

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

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Verizon is a global trailblazer in wireless, leading the world in the development and deployment of next-generation technologies, using both licensed and unlicensed spectrum. In 2018, we launched the first commercial 5G network in the world: a fixed wireless broadband service using millimeter wave spectrum with peak speeds approaching 1 Gbps.<sup>1</sup> This year promises even more exciting 5G developments, as we launch mobile 5G service in early 2019 and expand rapidly.<sup>2</sup> While wide-area licensed spectrum is fundamental to Verizon's multi-billion dollar investment in 5G, unlicensed spectrum is also a vital and growing part of our network and our customers' wireless experience. Last fall, for example, we achieved a 1.45 Gbps wireless connection in a live commercial environment using a combination of licensed and unlicensed spectrum.<sup>3</sup>

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<sup>1</sup> Press Release, Verizon, *Verizon turns on world's first 5G network* (Oct. 1, 2018), <https://www.verizon.com/about/news/verizon-turns-worlds-first-5g-network>; Press Release, Verizon, *5G is here* (Sept. 11, 2018), <https://www.verizon.com/about/news/5g-here>.

<sup>2</sup> Press Release, Verizon, *Verizon and Samsung to release 5G smartphone in the U.S. in first half of 2019* (Dec. 3, 2018), <https://www.verizon.com/about/news/verizon-and-samsung-release-5g-smartphone-us-first-half-2019>.

<sup>3</sup> Press Release, Verizon, *Verizon, Nokia and Qualcomm use LTE Advanced technology of six carrier aggregation to reach 1.45 Gbps*, (Sept. 27, 2018), <https://www.verizon.com/about/news/verizon-nokia-and-qualcomm-use-lte-advanced-technology-six-carrier-aggregation-reach-145-gbps>.

The United States needs to identify additional spectrum for both licensed and unlicensed use. Spectrum in the 6 GHz band affords an opportunity to introduce unlicensed operations using a new, robust spectrum sharing regime. At the same time, the Commission should continue to explore ways to address the dearth of licensed mid-band spectrum for 5G and other next-generation services in the United States. To facilitate a successful 5G revolution and cement the United States' position as a wireless leader, the Commission should pursue both unlicensed and licensed spectrum allocations.

## **I. INTRODUCTION AND SUMMARY**

Verizon is a strong advocate for promoting both licensed and unlicensed spectrum uses in the United States. For unlicensed, new spectrum sharing regimes can serve as important pieces of the wireless puzzle, as they can free more spectrum for commercial use than would otherwise be available and advance yet more innovation. But they can do so only as long as incumbent operations in the band are protected. The 6 GHz incumbents provide important services, including, among other things, fixed point-to-point microwave links that support wireless backhaul and public safety. These services must not be disrupted by new unlicensed use.

As long as valuable incumbent uses are protected, unlicensed use in 6 GHz spectrum holds substantial promise to develop new services and enhance existing ones. Unlicensed versions of LTE (*e.g.*, LAA, LTE-U, or newer versions) and WiFi will help expand capacity, relieve congestion on licensed wireless networks, and offer new broadband access points. To preserve a dynamic unlicensed ecosystem, any rules governing unlicensed operation in the band must maintain a technology-neutral approach that ensures permission-less innovation subject to compliance with all technical rules.

The key to promoting unlicensed use in the 6 GHz band is a sharing model that protects incumbents through a cloud-based, IP-connected Automated Frequency Coordination (“AFC”)

manager. Unlike traditional unlicensed approaches that involve free-standing unmanaged devices, the AFC should use a “closed loop” network framework that positively controls unlicensed radio access to the band and thereby protects incumbent operations. Active AFC management of unlicensed access points will enable greater security and protection and, in turn, allow for higher powered unlicensed use.

At the same time, the Commission must not lose sight of the need for additional spectrum to support 5G services and meet demand. While the proposal to free up spectrum in the 3.7-4.2 GHz band for licensed use is a crucial step, Verizon urges the Commission to continue to explore other options to free up additional licensed spectrum, especially in mid-band frequencies. By advancing both unlicensed and licensed uses, the Commission can promote innovation and investment and help ensure that the United States continues to lead the world in 5G and next-generation wireless technologies and services.

## **II. UNLICENSED USES CAN THRIVE IN THE 6 GHz BAND, SUBJECT TO A ROBUST AUTOMATED FREQUENCY COORDINATION REGIME.**

The Commission should apply an automated, database-driven spectrum access framework to spectrum in the 6 GHz band made available for unlicensed use. This sophisticated, managed approach not only provides for the secure protection of incumbent licensed services, but also allows new unlicensed operations at higher power levels for more intense and efficient spectrum use. By taking these steps, the Commission can balance incumbent concerns about uninterrupted licensed service with the increasing need for spectrum for innovative use.<sup>4</sup>

Traditionally, unlicensed operations have been unmanaged—meaning they do not involve registration with a database or coordination with licensed uses based upon location or power

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<sup>4</sup> See *Unlicensed Use of the 6 GHz Band*, Notice of Proposed Rulemaking, FCC 18-147, at ¶ 22 (rel. Oct. 24, 2018) (“*NPRM*”).

level or frequency/channel usage. They are required only to operate subject to technical limits set out in Part 15 and the obligation not to cause harmful interference to licensed users, while accepting any interference they receive.<sup>5</sup> This approach allows for fairly simple regulation of unlicensed radios. But because it lacks sufficient measures to enable effective enforcement for the protection of licensed services in the band, it requires low power operations based on worst-case assumptions. Now, by taking advantage of IP connectivity that is available nearly everywhere and at very low cost, an AFC system can actively manage unlicensed radio access while protecting incumbents. This opens up exciting new opportunities to share spectrum.

**A. An AFC System Should Protect Incumbent Service Licenses.**

The Commission should require the use of an AFC system that uses positive control to manage operations between new unlicensed devices and existing incumbent uses. This approach, explained in detail below, will improve on past sharing arrangements that lacked needed security components, like Dynamic Frequency Selection (“DFS”) and TV White Spaces (“TVWS”), but is a less complex sharing regime than the Spectrum Access Systems (“SASs”) used in the Citizens Broadband Radio Service (“CBRS”). In short, it protects incumbent uses while expanding unlicensed opportunities.

*A closed-loop control system should manage unlicensed use in the 6 GHz band.* An AFC control system based on a closed loop will require access points to report location details and intended power levels before receiving permission to operate on specific frequencies. If done properly, such a system can manage unlicensed operations while protecting 6 GHz incumbents from harmful interference. The Commission should thus adopt its proposal to allow

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<sup>5</sup> See 47 C.F.R. §§ 15.5, 15.15, 15.101(a), 15.201(a); *Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, 29 FCC Rcd 4127, 4128 ¶ 3 (2014) (“*U-NII First R&O*”).

unlicensed use only on frequencies determined by an AFC system,<sup>6</sup> and to prohibit unlicensed devices from operating co-channel with any fixed link within that link's defined exclusion zone as implemented by the AFC.<sup>7</sup>

Specifically, the AFC system should be a positive, centralized controller able to select the appropriate channel allocation and/or power level for a requesting access point so as to protect incumbent service licensees from harmful interference. The AFC should be sufficiently sophisticated to assess interference risks by accounting for power and antenna directivity and aggregate interference. The AFC should have the capability to change the device's chosen channel and/or power level—or even turn it off—if interference is a concern.

Use of the AFC system should apply across all portions of the band made available for unlicensed shared use—both outdoors and indoors.<sup>8</sup> No unlicensed access point should operate in the shared environment on a stand-alone basis or be able to choose a channel autonomously. Access point devices themselves cannot understand the entire radio environment—meaning they cannot be aware of nearby incumbent licensed operations or how, for example, operation by a window in a high-rise building could create harmful interference. An autonomous decentralized access-point-based approach would make it much harder, if not impossible, to account for these considerations in a failsafe manner. For example, the Commission would need to retest every manufacturer's radio model as firmware or software are upgraded over their lifetimes, in order to ensure ongoing compliance with the interference-control methodology.

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<sup>6</sup> See *NPRM* at ¶¶ 20, 25.

<sup>7</sup> See *id.* at ¶ 23.

<sup>8</sup> Compare *id.* at ¶¶ 20, 69.

Realistically, indoor unlicensed operations have the potential to interfere with incumbent operations and should be coordinated. And because the capabilities of all devices will span the entire 6 GHz band dedicated to unlicensed use, incorporating AFC connectivity and registration requirements are not additional burdens for indoor access points. As all of these types of access points are always IP connected, connection to the AFC system is not an undue burden. Having both connectivity (the ability of AFC to say no) and registration strengthens protection of the incumbents.

***Unlicensed access points should be registered before receiving channel assignments.***

Registration with the AFC system allows for security, identification, and authentication of unlicensed access point devices, as well as understanding a device's capabilities. Device registration in the AFC database therefore is important and is not an undue burden when combined with IP connectivity-to-AFC requirements. Registration should include conveying a secure unique digital identifier for each access point via the IP protocol to the AFC.<sup>9</sup>

Registration helps assure certification, support security methods, track down problems, and avoid spoofing and noncompliance. Critically, registration with the AFC (and positive control) allows the AFC to vet the access point device for erroneous or false locations and, in the event of interference effects, to aid in tracking down or turning off bad devices. In contrast, unregistered devices would be much harder to identify, track down, and shut off if they become non-compliant and cause interference. Registration will help advance a sharing regime without taking on significant burdens. Further, registration of access point devices enables the collection and tracking of user statistics (*e.g.*, quantity of devices and how they are distributed in an area).

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<sup>9</sup> See *id.* at ¶¶ 27-28, 87-88.



***Testing and certification should focus on the AFC and responses to AFC direction.***<sup>10</sup>

The FCC should test and certify AFC designs to ensure positive control capabilities, such that unlicensed devices may operate only under the command of the AFC. This testing and certification should extend to communication and security protocols for how the unlicensed devices register and communicate with the controlling AFC. Industry can work out these details, mandate specifications, and create requirements that can be tested.

Further, all future software and firmware AFC upgrades must be reviewed for conformance to ensure that any future iterations of AFCs will deploy correct and appropriate methods to protect incumbent service operations. It is also important to ensure that no unauthorized or altered software/firmware or devices for foreign markets are able to take operational control of the access point device.

***Three spectrum sharing examples help inform how the FCC should model an AFC.***

Experience with Terminal Doppler Weather Radar (“TDWR”) systems and the television white space (“TVWS”) database highlight the problems associated with autonomous devices and the lack of positive database control of access points. A third example—three-tiered sharing coordinated by Spectrum Access Systems in the 3.5 GHz band—represents a significant improvement over the first two approaches, but is overly complex in ways that are not necessary to protect 6 GHz band incumbents.

*TDWR/Dynamic Frequency Selection.* In 2009, the FAA reported harmful interference to TDWR systems operating in the 5.6-5.65 GHz portion of the U-NII-2C band.<sup>11</sup> Autonomous

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<sup>10</sup> See *id.* at ¶¶ 31-32, 34.

<sup>11</sup> See John E. Carroll et al., NTIA Technical Report TR-11-473, Case Study: Investigation of Interference into 5 GHz Weather Radars from Unlicensed National Information Infrastructure Devices, Part 1 (Nov. 2010), <https://www.its.bldrdoc.gov/publications/2548.aspx>; John E.

U-NII devices were the source of the interference, despite rules that required U-NII devices operating in these frequencies to incorporate an interference mitigation technique called Dynamic Frequency Selection (“DFS”).<sup>12</sup> In many cases, third parties had modified software configurations or hardware settings, or the original equipment manufacturers had altered firmware or parameters, to enable operation in frequency bands other than those for which the devices had been certified or without properly implementing the mandated scanning protocols.<sup>13</sup> The FCC later modified its rules to require manufacturers to secure the software in all U-NII devices to prevent unlawful modifications,<sup>14</sup> but interference continues to be a problem.<sup>15</sup> This experience illustrates the critical need for AFC control: if an access point device acts autonomously and is permitted to decide what channel to use on its own, then harmful interference is unavoidable.

*TV White Spaces.* In 2010, the Commission adopted rules to allow unlicensed radio transmitters to operate in the television “white spaces” where TV channels are unused.<sup>16</sup> The

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Carroll et al., NTIA Technical Report TR-11-479, Case Study: Investigation of Interference into 5 GHz Weather Radars from Unlicensed National Information Infrastructure Devices, Part 2 (July 2011), <https://www.its.bldrdoc.gov/publications/2554.aspx>; John E. Carroll et al., NTIA Technical Report TR-12-486, Case Study: Investigation of Interference into 5 GHz Weather Radars from Unlicensed National Information Infrastructure Devices, Part 3 (June 2012), <https://www.its.bldrdoc.gov/publications/2677.aspx>.

<sup>12</sup> See 47 C.F.R. § 15.407(h)(2).

<sup>13</sup> See *Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, Notice of Proposed Rulemaking, 28 FCC Rcd 1769, 1772 ¶ 9 (2013).

<sup>14</sup> See *U-NII First R&O*, *supra* note 5.

<sup>15</sup> The FCC’s enforcement activities have been ongoing. See FCC, Enforcement Bureau, U-NII and TDWR Interference Enforcement, <https://www.fcc.gov/general/u-nii-and-tdwr-interference-enforcement> (last visited Feb. 15, 2019) (listing enforcement actions taken against companies operating devices causing interference to TDWR systems).

<sup>16</sup> See *Unlicensed Operation in the TV Broadcast Bands*, Second Memorandum and Order, 25 FCC Rcd 18661 (2010).

primary method of preventing interference to TV and other services is a geo-location capability in the white space device combined with database access to identify vacant TV channels at specific locations. By 2015, serious design flaws in the TVWS database system had become apparent,<sup>17</sup> including the entry of inaccurate location information, false or questionable names by installers, fake serial numbers, and falsified or missing contact information. The FCC has since proposed rule changes to improve the integrity of the TVWS database system,<sup>18</sup> which remain pending. While white space database administrators have corrected or deleted obviously false information, the nature of the database itself remains more of a standalone registration process that is unable to prevent harmful interference. This experience underscores the difficulties of relying on the autonomous access points rather than a closed-loop system to control channel usage.

*3.5 GHz/SAS.* The FCC's framework for sharing in the CBRS band relies on a Spectrum Access System, or SAS, to coordinate spectrum access. The CBRS rules are complex, however, because of the unique need to manage sharing in the 3.5 GHz band between itinerant incumbents and *two* new classes of entrants (Priority Access Licensees and General Authorized Access users), as well as the need for different categories of devices, different protection methods, the lack of incumbent location self-reporting of operation and location, and the need for an Environmental Sensing Capability.<sup>19</sup> But many of the advanced features needed to manage the

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<sup>17</sup> National Association of Broadcasters, Petition to Amend Sections 47 C.F.R. 15.711(b) and 47 C.F.R. 15.717 Regarding Changes to Certain Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap and Channel 37, RM-11745 (Mar. 19, 2015).

<sup>18</sup> *See Amendment of Part 15 of the Commission's Rules for Unlicensed White Space Devices*, Notice of Proposed Rulemaking and Order, 31 FCC Rcd 1657 (2016).

<sup>19</sup> *See Promoting Investment in the 3550-3700 MHz Band*, Report and Order, FCC 18-149 (rel. Oct. 24, 2018); 47 C.F.R. Part 96.

complexities of the CBRS band are unnecessary to protect 6 GHz incumbents. As a result, the AFC can remain relatively simple but still provide positive control, security, and identity management.

**B. An AFC Framework Will Enable Higher Powered Unlicensed Access Points.**

The intelligence and security associated with an AFC framework as described above should enable higher powered access point operations in some circumstances that would otherwise be prohibited with traditional autonomous Part 15 device operations. Because the AFC will know the location and operating parameters of the licensed operations it is required to protect, there is no need to restrict access points to extremely low power levels to avoid the threat of interference to other users (either licensed or unlicensed) in a shared band.<sup>20</sup>

The AFC system should calculate a list of available frequencies and the maximum power permitted on each one in any given location.<sup>21</sup> A standardized protocol for the AFC to communicate with any access point device will enable the AFC to control frequency and the power level appropriately. As a result, the FCC can permit access point operations at power levels above 36 dBm EIRP. Additionally, the AFC can coordinate and eliminate interference to existing FS and FSS incumbents, while considering real-time parameters such as antenna directivity and gain, to allow higher EIRPs for longer effective ranges needed for applications such as fixed wireless and broadband access.

Indeed, with AFC positive control, there is no reason to maintain the current very low Part 15 power levels based upon existing 20 megahertz wide channels. The Commission could allow power levels as high as 50 dBm or more. In addition, it should consider adoption of a

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<sup>20</sup> Compare *NPRM* at ¶¶ 78-80.

<sup>21</sup> See *id.* at ¶ 26.

power spectral density limit rather than a single power level, *e.g.*, 50 dBm/20 megahertz.

Adopting a higher power spectral density limit will promote rural broadband and other services that require coverage of larger distances with larger throughput.

### **C. The Rules Should Maintain a Technology-Neutral Unlicensed Policy.**

Unlicensed use in the 6 GHz band should be technology neutral to preserve and advance the vibrant unlicensed ecosystem. Prescribing particular air-interfaces or etiquette protocols for new technologies would artificially raise barriers to entry.<sup>22</sup> Indeed, Chairman Pai has noted that “[w]e ... want to make unlicensed spectrum more usable for *all* technologies.”<sup>23</sup>

The unlicensed ecosystem is competitive and diverse and includes millions of WiFi-enabled broadband devices and, increasingly, LAA-connected and other devices.<sup>24</sup> LAA is a version of LTE developed to leverage unlicensed spectrum to complement licensed spectrum resources by relieving congestion on commercial mobile networks.<sup>25</sup> The success of LAA demonstrates the advantages of a technology-neutral approach.<sup>26</sup> LAA is driving better

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<sup>22</sup> See *Modification of the Commission’s Rules for Unlicensed Devices and Equipment Approval*, Order and Second Memorandum Opinion and Order, 29 FCC Rcd 6366, 6370 ¶ 11 (2014).

<sup>23</sup> Remarks of FCC Chairman Ajit Pai at the Mobile World Congress, Barcelona, Spain, at 2 (Feb. 26, 2018), <https://docs.fcc.gov/public/attachments/DOC-349432A1.pdf>.

<sup>24</sup> See *NPRM* at ¶¶ 3-7.

<sup>25</sup> See *id.* at ¶ 6; *Office of Engineering and Technology and Wireless Telecommunications Bureau Seek Information on Current Trends in LTE-U and LAA Technology*, Public Notice, 30 FCC Rcd 4457 (OET/WTB 2015).

<sup>26</sup> See Qualcomm, ONQBlog, *Wireless innovation—From LTE-U/LAA to 5G spectrum sharing* (Mar. 29, 2018), <https://www.qualcomm.com/news/onq/2018/03/29/lte-u-5g-spectrum-sharing>. (noting that initial deployments demonstrate that using unlicensed spectrum with LTE “is working extremely well for consumers”).

indoor/outdoor mobility, a reduction in call drops, and the enhancement of existing WiFi access points.<sup>27</sup>

The Commission should build on these successes and extend technology-neutral principles to unlicensed deployments in the 6 GHz band, ensuring continued innovation and enabling new and transformative technologies to emerge. As long as new entrants comply with FCC rules and implement techniques to coexist with other unlicensed users, the Commission should maintain its longstanding policy of technological neutrality with respect to unlicensed devices.

### **III. THE FCC SHOULD CONTINUE TO PURSUE LICENSED OPPORTUNITIES TO MEET THE CRITICAL NEED FOR MID-BAND SPECTRUM.**

Even as we explore new opportunities for unlicensed use, the path to continued global leadership in wireless goes through 5G. And to win the race to 5G, the United States must quickly introduce a significant amount of mid-band spectrum for flexible, exclusive-use licenses. While multiple spectrum auctions and other smart spectrum policies in the lower bands helped make the United States the leader in 4G—and the FCC has repurposed millimeter wave spectrum to help support the transition to 5G—these accomplishments are not enough.<sup>28</sup> Mid-band spectrum is imperative for 5G because it offers wider channel bandwidths than lower band spectrum and more favorable propagation characteristics than millimeter wave spectrum.<sup>29</sup> In

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<sup>27</sup> See *id.* The benefits of LAA can be increased by raising Part 15 EIRP limits. As noted above, because an AFC would manage unlicensed access in the 6 GHz band, the Commission should allow higher power levels.

<sup>28</sup> Ajit Pai, *Scoring a Victory for 5G*, FCC Blog (June 20, 2018), <https://www.fcc.gov/newsevents/blog/2018/06/20/scoring-victory-5g>.

<sup>29</sup> *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, 32 FCC Rcd 6373, 6375 ¶ 6 (2017).

other words, it delivers much higher peak data rates than low band spectrum and provides better coverage than millimeter wave frequencies.

Nations around the world have recognized and acted upon the need for mid-band spectrum in deploying 5G networks by moving aggressively to make hundreds of megahertz of mid-band spectrum available for licensed mobile use.<sup>30</sup> As explained in a recent Analysys Mason report, countries including Japan, South Korea, Spain, and the United Kingdom have auctioned or assigned substantial amounts of mid-band spectrum since 2018—with South Korea auctioning almost 300 megahertz of mid-band spectrum in June 2018 and Japan committing 500 megahertz of mid-band spectrum to 5G by March of 2019.<sup>31</sup> Other countries, including China, Australia, and Germany, have confirmed that they will assign additional mid-band spectrum by June 2019; China has committed to release nearly 500 megahertz of mid-band spectrum and Germany plans to designate 400 megahertz to mobile in the first half of 2019.<sup>32</sup> The United States, by comparison, is now in sixth place out of ten countries in terms of mid-band spectrum availability, despite FCC and NTIA actions to date.<sup>33</sup>

To avoid falling behind in 5G, the Commission must waste no time in making similarly large swaths of mid-band spectrum available for licensed 5G providers. In particular, the Commission must expand the mid-band licensing initiative beyond 3.5 GHz. The 3.7-4.2 GHz rulemaking is examining how much of that band can be repurposed for licensed use, but

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<sup>30</sup> See CTIA, *The Global Race to 5G*, at 7-8 (Apr. 2018) (“Global Race Report”), <https://api.ctia.org/wp-content/uploads/2018/04/Race-to-5G-Report.pdf>.

<sup>31</sup> See David Abecassis et al., *Mid-Band Spectrum Global Update*, Analysys Mason, at 1-2 (Nov. 2018) (“Analysys Report”), *attached to* Reply Comments of CTIA, GN Docket No. 18-122 (filed Dec. 11, 2018).

<sup>32</sup> Analysys Report at 1-3.

<sup>33</sup> See *Global Race Report* at 11.

incumbent satellite operators, at present, are proposing to make available just 180 megahertz for licensed services. While Verizon is committed to maximizing the opportunity in the 3.7-4.2 GHz band, it has called for making available hundreds of megahertz of mid-band spectrum to advance U.S. interests in 5G. As Chairman Pai has observed, “[w]hen it comes to 5G, we need to keep the playbook fresh and forward leaning.”<sup>34</sup> This must include freeing up additional mid-band spectrum for licensed mobile use.

#### IV. CONCLUSION

The Commission should apply a cloud-based, automated, IP-connected AFC management framework to enable unlicensed use in 6 GHz band spectrum, while protecting incumbent licensed services. By pursuing steps to make more mid-band spectrum available for both unlicensed and licensed uses, the Commission can promote continued innovation and investment needed to lead the world in 5G and next generation wireless technologies and services.

Respectfully submitted,

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<sup>34</sup> *Scoring a Victory for 5G*, *supra* note 28.