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

In the Matter of	)	
	)	
Amendment of Part 15 of the Commission's	)	ET Docket No. 14-165
Rules for Unlicensed Operations in the	)	
Television Bands, Repurposed 600 MHz	)	
Band, 600 MHz Guard Bands and Duplex	)	
Gap, and Channel 37	)	

COMMENTS OF DYNAMIC SPECTRUM ALLIANCE

Martha SUAREZ
President
Dynamic Spectrum Alliance

June 10, 2019

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SUMMARY

The Dynamic Spectrum Alliance ("DSA")[1] supports Microsoft's Petition for Rulemaking ("Petition")[2]. We believe that Microsoft's proposed rule changes to increase the EIRP limit[3] and the height above average terrain limit for fixed white spaces devices (WSDs) operating in less congested area[4] are measured, practical, allow for more intensive use of spectrum resources while protecting licensees, and will increase broadband access for residents in hard to reach areas. Microsoft's proposal to have the Commission re-examine higher power fixed WSD operations on a first adjacent channel has the potential for increasing the amount of white spaces spectrum available in less congested areas after the repacking of television stations once the incentive auction is completed. The proposal is especially timely in light of advances in cloud computing which may facilitate the separation-distance calculations needed to unlock this unused spectrum while preventing harmful interference.

Microsoft's proposal to allow for fixed transportable WSD operations within a geofenced area at higher EIRP levels in less congested areas will also support rural industries. The Commission's rules currently allow for geofencing of personal / portable devices, but expanding these rules to fixed devices will allow WSDs mounted on tractors, school buses, mining equipment, or other moving platforms to take advantage of the greater range provided by the

[1] The Dynamic Spectrum Alliance is a global, cross-industry alliance focused on increasing dynamic access to unused radio frequencies. The membership spans multinational companies, small- and medium-sized enterprises, academic, research, and other organizations from around the world, all working to create innovative solutions that will increase the utilization of available spectrum to the benefit of consumers and businesses alike. A full list of DSA members is available on the DSA's website at www.dynamicspectrumalliance.org/members/.

[2] Petition for Rulemaking of Microsoft Corporation, ET Docket No. 14-165 (filed May 3, 2019). ("Petition").

[3] *Petition* at 4.

[4] *Petition* at 11.

fixed WSD rules.[5] The DSA is also supports the proposal to create a new class of narrow-channel WSD intended for Internet of Things ("IoT") with streamlined and clarified rules. To allow IoT WSDs to more easily leverage the properties of radio waves propagating in the UHF and VHF spectrum bands will facilitate important new use cases and expand the economic benefits of IoT for rural industries.

Finally, if the Commission releases a Further Notice of Proposed Rulemaking, it should consider some features included in the DSA Model Rules.[6] First, the Commission should allow White Spaces Database ("WSDB") providers to utilize a terrain-based model to determine available channels and maximum EIRP at a location as long as the model is underpinned by equivalent protection for incumbents as underpins its rules using the HAAT and F-Curve approach. We believe that use of a terrain-based model will increase the availability of higher power fixed WSD operations in less congested areas.

Another potential rule change to improve the affordability of fixed WSDs in rural areas would be to adopt the ETSI approach .[7] Under the ETSI rules, there are five numbered device emission classes, with progressively more relaxed emissions masks. The more relaxed masks, however, comes with correspondingly increased separation distances, protecting incumbents while allowing the market to identify the most productive trade-off between device cost, due to more stringent filtering, and the number of available channels. The DSA proposes that the

[5] *See* 47 C.F.R. § 15.711(d)(5)

[6] See Dynamic Spectrum Alliance *Dynamic Spectrum Alliance Model Rules and Regulations for the Use of Television White Spaces v2.0, Dec. 2017* ("DSA Model Rules") http://dynamicspectrumalliance.org/wp-content/uploads/2018/01/Model-Rules-and-Regulations-for-the-use-of-TVWS.pdf. ("DSA Model Rules")

[7] ETSI, *White Space Devices (WSD); Wireless Access Systems operating in the 470 MHz to 790 MHz TV broadcast band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU* (Jan. 2018). https://www.etsi.org/deliver/etsi_en/301500_301599/301598/02.01.01_60/en_301598v020101p.pdf.

Commission considers amending its WSD rules to allow for similar devices emission classes. Although it may not be necessary for the Commission to adopt all five ETSI device emission classes, the Commission should consider creating at least one alternative emissions class comparable to ETSI Device Emission Class 4 or Class 5 that would only operate in rural areas.

I. THE DSA SUPPORTS A HIGHER EIRP LIMIT FOR WSDs OPERATING IN LESS CONGESTED AREAS

Microsoft's proposal to increase the EIRP limits for fixed WSD operating in less congested areas by a few dBs is a modest one that allows for greater spectrum sharing, extends the coverage area for network incorporating WSDs and does not increase the risk of harmful interference. Additionally, implementation of the proposal comes with minimal administrative burdens as it would merely extend the existing methodology used for the WSDBs to determine the available channels that can operate at this higher power limit in less congested areas.

The increase in EIRP level would come exclusively through an increase in the maximum antenna gain allowed. In general, the lower the frequency, the larger the antenna required to achieve the same gain. Networks incorporating fixed WSD are intended to be lower cost and easy to deploy. Anecdotally, high gain antennas operating in the UHF and VHF bands beyond a certain gain start getting very large and expensive. As Microsoft points out, there may be a practical limit to what the maximum increase in antenna gain for a fixed WSD operating in less congested areas.

WSD links can be used to provide point-to-point ("P2P") backhaul to an Internet point or presence and provide point-to-multi-point ("P2MP") broadband access from the base station for the customer premise equipment (CPE). Higher gain antennas may have the greatest impact in

reducing the cost of network topologies incorporating P2P backhaul over fixed WSD channels as there would be a limited number of large antennas required. In this network concept, the last-mile broadband access could also be provided to rural consumers by fixed P2MP WSDs operating over a different set of white spaces channels or in a different frequency band.

II. THE DSA SUPPORTS INCREASING THE HEIGHT ABOVE AVERAGE TERRAIN LIMIT IN LESS CONGESTED AREAS

Similar to its approach for increasing the EIRP limit in less congested areas, Microsoft's proposal to increase the Height Above Average Terrain ("HAAT") limit in less congested areas is measured and does not increase the risk of interference.[8] There are limitations to determining the list of available channels in certain geographies using the existing HAAT restrictions and the F-Curve methodology. These geographies tend to be exclusively in rural areas where the only places available for locating a WSD base station to obtain any degree of coverage, for example in a remote valley, may be on a natural feature such as a ridge.

Microsoft's proposal would increase the HAAT in these typically more remote areas. To ensure that incumbents remain protected, it would extend the existing methodology for determining available channels.

III. THE DSA SUPPORTS THE COMMISSION TAKING A FRESH LOOK AT HIGHER POWER WSD OPERATIONS ON THE FIRST ADJACENT CHANNEL

Demonstrations in both South Africa and Ghana have shown that a WSD operating at 4 W EIRP can operate on a first adjacent channel to an over-the-air television broadcaster without causing harmful interference. While the Ghanaian trial examined the potential effects on

[8] Petition at 11.

analog television broadcasts, the South African trial considered both analog and digital television broadcast stations.[9]

In 2014, the Commission proposed to allow 4 W EIRP WSDs to operate at a 3 MHz offset to a broadcast television channel.[10] The rationale was that there will be less spectrum available for WSD after the repacking of the TV bands are completed and that allowing WSDs to operate closer to the broadcast station will allow for more intensive use of spectrum resources.

The Commission's 2015 Report and Order allows for a fixed WSD to operate with a 3 MHz offset from a broadcaster at a maximum EIRP of 100 mW at a maximum height of 10 meters above ground level – which limits its potential use to local fill-in spectrum, as the coverage area is limited. In the same Report and Order, the Commission authorized a 40 mW fixed WSD to operate on a first adjacent channel, again with a height limitation of 10 meters above ground level, based on the record created through the end of 2014.[11] The Commission affirmed its decision in its March 2019 Order on Reconsideration.[12]

The DSA agrees with Microsoft's proposal and believes it is time for the Commission to take a fresh look at allowing fixed WSD to operate at higher powers closer to broadcast television stations. There will be fewer white space available even in some rural areas beyond the

[9] M.T. Masonta, L.M. Kola, A.A. Lysko, L. Pieterse and M. Velempini, *Network Performance Analysis of the Limpopo TV White Space (TVWS) Trial Network at 2,* IEEE Africon 2015.
[10] *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 et al.*, Notice of Proposed Rulemaking, 29 FCC Rcd. 12,248 (2014).
[11] *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 et al.*, Report and Order, 30 FCC Rcd. 9551, 9640-41¶ 213-214 (2015).
[12] *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 et al.*, Report and Order and Order on Reconsideration at ¶42-47 (2019).

limited number of stations that are repacked for the simple reason that the Commission has a hands off philosophy when it comes to displaced stations selecting a new channel. The protection criteria require that a single white space channel requires a contiguous block of three vacant channels or said another way, there needs to be at least one vacant channel between a 4 W (or 10 W) EIRP WSD and the nearest broadcast television station. The new channel selected in some instances can lead to a very inefficient use of the spectrum resource with respect to potentially limiting white space operations that can provide broadband to unserved and underserved communities. As stated by Microsoft in its Petition, it is warranted for the Commission as a minimum to ask questions about whether fixed WSDs can operate at higher powers on first adjacent channels to unlock spectrum that would otherwise be unavailable..

IV. THE DSA SUPPORTS THE COMMISSION ALLOWING GEOFENCED FIXED WSD OPERATIONS IN LESS CONGESTED AREAS

The Commission's rules allow for personal / portable WSDs to operate on available channels within a geofenced area that the WSDB has determined will not cause harmful interference to incumbents.[13] Microsoft's proposal for the Commission to establish a similar framework for fixed devices with a geofenced area is a logical extension of these rules to increase the use of spectrum without increasing the risk of harmful interference. Such geofenced operations can support rural industry broadly, and particularly, agriculture and extractive industries, where construction, transportation, or farm equipment can operate within a defined area. Further, a demonstration of geofenced operations has provided Internet connectivity to students on long school buses on rural routes.[14]

[13] *See* 47 C.F.R. § 15.711(d)(5)
[14] Petition at 22-26.

While Microsoft proposes a specific approach to ensuring that movable higher power WSD operate only within the geofenced area, the Commission might consider inquiring about other approaches to ensure licensees are protected from receiving harmful interference. The DSA believes the Commission can achieve a more generally applicable approach by removing the word "vicinity" from the Microsoft proposal[15]. As drafted, we perceive the geofence as a self-contained area of limited geographic extent where the fixed WSD can operate on the same set of channels. We believe Microsoft's intent for its proposed rule change is to enable a white spaces canopy over a given vehicle's route. The area covered under the geofence would represent all potential vehicle routes a vehicle equipped with a WSD could take. The DSA would expect shape of such a geofence to be irregular and it should not include the interior areas within which the WSD would not be transportable.

The DSA asks the Commission to consider introducing a method that would allow a geofence to be created for available white space channels over a pre-defined planned route. The coverage area could be small or large, as required. The list of available channels could vary across the geofence, The method to obtain the channel availability list along such larger area or mostly longer roads, should require checking the channel availability along the entire pre-defined planned route and input the coordinates into the WSDB.

V. THE DSA SUPPORTS CREATION OF A NEW CLASS OF NARROWBAND WSDs TAILORED FOR IoT

The Commission's white space rules were developed to protect licensees from broadband fixed and personal/portable WSD operations. Narrow-band or narrow-channel WSDs were never

[15] Petition at 24.

envisioned. As with single channel or bonded channel WSDs, narrow-band WSDs can take advantage of the greater range, better penetration though common building materials, and non-line-of sight operation. These benefits can be applied to outdoor IoT use cases in agriculture and environmental sensing.

As Microsoft points out in its petition, there are some specific technical rules that limit the commercial attractiveness of IoT operations in the TV white spaces.[16] Two of these limiting rules are the conducted power spectral density limits and the conducted adjacent channel limits. In its March Report and Order and Order on Reconsideration, when discussing its decision confirming a 100 mW fixed WSD can operate with a 3 MHz offset to a broadcast station, the Commission states "This change allows a white space device to operate with 50 milliwatts EIRP in a three megahertz segment of each of the contiguous television channels (100 milliwatts total), leaving a frequency separation of three megahertz between a white space device's operating frequency band and the edges of the occupied adjacent television channel".[17] Imagine a single 100 kHz channel in the center of a 6 MHz white space channel, where there is effectively at least a 3 MHz offset from the nearest broadcaster. Under the current rules it could not operate at 50 mW EIRP. It is hard to imagine soil moisture and other sensors in the field with antenna higher than 10 meters above ground level.

The DSA believes the Commission has the opportunity to create a new class of narrow-channel WSDs, with technical and operational rules that protect licensees, but which are more

[16] Petition at 16-17.
[17] *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 et al.*, Report and Order and Order on Reconsideration at ¶ 54, (March 2019)

suitably tailored for IoT uses. We believe that Microsoft's proposal takes a very conservative approach to ensuring narrowband WSDs do not cause harmful interference. The Commission should move forward with a FNPRM along the lines Microsoft proposes as it is clear the potential direct and spillover economic benefits for narrowband WSDs for IoT are high and potential risk for harmful interference is low.

One issue not taken up in Microsoft's petition that DSA believes the Commission should seek comment on is the potential range of spectrum management tools and techniques for communication and coordination between broadband and narrowband white space operations.

VI. THE DSA SUPPORTS THE USE OF TERRAIN BASED MODELS TO DETERMINE THE LIST OF AVAILABLE CHANNELS AT A LOCATION

Under the Commission's rules, fixed WSDs are required to access a database server at least once per day or if the device changes location. The WSD receives a list of available channels and the maximum allowed transmit power (which is in part a function of frequency separation from local broadcast stations). In the U.S., TV viewers are protected within standardized and static uniform field strength contours around TV transmitters, calculated using the relatively simple and very conservative (both unrealistic and often overly protective) FCC Curve propagation model that considers only the average height of terrain in a given direction, while taking no specific account of basic geographic features (e.g., mountains, lakes), nor of trees, buildings or other "clutter" that more sophisticated Geographic Information Systems (GIS) models use.[18] Today, radio propagation modeling is well-established and rapidly becoming more granular as

[18] *Automated Frequency Coordination: An Established Tool for Modern Spectrum Management,* Dynamic Spectrum Alliance, March 2019, page 23. http://dynamicspectrumalliance.org/wp-content/uploads/2019/03/DSA_DB-Report_Final_03122019.pdf.

very detailed GIS data on terrain, clutter and other factors enhance the algorithms used by spectrum databases to enforce compliance with interference protection rules.[19]

The Commission established its initial rules for WSDs over a decade ago. The DSA can appreciate why the Commission at that time chose to protect broadcasters, for example, through F Curves and HAAT methodology rather than using terrain-based models such as the Longley-Rice model used by the very same broadcasters. While many of the reasons for not allowing use of terrain-based models have been lost to time, our understanding is that there was uncertainty how the WSDB infrastructure would be able to handle the more computationally intensive calculations, assuming large numbers of personal / portable WSDs.

The DSA supports models that protect incumbents but maximize spectrum utility. To that end, we support models that use point-to-point modeling. In addition, we support models that account for the variability in terrain in calculating propagation and spectrum availability. Annex B of the DSA Model Rules describes our preferred model, being the Longley-Rice propagation model. However, the DSA believes that ITU-R. P-1812 is also an acceptable propagation model for this purpose as described in Annex C. Other models may also be appropriate, provided they use point-to-point calculations and account for terrain variability.[20]

The DSA believes that a significant difference between 2009 and 2019 is the growth of cloud (computing). A WSDB calculation engine operating in the cloud is able to provision, manually or automatically, as much computing resource as it needs for only the time that it is needed. This

[19] *Automated Frequency Coordination: An Established Tool for Modern Spectrum Management,* Dynamic Spectrum Alliance, March 2019, page 30.
[20] DSA Model Rules at 7.

enables a cost-effective approach both to large-scale precomputation and to meeting ongoing demand without the burden of expensive permanent infrastructure. While we would like to see terrain (and clutter) based models used for all WSDs, consistent with the Commission's objective of improving broadband access in unserved and underserved areas, the DSA believes the low hanging fruit would be for the Commission to allow terrain-based models be used for fixed WSD operating in excess of 100 mW EIRP. Use of terrain-based models such as Longley-Rice can potentially make additional spectrum available for white space use in less congested areas. We agree with Microsoft's position that the Commission […should merely offer WSDB operators the option of of calculating separation distances using this more sophisticated and more accurate model – and perhaps only for certain classes of devices in certain areas…].[21]

VII. THE DSA SUPPORTS THE CREATION OF MULTIPLE DEVICE EMISSION CLASS WSDs WITH CORRESPONDING CHANGES TO SEPARATION DISTANCES

The DSA Model Rules accommodate the five device emission classes under the ETSI-based approach, where the most stringent emissions mask corresponds to the lowest number class. Device Emission Class – 1 corresponds to the FCC rule for adjacent channel emissions once the difference between U.S. (6 MHz) and European (8 MHz) television channel bandwidth is accounted for.[22]

[21] Petition at 10.

[22] The UK regulator Ofcom adopted the ETSI approach in its TV White Space rules. Under Ofcom's rules, the fixed WSD must report its Device Emission Class to the WSDB during its registration. The Commission could adopt a similar approach to implementing additional device emission classes. Ofcom, *Implementing TV White Spaces*, §§ A8.19, A11.127, (Feb. 12, 2015). https://www.ofcom.org.uk/__data/assets/pdf_file/0034/68668/tvws-statement.pdf.

While DSA does not propose that the FCC adopt all five ETSI device emission classes (or 6 MHz equivalents thereof), if the Commission is re-examining its white spaces rules that have the most significant impact on WSD service availability and affordability, it should consider creating a second device emission class with a more relaxed emission mask.

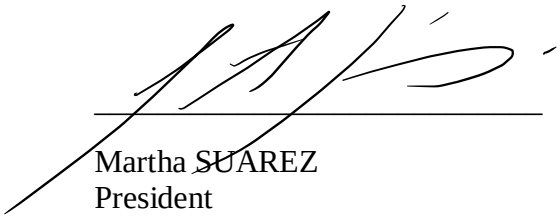
Such an approach would not increase the risk of harmful interference because a WSD with the more relaxed mask would be required to operate with a greater separation distance from licensees. However, in rural and remote areas, operating at a greater distance from a distant broadcast station is often well worth the trade-off if it means having access to lower cost base stations and customer premise equipment. The DSA's understanding is that one of the most significant and expensive technical challenges that WSD manufacturers face in reaching the 1 W conducted power limit is meeting the stringent emissions mask requirements. A second class of fixed WSDs that can operate with a more relaxed emissions mask will provide a greater coverage in rural areas and at lower cost than what can be achieved today.

CONCLUSION

The DSA believes Microsoft's Petition, if adopted by the Commission in a Further Notice of Proposed Rule Making, will lead to increased availability of broadband in less congested areas, open up the TV white spaces to IoT applications and overall, increase utilization of spectrum through shared use.

The DSA also proposes that the Commission consider changes to two additional rules based on the DSA Model Rules – allowing for the use of terrain-based models and allowing for a second device emission class of fixed WSD - that will increase the availability of white space spectrum and increase the affordability of the broadband service respectively.

Respectfully submitted,



Martha SUAREZ
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