Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
Unlicensed White Space Device Operations in the Television Bands	)	ET Docket No. 20-36
	)	

To: The Commission

COMMENTS OF
PUBLIC INTEREST SPECTRUM COALITION

NEW AMERICA'S OPEN TECHNOLOGY INSTITUTE
PUBLIC KNOWLEDGE
CONSUMER REPORTS
ACCESS HUMBOLDT
NEXT CENTURY CITIES
COMMON CAUSE
TRIBAL DIGITAL VILLAGE NETWORK
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New America's Open Technology Institute, Public Knowledge, Consumer Reports, Access Humboldt, Next Century Cities, Common Cause, Tribal Digital Village Network, Benton Institute for Broadband and Society, and X-Lab ("Public Interest Spectrum Coalition" or "PISC") hereby submit these comments on the Notice of Proposed Rulemaking ("*NPRM*") adopted in the above-captioned proceeding.[1] PISC generally supports the Commission's proposed rule changes, but also urges the Commission to go further to facilitate more intensive use of the vacant TVWS spectrum to address what remains a cavernous digital divide.

I. Summary

The lack of broadband internet access in many rural and tribal communities underscore the urgency of boosting TV White Space technology and deployments to help bridge this gap. These less-densely-populated areas tend to have lower rates of broadband adoption due to the high costs for both backhaul and last mile buildout. TV White Space technology has proven itself

[1] *Unlicensed White Space Device Operations in the Television Bands*, Notice of Proposed Rulemaking, ET Docket No. 20-36, FCC 20-17 (rel. Mar. 2, 2020) ("*NPRM*"). The *NPRM* was published in the Federal Register on April 3, 2020 and established May 4, 2020 as the deadline for filing initial Comments. *See* 85 Fed. Reg. 18901 (Apr. 2, 2020).

as a powerful tool for expanding broadband access in hard-to-serve areas. Because of its superior propagation characteristics, unlicensed TVWS spectrum can serve as the infrastructure to support broadband internet connectivity for unserved and underserved consumers at a relatively low cost to providers.

First, PISC urges the Commission to authorize or require White Space Databases ("WSDBs") to utilize propagation models that take accurate account of real-world terrain and clutter in the local area where operators request use of TVWS channels. WSDBs currently over-protect TV viewers within standardized and static contours based on an outdated free space propagation model that takes no specific account of basic geographic features (e.g., mountains, dense forests), nor of buildings or other "clutter" that more sophisticated GIS models use. The Commission should authorize use of the Longley-Rice Irregular Terrain Model (ITM) methodology, which the Commission has authorized for automated frequency coordination by geolocation databases in other shared bands (e.g., 6 GHz).

Second, PISC supports the Commission's proposal to permit fixed WSDs to operate at higher power limits in locations where operators have 6 megahertz of separation from TV stations, at least in areas of the country with lower population densities.

Third, PISC likewise supports the Commission's proposal to increase the maximum height above average terrain ("HAAT") to 500 meters for fixed WSDs operating with at least 6 megahertz separation from TV stations.

Fourth, and relatedly, PISC urges the Commission not to limit the higher transmit power and HAAT limits proposed in the *NPRM* for fixed WSDs to "less congested areas" defined as a percentage of TV channels that are vacant. This definition is unnecessarily restrictive, since it's tied to the number of TV stations in operation rather than the specific interference environment.

If the Commission allows or requires WSDBs to make interference calculations using a terrain-based propagation model, such as the ITM model noted above, this would focus the calculation on power, elevation and the actual terrain in that local area rather than arbitrarily restricting the locations where higher-power WSDs can provide service.

Fifth, PISC urge the Commission to authorize higher-power TV White Space devices ("WSDs") on moveable platforms that can operate within a geofence. To facilitate the public interest benefits for education, agriculture, and many other purposes, PISC urges the Commission to adopt rules that would allow a geofence of available white space channels to be calculated across a pre-defined area, or a pre-planned route. The Commission should also make it clear that the list of available channels can differ across the geofence.

Sixth, the Commission should allow for higher power operations on channels immediately adjacent to television operations provided the WSD is separated by 3 megahertz from the adjacent TV channel. Three megahertz of spacing between a TVWS signal and a TV broadcast channel appears sufficient to avoid harmful interference to TV viewers at power levels even significantly greater than 100 milliwatts.

Seventh, PISC urges the Commission to authorize White Space Databases to take account of directional antenna characteristics rather than assume, unrealistically, that all antennas are omnidirectional. Doing so is critical to enable rural broadband deployments on a point-to-multipoint basis in many areas where ISPs cannot access TVWS, or all the actually vacant TVWS, today.

Finally, PISC supports the Commission's proposal to create a new class of narrowband WSDs with technical rules that facilitate applications relevant to the emerging Internet of Things (IoT), as well as remote monitoring, SCADA and other innovation.

II. TV White Space Technology has Proven it Can Extend Connectivity in Rural, Tribal and Other Unserved Areas, Helping to Close the Digital Divide

The United States still struggles with a cavernous digital divide that has left millions of Americans without access to high-speed broadband services. This divide particularly harms people in rural and low-income communities. The Commission's most recent Broadband Deployment Report stated that over 19 million Americans do not have access to high-speed broadband.[2] However, due to the prohibitive barrier that cost presents to millions of Americans in adopting broadband, as well as flaws in the Commission's Form 477 data collection program, that number is almost certainly much higher. The Pew Research Center found that only 56 percent of U.S. adults who make less than $30,000 a year reported having access to broadband at home, compared to 81 percent of those who make between $30,000 and $99,999 annually.[3] A separate Pew Research survey found that only 63 percent of rural Americans reported having home broadband, compared to 79 percent of suburban Americans and 75 percent of Americans living in urban areas.[4]

The digital divide, particularly in rural America, is likely much worse than the Commission can see through its own data collection. The Government Accountability Office,[5]

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[2] 2020 Broadband Deployment Report, GN Docket No. 19-285, at Fig. 1 (rel. April 24, 2020), https://docs.fcc.gov/public/attachments/FCC-20-50A1.pdf.

[3] Monica Anderson and Madhumitha Kumar, "Digital divide persists even as lower-income Americans make gains in tech adoption," Pew Research Center (May 7, 2019), https://www.pewresearch.org/fact-tank/2019/05/07/digital-divide-persists-even-as-lower-incomeamericans-make-gains-in-tech-adoption/. The U.S. Census Bureau's American Community Survey found a comparable divide. *See* "Household Income in the Last 12 Months (in 2018 Inflation-Adjusted Dollars) by Presence and Type of Internet Subscription in Household," U.S. Census Bureau, https://tinyurl.com/yczql45a.

[4] Andrew Perrin, "Digital gap between rural and nonrural America persists," Pew Research Center (May 31, 2019), https://www.pewresearch.org/fact-tank/2019/05/31/digital-gap-between-rural-and-nonruralamerica-persists/.

[5] Government Accountability Office, "Broadband Internet: FCC's Data Overstate Access on Tribal Lands" (Sept. 2018), https://www.gao.gov/assets/700/694386.pdf.

Microsoft,[6] and independent researchers[7] have found that the Form 477 data collection method likely overstates the availability of broadband by allowing internet service providers to mark an entire census block as being "served" even if only one location in that census tract is being served or could possibly be served. This methodology is most likely to overstate deployment in rural areas where census blocks tend to be larger than in cities or more populated areas.

Bipartisan agreement in Congress and at the Commission itself that Form 477 data is inaccurate resulted in the recent enactment of the *Broadband DATA Act*[8] and the *Establishing the Digital Opportunity Data Collection* Report & Order at the Commission.[9] Studies have found that the number of unserved Americans could be 42 million,[10] or even as high as 162 million.[11] Although the specifics of increasing the granularity of broadband mapping are the subject of other Commission actions, the vast divide between those who have access to broadband—whether due to cost or a lack of deployment in their area—and those who do not should be the focus of this proceeding.

The lack of deployment and higher costs in rural and tribal areas in particular underscore the urgency of boosting TV White Space technology and deployments to help bridge this gap.

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[6] Microsoft, "United States broadband availability and usage analysis" (accessed on May 4, 2020), https://news.microsoft.com/rural-broadband/#broadband-availability ("Microsoft Broadband Availability Analysis.").

[7] John Busby et al., "FCC Reports Broadband Unavailable to 21.3 Million Americans, BroadbandNow Study Indicates 42 Million Do Not Have Access," BroadbandNow Research (Feb. 3, 2020) https://broadbandnow.com/research/fcc-underestimates-unserved-by-50-percent ("BroadbandNow Report").

[8] "Bipartisan E&C Leaders Applaud Signing of 5G Security and Broadband Mapping Legislation," Energy and Commerce Committee Press Release (March 23, 2020), https://energycommerce.house.gov/newsroom/press-releases/bipartisan-ec-leaders-applaud-signing-of-5g-security-and-broadband-mapping.

[9] Fifth Report and Order, Memorandum Opinion and Order and Order on Reconsideration, and Further Notice of Proposed Rulemaking, WC Docket No. 17-287, WC Docket No. 11-42, and WC Docket No. 09-197 (rel. Nov. 14, 2019).

[10] *BroadbandNow Report*, *supra* note 7.

[11] *Microsoft Broadband Availability Analysis*, *supra* note 6.

These areas tend to have lower rates of broadband adoption due to the high costs for both backhaul and last mile buildout. The economic case (or rather, the lack thereof) for telecommunications companies and internet service providers in these areas has resulted in too many Americans settling for either no fixed terrestrial broadband access or at best an option to pay for very expensive satellite internet access that can be less reliable due to weather and inherent latency.

TV White Space technology has proven itself to be a powerful tool for expanding broadband access in hard-to-serve areas. Because of its superior propagation characteristics, this unlicensed spectrum can serve as the infrastructure to support broadband internet connectivity for unserved and underserved consumers at a relatively low cost to providers.[12] There is already a growing recent history showcasing how TVWS technology has been leveraged to meet a variety of challenging connectivity needs:

- Microsoft's Airband Initiative played a leading role in helping its partners (mostly ISPs in unserved rural and tribal communities) to bring broadband access to more than 630,000 million unserved people over the past 18 months.[13] One provider, Wisper Internet, has plans to extend service to nearly one million residents of unserved areas in Arkansas, Illinois, Indiana, Kansas, Missouri and Oklahoma.[14] Sacred Wind Communications plans to provide broadband connectivity to around 47,000 people both on and off Navajo lands in New

[12] Shelley McKinley, "Microsoft Airband: An annual update on connecting rural America," Microsoft Blog (March 5, 2020), https://blogs.microsoft.com/on-the-issues/2020/03/05/update-connecting-rural-america/ ("The price of TV white spaces devices (TVWS) – a new connectivity technology that's particularly useful in rural areas where laying cable simply isn't an option – continues to drop. In the last year, the cost of customer equipment has plummeted by 50%, all while achievable speeds have increased tenfold.") ("Microsoft 2020 Airband Update.").
[13] *Ibid.*
[14] *Ibid*.

Mexico, according to the company.[15] The company reports that its Airband ISP Program offers providers in 47 states plus Washington D.C. and Puerto Rico access to "critical assets, helping them connect rural communities."[16]

- A 2017 initiative spearheaded by the Appalachian Regional Commission and Garrett County, MD harnessed TVWS technology to provide broadband access to 3,000 rural and unserved households and small businesses in hard-to-serve areas. The project was declared a complete success and a model effort by Maryland Gov. Larry Hogan in 2017.[17] In a recent Brookings paper, Dr. Nicol Turner-Lee profiled Declaration Networks Group, the WISP that built out the Garrett Country initiative.[18]
- In 2018, Declaration Networks Group entered a partnership with Microsoft to deploy fixed wireless service, relying in part on TVWS, to more than 65,000 people in Accomack and Northampton Counties on the Eastern Shore of Virginia through 2021.[19] The Commission provided DNG additional funding in 2019 to support the company bringing broadband to 2,454 more homes in Garrett County over the next ten years.[20]

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[15] *Ibid.*
[16] *Ibid.*
[17] *See* Office of the Governor, "Governor Larry Hogan Announces Successful Rural Broadband Launch in Garrett County," Press Release (Oct. 12, 2017), http://governor.maryland.gov/2017/10/12/governorlarryhogan-announces-successful-rural-broadband-launch-in-garrett-county/. A feasibility study by Garrett County's economic development office "concluded that a public-private partnership using fixed wireless technology (TV White Space (TVWS) and other unlicensed spectrum) is the best solution for the rugged, remote areas of Garrett County." Garrett County, Office of Economic Development, "Rural Broadband Expansion – Home," https://www.garrettcounty.org/broadband.
[18] Nicol Turner-Lee, "From Rural Digital Divides to Local Solutions," The Brookings Institution (April 2, 2020), https://www.brookings.edu/longform/from-rural-digital-divides-to-local-solutions/?utm_campaign=Center%20for%20Technology%20Innovation&utm_source=hs_email&utm_medium=email&utm_content=85956984.
[19] *Ibid.*
[20] *Ibid.*

- Rise Broadband uses TVWS at 470-698 MHz to deploy broadband in rural areas following strong results from its initial testing.[21] Last year, Rise put TVWS equipment on its first three towers in rural Illinois, and subsequently reported that all of the lab and field testing showed that the service could provide speeds faster than 25 mbps download by 3 mbps upload.[22] Rise also reported that using TVWS empowers the company to bring high-speed broadband at greater distances.[23]
- A collaborative pilot program that used TVWS in Virginia to close the homework gap, a consortium including Mid-Atlantic Broadband Communities Corporation, Microsoft and the Charlotte County and Halifax County Public Schools used TV White Space devices produced by Adaptrum, a California company, to extend the broadband access from 18 schools in the Charlotte County and Halifax County public school districts to the households of eligible students lacking access to broadband at home.[24] As Microsoft told Commission: "The pilot project served one of Virginia's neediest and most underserved student populations: median incomes in Charlotte and Halifax counties are roughly half the state average, the poverty rate in these counties is almost double the state average, and their college graduation rates are half the national average. **The pilot project provided access to over 200 households which otherwise lacked access to broadband**."[25]

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[21] Monica Alleven, "Rise Broadband encouraged by TV white space, 60 GHz speeds," FierceWireless (March 20, 2019), https://www.fiercewireless.com/wireless/rise-broadband-encouraged-by-tv-whitespace-60-ghz-speeds.
[22] *Ibid.*
[23] *Ibid.*
[24] Ex Parte Letter from Microsoft, ET Docket No. 20-36, CC Docket No. 02-6, WC Docket No. 10-90, WC Docket No. 13-184, and WT Docket No. 18- 353 (March 17, 2020), https://ecfsapi.fcc.gov/file/103172602803538/Microsoft%20Ex%20Parte%20-%203.17.2020.pdf.
[25] *Ibid.* Emphasis added. The pilot ended due to current E-Rate restrictions on the extension of school networks to serve students' educational needs off campus. Nevertheless, Adaptrum and B2X, a local ISP, continue to provide free connectivity to about 80 households, which Adaptrum uses as a testbed for release of new TV White Space products and features.

- The **Gigabit Libraries Project**, supported by the federal Institute for Museum and Library Services (IMLS), awarded grants for nine projects in 2017 to harness TVWS to "support remote fixed and portable library access points at new locations in their communities" and has continued to do so since.[26] Underserved libraries and communities in Kalamazoo, MI; State College, PA; Millinocket, ME; Milledgeville, GA; Beatrice, NE; Huron, SD; and Toppenish, WA; Torreon, NM, Acoma, NM; with Mescalero, NM and Douglas, AZ (pending completion of installation) have received grants. Libraries partnering with schools, clinics, colleges and other anchor institutions, as second responders, install dual-use, wide area wireless networks using TVWS spectrum and Wi-Fi to both extend broadband access and strengthen community resilience against disasters.[27]
- **The Department of Veterans Affairs**, is partnering with Microsoft's Airband Initiative to improve access for veterans in rural areas. Microsoft committed to offering "capital, technology expertise and training resources."[28]
- **An agribusiness TVWS effort**, supported by Microsoft, seeks to utilize TVWS technology to improve precision agriculture. The Commission granted the project an experimental license in March 2017.[29]
- **The Air-U deployment at West Virginia University**, initiated by New America's Wireless Future Program, showcased the capability TVWS has to bring Wi-Fi connectivity outdoors at a low cost to public areas on campuses without connectivity and that have characteristics

[26] Gigabit Libraries Network, "Winners of 'Beyond the Walls' Awards Announced," Press Release (May 9, 2017), http://giglibraries.net/BeyondTheWallsAnnouncement.
[27] "Broadband Communities – News & Views," Broadband Community Wires (Sep. 7, 2018), http://bbpmag.com/wordpress2/2018/09/libraries-whitespace-project-wins-imls-leadership-grant-2/.
[28] Joan Engebretson, "Microsoft, Veterans Affairs Partner on Rural Broadband," Telecompetitor (May 23, 2019), https://www.telecompetitor.com/microsoft-veterans-affairs-partner-on-rural-broadband/.
[29] Id..; *see also* Microsoft Corporation, "Application for New or Modified Radio Station Under Part 5 of FCC Rules," File No. 0136-EX-CN-2017 (submitted Mar. 3, 2017).

rendering conventional Wi-Fi difficult due to distance from backhaul (in this case, the vast campus of WVU).

- **The Yurok Tribe in northern CA** received grants in 2010 from the USDA Rural Utilities Service and the California Consumer Protection Agency to bring broadband access to the reservation.[30] The Yurok Tribe used TVWS technology due to its ability to "penetrate forests" and the fact that TVWS "requires far fewer towers and less disturbance of the Tribe's culturally rich landscape,"[31] adding, "The Tribe will be installing only three new 60-foot towers and adding additional equipment on three existing towers. Standard broadband towers are typically 100 feet tall [but the TVWS] signals cannot be impeded by physical structures."[32] Although this initiative is a decade old, it illustrates how the unique propagation characteristics of TVWS can have a large impact in remote areas, such as where the Yurok Tribe live, that otherwise have no viable options for broadband access.

III. The Commission Should Authorize TV Bands Databases to Employ Terrain-Based and Other Real-World Propagation Models

PISC urges the Commission to authorize White Space Databases ("WSDBs") to utilize one or more terrain-based propagation models as an option for calculating allowable channels, power and HAAT at a particular location. Under current rules, WSDBs over-protect TV viewers within standardized and static contours calculated using an unrealistic and overly restrictive free

[30] Yurok Tribe Information Services Department, "A Rural Broadband Model" (2011), http://www.yuroktribe.org/departments/infoservices/documents/A_Rural_Broadband_Model.pdf at 1.
[31] Carlson Wireless Technologies, "Yurok Tribe First to Benefit from the New Remote Broadband Technology Offered by Carlson Wireless," Carlson Wireless Technologies Press Release (Jan. 25, 2011), https://www.carlsonwireless.com/press-releases/yurok-tribe-first-benefit-new-remote-broadband-technology-offered-carlson-wireless/.
[32] *Yurok Today: The Voice of the Yurok People* at 7 (2011), https://www.yuroktribe.org/documents/newsletter_february.pdf.

space propagation model that considers only the average height above terrain in a given direction, while taking no specific account of basic geographic features (e.g., mountains, dense forests), nor of trees, buildings or other "clutter" that more sophisticated GIS models use.[33]

To facilitate this modeling, the Commission should authorize use of the Longley-Rice Irregular Terrain Model (ITM) methodology, which has now been authorized by the Commission to coordinate spectrum sharing in other bands. The CBRS Spectrum Access Systems ("SAS") uses the ITM to calculate interference over longer distances to protect U.S. Navy radar operations and other incumbents in the 3.5 GHz band.[34] More recently the Commission authorized the use of terrain-based and clutter models by Automated Frequency Coordination ("AFCs") in the 6 GHz Report and Order, adopted 5-0 at its April monthly meeting, to protect incumbents and govern access for Wi-Fi and other unlicensed services in the U-NII-5 and U-NII-7 bands.[35] AFCs will use ITM to calculate path loss for distances further than 1 kilometer, both protecting 6 GHz band incumbents and promoting more intensive and productive spectrum use. AFCs are also authorized to use a supplemental model to apply clutter losses.[36]

Although ITM was considered computationally complex decades ago, authorizing its use for coordinating use between TVWS and TV channel operations will both bring the TVWS rules into better alignment with more recent spectrum sharing frameworks – particularly CBRS and 6

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[33] *See Automated Frequency Coordination: An Established Tool for Modern Spectrum Management,* Dynamic Spectrum Alliance, at 23 (March 2019), available at http://dynamicspectrumalliance.org/wp-content/uploads/2019/03/DSA_DB-Report_Final_03122019.pdf. The report notes that the TVWS rules adopted in the United Kingdom use more granular data to ensure the use of TVWS is limited only as needed to protect nearby TV viewing. "Ofcom's TVWS rules, promulgated later and with the benefit of more granular pixel-based simulations of TV signal strength, permits more accurate database calculations and hence both more bandwidth for WSDs and more protection for viewers."

[34] *See* WinnForum Requirement R2-SGN-03, et al., in WINNF-TS-0112v1.8.0.

[35] Report and Order and Further Notice of Proposed Rulemaking, *Unlicensed Use of the 6 GHz Band,* ET Docket No. 18-295 and GN Docket No. 17-183 (rel. Apr. 24, 2020).

[36] *Ibid.* We recognize that clutter modeling will be important for TVWS in rural areas, since very low-band TV frequencies have lower clutter losses than do mid-band 6 GHz frequencies.

GHz – and support the more accurate and granular calculations that could facilitate other productive changes proposed in the *NPRM*. In sum, PISC urges the Commission to authorize WSDBs to utilize real-world propagation models that take accurate account of real-world terrain and clutter losses in the local area where operators request use of TVWS.

IV. The Commission Should Permit Higher Power and HAAT Limits for Fixed White Space Devices, While Sunsetting the 'Less Congested Areas' Restriction

The Public Interest Spectrum Coalition supports the Commission's proposal to permit fixed WSDs to operate at higher power limits on channels with 6 megahertz or greater separation from TV stations, at least in areas of the country with lower population densities. PISC fully agrees with the Commission's finding that allowing fixed WSD operations at a higher EIRP limit in less congested areas—and therefore rural areas—will empower TVWS networks "to reach users at greater distances, thus enabling improved broadband coverage at less cost in these hard-to-reach areas."[37] Allowing fixed WSDs to operate at a maximum 16 Watts EIRP is a modest change that allows TVWS operators to cover more customers with a given amount of investment, a critical factor in the availability and affordability of rural broadband.

PISC likewise supports the Commission's proposal to increase the maximum height above average terrain ("HAAT") to 500 meters for fixed WSDs operating with at least 6 megahertz separation from TV stations.[38] This change would enable ISPs to better serve communities with greatly differing gradations of height above mean sea level across the 360 radials drawn from the WSD site. Increasing the HAAT to 500 meters would particularly help rural communities situated in valleys or at the base of mountains, where the transmitter could be

[37] *NPRM* ¶ 12.
[38] *NPRM* at ¶ 17.

installed somewhere above the community on a natural feature—a ledge or a ridge—to bring point-to-multipoint broadband access to the people who live in that surrounding area. This might not be a widespread use case, but because extending broadband access in these locations is so challenging, the Commission should adopt this change—particularly since in these niche cases it is likely that the cost of deploying fixed broadband is far more expensive for both providers and consumers that TVWS is likely the most economically sound option.

At the same time, PISC urges the Commission not to limit the higher transmit power and HAAT limits proposed in the *NPRM* for fixed WSDs to "less congested areas" defined as a percentage of TV channels that are vacant.[39] This definition is unnecessarily restrictive, since it's tied to the number of TV stations in operation rather than the specific interference environment that can be calculated in a more granular way by a White Space Database. If the Commission allows or requires WSDBs to make interference calculations using a terrain-based propagation model, such as the Longley-Rice ITM model, as we propose above, this would focus the definition on power, elevation and the actual terrain in that local area rather than arbitrarily restricting the areas where higher-power WSDs can provide service. White Space Databases are entirely capable of calculating a maximum allowable power level considering the height, location, terrain and potentially the clutter environment as well.

While years ago the "less congested areas" concept provided a useful rule of thumb, with terrain-based modeling and more sophisticated TVDBs it seems unnecessary to take into account the number of occupied broadcast channels that are not first- or second-adjacent to the channel

[39] *NPRM* at ¶¶ 35-36. The concept of "less congested areas" provides that "fixed white space devices are allowed to operate in the low VHF, high VHF, and UHF TV bands in 'less congested' locations where within the band of intended operation at least half of the TV channels that will continue to be allocated and assigned only for broadcast service are unused for broadcast and other protected services and are available for white space device use." *Ibid*.

used by the WSD. If a certified White Space Database has the capability, it should be allowed to authorize operation up to the maximum power allowable for a fixed WSD operating with 6 megahertz or more separation from an occupied TV channel. Shifting to ITM negates any potential need for higher power devices to be restricted to "less congested" areas, instead promoting spectrum efficiency that will support higher rates of deployment in areas regardless of how many TV stations happen to be operating more than 6 megahertz in frequency from the TVWS user.

The Commission should also consider eliminating the current restriction on height above ground level ("AGL").[40] Since interference calculations are done based upon HAAT instead of height AGL, this renders the separate AGL metric unnecessary. This limit would also be unnecessary to the extent a real-world, terrain-based propagation model is used.

The Commission should do everything possible to increase the ability of broadband providers to leverage TVWS as a method of bringing high-speed broadband to unserved and underserved consumers at the lowest possible cost. Limiting providers' ability to extend broadband access in rural, tribal, and other hard-to-serve areas will in turn limit the efficacy of these rule changes in the effort to bridge the digital divide, reach more consumers, and open up more spectrum-as-infrastructure for ISPs.

V. The Commission Should Enable White Space Devices on Portable Platforms, Including School Buses, within Geofenced Areas Verified by the TV Bands Database

The Public Interest Spectrum Coalition urges the Commission to authorize higher-power TV White Space devices ("WSDs") on moveable platforms that can operate within a geofence.

[40] *NPRM* ¶ 26.

Our groups support the Commission's proposal to allow WSDs "to operate on TV Channels 2-35 on mobile platforms within geo-fenced areas at higher power levels than the rules currently permit for portable devices, ...[41] We believe this will spur innovation and productivity as farms, ranches and facilities sprawled across campus-like settings take advantage of the superior propagation of TVWS to connect agricultural equipment and other assets that are mobile within a local area. Adopting this policy also has the significant potential to help bridge the Homework Gap, particularly during the COVID-19 pandemic where schools and local governments are seeking novel solutions such as Wi-Fi-enabled buses and leveraging TVWS to connect students who do not have broadband access and cannot participate in remote learning.

Equipping school buses with Wi-Fi hotspots to connect students is particularly beneficial to students without broadband access at home, as the Coachella Valley school district demonstrated starting in 2015.[42] However, in the time of the COVID-19 pandemic, school districts are turning to the solution of using school buses as Wi-Fi hotspots to provide students without broadband access at home an option of getting online to facilitate the remote learning that has become necessary as the classroom has become the household. School districts in South Bend, Indiana,[43] in Illinois,[44] and South Carolina[45] are among those using school buses as Wi-Fi

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[41] *NPRM* at ¶ 39.

[42] Carter Evans, "Calif. school district puts Wi-Fi on wheels to close digital divide," CBS News (April 6, 2016), https://www.cbsnews.com/news/california-coachella-valley-school-district-closes-digital-divide-with-wifi-on-school-buses/.

[43] Allie Kirkman, "Where South Bend students can find buses with free access to Wi-Fi," The South Bend Tribune (March 18, 2020), https://www.southbendtribune.com/news/education/where-south-bend-students-can-find-buses-with-free-access/article_5abbd124-6921-11ea-b327-dfcc140fb44c.html.

[44] Lee V. Gaines, "While Schools Are Closed, Illinois District Uses Buses As Wi-Fi Hotspots," Illinois Public Media (March 19, 2020), https://will.illinois.edu/news/story/while-schools-are-closed-illinois-district-uses-buses-as-wi-fi-hotspots.

[45] Jacob Reynolds, "S.C. likely to roll out wifi-enabled buses on Monday as students learn at home," WLTX 19 (March 18, 2020), https://www.wltx.com/article/news/education/sc-likely-to-roll-out-wifi-enabled-buses-on-monday-as-students-learn-at-home/101-feb0f900-dd3c-41ea-88da-2dbacaefecf8.

hotspots to temporarily provide internet access to students who do not have it.[46] School buses can provide broadband connectivity to students in two different modes: as transportation, allowing students to study on the way to or from school; and also by being parked in strategic locations for use as a Wi-Fi hotspot for students without adequate internet access at home. With access to TVWS technology this solution would prove particularly helpful in both rural and low-income urban areas.

Allowing higher-power operations in a geofenced area would also greatly benefit farms as low-cost option for connectivity to support precision agriculture and the monitoring of soil and other conditions. For smart farming services, Wi-Fi networks are generally preferred to LTE and 4G networks for connectivity because once they have been deployed, they are less costly to sustain, customize, and operate.[47] Farmers and ranchers are able to use Wi-Fi-enabled smart agriculture to review data and weather conditions, as well as monitor crops, soil conditions, and the status of their animals.[48] Several pilot programs, such as Microsoft's FarmBeats program, and the partnership between BlueTown and the University of California's Kearney Agricultural Research and Education Center, have showcased the vast benefits smart agriculture powered by Wi-Fi can produce.[49]

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[46] Nicol Turner Lee, "How parking a wireless school bus can help all students get back to school," *The Hill* (March 30, 2020), https://thehill.com/opinion/education/490174-how-parking-a-wireless-school-bus-can-help-all-students-get-back-to-school.

[47] Stephanie Bergeron Kinch, "Agriculture: A cash cow for Wi-Fi-based IoT?," Wi-Fi NOW (June 2, 2018), https://wifinowevents.com/news-and-blog/agriculture-a-cash-cow-for-wi-fi-based-iot/. Agnov8's CEO Andrew Cameron "says that Wi-Fi has a competitive advantage over LTE and 4G networks because it is more economically feasible to maintain and operate once it is installed. Farmers can check data and conditions on their smartphones and tablets, and the system is compatible with other Wi-Fi-enabled technology. Wi-Fi works especially well for smaller farms, he says." *Ibid*.

[48] *Ibid*.

[49] Michael Calabrese and Amir Nasr, "The 5.9 GHz Band: Removing the Roadblock to Gigabit Wi-Fi," Wireless Future Project Issue Brief, New America's Open Technology Institute, at 20-21 (March 2020), https://ecfsapi.fcc.gov/file/103101043510278/OTI%205.9%20GHz%20Issue%20Brief_CalabreseNasr_FINAL_030920.pdf.

To facilitate the public interest benefits for education, agriculture, and many other purposes, PISC urges the Commission to adopt rules that would allow WSDBs to calculate a geofence of available white space channels throughout a pre-defined area, or a pre-planned route. The Commission should also make it clear that the list of available channels can differ across the geofence.

VI. The Commission Should Permit Higher Power Limits for Fixed Devices in First Adjacent Channels

The Commission should allow for higher power operations on channels immediately adjacent to television operations. As Microsoft highlighted in its initial petition, "because broadcasters are often dispersed throughout the band, rather than being efficiently packed, broadcasters can effectively restrict three times more spectrum than they actually use because each broadcaster is currently entitled to a 6 MHz buffer on either side of its own 6 MHz channel of operation."[50] This creates the problem, as the *NPRM* notes, "that, even in rural areas, there may not be three contiguous vacant channels available for use by white space devices . . .." PISC agrees with Microsoft and others that the Commission can and should authorize the use of fixed WSDs at higher power on the first-adjacent channel to television broadcasting where appropriate interference safeguards can be established."[51]

WISPA has similarly emphasized the need for this additional capacity in rural areas and that providers have the ability to use spectrum adjacent to TV channels to improve service: "With access to spectrum adjacent to TV broadcast channels – with appropriate interference

[50] Microsoft Corporation, Petition for Rulemaking, ET Docket No. 14-165 and RM-11840, at 6 (May 3, 2019) ("Microsoft Petition"), https://ecfsapi.fcc.gov/file/1050380945109/White%20Spaces%20Petition%20for%20Rulemaking%20(May%203% 202019).pdf.
[51] *NPRM* at ¶ 51.

protection – WISPs can aggregate more spectrum and more contiguous spectrum to increase capacity. In some cases, the additional spectrum may be the difference between investing in TV white space equipment and deploying service or forgoing the opportunity altogether."[52]

The Commission has previously proposed 4 watts EIRP fixed WSD operations in the middle 6 megahertz of two vacant channels, thereby creating a three-megahertz guard band between the unlicensed signal and TV channel operations.[53] Three megahertz of spacing between a TVWS signal and a TV broadcast channel appears sufficient to avoid harmful interference to TV viewers at power levels even higher than 100 milliwatts.

Tests in South Africa and Ghana have found 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. Although the Ghanaian trial looked into the potential effects on analog television broadcasts, the South African trial reviewed both analog and digital television broadcast stations.[54] U.S. providers contend that operations at an EIRP level of +32 dBm or higher on first-adjacent channels with a 3 megahertz separation from a local TV station would be even less likely to cause harmful interference. If the Commission were to additionally adopt terrain-based modeling, the resulting granularity of interference calculations by the White Space Database would also reduce the risk of harmful interference to nearby TV viewers.

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[52] Comments of WISPA, ET Docket No. 14-165 and RM-11840, at 3 (filed June 10, 2019).
[53] *Report and Order,* ET Docket No. 14-165 and GN Docket No. 12-268, at ¶¶ 34-36 (Rel. Aug. 11, 2015) (*2015 TV White Spaces Order*).
[54] 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," *IEEE Africon 2015*, 14-17, at 2 (Sept. 2015).

VII. The Commission Should Authorize Directional Antennas and Sectorization to Facilitate Fixed Point-to-Multipoint Deployments

To help promote the use of TVWS technology to bring high-speed broadband to rural and other underserved areas, PISC urges the Commission to authorize White Space Databases to take account of directional antenna characteristics rather than assume, unrealistically, that all antennas are omnidirectional. Doing so is critical to enable rural broadband deployments on a point-to-multipoint ("P2MP") basis in many areas where ISPs cannot access any or all of the actually vacant TVWS today. Accounting for directional antennas and the ability of WISPs to sectorize their networks also better protects TV band incumbents. As the CBRS Spectrum Access Systems already in commercial operation are demonstrating, geolocation databases now have the capability to factor in more variables, including directional antennas. This could be defined as a value-added service provided by the WSDB's for an additional fee.

VIII. The Commission Should Authorize a New Class of Narrowband White Space Devices

PISC supports the Commission's proposal to create a new class of narrowband WSDs with technical rules that facilitate applications relevant to the emerging Internet of Things (IoT), as well as remote monitoring, SCADA and other innovation. While the Commission could not have anticipated the use of TVWS for narrowband IoT a decade ago when it promulgated the original rules, it is clear today that use cases including agribusiness, utilities and environmental sensing could greatly benefit from NB-IoT on unlicensed spectrum with TV band propagation characteristics. Because of the clear economic benefits and low risk of interference, the Commission should adopt robust rules to facilitate this new class of NB-IoTs to take advantage of the superior propagation characteristics of TVWS spectrum.

IX. Conclusion

The Public Interest Spectrum Coalition urges the Commission to make these important changes to the rules governing TV White Spaces so that WISPs, school districts and other entities can extend broadband internet access to more locations in rural, tribal, low-income, and other hard-to-serve areas at a reasonable cost. The ability of automated frequency coordination to both safeguard incumbents from interference and enhance the efficient use of available spectrum in the public interest has advanced tremendously since TVWS technical rules were first adopted. TV White Space technology has now proven it has the capability to bridge the digital divide in meaningful ways, and the Commission should adopt these rule changes to capitalize on this potential to the fullest feasible extent.

Respectfully submitted,

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