**Before the**
**Federal Communications Commission**
**Washington, D.C. 20554**

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| In the Matter of | ) | |
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| Unlicensed Use of the 6 GHz Band | ) | ET Docket No. 18-295 |
| | ) | |
| Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz | ) | GN Docket No. 17-183 |
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# REPLY COMMENTS OF FEDERATED WIRELESS, INC.

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**REPLY COMMENTS OF FEDERATED WIRELESS, INC.**

## I. INTRODUCTION AND SUMMARY.

Federated Wireless, Inc. ("Federated Wireless") hereby replies to the comments filed in response to the Notice of Proposed Rulemaking ("NPRM") issued by the Federal Communications Commission ("Commission") in the above-captioned proceeding.[1] Federated Wireless commends the Commission for its continuing efforts to make available much-needed licensed, unlicensed, and shared spectrum for flexible use to meet the growing demand for broadband and next-generation wireless service. To achieve these ends, Federated Wireless urges the Commission to ensure that the rules governing the automated frequency coordination ("AFC") systems that will facilitate unlicensed spectrum access in the 5925-7125 MHz ("6 GHz") band are carefully targeted toward best serving the dual goals of fully protecting important incumbent operations and maximizing spectrum access for newly authorized unlicensed use.

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[1] *Unlicensed Use of the 6 GHz Band, Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, ET Docket No. 18-295, GN Docket No. 17-183, Notice of Proposed Rulemaking, FCC 18-147 (2018) ("NPRM").

## II. THE COMMISSION SHOULD PRIORITIZE THE UNDERLYING GOALS OF THIS PROCEEDING IN CHOOSING AN AFC MODEL.

Federated Wireless is pleased with the broad support in the record for the principles it advanced in its initial comments.[2] Specifically, commenters agreed that the Commission's rules for the design and implementation of the AFC system should reflect the characteristics of the band and its users in order to best enable the AFC systems to protect incumbent operations, including by enabling a "closed loop" architecture in which the AFC system is regularly synchronized with the Commission's databases with respect to incumbent licensee operations and a mechanism under which unlicensed devices regularly query the AFC system to obtain channel availability information.[3] Commenters similarly agreed that the AFC system should leverage the capabilities of the cloud, including artificial intelligence and machine learning tools made possible through the use of cloud computing, to optimize the functionality of AFC systems and simplify the development and deployment of unlicensed devices.[4] The record also demonstrates that the Commission could benefit the 6 GHz ecosystem by leveraging industry incentives to create a successful sharing regime by empowering multi-stakeholder bodies to develop consensus standards that foster the development of new services and protect incumbent operations.[5] Commenters also agreed that it is important that the Commission's rules promote competition and innovation among AFC system operators.[6] Federated Wireless reiterates the

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[2] *See* Comments of Federated Wireless, Inc., ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019).

[3] *See, e.g.*, Comments of Verizon, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019).

[4] *Id.*, Comments of Motorola, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019).

[5] Comments of the Wireless Innovation Forum, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019); Comments of Comsearch, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) ("Comsearch Comments").

[6] *See, e.g.* Comments of Hewlett Packard Enterprise Company, ET Docket No. 18-295, GN Docket No. 17-183, at 24 (filed Feb. 15, 2019); Comments of the RLAN Group, ET Docket No. 18-295, GN Docket No. 17-183, at 66-67 (filed Feb. 15, 2019) ("RLAN Group Comments").

importance of incorporating these principles in the design of the AFC system, and urges the Commission to act expeditiously to bring much-needed unlicensed spectrum to market to support new and innovative services.

In addition to the capabilities identified as important in its initial comments, Federated Wireless observes that the Commission's decisions with respect to the design and implementation of AFC systems should further be informed by the two prevailing goals of this proceeding, namely to meet the growing demand for wireless broadband connections by "expand[ing] unlicensed use of the spectrum," and to protect incumbent services in the band from "harmful interference" as a result of such expanded unlicensed access.[7] Federated Wireless therefore submits that the Commission's decisions with respect to the design and functionality of AFC systems, which will be responsible for calculating the protection zones around incumbent operations and determining which frequencies are available for unlicensed use in a given area, should be guided by reference to the fundamental question of how such a decision will enable appropriate incumbent protections while maximizing spectrum availability for unlicensed users. It is thus clear that the defining characteristic of an AFC system should not be the degree to which it is "simple" or "easy to implement,"[8] but rather the degree to which it is able to facilitate dense, efficient unlicensed spectrum use while fully protecting incumbents. Federated Wireless thus agrees with the RLAN Group that "AFC rules should be animated by a single principle: an AFC implementation must correctly determine whether a device operating at a given location, on a given range of frequencies, and at a given power level would exceed the chosen interference

[7] NPRM at para. 3.

[8] *Id.* at para. 25.

protection criterion for any FS receiver."[9] In performing this function, the AFC should have the ability to avail itself of the information needed to maximize the amount of spectrum available for unlicensed uses. This goal can be met, however, without mandating a specific, one-size-fits-all approach to AFC design and operation. Instead, the Commission should adopt a flexible set of rules that will allow different AFC implementations to accommodate a wide range of use cases and deployment scenarios, including those that can be served by a more simplistic implementation of an AFC system.

While simplicity and ease of implementation are certainly important qualities to consider, the Commission should avoid allowing these factors to dictate its decisions with respect to the capabilities that should be incorporated into the AFC system. Prioritizing simplicity and expediency in this manner would necessarily lead to trade-offs in the amount of spectrum available for unlicensed use, as the simplest implementations of AFC systems would have to rely on worst-case assumptions regarding the local radiofrequency environment, incumbent and unlicensed device configurations, the local clutter environment, and the location of unlicensed devices, among other inputs. The use of such worst-case assumptions would, in turn, require the AFC to implement larger exclusion zones than would otherwise be necessary if the AFC system's interference calculations relied on real-world, more refined inputs and models. A mandate of simplicity in the AFC system's implementation and capabilities would therefore artificially constrain the availability of unlicensed spectrum in the 6 GHz band. The Commission should no more mandate the implementation of a simplistic AFC system than it should adopt rules that necessitate complexity in the functioning of the AFC system. Instead, the Commission

[9] RLAN Group Comments at 50.

should enable industry to determine the level of refinement needed to support various use cases and deployment scenarios, as industry is best positioned to make those determinations. To do so, the Commission could allow the implementation of a range of AFC system solutions by allowing system operators to build more conservatism into the interference analysis of their AFC systems if they so choose. For example, instead of mandating that all AFC systems use the same propagation model, the Commission could instead simply define the upper bound for modeling propagation loss and thereby enable AFC system operators to design their systems to that upper bound, or to a more conservative level, depending on their and their customers' business needs.

Moreover, a reliance on worst-case assumptions to calculate the interference protections for incumbent operations would contradict the Commission's long-held view that employing worst-case assumptions leads to inefficient spectrum use and therefore does not serve the public interest. The Commission previously found that prescribing pre-defined "separation distances based on a worst case scenario without considering factors such as the actual technical characteristics" of the operations in a particular band may produce a result that is "spectrally inefficient and overly conservative."[10] Indeed, the "adoption of static protection zones based on worst case assumptions would overprotect" incumbents at the expense of new uses in shared bands and "would effectively prohibit new deployment in some geographic areas without any demonstration that such deployments would actually cause interference to individual incumbent

[10] *Office of Engineering and Technology Seeks to Supplement the Incentive Auction Proceeding Record Regarding Potential Interference Between Broadcast Television and Wireless Services*, Public Notice, ET Docket No. 14-14, GN Docket No. 12-268, 29 FCC Rcd 712, 715 (OET 2014).

stations. Such an approach would be inconsistent with the Commission's goals as it would be likely to impede innovation and erect barriers to efficient use."[11]

Conversely, the Commission has previously recognized that a model that accounts for "real-world deployment conditions" and calculates "interference effects based on average measurements will present a more realistic picture of the actual RF environment for the purpose of determining protection of incumbent systems."[12] By considering variables, such as building penetration loss, clutter, or antenna patterns, for instance, an AFC system could more accurately pinpoint what interference protection is actually needed to protect incumbent operations in a given area, thereby improving the efficiency of spectrum use and optimizing 6 GHz exclusion zones. The Commission should therefore ensure that the inputs used by the AFC system to calculate incumbent protection requirements and determine available frequencies for unlicensed use enable the AFC system to do so in a way that best advances the goals of this proceeding and do not sacrifice spectrum availability in the name of simplicity.

## III. THE INPUTS USED BY THE AFC SYSTEM TO CALCULATE INCUMBENT PROTECTION REQUIREMENTS WILL HAVE SIGNIFICANT EFFECTS ON THE AMOUNT OF SPECTRUM AVAILABLE FOR UNLICENSED USE.

As described above, the data on which the AFC relies in defining the exclusion zones necessary to protect incumbent 6 GHz users is crucial to determining the AFC system's capabilities in maximizing the amount of spectrum available for unlicensed use. An analysis could be conducted of the amount of spectrum available for unlicensed use in a given area pursuant to an AFC implementation that uses "simple" inputs for purposes of the AFC system's

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[11] *Amendment of the Commission's Rules With Regard to Commercial Operations in the 3550-3650 MHz Band*, GN Docket No. 12-354, Order on Reconsideration and Second Report and Order, FCC 16-55, at para. 254 (2016).

[12] *Id.* at paras. 106, 250.

interference calculations as compared with the amount of spectrum that could be made available using more refined, real-world data regarding inputs including, but not limited to, the following. While an AFC system relying on more simplistic models and conservative assumptions could satisfy the AFC system's obligation to protect incumbents and determine frequency availability for unlicensed use, the Commission's rules should not foreclose the ability of an AFC system operator to obtain and make use of more refined, real-world data to better target incumbent protections and optimize spectrum availability for unlicensed users.

*Propagation Model*. The simplest and most expedient implementation of a propagation model for use in the AFC system's interference calculations would be to use a free space path loss model. However, as the Commission noted in the NPRM, such a model "would effectively assume worst case conditions for every link and likely overestimate the potential interference in most cases and unnecessarily restrict access to the spectrum for unlicensed use."[13] Similarly, other widely used models such as the Irregular Terrain Model account for the effects of terrain above mean sea level elevation, surface refractivity, ground conductivity, antenna polarization, and climate on transmission loss, but do not "consider effects of buildings, foliage, or other man-made structures."[14] Another widely used model is the Hybrid model, extensively used in CBRS, which accounts for terrain elevation, site-specific corrections related spans of water, terrain slope, and mountains as well as some overall clutter for urban and suburban environment.[15] Such easily implemented propagation models may provide for simplicity in the AFC system, but

[13] NPRM at para. 49.

[14] *Id.*

[15] Hybrid model is a terminology used in CBRS to describe the propagation model used in the R2-SGN-04 of WINNF-TS-0112 for PPA and GWPZ calculations.

would likely lead to overprotection of incumbents and artificially limit the ability of unlicensed users to access the 6 GHz spectrum. A more refined propagation model, such as ITU-R P.2108,[16] ITU-R P.1411,[17] WINNER II,[18] or some hybrid thereof, that incorporates clutter, elevation, refractivity, and climate data could better account for clutter loss, building penetration loss,[19] and atmospheric loss to more accurately target the necessary incumbent protections and maximize unlicensed spectrum availability based on the local environment. For example, the model should ideally account for clutter in the immediate vicinity of nodes to be able to properly model dense urban clutter overshadowing a node. Moreover, the effects of atmospheric conditions, such as water vapor and oxygen, on 6 GHz propagation may be an additive element of the propagation.

*Building Penetration Loss*. Enabling the AFC system to consider attenuation losses from building materials in conducting its interference analyses will substantially improve the sharing scenario, particularly for those unlicensed access points that are deployed indoors. ITU models show median building entry losses of can vary from 18 dB for traditional construction to as much as 30 dB for thermally efficient construction and that the losses increase at larger elevation angles. Knowledge of the building construction material and the location of the unlicensed devices within the building would allow the AFC system to determine the appropriate value of building loss to include in its interference analysis. Indeed, studies have found that models that

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[16] *See* ITU-R Recommendation P.2108, "Prediction of Clutter Loss", Geneva: International Telecommunication Union, Radiocommunication Sector, June 2017.

[17] *See* ITU-R Recommendation P.1411, "Propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz", Geneva: International Telecommunication Union, Radiocommunication Sector, August 2017.

[18] *See WINNER II Channel Models*, https://www.cept.org/files/8339/winner2%20-%20final%20report.pdf.

[19] *See, e.g.*, ITU-R Recommendation P.1238, "Propagation data and prediction methods for the planning of indoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz," Geneva: International Telecommunications Union, Radiocommunication Sector, June 2017.

fail to appropriately consider the effect of building attenuation losses will have a negative effect on the availability of spectrum for shared access.[20]

*I/N Values*. Many commenters are promoting the use of a -6 dB I/N incumbent protection criterion, while the Commission proposed to employ a 0 dB I/N threshold in the NPRM.[21] The interference protection criterion is critical to determining the separation distance that must be maintained between co-channel access points and incumbent fixed link receivers. A 6 dB variation such as that currently being proposed is likely to have a significant impact on the size of the required separation distances needed to enforce incumbent protections and therefore on the number of access points that could be deployed in the 6 GHz band. It is critical that the rules governing unlicensed use in the 6 GHz band ensure that incumbent fixed service ("FS") operations are fully protected. However, a one-size-fits-all protection criterion approach necessarily requires the use of very conservative assumptions that base the protection requirements on worst-case incumbent link characteristics. To avoid such an outcome, which would constrain the availability of spectrum for unlicensed use in the 6 GHz band, the I/N protection criterion could be defined based on certain operational characteristics and environmental conditions of a particular FS link, including the height above ground level of the receiver, receive antenna gain pattern, operating frequency and bandwidth, and any additional gain terms in the interference link budget (fade margin, etc.).[22] In addition, FS operators could

[20] *See* Comsearch Comments at Appendix A.

[21] *See* RLAN Group Comments at 4; Comments of the Wi-Fi Alliance, ET Docket No. 18-295, GN Docket No. 17-183, at 24 (filed Feb. 15, 2019); Comments of the Fixed Wireless Communications Coalition, ET Docket No. 18-295, GN Docket No. 17-183, at 22 (filed Feb. 15, 2019).

[22] As a practical matter, incorporating the operational characteristics and environmental conditions of a particular FS link in an interference analysis is best accomplished through a C/I, not I/N, protection criterion.

seek additional protections or enter into arrangements with AFC system operators to receive less protection as necessary.[23] This more tailored, site-specific approach to incumbent FS link protection could be achieved through the use of AFC systems that are regularly updated to accept new protection criteria and that operate in a closed-loop manner with unlicensed devices periodically providing the information the AFC system needs to conduct its interference analyses and thereafter receiving updated frequency availability information.

*Unlicensed Device Location*. The simplest implementation of an AFC system would provide the system with very little knowledge of an unlicensed device's location. As such, the system would have to assume worst-case geolocation accuracy and worst-case antenna height, as well as assume that all unlicensed standard-power access points are deployed outdoors. These worst-case assumptions would lead to overstated incumbent protection requirements. In contrast, knowledge of a device's location with a reasonable degree of accuracy along the *x*, *y*, and *z* axes would allow for significantly more accurate interference analyses. In addition, if an AFC system knows whether a device is deployed outdoors or indoors, it can take building penetration loss into account when conducting its interference calculations, such that the system would be able to better facilitate robust unlicensed deployment and spectrum use.

*Incumbent Antenna Configuration*. The antenna pattern of an incumbent FS receiver will directly impact the shape and span of the required protection zone around such a receiver, and the ability of the AFC system to consider these antenna patterns will likewise have an effect on the availability of spectrum for unlicensed operations. The receive antenna gain can vary widely

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Nonetheless, the fact remains that the protection criterion can be tailored to the characteristics of a given link and not simply by reference to mere worst-case assumptions.

[23] *See, e.g.*, 47 C.F.R. § 96.17(e), (f) (permitting incumbent satellite earth station operators in the CBRS bands to agree to less stringent protection requirements or seek additional protections as needed).

in both the horizontal and vertical planes based on the location of the standard-power access point for which a computation to determine the protection zone is being performed. A simplistic model that employs worst-case assumptions, and thus assumes a wide receive antenna pattern, will apply high gain in all directions and as a result lead to overestimation of the potential for interference and required protection distances. Conversely, enabling the AFC system to leverage antenna patterns that more accurately reflect the real-world behavior of incumbent FS links in both the vertical and horizontal directions will allow the AFC system to produce a much more precise estimate of the gain for the locations outside the narrow beamwidth of FS links and thus better target the needed protections. This could be accomplished by leveraging the E and H plane or, if available, utilizing the 3D antenna patterns of incumbent FS receivers to ensure that the position of the standard-power access points is accounted for in both the horizontal and vertical planes.

## IV. THE AFC SYSTEM SHOULD POSSESS INTERFERENCING REPORTING AND MITIGATION CAPABILITIES

Federated Wireless agrees with those commenters who point out that incumbent operators should not bear the responsibility of identifying and mitigating the source of interference from unlicensed operations.[24] In all other spectrum-sharing paradigms—including unlicensed operation using Dynamic Frequency Selection, TV White Spaces, and CBRS—the responsibility for avoiding and mitigating interference events falls on the sharing system operator and/or shared access users. The Commission's rules for unlicensed operation in the 6 GHz band should therefore enable the AFC system to perform a function for which it is naturally suited, and naturally situated, namely interference resolution. With knowledge of an unlicensed device's

[24] *See, e.g.*, Comments of APCO International, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019).

geolocation to a reasonable degree of accuracy, the AFC system could aid in resolving instances in which an incumbent user experiences interference, rather than requiring the incumbent to deploy engineers in the field to seek out the source of interference using spectrum analyzers. Leveraging the AFC system's knowledge of unlicensed device locations and the local RF environment, as well as enabling the AFC system to receive interference reports from incumbent users, would allow the AFC to perform an important interference mitigation function. Moreover, the AFC should have the capability and information necessary to confirm and produce records of the requests for channel availability information and status of active unlicensed devices, as well as the associated computations used to identify the channels available for use by such unlicensed devices. In addition to allowing the AFC system to expedite interference mitigation and relieve incumbent operators of the need to manually seek out the source of interference from a service from which they are expressly protected under the Commission's rules, such a capability would also enable the AFC system to provide a resource to the Commission's Enforcement Bureau to aid in further analysis and resolution of interference events.

## V. CONCLUSION.

Federated Wireless applauds the Commission for its continued efforts to make available unlicensed spectrum to meet exponentially growing demand and support the development of new and innovative services. To ensure that its rules for the 6 GHz band best achieve these ends, Federated Wireless urges the Commission to adopt AFC rules that are carefully targeted toward

best serving the dual goals of fully protecting important incumbent operations and maximizing spectrum access for newly authorized unlicensed use.

Respectfully submitted,

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