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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 THE DYNAMIC SPECTRUM ALLIANCE

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I. INTRODUCTION AND SUMMARY

The Dynamic Spectrum Alliance (DSA)[1] hereby submits these comments in response to the Federal Communications Commission's (FCC or the Commission) *Second Further Notice of Proposed Rulemaking* (Second FNPRM).[2] The DSA congratulates the Commission for its continued groundbreaking work in making the 6 GHz band available to different categories of unlicensed devices, while ensuring the protection of incumbent operations. As an organization focused on more efficient utilization of spectrum to foster innovation and affordable connectivity, DSA's members were thrilled when the Office of Engineering and Technology (OET) approved seven entities to operate Automated Frequency Coordination (AFC) systems last month,[3] which is now enabling Standard Power (SP) device operations across the United States.[4] This milestone was critical for the ongoing development of a global ecosystem for SP devices as national regulatory authorities worldwide are regularly monitoring the Commission's actions.

[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 Use of the 6 GHz Band; Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Second Report & Order, Second Further Notice of Proposed Rulemaking, Memorandum Opinion and Order on Remand, FCC No. 23-86, ET Docket No. 18-295, GN Docket No. 17-183, ¶ 18 (rel. Nov. 1, 2023) ("6 GHz Second Report & Order" or "6 GHz Second FNPRM" as appropriate).

[3] *OET Announces Approval of Seven 6 GHz Band Automated Frequency Coordination Systems for Commercial Operation and Seeks Comment on C3 Spectra's Proposed AFC System*, Public Notice, DA No. 24-166, ET Docket No. 21-352 (rel. Feb. 23, 2024).

[4] DSA press release is available at https://dynamicspectrumalliance.org/2024/DSA_FCC_Decision_FINAL.pdf.

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The DSA appreciates the opportunity to provide comments on ways in which the use of the 6 GHz band can be expanded for Very Low Power (VLP) unlicensed devices. The DSA's view is that spectrum management approaches should only be as complex as necessary to achieve their objectives. In keeping with this principle, the DSA supports the Commission's proposal to extend its rules now in effect for VLP devices that can operate indoors or outdoors in the U-NII-5 and U-NII-7 bands to the U-NII-6 and U-NII-8 bands. There have been several studies submitted for the record that show VLP devices will be able to share these bands with incumbent operations without creating a significant risk of harmful interference.

The DSA supports the Commission authorizing client-to-client (C2C) communications for Low Power Indoor (LPI) devices at an EIRP limit of 24 dBm combined with a -1 dBm / MHz PSD limit or at the same EIRP PSD limit as LPI client-to-access point communications. As DSA stated in its comments to the OET Public Notice on C2C communications in the 6 GHz band,[5] LPI C2C communications are "envisioned to fill in a unique space in the continuum of indoor 6 GHz unlicensed use cases where high throughput and low latency are required."[6]

Composite devices that meet the Commission's requirements for LPI operations are also capable of operating in SP mode. As these composite devices are being introduced in the market, the Commission's rules should accommodate both. The growing consensus amongst Wi-Fi ecosystem participants is that the enabling signal level received and decoded by a client

[5] The Office of Engineering & Technology Seeks Additional Information Regarding Client-to-Client Device Communications in the 6 GHz Band, Public Notice, 36 FCC Rcd 36, 37 (OET 2021) ("6 GHz Client-to-Client PN").

[6] Comments of the Dynamic Spectrum Alliance, *6 GHz Client-to-Client PN*, GN Docket No. 17-173, filed Feb. 22, 2021.

device engaged in C2C communications from an LPI access point should be set at -82 dBm (in a 20 MHz channel), which is the IEEE 802.11 standard's minimum receiver sensitivity for the lowest modulation coding scheme level. Determining the enabling signal level for C2C communications where the enabling signal is transmitted by an SP or composite access point remains a work in progress for the industry.

The DSA supports indoor VLP C2C communications at the proposed 14 dBm EIRP limit combined with a -1 dBm/MHz EIRP PSD limit. Under the current rules, VLP devices in the U-NII-5 and U-NII-7 bands can communicate directly with each other. Only 80, 160, and 320-MHz channels can communicate at up to 14 dBm. We propose the Commission adopt an identical rule for the U-NII-6 and U-NII-8 bands. The benefit of the indoor VLP C2C proposal is that the EIRP limit for 40 MHz channels would increase to 14 dBm.

The DSA sees some value in aspects of the Commission's proposal to permit C2C communication between VLP client devices when they are both under the control of the same VLP access point and the geofencing system, but the proposed power levels are too low. In general, there is little incremental benefit for the use of VLP devices at a 14 dBm EIRP limit combined with a +1 dBm/MHz EIRP PSD limit to justify the costs of pursuing a geofence approach.

However, the DSA believes that if the Commission considers a 21 dBm EIRP limit combined with an 8 dBm / MHz EIRP PSD limit for its geofence proposal, there will be sufficient industry interest to justify the necessary investments. The higher power level of these

devices and proposed VLP access point and client device network topology equipped with geofencing warrants a new category of unlicensed 6 GHz devices.

DSA's members have extensive experience with the TV White Space Database, Spectrum Access Systems, and AFC systems. The DSA believes that the Commission and industry can leverage the experience gained in developing these systems to commercialize this new category of 6 GHz devices at a quicker pace.

II. THE COMMISSION SHOULD SET UNIFORM LIMITS FOR UNLICENSED VERY LOW POWER DEVICES OPERATING ACROSS THE 6 GHz BAND

The DSA supports the Commission's proposal to authorize VLP devices to operate in the U-NII-6 and U-NII-8 bands at the same limits approved for VLP devices operating in the U-NII-5 and U-NII-7 bands.[7] Authorization of these additional two bands for VLP devices will increase the overall spectrum capacity available for VLP applications and allow for seven contiguous 160 MHz and three contiguous 320 MHz channels. The larger channel sizes will allow VLP devices to operate with greater throughput and reduced latency. From a commercial standpoint, it is important for the Commission to have uniform limits for VLP devices across the entire 6 GHz band.

The DSA is aware of several quantitative studies conducted over recent years that show VLP operations do not present significant risk of harmful interference to the incumbents

[7] *See* 6 GHz Second FNPRM ¶173.

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operating in the 6 GHz band. These incumbents include fixed service microwave links and various Broadcast Auxiliary Services (BAS)/ Cable Television Relay Service (CARS) operations, including electronic news gathering (ENG) central receive sites, truck-mounted receivers, and low power short range devices. Many of the Commission's conclusions regarding VLP device operations in the U-NII-5 and U-NII-7 bands are directly applicable to the U-NII-6 and U-NII-8 bands.

In its 6 GHz Second Report and Order, the Commission determined that the risk of harmful interference to incumbent services in the U-NII-5 and U-NII-7 bands from VLP devices was "insignificant".[8] Fixed service links in the U-NII-8 band share the same technical and operational characteristics as those in the U-NII-5 and U-NII-7 bands. Therefore, it should come as no surprise that the Commission believes VLP devices operating in the U-NII-8 bands also present an insignificant risk of harmful interference to fixed service links.[9]

With respect to BAS / CARS operations in the two bands, however, it is important to consider news gathering central receive sites, outdoor ENG trucks, and low-power short range mobile devices independently as they have different characteristics. The Commission notes that the communications link between the ENG truck and central receive site share many of the characteristics of a fixed microwave link.[10] The ENG truck is stationary, not mobile, when it is transmitting to the central receive site. The ENG truck antenna represents a temporary fixed

[8] *Id.*

[9] *Id.*

[10] *See id.* ¶ 175.

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link. A 2023 VLP/ENG study showed that the risk of harmful interference to the central receive sites from VLP devices operating in the U-NII-6 and U-NII-8 bands is less than the risk from LPI devices, and for both categories of unlicensed devices, the risk of causing harmful interference is extremely low.[11]

Regarding outdoor news gathering trucks, last fall, a DSA member company submitted a study to the Commission that demonstrated VLP device operations do not present a significant risk of causing harmful interference to ENG links between wireless camera backs operating in the 6 GHz band and truck-mounted receivers.[12] The DSA refers the Commission to the study.

Under the Commission's proposed rules, VLP devices will incorporate a contention-based protocol. For low-power short range devices -- Low Power Auxiliary Stations (LPAS) -- operating in the U-NII-8 band, such as wireless microphones, cue and control communications, and TV synchronization signals, the combination of a VLP device's contention-based protocol, low power, and low probability for co-channel operations in the same location significantly minimizes the risk of harmful interference.

[11] *See 2023 VLP/ENG Study* at 2–6*;* Letter from Paul Caritj, Counsel to Apple Inc., Broadcom Inc., and Meta Platforms, Inc., to Marlene H. Dortch, Sec'y, FCC, ET Docket No. 18-295, GN Docket No. 17-183 at 3–5 (filed Sept. 21, 2023).

[12] *See* 2023 Broadcom ENG Study; Letter from Paul Caritj, Counsel to Broadcom Inc., to Marlene H. Dortch, Sec'y, FCC, ET Docket No. 18-295, GN Docket No. 17-183 (filed Sept. 27, 2023).

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III. WITH THE RECORD REFRESHED THE COMMISSION SHOULD BE READY TO AUTHORIZE INDOOR CLIENT-TO-CLIENT COMMUNICATIONS

LPI C2C communications are envisioned to fill in a unique space in the continuum of indoor 6 GHz unlicensed use cases where high throughput and low latency are required. VLP devices are currently limited to the U-NII-5 and U-NII-7 bands with a 14 dBm EIRP limit combined with a -5 dBm EIRP PSD limit. The 6 GHz Second FNPRM proposes extending these limits to the U-NII-6 and U-NII-8 bands. Although an important VLP use case is Augmented, Virtual, and Mixed Reality (AR/VR/MR), an increased EIRP limit will help ensure robust performance for many immersive AR/VR/MR applications and for many other indoor applications.

C2C communications will promote greater spectral efficiency, reduce latency, lower duty cycles, and improve energy efficiency for unlicensed 6 GHz operations and devices. C2C communications will reduce the overall amount of 6 GHz energy in the air at any time as there will be fewer and shorter transmissions. In particular, the latency of direct LPI C2C communications is inherently lower than that for communications between LPI client devices where each LPI client must send a signal back through its respective LPI access point and must share the channel with other client devices that are associated with that access point in order to communicate with a nearby LPI client.

The Commission should authorize indoor C2C communications between indoor LPI devices and between indoor LPI and indoor SP devices (at the LPI client's EIRP PSD limit).

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Indoor LPI client devices should be able to receive an enabling signal from LPI access points and from composite access points, which consist of both an SP access point under control of an AFC and an LPI access point. As the Commission noted, it has been over two years since it received comments on OET's public notice on C2C communications[13] and there is now more information available on several relevant topics.[14] The DSA believes the record on C2C device communications should be refreshed to include 6 GHz composite client devices, which are of commercial interest.

Important use cases for C2C communications include digital learning, AR/VR/MR for entertainment, and multi-player gaming. In a digital learning setting, be it a formal classroom or an informal space in a commercial, industrial, healthcare facility, etc., the instructor using a C2C topology can stream high-definition content directly to students' devices, allowing for more immersive real-time interactions. With all these use cases, a great user experience is key to success. The digital learning content can be deployed with low latency and without increasing the traffic loads on the facilities infrastructure.

There will also be scenarios where the client devices communicating may be separated by an indoor wall. The higher power of an LPI client can provide a sufficient margin to the link budget. C2C communications will also allow digital learning to occur in enclosed areas where there is no Wi-Fi infrastructure in place.

[13] *See* 6 GHz Client-to-Client PN.

[14] *See* 6 GHz Second FNPRM ¶191.

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Another important C2C use case is AR/VR/MR entertainment applications that allow communications directly between a headset or glasses and an AR/VR/MR device, rather than requiring both to connect to the same AP and share the medium with all the other associated client devices. There is also an opportunity for non-AR/VR/MR multi-player gaming applications to utilize C2C devices operating on large bandwidth channels.

Given a growing Wi-Fi industry consensus, the DSA recommends that the enabling signal strength threshold be set at -82 dBm (in a 20 MHz bandwidth) for LPI C2C communications. The -82 dBm (in a 20 MHz channel) value is the IEEE 802.11 standard's minimum receiver sensitivity for the lowest modulation coding scheme level. The -82 dBm enabling signal strength threshold should address the concern the Commission raised in a scenario where the LPI client receives an enabling signal from the AP that is too weak to conduct communications (because it is outdoors) but sufficiently strong to allow it to communicate with another client device.[15] The enabling signal strength for a composite access point to enable an LPI client device still needs to be determined.

The Commission asks how frequently a client device should be required to receive an enabling signal to continue transmitting to another client device.[16] The DSA believes the record established in the PN makes clear that if a client device can decode an enabling signal transmitted by an LPI AP within the previous four seconds, the risk that the client device is

[15] *See id.* ¶193.

[16] *Id.* ¶191.

outdoors and can potentially cause harmful interference to incumbent services is *de minimis.* If the enabling signal threshold is set at -82 dBm for LPI devices, any residual concerns the Commission may have regarding the rate of recurrence of the transmitted enabling signal should be allayed. With respect to C2C communication involving composite devices operating in the U-NII-5 or U-NII-7 bands, the AFC recheck time for SP devices should apply.

Finally, the Commission's proposal for VLP devices operating within a geofenced area includes two additional proposals for C2C communications. Non-geofenced VLP devices operating in the U-NII-5 and UNII-7 bands are already permitted to communicate with each other, both indoors and outdoors.

The first of these C2C proposals is for VLP devices operating under control of an indoor LPI access point to engage in C2C communications with a 14 dBm EIRP limit combined with a -1 dBm/MHz EIRP PSD limit.[17] The benefit is that VLP devices operating in 40 MHz channels could communicate with one another at up to 14 dBm, which they cannot do now. The Commission should also consider permitting VLP C2C communications if the device can decode an enabling signal from an authorized LPI access point within the previous four seconds.

In the second VLP C2C proposal, VLP devices operating under control of a VLP access point within a geofenced area can operate at 14 dBm for all channel bandwidths, 20 MHz to 320 MHz, both indoors and outdoors[18]. As described below, the DSA has broader concerns

[17] *See id.* ¶150.

[18] *See id.* ¶151.

regarding the EIRP and EIRP PSD limits of the geofence proposal and believes the Commission should consider a 21 dBm EIRP limit combined with an 8 dBm / MHz EIRP PSD limit for its geofence proposal.

IV. THE COMMISSION SHOULD CREATE A NEW CATEGORY OF 6 GHz UNLICENSED DEVICES OUTSIDE OF GEOFENCED AREAS AT UP TO 21 dBm EIRP

Under the Commission's rules, the EIRP limit for VLP devices operating in the U-NII-5 and U-NII-7 bands is 14 dBm for a 320 MHz wide channel, the largest channel bandwidth permitted. The EIRP PSD limit is -5 dB/MHz. While the EIRP PSD limit also results in a 14 dBm EIRP limit for 160- and 80 MHz wide channels, the EIRP limit drops for smaller channel widths. Given the typical signal strength fluctuations observed with handheld and body-worn devices, there remains a question of the commercial utility of smaller channel sizes outside of operations in highly controlled environments.

In the FNPRM, the Commission proposes the same EIRP and EIRP PSD limits for VLP operations in the U-NII-6 and U-NII-8 bands. As an alternative, the Commission also proposes to permit VLP devices to operate in the U-NII-5 through U-NII-8 bands with an EIRP limit of 14 dBm and an EIRP PSD limit of 1 dBm/MHz provided the devices operate under the control of

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a geofencing system.[19] This would allow VLP devices operating on 20 MHz and 40 MHz channels to also operate up to 14 dBm EIRP.

Collectively, DSA members have considerable experience interacting with the Commission on the policy development and implementation of dynamic spectrum management systems for the TV White Spaces, CBRS, and 6 GHz bands. DSA members do not believe that the Commission's proposal – VLP devices with a 14 dBm EIRP limit and a 1 dBm EIRP PSD for operations within geofenced areas -- provides sufficient economic incentive for companies to make the necessary investments at scale given the anticipated challenges for developing and successfully commercializing such a framework. The incremental benefit would be for VLP devices operating outdoors on 20 MHz or 40 MHz channel bandwidths and operating indoors on a 20 MHz channel. While there undoubtedly will be use cases that rely on 20 MHz and 40 MHz channels, most use cases identified today would leverage the large channel sizes used by Wi-Fi 6E and Wi-Fi 7 devices.

In the alternative, the Commission asks whether it could allow a "power limit higher than 14 dBm EIRP, e.g., up to 21 dBm EIRP".[20] The DSA believes that a geofenced VLP framework with an EIRP limit of 21 dBm combined with an EIRP PSD limit of 8 dBm/MHz would provide a sufficient incentive for companies in the VLP ecosystem to undertake the risk and make the necessary investments. The higher EIRP limit, for example, will provide greater reliability for

[19] *See id.* ¶105.

[20] *See id.* ¶107.

AR/VR/MR applications across diverse environments and consequently a better user experience. The increased EIRP PSD limits will enable narrow band applications, which may not be feasible under the VLP limits.

The Commission's proposed geofencing system is intended to protect fixed microwave service, BAS, CARS, radioastronomy, and FSS receive sites operating in the 6 GHz band. One can envision that the size of the geofenced area (or conversely the size of the exclusion zone) will vary, depending on the Geofenced VLP device power level. In all cases, the incumbent operations will be protected from receiving harmful interference because of the geofence's design.

Although the envisioned geofencing system would not be identical to AFC systems authorized to date, the Commission's intent is that it provides functionally equivalent protection to licensed incumbent operations. Further, the Commission also believes that a geofence approach "could be implemented using the same methodology that [it] previously developed for standard power access points and fixed client devices to protect these services,"[21] thus the two-tier (access point and client device) approach.

One potential difference between the currently authorized AFC systems and the proposed geofence approach is the system architecture. The Commission's regulations require the AFC system operates as a centralized model. The Commission's geofence proposal permits use of either a distributed architecture or a centralized model. A distributed architecture can protect

[21] *See id.* ¶114.

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incumbents and could lead to significant cost savings for those implementing the geofence. A distributed architecture, though, could not be implemented as an AFC today under the Commission's rules.[22] The Commission should consider the evolving role of distributed architectures in spectrum sharing.

The DSA has concerns over the Commission's proposed mechanism for protecting BAS / CARS receivers. We agree that BAS / CARS receivers must be protected. However, circular protection areas might cause large swaths of urban centers to be unavailable to Geofenced VLP devices, whether indoors or outdoors, across the entire U-NII-6 or U-NII-8 bands. The Commission proposes BAS / CARS licensees to "register their receive site information in the Commission databases so that geofencing systems can use site specific data to create appropriate exclusion zones in these sites."[23]

It appears that the Commission is looking to address both scheduled and unscheduled events. Some DSA members recall the issues surrounding the timely protection of wireless microphone reservations in the TV White Spaces database, including the well-intentioned 'database push,' which would have drained the battery of portable devices because the device would always have to be listening to receive the localized notification that channel(s) needs to be vacated. The approach for addressing unscheduled events, including coordination among AFC

[22] As an aside, the DSA urges the Commission to continue increasing its expertise on implementing distributed architectures for spectrum sharing (e.g., preloading geofenced areas in portable devices), because this approach may also be relevant to future discussions on bands included in the National Spectrum Strategy, in addition to 6 GHz Standard Power devices and Geofenced VLP devices.

[23] *See id.* ¶134.

systems, if required, are non-trivial issues. Fortunately, DSA members are familiar with many of these issues.

V. CONCLUSION

The DSA applauds the Commission's continued efforts in making available spectrum in the 6 GHz band for different categories of unlicensed devices. The DSA supports the Commission's proposals to: (1) extend the regulatory framework for VLP devices to the U-NII-6 and U-NII-8 bands and (2) authorize direct C2C communications. As proposed, the DSA believes that the EIRP and EIRP PSD limits of the geofence approach may provide insufficient incentives given the challenges. If the Commission increases the EIRP limit to 21 dBm, combined with an EIRP PSD limit of 8 dBm / MHz, the type of rapid response from the Wi-Fi ecosystem seen when the original 6 GHz rules become effective will likely follow.

Respectfully submitted,

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