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

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

COMMENTS OF THE DYNAMIC SPECTRUM ALLIANCE

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COMMENTS OF THE DYNAMIC SPECTRUM ALLIANCE

The Dynamic Spectrum Alliance ("DSA")[1] submits these comments in response to the Federal Communications Commission's (the "FCC" or "Commission") Further Notice of Proposed Rulemaking regarding the use of a terrain-based propagation model such as Longley-Rice for determining unlicensed TV White Space ("White Space") channel availability. [2]

DSA supports propagation models that protect incumbents but maximize spectrum utility. To this end, DSA supports propagation models that use point-to-point modeling and take into account the variability in terrain when calculating spectrum availability. Both the Longley-Rice and the ITU-R. P-1812 are terrain-based propagation models that may serve as the basis for White Space channel availability calculations.[3] Other models may also be appropriate, provided that they use point-to-point calculations and account for terrain variability. The DSA's preferred propagation model for determining White Space channel availability is Longley-Rice operated in the point-to-point mode.

The methodology the Commission uses to protect digital television from White Space devices is based on F-curves ("contour method") that are decades old. While the original model's

[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 the DSA members is available on the DSA's website at www.dynamicspectrumalliance.org/members/.
[2] Unlicensed White Space Device Operations in the Television Bands, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 12603 (2020) ("Report and Order" or "Further Notice").
[3] "Model Rules and Regulations for the Use of Television White Spaces v2.0", Dynamic Spectrum Alliance, December 2017 (http://dynamicspectrumalliance.org/wp-content/uploads/2018/01/Model-Rules-and-Regulations-for-the-use-of-TVWS.pdf) at Annexes A through C.

field strength contours have been refined and updated over time as a result of additional technical studies, one of the model's fundamental shortcomings remains the manner in which it addresses the effects of terrain on the transmitted broadcast television signal. Understandably, because the model is based on the average terrain over a limited range, the contour method works better in regions where the geography is flat, such as the midwestern region in the United States, than in regions where the geography is more hilly or mountainous. Not surprisingly, the difference between measured and predicted field strength values using the contour methodology is less where there is less variation in terrain across the coverage area.

The Longley-Rice model, also referred to as the Irregular Terrain Model, was developed for television frequency planning purposes. "The Longley-Rice radio propagation model is used to make predictions of radio field strength at specific geographic points based on the elevation profile of terrain between the transmitter and each specific reception point. A computer is needed to make these predictions because of the large number of reception points that must be individually examined."[4]

With the Longley-Rice model, the area subject to the calculation is divided into rectangular cells. The cell dimension is a user inputted parameter. The smaller the cell size, the smaller the associated root mean square error will be. However, with small cell sizes, more computing power will be required – all other things being equal. And unlike the contour methodology, Longley-Rice not only considers the terrain along a path, but it also accounts for

[4] United States Federal Communications Commission Office of Engineering Technology, OET BULLETIN No. 69 Longley-Rice Methodology for Evaluating TV Coverage and Interference, February 06, 2004.

atmospheric factors and other factors that vary by situation, time, and location. Some of these variables have default value and others can be tuned by the user. The output from the model may take on one of several forms at the user's option. The simplest of these forms is the reference attenuation. This is the median attenuation relative to a free space signal that should be observed on the set of all similar paths during times when atmospheric conditions correspond to a standard, well-mixed, atmosphere. The second form of output provides the two- or three-dimensional cumulative distribution of attenuation in which time, location, and situation variability are all accounted for.

The original Longley Rice model dates back to 1968. When the current version Longley Rice model was released in the 1980s, the computing power available at the time limited its use. With computing power increasing over the intervening decades and the advent of cloud computing, the key barrier for widespread use of the Longley-Rice model to make more granular field strength predictions has fallen significantly.

DSA noted as much in its 2019 publication *Automated Frequency Coordination and Established Tool for Modern Spectrum Management*, "while spectrum database coordination is nothing new, it has in recent years evolved from manual, to automated, to dynamic – adding automation and propagation modeling to static licensing data."[5] The report goes on to say, "Today, radio propagation modeling is well-established and rapidly becoming more granular as very detailed GIS data on terrain, clutter and other factors enhance the algorithms used by

[5] *Automated Frequency Coordination: An Established Tool for Modern Spectrum Management, Dynamic Spectrum Alliance*, March 2019 at 2. http://dynamicspectrumalliance.org/wp-content/uploads/2019/03/DSA_DB-Report_Final_03122019.pdf .

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spectrum databases to enforce compliance with interference protection rules."[6] More broadly, DSA believes that "coordination databases that incorporate real-world details on terrain, clutter (trees, buildings), and other GIS data sets that obviate the need for worst-case assumptions about interference will enable far more intensive spectrum use."[7]

DSA's comments in response to Microsoft's 2019 Petition for Rulemaking supported the idea of using terrain (and clutter) based models used for all WSDs and suggested that "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."[8]

This was followed up with DSA's comments to Unlicensed White Space Device Operations in the Television Bands NPRM that noted, "With the growth of the cloud computing model, the WSDB calculation of available channels in smaller cell sizes is not capacity constrained. It is now both desirable and feasible for the Commission to permit use of a terrain-based model to calculate the list of available channels for fixed WSD operations at a location and the maximum EIRP for each channel."[9]

DSA summarized its position in its Reply Comments to the Unlicensed White Space Devices proceeding concluding, "A terrain-based model can determine the separation distance beyond the protected contour on the co- and first-adjacent channels required to provide the requisite level of protection for incumbent broadcasters with greater accuracy than the current

[6] *Id.* at 23.
[7] *Id*. at 29.
[8] *See* Comments of the Dynamic Spectrum Alliance, ET Docket No. 14-165 and RM-11840, (filed June 10, 2019) at 13.
[9] *See* Comments of the Dynamic Spectrum Alliance, ET Docket No. 20-36, (filed on May 3, 2020) at 21-22.

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methodology based on the F-curves and HAAT. A terrain-based model can also be used to enable higher power WSD operations on the first adjacent channel and on a channel whose edge is located 3 MHz for the edge of the broadcast channel."[10]

DSA recognizes that, as with all models, there are some limitations. For example, our understanding is that the polarization parameter in the Longley-Rice must be specified as either horizontal or vertical. Typically, the DTV antenna is horizontally polarized and the fixed White Space device antenna is vertically polarized. DSA identified that cross polarization loss can be a significant loss mechanism for broadcast television, citing Annex 1 of Recommendation ITU-R BT.419 entitled, "Advantages to be gained by using orthogonal wave polarizations in the planning of television broadcasting services in the VHF and UHF bands."[11] Tests performed in the United Kingdom showed that for orthogonally polarized signals the median value of discrimination was 18 dB, and under the same conditions, the values exceeded at 90% and 10% of the receiving sites were about 9 dB and 25 dB respectively. Further the tests found that in practice, a combined discrimination value of 16 dB may be applied for all angles of azimuth in the terrestrial television band. Accordingly, this value could be expected to be exceeded at more than 50% of locations.[12] Even though Longley-Rice will not be able to incorporate real-world cross-polarization loss, which could be significant, DSA believes the benefits of using a terrain-based propagation to determine White Space channel availability outweigh any limitations.

[10] *See* Reply Comments of the Dynamic Spectrum Alliance, ET Docket No. 20-36, (filed on June 2, 2020) at 4-6.
[11] *See* Comments of the Dynamic Spectrum Alliance, ET Docket No. 20-36, (filed on May 3, 2020) at 26-27.
[12] *See Directivity and polarization discrimination of antennas in the reception of television broadcasting*, ITU-Recommendation ITU-R BT.419, Number BT.419-3 (06/90). June 1990. https://www.itu.int/dms_pubrec/itu-r/rec/bt/R-REC-BT.419-3-199006-I!!PDF-E.pdf.

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Another key parameter that the White Space Database Administrator ("WSDA") would input into the model is climate codes. The seven climate codes include equatorial, continental subtropical, maritime subtropical, desert, continental temperate, maritime temperate over land, and maritime temperate over sea. All other things being equal, the median path loss in a continental subtropical climate theoretically could be sufficiently different than the median path loss in a continental temperate environment, leading to a change in White Space channel availability if the incorrect climate code is entered. Other model tuning parameters may also be tied to local values. It speaks to the need for testing whether the Longley Rice model accurately determines White Space channel availability through simulation, using combinations of input parameters, rather than 'public testing,' presumably where the there is a physical test site set up at a particular location.

Additionally, given the number of model tuning parameters and their interrelationship, DSA suggests the Commission permit the WSDA to determine the parameter values. Settling on the model tuning parameters should not become a protracted negotiation amongst the various stakeholders. The bottom line is that the WSDA must ensure incumbents are protected from receiving harmful interference. In the end, use of Longley-Rice for determining White Space channel availability has to be certified by the Commission. This is the Commission's ultimate leverage that the tuning parameters are appropriate.

Finally, DSA believes Longley Rice could be applied broadly to determine White Space channel availability where the model is valid (e.g., replace the F-curves, used for incumbents other than television broadcasters). With that said, DSA understands there is a cost to add these

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additional features to the WSDBs' current line-of-sight model. While it is clear the White Spaces ecosystem benefits by additional spectrum being made available through use of a terrain-based model, it is unclear the extent to which the upfront cost of applying Longley Rice to each incumbent service can be recouped. For this reason, DSA suggests that the Commission provide WSDAs the option of applying a terrain-based model to the different incumbent services operating in the broadcast television bands.

Respectfully submitted,

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