Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D.C. 20554

In the Matter of	)	
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

COMMENTS OF DYNAMIC SPECTRUM ALLIANCE

Kalpak Gude
Dynamic Spectrum Alliance
3855 SW 153rd Drive
Beaverton, OR 97003

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INTRODUCTION AND SUMMARY

The Dynamic Spectrum Alliance (DSA)[1] welcomes the Federal Communications Commission's (FCC or Commission) Notice of Proposed Rulemaking on the 6 GHz band (NPRM).[2] The NPRM is a significant step in the right direction, addressing the nation's growing demand for wireless broadband by identifying new mid-band spectrum for unlicensed use. As the Commission is aware,[3] existing Wi-Fi spectrum is already overburdened in many locations, experiencing congestion at peak busy hours. Recent studies have concluded that the country needs a significant expansion in the amount of available unlicensed spectrum just to keep pace with existing technologies, and will need even more unlicensed spectrum to support the new and innovative uses that will maintain U.S. technological leadership.[4] The 6 GHz band is an ideal location in which to expand unlicensed use: the band's "virtually identical propagation properties" to the core 5 GHz bands and its "proximity" to those bands will help ensure that consumers and businesses can take advantage of this new spectrum in a quick and cost-effective manner.[5]

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

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

3 *See, e.g., id.* ¶¶ 3-7.

4 *E.g.*, Steve Methley & William Webb, Quotient Assocs. Ltd., *Wi-Fi Spectrum Needs Study* 26 (2017); Rolf de Vegt et al., Qualcomm Techs., Inc., *A Quantification of 5 GHz Unlicensed Band Spectrum Needs* (2016).

5 NPRM ¶ 19.

DSA applauds the Commission's recognition that dynamic spectrum access can maximize efficient use of the 6 GHz band by expanding unlicensed access while protecting the various incumbent users of the band. The automated frequency coordination (AFC) system proposed in the NPRM builds on the hard work of the Commission and industry stakeholders in this proceeding and in other bands to increase economic and consumer value of the nation's spectrum resources.[6] Since its founding in 2013, DSA has been at the forefront of advancing AFC technology and regulatory frameworks from below 1 GHz in the Television White Spaces to the mid-band from 2.4 GHz to 5.9 GHz and more recently in several millimetric bands, working with regulators and industry around the world to drive adoption of these proven techniques. Our members are well positioned to deliver on the Commission's AFC vision.

DSA recommends that the Commission adopt its proposed framework, but with an eye toward maximizing spectrum utilization in the band. AFC-governed standard-power devices and indoor-only low-power devices will greatly advance wireless broadband while protecting incumbents that primarily operate at very high powers outdoors. Allowing indoor-only unlicensed devices that operate at much lower powers throughout the entire 6 GHz band, wherever technically feasible, is a commonsense sharing approach fully supported by the DSA. Allowing standard-power access, especially outdoors, through automated frequency coordination, is another important step in ensuring underutilized spectrum is put to more productive use, and is the focus of these comments. DSA recommends that the Commission ensure that its technical and operational rules related to AFC allow innovators to realize the 6 GHz band's full potential. The Commission can do so by adopting simple, flexible, ends-oriented rules that allow diverse AFC

[6] *See, e.g., id.* ¶ 23 n.66 (identifying frequency coordination database systems in bands for "[w]hite space and Citizens Broadband Radio Service devices" under 47 C.F.R. §§ 15.711(c)(2), 96.39(c), and 96.59(a)).

system implementations to address a broad range of access point and device applications and business models. Specifically, DSA recommends that the Commission: (1) permit AFC-governed standard-power operations in the U-NII-5 and U-NII-7 bands, as well as in U-NII-8 outside of Broadcast Auxiliary Service (BAS) areas; (2) reject calls to over-regulate through rules that dictate the details of AFC implementations; (3) permit multiple AFC operators to compete in the marketplace; (4) allow AFC operators to use two- or three-dimensional approaches to calculating permitted areas of operation; (5) ensure consumers can use the 6 GHz band for AFC-enabled mobile devices; and (6) allow higher-gain antennas and steerable point-to-point and point-to-multipoint operations governed by AFC.

I. AFC Is an Established Tool for Modern Spectrum Management.

In recent years, as demand for wireless connectivity has surged, the use of databases to coordinate more intensive and efficient spectrum sharing has emerged as a critical regulatory tool. Regulators in a number of countries have authorized automated and even dynamic frequency coordination databases to manage real-time assignments in shared bands and to protect incumbent operations (including military and public safety systems) from harmful interference. In the United States, Congress in 2018 mandated development of a national spectrum plan that includes examining "existing and planned databases or spectrum access systems designed to promote spectrum sharing."[7]

The reliance on automated databases to facilitate more advanced and low-cost telecommunications has a long and storied history that extends from the replacement of manual switchboard operators to the Domain Name Service databases that serve as the essential circulatory system of the Internet itself. These advances have proven so beneficial in promoting universal and

[7] Ray Baum's Act of 2018, Pub. L. 115–141, § 618, 132 Stat. 1080, 1113 (2018).

affordable communication that they are taken for granted today. Although the use of databases as a tool for spectrum management is a more recent development, it has proven no less compelling as a means of achieving large-scale, low-cost, and virtually real-time access to communications capacity that would otherwise go unused.

The use of databases to coordinate spectrum assignments has evolved, but is nothing new. AFCs simply automate the process of manual spectrum coordination. The basic steps are exactly the same as in a manual coordination process. What is new are (1) surging consumer demand for wireless connectivity that requires intensive sharing of underutilized frequency bands; (2) significant improvements in computer power to efficiently and rapidly run advanced propagation analyses and coordinate devices and users in near real-time; and (3) more agile wireless equipment that can interact directly with a dynamic frequency coordination database. There is no question that the technical ability exists to automate frequency coordination and thereby lower transaction costs, use spectrum more efficiently, speed time to market, protect incumbents from interference with certainty, and generally expand the supply of wireless connectivity that is fast becoming, like electricity, a critical input for most other industries and economic activity.

AFC systems are known by different names in different frequency bands. They can also be more or less dynamic with respect to inputs. However, the basic steps are the same and the outcome is determined by the rules and framework adopted by each national regulatory authority. Frequency coordination databases facilitate spectrum sharing by carrying out at least the following core functions:

- Protect incumbent licensees or other users from interference caused by entrants with lower priority (and, in some cases, coordinate among users with the same priority).
- Provide authoritative and, in some bands, virtually real-time decisions on requests to transmit or assign usage rights.
- Enforce the use of authorized devices.
- Monitor spectrum assignments and, in some cases, actual usage.

The United States has led the world in the development of spectrum coordination technology and policy, and many other countries are seeing the wisdom of the Commission's efforts. In the United States alone, spectrum coordination databases have demonstrated the ability to facilitate a variety of regulatory frameworks, including licensed, unlicensed, and lightly licensed sharing regimes. In some bands, databases facilitate coordination among licensees of the same type, while in other bands the coordination is among site-based users licensed for different services. Regulators now have the models and technologies to authorize AFC systems that best fit the regulators' policy goals, which will vary depending on the nature of the incumbent service, the propagation characteristics and size of the band, the nature of the shared-access use, and other factors. In all cases the grant provided by the AFC is the equivalent to a time-bounded authorization (or license) to transmit.

Spectrum coordination solutions are also a force multiplier for regulators: by automating assignments and monitoring usage, databases enhance efficient allocation of national spectrum resources while strengthening enforcement and ensuring the protection of incumbent users with a higher licensing priority. In addition, database coordination creates an opportunity to achieve more intensive and efficient use of a band by incorporating detailed Geographic Information Systems

data (*e.g.*, on terrain and clutter) and even dynamic data (*e.g.*, from spectrum sensing) that reflect the real-world spectrum environment on a very localized basis and thereby support far more sophisticated propagation and interference modeling. The availability, flexibility, and reliability of spectrum coordination systems make them a critical tool for the Commission to meet the growing and diverse spectrum needs of industry, government, national security, and individual users.

II. AFC Will Enable Successful Spectrum Sharing in the 6 GHz Band and Lay the Groundwork for Future Sharing Efforts.

AFC is the centerpiece of the Commission's pro-consumer, pro-innovation proposal in the NPRM. As the Commission has noted, the AFC proposal is the product of "good-faith effort" at compromise based on "detailed technical evaluations" to "accommodat[e] shared use" of the band without causing harmful interference to incumbent users.[8] The AFC will be positioned to succeed quickly because it leverages over a decade of regulatory innovation by the Commission in other bands and painstaking engineering work by multi-stakeholder organizations. DSA is committed to ensuring that this state-of-the-art dynamic access approach to spectrum sharing is a success.

As DSA has argued previously, spectrum sharing must be the "new normal" for FCC spectrum-management policy.[9] Treating licensed and unlicensed access to particular spectrum bands as mutually exclusive is wasteful and inefficient, avoidably leaving spectrum unused at some time and in some places. The opportunity costs of that outmoded approach will only increase as wireless uses of all kinds continue to multiply. Innovative technologies like the AFC's dynamic databases create opportunities to unlock previously unavailable spectrum or intensify spectrum

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8 *See id.* ¶ 17 & nn.50-51.

9 *E.g.*, Comments of Dynamic Spectrum Alliance at 2, GN Docket No. 17-183 (filed Oct. 2, 2017).

use without causing harmful interference to incumbent operations. DSA is optimistic that the Commission will issue final rules that establish the 6 GHz band as a benchmark example for future spectrum-sharing efforts.

III. A Robust AFC System Will Increase Spectrum Efficiency While Protecting Incumbent Users in the Band.

Facilitating unlicensed RLAN operations is the most logical way to increase intensity of spectrum use in the 6 GHz band. The Commission is correct that an AFC system for standard-power RLAN operations will protect fixed-service (FS) operators in the U-NII-5 and U-NII-7 bands. In addition, an AFC can enable standard-power RLAN operations to share with existing FS operations that are allowed to operate in U-NII-8 outside of BAS service areas. Because the RLAN devices that the Commission proposes to permit are fundamentally compatible and complementary with incumbent FS uses, harmful interference would be rare even without frequency coordination through an AFC. In addition, the AFC will address even the rare instances of possible harmful interference, and ensure that no single emitter increases noise at an FS receiver above acceptable levels.

A. FS and RLAN Deployments Are Complementary.

FS and RLAN deployments are complementary for several reasons. First, they occupy fundamentally different physical spaces, minimizing the chances of harmful interference. The average FS receiver height is 43 meters, whereas RLAN access points and client devices typically will be used at or around ground level, or else inside a building that will significantly mitigate any potential interference.[10] Moreover, the RKF Study the Commission cited in the NPRM forecast

[10] *See, e.g.*, RKF Engineering Services, *Frequency Sharing for Radio Local Area Networks in the 6 GHz Band* 24-26 (Jan. 2018) (RKF Study), *as attached to* Letter from Paul Margie, Counsel, Apple Inc., Broadcom Corporation, Facebook, Inc., Hewlett Packard Enterprise, and

that even by 2021, 98% of RLAN deployments will be indoors, versus only 2% outdoors.[11] RLAN deployments thus are overwhelmingly indoors and low to the ground (especially in the small minority of situations where they are outdoors), precisely the opposite of FS receivers, which are invariably mounted outdoors to serve their intended purpose, most often on the tops of tall structures.

Second, typical, well-engineered FS systems use high-quality, highly directional antennas. This protects these systems from harmful interference from RLAN devices, which would only have the possibility of impacting operations in extremely unlikely real-world scenarios. As the record already demonstrates, standard FS antennas reject at least 30 dB from outside signals ten degrees off the antenna's axis, and at least 10 dB from signals only two degrees off the antenna's axis.[12] Ultra-high performance antennas common in congested urban areas of greatest concern to incumbents offer vastly better rejection, of over 30 dB at two degrees off boresight and over 90 dB front-to-side and front-to-back ratios. Because FS receivers typically operate at significant heights, even the tiny percentage of RLAN devices that may operate outdoors or indoors at high elevation are exceedingly unlikely to deliver signals to FS receivers at angles and received-power levels that would overcome the antennas' rejection rates.

Microsoft Corporation to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 17-183 (filed Jan. 26, 2018).

11 RKF Study at 14.

12 *See* Letter from Apple Inc., Broadcom, Inc., Cisco Systems, Inc., Facebook, Inc., Google LLC, Hewlett Packard Enterprise, Intel Corporation, Microsoft Corporation, Qualcomm Incorporated, and Ruckus Networks, an ARRIS Company to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 17-183, at 9 (filed May 14, 2018).

Third, RLAN devices operate at very low duty cycles with low EIRP. The RKF Study, for example, concluded that RLAN devices would exhibit duty cycles around 0.44%,[13] with a weighted average EIRP of 19.28 dBm.[14] Thus, even the extremely rare RLAN devices that could conceivably cause harmful interference to FS links in "ideal" circumstances would, in reality, operate at EIRP levels unlikely to reach FS receivers at any meaningful power and, even if that did occur, would do so in very brief and infrequent bursts. Given this advantageous complementarity, it would be an unsustainable spectrum-management policy to allow FS operations' presence in the 6 GHz band to preclude additional uses. RLAN sharing is an ideal fit for making more efficient use of this spectrum without disrupting existing links—this is exactly the kind of sharing opportunity that the Commission must recognize if it is to provide consumers with the spectrum resources they will need in the future. Forgoing the opportunity here under such favorable circumstances would undermine Commission efforts to allow sharing—including opportunities for licensed services to enter bands with government or satellite incumbents—in other bands.

B. AFC Will Prevent Harmful Interference to FS Links.

The RKF Study and other evidence before the Commission demonstrate that, even without AFC, it is very unlikely that an RLAN access point will increase noise at an FS receiver sufficiently to cause harmful interference. The FCC's proposal to layer a requirement that standard-power RLANs be controlled by an AFC system addresses even that small possibility by using Commission data to identify available frequencies for RLANs only where operations will not cause harmful interference.

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[13] RKF Study at 15.

[14] *See id.* at 17-23.

The AFC approach will allow FS operators to add new sites and organically modify or move existing sites. To account for these changes, AFCs will periodically refresh their pulls of available Universal Licensing System (ULS) data and update their determinations of where RLAN operations are permissible. This is a straightforward process for AFC operators to implement. Because FS incumbents are required to register their transmitters and receivers long before the links go online, a one-month recheck interval is more than sufficient to provide them robust (and likely overly conservative) protection.

IV. The Commission Should Adopt Simple, Flexible, Ends-Oriented Rules for AFC Systems, Rather than Prescribing Rigid Requirements for System Operation.

The Commission has "envision[ed] the AFC system to be a simple database that is easy to implement."[15] That is undoubtably the right approach, and the Commission's final rules should reflect that guiding principle. The best way for the Commission to ensure success in the 6 GHz band is to issue simple, flexible, ends-oriented rules, rather adopting an over-regulatory approach that attempts to predict and prescribe the fine details of AFC implementation. After identifying acceptable interference-protection outcomes, the Commission should let AFC operators develop and consumers choose among different compliant AFC approaches that are reflective of geography, market sector, and user needs. DSA here discusses only some ways the Commission can use simple rules to foster innovation in AFC implementations.

A. The Commission Should Recognize that Consumers of AFC-Controlled RLAN Devices Will Vary Significantly.

RLAN operators will vary greatly, and in numerous ways. For example, consumers, enterprises, educational institutions, hospitals, municipalities, and military users will expect

[15] NPRM ¶ 25.

different capabilities and be willing to spend greater or lesser sums of money on access points.[16] The geographic-coverage needs of these user classes will differ, as will their proximity to FS operators. Consequently, some will prefer sophisticated, professionally installed AFC implementations that account for details like the precise height of their devices in order to increase the number of available channels, and others will prefer simpler and lower-cost implementations that do not account for factors such as device height, even if that means sacrificing potentially available frequencies or power levels.

The Commission cannot reliably predict the multiplicity of these preferences and on-the-ground facts, and should not forbid consumers from making this choice. Prescribing complex rules on the details of AFC implementation would lock in existing technological capabilities, increase downstream costs, and restrict further progress. For example, there is no reason for the Commission to prescribe details like whether AFC systems must be device-resident or cloud-based, whether AFC components may be distributed across multiple systems or must be unitary, whether AFC systems should convey available frequencies or unavailable frequencies, or whether AFCs should rule out certain locations entirely versus permitting operations at particular safe bandwidths and power spectral densities.[17] Likewise, the Commission should not directly or indirectly specify the content of message exchanges between AFC-managed devices and AFC systems beyond requiring they be fully secured. Instead, the Commission's rules should be limited to interference-protection outcomes and developing certification procedures to ensure RLAN devices do not operate in locations where they could risk harmful interference. DSA has deep knowledge in this area and is committed to working with the Commission on certification

[16] *Cf. id.* ¶ 21 (discussing various examples of potential RLAN users).

[17] *Cf. id.* ¶¶ 25-26 (requesting comments on some AFC implementation details).

procedures that are helpful and administrable for regulators and that also allow this flexibility for AFC operators and consumers.

B. The Commission Should Permit Multiple AFC Operators to Compete and Charge Fees.

The Commission should permit multiple entities to operate AFC systems, and should not require devices to interoperate with all AFCs.[18] Mandating that all devices support all AFC systems (and presumably, therefore, that all AFC systems support all devices) would significantly and unnecessarily increase the complexity of all AFCs, raising costs across the board and precluding lightweight, vendor-specific AFC implementations. While there may be scenarios in which customers want devices that can communicate with several or even all AFC operators, that often will not be the case, and there is no need to impose such an unnecessary and costly requirement.

Similarly, there is no need for AFCs to communicate with one another, and the FCC should not mandate such inter-communication capabilities.[19] Each AFC operator can obtain the information that it needs directly from ULS and perform the necessary calculations. Coordination among AFCs is simply unnecessary for interference-protection mechanisms because of the unique nature of 6 GHz band incumbents and would invite needless complexity into the process.

Finally, the Commission should permit but not require AFC system operators to charge fees. In current Wi-Fi bands, end users can purchase low-cost access points today for as little as $10 or spend several thousand dollars on specialized, hardened access points suitable for extreme temperatures or operation in explosive environments such as refineries. The Commission should

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[18] *Cf. id.* ¶ 33.

[19] *Cf. id.*

allow the AFC market to flourish to bring the full diversity and innovation characteristic of existing ISM and U-NII bands to 6 GHz.

C. The Commission Should Allow Three-Dimensional Approaches to Calculating Permitted Areas of Operation.

The Commission can also facilitate AFC implementation that is responsive to the varying needs of users by permitting AFC operators to define the areas in which RLAN devices can operate in either three dimensions or two dimensions. A mandatory two-dimensional approach "based on a typical installation height of standard-power access points"[20] would be arbitrary and inefficient, as neither FS receiver locations nor RLAN device heights are uniform. Requiring such an approach would deny the very complementary elevation differences between current 6 GHz incumbents and RLAN devices that make sharing feasible in this band in the first place. In reality, a two-dimensional approach would effectively rely on worst-case device heights, leaving valuable spectrum unused—even where devices could have operated on those frequencies without causing harmful interference given the differences in heights between FS links and RLAN operations.

Defining permitted operation areas in three dimensions will not be significantly more difficult for AFC operators. Even where existing geolocation technologies provide information on an RLAN device's height with limited accuracy or precision, AFC operators can account for that uncertainty. As discussed above, different RLAN users will have different preferences in this regard. Certain enterprise users may prefer a professionally installed RLAN access point or one with very precise, automated geolocation in order to maximize its use of available spectrum. Home access point users may prefer a less expensive device with less precise geolocation (and accordingly a more conservative approach to permitted operations based on geolocation

[20] *Cf. id.* ¶ 51.

uncertainty), or even one that calculates permitted areas in only two dimensions based on a reasonable worst-case RLAN device height. As long as AFC calculations are effective, the Commission should allow geolocation strategies to adapt to the diversity of users and cost points in the RLAN market.

D. The Commission Should Permit Both Standard-Power Mobile and Fixed Operations Under AFC Control.

The Commission should also ensure flexibility by permitting portable, as well as fixed, operations by AFC-controlled devices.[21] Portable device hotspots are a major RLAN application today that are relied on by millions of consumers. Standard-power portable device hotspots are envisioned to provide fundamental 5G services such as content streaming or augmented or virtual reality. Vehicular access points are a more recent but fundamental application of critical interest to the rail and automotive industries, as well as consumers. Less well known are the numerous enterprise and government applications. Mobile—or at least non-fixed—access points exist on cranes in rail and shipyards, on military bases, in hospitals, on farms using precision agriculture, in mines, on mobile incident response command trailers, and on the sidelines of every National Football League game. All of these uses need the additional spectrum promised by the 6 GHz band where it will not interfere with incumbent operations.

The Commission has already concluded that it can protect licensees in other bands from interference from portable or mobile devices using a simple combination of re-check periods tied to motion as well as time.[22] There is no reason that approach or similar variations cannot work in the 6 GHz band for portable devices and devices in or on vehicles, as long as a manufacturer is

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[21] *See id.* ¶ 76.

[22] The Commission has applied this approach in the 600 MHz band, *see generally* 47 C.F.R. § 15.711(d), and for Citizens Broadband Radio Service devices, *see generally* 47 C.F.R. § 96.39(a).

able to demonstrate in the certification process that its device is able to prevent harmful interference. For example, a device could vary how often it re-checks available frequencies based on its location and velocity. Or, because FS operations are submitted to ULS before operations begin, a device may be able to identify in advance areas in which standard-power operations will be permitted and re-check available frequencies only when approaching the vicinity of an FS link. Some enterprise applications listed above take place entirely on private property, such as a railyard or container terminal, and can be easily geofenced. The Commission should allow these and other, unforeseen variations to flourish, provided the bottom-line objective of preventing harmful interference to incumbent operations is achieved.

E. The Commission Should Allow Higher-Gain Antennas and Steerable Point-to-Point and Point-to-Multipoint Operations Under AFC Control.

Finally, the Commission should align its approach in the 6 GHz band to the successful approach in existing U-NII bands by facilitating higher-gain antennas as well as steerable point-to-point and point-to-multipoint operations. Restrictions on antenna gain inconsistent with existing U-NII rules, such as in the U-NII-3 band, would hamper enterprise deployments in particular, which often rely on sectorized antennas to cover larger footprints. AFC control will account for the unique nature of these directional antennas in determining available frequencies, protecting incumbents while allowing these valuable RLAN deployments to thrive. The Commission should likewise ensure that its 6 GHz rules are sufficiently flexible to permit steerable point-to-point and point-to-multipoint technologies to facilitate broadband deployment. This will help improve connectivity and competition in all markets, including but not limited to under-served areas and rural communities. AFC systems can easily incorporate and apply the beam patterns of such antennas in a verifiable manner, and artificial limitations on the geographic areas in which these operations are permitted are unnecessary. The Commission's approach in U-NII-3

has been successful in helping bridge the digital divide, and the Commission can build upon that success in the 6 GHz band by permitting flexible AFC operations that would account for these unique use cases and devices.

CONCLUSION

DSA appreciates the Commission's forward-thinking 6 GHz-band proposal and is eager to work with the Commission to ensure that dynamic spectrum access is a success in the band. The AFC approach the Commission proposes is only the most recent example of use of effective spectrum-sharing technologies to increase access to spectrum, and it is the result of hard work by Commission staff and a wide array of companies dedicated to making the most of the United States' spectrum resources. DSA encourages the Commission to adopt its proposed framework, and to enact simple, flexible rules to support investment and innovation in the 6 GHz band.

Respectfully submitted,

Kalpak Gude
President
Dynamic Spectrum Alliance

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