

**Before the
Federal Communications Commission
Washington, DC 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
)	
To: The Commission		

**REPLY COMMENTS OF
OPEN TECHNOLOGY INSTITUTE AT NEW AMERICA
AMERICAN LIBRARY ASSOCIATION
CONSUMER FEDERATION OF AMERICA
COSN—CONSORTIUM FOR SCHOOL NETWORKING
PUBLIC KNOWLEDGE
ACCESS HUMBOLDT
X-LAB**

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The Open Technology Institute at New America (“OTI”), Consumer Federation of America, Public Knowledge, COSN—Consortium For School Networking, Access Humboldt and X-Lab (together the “Public Interest Organizations” or “PIOs”) hereby submit Reply Comments in response to comments filed in the docket of the above-captioned proceedings (“6 GHz NPRM”).¹ The record reflects strong support for the Commission’s proposal to authorize unlicensed access to 1,200 megahertz across the entire 6 GHz band. A diverse range of parties also support ensuring that all four band segments are available to homes, small business, schools and libraries for lower-power and indoor-only use under Part 15 rules that do not require the Automated Frequency Coordination necessary to protect incumbent users in relation to outdoor and higher-power unlicensed use.

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

I. INTRODUCTION AND SUMMARY

As organizations committed to facilitating more open, fast and affordable wireless connectivity for all Americans, the PIOs strongly agree that affordable access to the 6 GHz band in every home and business is essential for gigabit-fast Wi-Fi and other connectivity needs as the nation advances to a 5G wireless ecosystem. Access to 6 GHz spectrum proximate to the 5 GHz band is also needed to facilitate high-capacity and affordable fixed wireless broadband in rural and underserved communities. Continued rapid growth in data traffic on unlicensed bands will only continue as the emerging Internet of Things (“IoT”) and 5G ecosystem require much more capacity, particularly indoors where bottlenecks to distributing the gigabit capacity delivered to homes and businesses by fixed providers are already apparent. The 6 GHz band, being adjacent to the 5 GHz band, offers the contiguous and high-capacity channels critical to ensure Wi-Fi and other unlicensed innovations needed to extend the benefits of a 5G ecosystem to all Americans.

The record reflects diverse and strong support for the Commission’s proposals to extend unlicensed use across all 1200 megahertz from 5925 to 7125 MHz. More specifically, the record demonstrates broad support for the Commission’s proposal to authorize low-power and indoor-only (“LPI”) operations in the U-NII-6 and U-NII-8 without a coordination requirement *and* for extending this LPI authorization to the U-NII-5 and U-NII-7 band segments as well. Allowing LPI without the cost or complexity of prior or ongoing Automated Frequency Coordination (“AFC”) will give consumers, small businesses, schools, libraries and other ordinary users the benefit of gigabit-fast Wi-Fi and other unlicensed innovations indoors at the lowest possible cost and complexity. Leading companies and trade associations representing not only consumers, but the cable industry, rural Internet service providers, the technology and semiconductor industries,

consumer electronics and aerospace industries, and other commenters joined the Public Interest Organizations in support of extending low-power, indoor-only use across all four band segments.

The Commission should base policies on risk-informed interference assessments and not unrealistic worst-case scenarios. The imposition on an AFC system is as unnecessary for LPI use of U-NII-5 and U-NII-7 as it is for use of U-NII-6 and U-NII-8. All four band segments can host LPI operations without harming incumbents, as studies have shown. The Commission's conclusion that low-power indoor devices can share the U-NII-6 and U-NII-8 bands logically extends to the U-NII-5 and U-NII-7 bands as well due to the fact both currently host the same incumbent operations. The PIOs join the many commenters that strongly oppose any requirement of professional installation for indoor use, whether LPI or at standard power under AFC control.

Despite this very low risk of interference, some FS incumbents argue that the excess margins that enable their links to tolerate a degree of interference are somehow "paid for" and cannot be considered to justify unlicensed sharing. Such claims do not withstand a reasonable balancing that considers the overall public interest. It would not serve the broader public interest to set FS protection criteria to maximize throughput on a link, regardless of the social cost. While it's true that FS operators may choose to increase the modulation of their links, marginally improving the economics of the band for their own service, the Commission should conclude that the overall public interest is not served by overly-restrictive protections for higher-order modulations far excess of the minimum 4.4 bits/sec/Hz required 99.7% of the time by the Commission's rules

The 6 GHz proceeding also presents an opportunity to make more wide-channel spectrum available as public infrastructure for WISPs and other operators attempting to deploy high-capacity and affordable fixed wireless broadband in rural and other underserved areas. There is

strong support for authorizing higher-power operations outdoors in rural and underserved areas, subject to automated frequency control, for both point-to-point and point-to-multipoint (“PtMP”) operations. This will enable more cost-effective point-to-point and point-to-multipoint services that could bring high-speed broadband access to more Americans. Accordingly, we urge the Commission to adopt for U-NII-5 and U-NII-7 the same antenna gain and power limits that apply to the 5 GHz U-NII bands, subject to prior coordination by a certified AFC system.

The Commission should also dismiss the predictable objections from the automotive industry that unlicensed operations in the 6 GHz band will harm hypothetical DSRC or C-V2X safety operations in the 5.9 GHz. That band remains, after several decades, almost entirely unused. Because of this, DSRC is largely seen as an outdated technology, and the future of the 5.9 GHz band is itself likely to be reconsidered by the Commission. At least two commissioners agree that the 5.9 GHz band should be shared for unlicensed as well. Therefore, to the degree the Commission takes the 5.9 GHz band into consideration in this proceeding, it should only serve to strengthen arguments for authorizing unlicensed access in both bands. The combination would create a more contiguous band of wide channels for unlicensed use that could enable next generation, gigabit-fast Wi-Fi and other unlicensed innovation.

Finally, the Commission should reject Qualcomm’s proposal to give its synchronous RLAN technology priority in the U-NII-7 band. Adopting rules that give a particular technology priority use of an unlicensed band is the exact opposite of the “technology-neutral” approach that has always been at the heart of the Commission’s unlicensed rules. While the Commission could reasonably consider requiring similar RLAN technologies to include coexistence features, the agency should not adopt any rules that prioritizes any specific technology, even if it is (today, but probably only temporarily) more efficient than another unlicensed technology.

II. THERE IS STRONG SUPPORT FOR AFFORDABLE LOW-POWER, INDOOR-ONLY USE OF U-NII-5 AND U-NII-7 BAND SEGMENTS WITHOUT AN AFC REQUIREMENT

The Commission’s proposal to allow low power, indoor-only operations on an unlicensed basis in the U-NII-6 and U-NII-8 bands free from the cost and complications of Automated Frequency Coordination (“AFC”) will provide much-needed capacity to next generation Wi-Fi and other unlicensed technologies.² The record demonstrates broad and strong support for this approach *and* for extending this authorization of low-power, indoor-only unlicensed use across the U-NII-5 and U-NII-7 band segments, thereby giving consumer, small businesses, schools, libraries and other ordinary users the benefit of gigabit-fast Wi-Fi and other innovations indoors at the lowest possible cost and complexity. Leading companies and trade associations representing the cable industry (e.g., Charter, NCTA), rural Internet service providers (e.g., WISPA, Cambium Networks), the technology and semiconductor industries (Apple, Facebook, Hewlett Packard Enterprise, Ericsson, Microsoft, Cisco, Broadcom, and Sony Electronics), and other commenters including the Wi-Fi Alliance, Boeing and G.E. Healthcare, all joined the Public Interest Organizations in support of extending low-power, indoor-only use across all four band segments.³

² See *6 GHz NPRM* at ¶¶ 59 and ¶ 73.

³ See, e.g., Comments of Apple Inc. ET Docket No. 18-295, GN Docket No. 17-183, at 4-5, 11-13 (filed Feb. 15, 2019) (Apple Comments); Comments of NCTA—The Internet & Television Assn., ET Docket No. 18-295, GN Docket No. 17-183, at 6 (filed Feb. 15, 2019) (NCTA Comments); Comments of Dynamic Spectrum Alliance, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) (DSA Comments) at 2 (“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.”); Comments of Wi-Fi Alliance, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) (Wi-Fi Alliance Comments) at 18; Comments of Wireless Internet Service Providers Assn., ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) (WISPA Comments) at iv; Comments of Broadcom Inc., ET Docket No. 18-295, GN Docket No. 17-183, at 40-44 (filed Feb. 15, 2019) (Broadcom Comments) at 29; G.E. Healthcare, ET Docket No. 18-295, GN Docket No. 17-183, at 7-8 (filed Feb. 15, 2019); Comments of Cisco Systems, Inc., ET Docket No. 18-295, GN Docket No. 17-183, at 3, 13 (filed Feb. 15, 2019) (Cisco Comments); Comments of Charter Communications Inc., ET Docket No. 18-295; GN Docket No. 17-183, at 3 (filed Feb. 15, 2019) (Charter

In addition, the PIOs agree with these same parties that professional installation is not necessary to protect band incumbents from indoor-only unlicensed use even at the higher (but still low) power levels proposed in the NPRM for devices in U-NII-5 and U-NII-7 operating under AFC control.⁴

A. The Commission Should Authorize Low-Power Indoor-Only Unlicensed Use Across the Entire 6 GHz Band

Our groups agree with WISPA, the Dynamic Spectrum Alliance (“DSA”), NCTA, the Wi-Fi Alliance, the RLAN Group and numerous other parties cited just above that enabling lower-power indoor (“LPI”) operations free from an AFC requirement across the entire 6 GHz band is critical to addressing the growing congestion in unlicensed bands and to enabling gigabit-fast Wi-Fi for ordinary consumers, small businesses and community institutions at an affordable cost.⁵ WISPA correctly observes that allowing LPI unlicensed operations in “up to 1200 megahertz of additional spectrum [can] support broadband connectivity and a variety of other high throughput and low latency applications for residences and businesses across America, thus

Comments); Comments of Qualcomm, ET Docket No. 18-295, GN Docket No. 17-183, at 5 (filed Feb. 15, 2019) (Qualcomm Comments); Comments of Sony Electronics Inc., ET Docket No. 18-295, GN Docket No. 17-183, at 2 (filed Feb. 15, 2019); Comments of Cambium Networks, Ltd., ET Docket No. 18-295, GN Docket No. 17-183, at 2 (filed Feb. 15, 2019); Comments of Quantenna Communications Inc., ET Docket No. 18-295, GN Docket No. 17-183, at 3 (filed Feb. 15, 2019) (Quantenna Comments); Comments of Hewlett Packard Enterprise Co., ET Docket No. 18-295, GN Docket No. 17-183, at 8-12 (filed Feb. 15, 2019) (HPE Comments); Comments of Microsoft Corporation, ET Docket No. 18-295, GN Docket No. 17-183, at 3,15-21 (filed Feb. 15, 2019) (Microsoft Comments); Comments of Apple Inc., Broadcom Inc., Cisco Systems, Inc.; Facebook, Inc.; Google LLC, Hewlett Packard Enterprise, Intel Corporation, Marvell Semiconductor, Inc., Microsoft Corporation, Qualcomm Incorporated, and Ruckus Networks, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) (RLAN Group Comments) at 17-35.

⁴ See, e.g., Qualcomm Comments at 7, 19; NCTA Comments at 15; RLAN Group Comments at 76; Microsoft Comments at 24; Wi-Fi Alliance Comments at 22; Broadcom Comments at 29; Quantenna Comments at 3.

⁵ See, e.g., Qualcomm Comments at 5 (“[u]nlicensed operations in the proposed 6 GHz band would enable multiple wideband channels and ultra-high-speed connections in homes, businesses, schools, universities, and libraries across America.”).

promoting consumer access to broadband and encouraging innovation in new technologies, services, and applications.”⁶

The U-NII-6 and U-NII-8 bands together provide only a single channel as wide as the 160 megahertz needed to take full advantage of the emerging IEEE 802.11ax standard. Indeed, as WISPA observes, the U-NII-6 band is only 100 megahertz wide, “so devices operating there would not be able to operate using, for example, the 160-megahertz channels available in 802.11ax unless they also have access to the adjacent U-NII-5 or U-NII-7 bands.”⁷ NCTA similarly argues that enabling low-power, indoor-only operations in the U-NII-6 and U-NII-8 sub-bands “would provide benefits for many residential users, particularly as the use of mesh networks for whole-home coverage increases.”⁸

Consumer access to wide, contiguous channels across the 6 GHz band is essential to fueling the capacity needed to distribute connectivity as fixed broadband providers increasingly deliver a gigabit and even multi-gigabits of throughput to ordinary homes and small businesses. Increasingly the home and business broadband bottleneck is reversing as the capacity of affordable home Wi-Fi networks become the limiting factor in the utility of Internet access. Cisco details the “exploding” demand for spectrum and how crucial unlicensed spectrum is for internet-connected devices and activities: “Unless the Commission opens new frequencies for unlicensed operations now, rising demand will increasingly result in congestion and adversely impact the user experience.”⁹ An article in *IEEE Spectrum* observes that congestion in the 2.4

⁶ WISPA Comments at 28.

⁷ *Ibid.*

⁸ NCTA Comments at 15.

⁹ Cisco Comments at 4. “The VNI reflects that Wi-Fi is ‘the crucial link’ to the Internet for numerous applications, and that the United States’ reliance on Wi-Fi to carry enormous amounts of data will grow markedly over the coming years. . . . the VNI shows that Wi-Fi will grow from 50.4% of total [Internet] traffic in 2017 to 56.6% of traffic in 2022. Those percentage increases are significant in isolation, but they represent staggering increases in the total data carried by Wi-Fi when taking into consideration that . . .

GHz band is so bad that “it has pretty much made the 2.4-GHz band unusable for transferring data at high rates,” while few wide channels are available to consumers in the 5 GHz band because of prohibitions or restrictions on sharing in radar band segments.¹⁰

The PIOs agree with Facebook that “[t]he fragmented approach proposed by the Commission would severely limit efficient use of the spectrum. . . . This, in turn, would reduce public benefits of using the band, impact economies of scale for equipment in the band and would devalue the spectrum. Lastly, by making the entire 6 GHz band available for LPI operations, the Commission will encourage more innovation and investment sooner.”¹¹ Boeing similarly asserts that authorizing the use of U-NII-5 and U-NII-7 devices in indoor locations without the mandated facilitation of AFC would “substantially reduce the costs of U-NII-5 and U-NII-7 devices that are designed solely for indoor use. . . . Given the fact that the vast majority of unlicensed systems operate indoors, a decision to permit all 6 GHz U-NII devices to operate indoors without AFC control is warranted and can be implemented without resulting in harmful interference to incumbent services.”¹²

B. The Record Demonstrates There is No Greater Risk of Harmful Interference to Incumbents from LPI Use in U-NII-5/7 than in U-NII-6/8

While the record reflects strong, vast support for authorizing LPI use across all four band segments, there is opposition to this proposal as well. The opposition stems from the fear that this proposal will result in harmful interference for incumbent operations, including satellite

Internet traffic in the United States will likewise grow from 337.2 exabytes in 2017 to 1.03 zettabytes (or roughly 1,030 exabytes) in 2022. . . . [I]n 2022 Wi-Fi will carry more than triple the amount of data than it did two years ago. Unless the Commission opens new frequencies for unlicensed operations now, rising demand will increasingly result in congestion and adversely impact the user experience.” *Ibid.*

¹⁰ Terry Ngo, “Why Wi-Fi Stinks—and How to Fix It,” IEEE Spectrum (June 28, 2016), available at <https://spectrum.ieee.org/telecom/wireless/why-wifi-stinksand-how-to-fix-it>.

¹¹ Facebook Comments at 4.

¹² Boeing Comments at 6.

uplinks and high-power FS links.¹³ These concerns are unfounded, as the record demonstrates. Reliance on an AFC system is as unnecessary for low-power, indoor-only use of U-NII-5 and U-NII-7 and it is for use of U-NII-6 and U-NII-8.

The Commission should base policies on risk-informed interference assessments and not unrealistic worst-case scenarios.¹⁴ As HPE’s comments so aptly put it, “a low-power indoor WLAN access point would have to win the ‘interference lottery’ by somehow falling into four different and unlikely corner-case situations simultaneously— related to space, energy, frequency, and time—in order to cause harmful interference to an FS link.”¹⁵ Commenters point out that the Commission itself concluded in the *6 GHz NPRM* that LPI devices can share U-NII-6 and U-NII-8 bands with incumbent operations without imposing harmful interference.¹⁶ The Commission’s conclusion that low-power indoor devices can share the U-NII-6 and U-NII-8 bands logically extends to the U-NII-5 and U-NII-7 bands as well due to the fact both currently host the same incumbent operations.

Apple, Broadcom, Cisco, Facebook, Google, Hewlett Packard Enterprise, Intel, Marvell, Microsoft, Qualcomm, and Ruckus explain this reality in their joint comments:

U-NII-5 and U-NII-7 . . . are primarily used by terrestrial FS P2P links and FSS uplink transmissions. Notably, these operations are also present in the U-NII-6 and U-NII-8 bands where the Commission has proposed to allow LPI operations and has concluded that the combination of low-power and indoor-only operational restrictions will protect incumbents from harmful interference. LPI operations will protect FS and FSS

¹³ See, e.g., Intelsat License LLC, SES Americom, Inc. Comments; National Association of Broadcasters ET Docket No. 18-295, GN Docket No. 17-183, at 3 (filed Feb. 15, 2019); Comments of AT&T, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019).

¹⁴ The FCC’s Technological Advisory Council (“TAC”), in its proposed spectrum management principles, emphasized this point: “The TAC recommends that . . . the Commission should not base its rules on exceptional events. . . . [I]t is essential to bring realism into modeling of coexistence scenarios.” Public Notice, *Office of Engineering and Technology Seeks Comment on Technological Advisory Council Spectrum Policy Recommendations*, 32 FCC Rcd 10160, at 10162 (2017).

¹⁵ HPE Comments at 13.

¹⁶ Microsoft Comments at 6; WISPA Comments at 28.

incumbents and can do so throughout the 6 GHz band—in addition to the other classes of incumbents found in U-NII-6 and U-NII-8.¹⁷

Microsoft similarly explains why there is no basis to infer that LPI transmissions in U-NII-5 would create any greater risk of interference for uplink Fixed Satellite Service (“FSS”) incumbents in U-NII-5 than it would in U-NII-6. “The U-NII-6 band has a spectrum allocation for the mobile service and the Fixed-Satellite Service (‘FSS’) (earth-to-space), but not for the Fixed Service (‘FS’). The Commission stated that it believes that standard-power access points operating outdoors will not cause harmful interference to incumbent FSS operations. By extension, LPI devices operating at several dB in radiated power below standard-power access points should not cause harmful interference to FSS uplinks.”¹⁸

The PIOs also concurs with WISPA that just as the Commission has determined that LPI use without the need for authorization from an AFC system will not cause harmful interference to incumbent services in the U-NII-6 and U-NII-8 bands, “for much the same reason, lower-power operations are not likely to interfere with higher-power or incumbent licensed operations in the U-NII-5 and U-NII7 bands either, and should therefore be permitted without AFC in these bands as well.”¹⁹ NCTA observes that because of the lower power levels, “[w]alls and windows should greatly attenuate signal strength at these frequencies, thus likely avoiding harmful interference to incumbents in the band.”²⁰

¹⁷ RLAN Group Comments at 18-19.

¹⁸ Comments of Microsoft at 6.

¹⁹ Comments of WISPA at 28.

²⁰ Comments of NCTA at 15.

C. The Commission Should Reject FS Operator Claims that they ‘Pay For’ Excess Margin by Deploying Higher Modulation Links Beyond Part 101 Requirements

HPE, Broadcom and other commenters correctly conclude that analyses of real-world FS links show that incumbents can share the band with LPI operations with *de minimis* risk of interference.²¹ As a number of technology companies explained in their comments, the RKF Study demonstrates that the probability of harmful interference is extremely low.²² RKF assumed that radio local area networks (“RLANs”) will operate both indoors and outdoors at substantially higher power levels than what the Commission has proposed for LPI devices. RKF’s analysis of FS links registered in ULS in 2017 – and of others registered more recently – demonstrates that typical FS systems have fade margins that far exceed 25 - 40 dB.²³ This capability would tolerate interference even far above -6 dB I/N threshold without degrading FS link reliability requirements.²⁴ It appears it would take the unlikely combination of an LPI RLAN in an uncoated window overlooking a very high-modulation FS receiver to potentially cause harmful interference.

Despite this very low risk of interference, some FS incumbents argued that to the extent any measurable surplus margin may exist on a given link that this is “paid for” and beyond the reach of regulatory analysis.²⁵ For example, the Fixed Wireless Communications Coalition

²¹ See, e.g., HPE Comments at 19; Broadcom Comments at 6-25.

²² Microsoft Comments at 7; Facebook Comments at 3-4; HPE Comments at 19; Apple Comments at 19 (“The RKF Study demonstrated that the nationwide operation of standard-power RLAN devices operating indoors and outdoors, without any additional sharing mechanisms, would result in less than 0.2% of FS links receiving sufficient energy to even conceivably cause measurable interference to a receiver—i.e., exceeding a conservative -6 dB I/N interference threshold. At a threshold of 0 dB I/N, RKF found a still lower rate of 0.1%.”).

²³ Comments of the Fixed Wireless Communications Coalition, ET Docket No. 18-295, GN Docket No. 17-183, at 16 (filed Feb. 15, 2019) (FWCC Comments).

²⁴ Broadcom Comments at 22.

²⁵ See, e.g., FWCC Comments at 17 (“FS operators pay more for equipment that offers adequate fade margin because they need the added reliability—not to accommodate unlicensed devices.”).

(“FWCC”) states that “FS operators pay more for equipment that offers adequate fade margin because they need the added reliability—not to accommodate unlicensed devices.”

Such claims deserve critical scrutiny and, in our view, cannot withstand a reasonable balancing that considers the overall public interest. While it’s true that FS operators may choose to increase the modulation of their links, marginally improving the economics of the band for their own service, the Commission should conclude that the overall public interest is not served by overly-restrictive protections for higher-order modulations far excess of the minimum 4.4 bits/sec/Hz required 99.7% of the time by the Commission’s rules. To the extent that a FS incumbent coordinates a link path at a specific EIRP and associated antenna pattern with pre-existing incumbent license holders, we contend that this is the most that an incumbent could possibly claim was “paid for” even if newer equipment capable of achieving higher order modulations is installed after the fact.

It is not in the public interest for the Commission to set the FS protection criteria to maximize throughput on a link, regardless of the social cost. The question before the Commission is whether a Part 101 license carries an unlimited margin guarantee, especially when the license itself is effectively cost-free, not auctioned, and requires the payment of only a modest processing fee to the Commission. We respectfully argue that the Commission has both the authority and responsibility to decompose link margin values and apply critical scrutiny to each component. To the extent that a path requires no coordination with existing licensees – and uses adaptive modulation – we again contend that that Part 101 requirement of 4.4 bits/sec/Hz 99.7% of the time represents the limit of any guarantee.

FS licensees are of course free to deploy the most advanced equipment available to opportunistically leverage the somewhat higher performance that may be available most or all of

the time as a result of the 25 - 40 dB fade margin that necessarily results, according to FWCC, from industry standard availability calculations.²⁶ However, the advance of signal processing technology must not become a barrier to more intensive use of spectrum where feasible. Clearly, in a deep fade, FS operators employing very high order modulations opportunistically will accept some lower modulation as the availability floor. Part 101 provides a simple answer that ensures continuous link availability with a reasonable minimum performance standard.

Moreover, as we explore further in Section IV below, making this unlicensed spectrum capacity available is far more important to the Commission's goal to expand high-speed and affordable fixed wireless connectivity in rural and underserved areas than is maintaining a wasteful, preemptive reservation of excess margin for FS operators trying to squeeze out a bit more throughput on their links. If the Commission decides to give every incumbent in underutilized bands a blank check for *absolute* protection for whatever equipment they decide to deploy, spectrum sharing to meet the nation's surging demand for affordable connectivity will be sacrificed.

Finally, as Facebook explained: "In the real world, the impact of LPI devices should be even less than suggested in the RKF study because... a number of mitigating factors, including building loss and limited radiated power were not taken into account."²⁷ The RKF study did not assess the impact of building material and clutter losses. Microsoft similarly observed in its

²⁶ *Id.* at 16 ("System designers combat the problem [of fade] by building in 'fade margin'—extra reserves of signal power to compensate for the loss of received power caused by fades. Depending on the reliability needed, fade margins are typically in the range of 25-40 dB.")

²⁷ Facebook Comments at 3-4. As Apple explained: "In the real world, the probability of a link's receiving even this minimal level of energy would be lower still. Moreover, even these results exaggerate the likelihood of real-world interference because RKF did not account for important sources of attenuation such as polarization mismatch and feeder loss or common robustness features routinely included in FS link designs such as spatial diversity, cross-polarization, adaptive modulation, and forward error correction. The analysis also assumed not only indoor but also outdoor operations and included outdoor transmissions up to 35.3 dBm (approximately 4 Watts)—which would not be present when considering LPI." Apple Comments at 19.

comments: “Our expectation is that if only LPI devices were modeled, and building and clutter loss accounted for, the small probability of harmful interference would be further reduced.”²⁸

III. AUTOMATED FREQUENCY COORDINATION IS WELL-ESTABLISHED AND CAN RELIABLY ENSURE HIGHER-POWER OUTDOOR AND INDOOR UNLICENSED OPERATIONS DO NOT INTERFERE WITH INCUMBENT FIXED SERVICES

The record demonstrates strong support for the Commission’s proposed use of Automated Frequency Coordination to protect incumbent operations in any portion of the band authorized for unlicensed outdoor or higher-power indoor use. The PIOs strongly agree with the Dynamic Spectrum Alliance (“DSA”) that “AFC is an established tool for modern spectrum management.”²⁹ As consumer and business demand for wireless connectivity has surged – and every valuable band is assigned to some incumbent service – the use of databases to coordinate more intensive and efficient spectrum sharing has emerged as a critical regulatory tool. Congress acknowledged this in the Ray Baum’s Act of 2018 in which it mandated development of a national spectrum plan that includes examining “existing and planned databases or spectrum access systems designed to promote spectrum sharing.”³⁰

Of course, Congressional confidence in the efficacy of database-coordinated spectrum sharing derives in large part from the Commission’s considerable experience in shaping the evolution of database-driven spectrum sharing from database-assisted, to automated, to dynamic. The DSA describes this evolution in a new in-depth report, *Automated Frequency Coordination: An Established Tool for Modern Spectrum Management*, stating:

This evolution has generally progressed from the manual, database-informed coordination of fixed links and satellite earth stations; to database-assisted coordination

²⁸ Microsoft Comments at 7.

²⁹ DSA Comments at 3.

³⁰ Ray Baum’s Act of 2018, Pub. L. 115–141, § 614, 132 Stat. 1080, 1109 (2018).

of point-to-point links on a semi-automated basis (e.g., in the 70/80/90 GHz bands); to the fully-automated frequency coordination of unlicensed sharing of vacant TV channels (TV White Space); to, most recently, the dynamic coordination of a three-tier hierarchy of sharing by Spectrum Access System databases across the 3550-3700 MHz band with U.S. Navy radar (the Citizens Broadband Radio Service).³¹

Nor is confidence in the future of AFC to unlock unused spectrum capacity to meet the surging demand for wireless connectivity restricted to the U.S. Ofcom, the UK regulator, stated in the agency's 2016 *Framework for Spectrum Sharing* that “[g]eolocation databases are making it easier for devices to identify spectrum that is available for sharing while protecting the operation of existing services. . . . the fundamental principle is not frequency specific and can be extended to a broader range of frequencies.”³² More specifically, the European Union is in the process of authorizing unlicensed RLAN sharing of the U-NII-5 band, likely subject to AFC. The DSA report describes the status of this effort: “Similar to the FCC’s pending rulemaking, the European Commission has tasked a working group to study the regulatory and technical feasibility of authorizing unlicensed RLANs to operate on secondary basis in the 6 GHz band (5925-6425 MHz). A final draft report, including an assessment of coexistence scenarios with band incumbents, is expected by May 2019, followed by a public consultation and a final report by March of 2020.”³³ This EU initiative will make unlicensed use of 6 GHz even more valuable

³¹ Dynamic Spectrum Alliance, *Automated Frequency Coordination: An Established Tool for Modern Spectrum Management*, at 2 (March 2019) (“DSA Report”).

³² Office of Communications (Ofcom), *A Framework for Spectrum Sharing*, Statement, at 27 (April 14, 2016), available at https://www.ofcom.org.uk/data/assets/pdf_file/0028/68239/statement.pdf. See also Ofcom, *Spectrum Management Strategy* (April 30, 2014), available at https://www.ofcom.org.uk/data/assets/pdf_file/0021/71436/statement.pdf.

³³ *DSA Report, supra*, at 5. See European Commission, Directorate-General for Communications Networks, Content and Technology, “Mandate to CEPT to Study Feasibility and Identify Harmonised Technical Conditions for Wireless Access Systems Including Radio Local Area Networks in the 5925-6425 MHz Band for the Provision of Wireless Broadband Services,” at 4 (Dec. 19, 2017), available at https://www.cept.org/Documents/ecc/41497/ecc-18-047-annex_mandate-rlan-6-ghz. The band 5925-6425 MHz is currently used across Europe by the Fixed Service and Fixed Satellite Service (Earth to space), but is also “allocated by ITU Radio Regulations (RR) to the Mobile service on a primary basis.” *Id.* at 1.

to consumers and businesses since, like Wi-Fi today, a global market for devices will rapidly drive costs the most affordable possible level.

We fully concur with DSA “[t]here is no question that today we have the technical ability to automate frequency coordination and thereby lower transaction costs, use spectrum more efficiently, speed time to market, protect incumbents from interference with greater certainty, and generally expand the supply of wireless connectivity that is fast becoming an input into every other industry in advanced economies.”³⁴ DSA correctly observes that while incumbent services – including the FS, FSS and BAS incumbents operating in 6 GHz today – will typically characterize the delegation of real-time spectrum access decisions to database algorithms as a risky and unproven technology, “the reality is the use of databases to coordinate spectrum assignments has evolved, but is *nothing new*. The basic steps are exactly the same as in a manual coordination process.”³⁵

Indeed, what some incumbents ignore is that automated frequency coordination systems certified by the Commission are far more likely to objectively and consistently protect incumbents than any other approach. The *DSA Report* correctly states that “a foundational benefit of automated frequency coordination is the consistent *ex ante* protection of incumbent operations, as well as the ability to remediate any interference that does result.”³⁶ As Google’s Preston Marshall describes it, the focus of dynamic frequency coordination is the “prediction, and avoidance, of possible interference, rather than detecting and mitigating the condition.”³⁷

³⁴ *DSA Report* at 7.

³⁵ *Ibid* (emphasis added).

³⁶ *Id.* at 30.

³⁷ Preston Marshall, *Three-Tier Shared Spectrum, Shared Infrastructure, and a Path to 5G*, at 104 (Cambridge Univ. Press, 2017). Ideally, coordination should be “invisible to the current users of the spectrum being shared.” *Id.* at 82.

This is likely why APCO and some other public safety entities agreed in their comments that properly designed AFC is an appropriate mechanism to protect incumbents.³⁸

Another advantage to AFC systems noted in the *DSA Report* is that incumbents bear no costs other than accurately updating their licensing data and are free to add or modify operations, which the secondary users must work around subject to database control. DSA states: “So long as the rules require – and the automated database system enforces – non-interference to incumbent operations, there is little if any cost to incumbents. Incumbents are not necessarily restricted from expanding or changing their location or frequency use, as they would be with a grandfathering approach.”³⁹

Finally, as the PIOs opined in their comments, we reiterate our agreement with DSA that the Commission “should authorize the simplest possible database solution that will achieve the regulatory goal” of expanding access to unlicensed spectrum while reasonably protecting incumbents from harmful interference.⁴⁰ Virtually all commenters supporting AFC control of the band support, as Qualcomm puts it, automated coordination by AFC systems that are simple, non-synchronized, and which do not attempt to account for aggregate interference.⁴¹ There is strong support in the record for rules that allow flexible AFC implementation options that may vary depending on uses and users throughout the band.

³⁸ See Comments of the National Public Safety Telecommunications Council at 10, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) (NPSTC Comments) (“support[ing] a centralized [AFC] . . . with up-to-date information and appropriate algorithms and protocols”); see also Comments of APCO International at 5, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) (APCO Comments) (supporting “AFC system . . . designed to effectively protect new and existing public safety licensees from interference” and that is “thoroughly tested and proven in advance”); Comments of Idaho Power Company at 6-7, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 14, 2019).

³⁹ *DSA Report* at 31.

⁴⁰ *Id.* at 53.

⁴¹ Qualcomm Comments at 5.

For example, in initial comments the PIOs stated it would be appropriate in this band to allow “both centralized and decentralized models for device and end-user coordination” and to allow a range of entities or groups to “seek certification as an AFC”).⁴² A number of commenters agreed that a range of business models can support an AFC system and that there is no need for every device to work with every AFC operator, or vice-versa.⁴³ We agree with Broadcom that AFC systems “must be simple, flexible, and customizable”; that so long as AFCs are reliable, the Commission should be open to certifying systems that are “centralized, decentralized, on-device, cloud-based, proprietary, non-profit, or for-profit to meet the needs of many different kinds of users.”⁴⁴

IV. THERE IS STRONG SUPPORT FOR HIGHER-POWER UNLICENSED OPERATIONS IN THE U-NII-5 AND U-NII-7 BAND SEGMENTS UNDER AFC CONTROL

In our initial comments, the PIOs urged the Commission to recognize that the 6 GHz proceeding is an opportunity to make more wide-channel spectrum available as public infrastructure for WISPs and other operators attempting to make high-capacity and affordable fixed wireless broadband available in rural and other underserved areas.⁴⁵ Comments filed by a diverse range of parties likewise demonstrate strong support for authorizing higher-power operations outdoors in rural and underserved areas, subject to automated frequency control.⁴⁶

⁴² PIO Comments at 26-27.

⁴³ *See, e.g.*, RLAN Group Comments at 40 (Commission “should not regulate details of AFC system architectures or intervene in private negotiations between AFC operators and device manufacturers by, for example, requiring that every AFC be able to work with every device”); Wi-Fi Alliance Comments at 26-28 (arguing against “a requirement that devices be able to communicate with multiple AFCs,” required “inter-AFC coordination,” and any restriction of “AFC operator eligibility to specific entities or a class of entities”).

⁴⁴ Broadcom Comments at 4.

⁴⁵ PIO Comments at 21-22.

⁴⁶ *See e.g.*, WISPA Comments at 10-11; CTIA Comments at 22; NCTA Comments at 10; RLAN Group Comments at 3; DSA Comments at 15-16; Broadcom Comments at 38-39; Facebook Comments at 8; Starry Comments at 2-3; Cambium Comments at 2-3.

We agree as well with WISPA and other commenters that the Commission should allow higher-power outdoor use for both point-to-point and point-to-multipoint (“PtMP”) operations.⁴⁷ This will enable more cost-effective point-to-point and point-to-multipoint services that could bring high-speed broadband access to more Americans.

Accordingly, the PIOs urge the Commission to adopt for U-NII-5 and U-NII-7 the same antenna gain and power limits that apply to the 5 GHz U-NII bands, subject to prior coordination by a certified AFC system. This will allow equipment already deployed in the 5 GHz band to be adapted quickly and at marginal cost to operate in the 6 GHz band. The PIOs agree with Starry that the Commission should “allow higher gain antennas on access points under the control of an AFC and client devices in the U-NII-5 and U-NII-7 bands” and do so “without limitation on whether the devices are in urban or rural areas,” thereby making promoting the most efficient use of spectrum.⁴⁸

Starry further observes how critical these technical rules will be to making high-speed and affordable broadband service practical in underserved areas:

Higher gain antennas and point-to-multipoint deployments are essential to fixed wireless providers. Higher gains increase directionality and extend the distance between an access point and a client device, allowing one base station to serve more end users (and thereby driving down the unit cost and improving the economics of a system). Point-to-multipoint has the same effect – instead of blasting energy omni-directionally, a fixed provider using a steerable point-to-multipoint antenna is capable of directing the energy in specific locations, freeing up airspace that would otherwise be needlessly occupied.⁴⁹

⁴⁷ See WISPA Comments at 10-11; DSA Comments at 15; Broadcom Comments at 38-39; Facebook Comments at 8; Starry Comments at 2-3; PIO Comments at 21-22. See also NCTA Comments at 10 (“NCTA also would support higher power operations on a fixed P2P or fixed point-to-multipoint (P2MP) basis in rural and underserved areas, as long as those operations would not materially increase the risk of interference to C-Band uplinks or existing Wi-Fi networks.”).

⁴⁸ Starry Comments at 2.

⁴⁹ *Id.* at 3.

The Commission itself stated in the *6 GHz NPRM* that it is seeking to repurpose the “broad swaths” of spectrum available in the 6 GHz band to “make broadband connectivity available to all Americans, especially those in rural and underserved areas.”⁵⁰ The authorization of outdoor use of wide, contiguous channels of 6 GHz spectrum at higher power – in areas where it can be prior-coordinated by AFC – is the way to operationalize this goal. The PIOs therefore agree with Broadcom and other commenters that “[a]uthorizing outdoor point-to-point and point-to-multipoint operations in the 6 GHz band is in the public interest because it will support the efficient, low-cost expansion of broadband services to rural and underserved communities.”⁵¹

WISPA likewise explains that higher power use of the band is crucial to its own deployment in rural areas: “If the Commission desires to maximize rural deployment, permitting higher-power operations in the U-NII-5 and U-NII-7 bands will promote that objective. Limiting power – especially where, as here, spectrum can be safely shared with licensees through AFC – will drive up deployment costs or, even worse, leave unserved areas on the wrong side of the digital divide.”⁵²

Critically, the Commission should acknowledge that subjecting these deployments to AFC authorization will alleviate any concerns of interference or harms. On this point, Starry correctly explains that “artificial geographic limitation is unnecessary. If an access point is under the control of an AFC, the AFC will adequately be able to protect the fixed point-to-point links in the area and coordinate the higher power gain accordingly. The Commission should trust in its decision to rely on modern spectrum sharing and coordination techniques to manage access to

⁵⁰ 6 GHz NPRM at ¶ 1.

⁵¹ Broadcom Comments at 38.

⁵² WISPA Comments at 9.

the 6 GHz band, and should avoid adding unnecessary static restrictions that can and should be appropriately delegated to the devices and the AFC.”⁵³

WISPA similarly argues that due to the use of the AFC, “Licensed operations will still be protected, and if an urban area has sufficient congestion to make few or no outdoor frequencies available in U-NII-5 or U-NII-7, then AFC will simply not authorize interfering operations.”⁵⁴ The use of the AFC to manage outdoor use has support from CompTIA as well.⁵⁵

V. THE COMMISSION SHOULD REJECT AUTO INDUSTRY ATTEMPTS TO FURTHER LIMIT THE VALUE OF WI-FI FOR CONSUMERS TO AVOID HYPOTHETICAL HARM TO HYPOTHETICAL DSRC DEPLOYMENTS IN THE 5.9 GHZ BAND

A few commenters from the automotive industry argue the Commission needs to ensure that incumbent Dedicated Short Range Communications (DSRC) operations and hypothetical Intelligent Transportation System (ITS) communications at the top of the 5.9 GHz band remain unharmed in the context of this proceeding.⁵⁶ “Without proper safeguards in place, out-of-band emissions (“OOBE”) from secondary 6 GHz unlicensed operations will degrade primary licensed vehicle safety communications operations in the 5.9 GHz band,” stated the 5G Automotive Association (“5GAA”), which represents a coalition of automobile and telecommunications firms.⁵⁷ Toyota similarly opines that it “is concerned that, even at this proposed level, there is a potential for harmful interference to DSRC reception, particularly if an unlicensed device

⁵³ Starry Comments at 3.

⁵⁴ WISPA Comments at 10.

⁵⁵ CompTIA Comments at 2 (“If expanding AFC management to standard-power and/or outdoor unlicensed devices in the U-NII-6 and U-NII-8 bands will pose no additional cost or operational burden, it merits Commission consideration.”).

⁵⁶ 5G Automotive Association Comments, ET Docket No. 18-295, GN Docket No. 17-183 (Feb. 15, 2019) (“5GAA Comments”); Toyota Motor Corporation Comments, ET Docket No. 18-295 (Feb. 15, 2019) (“Toyota Comments”).

⁵⁷ 5GAA Comments at 2.

operating in the 6 GHz band is transmitting from within—or immediately adjacent to—a DSRC-enabled vehicle.”⁵⁸

The Commission should not preempt the tremendous public interest benefits of authorizing contiguous wide channels needed to enable gigabit-fast Wi-Fi and other unlicensed innovation because of the auto industry’s hypothetical use of the 5.9 GHz band. DSRC is widely seen as an outdated and failed technology. Indeed, the Commission seems likely to reconsider whether the 5.9 GHz band – which lies fallow 20 years after its allocation to the auto industry – is even the most optimal allocation for real-time safety signaling, whether using DSRC or emerging standards based on 5G cellular standard. As recently as February, Commissioner Michael O’Rielly stated: “DSRC as it is currently in our rules is an outdated technology” unlikely to deliver the ubiquitous adoption necessary to achieve even its basic safety mission.⁵⁹ In fact, 5GAA’s own advocacy at the Commission reflects how the industry has moved towards 5G-based cellular vehicle-to-everything (C-V2X) technology to fulfill the operations that were previously expected of DSRC.⁶⁰ NCTA recently highlighted the fact that the increasing use of unlicensed operations in UNII-3 suggests that “[i]f engineers were starting today with a clean slate and looking for a home for automotive operations, they would never choose the 5.9 GHz band.”⁶¹

The 5.9 GHz band was reserved for ITS use in the late 1990’s to ensure the facilitation of auto safety. However, as the European Union’s allocation of ITS spectrum suggests, only 20 or

⁵⁸ Toyota Comments at 3.

⁵⁹ FCC February Open Meeting, Press Conference with Commissioners O’Rielly and Carr (Feb. 2019), <https://www.youtube.com/watch?v=1dCW8jiM7xc>.

⁶⁰ FCC Public Notice, “Office of Engineering and Technology and Wireless Telecommunications Bureau Seek Comment on 5GAA Petition for Waiver to Allow Deployment of Cellular Vehicle-to-Everything (CV2X) Technology in the 5.9 GHz Band,” DA 18-1231 (rel. Dec. 6, 2018).

⁶¹ NCTA ex parte letter, ET Docket No. 13-49 (Oct. 23, 2018), <https://ecfsapi.fcc.gov/file/1023778523876/Oct%2023%205.9%20GHz%20Ex%20Parte.pdf>.

30 MHz is actually necessary for critical and real-time safety applications. As the Commission and the Department of Transportation continue to review the future of the 5.9 GHz band and the amount reserved for automotive makers to protect public safety, the Commission should not prioritize the claims of incumbents of a neighboring band to make decisions on the future of the 6 GHz band, particularly incumbents that might soon relinquish some of what is currently almost entirely unused spectrum. Commissioners O’Rielly and Jessica Rosenworcel have expressed interest in opening the 5.9 GHz band for unlicensed use, as it would complement and amplify the benefits of current unlicensed operations in the adjacent 5 GHz U-NII-3 band, as well the extension of unlicensed access proposed in this proceedings.⁶²

The 5.9 GHz band is already a roadblock in the middle of a potential Wi-Fi superhighway that would generate enormous public interest benefits to consumers, business and the economy overall. Therefore, as the Commission considers the 5.9 GHz band in deciding the fate of the 6 GHz band, the PIOs agree with NCTA’s view that “opening the 5.9 GHz band for unlicensed use and adopting favorable unlicensed access rules for the 6 GHz band” should be adopted in tandem since failing to do so could “jeopardiz[e] the tremendous investment and innovation already put towards next-generation applications, including the Internet of Things, and caus[e] residential broadband and business and industrial applications to suffer service degradation.”⁶³

⁶² Public Interest Spectrum Coalition Comments , GN Docket No. 18-357 (Feb. 8, 2019), https://ecfsapi.fcc.gov/file/10209245569717/Public%20Interest%20Comments%20Opposing%20GAA%20Waiver_FINAL_020819.pdf.

⁶³ NCTA Comments at 7 and 2 (“In combination with unlicensed access to the 5.9 GHz band, the 6 GHz band presents a unique opportunity to address the pressing need for additional unlicensed mid-band spectrum resources.”).

VI. THE COMMISSION SHOULD ADOPT TECHNOLOGY-NEUTRAL RULES FOR THE BAND

In its comments, Qualcomm proposes a radical departure from the basic principles of unlicensed spectrum and the Commission’s Part 15 rules. As Qualcomm itself concedes, its proposal “gives precedence to synchronized operations in this portion of band but allows non-synchronized operations when no over the air synchronization timing reference signaling is detected.”⁶⁴ Unlicensed users using Wi-Fi, for example, would still have access to the band, but only when no synchronized operations are present.

Ironically, Qualcomm claims it would be “technology-neutral” to prioritize its new technology, asserting that its synchronized 5G New Radio product can coordinate among access points more efficiently than Wi-Fi currently does.⁶⁵ Needless to say, adopting rules that give a particular technology priority use of an unlicensed band is the exact opposite of the “technology-neutral” approach that has always been at the heart of the Commission’s unlicensed rules. While the Commission could reasonably consider requiring similar RLAN technologies to include coexistence features, the agency should not adopt any rules that prioritizes any specific technology, even if it is (today, but probably only temporarily) more efficient than another unlicensed technology.

It’s critical to remember that the Commission neither foresaw nor wrote Part 15 to prioritize Wi-Fi; rather, Wi-Fi emerged on unlicensed spectrum precisely because the Part 15 rules are technology neutral and offered spectrum open to innovation and free public use. Abandoning that basic principle to pick “winners and losers” on unlicensed spectrum bands would be both a radical departure and a tragic mistake.

⁶⁴ *Id.* at 23.

⁶⁵ Qualcomm Comments at 4.

VII. Conclusion

The PIOs applaud the Commission for proposing to extend shared, unlicensed access to all 1200 megahertz across the entire 6 GHz band. To maximize the public interest benefits of its proposal, we urge the Commission to ensure that ordinary consumers, small businesses, school, libraries and every American can benefit from next generation Wi-Fi and other unlicensed innovation by authorizing low-power, indoor-only use of all four 6 GHz band segments without the cost or complexity of an AFC requirement. The record shows strong support for this proposal, as well as for higher-power outdoor use of the U-NII-5 and U-NII-7 bands, subject to AFC control, to facilitate more affordable and higher-capacity fixed wireless broadband in rural and other underserved communities.

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