

**Before the
Federal Communications Commission
Washington, DC 20554**

In the Matter of)
)
Office of Engineering and Technology) ET Docket No. 15-105
And Wireless Telecommunications Bureau)
Seek Information on Current Trends in)
LTE-U and LAA Technology)

To: The Commission

**REPLY COMMENTS OF
OPEN TECHNOLOGY INSTITUTE AT NEW AMERICA
PUBLIC KNOWLEDGE
FREE PRESS
COMMON CAUSE**

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The Open Technology Institute at New America, Public Knowledge, Free Press and Common Cause (collectively the “Public Interest Organizations”) submit these Reply Comments in response to the Commission’s *Public Notice* in the proceeding referenced above.¹

The Public Interest Organizations commend the Commission for this effort to understand the potential consequences of the use and control of unlicensed spectrum as ancillary to a license-anchored carrier network. Two of our organizations previously filed *ex parte* letters in the 3.5 GHz proceeding, expressing concerns about the potential adverse impact of LTE-Unlicensed/Licensed Assisted Access (LTE-U/LAA) on consumers using Wi-Fi as well as the obvious incentives for anti-competitive behavior inherent in a technology designed to rely on a

¹ *Public Notice*, Office of Engineering and Technology and Wireless Telecommunications Bureau Seek Information on Current Trends in LTE-U and LAA Technology, DA 15-516, ET Docket No. 15-105 (released May 5, 2015) (“*Public Notice*”).

control channel anchored in expensive licensed spectrum.² Accordingly, our groups file these Reply Comments to help inform the Commission as it considers what steps are needed to ensure that all technologies and users have fair access to the nation’s unlicensed spectrum commons.

I. Introduction and Summary

The large and rapidly rising increase in consumer benefit from wireless broadband Internet access in the U.S. has rested on the separate but complementary roles of access to licensed and unlicensed spectrum. The use of Wi-Fi to offload a majority of mobile device traffic has ushered in a revolution in efficient small cell spectrum re-use. Coexistence features appropriate to a shared spectrum commons have led to worldwide Wi-Fi standards that promote spectrum re-use, open entry, decentralized investment, innovation and competition. Economic studies estimate Wi-Fi’s value to the U.S. economy exceeds \$200 billion annually. To keep this engine of consumer welfare growing, it would be wise to observe the regulatory version of the Hippocratic Oath: first, do no harm to the commons.

Coexistence and fair-sharing standards are built into Wi-Fi’s DNA – and without them it would not be such a boon to consumers and the economy. Although these features impose an “overhead” cost on Wi-Fi throughput, this is more than offset by the fact that at low power many different users can coexist and occupy the same frequencies in a relatively small area – and without the need for centralized coordination or control. This “connectivity without permission” is a key ingredient in Wi-Fi’s success in spurring both innovation and widespread deployment by individuals and business establishments at the end points of the Internet.

² See Open Technology Institute at New America and Public Knowledge, Letter to Marlene H. Dortch, *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, GN Docket No. 12-354 (March 16, 2015); Open Technology Institute at New America, Letter to Marlene H. Dortch, *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, GN Docket No. 12-354 (April 10, 2015).

In contrast, LTE-U/LAA is designed to be centrally controlled by a network anchored in a separate, *exclusively-licensed* frequency band. 3GPP, the mobile industry standards body, may ultimately design LAA in a manner that shares fairly with Wi-Fi and other unlicensed technologies; yet several studies filed by commenters demonstrate that the version of LTE-U that U.S. carriers plan to deploy by next year coexists poorly with Wi-Fi, degrading both throughput and latency (delay). OTI and PK agree with a number of other comments concluding that fair coexistence will be possible only if LAA implements Listen Before Talk (LBT) effectively, ideally through a consensus process with IEEE 802.11. Unfortunately, the 3GPP standard-setting process does not appear to be on a course toward fair coexistence.

The Public Interest Organizations are particularly concerned that mobile carriers will have both the ability and strong incentives to use LTE-U and LAA to engage in anti-competitive behavior harmful to consumers, while for the first time being able to charge consumers for the use of unlicensed spectrum. Carriers also have powerful incentives to use LTE-U to deter mobile market entry by “Wi-Fi First” providers, such as wireline ISPs. Carriers deploying LTE-U will have the apparent option to adjust their access points to introduce just enough latency to frustrate consumer use of real-time applications, such as video calling. This anti-competitive counterattack against Wi-Fi as a carrier substitute is particularly acute and immediate with respect to LTE-U. Moreover, mobile carriers deploying LTE-U and LAA operators will entirely avoid the ill-effects of any resulting poor coexistence on unlicensed bands, since they can shift their users and traffic at will to their exclusive, licensed spectrum.

The Public Interest Organizations are also concerned that both LTE-U and LAA are designed to be centrally controlled by a network anchored in a separate, *exclusively-licensed* frequency band. LTE-U and LAA are radically different from any current unlicensed

technology, all of which operate wholly in unlicensed spectrum on a standalone basis. If, as a result, access to licensed frequencies becomes a de facto prerequisite for successful use of unlicensed spectrum, such an outcome would not only foreclose competition from “Wi-Fi First” market entrants, but could also foreclose the ability of many individual firms, retail outlets, municipalities, schools, libraries, community groups and even some individual homeowners and apartment dwellers to “disintermediate” the wireless industry owners holding exclusive government licenses for mobile spectrum. “Connectivity without permission” – the hallmark of the Wi-Fi revolution – could be snuffed out if the Commission effectively concurs in giving license-anchored carrier networks superior rights to occupy and exclude others from fair use of unlicensed spectrum wherever it best serves such licensees’ business strategy.

The Public Interest Organizations further observe that Qualcomm has strong patent licensing incentives to promote licensed carrier-based unlicensed technologies in a manner that crowds out or disadvantages Wi-Fi deployments. A major patent-holding company like Qualcomm stands to make more licensing revenues, block more competitors, and monopolize more strongly a field based on a standard promulgated by 3GPP than one based on a standard promulgated by IEEE. Patent licensing thus creates an incentive for pushing for greater adoption of LAA, and inhibiting use of Wi-Fi, the IEEE standard. Indeed, Qualcomm has already declared that it is pulling itself out of the Wi-Fi standard-setting process in view of IEEE’s amended patent policy, saying that it “will not make licensing commitments under the new policy.”

The Public Interest Organizations support the recommendations suggested by NCTA, which urge the Commission to: (1) convene a meeting of the Chief of the Office of Engineering and Technology and a representative group of licensed carriers and the unlicensed community to initiate a process to establish effective sharing mechanisms; (2) establish a working group

composed of Commission staff and engineers from interested parties to carry forth this work after this initial meeting in weekly meetings; (3) seek monthly status reports from IEEE and 3GPP on the progress of coordination between these bodies on establishing effective sharing; and (4) ensure that licensees do not launch non-standard versions of LTE-U until these processes have been completed to the Commission's satisfaction. The Public Interest Organizations further recommend that the Commission also consider, as part of this collaborative process, seeking agreement among the parties for public and transparent testing first of LTE-U and later LAA equipment under a variety of Wi-Fi deployment scenarios, as well as in conjunction with deployment of Bluetooth and other unlicensed technologies.

The Commission has adopted strong rules to preserve and nurture the Internet's core value of "innovation without permission." It likewise should preserve the collaborative culture of "connectivity without permission" on the open and shared unlicensed bands that have proved so valuable for innovation, free speech and the U.S. economy. The slogan "technological neutrality" must not become a glib rationale for technology designed to make control of licensed frequencies a *de facto* prerequisite for successful use of the unlicensed spectrum where license-anchored services operate.

II. Without Fair Coexistence Features, LTE-U Deployments by Carriers Will Harm Consumers and Undermine the Proven Economic Benefits of Wi-Fi

There can be little doubt that the large and rapidly rising increase in consumer benefit from wireless broadband Internet access in the U.S. has rested on the separate but complementary roles of access to licensed and unlicensed spectrum. Commissioner Rosenworcel summed up a few of the enormous consumer and economic benefits of Wi-Fi at SXSW this year, stating: "Wi-Fi is how we get online. . . . Wi-Fi is how we foster innovation. . . .

Wi-Fi is also a boon to the economy. . . . \$140 billion annually – and it’s only going to grow. . . . We need to keep it coming. We need to make Wi-Fi a priority in spectrum policy.”³ Of course, to keep this engine of consumer welfare growing, it would be wise to observe the regulatory version of the Hippocratic Oath: First do no harm.

Today more than 63 percent of U.S. households have one or more Wi-Fi networks, a take-up rate expected to rise to 86 percent by 2017.⁴ There are far more unlicensed than licensed devices.⁵ This is inevitable, since virtually every licensed device incorporates Wi-Fi – and in most cases depends heavily on Wi-Fi to make high data-rate applications like video both feasible and affordable to users. But most other Wi-Fi devices are not connected to cellular networks. For example, more than 90 percent of iPads and other tablets are used exclusively on wireline connections via Wi-Fi.

The use of Wi-Fi to offload an increasingly large share of mobile device traffic onto fixed (wireline) networks has ushered in a revolution in efficient small cell spectrum re-use. Five years ago American adults spent less than one hour a day on mobile devices. Today adults spend nearly three hours per day on mobile devices, a majority of their total time consuming digital media.⁶ The increasing ability of consumers to connect their mobile devices to high-capacity wireline networks using Wi-Fi and unlicensed spectrum has not only accommodated a nearly 60 percent year-over-year growth rate in mobile data traffic, but it is spawning new hybrid network

³ Remarks of Commissioner Jessica Rosenworcel, SXSW Interactive, Austin, Texas (March 16, 2015).

⁴ Raul Katz, *Assessment of the Economic Value of Unlicensed Spectrum in the United States*, Telecom Advisory Services, at 14 (February 2014), available at: <http://www.wififorward.org/wp-content/uploads/2014/01/Value-of-Unlicensed-Spectrum-to-the-US-Economy-Full-Report.pdf>.

⁵ Comments of Wi-Fi Alliance, *Public Notice*, ET Docket No. 15-105, at 7 (June 11, 2015) (“Comments of Wi-Fi Alliance”).

⁶ Mary Meeker, *Internet Trends 2015—Code Conference*, Kleiner Perkins Caufield Beyers, at 14 (May 27, 2015), available at: http://kpcbweb2.s3.amazonaws.com/files/90/Internet_Trends_2015.pdf?1432854058.

business models, such as Republic Wireless and Cablevision’s Freewheel – “Wi-Fi First” networks that offer the promise of increasing inter-platform innovation and competition.

As Cisco observes, citing its own semiannual *Mobile Visual Networking Index* study, “Wi-Fi is the workhorse of the Internet – 50 percent of all Internet traffic begins or ends on Wi-Fi.” Wi-Fi carries “a significantly larger share of [mobile data] traffic than mobile LTE.”⁷ Unlicensed spectrum already carries the majority of all mobile device data traffic and will soon carry twice as much traffic as licensed spectrum. Cisco’s *Virtual Networking Index* estimates that Wi-Fi offloaded 57 percent of all U.S. mobile data traffic onto fixed (wireline) networks in 2014 and projects that 66 percent of U.S. mobile data traffic will be offloaded via Wi-Fi by 2019.⁸ Mobidia, which measures the actual usage of tens of thousands of consumers, reports that Wi-Fi is already carrying an average 80 percent of total mobile device data traffic for iPhone and Android users, the same level that a European Commission study projected would be the level of Wi-Fi offloading across Western Europe by 2016.⁹ Wi-Fi dominates connectivity for tablets, laptops and e-readers to an even greater extent, with roughly 80 percent of users relying exclusively on Wi-Fi rather than on a carrier network.¹⁰

⁷ Comments of Cisco Systems, Inc., *Public Notice*, ET Docket No. 15-105, at 3 (June 11, 2015) (“Comments of Cisco”).

⁸ Robert Pepper, *Cisco Visual Networking Index (VNI) Mobile Data Traffic Update, 2014-2019*, presentation at Mobile World Congress, GSMA Seminar (March 3, 2015), available at <http://www.gsma.com/spectrum/wp-content/uploads/2015/03/MWC15-Spectrum-Seminar.-Dr-Roberto-Pepper.-Cisco-presentation.pdf>. Globally Cisco projects that by 2018 more than 60 percent of *all* Internet traffic (fixed and mobile) will connect to the end user over a Wi-Fi connection, including both mobile device offload and home/enterprise routers.

⁹ Mobidia, “Network Usage Insights: Average Data Usage for LTE, 3G and WiFi of Wireless Subscribers in the USA, Q3 2014” (Nov. 2014); J. Scott Marcus and John Burns, *Study on the Impact of Traffic Off-Loading and Related Technological Trends on the Demand for Wireless Broadband Spectrum*, European Commission, at 3 (August 2013). The EC study used data from surveys that monitored the actual activity of thousands of mobile devices to project offload rates for the U.K., France, Spain, Germany and Italy.

¹⁰ Stuart Taylor and Tine Christensen, *Understanding the Changing Mobile User: Gain Insights from Cisco’s Mobile Consumer Research*, Cisco Systems Inc., at 3 (November 2013).

In addition to providing a tremendous boost in wireless capacity through spectrum re-use, the unlicensed bands have also proven to be a sandbox for innovation. As former GigaOm analyst Kevin Fitchard wrote, “[u]nlike cellular spectrum which is licensed and tightly controlled by the operators, the openness of the unlicensed bands allows anyone with a new idea to go for broke.”¹¹ One reflection of how open, unlicensed access to spectrum lowers the barriers to entry and innovation is the proliferation of new device certifications on these bands. Far more devices have been certified to use the 2.4 GHz unlicensed band (more than 20,000 as of early 2013) than in any other band (the FM band was second with 7,275 devices certified). More than 22,000 products have been Wi-Fi certified and the Wi-Fi Alliance projects that sales of devices with Wi-Fi connectivity will exceed 4 billion by 2020 (a six-fold increase since 2010).¹²

Unlicensed Wi-Fi routers, chips and services are a rapidly-growing, multi-billion-dollar industry. But more important for the economy overall is the tremendous *multiplier effect* that Wi-Fi has on the use and utility of the Internet by making a single wired connection available for shared use on a very low-cost, do-it-yourself basis. This generates enormous consumer welfare. Moreover, the ability to access sufficient amounts of unlicensed spectrum – in homes, businesses, in rapidly proliferating public hot spots and across hot zones – is a complement and cost saving to both commercial wireless carriers and to wireline ISPs seeking to give their customers the ability to access content away from their home wired connections.¹³

¹¹ Kevin Fitchard, “Wi-Fi: A Beautiful Chaos – Part 2,” *The Beacon: Wi-Fi Alliance blog* (September 9, 2014), available at: <http://www.wi-fi.org/beacon/kevin-fitchard/wi-fi-a-beautiful-chaos-part-2#sthash.ThWaXOLB.dpuf>.

¹² Wi-Fi Alliance, “Wi-Fi Alliance celebrates 15 years of Wi-Fi,” *Press Release*, (September 8, 2014), available at: <http://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-celebrates-15-years-of-wi-fi>

¹³ One example is the enormous cost savings experienced by mobile carriers attributable to Wi-Fi connections carrying the majority of their customer’s smartphone data traffic. A 2012 study by Consumer Federation of America economist Mark Cooper found that Wi-Fi offloading, in addition to reducing the spectrum needed by U.S. carriers, also reduced the infrastructure costs of cellular broadband service by roughly \$20 billion per year, “which is a substantial savings in a market with annual revenues of \$70

A series of economic studies have documented the steadily increasing economic value of unlicensed spectrum use for both personal and business productivity. A pair of 2014 studies by NYU economist Raul Katz estimated that the broader set of applications currently operating in unlicensed spectrum bands in the United States (primarily Wi-Fi and RFID) generated a total economic value of \$222 billion in 2013, which he projected will increase to \$531 billion by 2017.¹⁴ A second pair of economic studies by the Consumer Electronics Association estimates that unlicensed spectrum generates \$62 billion in retail sales value for devices and over \$200 billion when combined with “unlicensed spectrum’s value in terms of cost savings to individuals and firms.”¹⁵

In fact, the benefits of unlicensed spectrum extend far beyond wireless broadband. Cisco’s *Visual Networking Index* projects a tripling of machine-to-machine connections by 2019, nearly half of which are expected to be in the home applications, such as home automation, monitoring and tracking, and security and surveillance video.¹⁶ Open wireless strategies (Wi-Fi and other unlicensed technologies) already are dominant in a number of industries that are rapidly incorporating wireless connectivity, making up 70 percent of smart grid communications,

billion.” Comments of Consumer Federation of America, *In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Notice of Proposed Rulemaking, FCC 12-118, Docket No. 12-268 (January 25, 2013), at 2, 19 (updating key findings from its previously published study on the economics of Wi-Fi offloading).

¹⁴ Raul Katz, *Assessment of the Future Economic Value of Unlicensed Spectrum in the United States*, Telecom Advisory Services, (August 2014), at 28. Available at: <http://www.wififorward.org/wp-content/uploads/2014/01/Katz-Future-Value-Unlicensed-Spectrum-final-version-1.pdf>. Katz’s estimate of economic value included both consumer and producer surplus for residential Wi-Fi, Wi-Fi offloading from mobile devices, RFID and Wi-Fi only tablets. Katz also estimated that unlicensed operations contributed \$6.7 billion to the nation’s GDP in 2013, a contribution that will grow to \$13.5 billion by 2017. See also Raul Katz, *Assessment of the Economic Value of Unlicensed Spectrum in the United States*, Telecom Advisory Services, at 72 (February 2014).

¹⁵ Comments of Consumer Electronics Association, *Public Notice*, ET Docket No. 15-105, at 3, notes 6 and 7 (June 11, 2015) (“Comments of CEA”); see also Paul Milgrom, Jonathan Levin, and Assaf Eilat, *The Case for Unlicensed Spectrum*, at 19 (October 2011) (“Milgrom Study”) (estimating the economic value of the share of mobile data traffic carried by Wi-Fi to be at least \$25 billion annually), available at <http://web.stanford.edu/~jdlevin/Papers/UnlicensedSpectrum.pdf>.

¹⁶ *Cisco Visual Networking Index (VNI): Forecast and Methodology, 2014-2019*, supra note 8.

80 percent of wireless healthcare solutions, over 90 percent of wireless tablet connectivity, nearly all RFID inventory and asset tracking, as well as a growing share of the emerging Internet of Things.¹⁷ Using unlicensed spectrum, power companies have been able to deploy advanced smart grid solutions without vying for their own piece of spectrum – a cost prohibitive to most innovators. Thanks primarily to the availability of unlicensed spectrum at 900MHz, only one major provider in the smart grid market uses its own licensed spectrum.¹⁸ In contrast, Europe’s lack of an equivalent open wireless alternative to 900 MHz has resulted in only 15 percent wireless deployment (the rest uses wireline) – a situation that has stagnated the deployment of smart grid technology in European markets.¹⁹

Unlicensed spectrum as a public resource increasingly serves as an incubator of wireless innovation. Although Wi-Fi is the best known unlicensed standard, the expansion of unlicensed spectrum has also enabled other communications technologies, such as Bluetooth, ZigBee, z-Wave, Near Field Communication (NFC) and wireless HD connections, “technologies [that] have opened new frontiers of communications for consumers.”²⁰ In their valuation study, economists Milgrom and Levin observed that “the primary benefits of unlicensed spectrum may very well come from innovations that cannot yet be foreseen. ... [U]nlicensed spectrum is an enabling resource. It provides a platform for innovation upon which innovators may face lower barriers to bringing new wireless products to market.”²¹ Unlicensed spectrum is becoming the connective tissue of the emerging Internet of Things. Energy monitoring, environmental

¹⁷ See Yochai Benkler, *Open Wireless vs. Licensed Spectrum: Evidence from Market Adoption*, HARVARD J. LAW & TECHNOLOGY, Vol. 26, No. 1, at 72 (Fall 2012).

¹⁸ See *Id.* at 110. (“A single major provider in this market, Sensus, uses its own licensed spectrum. It serves 20% of the market”) (citations omitted).

¹⁹ See *Id.*, at 110-113.

²⁰ Comments of Consumer Electronics Association, *Revision of Part 15 in the 5 GHz Band*, ET Docket No. 13-49, at 7 (May 28, 2013).

²¹ See Milgrom Study, *supra* note 16, at 2.

monitoring and controls, mobile health care monitoring, industrial automation, intelligent transportation networks, and control systems (for agricultural machinery, toll booths, traffic lights) are all rapidly gaining users as costs decline.²² As the President’s Council of Advisors on Science and Technology (PCAST) observed in its 2012 report and recommendations, by 2020 “the connected device market is expected to be dominated not by mobile phones, as it is today, but by machine to machine (M2M) devices – as many as 50 billion of them by some estimates.”²³

The Public Interest Organizations concur with NCTA’s observation that underlying the tremendous spectral efficiencies, economic and social benefits of unlicensed technologies, and of Wi-Fi in particular, “is a history of careful and collaborative stewardship of shared frequency bands” through IEEE.²⁴ Coexistence features appropriate to a shared spectrum commons have led to worldwide Wi-Fi standards that promote spectrum re-use, open entry, decentralized investment and innovation. The Public Interest Organizations remain concerned that mobile carriers will have both the ability and strong incentives to aggregate General Authorized Access spectrum as a free adjunct to their licensed networks, initially as one-way Supplemental Down Link channels, both lowering their costs for licensed spectrum and for the first time letting them charge consumers for the use of unlicensed spectrum. Carriers deploying LTE-U will have the apparent option to adjust their access points to introduce just enough latency to frustrate consumer use of real-time applications over Wi-Fi and other unlicensed technologies, such as FaceTime video calling. Carriers would also have powerful incentives to use LTE-U to deter

²² See Thanki Study at 65.

²³ President’s Council of Advisers on Science and Technology, *Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth*, Report to the President, at 41 (July 2012) (“PCAST report”); see also Hans Vestberg, President and CEO, Ericsson, Address to Shareholders (April 13, 2010) (predicting 50 billion connected devices by 2020), available at <http://www.ericsson.com/thecompany/press/releases/2010/04/1403231>.

²⁴ Comments of National Cable & Telecommunications Association, *Public Notice*, ET Docket No. 15-105, at 1 (June 11, 2015) (“Comments of NCTA”).

mobile market entry by “Wi-Fi First” providers, such as wireline ISPs, a development that would also undermine intensive use of this breakthrough small cell band and harm a far wider range of small cell users, including community networks as well as individual business and household users.

III. The Record Shows that LTE-U Users Could Degrade the Public’s Use of Wi-Fi Unless Robust Coexistence Features are Added

As the Wireless Internet Service Providers Association (WISPA) and several other commenters explained, fair coexistence standards are built into Wi-Fi’s DNA – and without them it would not be such a boon to consumers and the economy.²⁵ Wi-Fi incorporates several distinct coexistence mechanisms, most notably features known as Listen Before Talk (LBT) and “exponential back-off.”²⁶ Wi-Fi and Bluetooth also include mechanisms to ensure they can fairly coexist with each other.²⁷ Although these features impose a higher “overhead” on Wi-Fi throughput, in the context of open spectrum shared by the public at large, this is more than offset by the fact that at low power many different users can coexist and occupy the same frequencies in a relatively small area – and without the need for centralized coordination or control. This “connectivity without permission” is a key ingredient in Wi-Fi’s success in spurring both innovation and massive deployments by individuals at the end points of the Internet.

In contrast, LTE-U/LAA is designed to be centrally controlled by a network anchored in a separate, *exclusively-licensed* frequency band. More troubling are the studies filed by commenters concluding that while 3GPP may ultimately design LAA in a manner that shares

²⁵ Wireless Internet Service Providers Association, *Public Notice*, ET Docket No. 15-105, (June 11, 2015) (“Comments of WISPA”) at 3.

²⁶ Comments of Google, Inc., *Public Notice*, ET Docket No. 15-105, (June 11, 2015) (“Comments of Google”) at 8; Comments of NCTA at 7-8, 16-17.

²⁷ Comments of Google at 4.

fairly with Wi-Fi and other unlicensed technologies, the version of LTE-U that U.S. carriers plan to deploy by next year coexists poorly with Wi-Fi:

- The technical study filed by Google found that LTE-U’s duty-cycled approach, along with its lack of a coexistence mechanism when Wi-Fi is received at a power level below -62 dBm, would substantially degrade Wi-Fi throughput. Google also finds a “potentially large impact of LTE-U on Wi-Fi latency,”²⁸ which could determine whether Wi-Fi can be viable as a competitive substitute to licensed carrier offerings.
- Broadcom’s testing, summarized in its comments, similarly found that unlicensed LTE would severely degrade Wi-Fi throughput, speeds, and latency (time delay) of packet delivery for real-time applications such as VoIP. Broadcom concludes that “the simulations demonstrate consistent degradation of VoIP unless LAA coexistence mechanisms are robust”²⁹
- NCTA’s comments summarizing testing by CableLabs similarly confirms that LTE-U/LAA significantly degrades consumer Wi-Fi throughput and latency.³⁰ “LTE-U’s duty cycling approach would, in effect, turn Wi-Fi’s own politeness [protocols] against it, causing Wi-Fi devices to conclude that there is significantly more traffic in the band than there truly is.”³¹

To be sure, unlicensed LTE proponents claim that their own simulations demonstrate that LTE-U and LAA can share effectively with Wi-Fi users.³² However, The Public Interest

²⁸ Nihar Jindal and Donald Breslin, “LTE and Wi-Fi in Unlicensed Spectrum: A Coexistence Study,” (2015) (“Google Study”), Attachment A to Comments of Google, at 20.

²⁹ Comments of Broadcom Corporation, *Public Notice*, ET Docket No. 15-105, at 4-5 (June 11, 2015) (“Comments of Broadcom”).

³⁰ Comments of NCTA at 19-22; Comments of Cablevision at 15-17; CableLabs, Impact of LTE in Unlicensed Spectrum on Wi-Fi (July 15, 2014), available at: <https://mentor.ieee.org/802.19/dcn/14/19-14-0037-02-0CUB-impact-of-lte-in-unlicensed-spectrum-on-wi-fi.pptx>.

³¹ Comments of NCTA at 19.

³² See Comments of T-Mobile USA, Inc., *Public Notice*, ET Docket No. 15-105, at 11 (June 11, 2015) (“Comments of T-Mobile”); Comments of Qualcomm Incorporated, *Public Notice*, ET Docket No. 15-

Organizations are concerned that the flaws in those simulation tests described by NCTA and Broadcom (among them, ignoring the impact on latency) suggest that considerably more transparent and collaborative testing will be needed before the Commission can be comfortable authorizing this new type of licensed-to-unlicensed equipment.³³ For example, Cisco notes that although loads on Wi-Fi channels can be highly dynamic, LTE-U “simulations demonstrating fair access to spectrum in the presence of LTE-U and Wi-Fi have focused on simpler and less dynamic use cases.”³⁴

With respect to 3GPP’s ongoing development of LAA, it is positive to see several commenters involved in that process reporting that the standard is likely to include “a specific Listen-Before-Talk protocol that is required in Europe and Japan.” Nonetheless, The Public Interest Organizations agree with Google’s conclusion that fair coexistence will be possible only if LAA implements LBT effectively, ideally through a consensus process with IEEE.³⁵ Unfortunately, the 3GPP standard-setting process does not appear to be on a course toward fair coexistence. As NCTA describes in detail, it appears that 3GPP is considering four optional approaches to coexistence, none of which would mandate the sort of LBT and back-off features that enable fair and widespread use of the unlicensed commons by Wi-Fi devices.³⁶

105, (June 11, 2015) at 17-19; Comments of Nokia (d/b/a Nokia Solutions and Networks US LLC) and Networks US LLC), *Public Notice*, ET Docket No. 15-105, (June 11, 2015) at 9-14.

³³ Comments of NCTA at 14-16; Comments of Cisco at 7. NCTA also cites an analysis by IEEE highlighting “numerous flaws in 3GPP’s method for simulating interference between LAA and Wi-Fi.” Comments of NCTA at 31, see Comments of NCTA at 30, note 48, E-mail to Dino Flore, 3GPP TSG RAN Chair, Qualcomm, et al. from Paul Nikolich Chairman, IEEE 802 LMSC (Mar. 13, 2015) <https://mentor.ieee.org/802-ec/dcn/15/ec-15-0025-00-00EC-3gpp-march-2015-liaison-1-final.pdf> (discussing the liaison statement regarding clarification of LBT categories).

³⁴ Comments of Cisco at 7.

³⁵ Google Study, *supra* note 29, at 21.

³⁶ Comments of NCTA at 7-9; *see also* Joey Padden, Lead Architect, CableLabs, “Wi-Fi v. EU LBT: Houston, We Have a Problem,” *CableLabs blog* (November 17, 2014) (“CableLabs November 2014 blog post”) available at: <http://www.cablelabs.com/wi-fi-vs-eu-lbt-houston-we-have-a-problem/>.

IV. Licensed Carriers have Strong Incentives to Engage in Anti-Competitive Behavior that is Contrary to the Coexistence of All Other Unlicensed Users

The IEEE's 802.11 family of contention-based coexistence standards give Wi-Fi chip and device makers, as well as operators, strong reasons to cooperate with one another, since degradation of performance in the unlicensed band harms everyone equally. Generally, in the unlicensed bands, Wi-Fi operators do not have an incentive to occupy a channel when not actively sending a signal, or to transmit for an overly long time interval, or to use a disproportionate amount of the shared bandwidth. Parties have a general interest in cooperating with each other. As Cablevision correctly observed: "The fact that Wi-Fi and other unlicensed technologies must transmit control data in the unlicensed channel makes politeness even more essential, because loss of control data due to interference has a particularly significant effect on network performance."³⁷

Of course, wireless carriers (and their equipment manufacturers) have a very different set of economic incentives when it comes to aggregating unlicensed spectrum as an adjunct to their licensed spectrum. Unlicensed LTE appears designed to deliver three advantages to licensed carriers at a time when they face both a shortage of costly licensed spectrum (relative to consumer data demand) and the competitive threat of increasingly ubiquitous and inexpensive Wi-Fi connectivity.

First, LTE-U/LAA provides additional free spectrum capacity to carrier networks built on licensed spectrum. Even better, because the control channel is anchored in licensed spectrum, preferred access to the public spectrum commons still is exclusive to license holders, but free from the sort of payments associated with spectrum auctions or secondary market purchases.

³⁷ Comments of Cablevision at 11.

Second, mobile operators can begin to monetize data traffic on this free unlicensed spectrum, since consumers will in many cases no longer be able to distinguish between being on licensed and unlicensed spectrum. Carrier-sold devices that today are designed to default to Wi-Fi, which is a tremendous benefit to consumers who would otherwise exceed their data caps, will likely be designed or controlled by carriers to default to the carrier network and higher-priced connectivity. Consumers may no longer be able to clearly see or have a choice concerning whether their mobile device data traffic is carried over the carrier network or, alternatively, via Wi-Fi over a wireline LAN at home, at work, or in a public space at no marginal cost. Consumers will bump up against pricey data caps more quickly – and be deterred from high-bandwidth applications more readily, particularly harming younger users and those with lower incomes.

Third, as Cablevision bluntly observes, even as carriers expropriate the commons, “they simultaneously degrade competing services that operate in the same unlicensed spectrum and use Wi-Fi technology.”³⁸ As the competitive threat from “Wi-Fi First” and “Wi-Fi Only” mobile providers intensifies, licensed carriers will have increasing incentives to control or contaminate the high-capacity unlicensed bands, including the newly-allocated General Authorized Access spectrum in the 3.5 GHz band.

Moreover, as Google and other commenters explained, “LTE-U and LAA operators will have an exclusive, licensed spectrum option that allows them to minimize or entirely avoid the ill-effects of poor coexistence” on unlicensed bands.³⁹ Because LTE-U and LAA are anchored in licensed spectrum and are not required to use coexistence protocols, mobile operators do not face

³⁸ Comments of Cablevision at 9-10 (“Since the licensed carriers cannot foreclose competition by *buying* unlicensed spectrum, they can exclude rivals’ use of that spectrum by consuming it.”)

³⁹ Comments of Google at 9; *see also* Comments of NCTA at 1; Comments of Cablevision at 11 (“by insulating important LTE control functions in licensed spectrum, LTE-U and LAA operators [are] less susceptible to interference in the unlicensed bands than [are] unlicensed technologies”).

a risk of interference from other unlicensed users.⁴⁰ Licensed operators can shift traffic back onto their exclusive-use spectrum if necessary. Carriers using LTE-U/LAA have also put a premium on coordinating among themselves to minimize interference to one another on the unlicensed bands (clear channel selection), but not with standalone unlicensed users, including Wi-Fi.⁴¹

To further understand the motivations at work, the Commission need go no further than the joint 3GPP submission (3GPP R1-152374) by twelve major mobile carriers and OEMs – including T-Mobile and China Mobile – asserting their determination that LAA should not be allowed to operate in a standalone mode that would allow competitors, or the public at large, to commoditize the technology and disintermediate the carriers.⁴² “Standalone deployment in unlicensed spectrum implies drastically different business models from nowadays and might impact the value chain” and risk the “possible disintermediation of cellular operators,” the carriers stated.⁴³ Indeed, T-Mobile and its brethren are seeking to prevent unlicensed LTE from having precisely the sort of open, interoperable and accessible qualities that have made Wi-Fi a boon to consumers and the economy.

The Public Interest Organizations are particularly concerned about this effort to anchor the control channel for LTE use of unlicensed spectrum in a licensed band, effectively preserving any benefits of the technology only for traditional wireless carriers purchasing access to licensed

⁴⁰ See Comments of Cablevision at 11 (“The fact that WiFi and other unlicensed technologies must transmit control data in the unlicensed channel makes politeness even more essential, because the loss of control data due to interference has a particularly significant effect on network performance”).

⁴¹ See Comments of T-Mobile at 12 (LTE-U’s channel selection in the unlicensed spectrum is based on “avoiding the channels with strong LTE-U links of other operators to the maximum extent possible”); Comments of NCTA at 18; see also Comments of NCTA at 15, note 31, citing Huawei, *U-LTE: Unlicensed Spectrum Utilization of LTE*, at 3, available www.huawei.com/ilink/en/download/HW_32780.

⁴² See Comments of NCTA at 33-34; Comments of Wi-Fi Alliance at 9-10; see also Comments of T-Mobile at 12 (“Operation of LTE-U will not be possible without a licensed carrier”).

⁴³ 3GPP Working Group 1, 3GPP Working Group 1, *WF on Precluding Standalone Access of LTE on Unlicensed Carrier*, 3GPP TSG RAN, slide 2 (April 20-24, 2015), available at: http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_80b/Docs/R1-152374.zip.

spectrum.⁴⁴ On this point, our groups concur with NCTA that “[n]ot only have licensed carriers skirted the standards process to avoid constructive input from other industry groups . . . the carriers have intentionally created an unlicensed protocol that excludes non-licensees.”⁴⁵

Another challenge in addressing LTE-U/LAA will be that carriers can embrace coexistence mechanisms, to a degree, while still using the technology for anti-competitive purposes that harm consumers. As several commenters explained and demonstrated in their technical studies, unlicensed LTE (whether LTE-U or LAA) need not completely jam or severely degrade Wi-Fi in order to ensure that unlicensed bands cannot be used as a close substitute for carrier services. Even if home, business and school Wi-Fi networks are able to continue operating, poor coexistence features can increase latency (packet delay), jitter, packet loss and/or reduce throughput just enough that Wi-Fi networks would become unable to support real-time applications such as video, voice calling, and real-time gaming.⁴⁶

As a number of commenters observed, even if LTE-U and/or LAA incorporates sharing mechanisms in its standard, “these are all optional and carriers have little incentive to employ them in an effective manner.”⁴⁷

The Public Interest Organizations agree with Google (and other commenters) that an unlicensed spectrum user with incentives so utterly at odds with all other unlicensed users “is particularly worrisome inasmuch as licensed mobile operators may view some Wi-Fi providers, such as cable companies offering Wi-Fi hotspots to their customers, as competitors.”⁴⁸ Wi-Fi is clearly poised to offer direct competition to a steadily consolidating and effectively

⁴⁴ See CableLabs, blog post (November 2014).

⁴⁵ Comments of NCTA at 35.

⁴⁶ Comments of NCTA at 26; Comments of Microsoft Corporation, *Public Notice*, ET Docket No. 15-105, at 1 (June 11, 2015) (“Comments of Microsoft”).

⁴⁷ Comments of NCTA 23.

⁴⁸ Comments of Google at 9. See also Comments of Cablevision at 8-10.

uncompetitive mobile carrier market.⁴⁹ For example, Cablevision has leveraged its wireline assets and 1.6 million Wi-Fi hotspots (by year end) to launch Freewheel, a service that relies entirely on Wi-Fi and offers unlimited voice, data and text to customers for \$10 per month.⁵⁰

“Wi-Fi-first” offerings in the U.S. remain nascent. In France however, wireline broadband provider Iliad disrupted the French mobile carrier market by turning four million of its residential urban and suburban customers into Wi-Fi hotspots and launching Free Mobile. Free Mobile pushes customers primarily onto its fixed network via Wi-Fi, as Cablevision’s Freewheel does, but with licensed cellular service as a back-up (as MVNO providers such as Republic Wireless, FreedomPop, Scratch Wireless and, most recently, Google’s ProjectFi are doing now in the U.S.).⁵¹

The Public Interest Organizations also agree with Cablevision that although licensed carriers have an economic incentive to use LTE-U to undermine potentially disruptive competition from “Wi-Fi First” providers, the real disruption caused by LTE-U and LAA would be to consumers who rely more and more on Wi-Fi to make wireless Internet access faster and more affordable.⁵² As Cablevision correctly states, “[t]he emergence of these [Wi-Fi-based] competitors makes it easier for subscribers to licensed carriers to use their dual-mode devices,

⁴⁹ See, e.g., Paul Barbagallo and Tim McElgunn, “WiFi, Once a Lifeline for Mobile Carriers, Is Now a Threat,” *Bloomberg BNA* (May 28, 2014), available at: <http://www.bna.com/wifi-once-lifeline-n17179890780/>; Michael Calabrese, *Solving the ‘Spectrum Crunch’: Unlicensed Spectrum on a High Fiber Diet*, Time Warner Cable Research Program on Digital Communications (Fall 2013).

⁵⁰ Comments of Cablevision at 2.

⁵¹ See Om Malik, “How France’s Free Will Reinvent Mobile,” *GigaOm* (January 9, 2012), available at <http://gigaom.com/2012/01/09/how-frances-free-will-reinvent-mobile/>. “We will go to wide area network (3G and 2.5G) when we are not in Wi-Fi coverage,” Iliad and Free.fr founder Xavier Neil told Malik. “We are trying to be the cheapest mobile service in France.” See also Kevin Fitchard, “Free Mobile Corners 5.4 percent of France’s Mobile Market in 6 Months,” *GigaOm* (August 31, 2012), available at <http://gigaom.com/2012/08/31/free-mobile-corners-5-4-of-frances-mobile-market-in-6-months/>.

⁵² Comments of Cablevision at 2.

such as handsets and tablets, to reduce their reliance on high-priced licensed service, or to avoid exceeding the data caps that often govern licensed service offerings.”⁵³

This anti-competitive counterattack against Wi-Fi as a carrier substitute is particularly acute and immediate with respect to LTE-U. LTE-U is designed specifically for two economies, the U.S. and Japan, without a coexistence or fair share requirement.⁵⁴ Indeed, as Wi-Fi Alliance explains, the *Public Notice* inaccurately characterizes LTE-U as a “pre-standard” version of LAA.⁵⁵ In fact, the use of LTE on unlicensed bands being promoted by the LTE Forum is a proprietary system using an approach that has already been explicitly rejected by 3GPP, which is developing LAA as a technology that will comply with the requirements in place in Europe and in all but a few countries (such as the U.S.). Those standards make use of a polite protocol that fairly allocates available bandwidth a prerequisite for use of the commons.⁵⁶ As Cisco and other commenters observe, the LTE-U specification does not include use of “Listen Before Talk” technology.⁵⁷

WISPA is correct that since LTE-U is designed exclusively to harness unlicensed bandwidth for carrier Supplemental Down Link (SDL), and has no in-band uplink, “it is a one-way transmission – basically the equivalent of a broadcast technology.”⁵⁸ LTE-U specifications also enable individual mobile carriers to choose to set the length of a single transmission at more than 50 milliseconds, to maximize LTE-U’s average throughput. By comparison, Wi-Fi transmissions are generally less than 1 millisecond, and usually no more than 4-5 milliseconds,

⁵³ Comments of Cablevision at 9.

⁵⁴ Comments of Google at 4; Comments of NCTA at 13.

⁵⁵ Comments of Wi-Fi Alliance at 7-8.

⁵⁶ See Comments of Cisco at 6, noting that the ETSI Broadband Radio Access Network (BRAN) committee is developing a set of minimum “fairness” requirements for 5 GHz access in Europe.

⁵⁷ Comments of Cisco at 7.

⁵⁸ Comments of WISPA at 3.

“putting an emphasis on fairness over performance.”⁵⁹ As a result, multiple LTE-U/LAA transmitters [or carriers] can “‘blanket’ an entire unlicensed band, effectively hijacking them.”⁶⁰

Moreover, several commenters note that one of the three mechanisms that LTE-U will purportedly use to effectively share unlicensed spectrum – clear channel selection – seems more likely to worsen interference to Wi-Fi by spreading competing LTE-U users across the various available channels.⁶¹ In addition, even when there is no data to send, carriers deploying LTE-U on their licensed bands “could occupy a channel and continuously transmit to dominate the channel and be in full compliance with LTE-U.”⁶²

V. The Purchase of Licensed Spectrum Must not Confer Superior Rights to Access and Use Unlicensed Spectrum

The Public Interest Organizations are particularly concerned that both LTE-U and LAA are designed to be centrally controlled by a network anchored in a separate, *exclusively-licensed* frequency band. If deployed, LTE-U and LAA will be radically different from any current unlicensed technology, all of which operate wholly in unlicensed spectrum on a standalone basis. As T-Mobile states candidly in its comments, “[o]peration of LTE-U will not be possible without a licensed carrier.”⁶³ This effectively limits any benefits of the technology to traditional wireless carriers purchasing access to licensed technology.⁶⁴ Moreover, as noted above, T-Mobile has joined with other mobile operators and OEMs pushing hard at 3GPP against any standard that

⁵⁹ Comments of Cisco at 7.

⁶⁰ Comments of WISPA at 4.

⁶¹ See Comments of NCTA at 10; Comments of T-Mobile at 9-10 (explaining that both LTE-U and LAA will use “Channel Selection” to “select the ‘cleanest’ channel based on Wi-Fi and LTE measurements”).

⁶² Comments of NCTA at 11; see also Comments of Cisco at 7-8 (“When a scheduled system (like LTE-U) attempts to interact with a carrier sense system (like Wi-Fi), there is a temptation to ‘pre-reserve’ the wireless medium for the scheduled system by transmitting unneeded energy to essentially hold the channel . . .”).

⁶³ Comments of T-Mobile at 12.

⁶⁴ CableLabs, blog, post (November 2014).

would allow LAA to operate in a standalone mode that might allow competitors, or the public at large, to use the technology free from carrier control and thereby “disintermediate[e] cellular operators.”⁶⁵

The Public Interest Organizations agree with the concerns expressed by Microsoft and other commenters that “any technology that makes use of a licensed control channel will use that channel to give it a priority access to the medium, and [in the case of LTE-U/LAA] degrade the performance of services delivered over Wi-Fi and other technologies that rely exclusively on unlicensed spectrum.”⁶⁶ For that reason, Google is correct in asserting that the Commission must consider the possibility that “[u]ltimately, access to licensed frequencies could become a *de facto* prerequisite for successful use of the unlicensed spectrum where license-anchored services operate.”⁶⁷ Such an outcome would not only foreclose competition from “Wi-Fi First” market entrants, such as cable companies or other firms leveraging sunk costs in wireline assets, but could also foreclose the ability of many individual firms, retail outlets, municipalities, schools, libraries, community groups and even some individual homeowners and apartment dwellers to “disintermediate” the wireless industry owners holding exclusive government licenses for mobile spectrum. “Connectivity without permission” – the hallmark of the Wi-Fi revolution – could be snuffed out if the Commission effectively concurs in giving license-anchored carrier networks superior rights to occupy and exclude others from fair use of unlicensed spectrum wherever it best serves such licensees’ business strategy.

The Public Interest Organizations believe that a failure to require “rules of the road” that require coexistence and fair sharing among unlicensed broadband technologies would represent

⁶⁵ See Comments of NCTA at 33-34; Comments of Wi-Fi Alliance at 9-10; *see also* Comments of T-Mobile at 12 (“Operation of LTE-U will not be possible without a licensed carrier.”).

⁶⁶ Comments of Microsoft at 1.

⁶⁷ Comments of Google at 9.

an even greater tragedy of the unlicensed commons if it led to less intensive use of unlicensed bands overall. The Commission needs to consider that although mobile carriers are likely to deploy LTE-U and LAA on a targeted basis initially, mostly in dense urban areas, any widespread disruption of Wi-Fi in those places will have, over time, a far larger negative impact on consumers and the unlicensed economy in general. Firms and individuals will be deterred from purchasing or operating Wi-Fi access points or networks if unlicensed LTE creates persistent uncertainty about whether the devices and networks will be reliable enough to justify the cost. Chip and equipment upgrades could slow down. Some smartphones and other mobile devices sold through carriers might stop including a Wi-Fi chip or, as noted above, change the default in the device so that consumers are pushed onto the carrier's LTE-U or LAA unlicensed bandwidth, causing consumers to be billed for data offload over unlicensed spectrum that was previously available at no marginal cost (at least where the underlying wireline network was already provisioned).

Any diminution in the current trend toward more pervasive and intensive *public* use and control over Wi-Fi and other unlicensed technologies would be particularly perverse because the comments and studies in the record suggest that LTE-U could be grossly *inefficient* when viewed from the perspective of spectrum re-use, consumer welfare and the public interest. The *Public Notice* notes the claims of LTE-U proponents that LTE technology is more efficient than Wi-Fi and other unlicensed technologies.⁶⁸ However, it is crucial to bear in mind that the “efficiency” of a technology designed for exclusively-licensed spectrum, with a single licensee managing the allocation of all time slots, is entirely different from the “efficiency” of the commons. As the Wi-Fi Alliance explains in its comments, not only is this statement unproven, but the dominance of

⁶⁸ *Public Notice* at 1 (“[o]thers have asserted that LTE-U and LAA are more efficient than other currently available unlicensed technologies . . .”).

unlicensed bands by a license-anchored technology under the control of a small number of companies could harm consumers far more than it benefits them. “The efficient use of unlicensed spectrum by technologies such as Wi-Fi is due in large part to the fact that unlicensed technologies were designed from the start to operate in an unpredictable, unmanaged, radio environment.”⁶⁹

In other words, precisely because of open entry, contention-based protocols and consumer willingness to endure “best effort” connectivity in exchange for affordability and the freedom to connect as they please, the unlicensed bands very intensively use and re-use spectrum far more efficiently than any other bands of spectrum. As the FCC’s Ruth Milkman observed near the end of her tenure as Chief of the Wireless Telecommunications Bureau, the aggregate capacity of the world’s Wi-Fi networks “is 28 times greater than the capacity of the world’s 3G and 4G networks, which use licensed spectrum.”⁷⁰

VI. Qualcomm has Incentives to Resist IEEE Collaboration on Standards and to Foreclose Rival Chip Manufacturers and Competing “Wi-Fi First” Operators

As the Commission well knows from its experience with 700 MHz interoperability, carriers and manufacturers will adopt 3GPP standards globally to achieve economies of scale. The company driving development of LTE-U and LAA, Qualcomm, has strong patent licensing incentives to promote licensed carrier-based unlicensed technologies in a manner that crowds out or disadvantages Wi-Fi deployments.⁷¹ Qualcomm holds patents on both Wi-Fi and LAA,⁷² but

⁶⁹ Comments of Wi-Fi Alliance at 6.

⁷⁰ “WTB Chief Ruth Milkman’s Remarks at Georgetown Spectrum Policy Workshop,” Federal Communications Commission, transcript (June 14, 2013), at 2, *available at* <http://www.fcc.gov/document/wtb-chief-ruth-milkman-remarks-georgetown-spectrum-policy-workshop>.

⁷¹ By all accounts, Qualcomm is heavily invested in patent licensing. The U.S. Patent and Trademark Office reports over 20,000 patents and patent applications owned by Qualcomm, while in 2014 Qualcomm reported its patent licensing arm made over \$7.5 billion in revenue.

the restrictions on licensing for each of those technologies is different, with LAA being much more favorable to Qualcomm. Both technologies are standardized by standard-setting organizations, IEEE and 3GPP respectively, and each organization requires participants in the standard-setting process to declare to the organization any patents essential to implementing the standard and then to license those patents on “fair, reasonable and non-discriminatory” (FRAND) terms to anyone wishing to implement the standard.⁷³ But each standard-setting organization determines what constitutes FRAND licensing terms, and 3GPP would give Qualcomm much more freedom than IEEE to engage in licensing practices that maximize Qualcomm’s interests.

IEEE maintains a strong, specific FRAND licensing policy. Based on its goal of “widespread adoption” of its standards,⁷⁴ the IEEE places clear requirements on holders of standard-essential patents, for example preventing them from pursuing a “Prohibitive Order” against potential infringers and specifying conditions on what constitutes a “Reasonable Rate” for patent royalties.⁷⁵ Indeed, the IEEE continues to review its patent licensing policy in view of

Qualcomm, 2014 Annual Report on Form 10-K, *available at* <http://investor.qualcomm.com/secfiling.cfm?filingID=1234452-14-320&CIK=804328>.

⁷² Qualcomm 10-K, *supra* note 1, at 7-8.

⁷³ When a company develops a new technology and wishes that technology to be incorporated into a standard, the standards-setting organization often imposes a requirement: the company must guarantee that it will fairly license any patents covering that technology. This is a basic bargain: the company gets widespread adoption of its technology, in exchange for the company agreeing to lower license fees on patents to that technology. This bargain is known as a “fair, reasonable and non-discriminatory,” or FRAND, license obligation.

⁷⁴ Brief of *Amicus Curiae* IEEE in Support of No Party at note 14, *Ericsson, Inc. v. D-Link Sys., Inc.*, Nos. 13-1625, -1632, -1532, -1633 (Dec. 20, 2013), *available at* <http://essentialpatentblog.wp.lexblogs.com/wp-content/uploads/sites/234/2014/01/2013.12.20-67-Brief-of-Amicus-Curiae-of-IEEE.pdf>.

⁷⁵ Approved Clause 6 of the IEE-SA Standards Board Bylaws (2015), <http://standards.ieee.org/develop/policies/bylaws/approved-changes.pdf>.

changes in the law and stakeholder concerns, and earlier this year amended its policy in that regard.⁷⁶

In contrast, 3GPP maintains no patent policy of its own, instead deferring to the policies of its member organizations, primarily the European Telecommunications Standards Institute (ETSI), whose patent policy is substantially less rigorous. The ETSI policy only obligates holders of standard-essential patents to license on FRAND terms, without giving particular definitions or conditions as the IEEE policy does.⁷⁷ Furthermore, the ETSI policy allows companies like Qualcomm to deny patent licenses to chipmakers and only offer licenses to users of those chips, despite the “non-discriminatory” component of the licensing requirement.⁷⁸

Consequently, a major patent-holding company like Qualcomm would stand to make more licensing revenues, block more competitors, and monopolize more strongly a field based on a standard promulgated by 3GPP than based on one by IEEE. Patent licensing thus creates an incentive for pushing for greater adoption of LAA, the 3GPP standard, and inhibiting use of Wi-Fi, the IEEE standard. Indeed, Qualcomm has already declared that it is pulling itself out of the Wi-Fi standard-setting process in view of IEEE’s amended patent policy, saying that it “will not make licensing commitments under the new policy.”⁷⁹

⁷⁶ Press Release, *Public Knowledge Applauds IEEE Vote to Rein In Standards-Essential Patent Abuse* (Feb. 10, 2015), <https://www.publicknowledge.org/press-release/public-knowledge-applauds-ieee-vote-to-rein-in-standards-essential-patent-a>.

⁷⁷ ETSI Rules of Procedure, Annex 6: ETSI Intellectual Property Rights Policy (Nov. 19, 2014), <http://www.etsi.org/images/files/IPR/etsi-ipr-policy.pdf>.

⁷⁸ *Id.* at 42 (applying RAND requirements only to devices “fully conforming” to a standard).

⁷⁹ See Susan Decker and Ian King, “Qualcomm Says It Won’t Follow New Wi-Fi Rules on Patents,” Bloomberg News, February 11, 2015, *available at* <http://www.bloomberg.com/news/articles/2015-02-11/qualcomm-says-new-wi-fi-standard-rules-unfair-may-not-take-part>.

VII. Recommendation and Conclusion

The Public Interest Organizations agree with the many commenters opining that ideally the standards organizations – 3GPP and IEEE 802.11 – should begin collaborating on a consensus approach to fair sharing, including robust coexistence mechanisms.⁸⁰ Our groups agree that the Commission should closely monitor the 3GPP process and encourage such collaboration and consensus. But if these efforts fail, The Public Interest Organizations strongly agree with Microsoft that “the Commission has a role to play as a convener, a facilitator, and as a regulatory backstop.”⁸¹

Indeed, while the Commission can continue to monitor and encourage a consensus on strong coexistence mechanisms in the LAA standards process, it appears that a reliance on a multi-stakeholder standards process that includes both licensed and unlicensed interests (3GPP and IEEE, respectively) is no longer relevant to LTE-U. The Wi-Fi Alliance notes that “the LTE-U Forum is no longer active” since its work is considered complete.⁸² If true, then The Public Interest Organizations agree with Cisco that, with respect to LTE-U, the Commission needs to expressly examine a number of coexistence features and issues that could be contributing to the testing results reported in the comments filed by Broadcom, Google and NCTA (noted above).⁸³ Our groups further agree with Cisco that the Commission’s mandate of “good engineering

⁸⁰ See, e.g., Comments of Broadcom at 2 (“[t]here is no formal role for IEEE.802.11 in the 3GPP process . . . but strong collaboration and close coordination between 3GPP and IEEE is necessary”).

⁸¹ Comments of Microsoft at 2.

⁸² Comments of Wi-Fi Alliance at 8.

⁸³ Comments of Cisco at 7-8 (raising questions including whether LTE-U will deploy equipment without LBT, the ability of operators to set transmission durations to 50 milliseconds or more, whether operators can choose to “pre-reserve” unlicensed spectrum by continuing to transmit energy to hold the channel, etc.).

design”⁸⁴ incorporates “the concept that all technologies must have a fair and reasonable opportunity to contend for unlicensed spectrum.”⁸⁵

More generally, The Public Interest Organizations support the recommendations suggested by NCTA, which urge the Commission to: “(1) convene a meeting of the Chief of the Office of Engineering and Technology and a representative group of licensed carriers and the unlicensed community to initiate a process to establish effective sharing mechanisms; (2) establish a working group composed of Commission staff and engineers from interested parties to carry forth this work after this initial meeting in weekly meetings; (3) seek monthly status reports from IEEE and 3GPP on the progress of coordination between these bodies on establishing effective sharing; and (4) ensure that licensees do not launch non-standard version of LTE-U until these processes have been completed to the Commission’s satisfaction.”⁸⁶ The Public Interest Organizations further recommend that the Commission also consider, as part of this collaborative process, seeking agreement among the parties for public and transparent testing of first LTE-U and later LAA equipment under a variety of Wi-Fi deployment scenarios, as well as in connection with Bluetooth and other unlicensed technologies.

Just as the Commission has adopted strong rules to preserve and nurture the Internet’s core value of “innovation without permission,” the Commission should preserve the collaborative culture of “connectivity without permission” on the open and shared unlicensed bands that have proven so valuable to innovation, free speech and the U.S. economy. The slogan “technological neutrality” must not become a glib rationale for technology designed to make access to licensed frequencies a *de facto* prerequisite for successful use of unlicensed spectrum where license-anchored services operate. Although a process of multi-stakeholder consensus on

⁸⁴ 47 C.F.R. Section 15.15(a).

⁸⁵ Comments of Cisco at 8.

⁸⁶ Comments of NCTA at 36.

robust coexistence mechanisms may well result in future standards for LAA, or even for a standalone version of Unlicensed LTE, that share fairly with Wi-Fi and other existing unlicensed technologies, the FCC must be prepared to act as a regulatory backstop. While The Public Interest Organizations agree that the Commission should avoid specifying particular coexistence technologies, it is entirely consistent with “technological neutrality” for the Commission to impose general “rules of the road” that mandate coexistence capabilities, just as the agency does with other operating parameters that impact other users (such as power and out-of-band emission levels).

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