



Perspectives from FSF Scholars
February 7, 2020
Vol. 15, No. 7

Wi-Fi 6E Can Modernize Unlicensed Wireless

by

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Introduction and Summary

Wi-Fi® wireless networks serve an increasingly indispensable role in the broadband distribution ecosystem. But Wi-Fi in its present form cannot satisfy evolving user demands: additional devices and new use cases necessitate updated capabilities and more spectrum. "Wi-Fi 6," the latest iteration of the technical standard, includes features to address current and future needs. Devices that support it are available commercially today. The FCC, for its part, has proposed to permit unlicensed devices to share spectrum in the 6 GHz band. A successful and timely resolution of that rulemaking would allow Wi-Fi 6 devices able to operate in that band – commercially branded as "Wi-Fi 6E" – to usher in quickly a new era of unlicensed wireless growth and innovation.

In October 2018, the Wi-Fi Alliance® introduced Wi-Fi 6. Wi-Fi 6 supports higher speeds, lower latency, more devices, and additional frequency bands. That same month, the FCC initiated a proceeding to authorize unlicensed operations, on a shared basis, throughout the 6 GHz band. Lively disagreement in the docket focuses on two topics, interference and spectrum policy. Incumbent users contend that unlicensed devices may cause unacceptable levels of interference. Those focused on the need to free up additional mid-band spectrum for 5G,

meanwhile, urge the Commission to repurpose the upper portion of the band for licensed use. Not surprisingly, other interested parties have voiced opposing views on both issues.

I do not find it necessary, for my purposes here, to take a position on the merits in either debate. As the expert agency, the FCC is capable of resolving technical questions relating to interference. And, leaving questions about the upper 6 GHz band to the side, it appears that a general consensus exists among proponents of agency action that unlicensed devices at the least should be allowed to share the lower portion of that band.

Accordingly, I urge the Commission to work expeditiously to bring this rulemaking to a productive close. The factual premise that led to this rulemaking is that, through the use of interference mitigation techniques (*i.e.*, Automatic Frequency Coordination) and power limits, unlicensed operations and incumbent services can coexist in the 6 GHz band. To the extent that the record so confirms, it is time to unleash the full potential of Wi-Fi 6E.

Wi-Fi Demands New Technical Standards and Additional Unlicensed Spectrum

Wi-Fi networks play a critical connectivity part in Americans' daily lives. Consumers rely upon Wi-Fi at home; as a substitute for, and complement to, wireless data offerings in public; and as a wireless access solution in areas where mobile broadband to date has not been deployed. Businesses offer free Wi-Fi as a way to attract and retain customers. Mobile operators offload traffic to Wi-Fi from their limited-capacity cellular networks. And Internet of Things (IoT) devices rely upon Wi-Fi for connectivity.

The history of Wi-Fi tells an unparalleled technological success story. Some illustrative statistics:

- More than three out of every four U.S. consumers utilize Wi-Fi as the primary method to connect devices to in-home Internet access services.¹
- The global installed base of Wi-Fi devices exceeds 13 billion. Manufacturers were expected to ship over 4 billion devices in 2019.²
- There will be a total of 77 million public Wi-Fi hot spots in the U.S. by 2022.³
- Wi-Fi's global economic value in 2018 approached \$2 trillion – and is predicted to reach nearly \$3.5 trillion by 2023.⁴

¹ Security Sales & Integration, "Large Majority of Broadband Households Use WiFi as Primary Connection, Study Finds" (January 24, 2018), available at <https://www.securitysales.com/research/majority-broadband-households-wifi-connection/> ("76% of North American broadband households use WiFi as their primary connected technology.").

² Wi-Fi Alliance, "Wi-Fi Alliance® celebrates 20 years of Wi-Fi®" (June 4, 2019), available at <https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-celebrates-20-years-of-wi-fi>.

³ See WifiForward, "The Wi-Fi Success Story," available at <http://wififorward.org/wp-content/uploads/2019/07/The-Wi-Fi-Success-Story-Infographic-1.pdf> (citation omitted).

However, current Wi-Fi offerings are showing their age. In part this is because Wi-Fi is a victim of its own success. As the numbers above make plain, the number of connected devices (both consumer and, in particular, IoT⁵) is exploding. The laws of physics dictate that more devices operating in a fixed amount of spectrum inevitably leads to overcrowding.⁶

In addition, relentless technological progress and innovation have produced new use cases – such as 4K video streaming, Augmented Reality and Virtual Reality, online gaming, etc. – that require ever-greater bandwidth and lower latency. And the 5G networks that wireless carriers are deploying demand a more robust offloading solution. New capabilities and additional spectrum therefore are essential to Wi-Fi's continued growth and viability. Fortunately, efforts are underway to move forward on both fronts.

Wi-Fi 6. Over the past twenty-plus years, Wi-Fi technical standards have evolved steadily to keep pace as Internet access speeds have increased and new uses have emerged. The first widely adopted specification, Institute of Electrical and Electronics Engineers (IEEE) 802.11(b), was issued in 1999. It supported speeds up to 11 Mbps, for its time an impressive feat.⁷ By contrast, the two most common standards in use today, IEEE 802.11(n) (recently rebranded as Wi-Fi 4) and IEEE 802.11ac (Wi-Fi 5),⁸ enable data rates up to 600 Mbps and 3.46 Gbps, respectively.⁹

Wi-Fi 6 (IEEE 802.11ax), the latest version of the specification, was introduced by the Wi-Fi Alliance in October 2018.¹⁰ Wi-Fi 6 offers more bandwidth (speeds up to 10 Gbps), less latency, and lower power consumption. It also performs better in high-congestion locations (*e.g.*, stadiums and airports) and provides improved support for the exploding number of consumer and IoT devices.¹¹ And it is well-suited to serve as a vital complement to 5G wireless networks¹² and

⁴ See Wi-Fi Alliance, "Global economic value of Wi-Fi® nears \$2 trillion in 2018," available at https://www.wi-fi.org/download.php?file=/sites/default/files/private/Value_of_Wi-Fi_Highlights.pdf. The U.S. represents twenty five percent of that total. *Id.*

⁵ See Statista, "Internet of Things (IoT) connected devices installed base worldwide from 2015 to 2025 (*in billions*)" (November 14, 2019), available at <https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/> ("The total installed base of Internet of Things (IoT) connected devices is projected to amount to 75.44 billion worldwide by 2025, a fivefold increase in ten years.").

⁶ See, *e.g.*, 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> (describing how "the wireless highways through which Wi-Fi traffic moves have gotten and will continue to get more crowded").

⁷ See Keith Shaw, "802.11: Wi-Fi standards and speeds explained," *Network World* (October 9, 2018), available at <https://www.networkworld.com/article/3238664/80211-wi-fi-standards-and-speeds-explained.html>.

⁸ See Wi-Fi Alliance, "Wi-Fi Alliance® introduces Wi-Fi 6" (October 3, 2018), available at <https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-introduces-wi-fi-6>.

⁹ See Keith Shaw, "802.11: Wi-Fi standards and speeds explained," *Network World* (October 9, 2018), available at <https://www.networkworld.com/article/3238664/80211-wi-fi-standards-and-speeds-explained.html>.

¹⁰ See Wi-Fi Alliance, "Wi-Fi Alliance® introduces Wi-Fi 6" (October 3, 2018), available at <https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-introduces-wi-fi-6>.

¹¹ See generally Wi-Fi Alliance, "Wi-Fi 6: Advanced uses for a new era of connectivity (October 2019), available at https://www.wi-fi.org/download.php?file=/sites/default/files/private/Wi-Fi_6_Use_Case_white_paper_20191011.pdf.

¹² See Luke O'Neill, "It's not Wi-Fi 6 vs. 5G – it's Wi-Fi 6 and 5G," *TechTarget* (November 2019), available at <https://searchnetworking.techtarget.com/feature/Its-not-Wi-Fi-6-vs-5G-its-Wi-Fi-6-and-5G> (explaining how "Wi-Fi 6 and 5G are expected to complement each other"). See also "The FCC's 5G FAST Plan," available at <https://www.fcc.gov/5G> ("Recognizing that unlicensed spectrum will be important for 5G, the agency is creating new opportunities for the next generation of Wi-Fi in the 6 GHz and above 95 GHz band.") (citations omitted).

"10G" wireline offerings from cable operators.¹³ Wi-Fi 6-compatible devices are available for purchase today.¹⁴

Wi-Fi 6E and the 6 GHz band. For consumers to reap all of the benefits of Wi-Fi 6, however, additional unlicensed spectrum must be made available. There are two primary reasons for this. One, the spectrum that the FCC allocated in the 2.4 GHz and 5 GHz bands for unlicensed use in 1985 is overcrowded and encumbered by networks based upon the Wi-Fi 4 and 5 standards.¹⁵ Two, for Wi-Fi 6 to achieve its full potential, it requires wider data channels (160 MHz) than existing spectrum can support.¹⁶ Wi-Fi 6 proponents have championed the 6 GHz band as a source for new unlicensed capacity, both in the U.S. and internationally – so much so that the Wi-Fi Alliance recently unveiled Wi-Fi 6E, specific consumer-facing branding for those devices capable of operating in that band.¹⁷

The FCC similarly views the 6 GHz band as a viable source of new unlicensed spectrum. In October 2018, the agency unanimously adopted an *NPRM* that would allow unlicensed devices to share a total of 1,200 MHz of spectrum between 5.925 and 7.125 GHz.¹⁸ Under the Commission's proposal, devices utilizing Automatic Frequency Coordination (AFC) to protect incumbent services could operate at full power in 850 MHz of that spectrum, while lower power devices could utilize the remaining 350 MHz.¹⁹ That spectrum is licensed primarily to Critical Infrastructure Industry (CII) users, which include electric, gas, and water utilities, oil and gas companies, and railroads; public safety; and broadcasters.

¹³ See Letter from Rob Alderfer, Vice President of Technology Policy, CableLabs, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183 (filed December 20, 2019), at 1 ("CableLabs highlighted that cable operators have invested significant resources to deploy gigabit broadband throughout their footprints and are working toward delivery of 10 gigabit speeds. Because most consumers access their broadband service through Wi-Fi, it is critical that Wi-Fi speeds keep pace with the wired speeds delivered to homes and businesses.").

¹⁴ See Ry Crist, "The iPhone 11 supports Wi-Fi 6. Here's what that means for you," *CNET* (September 16, 2019), available at <https://www.cnet.com/how-to/the-iphone-11-supports-wi-fi-6-here-is-what-that-means-for-you/> (pointing out that the iPhone 11, Samsung Galaxy S10, and Samsung Note 10 all support Wi-Fi 6).

¹⁵ See J.R. Flesch, Charles Cheevers & Kurt Lumbatis, "The Promise of WiFi in the 6 GHz Band" (2019), available at <https://www.nctatechnicalpapers.com/Paper/2019/2019-the-promise-of-wifi-in-the-6-ghz-band> ("The 5.925-7.125 GHz band (colloquially '6 GHz band') represents an immense opportunity for indoor WiFi to fully adopt the promise of WiFi6 in a green space environment and clear out the channel access baggage and heterogeneous technical epoch mix accumulated during the more or less organic growth of unlicensed, contention-based wireless services in the 2.4 and 5 GHz bands. In exploiting this clean break, it avoids disrupting the existing population of devices and their present state of interoperability (however suboptimal that may be).").

¹⁶ See Wi-Fi Alliance, "Wi-Fi Certified 6," available at <https://www.wi-fi.org/discover-wi-fi/wi-fi-certified-6> ("Wi-Fi 6E will utilize up to 14 additional 80 MHz channels and 7 additional 160 MHz channels in 6 GHz for applications such as high-definition video streaming and virtual reality. Wi-Fi 6E devices will leverage these wider channels and additional capacity to deliver greater network performance and support more Wi-Fi users at once, even in very dense and congested environments.").

¹⁷ See Wi-Fi Alliance, "Wi-Fi Alliance® brings Wi-Fi 6 into 6 GHz" (January 3, 2020), available at <https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-brings-wi-fi-6-into-6-ghz> (explaining that "6 GHz is well suited to facilitate Wi-Fi's continued growth ... due to its adjacency to 5 GHz where Wi-Fi already operates, greater availability of wider channel sizes, and accessibility to clear spectrum with less interference from legacy Wi-Fi 4 or Wi-Fi 5 devices").

¹⁸ See generally *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, Notice of Proposed Rulemaking, FCC 18-147 (adopted October 23, 2018).

¹⁹ See *id.* at para. 2.

Those incumbents object to various aspects of the FCC's plan. For example, CII users argue that unlicensed operations in the 6 GHz band would cause unacceptable levels of interference to microwave links used for mission-critical communications in metropolitan areas – and that, as a practical matter, AFC may not provide an adequate solution.²⁰ Parties also dispute whether low power indoor (LPI) and very low power (VLP) indoor/outdoor devices can avoid causing unacceptable levels of interference to incumbent licensees absent the use of AFC.²¹ Broadcasters, meanwhile, assert that, given potential interference to electronic newsgathering services, "the Commission should not permit uncoordinated unlicensed operations, whether indoors or outdoors."²² Proponents for unlicensed sharing of the band, not surprisingly, dispute these claims.²³

In addition, those focused on the race to 5G – an undisputed national policy priority²⁴ – take issue with the fact that the FCC's proposal would share the entire 6 GHz band between unlicensed devices and existing licensees. CTIA, for example, argues that, given the pressing need to free up more mid-band spectrum for 5G, the Commission should "promptly issue a

²⁰ See Letter from Emily S. Fisher, General Counsel and Corporate Secretary, Edison Electric Institute, *et al.*, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183 (filed January 13, 2020), at 2 (asserting that the attached report, prepared by Roberson & Associates, LLC, "considers interference from both residential and outdoor Wi-Fi access points and for Wi-Fi adjacent channel emissions [and] demonstrates that deployment of RLANs as currently proposed in the NPRM would cause all the point-to-point links in the Houston MSA to experience unacceptable levels of interference").

²¹ See, *e.g.*, *id.* (asserting that a "preliminary analysis of very low power ('VLP') operations indicates that the potential interference from VLP operations has been significantly under estimated"). See also Reply Comments, Edison Electric Institute, *et al.*, *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, Notice of Proposed Rulemaking, FCC 18-147 (submitted March 18, 2019) (arguing that "the Commission should not permit unrestricted low power indoor (LPI) operations all across the band without AFC").

²² Letter from Rick Kaplan, General Counsel and Executive Vice President, Legal and Regulatory Affairs, National Association of Broadcasters, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183 (filed December 5, 2019), at 1.

²³ See, *e.g.*, Paul Kirby, "Utilities' Study Predicts 6 GHz Unlicensed Interference," *TRDaily* (January 14, 2020), available at <http://www.trdailyonline.com/online/trd/2020/td011420/index.htm> ("In response to the study, David Marshack, managing director and chief operating officer of RKF Engineering Solutions LLC, said in a statement today, 'This analysis from the Roberson Group ... fails to reflect the real-world operations of 6 GHz devices by ignoring modern building construction, greatly understating the effects of clutter and buildings, and assuming that every person will stream 4K video at all times on a 6 GHz device.'"); Letter from Apple Inc., *et al.*, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183 (filed January 14, 2020), at 1 (claiming that the study submitted by the National Association of Broadcasters regarding potential interference to electronic newsgathering operations "fails to adequately reflect the detailed technical record in this proceeding" and "makes multiple errors that make its conclusions inapplicable to the proposals currently under consideration in the 6 GHz band").

²⁴ See, *e.g.*, Emily Birnbaum, "House passes bills to gain upper hand in race to 5G," *The Hill* (January 8, 2020), available at <https://thehill.com/policy/technology/477429-house-passes-bills-to-gain-upper-hand-in-race-to-5g> ("The legislation comes as the U.S. works to win the 'race to 5G....' Congress and the Trump administration have been working to diminish the power of Chinese telecommunications companies currently dominating the 5G industry while pouring more money into efforts to build out the networks in the U.S."); John Eggerton, "FCC's Pai: U.S. Will Lead Way in 5G Deployment," *Multichannel News* (November 5, 2019), available at <https://www.multichannel.com/news/fccs-pai-u-s-will-lead-way-in-5g-deployment> ("Pai asserted that the U.S. was poised to seize the high ground, in part thanks to the FCC's plan to 'ensure that our nation leads the way in 5G deployment.'").

Further Notice of Proposed Rulemaking seeking comment on licensing the 6.525-7.125 GHz band for flexible-use services and relocating incumbent Fixed Service ('FS') operations from that portion of the band to other comparable facilities...."²⁵

I take no position on the merits in either of these debates. With respect to concerns about interference, I defer to the Commission, guided by the technical experts in the Office of Engineering and Technology, to reach the proper conclusions. (I am encouraged, however, by the fact that this proceeding presumably would not exist absent a reasonable basis to believe that unlicensed operations and incumbent services are able to share this spectrum successfully.) With respect to calls to repurpose the upper portion of the 6 GHz band, I note that even those who advocate such an approach support unlicensed operations in the lower portion of the band.²⁶ As a result, I simply urge the FCC to resolve these, and any other, outstanding issues expeditiously – and, if at all possible, to do so in a way that frees up additional unlicensed spectrum for Wi-Fi 6E.

Conclusion

Going forward, Wi-Fi's ability to keep pace with user demands requires three things: greater throughput, new capabilities, and additional unlicensed spectrum. Standard setters have done their part; devices that support the next-generation specification, Wi-Fi 6, are on store shelves today. Having identified the 6 GHz band as a source for additional unlicensed spectrum, the FCC should act with dispatch to bring this rulemaking to a close. To the extent that Wi-Fi 6E devices can coexist harmoniously with incumbent licensee services, consumers, businesses, and network operators all will benefit.

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²⁵ Letter from Kara Graves, Director, Regulatory Affairs, CTIA, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183 (filed January 10, 2020), at 2.

²⁶ *See id.* ("Such action need not delay the introduction of unlicensed operations in the lower 6 GHz band, provided the Commission adopts a robust interference protection regime.").