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The Importance of Permissionless Innovation in Unlicensed Bands

I. INTRODUCTION

The U.S. wireless market is a world leader in innovation and consumer choice. In every key measurement, America's commercial wireless offerings – high and low band spectrum, consumer and business, licensed and unlicensed device offerings – are ahead of the global pack. Capital investment, research and development, and consumer and industry spending on these innovative products and services have provided jobs, economic growth, and tremendous productivity. Our licensed and unlicensed spectrum policy approaches represent two key elements of this American success story. In fact, FCC Chairman Tom Wheeler called the two, "more complimentary than competitive...Both are critically important to our mobile ecosystem."[1] But this success is not inevitable and its future is not guaranteed. Whether it's holding auctions that are open to everyone on the same terms or ensuring the permissionless innovation of unlicensed bands remains permissionless, U.S. policy leadership is always under threat from those that would have us turn our backs on a remarkable 15 years of American wireless triumph.

This success of the U.S. wireless industry has been due in no small part to the policies of the Federal Communications Commission (FCC). Economists estimate that the economic value of licensed spectrum made available for mobile wireless use is almost $500 billion and that the total social benefits from licensed spectrum are at least 10 to 20 times the direct economic value of the spectrum.[2] That value generates significant investment and spending. Wireless carriers, their suppliers and the employees of the firms in the wireless ecosystem generate in excess of $400 billion in spending annually. That economic impact results in substantial job creation; for every one person employed in the wireless industry, an additional 6.5 people benefit from jobs.[3] As the White House Council of Economic Advisors has stated, increased wireless broadband deployment (which depends on licensed spectrum) will "increase the rate of growth in per capita income; spur economic activity through new business investment; and support many new high-quality jobs."[4] In addition to direct economic benefits, licensed spectrum-dependent mobile broadband is improving access to educational content for students, making possible video-based telehealth services, improving capabilities for first responders, and fundamentally changing the way in which video programming is consumed.

The social and economic benefits of licensed spectrum are undeniable and the Commission must continue to look for ways to free up additional licensed spectrum. This paper, however, will focus on the other factor that has made the U.S. the world leader in wireless innovation and consumer choice – America's unlicensed spectrum policy. Here, bands that had

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[1] *See e.g.*, Statement of Tom Wheeler, Chairman, *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, 29 FCC Rcd 4127, 4179 (2014) ("*U-NII Expansion Order*").

[2] *Coleman Bazelon and Giulia McHenry, Mobile Broadband Spectrum: A Vital Resource for the American Economy*, The Brattle Group, May 11, 2015, available at http://www.ctia.org/docs/default-source/default-document-library/brattle_spectrum_051115.pdf.

[3] *Id*.

[4] Executive Office of the President Council of Economic Advisors, "The Economic Benefits of More Spectrum for Wireless Broadband," February 2012, available at http://www.whitehouse.gov/sites/default/files/cea_spectrum_report_2-21-2012.pdf.

once been "garbage" are today the "innovation" bands,[5] consistently producing new capabilities and enabling services and applications that add significant value to mobile broadband networks powered by licensed spectrum. In addition to countless societal benefits, the economic impact from unlicensed spectrum is also significant – as high as $222 billion annually.[6] The evolution of unlicensed – from spectrum wasteland to spectrum innovation zones – was the product of decades of regulatory trial and error. After years of allowing very low power unlicensed use of all spectrum other than the restricted bands the Commission recognized that those very low power levels were precluding a wide range of products that could otherwise be brought to market. As a result, the Commission has designated spectrum at 900 MHz, 2.4 GHz and 5 GHz that is primarily devoted to unlicensed at higher power levels, ultimately creating the successful mixture of licensed and unlicensed spectrum that has fueled the communications revolution.[7] And, to facilitate the most efficient use of that spectrum, the FCC has encouraged entrepreneurship, facilitated rapid technological advancement and allowed the public to enjoy the benefits of wireless devices for which traditional licensing simply is not practicable.

While the Commission has modified its unlicensed rules over the years, certain fundamental FCC principles have remained constant. Chief among these principles has been a minimally intrusive regulatory approach, with unlicensed devices authorized to freely operate in accord with basic technical requirements designed to mitigate interference, limit radiofrequency ("RF") exposure, and maximize the utilization of the unlicensed bands. As its regulatory scheme for unlicensed has evolved, and as discussed in more detail in Section IV, the FCC consistently has avoided any requirement that devices operating in unlicensed spectrum adhere to specifications developed by any particular standards setting organization, employ any particular co-existence protocol, or pass any sort of litmus test for compatibility with other unlicensed technologies.

This paper reviews the extraordinary variety of technologies (some proprietary and some emanating from standard-setting bodies) that have found a home in bands primarily devoted to unlicensed use. It finds that the FCC's decades-long rejection of stifling government regulations on unlicensed devices has allowed incredible innovation and experimentation to flourish, and that the Commission should carefully safeguard its successful policy of permissionless innovation in the unlicensed bands.

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[5] *See* Remarks of Commissioner Jessica Rosenworcel, Federal Communications Commission, "The Future of Unlicensed Spectrum," Computer History Museum, Mountain View, CA (Sept. 11, 2014).

[6] *See* Raul Katz, "Assessment Of The Economic Value Of Unlicensed Spectrum In The United States," Table C (Feb. 2014), *available at http://www.wififorward.org/wp-content/uploads/2014/01/Value-of-Unlicensed-Spectrum-to-the-US-Economy-Full-Report.pdf.*

[7] *See e.g.*, Statement of Jessica Rosenworcel, Commissioner, *U-NII Expansion Order*, 29 FCC Rcd at 4181 ("[T]he power of unlicensed goes beyond onramps to the Internet and offloading for licensed services. It is the power of setting aside more of our airwaves for experiment and innovation…."); Statement of Michael O'Rielly, Commissioner, *U-NII Expansion Order*, 29 FCC Rcd at 4184 ("The beauty of unlicensed spectrum, I learned, is that no one can predict with certainty what it will ultimately be used for, but it is a very safe bet that some uses will far exceed expectations or even become game changers.").

II. SINCE 1938, THE FCC HAS PERMITTED UNLICENSED OPERATION OF RF DEVICES THAT MEET BASIC TECHNICAL AND OPERATIONAL CRITERIA

Although the dramatic growth of unlicensed devices is of relatively recent vintage, the FCC's policy of allowing unlicensed RF radiation can be traced back more than seventy-five years to 1938.[8] At that time, the FCC authorized some of the first record players, carrier current communication systems, and remote control devices to operate on an unlicensed basis, provided they met key criteria: (1) RF emissions and field strength were relatively low level; and (2) no harmful interference was caused to licensed services.[9]

These criteria should sound remarkably familiar to those deploying unlicensed technology today, as they were restored as the foundation of Part 15 three decades ago. At the time the initial unlicensed rules were promulgated in 1938, most unlicensed RF devices were designed to operate in the MF (0.3-3 MHz) and HF (3-30 MHz) frequency bands, and compliance with the required very low field strength levels was relatively easy to achieve. However, the applicable rule at the time reduced the acceptable field strength level as the frequency increased, so manufacturers found compliance difficult as products intended for operation on higher frequencies were developed. Over the ensuing years, Part 15 was frequently amended in response to technology-specific petitions for rulemaking to permit the operation of additional unlicensed RF equipment at higher power levels in higher frequencies (such as wireless microphones, telemetry systems, garage door openers, TV interface devices, field disturbance sensors, auditory assistance devices, control and security alarm apparatus, and cordless telephones). By the late 1980s, the Commission concluded that this incremental method of adopting device-specific regulations resulted in rules that were "lengthy and difficult … to understand," "overly complex," and "unnecessarily restrictive."[10] Thus, the FCC returned to a technology neutral approach that established generally uniform "minimal restrictions on usage, bandwidth, modulation technique and other technical parameters."[11] The flexibility inherent in this approach set the stage for the explosion of unlicensed devices we now enjoy particularly in the 2.4 GHz and 5 GHz bands and the ever-faster development cycles that characterize modern information and communications technologies.

Having determined that "technical requirements that would tend to favor one technology over another" would not benefit the public interest,[12] the Commission has "historically adopted

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[8] *Revision of Part 15 of the Rules regarding the Operation of Radio Frequency Devices without an Individual License*, First Report and Order, 4 FCC Rcd 3493, 3494 ¶ 2 (1989) ("*1989 First Report and Order*").

[9] *Id.*

[10] *Id.* ¶¶ 4, 8.

[11] *Id.* ¶ 6.

[12] *Service Rules in the Government Transfer Bands*, Report and Order, 17 FCC Rcd 9980, 10030-31 ¶ 123 (2002).

rules that are technology neutral."[13] While the rules governing the 900 MHz, 2.4 GHz and 5 GHz unlicensed bands differ somewhat from band to band to avoid interference to their particular neighboring services, they generally are confined to limit power (either output power, field strength or equivalent isotropic radiated power), mandate compliance with frequency hopping requirements or the use of digital modulation and, in the case of certain 5 GHz frequencies, require transmit power control and dynamic frequency selection techniques.[14] Despite efforts to change this technology neutral approach, the FCC has never required unlicensed devices be compatible with any particular unlicensed technology or require any specific co-existence protocol.[15] Within the frequency bands designated primarily for unlicensed uses, and subject to these minimal technical constraints, a company can strike out on its own and innovate.[16]

III. THE UNLICENSED BANDS ARE A HOTBED OF PERMISSIONLESS INNOVATION

As FCC staff explained over a decade ago, "[b]ecause they are free from the delays inherent in the licensing process, unlicensed devices can frequently be designed to fill a unique need and be introduced into the marketplace rather quickly."[17] In the wake of the FCC's initial 1938 unlicensed decision, manufacturers of unlicensed record players, carrier current communication systems, and remote control devices entered the market.[18] The 1950s saw the introduction of radio receivers and low power transmitters operating in the 27 MHz band and above 70 MHz.[19] Devices using new wireless capabilities in the unlicensed bands complemented the growth of suburbia with its bigger houses and spread-out communities: Wireless microphones, telemetry systems, garage door operators, television interface devices, anti-pilferage systems for retail stores, auditory assistance devices, control and security alarm

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[13] *See, e.g.*, *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, 4458 (May 5, 2015).

[14] *See* 47 C.F.R. §§15.247, 15.248, 15.407.

[15] *See, e.g.*, *Modification of Parts 2 & 15 of the Commission's Rules,* Order and Second Memorandum Opinion and Order, 29 FCC Rcd 6366 (2014) (rejecting proposal to adopt a specific "spectrum etiquette" requirement for unlicensed transmitters operating in the 902-928 MHz, 2.4 GHz, and 5.8 GHz bands) ("*2014 Etiquette Order*").

[16] *See, e.g.*, *Operation of Unlicensed NII Devices in the 5 GHz Band*, Report and Order, 12 FCC Rcd 1576, 1577 ¶ 1 (1997) ("In order to permit significant flexibility in the design and operation of these devices, we are adopting the minimum technical rules necessary to prevent interference to other services and to ensure that the spectrum is use efficiently") ("*1997 U-NII Report and Order*").

[17] Kenneth R. Carter, Ahmed Lahjouji, and Neal McNeil, *Unlicensed and Unshackled: A Joint OSP-OET White Paper on Unlicensed Devices and Their Regulatory Issues*, OSP Working Paper Series No. 39, at 5 (May 2003) ("OSP-OET White Paper"), https://apps.fcc.gov/edocs_public/attachmatch/DOC-234741A1.pdf.

[18] OSP-OET White Paper at 6.

[19] *Id.*

apparatus, and cordless telephones all entered the marketplace starting in the 1960s.[20] By 1995, there were "several million" devices operating on an unlicensed basis in the 900 MHz band, including cordless phones "offering high quality voice operations," wireless local area networks enabling "tetherless voice and data transmission," and automated utility meters allowing utility companies to read residential meters from a far.[21] Contemporary homes are full of unlicensed devices utilizing the 900 MHz, 2.4 GHz and 5 GHz bands, including wireless routers, video transmitters and receivers, wireless speakers, cameras, baby monitors,[22] wireless keyboards and mice,[23] and thermostats.[24]

Many technologies and implementations in the major unlicensed bands demonstrate that non-standard and beta technologies have been operating in the unlicensed bands successfully, alongside their standardized cousins. Today's unlicensed devices show remarkable technological diversity,[25] utilizing both standardized and proprietary technologies.[26] For example, both standard and proprietary wireless technologies are playing a part in the emerging Internet of Things ("IoT"). One existing technology that is increasingly playing in the IoT is radio-frequency identification ("RFID"), which "use[s] radio waves to automatically identify people or objects" through a reader (creating a radio field) and tag (a microchip which senses and transmits data back to the reader) system.[27] RFID operates on an unlicensed basis in several bands – 125-133 kHz, 13.56 MHz, 433 MHz, 900 MHz, 2.4 GHz, and 5 GHz. Common applications of RFID include pet recovery, package and inventory tracking, electronic toll collection, office security badges, and newer credit cards. Near Field Communications ("NFC"), a type of RFID, powers point-of-sale mobile phone payment systems and phone-to-phone data transmission. Closer to home, an NFC tag on the washing machine when tapped with an NFC-

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[20] *Id.*

[21] *Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicular monitoring Systems*, Report and Order, 10 FCC Rcd 4695, 4699-700 ¶ 8 (1995) ("*LMS Report and Order*").

[22] *See* Apple, *Wi-Fi and Bluetooth: Potential Sources of Wireless Interference* (Last Modified Mar. 6, 2015), https://support.apple.com/en-us/HT201542 ("*Potential Sources of Wireless Interference*"); Amit Hakoo, *Interference Detection and Mitigation with Cisco CleanAir*, CISCO BLOG MOBILITY (Sept. 5, 2013 5:00AM PT.

[23] Turning Technologies, RF INTEROPERABILITY 7, version 1.3 (Oct. 21, 2013), https://www.turningtechnologies.com/pdf/UserGuides/RFInteroperabilityDoc.pdf.

[24] Anitha TG, Cypress Platform, Comparison of 2.4-GHz proprietary RF and Bluetooth 4.0 for HID applications (Dec. 2010), https://www.element14.com/community/servlet/JiveServlet/previewBody/28087-102-2-77288/Bluetooth%20and%20proprietary%20RF.pdf.

[25] Gil Reiter, *Wireless Connectivity for the Internet of Things: One Size Does Not Fit All*, Texas Instruments White Paper, at 1, June 2014 ("Covering a wide variety of use cases, in various environments and serving diverse requirements, no single wireless standard can adequately prevail.") ("*One Size Does Not Fit All*"), http://www.ti.com/lit/wp/swry010/swry010.pdf.

[26] We use the term "proprietary" to refer to technologies that have not been adopted into an industry standards by a third-party, standards setting organization.

[27] RFID Journal, Frequency Asked Questions, http://www.rfidjournal.com/site/faqs.

enabled smartphone, can trigger a timer on a phone reminding you not to forget the laundry; a tag in the car can be programmed to increase volume, enable Bluetooth, disable Wi-Fi (to save battery) and start music on one's phone.[28]

Emerging technologies are benefiting consumers by making everyday tasks more efficient and, in many cases, automated. LoRaWAN is an emerging low power wide area network ("LPWAN") technology intended for wireless, battery-powered sensors, devices, and things in regional, national, and global networks.[29] LoRa provides a relatively low data range from 0.3 kbps to 50 kbps and envisions three different end-devices with varying uplink and receive windows designed to allow different applications.[30] For example, Senet created a LoRaWAN network in Silicon Valley and nearby areas to "optimize propane and heating fuel delivery and inventory," and now is opening the network to "IoT application verticals such as agriculture, smart parking, building management, supply chain management, water metering, water leak detection, industrial asset tracking and healthcare."[31] Other key applications for LoRaWAN connectivity include: Connecting power-consuming (or storing) assets to a managed electricity grid to enable the increased use of renewables; consumer devices that are connected in order to enhance the overall value proposition, particularly in the areas of home automation and assisted living; smart city applications to increase the day-to-day efficiency of cities and smooth the way to a highly urbanized future; agricultural monitoring and control applications to allow for more effective and efficient use of agricultural land and resource; and intelligent building applications to increase building efficiency.[32] All of these capabilities produce efficiencies for increasingly busy consumers, enhance consumer health and welfare, and generally improve the quality of life for Americans. Businesses of all types and sizes, from a small rural farm to major retail outlets, are also winners.

As some companies move ahead with proprietary solutions for LPWAN, others are developing standards. For example, the 3GPP standards body is incorporating LPWAN technologies into its standards for the IoT. Indeed, as is often the case, even before 3GPP finalizes this standard, pre-standard deployments are taking place. One pilot currently underway is a partnership between Verizon and PrecisionHawk, an unmanned aerial systems and data analysis firm, to collect and then synthesize data at a California winery.[33] The winery will then use the data to "identify disease, estimate yield, and harvest more effectively.[34]

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[28] Sharon Profis, *The Most Practical, Creative Ways to Use NFC with Your Android Device*, CNET (July 25, 2012), http://www.cnet.com/how-to/the-most-practical-creative-ways-to-use-nfc-with-your-android-device.

[29] LoRa Alliance, LoRa® Technology, https://www.lora-alliance.org/What-Is-LoRa/Technology.

[30] *Id.*

[31] Steve Rogerson, Senet brings LoraWan network to Silicon Valley, M2M Zone Newsdesk (July 2, 2015), http://www.m2mzone.com/senvall.

[32] Machina Research, *"LPWA Rechnologies; Unlock New IoT Market Potential*," at 3, *available at* https://www.lora-alliance.org/portals/0/documents/whitepapers/LoRa-Alliance-Whitepaper-LPWA-Technologies.pdf.

[33] Verizon, Press Release, Verizon Announces Availability of World's First Cat1 LTE Network Features for IoT, Expands its ThingSpace Platform (Dec. 1, 2015), http://www.prnewswire.com/news-

The variety of technologies that are available to connect devices based on form and function is nearly endless. Consumer devices such as wireless headsets and headphones, "smart" watches, and fitness trackers all may use Bluetooth to connect to a host device at a very short distance, such as a mobile phone. Similarly, kitchen refrigerators may display video from an upstairs television when connected through a home Wi-Fi network. Using yet another technology, a smart grid network may transmit data from home electric meters to utility companies more than 25 kilometers away over a 900-MHz radio using a proprietary protocol[35] or through a network connected by devices compliant with the Zigbee standard.[36] Zigbee is also used in other home automation products, and can control appliances, lighting, environment, energy management, and security.[37] A takeoff on the underlying standard that became Zigbee, the WirelessHART technology, provides connectivity in industrial settings by connecting "monitor pumps, cooling units, filters, engines, and valves otherwise difficult to access" other than through wireless technology, demonstrating how consumer and industry technologies are a two-way street.[38] Proprietary theatrical, concert, and sporting event radio systems operate in the 900 MHz, 2.4 GHz or 5 GHz bands ensuring that a scene change or dramatic on-the-field play is not ruined by unsightly wires.[39] The hottest gifts for the 2015 holiday season, drones, embraced the unlicensed bands both for control of unmanned vehicles and for the backhaul of video streams from the drones.[40]

Moving from connecting things to connecting people to the Internet broadly, Wireless Internet Service Providers (WISPs) heavily rely on nonstandard technologies in the 900 MHz, 2.4 GHz and 5 GHz bands to deliver broadband in hard to reach, rural locations.[41] As an example, one such provider, Cambium has deployed over four million devices globally that employ proprietary technology to deliver broadband access and backhaul.[42] Cambium's technology is based on Motorola's Canopy technology, which was one of the pioneers in fixed

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releases/verizon-announces-availability-of-worlds-first-cat1-lte-network-features-for-iot-expands-its-thingspace-platform-300186153.html.

[34] *Id.*

[35] *One Size Does Not Fit All* at 4.

[36] Raul L. Katz, Assessment of Current and Future Economic Value of unlicensed Spectrum in the United State at 64 (Aug. 2014).

[37] *Id.*

[38] *Id.*

[39] Clear-Com Communications Systems, Tempest Radio System RF Guide ("Tempest utilizes a proprietary Frequency Hopping Spread Spectrum (FHSS) technology that has 7 US patents…. Tempest's overall RF scheme is then dramatically enhanced with the addition of a proprietary Redundant Data Transmit 2xTX technology that transmits all audio packet data twice, once each on two consecutive hops."), http://www.clearcom.com/upload/download/TempestRFGuide.pdf ("Tempest RF Guide").

[40] Craig Issod, Basics of Radio Frequencies for FPV Quadcopter Drones, DroneFlyers (Nov. 17, 2014), http://www.droneflyers.com/2014/11/basics-radio-frequencies-fpv-quadcopter-drones.

[41] *See, e.g.*, FCC Wireless Broadband Access Task Force, *Report,* GN Docket No. 04-163 (Feb. 2005), https://apps.fcc.gov/edocs_public/attachmatch/DOC-257247A1.pdf.

[42] Comments of Cambium Networks, Ltd., ET Docket No. 15-105, at 2 (June 11, 2015).

wireless connectivity.[43] The current generation of technology delivers "more than double the spectral efficiency than [standard] 802.11n systems," which is especially important for harder to reach locations that cannot rely on wires or cable for high-speed Internet connectivity.[44] These rural broadband deployments often utilize the maximum available power, greater bandwidth and do not observe a meaningful "quiet period,"[45] ensuring connectivity to those that may otherwise not have it.[46]

IV. FCC HAS CONSIDERED AND REJECTED THE IDEA OF MANDATORY CO-EXISTENCE PROTOCOLS AND OTHER MEASURES TO AVOID POSSIBLE INTERFERENCE IN FAVOR OF MAINTAINING TECHNICAL FLEXIBILITY

The FCC's actions with respect to the unlicensed bands are a welcome manifestation of regulatory humility. When confronted with new devices and crowded unlicensed spectrum, the FCC has consistently rejected suggestions to set coexistence standards, impose protocols, or mandate specific technologies. The FCC has found that it is not the agency's job "to pick winners or losers, or select the 'best' technology to meet consumer demand," but rather the agency should "ensure that the marketplace is conducive to investment, innovation, and meeting the needs of consumers."[47] The Commission's choices to eschew excessive government prescription have prompted the market to respond to potentially harmful developments through cooperation and further innovation. Consumers and the U.S. economy have been the winners.

The Commission first authorized U-NII equipment in the 5 GHz band in 1997. At that time, the FCC expressly considered and rejected a listen-before-talk ("LBT") protocol as an interim spectrum etiquette mechanism in favor of the ultimate adoption of a co-existence protocol to be developed by industry.[48] Commenters "overwhelmingly oppose[d]" the proposal, objecting that the protocol was unnecessary, would preclude future innovation, and would hurt small businesses who would not be able to afford participation in an industry working group.[49] While the FCC acknowledged that there might be some benefits to a mandatory spectrum etiquette, it also found that "[d]rawbacks of an etiquette include an increase in the complexity of equipment design and, hence, an increase in cost to the manufacturer and the user, as well as a potential limitation on access to the spectrum by some technologies and equipment."[50] Further,

[43] Allan Law, *Cambium (formally Motorola) Point to Point wireless Bridges*, DIGITAL AIR WIRELESS BLOG (Aug. 18, 2014), http://www.digitalairwireless.com/wireless-blog/recent/cambium-formally-motorola-point-to-point-wireless-bridges.html.

[44] *Id.*

[45] *Modification of Parts 2 and 15 of the Commission's Rules for Unlicensed Devices and Equipment Approval*, Memorandum Opinion and Order, 22 FCC Rcd 11383, 11389 ¶ 19 (2007).

[46] Comments of Blaze Broadband, ET Docket. No. 03-201 (Oct. 15, 2007).

[47] *Deployment of Wireline Services Offering Advanced Telecommunications Capability*, Memorandum Opinion and Order and Notice of Proposed Rulemaking, 13 FCC Rcd 24011, 24014 ¶ 2 (1998).

[48] *1997 U-NII Report and Order*, 12 FCC Rcd at 1605 ¶ 68.

[49] *Id.* at 1604 ¶¶ 64-65.

[50] *Id.* at 1606 ¶ 70.

the Commission concluded that, "it may be very difficult to develop a spectrum etiquette at this time that will not limit the types of equipment that could most efficiently or effectively provide the desired broadband communications."[51] The Commission ultimately determined that any benefits of such a protocol were outweighed by the substantial costs,[52] and that its light-touch rules, particularly its maximum power limits "will generally allow for equal access and sharing of these bands by U-NII devices."[53]

Similarly, in 2004, the FCC considered and ultimately rejected calls for the imposition of either a mandatory "listen before talk" spectrum etiquette, a requirement that devices cease transmitting if no information is being sent, and/or a duty cycle requirement for the 900 MHz, 2.4 GHz and 5 GHz bands. Commenters on the proceeding observed, for example, that imposing a duty cycle on new technologies for providing wireless VoIP products would "require extensive redesign and development with attendant additional costs, further delays in deploying the technology and reduction in system capacity" hurting consumer choice, particularly in rural areas.[54] The Commission reasoned that "design flexibility has helped industry to develop efficient sharing and modulation schemes" and that "existing regulations have resulted in very efficient use of available unlicensed spectrum."[55]

And, just last year, the FCC reaffirmed its earlier decision to refrain from implementing a spectrum etiquette requirement, a duty cycle requirement or a requirement that devices cease transmitting if no information is being carried in the 900 MHz, 2.4 GHz and 5 GHz bands. Just as it had done in 2004, the Commission determined that there was no need for a mandatory etiquette in the bands.[56] The Commission reasoned that "[c]onsistent with the Commission's decision in 2004 not to adopt an etiquette requirement, we are concerned that adoption of such a requirement could impede design flexibility and innovation of a wide variety of devices that the current rules enable."[57]

V. CONCLUSION

The tremendous number of devices that are today utilizing the unlicensed spectrum bands is a testament to the wisdom of the Commission's light touch approach. Data from seventy-five years of experience demonstrate that the FCC's policy of authorizing unlicensed devices to operate without regard to compliance with particular standards or etiquettes, but instead subject

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[51] *Id.*

[52] *Id.* at 1605 ¶ 68.

[53] *Id*. at 1606 ¶ 71.

[54] Addendum to Presentation, attached to *Ex Parte* Letter of Harold Mordkofsy, Counsel to xG Technology Inc., to Marlene H. Dorth, FCC, ET Dockets 03-201, 04-186, and 02-380 (dated Mar. 30, 2010).

[55] *Modification of Parts 2 and 15 of the Commission's Rules*, Report and Order, 19 FCC Rcd 13539 (2004) ("*2004 Spectrum Etiquette Order*").

[56] *2014 Etiquette Order*, 29 FCC Rcd at 6370-71 ¶¶ 12-13.

[57] *2014 Etiquette Order*, 29 FCC Rcd at 6370 ¶ 10; *see also id.* at 6370 ¶ 11 ("an etiquette could potentially stifle innovation or preclude the use of certain types of devices in the 902-928 MHz band").

only to limits on power and certain operating parameters, is fostering innovation and critical economic growth. Even in an environment which is crowded with devices that have the potential to cause interference to one another, manufacturers have developed distinct technologies utilizing the unlicensed bands that permit wireless devices to co-exist and flourish. The Commission's record of success in maintaining its flexible approach should be a lodestar when considering new technologies entering existing unlicensed bands. As shown with earlier iterations of Bluetooth and Wi-Fi, industry has a track record of working together, without Commission mandates, to promote an environment in which the risk of interference is limited and consumers prevail.

Changing the Commission's cornerstone permissionless policy framework in favor of a more restricted regime would depart from this successful track record without ensuring a better or more efficient outcome. The bottom line is that the FCC's permissionless innovation is working, and the evidence of the last seventy-five years of technology advancements shows that spectrum etiquette, specific industry standards, and other restrictive mandates are not needed to ensure coexistence in the unlicensed bands.