions at 3-4.

⁶⁹ See Motorola reply to oppositions at 5-6.

⁷⁰ See Joint Petitioners reply to oppositions at 7-8.

⁷¹ See NAB opposition at 5-6 and Adaptrum *ex parte* filing dated March 8, 2011.

⁷² See NAB opposition at 6.

also argue that the petitions to modify the adjacent channel emission limits are procedurally defective because the Commission already considered and rejected similar requests in the *Second MO&O*.⁷³ Motorola disagrees, arguing that the Commission is not required to dismiss a petition that requests changes that were previously considered and rejected.⁷⁴

27. Spectrum Bridge filed *ex parte* comments on November 14, 2011 recommending changes to the rules concerning the adjacent channel emission limits and the power spectral density (PSD) limits.⁷⁵ Specifically, it requested that we increase the maximum permissible spectral density for fixed devices from 12.2 dBm/100 kHz to 18.2 dBm/100 kHz and establish a single adjacent channel emission limit of -42.8 dBm for fixed devices. It stated that an increase in the PSD limit is necessary to allow for roll-off to meet the adjacent channel emission limits and that an adjacent channel emission limit that is independent of the device power would eliminate the situation where a decrease in the in-band power requires a decrease in the adjacent channel power to meet a relative emission limit. Spectrum Bridge also stated that the database could determine the appropriate separation distances from protected services if the Commission provides flexibility in the PSD and adjacent channel emission limits, although it did not clearly describe how this would be accomplished.

28. *Decision.* We are modifying the rules for adjacent channel emission limits to specify fixed values, rather than vary the limit relative to the in-band power. Specifically, we are adopting a fixed adjacent channel emission limit for each category of TV bands device that is equivalent to the current emission limit for devices operating at maximum power. Devices operating at less than the maximum permitted power will not be required to suppress emissions below the fixed limits we are establishing. This eliminates the need for a device operating at less than the maximum permitted power to unnecessarily suppress adjacent channel emissions below the levels needed to prevent interference to other services in the TV bands, thus simplifying equipment design and reducing its cost. A fixed emission limit also simplifies compliance measurements, because the emission level can be measured directly rather than by comparing the in-band and adjacent channel power measured in two different bandwidths.

29. We calculate the appropriate fixed adjacent channel emission limits as follows. The current adjacent channel emission limit is -72.8 dB in a 100 kHz bandwidth, measured relative to the total in-band power in a 6 MHz bandwidth.⁷⁶ We are defining a fixed adjacent channel emission limit for each of the four maximum power levels at which TV bands devices can operate (fixed: 1 Watt; personal/portable: 100 mW; personal/portable operating adjacent to occupied channels: 40 mW; and sensing-only devices: 50 mW). The adjacent channel emission limit for each category of device is simply the maximum power permitted in a 6 MHz bandwidth minus 72.8 dB. A table showing these limits is provided below.

30. We also are slightly increasing the maximum permissible PSD for each category of TV bands device to address the roll-off concern raised by Spectrum Bridge. We established the PSD limits to prevent multiple TV bands devices with transmit bandwidths of much less than 6 MHz from sharing a channel, which could result in a total transmitted power within a channel significantly greater than the

⁷³ See NAB opposition at 3 and Shure reply to oppositions at 2.

⁷⁴ See Motorola reply to oppositions at 4.

⁷⁵ See Spectrum Bridge *ex parte* comments dated November 14, 2011. Power spectral density is a measure of the transmitter power within a specified bandwidth, which is defined as 100 kHz for TV bands devices.

⁷⁶ The current adjacent channel emission limit is -72.8 dB relative to the in-band power in a 6 MHz bandwidth, which is equivalent to -55 dB relative to the maximum in-band power in a 100 kHz bandwidth, when adjusted to compensate for the difference between measurement bandwidths. The adjacent channel emissions are measured in a 100 kHz bandwidth.

limits for individual fixed or personal/portable devices.⁷⁷ These limits were derived using the assumption that the maximum permitted power of a TV bands device is spread uniformly across a 6 MHz channel. However, we recognize that this assumption makes compliance with either the current or the modified adjacent channel emission limits we are adopting impractical if a device operates at the maximum permissible power level. For a TV bands device to operate at the maximum permissible power, it must fill the entire 6 MHz channel, leaving no margin for a roll-off from the in-band signal to the much lower level it must meet in the adjacent channel. We are therefore increasing the PSD limit for each category of TV bands device by 0.4 dB, which will allow a TV bands device to operate at the maximum permissible power in a bandwidth of 5.5 MHz instead of 6 MHz. This will allow 250 kHz for a roll-off from the in-band signal to each adjacent channel. We are not adopting a 6 dB (4 times) increase in the PSD limit as Spectrum Bridge suggests, because that change would allow devices to operate at maximum power in a bandwidth of much less than 6 MHz, thus making it possible for multiple devices to share a channel with a total power greater than the limits currently allowed for an individual device.

31. The revised PSD and adjacent channel emission limits that we are adopting are as follows.

Type of TV bands device	Power limit (6 MHz)	PSD limit (100 kHz)	Adjacent channel limit (100 kHz)
Fixed	30 dBm (1 Watt)	12.6 dBm	-42.8 dBm
Personal/portable (adj. channel)	16 dBm (40 mW)	-1.4 dBm	-56.8 dBm
Sensing only	17 dBm (50 mW)	-0.4 dBm	-55.8 dBm
All other personal/portable	20 dBm (100 mW)	2.6 dBm	-52.8 dBm

32. In our review of the PSD and adjacent channel emission issues, we discovered some minor inconsistencies and omissions in the rules concerning the measurement of emissions and are correcting them herein. Specifically, Section 15.709(c) does not specify whether compliance with the adjacent channel emission limits is determined through radiated or conducted measurements. In addition, Section 15.709(a)(5) requires measurement of the power conducted from the TV bands device into the antenna to determine compliance with the PSD limits. However, this is not possible for personal/portable devices which are required to have a permanently attached antenna. This section also does not include a requirement that fixed device PSD must be reduced in the same manner as the maximum conducted output power when the transmit antenna gain exceeds 6 dBi.⁷⁸ Such a requirement is necessary to ensure that the PSD is proportionally reduced when the maximum output power is reduced to prevent a device from transmitting in a bandwidth of much less than 5.5 MHz at the maximum permissible power level. To correct these omissions and inconsistencies, we are revising Sections 15.709(a) and (c) to specify that the PSD and adjacent channel emission limits are conducted power limits for fixed devices and EIRP (radiated) limits for personal/portable devices. We are also requiring that the conducted PSD limit for fixed devices be reduced by one dB for each dB that the maximum directional gain of the transmit antenna exceeds 6 dBi. These rule clarifications will not result in any increased compliance costs for equipment manufacturers.

33. We decline to relax the out-of-band emission limit to the specific values requested by Motorola, the Joint Petitioners, and the Wi-Fi Alliance. As the Commission previously noted in the *Second MO&O*, adjacent channel emissions from a TV bands device appear as co-channel emissions in an

⁷⁷ See *Second MO&O*, 25 FCC Rcd 18661, 18695 (2010) at ¶ 82.

⁷⁸ See 47 C.F.R. § 15.709(a). This section requires a one dB power reduction for each dB that the maximum antenna gain exceeds 6 dBi.

adjacent channel used by a TV station or other authorized service, and interference can occur to TV reception at very low undesired co-channel signal levels.⁷⁹ The Commission also noted that personal/portable TV bands devices are permitted to operate within the protected contours of adjacent channel TV stations, and fixed TV bands devices can operate as close as 0.1 kilometers outside the contours of adjacent channel stations and at significantly higher power than personal/portable TV bands devices.⁸⁰ Thus, we find it appropriate to require TV bands devices to meet tighter adjacent channel emission limits than other equipment such as Wi-Fi devices that do not typically operate adjacent to services that receive interference at the same low level as the broadcast TV service. We note that the relaxation of the limit requested by the petitioners is approximately 25 dB (316 times the power), which would be a very significant increase in adjacent channel power over the maximum the rules currently permit and would have the potential to cause interference to adjacent channel users in the TV bands.

34. We find that increasing the minimum separation distances between TV bands devices and adjacent channel TV stations as a way to offset the increased interference potential would be effective only in protecting TV reception but not other services that operate in or adjacent to the TV bands. For example, registered wireless microphones and other low power auxiliary services authorized under Part 74 would be impacted by the increased noise that TV bands devices would place in adjacent channels. This increased noise also could limit the use of personal/portable TV bands devices operating adjacent to fixed TV bands devices, thereby impairing efficient use of spectrum. Increasing the 1 kilometer protection distance around registered wireless microphones would be ineffective because registration provides only co-channel and not adjacent channel protection from TV bands devices. Further, the increased adjacent channel emission levels could impact wireless services adjacent to the TV bands, such as those above channel 51 (the subject of another petition discussed in detail below), land mobile radio services on frequencies below channels 7 and 14, and the Low Power Radio Service above channel 13.

35. For the reasons stated above, we decline to relax the adjacent channel emission limits to prevent interference to authorized services in and adjacent to the TV bands. We conclude that our decision on this issue promotes more efficient use of the TV spectrum by both licensed and unlicensed devices. We recognize the petitioners' argument that tighter emission limits could result in higher equipment costs. We find, however, that the record in this proceeding indicates that at least one equipment manufacturer, Adaptrum, is capable of building a prototype device that complies with the limits adopted in the *Second MO&O*.⁸¹ In addition, another manufacturer, Koos Technical Services, Inc., developed a device that complies with all the requirements for fixed TV bands devices, including the adjacent channel emission limits, and became the first party to obtain certification for a TV bands device.⁸² Further, tighter out-of-band emission limits can allow users to operate in adjacent frequency bands with less geographic separation between them, thus enabling more efficient and intensive use of spectrum. Thus, we conclude that the benefits of tighter out-of-band emission limits outweigh any increase in equipment cost that may be necessary to comply with these rules.

C. Protection of wireless services on channel 52

36. Prior to the June 12, 2009 digital television transition, full-service TV stations were permitted to operate on channels 52-69 (698 MHz to 806 MHz, also referred to as the 700 MHz band). The Commission reallocated these channels for services other than broadcast television. Under the band

⁷⁹ See *Second MO&O*, 25 FCC Rcd 18661, 18697 (2010) at ¶ 88.

⁸⁰ *Id.*

⁸¹ See Adaptrum *ex parte* dated March 8, 2011.

⁸² See Grant of Equipment Authorization for Koos Technical Services, Inc., FCC identification ZBGAWR-1, granted December 22, 2011. The Commission's equipment authorization database can be accessed at <http://www.fcc.gov/eas>.

plan that the Commission adopted, there are two channel groupings: 1) the lower 700 MHz band, consisting of channels 52-59, and 2) the upper 700 MHz band, consisting of channels 60-69.⁸³ The lower 700 MHz band is divided into five blocks designated A through E, and the upper 700 MHz band is divided into four blocks designated A through D, with two additional bands allocated for public safety use. Block A in the lower 700 MHz band, which is the subject of Cellular South's petition for reconsideration in this proceeding, consists of TV channel 52 paired with TV channel 57. This pairing of channels with a 30 MHz frequency separation between them is designed to allow the use of these channels for two-way wireless operations. Fixed base stations will transmit to mobile devices using channel 57, while mobile devices will transmit to base stations using channel 52. Therefore, base stations will incorporate receivers that receive signals from mobile devices on channel 52. The lower 700 MHz Block A was licensed through Commission Auction 73 in 2008.⁸⁴ Cellular South is one of the entities that obtained licenses for Block A through this auction. It did not previously participate in this proceeding.

37. Prospective bidders were made aware prior to Auction 73 that there would continue to be full-service and low power television stations on channel 51 after the auction. The Public Notice describing this auction's procedures cautioned potential bidders about Commission rules and requirements that place limits on the ability of 700 MHz band licensees to use this spectrum.⁸⁵ The Public Notice specifically pointed to Section 27.60 of the rules that requires wireless licensees to protect co-channel and adjacent channel TV stations, including stations on channel 51.⁸⁶ Thus, prospective bidders for Block A were given notice that there would be TV stations on adjacent channel 51, and the emission levels that a TV station may place in an adjacent channel are clearly specified in the Commission's rules.⁸⁷ These limits permit TV stations to place significantly higher power in an adjacent channel than Part 15 TV bands devices.⁸⁸

38. CTIA – the Wireless Association and the Rural Cellular Association filed a petition for rule making and a licensing freeze on March 15, 2011, requesting that the Commission take action to prevent further interference to Block A licensees.⁸⁹ To permit the Commission to evaluate the matters raised in the petition, the Media Bureau placed a freeze on the filing of new applications and most

⁸³ See <http://wireless.fcc.gov/auctions/data/bandplans/700MHzBandPlan.pdf>.

⁸⁴ See http://wireless.fcc.gov/auctions/default.htm?job=auction_summary&id=73.

⁸⁵ See *Auction of 700 MHz Band Licenses Scheduled for January 24, 2008*, DA 07-4171, 22 FCC Rcd 18141, 18155 (2007) at ¶ 39.

⁸⁶ *Id.*

⁸⁷ See 47 C.F.R. § 73.622(h).

⁸⁸ Section 73.622(h) requires attenuation of TV station emissions in the adjacent channel ranging from 47 dB in the 500 kHz segment closest to the TV station channel to 110 dB at the edge of the adjacent channel furthest from the TV station channel. These emissions are measured in a 500 kHz bandwidth and compared to the average transmitted power in the 6 MHz TV channel. Digital TV stations may operate at hundreds of kilowatts effective radiated power (ERP) on channel 51 as compared to fixed TV bands devices that can operate with a maximum of 2.4 watts ERP. Also, TV stations have a less stringent adjacent channel emission suppression requirement than TV bands devices over part of the adjacent channel. Thus, a TV station on channel 51 could produce emissions on channel 52 that are over a million times (60 dB) greater than those from a TV bands device on channel 51.

⁸⁹ See *Petition for Rulemaking and Request for Licensing Freezes by CTIA –the Wireless Association and Rural Cellular Association*, filed March 15, 2011, RM-11626.

applications for minor changes to low power and full power television stations on channel 51.⁹⁰ The Commission took that action to preserve the status quo and to ensure that new applications are not filed in anticipation of the future limitations proposed in the petition. It has not yet taken any other action with respect to this petition.

39. *Petitions and Comments.* Cellular South argues in its petition that the Commission should modify the TV bands device rules to provide additional protection for wireless services operating adjacent to TV channel 51 in the lower 700 MHz Block A, *i.e.*, on channel 52. Specifically, it argues that the Commission should: 1) prohibit all fixed TV bands device operation on TV channel 51, 2) limit the power of personal/portable TV bands devices on channel 51 to 40 milliwatts, 3) permit the registration of lower 700 MHz Block A base stations in the TV bands database and require a minimum separation distance of 0.1 kilometers between personal/portable devices and Block A base stations.⁹¹ Cellular South states that these steps will provide lower 700 MHz Block A wireless systems with protection equivalent to that granted to other TV band incumbents.

40. Cellular South argues that it could not have previously participated in this proceeding because at the time the *Second Report and Order* was released, equipment for the lower 700 MHz spectrum was not available, so it was impossible to know whether interference from TV bands devices would be likely to occur.⁹² It claims that the facts presented in its petition were unknown to it prior to the time for filing petitions for reconsideration of the *Second Report and Order* and that these facts could not have been discovered with the exercise of due diligence. Cellular South requests that the Commission consider its petition for reconsideration despite not having previously participating in this proceeding. It argues that the facts presented in its petition raise substantial public interest concerns because they relate to the potential for destructive interference to operations in the lower 700 MHz Block A from TV bands devices. Cellular South claims that due to these public interest concerns, the Commission is obligated to consider its petition without regard to whether the facts in them could have been presented on reconsideration of the *Second Report and Order*.

41. The Wi-Fi Alliance, Motorola, and WISPA support allowing the registration of lower 700 MHz Block A base stations in the TV bands database and establishing protection criteria to prevent interference to these stations.⁹³ However, these parties oppose Cellular South's request for a blanket prohibition on fixed devices operating on channel 51.

42. PISC argues that the Commission should reject Cellular South's request to limit the use of channel 51 as untimely and overly restrictive.⁹⁴ It states that Cellular South was aware when it purchased its licenses in 2008 that it had no protection from interference from users operating on adjacent channel 51 and for that reason paid a lower price for its spectrum.⁹⁵ PISC argues that Cellular South could have participated previously in the TV white spaces proceeding but failed to do so.⁹⁶ It states that if

⁹⁰ See *General Freeze on the Filing and Processing of Applications for Channel 51 Effective Immediately and Sixty (60) day Amendment Window for Pending Channel 51 Low Power Television, TV Translator and Class A Applications*, DA 11-1428, 26 FCC Rcd 11409 (2011).

⁹¹ See Cellular South petition at 3 and appendix at 7.

⁹² See Cellular South petition at 5.

⁹³ See Wi-Fi Alliance opposition at 4, Motorola opposition at 6, and WISPA opposition at 2. Motorola states that a two kilometer protection zone around each registered base station would provide adequate interference protection from fixed TV bands devices. See Motorola opposition at 6.

⁹⁴ See PISC opposition at 6.

⁹⁵ *Id.* at 7.

⁹⁶ *Id.* at 8.

the Commission decides to adopt interference protection rules for lower 700 MHz Block A base stations, it could require a well-defined exclusion zone around registered stations rather than nationwide restrictions.⁹⁷

43. Cellular South disagrees with parties that argue that fixed TV bands devices should be permitted to operate on channel 51. It states that commenting parties all agree that lower 700 MHz Block A licensees would suffer interference without additional protection and support including base stations in the database.⁹⁸ Cellular South argues that providing protection to lower 700 MHz Block A licensees that is equivalent to TV station protection requires prohibiting operation by fixed devices on channel 51, which is an adjacent channel to the lower 700 MHz band Block A.⁹⁹ It states that lower Block A systems will be built throughout the United States and that their aggregate protected service contours will cover the entire country.¹⁰⁰ Cellular South argues that the protection distance from lower 700 MHz Block A licensees should be at least 51 km, which is the same separation required from PLMRS systems authorized under waivers. It states that once lower 700 MHz Block A systems are built out, there are likely to be few locations more than 51 km from base stations.¹⁰¹

44. *Decision.* We decline to establish in this docket new requirements to protect wireless operations on channel 52. As an initial matter, we note that Cellular South's petition on this issue is not timely filed. The Commission adopted rules permitting TV band devices to operate on Channel 51 in its 2008 *Second Report and Order*.¹⁰² Pursuant to Section 1.429(d) of the Commission's rules,¹⁰³ the deadline for seeking reconsideration of that decision was 30 days after the summary of the *Second Report and Order* was published in the Federal Register. Cellular South filed its petition in January 2011, more than two years after the applicable due date.

45. As an independent and alternative basis, we dismiss Cellular South's petition on this issue pursuant to Section 1.429(b) of the Commission's rules, which precludes parties from relying on facts in petitions for reconsideration that were not presented to the Commission previously, unless those facts have changed or the party could not have known about those facts when it had an opportunity to comment.¹⁰⁴ No party raised the issue of protection criteria for services on channel 52 in response the *Notice* or *Further Notice* in this proceeding or at any time prior to Cellular South's petition for reconsideration. We are not persuaded that Cellular South could not previously participate in this proceeding. It purchased its licenses at auction in 2008, several months before the adoption of the *Second Report and Order*, and over two years before the adoption of the *Second MO&O*. Cellular South therefore had ample opportunity to make any concerns about potential interference from TV bands devices to wireless services in the lower 700 MHz Block A known to the Commission but failed to do so. While we recognize its argument that the final technical specifications for 700 MHz band equipment were not available until more recently, we do not find that a convincing explanation for not participating in the proceeding. If the precise technical parameters needed to perform an interference analysis are not known (*e.g.*, receiver bandwidth, noise floor, noise figure, antenna gain, and desired-to-undesired signal ratio),

⁹⁷ *Id.* at 8-9.

⁹⁸ See Cellular South reply to oppositions at 2.

⁹⁹ *Id.* at 4.

¹⁰⁰ *Id.* at 4.

¹⁰¹ *Id.* at 6.

¹⁰² *Second Report and Order*, 23 FCC Rcd at 16859 (para. 148).

¹⁰³ 47 C.F.R. § 1.429(d).

¹⁰⁴ 47 C.F.R. §§ 1.429(b)(1) and (2).

parties can make reasonable estimates of these parameters. Cellular South, however, did not provide any analysis or even express to the Commission any general concerns about possible interference prior to filing its petition for reconsideration.

46. As another independent and alternative basis for dismissing the petition on this issue, we reach the merits and rule against Cellular South. We find that there is no need to adopt new requirements as Cellular South requests because the current rules appropriately protect wireless operations on channel 52. The emission levels that a TV bands device may place in an adjacent channel are far below the levels that a full-service TV station on channel 51 may place in adjacent channel 52. Specifically, emissions from TV bands devices in the adjacent channel must be at least 72.8 dB below the level in the 6 MHz channel where the TV bands device operates. As discussed above, we are modifying the rules to specify maximum adjacent channel emission levels that provide this level of adjacent channel protection. For a personal/portable TV bands device operating on channel 51 at the maximum allowable power of 100 milliwatts EIRP, the maximum radiated emission in the adjacent channel would be -52.8 dBm EIRP or 132 microvolts per meter at a distance of three meters. This is below the Section 15.209 out-of-band emission limit of 200 microvolts per meter at three meters that applies to most Part 15 transmitters in this frequency band. In the case of fixed TV bands devices operating on channel 51 at the maximum EIRP of 4 watts, the maximum permitted emission in the adjacent channel is -36.8 dBm EIRP or 835 microvolts per meter at three meters.¹⁰⁵ While this is greater than the Section 15.209 limit, we note that this limit was developed with the assumption that there would be a 10 meter separation between a potentially interfering device and the device being protected.¹⁰⁶ We expect that there would typically be a much greater separation distance between a TV bands device and a wireless base station receiving channel 52, thus significantly reducing the signal level at the receiver and the likelihood of interference.¹⁰⁷ Thus, we find that there is a very low probability that TV bands devices on channel 51 will cause harmful interference to wireless services in the adjacent band. Because we are not adopting here protection criteria between TV bands devices and Block A stations, we see no reason to include 700 MHz Block A base stations in the TV bands databases.

47. While the Part 15 rules are designed to minimize the likelihood of interference to authorized services, there is always the possibility that interference may occur in certain situations. Therefore TV bands devices, like all other Part 15 devices, operate on a non-interference basis, meaning that in the event a device causes interference to an authorized service, the device must cease operation.¹⁰⁸ Because fixed TV bands devices must be registered in the TV bands database, if a licensee of a wireless system were to receive interference, it could check the database to find information on the interfering device. Also, as the Commission stated in the *Second Report and Order*, we intend to closely oversee the development and introduction of TV bands devices and take whatever actions may be necessary to correct any interference that may occur and will consider any rule changes that might be needed to better protect against harmful interference to incumbent services.¹⁰⁹ Because TV bands devices operate under the control of a database that provides a list of available channels to the TV bands devices, in the event of harmful interference the Commission could take steps such as requesting the database operators to limit

¹⁰⁵ For a fixed device, the maximum radiated power in the adjacent channel would be -42.8 dBm (conducted into the antenna) plus 6 dB for the antenna gain, producing an EIRP of -36.8 dBm.

¹⁰⁶ See *First Report and Order* in Docket 20780, 46 RR2d 473 (1979) at Appendix C.

¹⁰⁷ We also note that fixed devices and personal portable devices with power levels greater than 40 mW may operate on channel 51 only in locations where no TV station operates on adjacent channel 50, thus reducing the number of locations where higher power TV bands devices could operate in close proximity to Block A base stations.

¹⁰⁸ See 47 C.F.R. § 15.5.

¹⁰⁹ See *Second Report and Order*, 23 FCC Rcd 16807, 16808 (2008) at ¶ 1.

the use of certain TV channels in an area. Thus, we find no need to adopt new protection requirements for wireless services on channel 52 at this time.

D. New class of TV bands devices

48. As discussed above, the rules that the Commission adopted in the *Second Report and Order* allow for two classes of TV bands devices – fixed and personal/portable.¹¹⁰ Fixed devices may operate at power levels up to 4 watts EIRP and must either incorporate a geo-location capability such as GPS or be professionally installed and have the devices' geographic coordinates manually entered by the installer.¹¹¹ Personal/portable devices may operate with a power level up to 100 mW EIRP. Mode II personal/portable devices must incorporate a geo-location capability such as GPS to determine the geographic coordinates to within +/- 50 meters.¹¹² Both fixed and Mode II portable devices must access a database that provides a list of available channels at the devices' location.¹¹³ A Mode II portable device must re-check its location and the database for available channels if it changes location during operation.¹¹⁴ Mode I devices are not required to incorporate geo-location or database access capabilities, and they obtain a list of available channels on which they can operate from either a fixed or Mode II device that accesses a database.¹¹⁵ A portable device can operate in Mode II at locations where it can receive a geo-location signal, and in Mode I at locations where it cannot. Fixed devices may operate only on vacant TV channels that are not adjacent to occupied TV channels, while personal/portable devices may operate adjacent to occupied TV channels if their maximum EIRP is reduced to no more than 40 milliwatts.¹¹⁶

49. In the *Second MO&O*, the Commission decided that a Mode II device must use its geo-location capability to check its location at least once every 60 seconds while in operation to determine whether it has moved.¹¹⁷ In addition, the Commission required that a Mode II device check the database when it moves more than 100 meters from the location where it performed its last database check.¹¹⁸

50. *Petitions and Comments.* The Wi-Fi Alliance argues that a significant class of mass market Mode II personal/portable devices will be precluded because they are stationary and operate indoors and will be unable to reliably determine their geographic coordinates to within the limits specified in the rules.¹¹⁹ It requests that the Commission modify the rules to allow a new class of indoor fixed devices that operate at the same power level as Mode II personal/portable devices and that are permitted to operate adjacent to occupied TV channels.¹²⁰ The Wi-Fi Alliance does not specifically address whether this new class of device would need to incorporate geo-location capability. However, because it requests that they be classified as fixed devices, the current rules would permit manufacturers the option of specifying professional installation in place of incorporating a geo-location technology such as GPS.

¹¹⁰ See 47 C.F.R. § 15.703(c) and (i).

¹¹¹ See 47 C.F.R. §§ 15.709(a)(1) and 15.711(b)(1).

¹¹² See 47 C.F.R. §§ 15.709(a)(2) and 15.711(b)(2).

¹¹³ See 47 C.F.R. § 15.711(b)(3).

¹¹⁴ See 47 C.F.R. § 15.711(b)(3)(ii).

¹¹⁵ See 47 C.F.R. § 15.703(e).

¹¹⁶ See 47 C.F.R. § 15.712(a)(2).

¹¹⁷ See *Second MO&O*, 25 FCC Rcd 18661, 18687 (2010) at ¶ 59.

¹¹⁸ See *Second MO&O*, 25 FCC Rcd 18661, 18708 (2010) at ¶ 113.

¹¹⁹ See Wi-Fi Alliance petition at 2.

¹²⁰ See Wi-Fi Alliance petition at 4.

51. NAB, Shure, and NCTA oppose the Wi-Fi Alliance's petition. NAB argues that the intent of the Wi-Fi Alliance's request is to circumvent the requirement that low power devices used at fixed locations include a geo-location capability.¹²¹ Shure argues that a new class of indoor fixed devices will cause interference to wireless microphones on adjacent channels and that the devices the Wi-Fi Alliance describes should be classified as portable devices and meet the portable device requirements.¹²² NCTA believes that the Wi-Fi Alliance is attempting to circumvent the rules for portable devices by placing its proposed new class of devices under the fixed device rules.¹²³

52. *Decision.* We decline to establish a new class of fixed indoor devices as requested by the Wi-Fi Alliance.¹²⁴ The Wi-Fi Alliance states that the devices of interest would be mass market Mode II personal/portable devices, thus indicating to us that they would be small and easily transportable.¹²⁵ We find that such devices would have a high potential for causing interference to authorized services in the TV bands if they did not incorporate a geo-location capability to accurately determine their location. The devices could easily be moved to a different location without updating the coordinates, where they would then receive an inaccurate list of available channels.¹²⁶ In the absence of a geo-location capability, the coordinates would have to be manually entered into a device. In the case of mass market consumer devices, we would not consider the consumer to be a professional installer.¹²⁷ We expect that many consumers would lack knowledge or experience in determining and entering a device's coordinates and therefore would be likely to make more errors than a professional installer or, alternately, would be more likely to enter an improper set of coordinates. While we are denying the Wi-Fi Alliance's request to create a new category of TV bands device, as we noted above the current rules do in fact contain provisions that allow TV bands devices to operate without GPS under certain circumstances. Specifically, a personal/portable device can operate without GPS in Mode I if it communicates with either a fixed device or a Mode II personal/portable device that provides it with a list of available channels on which it can operate.

E. Confidentiality of database information

53. In the *Second MO&O*, the Commission decided that all information that is required by the Commission's rules to be in a TV bands database is to be publicly available, including fixed TV bands device registration and voluntarily submitted protected entity information, such as cable headends.¹²⁸ The Commission noted that the registration of a protected entity in the database will preclude operation of TV bands devices on one or more channels over specific areas and that there is the possibility of errors in the

¹²¹ See NAB opposition at 8.

¹²² See Shure reply to oppositions at 6-7.

¹²³ See NCTA opposition at 3.

¹²⁴ NAB argues that the request to establish a new class of TV bands device is untimely because the requirement to include a geo-location capability in fixed and Mode II personal/portable devices was adopted in the 2008 *Second Report and Order*. Because we are denying this request, we will not address NAB's argument concerning its timeliness.

¹²⁵ See Wi-Fi Alliance petition at 2.

¹²⁶ Unlike Mode II personal/portable devices, fixed devices are not required to re-establish their coordinates each time they are powered up. However, an operator would have to re-establish the location of (and update the database registration for) a fixed device if it is moved to another location or if its stored coordinates are altered. See 47 C.F.R. § 15.711(b)(1).

¹²⁷ See *Second MO&O*, 25 FCC Rcd 18661, 18723 (2010) at ¶ 150.

¹²⁸ See *Second MO&O*, 25 FCC Rcd 18661, 18710 (2010) at ¶ 119.

registration information.¹²⁹ It further noted that while much of the data will come from Commission databases that already are public sources, errors could result from the inadvertent entry of incorrect data or as a result of a party deliberately entering false data.¹³⁰ The Commission therefore found that it is appropriate to permit public examination of protected entity registration information to allow the detection and correction of errors.¹³¹

54. *Petitions and Replies.* NCTA requests that the Commission reconsider its decision to make all information in the TV bands database publicly available and in particular information identifying the precise geographic coordinates of cable headends and tower receive sites.¹³² It argues that a lack of security measures to protect this information could endanger critical infrastructure for broadband Internet, VOIP, emergency alert messaging, and other critical communications services. NCTA further argues that directives from the Department of Homeland Security require greater protections for critical communications infrastructure and that the Commission should require databases to incorporate measures to limit access to registered device manufacturers and operators of broadcasting and communications businesses.¹³³ NCTA believes that devices that receive TV bands database information should receive only the list of channels available for use and that adequate security measures must be incorporated to ensure that sensitive database information cannot be accessed through displays, device ports, or unprotected interfaces.

55. PISC opposes NCTA's petition, arguing that NCTA does not suggest any credible reason why cable headends are likely targets for terrorists and saboteurs.¹³⁴ It argues that NCTA's request is overly broad and would limit access to information in databases to a handful of TV band incumbents and private companies.¹³⁵ PISC further argues that cable headend information is already publicly available in cable companies' public inspection files and that public access to information in the TV bands database is necessary for data that serves as "licensing information" to allow protected entities to reserve TV band channels and preclude TV bands device access.¹³⁶ NCTA disagrees with PISC, arguing that cable headends are considered "critical infrastructure" by the Federal Government.¹³⁷ It states that while information on cable headends is already publicly available, the TV bands database would be the first comprehensive repository of headend and tower site information in an easily accessible public database.¹³⁸ NCTA states that its petition is not a pretext for limiting access to all information in a database and that registered device manufacturers and operators of broadcasting and communications businesses should be permitted to view information on cable headends in the database.¹³⁹ Google agrees that some information in the database may be sensitive in nature and require protection from public disclosure, although it does not provide any specific examples.¹⁴⁰ However, Google does not agree that

¹²⁹ *Id.*

¹³⁰ *Id.*

¹³¹ *Id.*

¹³² See NCTA petition at 2.

¹³³ *Id.* at 4, 7.

¹³⁴ See PISC opposition at 2.

¹³⁵ *Id.* at 3.

¹³⁶ *Id.* at 4-5.

¹³⁷ See NCTA reply to oppositions at 2.

¹³⁸ *Id.* at 3.

¹³⁹ *Id.* at 3.

¹⁴⁰ See Google opposition at 5.

the Commission should limit information exchanged between a database and TV bands device to a list of available channels because that could inhibit innovation such as the creation of value-added services.¹⁴¹ The Wi-Fi Alliance recommends that the Commission restrict access for viewing the locations of critical communications infrastructure in the database to certain authorized users.¹⁴²

56. *Decision.* We decline to require that the geographic coordinates or other information concerning cable headends in the TV bands database be kept confidential. First, we note that NCTA previously participated in this proceeding but never alleged prior to filing its petition that there is any need to keep information on cable headends confidential. The issue of public availability of database information was raised in the petitions for reconsideration of the *Second Report and Order* in this proceeding, and NCTA raised no concerns about the confidentiality of headend registrations in its response to these petitions.¹⁴³ In any case, we are not persuaded that making information about cable headends publicly available poses a security threat to communications infrastructure. Based on the documents referenced in NCTA's petition, virtually all communications facilities, including wireline, wireless, satellite, cable, and broadcasting facilities, could be classified as critical infrastructure.¹⁴⁴ Information on a large number of these communications facilities is already publicly available through the Commission's databases, and there is no evidence that the public availability of this information has ever posed a threat to the security of communications infrastructure.¹⁴⁵ Also, as NCTA and PISC note, information on the locations of cable headends is already publicly available from other sources, and the TV bands databases will only list those facilities that are outside the protected contours of the over-the-air TV stations being received and that the headend operator chooses to register.¹⁴⁶

57. While we are upholding the Commission's previous decision to make all information in the TV bands database publicly available, we note that the *Second MO&O* did not include specific text to codify this decision. We are therefore adding a new paragraph to Section 15.715 of the rules to specify that database administrators must provide a means to allow public access to the information in the database. Such access will be limited to the information that is required by the rules to be included in the databases and will not include any additional information that the database administrators may choose to collect. OET will advise the database administrators as necessary to implement this requirement. Codifying this rule does not impose any new costs or other burdens on database administrators because they were already required to provide the capability described.

¹⁴¹ *Id.*

¹⁴² See Wi-Fi Alliance opposition at 4.

¹⁴³ In its petition for reconsideration of the *Second Report and Order*, PISC requested that the Commission make all information in the TV bands database publicly available. See PISC petition for reconsideration of the *Second Report and Order* at 14. NCTA also filed a petition for reconsideration of the *Second Report and Order* and filed comments in response to other petitions, but it raised no objections to PISC's request to make TV bands database information publicly available.

¹⁴⁴ See NCTA reply to oppositions at 2. In footnote 5, NCTA cites page 12 of the U.S. Department of Homeland Security's *Communications Sector-Specific Plan* to argue that cable headends are classified as critical infrastructure. This document lists all communications sectors, including the wireline, wireless, satellite, cable, and broadcasting sectors.

¹⁴⁵ For example, information on broadcast facilities is publicly available through the Commission's Consolidated Database System (CDBS), and information on satellite and wireless services is publicly available through the Commission's Universal Licensing System (ULS).

¹⁴⁶ Headends that are more than 80 km outside the protected contour of the TV station being received may be registered only if the Commission grants a waiver of the 80 km distance limit in Section 15.712(b) of the rules.

F. Other Matters

58. As discussed above, OET designated ten parties as TV bands database administrators¹⁴⁷ and requires them to attend workshops conducted by Commission staff.¹⁴⁸ During the course of these workshops, the database administrators have noted that some rules require Commission interpretation and guidance to ensure that they are implemented consistently across all TV White Space databases. OET staff has provided guidance on how certain rules as written should be implemented by the database administrators. Information regarding these discussions, including any rule interpretations provided to the database administrators at these workshops, is posted on the Commission's web site at <http://www.fcc.gov/encyclopedia/white-space-database-administration>. In two cases, discussed below, we conclude that the rules should be modified to clearly state the requirements for protecting these services.

1. TV translator, low power TV and Class A TV station receive sites

59. The rules require that TV bands databases contain information on the location of receive sites for TV translator, low power TV, and Class A TV stations (collectively low power stations) and the channels of TV signals received for retransmission at such sites.¹⁴⁹ Our Consolidated Data Base System (CDBS) has the ability to store receive site information for low power stations, but the receive site information currently contained in the CDBS is incomplete or inaccurate and therefore not always reliable. For this reason, the Commission adopted rules that require low power stations to register their receive sites with the TV bands database administrators to obtain protection. Subsequent to the adoption of these rules, we have become concerned that if we were to allow parties to register receive site information both in the TV bands database and the CDBS, there could be conflicts in the data between the CDBS and the database registrations due to data entry errors or updates to the information in one database but not the other. We therefore find it is necessary to provide for a single registry for low power station receive site information, and that registry is to be the CDBS. The Commission's staff has constructed a webpage interface that will allow licensees of low power stations to easily provide us with their correct receive channel information. The information collected through this webpage interface will be used to update the CDBS. The Commission will issue a public notice when the interface is available to the public and will provide instructions on how to access it.

60. In view of our decision to acquire and maintain all low power station receive site data by means of the new receive site update facility and the CDBS system, we no longer find it necessary to require database administrators to provide a separate registration process for this information. In addition to relieving the database operators of a significant burden, this change will make the low power station receive site data in the CDBS more reliable and also avoid data conflicts between the CDBS and the database registration records. Accordingly, we are modifying Section 15.713(b)(2) of the rules to remove receive sites of TV translator, low power TV, and Class A TV stations from the list of facilities that are not contained in Commission databases and placing them in Section 15.713(b)(1) in the list of facilities that are contained in Commission databases. We are also modifying Section 15.715(c) to remove TV translator receive sites as an example of facilities not contained in Commission databases. These rule changes are procedural in nature in that we are changing the manner in which low power TV receive site information is collected and placed in the TV bands databases, but not the protection afforded to receive

¹⁴⁷ See *supra* footnote 12.

¹⁴⁸ The Chief of the OET has delegated authority to develop specific methods that will be used to designate TV bands database managers, to designate these database managers; to develop procedures that these database managers will use to ensure compliance with the requirements for database operations; to make determinations regarding the continued acceptability of individual database managers; and to perform other functions as needed for the administration of the TV bands databases. See 47 C.F.R. § 0.241(h).

¹⁴⁹ See 47 C.F.R. § 15.713(b)(2).

sites. Thus, these changes do not require prior notice under the Administrative Procedure Act (APA).¹⁵⁰

2. Protection of radio astronomy

61. Section 15.712(h) of the rules prohibits the operation of TV bands devices within 2.4 kilometers of certain radio astronomy and other receive sites to prevent interference to operations at those locations. This rule section specifies the geographic coordinates of receive sites that were provided to the Commission by the National Telecommunications and Information Administration (NTIA) in 2005. NTIA recently discovered inaccuracies in the coordinates for several radio astronomy receive sites and filed a request with the Commission to correct these inaccuracies.¹⁵¹ In particular, it provided corrected coordinates for the Arecibo Observatory in Puerto Rico and the Table Mountain receive site in Colorado. NTIA also requested that we modify the receive site coordinates listed in Section 15.712(h) to match those in footnote US388 to the Table Of Frequency Allocations in Section 2.106 of the rules because it determined that the coordinates in that footnote are correct.¹⁵² We find that NTIA's requested changes to this section will ensure that radio astronomy and other receive sites are protected against interference from TV bands devices and are therefore updating the rules to reflect the correct coordinates. In addition, we note that Section 15.712(h)(1) lists the Naval Radio Research Observatory in Sugar Grove, West Virginia as a protected site but does not specify its geographic coordinates. We are therefore revising this section to add the coordinates of that observatory. These rule revisions do not require TV bands devices to protect any additional radio astronomy sites or increase the size of the protected zones around them; they merely provide more precise geographic coordinates for the sites that TV bands devices were already required to protect. We find that these changes are insignificant in nature and impact, and inconsequential to the industry and the public. Thus, these rule changes do not require prior notice under the APA.¹⁵³

IV. PROCEDURAL MATTERS

A. Final Regulatory Flexibility Analysis

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

B. Final Paperwork Reduction Act of 1995 Analysis

63. This document contains modified information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It will be submitted to the Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA. OMB, the general public, and other Federal agencies are invited to comment on the new or modified information collection requirements contained in this proceeding. In addition, we note that pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. 3506(c)(4), we previously sought specific comment on how the Commission might further reduce the information collection burden for

¹⁵⁰ *See* 5 U.S.C. § 553(b)(A), which provides an exception to the notice requirement for rules of agency procedure. The “critical feature” of the procedural exception “is that it covers agency actions that do not themselves alter the rights or interests of parties, although it may alter the manner in which the parties present themselves or their viewpoints to the agency.” *JEM Broadcasting v. FCC*, 22 F.3d 320, 327 (1994), *quoting Batterton v. Marshall*, 648 F.2d 694, 707 (D.C.Cir.1980); *citing American Hosp. Ass'n v. Bowen*, 834 F.2d 1037, 1047 (D.C.Cir.1987); *Neighborhood TV Co. v. FCC*, 742 F.2d 629, 637 (D.C.Cir.1984).

¹⁵¹ *See* NTIA letter dated September 2, 2011 to the Chief, Office of Engineering and Technology.

¹⁵² *See* 47 C.F.R. § 2.106, footnote US388.

¹⁵³ *See* 5 U.S.C. § 553(b)(B). This exception to the notice requirement is “confined to those situations in which the administrative rule is a routine determination, insignificant in nature and impact, and inconsequential to the industry and to the public.” *Utility Solid Waste Activities Group v. EPA*, 236 F.3d 749, 755 (D.C. Cir., 2001) (*Solid Waste*), *citing Texaco v. FPC*, 412 F.2d 740, 743 (3rd Cir., 1969).

small business concerns with fewer than 25 employees.

C. Contact Persons

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

V. ORDERING CLAUSES

65. Accordingly, IT IS ORDERED that, pursuant to the authority contained in Sections 4(i), 302, 303(e), 303(f), and 307 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 302, 303(c), 303(f), and 307 this Third Memorandum Opinion and Order IS HEREBY ADOPTED.

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

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

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

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A
Parties Filing Petitions

Petitions for Reconsideration

1. Cellular South, Inc.
2. Motorola Solutions, Inc.
3. National Cable and Telecommunications Association
4. Wi-Fi Alliance
5. Wireless Internet Service Providers Association, Federation of Internet Solution Providers of the Americas, Native American Broadband Association, Spectrum Bridge, Inc., Comsearch, Carlson Wireless Technologies Inc. and Wireless Strategies, Inc.

Oppositions to Petitions for Reconsideration

1. Association for Maximum Service Television and National Association of Broadcasters
2. Cellular South
3. Google, Inc.
4. Motorola Solutions, Inc.
5. National Cable & Telecommunication Association
6. Public Interest Spectrum Coalition
7. Shure Incorporated
8. Stratus Wave Communications
9. Telcordia Technologies
10. Wi-Fi Alliance
11. Wireless Internet Service Providers Association

Replies to Oppositions to Petitions for Reconsideration

1. Cellular South
2. Motorola Solutions, Inc.
3. Shure Incorporated
4. Wireless Communications Association International
5. Wireless Internet Service Providers Association, Federation of Internet Solutions Providers of the Americas, Native American Broadband Association, Spectrum Bridge Inc., Comsearch and Carlson Wireless Technologies Inc.

APPENDIX B

Final Rules

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

PART 15 RADIO FREQUENCY DEVICES

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

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

§ 15.709 General technical requirements.

(a) * * *

(5) The power spectral density from the TVBD shall not be greater than the following values when measured in any 100 kHz band during any time interval of continuous transmission.

(i) Fixed devices: 12.6 dBm conducted power. If transmitting antennas of directional gain greater than 6 dBi are used, this conducted power level shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Personal/portable device operating adjacent to occupied TV channels: -1.4 dBm EIRP.

(iii) Sensing-only devices: -0.4 dBm EIRP.

(iv) All other personal/portable devices: 2.6 dBm EIRP.

* * * * *

(b) * * *

(2) The transmit antenna used with fixed devices may not be more than 30 meters above the ground. In addition, fixed devices may not be located at sites where the antenna height above average terrain is more than 250 meters. The HAAT is to be calculated by the TV bands database that the device contacts for available channels using computational software employing the methodology in §73.684(d) of this chapter.

* * * * *

(c) * * *

(1) In the television channels immediately adjacent to the channel in which the TVBD is operating, emissions from the TVBD shall not exceed the following levels.

(i) Fixed devices: -42.8 dBm conducted power.

(ii) Personal/portable device operating adjacent to occupied TV channels: -56.8 dBm EIRP.

(iii) Sensing-only devices: -55.8 dBm EIRP.

(iv) All other personal/portable devices: -52.8 dBm EIRP.

(2) Emission measurements in the adjacent channels shall be performed using a minimum resolution bandwidth of 100 kHz with an average detector. A narrower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 100 kHz.

* * * * *

2. Section 15.711 is amended by revising paragraph (b)(3)(iv) to read as follows:

§ 15.711 Interference avoidance methods.

* * * * *

(b) * * *

(3) * * *

(iv) (A) A Mode I personal/portable TVBD may only transmit upon receiving a list of available channels from a fixed or Mode II TVBD. A fixed or Mode II device may provide a Mode I device with a list of available channels only after it contacts its database, provides the database the FCC Identifier (FCC ID) of the Mode I device requesting available channels, and receives verification that the FCC ID is valid for operation.

(B) A Mode II device must provide a list of channels to the Mode I device that is the same as the list of channels available to the Mode II device.

(C) A fixed device may provide a list of available channels to a Mode I device only if the fixed device HAAT as verified by the TV bands database does not exceed 106 meters. The fixed device must provide a list of available channels to the Mode I device that is the same as the list of channels available to the fixed device, except that a Mode I device may operate only on those channels that are permissible for its use under §15.707. A fixed device may also obtain from a database a separate list of available channels that includes adjacent channels that would be available to a Mode I personal/portable device and provide that list to the Mode I device.

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

* * * * *

3. Section 15.712 is amended by replacing the table in paragraph (a)(2), adding a new paragraph (a)(3) and revising paragraph (h) to read as follows:

§ 15.712 Interference protection requirements.

* * * * *

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

Antenna height above average terrain of unlicensed device	Required separation (km) from digital or analog TV (full service or low power) protected contour	
	Co-channel (km)	Adjacent channel (km)
Less than 3 meters	4.0	0.4
3-Less than 10 meters	7.3	0.7
10-Less than 30 meters	11.1	1.2
30-Less than 50 meters	14.3	1.8
50-Less than 75 meters	18.0	2.0
75-Less than 100 meters	21.1	2.1
100-Less than 150 meters	25.3	2.2
150-Less than 200 meters	28.5	2.3
200-250 meters	31.2	2.4

(3) The antenna height above ground for a fixed TVBD may not exceed 30 meters.

* * * * *

(h)* * *

(1) The Naval Radio Research Observatory in Sugar Grove, West Virginia at 38 30 58 N and 79 16 48 W.

(2) The Table Mountain Radio Receiving Zone (TMRZ) at 40 08 02 N and 105 14 40 W.

(3) The following facilities:

Observatory	Latitude (deg/min/sec)	Longitude (deg/min/sec)
Allen Telescope Array	40 49 04 N	121 28 24 W
Arecibo Observatory	18 20 37 N	066 45 11 W
Green Bank Telescope (GBT)	38 25 59 N	079 50 23 W
Very Large Array (VLA)	Rectangle between latitudes 33 58 22 N and 34 14 56 N, and longitudes 107 24 40 W and 107 48 22 W	
Very Long Baseline Array (VLBA) Stations:		
Pie Town, NM	34 18 04 N	108 07 09 W
Kitt Peak, AZ	31 57 23 N	111 36 45 W
Los Alamos, NM	35 46 30 N	106 14 44 W
Ft. Davis, TX	30 38 06 N	103 56 41 W
N. Liberty, IA	41 46 17 N	091 34 27 W
Brewster, WA	48 07 52 N	119 41 00 W
Owens Valley, CA	37 13 54 N	118 16 37 W
St. Croix, VI	17 45 24 N	064 35 01 W
Hancock, NH	42 56 01 N	071 59 12 W
Mauna Kea, HI	19 48 05 N	155 27 20 W

4. Section 15.713 is amended by adding new paragraphs (b)(1)(ix) through (xi), removing paragraphs (b)(2)(ii) through (iv), re-designating paragraphs (b)(2)(v) through (vi) as paragraphs (b)(2)(ii) and (iii), and revising paragraphs (e)(6) to read as follows:

§ 15.713 TV bands database.

* * * * *

(b) * * *

(1) * * *

(i) * * *

(ix) Class A television station receive sites.

(x) Low power television station receive sites.

(xi) Television translator station receive sites.

(2) * * *

(i) * * *

(ii) Sites where low power auxiliary stations, including wireless microphones and wireless assist video devices, are used and their schedule for operation.

(iii) Fixed TVBD registrations.

* * * * *

(e) * * *

(6) A fixed device with an antenna height above ground that exceeds 30 meters or an antenna height above average terrain (HAAT) that exceeds 250 meters shall not be provided a list of available channels. The HAAT is to be calculated using computational software employing the methodology in § 73.684(d) of this chapter.

* * * * *

5. Section 15.715 is amended by revising paragraph (c) and adding a new paragraph (m):

§ 15.715 TV bands database administrator.

* * * * *

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

* * * * *

(m) Provide a means to make all information the rules require the database to contain publicly available, including fixed TVBD registrations and voluntarily submitted protected entity information.

APPENDIX C

Final Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act (RFA),¹ an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Notice of Proposed Rule Making (NPRM)* in ET Docket No. 04-186,² and an additional IRFA was incorporated in the *First Report and Order and Further Notice of Proposed Rule Making (Further Notice)* in ET Docket No. 04-186.³ The Commission sought written public comment on the proposals in the *NPRM* and in the *Further Notice*, including comment on the IRFAs. No comments were received in response to either IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.⁴

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

This Third Memorandum Opinion and Order responds to five petitions for reconsideration that were filed in response to the *Second Memorandum Opinion and Order* (“*Second MO&O*”) in this proceeding.⁵ It eliminates the 76 meter limitation on the height above average terrain of the sites where fixed TV bands devices may operate and increases the maximum permitted antenna height above average terrain from 106 meters to 250 meters. The Third Memorandum Opinion and Order also replaces the current relative limit with a fixed limit for TV bands device emissions that fall in the 6 MHz channels adjacent to the operating channel. Devices operating at the maximum permitted power must suppress adjacent channel emissions to the same level that the current rules require, but devices operating at less than the maximum power do not have to suppress emissions below this level. However, the Third Memorandum Opinion and Order upholds the majority of the Commission’s prior decisions permitting unlicensed broadband operations in the TV bands while making certain other minor changes and refinements to the rules for TV band devices. The Commission believes that these changes and clarifications to the rules will better ensure that licensed services are protected from interference while retaining flexibility for unlicensed devices to share spectrum with new services or to change frequencies if TV spectrum is reallocated for other purposes.

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

There were no public comments filed that specifically addressed the rules and policies proposed in the IRFA.

C. Response to Comments by the Chief Counsel for Advocacy of the Small Business Administration

Pursuant to the Small Business Jobs Act of 2010, the Commission is required to respond to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration and to provide

¹ See 5 U.S.C. § 603. The RFA, see 5 U.S.C. § 601-612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996), and the Small Business Jobs Act of 2010, Public Law No. 111-240, 124 Stat. 2504 (2010).

² *NPRM*, 19 FCC Rcd at 10018, 10048 (2004).

³ *Further Notice*, 21 FCC Rcd 12266, 12299 (2006).

⁴ See 5 U.S.C. 604.

⁵ See *Second Memorandum Opinion and Order* in ET Docket No. 04-186, 25 FCC Rcd 18661 (2010).

a detailed statement of any change made to the proposed rules as a result of those comments. The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

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

The RFA directs agencies to provide a description of, and, where feasible, an estimate of, the number of small entities that may be affected by the rules adopted herein.⁶ The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”⁷ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.⁸ 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).⁹

Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing. The Census Bureau defines this category as follows: “This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment.FN1 Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.”¹⁰ In this category, the SBA has deemed a business manufacturing radio and television broadcasting equipment, wireless telecommunications equipment, or both, to be small if it has fewer than 750 employees.¹¹ For this category of manufacturing, Census data for 2007 show that there were 919 firms that operated that year. Of those establishments, 531 had between 1 and 19 employees; 240 had between 20 and 99 employees; and 148 had more than 100 employees.¹² Since 771 establishments had fewer than 100 employees, and since only 148 had more than 100 employees, the vast majority of manufacturers in this category would be considered small under applicable standards.

Wireless Telecommunications Carriers (except satellite). Since 2007, the Census Bureau has placed wireless firms within this new, broad, economic census category.¹³ Under the present and prior categories, the SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.¹⁴ For

⁶ 5 U.S.C. § 604(a)(3).

⁷ 5 U.S.C. § 601(6).

⁸ 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.”

⁹ 15 U.S.C. § 632.

¹⁰ U.S. Census Bureau, 2002 NAICS Definitions, “334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing”; <http://www.census.gov/epcd/naics02/def/NDEF334.HTM#N3342>.

¹¹ See [13 C.F.R. § 121.201](#), NAICS code 334220.

¹² http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=300&-ds_name+EC0731I1&-lang=en.

¹³ U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”; <http://www.census.gov/naics/2007/def/ND517210.HTM#N517210>.

¹⁴ [13 C.F.R. § 121.201](#), NAICS code 517210.

this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.¹⁵ Of this total, 1,368 firms had employment of 999 or fewer employees and 15 had employment of 1000 employees or more.¹⁶ Similarly, according to Commission data, 413 carriers reported that they were engaged in the provision of wireless telephony, including cellular service, Personal Communications Service (PCS), and Specialized Mobile Radio (SMR) Telephony services.¹⁷ Of these, an estimated 261 have 1,500 or fewer employees and 152 have more than 1,500 employees.¹⁸ Consequently, the Commission estimates that approximately half or more of these firms can be considered small. Thus, using available data, we estimate that the majority of wireless firms can be considered small.

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

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

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

The RFA requires an agency to describe any significant alternatives that it has considered in developing its approach, which may include the following four alternatives (among others): “(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities; (3) the use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities.”¹⁹

While the Third Memorandum Opinion and Order generally upholds the rules adopted in the *Second Memorandum Opinion and Order*, the Commission made certain changes to those rules. It believed those changes and clarifications would provide for improved protection of licensed services in the TV bands, resolve certain uncertainties in the rules, and provide manufacturers with greater flexibility in designing products to meet market demands.

The Commission eliminated the prohibition on fixed TV bands device operation at sites where the ground elevation is more than 76 meters above the average elevation of the surrounding terrain, while maintaining the current antenna height above ground limit of 30 meters. In place of the site elevation limit, the Commission adopted a requirement that a fixed device may operate with an antenna height above average terrain of up to 250 meters, which is an increase from the current antenna height above average terrain limit of 106 meters (30 meters antenna height above ground plus 76 meters site above average terrain). Under the new rule, a fixed TV bands device could operate from a site with an elevation

¹⁵ U.S. Census Bureau, Subject Series: Information, Table 5, “Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210” (issued Nov. 2010).

¹⁶ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “100 employees or more.”

¹⁷ See *Trends in Telephone Service* at Table 5.3.

¹⁸ See *id.*

¹⁹ 5 U.S.C. § 603(c)(1) – (c)(4).

of up to 220 meters above average terrain using an antenna height above ground of 30 meters, resulting in an antenna height above average terrain of 250 meters. In reaching this decision, the Commission considered the competing views from various parties on whether the ground elevation limit unnecessarily restricts the locations where fixed TV bands devices can operate and whether an increase in the maximum antenna height above ground and average terrain can allow greater coverage by fixed TV bands devices without causing interference to authorized users of the TV bands. The Commission believes that the changes it adopted will allow for increased availability of wireless broadband services in rural and underserved areas while protecting television and other services that operate in the TV bands.

The Commission made certain changes to the technical requirements for TV bands devices. Specifically, it modified the limits for emissions that fall in TV channels adjacent to those where a TV bands device operates by specifying limits that are at fixed levels, rather than relative to the in-band power. This change simplifies compliance measurements, because it will no longer be necessary to compare the in-band and adjacent channel power, which had to be measured with two different bandwidths under the previous rules. Instead, compliance can be determined by directly measuring the adjacent channel power in a specified bandwidth for comparison to the limit. The rule changes that the Commission adopted also eliminate the need for devices operating at less than the maximum permitted power to suppress adjacent channel emissions to levels below those needed to prevent interference to other services in the TV bands. In reaching its decision to modify the adjacent channel emission limits, the Commission considered and rejected requests for a greater relaxation of the limit. The Commission found that the adopted limits are necessary to prevent interference to authorized services in and adjacent to the TV bands and to allow more efficient use of the TV spectrum by both licensed and unlicensed devices. The Commission recognized petitioners' arguments that tighter emission limits can result in higher equipment costs. However, the record indicated that at least one equipment manufacturer is capable of complying with the limits adopted in the *Second Memorandum Opinion and Order*.²⁰ The Commission noted that tighter out-of-band emission limits can allow users to operate in adjacent frequency bands with less geographic separation between them, thus enabling more efficient and intensive use of spectrum. Thus, it found that the benefits of tighter out-of-band emission limits outweigh the increase in equipment cost necessary to comply with the limits.

G. Report to Congress

The Commission will send a copy of the Third Memorandum Opinion and Order, including this FRFA, in a report to Congress and the Government Accountability Office pursuant to the Congressional Review Act.²¹ A copy of the Third Memorandum Opinion and Order and FRFA (or summaries thereof) will also be published in the Federal Register.²²

²⁰ See *Adaptrum ex parte* dated March 8, 2011.

²¹ See 5 U.S.C. § 801(a)(1)(A).

²² See 5 U.S.C. § 604(b).