

**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)	GN Docket No. 17-183
Between 3.7 and 24 GHz)	

To: The Commission

**COMMENTS OF
THE PUBLIC INTEREST SPECTRUM COALITION**

**NEW AMERICA'S OPEN TECHNOLOGY INSTITUTE
PUBLIC KNOWLEDGE
CONSUMER REPORTS
CONSUMER FEDERATION OF AMERICA
AMERICAN LIBRARY ASSOCIATION
SCHOOLS, HEALTH & LIBRARIES BROADBAND (SHLB) COALITION
TRIBAL DIGITAL VILLAGE NETWORK
NATIONAL HISPANIC MEDIA COALITION
CoSN – CONSORTIUM FOR SCHOOL NETWORKING
BENTON INSTITUTE FOR BROADBAND AND SOCIETY
NEXT CENTURY CITIES
ACCESS HUMBOLDT
X-LAB**

June 29, 2020

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The Public Interest Spectrum Coalition (“PISC”)—comprising New America’s Open Technology Institute, Public Knowledge, Consumer Federation of America, Consumer Reports, the American Library Association, the Schools, Health & Libraries (SHLB) Coalition, National Hispanic Media Coalition, CoSN—Consortium for School Networking, Benton Institute for Broadband and Society, Next Century Cities, Access Humboldt and X-Lab—hereby submits our initial comments in response to the questions presented in the Further Notice of Proposed Rulemaking (“FNPRM”) in the above-captioned proceedings.¹

I. Introduction and Summary

The Public Interest Spectrum Coalition (“PISC”) commends the Commission for its unanimous *Report and Order* authorizing open public access to an additional 1200 megahertz of unlicensed spectrum across the entirety of the 6 GHz band. Our organizations generally support

¹ *Unlicensed Use of the 6 GHz Band; Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Report and Order and Further Notice of Proposed Rulemaking, ET Docket No. 18-295 and GN Docket No. 17-183, FCC 20-51 (rel. Apr. 24, 2020) (“*Report and Order*” or “*FNPRM*”).

the Commission’s proposals in the *FNPRM*. We urge the agency to adopt the most robust possible technical rules so that the next generation of Wi-Fi technologies, as well as mobile 5G networks, can offer consumers and the American economy the potentially revolutionary benefits of affordable gigabit-fast connectivity and innovative new applications both at home and on the go. In these comments we address each of the four primary issues raised in the *FNPRM*.

First, PISC strongly supports the Commission’s proposal to authorize very low power (“VLP”) unlicensed devices to operate both indoors and outdoors across the band’s entire 1200 megahertz unburdened by any requirement to be under the control of an Automated Frequency Control (“AFC”) system.² It’s crucial that the Commission authorize VLP devices to operate at power levels up to 14 dBm EIRP (1 dBm/MHz power spectral density). PISC believes this is the minimum power level needed to achieve the enormous potential consumer and economic benefits of VLP, while also fully protecting band incumbents from harmful interference.

VLP devices with sufficient power to be fully functional will prove central to the entire 5G wireless ecosystem. Widespread access everywhere to untethered, solar- or battery-powered VLP devices will facilitate not only Wi-Fi 6 networks, but will also make 5G mobile networks far more valuable to consumers and workers alike. Just as the smartphone ignited an apps economy and a wave of innovation over the past decade, the ability to create a ‘personal area network’ (PAN) and tether a myriad of innovative new peripheral devices to smartphones, tablets, game boxes and other sources of wireless connectivity is likely to fuel yet another wave of innovation that benefits consumers worldwide. The full potential of next generation Wi-Fi 6

² See *Id.* at ¶ 234; *Ex Parte* Letter of Apple, Broadcom, et al., *Unlicensed Use of the 6 GHz Band; Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, ET Docket No. 18-295 and GN Docket No. 17-183 (July 2, 2019), at 5,7; *Ex Parte* Letter of Apple, Broadcom, et al., *Unlicensed Use of the 6 GHz Band; Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, ET Docket No. 18-295 and GN Docket No. 17-183 (Dec 9, 2019), at 8.

cannot be realized without the complementary innovation and productivity enabled by connecting VLP devices at a fully functional power level (i.e., 14 dBm EIRP). In addition to everyday consumer use, we expect that peripheral VLP devices, tethered to mobile access points, will become an essential tool to increase productivity for millions of mobile workers; to increase the productivity and cost-effectiveness of enterprise IoT; and also to enhance the quality of life for millions of Americans with disabilities.

Second, the Commission's historic decision in April to authorize low-power, indoor-only ("LPI") devices across the entire 6 GHz band will *potentially* make the enormous benefits of next generation Wi-Fi technology available and affordable to every home, business, school and library. However, these enormous public interest benefits will be undermined if the Commission restricts the power levels for LPI to an arbitrary level that might appear to be a "compromise" with powerful incumbents, but which in practice will make Wi-Fi routers far more costly, complex, and less useful for the average household or small business. In the context of the current pandemic, because Wi-Fi 6 routers and devices can come to market as soon as the end of this year, PISC believes it is critical that consumers and businesses have the indoor coverage they need to function well and affordably. The Commission should not pull the technical rug out from under ordinary consumers, small schools, and small businesses unless the engineering evidence in the record clearly establishes that LPI at up to 8 dBm/MHz will measurably and substantially increase the risk of harmful interference to incumbent users in the band.

Third, PISC strongly supports the authorization of higher power limits and antenna directivity for fixed standard-power access points in the U-NII-5 and U-NII-7 bands, whether operating indoors or outdoors, that harmonize with the rules for the nearby U-NII-3 band. PISC believes that addressing the broadband speed and affordability gap in rural, tribal, and other

underserved areas is a compelling public interest that justifies harmonizing the power and antenna gain limits for standard power operations under AFC control with the current limits that apply to U-NII-3. There is no reason to conclude that allowing increased power will pose a substantially greater risk to incumbent fixed microwave links if the Commission subjects deployments exceeding a threshold level (i.e., 36 dBm EIRP) to both professional installation and prior coordination and approval by a certified AFC.

Finally, PISC believes the Commission's world-leading decision in April to authorize unlicensed users to operate both indoors and outdoors at standard power under the control of a certified AFC fell short in one important respect: the *Report and Order* limits outdoor operations at power levels up to 36 dBm EIRP to completely *fixed* access points. There is little doubt that the use cases for connectivity on mobile platforms will greatly benefit consumers and the economy. For example, thousands of transportation systems (e.g., buses, commuter and freight trains, autonomous truck convoys, ferries) can give customers access to a higher-capacity RLAN along a pre-planned route, or within certain pre-cleared areas. We urge the Commission to authorize standard-power access points, under AFC control, for mobile applications under rules similar to those the Commission has proposed for personal/portable TV white space devices.

II. The Commission Should Authorize the Operation of Very-Low-Power Devices Across the Entire 6 GHz Band

PISC strongly supports the Commission’s proposal to “permit very low power devices to operate across the entirety of the 6 GHz band (5.950-7.125 GHz), both indoors and outdoors, without using an AFC.”³ The Commission should authorize very low power (“VLP”) unlicensed devices to operate both indoors and outdoors across the band’s entire 1200 megahertz at 14 dBm EIRP (and 1 dBm/MHz power spectral density) unburdened by any requirement to be under the control of an Automated Frequency Control (“AFC”) system.⁴ PISC believes this proposal is the minimum power level needed to achieve the enormous potential consumer and economic benefits of VLP, while also fully protecting band incumbents from harmful interference.

Ensuring that VLP devices are able to operate across all four 6 GHz sub-bands, both outdoors and indoors, is crucial to ensure that the next-generation of 5G- and Wi-Fi-powered use cases are able to thrive and benefit consumers. Just as the smartphone ignited an app economy and a wave of innovation over the past decade, the ability to create a ‘personal area network’ (PAN) and tether a myriad of innovative new peripheral devices to smartphones, laptops, game boxes, and other sources of wireless connectivity is likely to fuel yet another wave of innovation that benefits consumers worldwide. The full potential of next-generation Wi-Fi 6 cannot be realized without the complementary innovation and productivity enabled by connecting VLP devices at a fully functional power level (i.e., 14 dBm EIRP).

The Commission requests comment on the likely use cases for VLP devices and the resulting benefits for the American public.⁵ These use cases most obviously include a wide range

³ *FNPRM* at ¶ 235.

⁴ *See Id.* at ¶ 234; Apple, Broadcom et al. July 2, 2019 *Ex Parte*, at 5-7, *supra note 2*; Apple, Broadcom et al. Dec 9, 2019 *Ex Parte*, at 8, *supra note 2*.

⁵ *Ibid.*

of applications leveraging augmented reality (AR) and virtual reality (VR) that will promote education, gaming, recreation, health care, vehicle-based technologies, and many other verticals. Peripheral VLP devices, tethered to mobile access points (initially smartphones), will become an essential tool to increase productivity for millions of mobile workers, from repair and maintenance, to delivery services and public safety. Millions of people with disabilities will almost certainly benefit as wearable and possibly even implantable VLP devices assist them more readily with everyday tasks, enhancing their quality of life. Remote monitoring and enterprise IoT will be more robust, cost-effective and innovative with the capability to tether VLP devices to nearby Wi-Fi enabled access points.

PISC fully agrees with Apple, Broadcom, Cisco, Facebook, Google, Intel, Marvell Semiconductor, and Qualcomm that “while VLP will not support traditional access points, this device class will be critical for supporting indoor and outdoor portable use cases such as wearable peripherals including AR/VR and other ‘personal-area-network’ applications. Without usable VLP rules, it is unlikely that such devices will be practical in the near term due to the lack of the wide channels needed for low latency applications for outdoor use.”⁶ PISC agrees with the high-tech RLAN Group that “[t]he Commission can facilitate more rapid investment and innovation in the band by adopting rules to allow VLP use, without creating any additional risk of harmful interference to licensed incumbent services.”⁷

⁶ Ex Parte of Apple Inc., Broadcom Inc., Cisco Systems, Inc., Facebook, Inc., Google LLC, Intel Corporation, Marvell Semiconductor, Inc., and Qualcomm Incorporated, ET Docket No. 18-295, GN Docket No. 17-183 (Nov. 12, 2019), at 1.

⁷ Reply 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, an ARRIS Company, ET Docket No. 18-295, GN Docket No. 17-183 (March 18, 2019), at 10.

There is already ample support in the record for the importance of rules enabling VLP operations across the entire 6 GHz band. As Chairman Pai recently explained:

Very-low-power devices could enable a new and innovative generation of personal area network technologies with low latency, high capacity, and all-day battery life. These very-low-power devices could include accessibility technology for Americans with disabilities, virtual reality gaming, augmented reality glasses, in-vehicle systems, and other emerging technologies. We don't really know what this would lead to. And that's kind of the point with unlicensed innovation, isn't it? We want to set the building blocks in place so that engineers and technologists out there can figure out what it could mean for American consumers.⁸

Virtual reality and augmented reality in particular could fuel revolutionary new use cases for work, education, recreation and myriad other scenarios. A decade from now we will look back and chuckle at the memory of today's head-down horde of commuters, sports fans, vehicle passengers, mobile workers and others who typically access the benefits of wireless connectivity by staring down at a tiny screen—even if that means tripping over curbs, or missing a big play at the ball game. One of the most obvious consumer benefits of authorizing VLP peripherals will be that tens of millions of fans attending sporting and cultural events can keep their eyes on the live action while receiving their choice of AR information—statistics, replays, messages from fellow fans—displayed on glasses or some other VLP peripheral device. With peer-to-peer sharing, fans could directly share photos, video replays and more with one another. Tucked among thousands of fans in arenas, within inches of their bodies, devices at the power levels proposed by industry would pose no risk to high-power fixed links or other incumbents outside.

It is crucial to realize that VLP devices are not only about making Next Gen Wi-Fi 6 networks more useful and valuable to consumers. Widespread access everywhere to untethered,

⁸ Remarks of FCC Chairman Ajit Pai at the Wi-Fi Alliance Virtual Membership Meeting (June 2, 2020), at 2, available at <https://docs.fcc.gov/public/attachments/DOC-364693A1.pdf>.

battery-powered VLP devices will perhaps even more decisively make 5G mobile networks far more valuable to consumers and to workers in many jobs where peripherals (e.g., glasses, goggles, unfolding view screens) could play a significant role in enhancing productivity. A group of high-tech companies (including Apple, Broadcom, Facebook, Google, Hewlett Packard, Intel, Marvell Semiconductor, Microsoft, and Qualcomm) correctly described VLP devices as “the core of provisioning of 5G digitally immersive cellular services.”⁹ VLP devices will be central to mobile AR/VR services, ultra-high-definition streaming, high-speed tethering devices to broadband, and in-vehicle entertainment, according to the companies.¹⁰

There are several examples in the record describing how VLP operations across the entire 6 GHz band will unleash new use cases and devices, many of which we cannot even imagine today. As Apple explains: “[T]he Commission should authorize a category of very-low-power 6 GHz devices for indoor and outdoor use without AFC control. Such devices... would enable important applications at short ranges, including communications between devices and accessories such as headphones, hearing aids, watches, game controllers, and other peripherals.”¹¹ Facebook likewise details the benefits of permitting VLP devices to empower new use cases: “Innovators would gain access to 6 GHz band for flexible new use cases with greater flexibility, and lower cost, than either of the two device classes envisioned by the Commission (i.e., standard-power AFC-controlled devices or low-power indoor only devices (LPI)). A very-low-power device class that includes portable devices would complement the other two device classes by providing flexible spectrum access for short-range connectivity

⁹ Ex Parte of Apple Inc., Broadcom Inc., Facebook, Inc., Google LLC, Hewlett Packard Enterprise, Intel Corporation, Marvell Semiconductor, Inc., Microsoft Corporation, and Qualcomm Incorporated, ET Docket No. 18-295, GN Docket No. 17-183 (July 2, 2019), at 5.

¹⁰ *Ibid.*

¹¹ Comments of Apple, Inc., ET Docket No. 18-295, GN Docket No. 17-183 (Feb. 15, 2019), at 7-8.

between devices such as game console controllers, keyboards, headphones, or other wearable devices, and for other future use cases not yet foreseen.”¹²

One coalition of high-tech companies has emphasized how VLP devices are “critical” to realizing two future use cases in particular.¹³ First, personal area network (“PAN”) applications, where, as the companies explain, “devices will be exclusively battery powered and designed for either handheld use or to be worn on the user’s body,” such as “smartphones, glasses, watches, and earphones.”¹⁴ Second, the companies highlight how VLP devices are essential to powering vehicular applications, where “devices are designed to be installed in automobiles or other terrestrial vehicles. An in-dash display unit would be a typical example of a vehicular VLP device.”¹⁵

To encourage innovation and optimal value for VLP devices, use cases, and PANs more generally, we urge the Commission to adopt its proposal to authorize VLP across all four band segments and without any requirement for control by an Automated Frequency Coordination (“AFC”) system. As Qualcomm underscores, if the Commission were to implement varying rules for VLP devices in different sub-bands, it would reduce the effectiveness of the 6 GHz band to next-generation use cases. Qualcomm explains that “to permit in alternating 6 GHz sub-bands standard-power unlicensed devices under AFC control and LPI devices would hinder investment in the 6 GHz band. It would prevent LPI devices from being able to access wider channel sizes that straddle multiple U-NII sub-bands to facilitate higher speeds and thus reduces the potential for global harmonization with other jurisdictions that permit LPI in U-NII-5.”¹⁶

¹² Comments of Facebook, ET Docket No. 18-295, GN Docket No. 17-183 (Feb. 15, 2019), at 6.

¹³ Ex Parte of Apple Inc., Broadcom Inc., Cisco Systems, Inc., Facebook, Inc., Google LLC, and Qualcomm Incorporated, ET Docket No. 18-295, GN Docket No. 17-183 (Dec. 9, 2019), at 1.

¹⁴ *Ibid.*

¹⁵ *Ibid.*

¹⁶ Qualcomm Comments, ET Docket No. 18-295, GN Docket No. 17-183 (Feb. 15, 2019), at 10.

Peer-to-peer services are another potential use case that the Commission could unlock by ensuring VLP devices are able to access all four 6 GHz sub-bands. VLP devices should be able to connect directly with one another using any of the four sub-bands to 6 GHz spectrum. This will be enable high-speed, next-generation connectivity use cases for devices in the same vicinity. Peer-to-peer connectivity among VLP devices can facilitate next-generation operations in areas such as video games, education, shopping, manufacturing, tours in museums and other historic landmarks, as well as screen mirroring and other use cases yet to be innovated.

Schools and students are likely to be major users and beneficiaries. Thanks to massive investments, through E-Rate and other sources, most schools are fiber-fed and will be able to harness Wi-Fi 6 on 6 GHz spectrum to provide gigabit connectivity to the classroom. Online lectures, seminars, field trips, simulations, and group projects could become more immersive and more closely reflect the characteristics of in-classroom learning—while also potentially empowering styles of learning that go beyond the abilities of what teachers can facilitate in a classroom setting. Virtual visits to the Louvre, educational gaming and AR information streaming in during hands-on lab work are the most rudimentary examples of benefits. Remote laboratories are a more advanced and compelling use of wireless computing and remote control of peripheral devices.¹⁷ AR/VR learning could also play a significant role in assistive learning, according to experts.¹⁸

¹⁷ See, e.g., Jeremy Roschelle, Kemi Jona and Patricia Schank, “Remote Labs,” CIRCL—Center for Innovative Research in Cyberlearning, available at <https://circlcenter.org/remote-labs/>.

¹⁸ Eli Zimmerman, “AR/VR in K–12: Schools Use Immersive Technology for Assistive Learning,” EdTech Magazine (Aug. 22, 2019), <https://edtechmagazine.com/k12/article/2019/08/arvr-k-12-schools-use-immersive-technology-assistive-learning-perfcon> (“Experts have found virtual environments can give students who require extra assistance the opportunities to build the skills they need to be as successful in the classroom as their peers. ‘It’s being used ... to work with students on joint attention skills, sensory-based experiences, exposure therapy to reduce anxiety, social stories, community-based instruction, social skills, executive functioning, daily and independent living skills, safety

Rules any more strict than necessary to avoid actual harmful interference will deter or overly burden this sort of educational innovation. Will schools need to require individual students—or groups of collaborating students—to plug into the wall in order to use AR or VR for learning? Or will those peripherals need to be far more expensive, so that they are capable of operating as clients of the school’s Wi-Fi router? Within a short distance—whether in the classroom, on a school bus, on a field trip, or at home—students should be able to tether AR or VR goggles or glasses to their notebook or laptop.

Telecommuters—at home and especially for mobile workers on the move—also will increasingly benefit from VLP innovation. Loom.ai, a company recently profiled by the *New York Times*, is one example of a platform that is hoping to use virtual reality, as well as augmented reality glasses, to create virtual and immersive “meeting rooms” and facilitate a virtual work space for workers at home or at the office¹⁹ As offices and schools have been forced into remote operations during the COVID-19 pandemic, it has forced a re-think of how both work and learning can be better facilitated in an online format. While deep inequities still exist that leave millions of Americans without the high-speed broadband necessary to participate in remote work or learning, these emerging advances in work and school through AR and VR have potential to spur innovations in both spaces to benefit consumers.

awareness, and social modeling,’ said Jaclyn Wickham, founder of AcclimateVR, in a presentation hosted by the Center on Technology and Disability.”).

¹⁹ Clive Thompson, “What If Working From Home Goes on ... Forever?,” *The New York Times Magazine* (June 9, 2020), <https://www.nytimes.com/interactive/2020/06/09/magazine/remote-work-covid.html>.

III. Low-Power Indoor-Only Devices Should be Authorized to Operate at a Higher Power Spectral Density of 8 dBm/MHz and Up to 33 dBm EIRP over a 320 Megahertz Channel

PISC commends the Commission for authorizing low-power, indoor-only (“LPI”) devices across all 1200 megahertz of the 6 GHz band. At a fully functional power level, this will make the enormous benefits of next generation Wi-Fi technology, including multi-gigabit throughput and low-latency, available and affordable to every home, business, school and library. The only thing that could derail those enormous public interest benefits is if the Commission restricts the maximum power of LPI devices to an arbitrary level that might appear to be a “compromise” with powerful incumbents, but which in practice will make Wi-Fi routers more costly, complex and far less useful for the average household or small business.

As CableLabs, Charter, and Comcast have described in connection with their technical studies showing 6 GHz incumbents would not suffer undue risk of harmful interference at 8 dBm/MHz PSD, substantial and “negative consumer impacts would result if LPI Wi-Fi were authorized at a radiated PSD of less than 8 dBm/MHz.”²⁰ In the context of the current pandemic, because Wi-Fi 6 routers and devices can come to market as soon as the end of this year, PISC believes it is critical that consumers and businesses have the indoor coverage they need to function well and affordably. Nationwide work and school closures have highlighted how critical it is to have affordable, high-capacity internet connectivity throughout every home. Even homes with gigabit-capable fiber or cable service are discovering that today’s Wi-Fi is constrained in supporting multiple users engaged in video conferencing, streaming video and other high-

²⁰ Letter from CableLabs, Charter and Comcast to Marlene H. Dortch, ET Docket 18-295, GN Docket 17-183, at 3 (March 25, 2020) (“Cable March 25 Ex Parte”).

bandwidth applications. Stay-at-home orders are turning homes into classrooms and offices, a situation that could persist to varying degrees into 2021.

Accordingly, PISC applauds the Commission for seeking further comment on whether to allow LPI devices to operate at a higher power spectral density of 8 dBm/MHz with a maximum permissible EIRP of 33 dBm for devices operating in a 320 megahertz bandwidth.²¹ PISC agrees with the Commission's recognition that "these rules would be useful for many indoor devices that require high data rate transmissions such as indoor access points communicating with clients like high-performance video game controllers, and wearable video augmented reality and virtual reality devices."²² More fundamentally, as advocates for consumers and community anchor institutions, our groups are concerned that the fairly modest difference between a maximum 5 dBm/MHz and 8 dBm/MHz is likely to make an enormous difference on the affordability and quality of advanced Wi-Fi routers and whole-home coverage. The Commission should not pull the technical rug out from under ordinary consumers, small schools and small businesses unless the engineering evidence in the record clearly establishes that LPI at up to 8 dBm/MHz PSD will measurably and substantially increase the risk of harmful interference to incumbent users in the band.

The effective coverage area of an indoor Wi-Fi router is of the utmost importance to consumers. Without a minimally-adequate PSD limit, homes and businesses will suffer dead zones or require multiple routers and/repeaters. CableLabs has studied this extensively, and credibly, as the FCC recognized in the *Report and Order*.²³ CableLabs found that increasing the

²¹ See FNPRM at ¶ 244.

²² Id.

²³ *Report and Order* ¶¶ 117-118.

PSD limit from 5 to 8 dBm/MHz will increase the coverage by 31 to 43 percent and throughput by 53 to 63 percent, on average.²⁴

In economic terms, this increase in coverage is hugely valuable since the vast majority of Americans today rely on Wi-Fi for connectivity in an increasingly large share of homes, businesses and public buildings. In addition, even large enterprises will need robust indoor coverage for factory automation, warehouse fulfillment centers, and other venues where industrial IoT can boost productivity. For example, Mettis Aerospace has demonstrated at its 27-acre manufacturing facility in England that a Wi-Fi 6 IoT network using 80 megahertz channels can support applications including 4K video streaming, AR, large-scale file transfers, messaging and voice/video communications, as well as collecting data from thousands of IoT sensors.²⁵

Despite compelling public interest benefits, we concede that authorizing a higher PSD limit for LPI use would be difficult to justify if the record presented solid engineering evidence that the difference between 5 and 8 dBm/MHz PSD would make the difference between an extremely low risk of harmful interference to critical fixed links and, at 8 dBm/MHz, a substantially greater risk. However, the record clearly shows this is not the case. CableLabs submitted multiple studies with extensive analysis that modeled the interference risk of LPI devices to microwave P2P receivers, including simulation results that assumed all of the LPI access points operated at a PSD of 8 dBm/MHz.²⁶ The CableLabs simulation study showed that

²⁴ See *Ex Parte* Letter from Rob Alderfer, Vice President of Technology Policy, CableLabs, ET Docket No. 18-295, GN Docket No. 17-183 (March 30, 2020), at 4-5 (“CableLabs March 30 Ex Parte”).

²⁵ See Joe O’Halloran, “Mettis Aerospace completes world’s first phase-one Wi-Fi 6 4.0 trials,” *Computer Weekly* (Dec. 5, 2019), available at <https://www.computerweekly.com/news/252475056/Mettis-Aerospace-completes-worlds-first-phase-one-Wi-Fi-6-40-trials>.

²⁶ See Letter from Rob Alderfer, Vice President of Technology Policy, CableLabs, ET Docket No. 18-295, GN Docket No. 17-183 (March 19, 2020), at 2; Letter from Rob Alderfer, Vice President of Technology Policy, CableLabs, ET Docket No. 18-295, GN Docket No. 17-183

the interference protection criteria were met at both 5 dBm/MHz PSD *and* at the higher 8 dBm PSD. In the *Report and Order*, the Commission described in detail why it found the CableLabs study to be “persuasive” and not flawed as incumbents claimed, stating: “We find the CableLabs’ study persuasive because it uses actual airtime utilization data for hundreds of thousands of Wi-Fi access points along with a statistical model for building entry loss.”²⁷ The *Report and Order* further found that the CableLabs simulation results “addresses AT&T’s concern by assuming all access points operate at 8 dBm/MHz and . . . show the I/N was less than -6 dB in all instances,”²⁸ the level that the Fixed Wireless Communications Coalition, which represents the interest of the fixed microwave licensees, uses as a threshold for harmful interference to fixed microwave links.²⁹

In addition, as the *Report and Order* acknowledges, the “sporadic and bursty nature of Wi-Fi transmissions,” which is inherent in the contention-based protocol the Commission mandates in this Order, makes the occurrence of harmful interference even less likely.³⁰ Moreover, as the *Report and Order* recognizes, high-power point-to-point microwave links have enormous excess margins to protect against interference from severe weather or from the deep

CableLabs (Dec. 20, 2019); Letter from Rob Alderfer, CableLabs, to Marlene H. Dortch, ET Docket 18-295, GN Docket 17-183, at 5-7 (Feb. 14, 2020) (“CableLabs Feb. 14 Ex Parte”); Letter from Rob Alderfer, CableLabs, to Marlene H. Dortch, ET Docket 18-295, GN Docket 17-183, at 5-7 (March 19, 2020); *CableLabs March 30 Ex Parte*, *supra*, at 5-7.

²⁷ *Report and Order* at ¶ 118.

²⁸ *Id.* at ¶ 119.

²⁹ See *Cable March 25 Ex Parte*, *supra*, at 2-3, and studies referenced therein (“LPI Wi-Fi operation, even in worst-case scenarios, will maintain FS link reliability and will not cause harmful interference to FS, even at a conservative -6 dB I/N threshold.”).

³⁰ *Id.* at ¶ 142. “The data that CableLabs submitted, collected from 500,000 Wi-Fi access points, shows that 95% of access points have an activity factor of less than 2% and only 1% of access points are active more than 7% of the time. This illustrates that most of the time a particular access point will not be transmitting.” *Id.* at ¶ 141, citing *CableLabs Dec. 20, 2019 Ex Parte* at 4-5 (finding weighted average activity factor is 0.4%).

atmospheric multipath fade that can occur during the eight-hour period after midnight.³¹

Accordingly, the Commission concluded that “because the Wi-Fi access point busy hour is not between the 8-hour period after midnight, we conclude that the likelihood of harmful interference to fixed service microwave links from indoor low power Wi-Fi access points is insignificant.”³² The Commission’s conclusion, based on the CableLabs study, remains correct: indoor-only Wi-Fi, whether in homes, offices, schools or other establishments, are extremely unlikely to be operating at locations or times where even a line-of-sight transmission could overcome a microwave point-to-point link’s excess margin.³³

Fixed Service microwave links are designed with excess link margin to protect against interference that far exceeds any plausible impact that an indoor, low-power device operating at 8 dBm/MHz radiated PSD could possibly generate. Fixed link fade margins typically exceed 40 dB.³⁴ Thus, even in the corner cases posed by incumbent fixed link operators (e.g., a LPI router in an open window very close to a link’s main beam or receiver), “that interference is exceedingly unlikely to constitute harmful interference due to the available link margin.”³⁵ Even an unrealistically high assumption of a 10 or 20 dB increase in the noise from a LPI device directly to a fixed link receiver would not increase FS outage time, according to a coexistence

³¹ *Id.* at ¶ 143.

³² *Ibid.*

³³ *See, e.g.*, Presentation attached to Letter from Paul Margie to Marlene H. Dortch, ET Docket 18-295, GN Docket 17-183, at 2-3 (Oct. 7, 2019) (study shows that “the effect of RLAN devices on fixed-service receivers, even accounting for rare deep-fade events, is minimal and does not rise to the level of harmful interference.”).

³⁴ Chris Szymanski and Vinko Erceg, “Supplemental Link Margin Analysis,” Broadcom, Letter from Paul Caritj, counsel to Broadcom, to Marlene H. Dortch, ET Docket 18-295, GN Docket 17-183 (March 29, 2019) (“Broadcom Link Margin Analysis”). *See also* Letter from Apple, Broadcom, Cisco, et al. to Marlene H. Dortch, ET Docket 18-295, GN Docket 17-183 (Sept. 25, 2019) (applying industry-standard link planning algorithms shows virtually all FS links have more margin than required).

³⁵ *Broadcom Link Margin Analysis* at 1.

study filed by CableLabs using real-world Wi-Fi utilization data from 500,000 access points.³⁶ If FS operators need absolute certainty at the level of “five nines” at all times, they should move to a flexible use band and pay for that level of exclusive use.

At 5 dBm/MHz or at 8 dBm/MHz, harmful interference from the indoor operation of RLANs into FS receivers would be extremely rare with or without frequency coordination by an AFC. The two operate in entirely different locations and with transmit characteristics that are complementary. One is indoor-only, and the other is outdoor-only. FS fixed links are very high-power and directional, while indoor RLANs are very low power. FS fixed links are tower- or rooftop-mounted, while unlicensed devices typically operate at or near ground level. FS links transmit continuously at high power, while RLAN devices operate at very low duty cycles with low EIRP.³⁷

Unlike outdoor or enterprise Wi-Fi deployments, LPI devices would operate entirely within a home or business, where building materials significantly attenuate the already low-power signal and minimize any potential interference.³⁸ Routers are almost always on the floor, or mounted high in a corner; rarely would they be positioned in front of a window. And to the extent a RLAN may be on a high floor overlooking a lower rooftop with a FS link, windows in

³⁶ CableLabs, “6 GHz Low Power Indoor (LPI) Wi-Fi / Fixed Service Coexistence Study,” attached to *CableLabs Dec. 20 Ex Parte* (sensitivity analysis demonstrating that even in unproven corner cases in which a Wi-Fi AP caused an unrealistically high 10 or 20 dB noise rise - which was not observed in CableLabs’ simulation - there would be no impact on the Fixed Service).

³⁷ RKF Engineering Services, *Frequency Sharing for Radio Local Area Networks in the 6 GHz Band 24-26*, at 17-23 (Jan. 2018) (“RKF Study”), attached to Letter from Paul Margie, Counsel, Apple Inc., Broadcom Corporation, Facebook, Hewlett Packard Enterprise, and Microsoft Corp. to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 17-183, (Jan. 26, 2018).

³⁸ *Ibid.*

new and renovated buildings are increasingly coated for environmental reasons that also mitigate any signal leakage outdoors.

Moreover, it should be no surprise that the CableLabs study found no greater risk of harmful interference at the modestly higher power level of 8 dBm/MHz. The record demonstrates that FS links are high power and use high-quality, highly-directional antennas. Even standard-quality FS antennas would protect outdoor fixed links from RLAN signals only two degrees off the antenna's axis, while the sort of high-performance FS antennas typical in urban or other congested areas – where an indoor Wi-Fi router or RLAN device on an upper floor would most likely occur – are far more protective.³⁹ Sharing between two fixed services will never be absolutely risk-free, but it's hard to imagine two operations that could coexist with a higher comfort level than high-power, outdoor FS and very low power, indoor-only RLAN devices. Wi-Fi and other unlicensed devices also operate at very low duty cycles with low EIRP, as the high-tech industry coalition study documented, with the result that even the rare cases of leakage to a close-by FS receiver would cause interference in very brief and infrequent bursts.

The Commission must also consider the fact that encouraging Wi-Fi 6 and other unlicensed traffic to operate indoors at 8 dBm/MHz PSD could *reduce* the overall risk of harmful interference to FS incumbents. If 1200 megahertz is available at a low but adequate power indoors and without an AFC requirement, much of the unlicensed traffic that might have been at standard power (and higher cost) will instead rely on a low-power, indoor-only RLAN. The Commission should not want to force homes and businesses to operate at a much higher standard

³⁹ 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 (May 14, 2018), at 9.

power because LPI at 5 dBm/MHz PSD is inadequate or more costly than operating at standard power under AFC control. By making 1,200 contiguous megahertz of 6 GHz spectrum available inside every building, unlicensed routers and other devices will spread their transmissions over multiple and much wider channels, which substantially lowers the power spectral density (PSD) and therefore the risk of interference on the small slice of frequencies in use by a nearby high-power fixed microwave link.

IV. The Commission Should Authorize Higher Power Limits and Antenna Directivity for Both Point-to-Point and Point-to-Multipoint Fixed Operations in the U-NII-5 and U-NII-7 Bands

In the *FNPRM* the Commission acknowledges that the maximum 36 dBm EIRP power level adopted in the *Report and Order* for unlicensed operations in the U-NII-5 and U-NII-7 bands is not harmonized with the rules for the U-NII-1 and U-NII-3 bands, which allow for higher power point-to-point operations.⁴⁰ PISC thanks the Commission for seeking comment on “whether similar flexibility can be permitted in the 6 GHz band.”⁴¹ PISC strongly supports the authorization of higher power limits that harmonize with the rules for the U-NII-3 bands, consistent with Section 15.407(a)(3) of the Commission’s Rules.⁴²

PISC believes that addressing the broadband speed and affordability gap in rural, tribal and other underserved areas is a compelling public interest that justifies harmonizing the power and antenna gain limits for standard power operations under AFC control with the current limits in U-NII-3 and/or U-NII-1. Because fixed wireless equipment already deployed in the 5 GHz is

⁴⁰ *NPRM* at ¶ 252.

⁴¹ *Ibid.*

⁴² Section 15.407(a)(1)(iii) is the rule for fixed point-to-point operations in the 5.15-5.25 GHz U-NII-1 band, and Section 15.407(a)(3) is the rule for fixed point-to-point operations in the 5.725-5.85 GHz U-NII-3 band.

easily adaptable to operate in the 6 GHz band, new fixed wireless broadband networks can be placed quickly into operation, especially if the technical rules are harmonized.

There is no reason to conclude that allowing increased power will pose a substantially greater risk to incumbent fixed microwave links if the Commission subjects deployments exceeding a threshold level (i.e., 36 dBm EIRP) to both professional installation and prior coordination and approval by a certified AFC. The *FNPRM* acknowledges that the directional antennas commonly used by fixed wireless providers today are capable of transmitting energy in the direction of incumbent fixed links, explaining correctly that “when the transmit antenna points away from a microwave receiver, the effect would be that the access point has a lower EIRP in the direction of the receiver.”⁴³

Indeed, stakeholders that represent the band’s biggest incumbent users of licensed P2P microwave links affirmatively support a higher power level based on their confidence in the combination of directional antennas and the capabilities of a certified AFC. In its original comments in this proceeding, CTIA stated: “Because of the AFC’s capabilities to control unlicensed operating parameters specific to maintaining interference protection for each individual incumbent licensee’s operations, along with the sophistication of directional antennas that may be deployed, the Commission should consider adopting higher power levels for outdoor operations than those proposed in the NPRM.”⁴⁴ Verizon echoed this view, stating that “with AFC positive control, there is no reason to maintain the current very low Part 15 power levels

⁴³ *NPRM* at ¶ 254.

⁴⁴ Comments of CTIA, *Unlicensed Use of the 6 GHz Band; Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, ET Docket No. 18-295 and GN Docket No. 17-183 (February 15, 2019), at 20.

based on existing 20 megahertz wide channels. The Commission could allow power levels as high as 50 dBm or more.”⁴⁵

There is no reason why the rules should require AFCs to assume that every fixed wireless P2P or sector antenna is omnidirectional when that is demonstrably not the case for either P2P or for most P2MP deployments. The coordination of fixed unlicensed with fixed licensed P2P links should be particularly straightforward, especially given the capabilities of AFCs. With accurate inputs, an AFC far less sophisticated than the Spectrum Access Systems the Commission has already certified to protect U.S. Navy operations .in the 3.5 GHz band can make this calculation. The Commission can require either the operator or a professional installer to provide the AFC with the antenna’s technical characteristics, such as height, antenna manufacturer and model number, beam pattern (which could be pre-stored for a given antenna model), azimuth and up/down tilt.

In addition, the Commission should allow AFCs to take account of antenna pattern and orientation information for any standard power access point for which the information can be reliably determined and communicated to the AFC, irrespective of whether the AP is outdoors or seeking permission to operate above standard power. There are many scenarios where, both indoors and outdoors, an AFC could greenlight the use of substantially more vacant spectrum in the band if it knew that the AP is configured to use a directional antenna to transmit only in a certain direction or sector. For example, inside a warehouse or factory, the enterprise may only need (or want) an AP to transmit out from a corner of the room or building in one direction.

⁴⁵ Comments of Verizon, *Unlicensed Use of the 6 GHz Band; Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, ET Docket No. 18-295 and GN Docket No. 17-183 (February 15, 2019), at 10 (“Adopting a higher power spectral density limit will promote rural broadband and other services that require coverage of larger distances with larger throughput.”).

There seems to be no good reason to assume the AP's antenna is omnidirectional if it is not, particularly where that needlessly wastes spectrum capacity that could be put to productive use.

Nor is there a reason to preclude point-to-multipoint (P2MP) deployments, which are needed most in rural and underserved areas where unused 6 GHz spectrum is most abundant. The directional nature of *fixed* wireless P2MP permits the coordination of sectors even where fixed incumbent links are in the area, but located outside the beam of the base station and the client device return path.⁴⁶ The Commission's proposed AFC requirement, coupled with a professional installation requirement, should remove any concern about either higher antenna gain or P2MP deployments. If a higher-power operation in a particular location will cause harmful interference to an incumbent, the AFC will simply deny the request. The Commission can of course condition this authorization on its specific certification that an AFC is capable of making this calculation and on the operator submitting and updating all required parameters.

While the added risk of harmful interference would appear to be negligible, the public interest benefits are compelling and demonstrable. Both PISC and the Broadband Connects America coalition have explained at length in comments in other recent proceedings that rural, tribal and small town America lack access to high-speed broadband at much higher rates than their counterparts in urban and suburban areas.⁴⁷ The Commission's 2018 Broadband

⁴⁶ See Broadband Access Coalition, Notice of Oral *Ex Parte* Presentation, GN Docket 17-183 and RM-11791 (March 29, 2018). The technical analysis and presentation to FCC staff is at: [https://newamericadotorg.s3.amazonaws.com/documents/BAC_Google_FCC_Technical Preso P2MP-FSS Coex FINAL_032718_1.pdf](https://newamericadotorg.s3.amazonaws.com/documents/BAC_Google_FCC_Technical_Presen_P2MP-FSS_Coex_FINAL_032718_1.pdf).

⁴⁷ See, e.g., Comments of the Public Interest Spectrum Coalition, *Unlicensed White Space Device Operations in the Television Bands*, ET Docket No. 20-36 (May 4, 2020) ("PISC TVWS Comments"); Comments of the Broadband Connects America Coalition, ET Docket No. 20-36 (May 4, 2020); Comments of the Public Interest Spectrum Coalition, *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, GN Docket Nos. 18-122 and 17-183 (Oct. 29, 2018); Comments of the Broadband Connects America Coalition, *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, GN Docket Nos. 18-122 and 17-183 (Oct. 29, 2018).

Deployment Report found that roughly 30 percent of rural Americans live in a census tract where no internet service provider offers a fixed high-speed broadband service, while only 2 percent of the urban population lacks at least one provider offering 25/3 Mbps service.⁴⁸ A recent study by BroadbandNow Research found that 42 million Americans lack access to wireline or fixed wireless broadband, nearly 13 percent of the population, with a disproportionate share in rural and small town communities.⁴⁹ Surveys by the Pew Research Center found that only 63 percent of rural Americans said they having broadband at home, compared to 79 percent of suburban Americans and 75 percent of Americans living in urban areas.⁵⁰

These less-densely-populated areas tend to have lower rates of broadband adoption due to the high costs for both backhaul and last mile buildout. This makes fixed wireless access, both P2P and P2MP, particularly potent in narrowing the connectivity gap. Rural communities will especially benefit from the higher capacity throughput that wireless ISPs could potentially offer with local access to this spectrum. As the current COVID-19 crisis has made painfully clear, adequate and affordable broadband access has become critical for accessing education, healthcare, government services and the modern workplace.

The broadband gap in rural and in low-income areas brings wide-ranging harms, both economically and socially. Without high-speed broadband access, rural Americans are left at a disadvantage in relation to the modern workplace, educational system, access to online

⁴⁸ Federal Communications Commission, *2018 Broadband Deployment Report*, GN Docket No. 17-199 (Feb. 2, 2018), at ¶ 50, Table 1.

⁴⁹ John Busby et al., “FCC Reports Broadband Unavailable to 21.3 Million Americans, BroadbandNow Study Indicates 42 Million Do Not Have Access,” BroadbandNow Research (Feb. 3, 2020), <https://broadbandnow.com/research/fcc-underestimates-unserved-by-50-percent>.

⁵⁰ Andrew Perrin, “Digital gap between rural and nonrural America persists,” Pew Research Center (May 31, 2019), <https://www.pewresearch.org/fact-tank/2019/05/31/digital-gap-between-rural-and-nonrural-america-persists/>.

government services and many entertainment options. Studies show both people and economic activity is moving out of rural areas lacking high-speed and affordable broadband.

Even in rural areas where high-speed broadband has been deployed, consumers are far less likely to have a choice among competing providers.⁵¹ Rural consumers frequently pay more money for lower quality service despite the fact that, on average, they earn less than Americans living in urban areas.⁵² The increased cost for worse service plays a significant role in keeping rural Americans offline, as one of the primary barriers to broadband adoption is cost.⁵³

A major obstacle to bringing better access and more competition in the high-speed fixed broadband market is the cost of deployment for ISPs, as fiber and other wireline technologies can be five-to-seven times or more costly and far slower to deploy in less densely-populated or topographically-challenging areas.⁵⁴ More mid-band unlicensed spectrum for point-to-multipoint (P2MP) fixed wireless, on the other hand, can serve as the public infrastructure that enables high-speed broadband in underserved areas at a fraction of the cost of fiber and other wireline technologies. Capital costs to deploy fixed wireless systems are a fraction – about one-seventh

⁵¹ The Commission's 2016 Broadband Progress Report found that only 13% of Americans living in rural areas have more than one broadband provider, 48% have one provider, and 39% have none. Federal Communications Commission, *2016 Broadband Progress Report*, at ¶ 86, Table 6.

⁵² Sharon Stover, "Reaching rural America with broadband internet service," *PhysOrg*, (Jan. 17, 2018), available at <https://phys.org/news/2018-01-rural-america-broadband-internet.html#jCp>.

⁵³ See, e.g. Monica Anderson, "Digital divide persists even as lower-income Americans make gains in tech adoption," The Pew Research Center (March 22, 2017), <http://www.pewresearch.org/facttank/2017/03/22/digital-divide-persists-even-as-lower-income-americans-make-gains-in-tech-adoption/>; Amina Fazlullah, "Research Shows Cost is Biggest Barrier to Broadband Adoption," Benton Blog (Jan. 11, 2016), <https://www.benton.org/blog/research-shows-cost-biggest-barrier-broadband-adoption>.

⁵⁴ Jennifer Levitz and Valerie Bauerlein, *Rural America is Stranded in the Dial-Up Age*, *The Wall Street Journal* (June 16, 2017), at A1. The article estimates that it costs \$30,000 per mile to install optical fiber.

the cost – of fiber and are still able to provide high-throughput broadband service.⁵⁵ They are also far more cost-effective per gigabyte for this purpose than mobile systems. This comes about primarily because of their longer range through use of highly-directional client antennas (as proposed by the Coalition) that have considerable gain compared to mobile client antennas, and are mounted at a higher location above ground, typically near rooftop height. This approach also makes efficient use of spectrum, as the directional client antennas can separate out signals from multiple base stations whose coverage may overlap on the same frequency.

Authorizing higher-power operations in the U-NII-5 and U-NII-7 bands (under AFC control) provides the opportunity to use spectrum as public infrastructure to provide high-capacity broadband at affordable prices to rural, tribal and underserved areas across the country at no cost to the U.S. Treasury. Both PISC and the advocates of rural broadband advocates that comprise the Broadband Connects America coalition have observed that “[d]eploying high-throughput fixed broadband to rural and small town America does not need to depend entirely on the Connect America Fund and other subsidy programs.”⁵⁶ Fiber-based solutions cannot be built without substantial public subsidies in areas where population density is low. This makes access to unused mid-band spectrum capacity for high throughput and affordable fixed broadband service an essential tool for bridging the rural and underserved broadband gap.

⁵⁵ See The Carmel Group, *Ready for Takeoff: Broadband Wireless Access Providers Prepare to Soar with Fixed Wireless* (2017), at 12, Fig. 6.

⁵⁶ *Id.* at 17-21. “Deploying high-throughput fixed broadband to rural and small town America does not need to depend entirely on the Connect America Fund and other subsidy programs. By authorizing coordinated and shared use by point-to-multipoint (P2MP) fixed wireless services, the Commission can unlock unused spectrum as infrastructure to improve high-speed broadband access in rural areas at no cost to the Treasury.” *Ibid.*

V. The Commission Should Authorize Mobile Standard-Power Access Points Under AFC Control in the U-NII-5 and U-NII-7 Bands

PISC fully supported the Commission’s world-leading decision in April to authorize unlicensed users to operate both indoors and outdoors at standard power under the control of a certified Automated Frequency Coordination (“AFC”) system.⁵⁷ As a result, American consumers and enterprise are likely to yield the benefits of the world’s best Wi-Fi networks – and, in turn, the world’s most robust 5G wireless ecosystem. This happy result is, in part, a byproduct of the FCC’s leadership in authorizing advanced spectrum coordination technologies over the past decade, including most notably the TV White Spaces geolocation database and the Spectrum Access Systems that recently began successfully coordinating shared use of the 3.5 GHz band while fully protecting U.S. Navy radar and other incumbent users.

In one respect, however, the *Report and Order* fell short of leveraging the proven capabilities of automated frequency coordination by limiting outdoor use at power levels up to 36 dBm EIRP to completely *fixed* access points. The *FNPRM* asks whether the Commission should go further and authorize standard-power access points, under AFC control, for mobile applications under rules similar to those the Commission has proposed for personal/portable TV white space devices (“WSDs”). PISC believes the answer is an unqualified yes.

PISC recently filed comments and reply comments stating our strong support for the Commission’s proposal to allow WSDs “to operate on TV Channels 2-35 on mobile platforms within geo-fenced areas at higher power levels than the rules currently permit for portable

⁵⁷ Comments of New America’s Open Technology Institute, American Library Association, Consumer Federation of America, COSN—Consortium for School Networking, Public Knowledge, and Access Humboldt, ET Docket No. 18-295 and GN Docket No. 17-183 (Feb. 15, 2019) at 4, 25-27.

devices, . . .⁵⁸ We agreed that updating the TVWS technical rules in this regard will permit mobile platforms (e.g., school buses, farm equipment) to operate on unlicensed TV White Space spectrum at the same power level as other fixed WSDs.⁵⁹ The Commission’s proposal to allow TV White Space Databases to calculate areas in which WSDs can operate at full power is in part a product of the Commission’s successful experience with geolocation database control over personal/portable devices that are authorized to operate on TVWS frequencies while protecting the co-channel operation of both local TV stations and (in some markets) public safety operations.⁶⁰ If anything, we believe that because licensed fixed links are point-to-point, and the location of incumbent receivers is precisely known, it should be far more straightforward for AFCs to calculate a geofenced area in which a mobile access point can operate on a mobile platform at a maximum power level of up to 36 dBm EIRP.

There is little doubt that the use cases for mobile applications will greatly benefit consumers and the economy. As the Commission has repeatedly experienced with unlicensed spectrum and Wi-Fi, opening the door to innovation will always yield far greater benefits than our feeble imaginations can articulate today. Nevertheless, many use cases are quite evident. For example, thousands of public transportation systems can give their passengers access to a higher-capacity RLAN along a pre-planned route, or within certain pre-cleared areas. These include

⁵⁸ *NPRM* at ¶ 39.

⁵⁹ PISC TVWS Comments at 15-18; Reply Comments of the Public Interest Spectrum Coalition, *Unlicensed White Space Device Operations in the Television Bands*, ET Docket No. 20-36 (June 2, 2020), at 13-17.

⁶⁰ *Amendment of Part 15 of the Commission’s Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37*, Report and Order, ET Docket No. 14-165, GN Docket No. 12-268, at ¶ 88 (rel. Aug. 11, 2015) (noting the Commission’s “high degree of confidence that the databases can reliably protect [incumbent] operations” because “[p]ersonal/portable devices [that] rely on database access to determine their list of available channels . . . can protect [incumbents] in the same manner as fixed devices.”).

school buses and public buses, commuter trains and inter-city rail, ferry services and campus shuttles. Taking this further, a train, or a convoy of autonomous trucks on a highway, should not need to mount a separate access point on each train car or individual truck when one AP – connected to a mobile 5G carrier – can generate a roving RLAN that shares connectivity among the component cars or trucks.

A similar productivity boost can be achieved by connecting high-value cargo containers, such as refrigerated units or containers carrying animals tagged to monitor their physical condition. There is no need to put a more expensive AP on each separate shipping container if one – or the port, or the trailer truck – has a single AP and can create, on the fly, an RLAN to aggregate and process the data from whatever containers and other devices are within range. VLP devices could also jump on and off these next generation RLANs, assuming they are authorized as well at functional power levels.

Even more obvious benefits will accrue to the nation’s farmers, ranchers, loggers, national parks, industrial campuses, and other locations where an enterprise would benefit by being able to create a roving, high-capacity RLAN on platforms (e.g., agricultural implements) that move across their property, aggregating data and integrating myriad applications as the emerging Internet of Things increasingly monitors and connects more and more systems, assets and inputs to production. Allowing standard-power operations in a geofenced area would greatly benefit farms as low-cost option for connectivity to support precision agriculture and the monitoring of soil and other conditions. For smart farming services, Wi-Fi networks are generally preferred to LTE and 4G networks for connectivity because once they have been deployed, they are less costly to sustain, customize, and operate.⁶¹ Farmers and ranchers are able

⁶¹ Stephanie Bergeron Kinch, “Agriculture: A cash cow for Wi-Fi-based IoT?,” Wi-Fi NOW (June 2, 2018), <https://wifinowevents.com/news-and-blog/agriculture-a-cash-cow-for-wi-fi->

to use Wi-Fi-enabled smart agriculture to review data and weather conditions, as well as monitor crops, soil conditions, and the status of their animals.⁶² Several pilot programs, such as Microsoft’s FarmBeats program, and the partnership between BlueTown and the University of California’s Kearney Agricultural Research and Education Center, have showcased the vast benefits smart agriculture powered by Wi-Fi can produce.⁶³

The capability of an AFC to calculate and enforce interference protection zones for standard power unlicensed devices has been, perhaps, the issue of greatest consensus among advocates for fixed wireless incumbents and unlicensed/Wi-Fi use of the band.⁶⁴ Unless the Commission concludes, based on engineering evidence, that AFCs are incapable of calculating a geofenced area that is accurate enough to protect incumbent fixed links, PISC agrees with the Dynamic Spectrum Alliance that “the Commission can best fulfill the promise of the 6 GHz band not by attempting to prescribe detailed command-and-control regulations on the specifics of AFC operation. Instead, it should adopt “flexible, ends-oriented rules that both rigorously protect incumbents while allowing a diversity of AFC operators and models to flourish.”⁶⁵

[based-iot/](#). Agnov8’s CEO Andrew Cameron “says that Wi-Fi has a competitive advantage over LTE and 4G networks because it is more economically feasible to maintain and operate once it is installed. Farmers can check data and conditions on their smartphones and tablets, and the system is compatible with other Wi-Fi-enabled technology. Wi-Fi works especially well for smaller farms, he says.” *Ibid.*

⁶² *Ibid.*

⁶³ Michael Calabrese and Amir Nasr, “The 5.9 GHz Band: Removing the Roadblock to Gigabit Wi-Fi,” Wireless Future Project Issue Brief, New America’s Open Technology Institute, at 20-21 (March 2020), available at https://ecfsapi.fcc.gov/file/103101043510278/OTI%205.9%20GHz%20Issue%20Brief_CalabreseNasr_FINAL_030920.pdf.

⁶⁴ *See, e.g.*, Comments of the Fixed Wireless Communications Coalition, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019), at 13.

⁶⁵ Reply Comments of the Dynamic Spectrum Alliance, ET Docket No. 18-295 and GN Docket No. 17-183 (March 18, 2019), at 1.

Ends-oriented rules will allow the most flexible and intensive use of the 6 GHz band, subject only to safeguarding primary licensees from an undue risk of harmful interference. For example, both pre-calculated and real-time geofence areas should be allowed. The former could be most efficient along regular transportation routes, or for farms, campuses and other users with bounded perimeters, while the latter is likely necessary to accommodate less bounded or scheduled uses, such as truck convoys. If the AFC operators and multi-stakeholder group tasked with implementing the Commission's goals ultimately demonstrate—as part of AFC certification—that there is one or more ways to enable standard-power applications on mobile platforms, such a productive outcome should not be short-circuited based on hypothetical fears of incumbents who have adamantly opposed any more efficient shared use of this grossly underutilized band.

VI. Conclusion

PISC urges the Commission to adopt the most robust possible technical rules so that the next generation of Wi-Fi technologies, as well as mobile 5G networks, can offer consumers and the American economy the potentially revolutionary benefits of affordable gigabit-fast connectivity and innovative new applications both at home and on the go. This will necessarily include authorizing VLP devices to operate across the entirety of the 6 GHz band at sufficient power, both outdoors and indoors, as well modestly increasing the power limits for LPI devices to 8 dBm/MHz PSD. The Commission should further allow higher power limits and antenna directivity for both P2P and P2MP operations in the U-NII-5 and U-NII-7 bands, while also allowing mobile standard-power access points to operate under AFC control.

Respectfully submitted,

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