

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of

Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37, and

ET Docket No. 14-165

Amendment of Part 74 of the Commission's Rules for Low Power Auxiliary Stations in the Repurposed 600 MHz Band and 600 MHz Duplex Gap

Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions

GN Docket No. 12-268

COMMENTS OF THE DYNAMIC SPECTRUM ALLIANCE

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1. INTRODUCTION AND SUMMARY.

The Commission's Notice of Proposed Rulemaking (NPRM) recognizes that "unlicensed white space devices . . . rely heavily on access to unused channels in the television bands to provide important services."¹ Although the number of vacant channels available for unlicensed use is likely to shrink after the completion of the broadcast incentive auction and repacking of remaining broadcasters, this proceeding offers the Commission an opportunity to develop rules to support a vibrant unlicensed ecosystem in the remaining television broadcast spectrum and in the new 600 MHz wireless band. To do so, the Dynamic Spectrum Alliance (DSA)² urges the Commission to: (1) revise the existing white space rules to improve utilization of this otherwise-unused spectrum and (2) establish straightforward technical rules for unlicensed broadband use of the repurposed 600 MHz band. Consistent with the IEEE's 802.11af standard and the white space rules, the new 600 MHz rules should maximize the number of 6 MHz channels in which 40-milliwatt operation is permitted while avoiding harmful interference.

2. THE COMMISSION SHOULD UPDATE THE EXISTING WHITE SPACE RULES TO IMPROVE SPECTRUM UTILIZATION IN THE BROADCAST BANDS.

The Commission should adopt a number of targeted improvements to conform the white spaces rules to the rebanding of the 600 MHz band, and to reflect the actual performance of

¹ *Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37, and Amendment of Part 74 of the Commission's Rules for Low Power Auxiliary Stations in the Repurposed 600 MHz Band and 600 MHz Duplex Gap*, ET Docket No. 14-165; *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*; GN Docket No. 12-268, Notice of Proposed Rulemaking, 29 FCC Rcd 12248, ¶ 1 (2014) (NPRM).

² The Dynamic Spectrum Alliance is a global, cross-industry organization that includes multinational companies, small- and medium-sized enterprises, and academic, research, and other entities from around the world, all working to create innovative solutions that will increase the amount of available spectrum to the benefit of consumers and businesses alike. Further information and a full list of members are available at www.dynamicspectrumalliance.org.

television white space (TVWS) devices in the United States and abroad.³ Each of these modifications will improve spectrum utilization and better enable white space devices to flourish after the incentive auction is completed, all without causing harmful interference to broadcasters and other protected entities.

A. *The Commission should allow personal-portable devices to operate in channels 14-20.*

Today, the Commission's rules do not permit personal/portable devices to operate on channels 14 through 20 of the television broadcast spectrum.⁴ Personal/portable device operation is limited to channels 21 through 51, excluding channel 37 and two more channels reserved for wireless microphone use.⁵ However, as the Commission recognizes, many broadcast channels will be repurposed for mobile broadband as a part of the broadcast incentive auction, thereby leaving fewer white space channels overall and substantially fewer white space channels for personal/portable devices.⁶

To help maintain enough available in spectrum in local markets for successful use and deployment of unlicensed services and products, DSA supports the Commission's proposal to remove the prohibition on personal/portable device operation on channels 14-20.⁷ In 2008 and 2010, the Commission articulated two principal reasons for the limitation on low-power operation below channel 21. First, the Commission noted that prohibiting personal portable devices from operating on these channels would increase the number of channels wholly

³ See 47 C.F.R. Part 15, Subpart H.

⁴ See *id.* § 15.703(i).

⁵ NPRM at ¶¶ 22, 24.

⁶ *Id.* at ¶ 30.

⁷ *Id.* at ¶ 31.

available for wireless microphone uses.⁸ Second, the Commission decided to be “conservative” in protecting the private land mobile radio services (PLMRS), commercial mobile radio services (CMRS), and offshore radiotelephone services that operate in channels 14-20 in a limited number of areas.⁹ The Commission made these policy choices against the background of the then-prevailing belief, on the part of manufacturers of personal/portable devices, that channels 21 through 51 “would provide adequate spectrum resources for their products.”¹⁰

Since 2008, use of wireless services and applications has increased exponentially, driving increased demand for spectrum. Moreover, current white spaces between channel 21 and channel 51 will be repurposed to accommodate licensed wireless services, limiting the spectrum available for unlicensed use. At this critical juncture, every megahertz counts. The Commission and the public can no longer afford to exclude portable TVWS devices from channels 14-20 entirely, when those channels are used by PLMRS, CMRS, and offshore radiotelephone services “only intermittently” in a limited number of metropolitan areas, which geolocation database reservations can protect.¹¹ Wireless microphone use of channels below 21 likewise is episodic, geographically limited, predictable, and readily protected, where appropriate, through a reservation system.

⁸ *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, Second Report and Order and Memorandum Opinion and Order, 23 FCC Rcd 16807, ¶ 151 (2008) (2008 Order); *Unlicensed Operation in the TV Broadcast Bands*, ET Dkt. 04-186; *Additional Spectrum for Unlicensed Devices, Below 900 MHz and in the 3 GHz Band*, ET Dkt. 02-380, Second Memorandum Opinion and Order, 25 FCC Rcd 18661, ¶ 126 (2010) (2010 Order).

⁹ 2008 Order at ¶ 152; 2010 Order at ¶ 126.

¹⁰ 2008 Order at ¶ 152.

¹¹ 2008 Order at ¶ 138 (noting that “PLMRS/CMRS operations only use one to three channels in 13 metropolitan areas and other services on those channels, such as the Offshore Radiotelephone Service, similarly operate only in a few areas”), ¶ 142.

Accommodating personal/portable devices in these channels likewise will not increase the risk of harmful interference to Private Land Mobile Radio Service (PMLS) and Commercial Mobile Radio Service (CMRS) that operate on these channels in certain cities. Fixed TVWS device operations are already permitted on channels 14-20, and information regarding PMLS and CMRS operation on these channels is already incorporated into today's databases. As a result, their services are already being protected from harmful interference by fixed TVWS devices. Because databases have already gathered the necessary information regarding these operations, it will require a trivial effort to protect them from low-power personal/portable devices as well – databases merely need to update their algorithms to reflect that personal/portable devices can use these channels, and those changes need to be tested and validated.

B. The Commission should require TVWS geo-location databases to use terrain-based modeling, such as the Longley-Rice propagation methodology, to calculate required protection contours for broadcast operations.

The Commission's current white space rules rely on the F-curves methodology to calculate the reach of a broadcaster's signal.¹² The F-curves model does not take into account the presence of terrain, and as a result, it both underprotects and overprotects broadcast signals.¹³ Both of these errors are undesirable: underprotection increases the risk of harmful interference to broadcast operations, and overprotection unnecessarily prohibits unlicensed devices from using vacant spectrum.

The Commission should revisit this aspect of the rules now. When the FCC last considered this question, it defended its 1966 model by crediting an argument by the National

¹² 2010 Order at ¶ 21.

¹³ See James Carlson et al., *Studies on the Use of Television White Spaces in South Africa: Recommendations and Learnings from the Cape Town Television White Spaces Trial* 39-40 & Diagram 8.6.2, available at <http://www.tenet.ac.za/tvws/recommendations-and-learnings-from-the-cape-town-tv-white-spaces-trial> (last visited Dec. 8, 2014).

Cable and Telecommunications Association that “terrain-based measures are not yet ready to be deemed reliable.”¹⁴ That is clearly no longer the case, as the FCC has determined to rely on the terrain-based Longley-Rice propagation model to ensure broadcasters do not interfere with each other after they are repacked following the incentive auction.¹⁵ Moreover, DSA members have implemented the Longley-Rice propagation model in real world settings. In these members’ experience, Longley-Rice methodology protects broadcast operations from harmful interference, even in urban environments such as Cape Town, South Africa, where a trial required protection of numerous broadcasters. Because a terrain-based model will more accurately protect incumbent broadcasters consistent with this actual experience since the TWVS rules were issued, and will free up additional spectrum for unlicensed use, the FCC should require its protection methodology to take into account terrain effects.

C. The Commission should establish separation distances for intermediate power level operation.

DSA supports the Commission’s proposal to enable intermediate power levels for unlicensed TVWS operation.¹⁶ The Commission currently establishes separation distances for 40-milliwatt, 100-milliwatt, and 4-watt devices.¹⁷ It proposes to establish additional separation distances for 250-milliwatt, 625-milliwatt and 1600-milliwatt devices.¹⁸ These changes will allow devices operating at intermediate power levels to be placed closer to protected operations,

¹⁴ 2010 Order at ¶ 19.

¹⁵ See Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112–96, 126 Stat. 156, § 6403(b)(2) (2012) (requiring use of FCC Office of Engineering and Technology Bulletin 69, which incorporates the Longley-Rice propagation model, to calculate post-auction coverage areas for repacked broadcasters).

¹⁶ NPRM at ¶ 40.

¹⁷ *Id.* at ¶ 39.

¹⁸ *Id.*

thereby increasing spectrum utilization without affecting incumbent users. In addition, DSA members are confident that databases and devices will be able to take advantage of these additional deployment options very quickly, as intermediate power levels can be accommodated by existing technology with relative ease.

D. The Commission should allow channel bonding.

The Commission should enable unlicensed devices to operate across contiguous vacant channels without adhering to the adjacent emission limits between the two contiguous channels in use.¹⁹ The purpose of the adjacent channel emissions restriction is solely to protect adjacent broadcasters or other protected entities.²⁰ As the Commission recognizes in the NPRM, if white space operation is allowed on two contiguous channels, there is, by definition, “no TV station or other authorized service to protect” on the adjacent channel.²¹ Because channel bonding will allow more efficient use of white space without creating any risk of harmful interference to protected operations, DSA supports the Commission’s proposal.

E. The Commission should enable greater flexibility for white space operation in rural areas.

The Commission can and should enable greater flexibility for white space operation in rural areas while protecting television broadcasting, because low-frequency unlicensed devices can serve these areas especially well and because most rural areas are home to only a few broadcasters. As the Commission has recognized, unlicensed use of white space serves an important role in bringing broadband to unserved and underserved areas.²² Indeed, a number of DSA members have pursued projects specifically designed to deliver broadband to very rural or

¹⁹ *Id.* at ¶ 56.

²⁰ 2008 Order at ¶¶ 176, 177.

²¹ *Id.*

²² *Id.* at ¶ 1.

otherwise hard-to-reach areas.²³ For example, additional flexibility in antenna height would allow DSA members to serve rural areas more effectively without causing harmful interference to incumbents and other protected entities. For example, Adaptrum, a DSA member company, recently filed a petition for a waiver of the existing height limits on antennas to allow it to more effectively serve a rural community in Maine.²⁴ Given the paucity of incumbents in that area, Adaptrum's operations will be separated from the nearest U.S. broadcaster by three vacant channels.²⁵ As a result, Adaptrum's proposed deployment is very unlikely to cause harmful interference to existing broadcast operations. The Adaptrum request illustrates that the benefits of allowing flexibility in rural white space operations are significant and the risks are minimal. Similarly, the Commission should enable higher power limits in rural areas to the extent that such power levels do not cause harmful interference to protected users

Finally, DSA members also support the Commission's proposal to characterize areas as rural or non-rural based on the fraction of broadcast channels that are available for unlicensed use. While spectrum availability and population density are likely to be roughly correlated (i.e., there are likely to be fewer broadcasters and other protected entities in rural areas), interference risk is more directly related to the intensity of spectrum use, rather than the number of residents in a given area.

²³ See Dynamic Spectrum Alliance, Worldwide Trials and Pilots, www.dynamicspectrumalliance.org/pilots.html (discussing rural pilots in Limpopo, South Africa and Taoyuan County, Taiwan).

²⁴ See Public Notice, *Office of Engineering and Technology Declares the Adaptrum, Inc. Request for Waiver of Sections 15.709(B)(2) of the Rules To Be a "Permit but-Disclose" Proceeding For Ex Parte Purposes and Requests Comment*, ET Docket No. 14-187, Oct. 23, 2014.

²⁵ Letter from H. Sama Nwana, Executive Director, Dynamic Spectrum Alliance, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 14-187, Nov. 24, 2014.

3. THE COMMISSION SHOULD ESTABLISH TECHNICAL RULES THAT ENABLE MEANINGFUL UNLICENSED USE OF CHANNELS WITHIN THE REPURPOSED 600 MHz WIRELESS BAND.

The DSA urges the Commission to establish technical rules that enable operation of 40-milliwatt devices in the duplex gap and guard bands in the repurposed 600 MHz band, as well as in channel 37.

A. *The Commission should allow meaningful unlicensed operations in the duplex gap.*

The Commission should establish one 6-MHz-wide channel in the duplex gap and authorize operation on that channel at a power level of at least 40 milliwatts. DSA members agree with the Commission's tentative conclusion that a 3 MHz frequency separation will be sufficient to protect LTE downlink operations from harmful interference by unlicensed devices.²⁶

In a duplex gap of 11 MHz, moreover, the unlicensed channel should be placed at least 1 MHz away from LTE uplink. A buffer of 1 MHz between LTE uplink and unlicensed devices in an 11-MHz duplex gap would allot 4 MHz for low-power wireless microphones to operate adjacent to LTE downlink, enable 40-milliwatt operation of unlicensed devices in one 6 MHz channel, and create a small buffer between high-power LTE uplink and unlicensed devices, thereby enabling improved white space device operation. This configuration improves spectrum utilization because it will allow more effective use of unlicensed devices without compromising LTE operation or unduly limiting wireless microphone use. Wireless microphone use will not compromise LTE operation because the microphone devices operate at very low power in very narrow bandwidths no greater than 200 kHz. At the same time, this placement does not impair microphone usage. Rather, it leaves microphone users with the same 4-MHz allotment of

²⁶ See NPRM at ¶ 83; Letter from Paul Margie, Wiltshire & Grannis LLP, to Marlene H. Dortch, Secretary, FCC, Docket No. 12-268, at Broadcom Attachment, Broadcom Corporation 600MHz WIFI-LTE Analysis at 8-9 (filed July 22, 2014).

spectrum within the duplex gap that is proposed by the Commission in the NPRM.²⁷ Moreover, licensed microphone users have a variety of other spectrum options for their operations, including registering use of a white space channel with a TVWS database.²⁸ For all these reasons, the Commission should allow unlicensed devices to operate on one 6-MHz channel within the duplex gap.

B. The Commission should allow 40-milliwatt unlicensed devices to use guard bands of 9 MHz or more

The Commission anticipates that it will create a guard band of 7, 9 or 11 MHz between licensed wireless and broadcast operations.²⁹ If the guard band is 9 or 11 MHz, the Commission should allow unlicensed operation on one 6-MHz channel at a power level of at least 40 milliwatts. Consistent with the Commission's reasoning regarding the required separation between LTE downlink and unlicensed devices, one 6-MHz channel would fit into a 9-MHz guard band and still allow a 3 MHz separation from LTE operations.³⁰ The original white space rules were designed precisely to allow an unlicensed device to operate in a 6-MHz channel immediately adjacent to a broadcaster, so no separation is needed between unlicensed operation and broadcast operations at the lower end of the guard band. This approach will allow the Commission to maximize use of the otherwise-fallow spectrum in guard bands between LTE and broadcast services.

²⁷ NPRM at ¶ 92.

²⁸ *Id.* at ¶ 184.

²⁹ *Id.* at ¶ 78.

³⁰ *See id.* at ¶ 82.

C. *The Commission should allow unlicensed use of channel 37 and establish reasonable protection criteria for wireless telemetry and radio astronomy operations in channel 37.*

The Commission can and should allow unlicensed devices to operate in channel 37 while protecting existing users of the channel. The existing users — wireless telemetry and radio astronomy — both provide important services to the public. They are also in discrete and well-known locations: wireless telemetry users already are required to register with a database,³¹ and there are twelve radio astronomy telescopes placed at known and fixed locations throughout the United States.³² Members of DSA who offer database services are prepared to update their systems to protect these operations from harmful interference while authorizing devices to use channel 37 in locations where it is not being used. For example, geolocation databases can be used to accurately define protection zones for wireless telemetry users. This process would likely be similar to the process used to protect wireless microphone users today. For radio astronomy operations, DSA recommends that protection be based on ITU-R Recommendation 796-2 and the Longley-Rice propagation model. The ITU-R recommendation would provide the protection requirements for the radio astronomy receiver, and using the Longley-Rice model along 360 radials would provide the relevant predictions of the strength of the TVWS device's signal and corresponding protection contour.

D. *The Commission should allow use of Mode I, Mode II, and fixed devices in duplex gap, guard bands, and Channel 37.*

In the NPRM, the Commission proposes to allow both fixed and personal/portable devices in the duplex gap and guard bands and asks whether both personal/portable and fixed

³¹ *Id.* at ¶ 97.

³² *Id.* at ¶ 98.

devices should be permitted to use channel 37.³³ Personal/portable devices come in two types: Mode II (master) devices report their location and communicate directly with a database to obtain a list of available channels in their area.³⁴ Mode I (client) devices can rely on Mode II devices or fixed devices to obtain channel availability information.³⁵

DSA members urge the Commission to enable use of all three types of devices in the duplex gap, guard band, and channel 37. The NPRM proposes to allow fixed devices in each of these spaces. Because Mode II devices are required to report their location, the interference risk they pose to incumbent operations is no different than that of fixed devices. Mode I devices have a limited range around the master, and separation distances need only be increased to take into account this additional distance. Those distances are a function of the maximum power of the device, which is established by rule and will be tested during the Commission's device-certification process. Therefore, so long as separation distances are calculated to reflect the maximum distance from the master at which the client can operate based on its power, allowing Mode I devices in the duplex gap, guard bands, and channel 37 should not cause any increased risk of harmful interference.

Enabling access to each of these spaces is key to the health of the unlicensed ecosystem below 1 GHz. Spectrum below 1 GHz has favorable propagation characteristics, allowing signals to penetrate buildings and irregular terrain, increasing its utility in serving rural or hard-to-reach areas. Access to this band, along with other, higher-frequency spectrum also allows trade-offs between power, range, and throughput, enabling lower energy consumption.

³³ *Id.* at ¶¶ 80, 132.

³⁴ *Id.* at ¶ 20.

³⁵ *Id.*

Without adequate, nationwide access to unlicensed spectrum below 1 GHz, the personal/personal device market will not thrive. And many common devices that will incorporate white space technology, such as laptops and mobile phones, are likely to be configured as Mode I devices. As a result, the Commission should grant personal/portable devices full access to the duplex gap, guard bands, and channel 37.

4. THE COMMISSION SHOULD REQUIRE DEVICES TO PROVIDE INFORMATION ABOUT THE ACCURACY OF THEIR GEO-LOCATION CAPABILITIES AND REQUIRE DATABASES TO CALCULATE REQUIRED SEPARATION DISTANCES ACCORDINGLY.

Today's TVWS rules require that a fixed or Mode II personal/portable device incorporate a geo-location capability that can determine its geographic coordinates to within ± 50 meters.³⁶ The Commission should revise the rules to require that devices provide information regarding their location accuracy capabilities to databases and allow databases to calculate required separation distances based upon the accuracy of the device's reported location. This will allow technological flexibility while creating incentives to invest in developing devices with improved geo-location capability.

Location information serves a very different purpose in the TVWS context than in other contexts where the Commission is considering it. In the wireless 911 context, for example, the Commission has proposed rules that would require the delivery to public safety answering points of horizontal location within 50 meters of the caller for 67 percent of calls within two years, and for 80 percent of calls within five years, plus vertical location estimates within 3 meters of the caller for 67 percent of calls within three years, and for 80 percent of calls within five years.³⁷ Such accuracy, however, is not required for TVWS devices to protect other operations in the

³⁶ 47 C.F.R. § 15.711(b)(1). Fixed devices can also report their location based on the information provided a professional installer.

³⁷ *Wireless E911 Location Accuracy Requirements*, PS Docket No. 07-114, Third Further Notice of Proposed Rulemaking, 29 FCC Rcd. 2374, ¶ 3 (2014).

television bands. When a person calls 911, the purpose of the accuracy requirement is to identify where the caller is located, so first responders can go to that location. For TVWS devices, by contrast, the purpose of the location accuracy requirement is to ensure that a device *is not* located and operating in a place where it could cause harmful interference. As long as the TVWS device is not operating at a prohibited location, interference protection does not require that the network or any database know where the device actually is. In other words, so long as a TVWS database knows the range of possible locations where the device could be based on the device's geo-location capabilities, it can enforce appropriate separation rules based on those possible locations and harmful interference can be avoided even with less accurate or less precise devices.

Treating white space devices' location capabilities as an input to the database's protection analysis rather a fixed requirement will allow devices with a range of capabilities to operate in these bands. It will also incentivize efficiency and drive improvements in device capabilities: devices that can pinpoint their location more precisely will be able to access spectrum at more locations. Finally, it will also account for the realities of today's available technologies, which often have difficulty meeting the 50-meter accuracy requirement in indoor settings.

5. CONCLUSION

In this proceeding, the Commission has the opportunity to maximize spectrum utilization and support a vibrant ecosystem for unlicensed devices below 1 GHz. It should do by updating the existing TVWS rules to allow meaningful access for unlicensed devices after the 600 MHz rebanding, while ensuring that broadcasters, mobile operators and other protected users of the band do not experience harmful interference.

Respectfully submitted,



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