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 THE PUBLIC INTEREST SPECTRUM COALITION

NEW AMERICA'S OPEN TECHNOLOGY INSTITUTE
TRIBAL DIGITAL VILLAGE
PUBLIC KNOWLEDGE
ACCESS HUMBOLDT
COMMON CAUSE
SCHOOLS, HEALTH & LIBRARIES BROADBAND (SHLB) COALITION
BENTON INSTITUTE FOR BROADBAND & SOCIETY
INSTITUTE FOR LOCAL SELF RELIANCE

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New America's Open Technology Institute, Tribal Digital Village, Access Humboldt, Public Knowledge, Common Cause, the Schools, Health, Libraries Broadband (SHLB) Coalition, the Institute for Local Self Reliance, and the Benton Institute for Broadband & Society, together the Public Interest Spectrum Coalition ("PISC"), respectfully submit the following Comments in response to the Further Notice of Proposed Rulemaking in the above-captioned proceeding.[1]

I. Introduction and Summary

The Public Interest Spectrum Coalition ("PISC") filed both comments and reply comments last year urging the Commission to update the decade-old TV White Space operating rules and thereby adopt common-sense reforms to enable more extensive wireless broadband

[1] Unlicensed White Space Device Operations in the Television Bands, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852 (2020) ("Report and Order" or "FNPRM").

deployment in rural and remote areas.[2] Among the modernization improvements that PISC proposed in those comments was to allow or require TVWS Databases to use real-world propagation modeling, and in particular terrain-based models such as Longley-Rice Irregular Terrain Model ("ITM"), to more accurately identify vacant broadcast frequencies in a local area.[3] PISC applauds the Commission for adopting this FNPRM to seek further comment on the feasibility of updating the TV White Space rules to allow this well-established technique.

PISC believes that authorizing the Longley-Rice ITM, or other terrain-based propagation models, will promote fixed wireless broadband in rural, Tribal, and other hard-to-serve areas. In far too many communities, TV band spectrum lays idle because the outdated rules for opportunistic TVWS use assume a flat earth with no mountains, valleys, or other topographical features that often render a distant TV signal both unavailable and irrelevant to the local residents who are being denied wireless broadband connections under the current rules.

Longley-Rice ITM should be an optional method for TV White Space operators and database providers to determine channel availability. Since 2015 the Commission has authorized terrain-based modeling in the two other shared bands coordinated by automated frequency control databases. A terrain-based modeling system similar to the one the Commission approved years ago to enhance opportunistic sharing in the Citizens Broadband Radio Service ("CBRS") band would also work well in this band, that is: in point-to-point mode, with the points located along *and* within the protection curve, rather than merely the nearest point.

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[2] *Ibid.;* Comments of the Public Interest Spectrum Coalition, ET Docket No. 20-36 (May 4, 2020), https://ecfsapi.fcc.gov/file/10505295902324/TVWS%20Public%20Interest%20Comments_FINAL_050420.pdf ("Comments of PISC"); Reply Comments of the Public Interest Spectrum Coalition, ET Docket No. 20-36 (June 2, 2020), https://ecfsapi.fcc.gov/file/1060338998163/PISC%20TVWS%20Reply%20Comments%20FINAL_AsFiled_060220.pdf ("Reply Comments of PISC").

[3] FNPRM ¶ 79.

II. Enhancing Access to TV White Spaces Can Play a Key Role in Bridging the Rural Digital Divide

The digital divide has left millions of people in the United States without access to broadband service due to cost and lack of availability.[4] Low-income, rural, Tribal, and historically marginalized communities have all been harmed disproportionately by this digital divide. The COVID-19 pandemic has revealed the extent of the disparity in high-speed internet access as millions of households have been unable to move to engage in remote learning, working, and communicating at home due to a lack of reliable or affordable broadband. The pandemic has also demonstrated the potential for fixed wireless solutions, such as those powered by TV White Spaces, to serve as solutions to the digital divide both in a pandemic world and in the future. The Commission's grant of Special Temporary Authority to more than 100 wireless internet service providers ("WISPs") to extend service to consumers in need during the COVID-19 pandemic using 5.9 GHz spectrum provides a useful proof point for the benefits of making fallow low- and mid-band spectrum available to the greatest extent possible so long as incumbent services (in this case television viewers) are reasonably protected from harmful interference.[5]

Even prior to the pandemic, school districts have shown that TV White Spaces can provide essential spectrum to facilitate remote learning services. Two southern Virginia school districts that petitioned the Commission for E-Rate cost allocation waivers to extend access to their school networks to students at home highlighted the benefits of the technology in their petition: "Signals broadcast over TVWS can travel long distances to deliver high bandwidth internet service at low network costs. The areas surrounding the Participating Schools are well-

[4] Comments of PISC at 5.
[5] "FCC Grants Wireless ISPs Temporary Access to Spectrum in 5.9 GHz Band to Meet Increase in Rural Broadband Demand During Pandemic," Federal Communications Commission Release (March 27, 2020), https://docs.fcc.gov/public/attachments/DOC-363358A1.pdf.

suited for TVWS deployment because they contain a large number of vacant UHF channels eligible for TVWS transmission."[6] Pilot programs in Boulder, Colorado, rural Virginia, and Nebraska that employ TV White Spaces for service deployment have been expanded both in the context of the COVID-19 pandemic and broadly to connect students and families in their local communities.[7] As OTI wrote in its recent E-Rate Report:

> School bus and community hotspot connectivity can be improved through the use of TVWS spectrum . . . particularly where cellular network signals are weak or monthly subscription costs are high…. These signals are likely to be much stronger and closer to a consistent Wi-Fi signal than those offered by mobile hotspots, and as the technology develops, more school districts could adopt TVWS to connect school buses with more reliable high-speed broadband for trips to and from school, and for future emergencies similar to the current pandemic.[8]

Specifically, the introduction of the the Longley-Rice ITM will serve the public interest, particularly as the method is already tried and tested in a variety of different spectrum sharing contexts.[9] The adoption of ITM for TV White Spaces will facilitate deployment in communities

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[6] Joint Petition For Clarification or, in the Alternative, Waiver of Microsoft Corporation, MidAtlantic Broadband Communities Corporation, Charlotte County Public Schools, Halifax County Public Schools, GCR Company, Kinex Telecom, WC Docket No. 13-184 (June 7, 2016), available at https://ecfsapi.fcc.gov/file/60002098542.pdf. *See also* Petition for Waiver on behalf of Boulder Valley School District Samuelson-Glushko Technology Law & Policy Clinic (TLPC), WC Docket No. 13-184, WC Docket No. 10-90 (May 16, 2020), available at https://ecfsapi.fcc.gov/file/60001843683.pdf.

[7] Michael Calabrese and Amir Nasr, "The Online Learning Equity Gap: Innovative Solutions to Connect All Students at Home," New America's Open Technology Institute Report (Nov. 17, 2020), https://www.newamerica.org/oti/reports/online-learning-equity-gap/ ("OTI E-Rate Report").

[8] *Ibid.*

[9] Comments of PISC at 12 ("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. 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-NII7 bands. 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.").

needlessly excluded because they are within the current 'one-size-fits-all' exclusion zones, but where in reality there is no distant television signal or viewership that needs protection from interference. The spectrum is simply vacant and, as under the CBRS rules, a geolocation database can readily make the computation and achieve greater efficiency.

There are many remote and hard-to-serve areas in rural, Tribal, small town and even exurban parts of the U.S. where the use of ITM would support expanded broadband services, either by extending cost-effective coverage or by increasing the capacity of TVWS services. The adoption of terrain-based modeling could be particularly beneficial in Tribal areas, where current rules often deny the use of many channels on which distant TV signals are not viewable.

Tribal Digital Village ("TDV"), a PISC member and co-filer of these comments, has encountered this obstacle in its attempts to deploy broadband on its lands in San Diego County. On the Santa Ysabel reservation, in North San Diego County, TDV has a TVWS deployment located at a high elevation between the Palomar and Laguna Mountains. When TDV was conducting tests to determine potential deployment of service using existing infrastructure, they found it difficult to find identify sufficient TV spectrum to extend wireless broadband service due to interference they saw in the direction of Los Angeles. However, although San Diego TV signals are blocked by terrain and use of those channels would be free of interference, the channels are not available under the current flat earth rules.

Similarly, on the Manzanita reservation in East County San Diego, TDV worked to deploy TVWS, and found through testing that on the West-facing side of that reservation most channels were not available due to interference from San Diego TV stations. TDV subsequently went over the ridgeline to test on the East side of that reservation, which led to the San Diego interference decreasing dramatically. However, due to the 'flat-earth' distance-based protection

rules, the San Diego channels are not available even east of the mountains, a needless restriction exacerbated by the fact that in those locations there is interference from the direction of Mexico. TDV did this same deployment testing on the Campo reservation, located further South and bordering border, and the interference TDV experienced all came from the direction of Mexico, rather than San Diego. Yet the Tribal lands were still considered too close to the San Diego TV transmitters in terms of distance.

The current rules needlessly prohibit TDV, as well as many other Tribal and rural broadband providers, from using fallow spectrum and create burdensome hurdles for local Tribes trying to deploy service to their communities. PISC member Access Humboldt reports similar problems for rural deployment in Humboldt County, California, where the Yurok Tribe was among the first to deploy TVWS technology nearly a decade ago.[10]

Terrain-based models such as Longley-Rice would provide Tribes and other rural communities with the real-world modeling they need to support deployment of broadband services in these hard-to-serve areas. The Commission should recognize that mountains, foothills and other natural obstacles obstruct signals and effectively limit TV broadcast contours. There are parts of the country where consumers are unable to receive *any* over-the-air television reception, but under the current flat-earth assumption the TV White Space Database shows zero white space availability.

The Commission should affirmatively support terrain-based propagation methods, such as Longley-Rice, that help to overcome the challenges (both financial and technical) that exacerbate the lack of broadband access in large swaths of the country that are harder-to-serve.

[10] "TV White Space: Yurok Tribe to Be First to Benefit from New Device Offered by Carlson Wireless," Carlson Wireless Technologies (Jan. 26, 2011) https://carlsonwireless.com/blog/tv-white-space-yurok-tribe-first-benefit-new-device-offered-carlson-wireless/.

The topographical challenges that have kept rural, Tribal, and hard-to-serve communities across the country behind in the digital divide should be accounted for in the propagation model that determines channel availability for broadband deployment. The current model is failing consumers, providers, and the public interest in this regard.

As PISC has argued previously, the Commission's current restrictions on the propagation models used by White Space Databases ("WSDBs") is overly protective of broadcast stations and works through "standardized and static contours calculated using an unrealistic and overly restrictive free 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."[11] The rules imposed by the Commission in all bands, including the TV band, should allow WISPs, school districts, and other internet service providers to take specific characteristics of the local terrain into account and thus identify and use the *actual* spectrum available in a community. For example, communities separated from a distant TV market by prominent hills or mountains should be allowed to re-use TV channel frequencies that are not readily viewable in that area, even if both uses lie within a protected contour that would be relevant in flat terrain.

III. Terrain Modeling and Longley-Rice ITM in Particular are Proven Means of Promoting Spectrum Access and Efficiency

The Commission should adopt a terrain-based model—specifically the Longley-Rice ITM model—because it would satisfy the Commission's goal to "better serve the white space device community as well as television broadcasters and other protected entities in the television

[11] Comments of PISC at 11-12.

bands."[12] The Longley-Rice ITM has been tested and proven in a wide range of contexts and offers the precise sort of advanced propagation modeling that would empower the dynamic spectrum sharing required to make TV White Spaces work as efficiently as possible.

Subsequent to its adoption of the original TVWS rules, the Commission authorized the Longley-Rice ITM methodology to facilitate spectrum sharing in other bands where opportunistic access is governed by an automated geolocation database. The CBRS Spectrum Access Systems ("SAS") employs the model to determine interference across longer distances to shield the operations of the U.S. Navy and other incumbents in the 3.5 GHz band.[13] Since the model has been found adequate to protect Navy operations and 5G networks built by Priority Access Licensees ("PALs"), there is no reason to believe that television viewers and stations will not be at least as well protected from actual harmful interference.

In addition, less than a year ago the Commission again approved the use of terrain-based and clutter models by Automated Frequency Coordination ("AFCs") to provide protection for incumbents and generally regulate access for Wi-Fi and other unlicensed operations in the U-NII-5 and U-NII-7 sub-bands.[14] ITM will serve to calculate path loss for distances further than 1 kilometer for AFCs, with the dual purpose of shielding 6 GHz band incumbents and catalyzing more intensive and effective spectrum use. AFCs are also permitted to use a supplemental model to account for clutter losses.[15] The Commission should authorize its use and thereby align the TVWS rules with modern spectrum sharing frameworks such CBRS and 6 GHz while

[12] FNPRM ¶ 84.
[13] *See* WinnForum Requirement R2-SGN-03, et al., in WINNF-TS-0112v1.8.0.
[14] 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).
[15] *Ibid*. We acknowledge that clutter modeling will be important for TVWS in rural areas, since very low-band TV frequencies have lower clutter losses compared to mid-band 6 GHz frequencies.

simultaneously complementing the goals of improved broadband access and efficient spectrum use sought by the Commission's Report and Order and FNPRM.[16]

The Longley-Rice ITM may have been considered complex and unproven a decade ago, but today it is par for the course in terms of spectrum sharing management and should be included among the tools available for WSDBs. ITM is computationally feasible and in line with similar contemporary spectrum sharing database management and should be available to TV White Space operators and database managers as well. As WISPA has noted, Longley-Rice is no longer bound by overly complex calculations with which it is associated:

> ITM may have been computationally intensive at the time it was introduced, but today, more than 50 years later, it is a trivial calculation. The SAS used for CBRS must compute ITM losses from every CBSD within hundreds of kilometers (over 400 km in some cases) of some coastal dynamic protection areas ('DPAs') to a grid of points 1 km spaced across the DPA, which covers thousands of square kilometers. Common propagation prediction calculators perform ITM calculations on desktop computers at the rate of thousands per second.[17]

ITM also aligns with current rules, under which a WSDB is not required to locate individual TV sets, just to protect all viewers inside the station's licensing contour—which serves as a rough proxy for where viewing is feasible and relevant. By taking account of real-world terrain, ITM propagation modeling makes the identification of TV White Space—as well as the protection of viewers—more precise.[18] Individual TV receivers beyond a station's service contour have never been protected from potential interference even if the household can display the signal clearly. It therefore seems particularly unnecessary to block the use of channels where the broadcast TV signal is not viewable by an ordinary home TV antenna.

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[16] Comments of PISC at 12-13.
[17] Comments of the Wireless Internet Service Providers Association, ET Docket No. 20-36 (May 4, 2020) at 5-6.
[18] Reply Comments of PISC at 9-10.

Adoption of ITM could benefit both broadcasters and wireless microphone operators. Fixed white space devices require diminished relative power spectral density for service, which significantly decreases the likelihood of interference, and could therefore benefit from the use of ITM for more precise shielding from white space devices. Broadcasters additionally stand to benefit from improved propagation modeling that accounts for geographical features. As Microsoft has argued:

> The use of a terrain-based propagation model combined with . . . a more accurate D/U ratio for TV receivers will produce more accurate interference protection calculations and will allow service providers to expand service to additional areas where doing so would otherwise be precluded by outdated models and assumptions.[19]

Further, authorizing the use of Longley-Rice ITM in TV White Space spectrum—and advanced propagation modeling broadly—is also important at this time because it advances the Commission's world-leading innovations in dynamic spectrum sharing and the agency's goal to promote the most intensive possible use of prime spectrum that is consistent with protecting incumbent services from harmful interference.[20] It is notable that while the Commission's current TVWS rules only account for the average height of terrain in a specific direction—while failing to consider basic natural features such as mountains, trees, buildings, and other clutter that are included in more sophisticated GIS models—the United Kingdom's TVWS rules do take terrain and other GIS data into account. Ofcom adopted its TVWS rules years after the FCC initially did, and in doing so included far more granular, pixel-based simulations of TV signal strength to govern channel availability. Ofcom's rules, while unique to the UK, are notable because they embrace the principle of enabling more precise database calculations and

[19] Comments of Microsoft, ET Docket No. 20-36 (May 4, 2020) at 30.
[20] *See generally* Michael Calabrese, *Use it or Share it: A New Default Policy for Spectrum Management*, Open Technology Institute at New America (March 2021), available at https://tinyurl.com/jdxdnfrk.

subsequently the dual benefit of more bandwidth for WSDs as well as more protection for TV viewers.[21]

IV. Point-to-Point Mode is Applicable for Terrain-Based Longley-Rice Model

PISC agrees with the Commission's suggestion that point-to-point mode should be applicable for fixed devices.[22] Longley-Rice should include a collection of points along and within the protection curve, rather than focusing on the closest point on the curve or the shortest distance to a receiver. The Commission currently employs similar protections in the 3.5 GHz CBRS band. As the Dynamic Spectrum Alliance stated in its comments last year, ITM represents a "preferred" propagation model that "protect[s] incumbents but maximize[s] spectrum utility by using point-to-point modeling" while also "account[ing] for the variability in terrain in calculating propagation and spectrum availability."[23]

Further, ITM in point-to-point mode would determine the allowable coverage area from a set of points that protects virtually all receivers, both active and potential, within the contour. Databases can readily analyze an area wide enough that calculations of signals account for all of the area that would currently be included in the existing distance-based tables. Because PISC believes the use of ITM should be made optional, it would be futile and counterproductive to require calculations accounting for distances farther than the Commission's existing separation distances. It is also improbable that harmful interference at that point would occur or, if it did,

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[21] *See* Automated Frequency Coordination: An Established Tool for Modern Spectrum Management, Dynamic Spectrum Alliance, at 23 (March 2019), available at http://dynamicspectrumalliance.org/wpcontent/uploads/2019/03/DSA_DB-Report_Final_03122019.pdf. ("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.")

[22] FNPRM ¶ 85.

[23] Comments of the Dynamic Spectrum Alliance, ET Docket No. 20-36 (May 4, 2020) at 21.

whether it is relevant to protect a viewer beyond the broadcaster's media market. Further, if ITM identifies harmful interference, an ISP should be able to revert back to the current model.

V. Longley-Rice Should be an Optional Means of Determining Channel Availability

The Commission should authorize the use of Longley-Rice ITM not as the exclusive method for the determination of white space channel availability, but as an optional alternative to the current protection model.[24] TVWS stakeholders should have the flexibility to work out whether ITM is a standard or value-added feature, a market-based calculus that could change with experience. TV White Space operators and database providers should be empowered to compare the results of ITM computations and reach their own conclusions, subject to review and approval by the Commission's Office of Engineering and Technology. The Commission should provide the maximum flexibility for TV White Space operators and database providers to ensure that the widest set of use cases can tap into the potential of TV White Spaces for broadband deployment.

VI. Conclusion

The Commission should authorize the Longley-Rice terrain-based model for the determination of available channels in local areas and thereby facilitate TV White Space broadband deployment. The authorization of ITM as an optional method for identifying the availability of channels clearly benefits the public interest by promoting efficient use of vacant TV band spectrum and provides wireless ISPs, schools, libraries, and other anchor institutions in rural, Tribal, and hard-to-serve areas the spectrum-as-infrastructure required to deploy broadband

[24] FNPRM ¶ 87.

for their communities. The Commission should authorize Longley-Rice ITM—a common-sense measure that would align TVWS with modern-day spectrum sharing—to boost broadband adoption.

Respectfully submitted,

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