Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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

COMMENTS OF CABLEVISION SYSTEMS CORPORATION

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June 11, 2015

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I. INTRODUCTION

The Commission's Public Notice, inquiring about the threat of *licensed* carrier deployment of LTE-Unlicensed ("LTE-U") and LTE-Licensed Assisted Access ("LAA") on millions of WiFi consumers and competing WiFi services using *unlicensed* bands, asks the right questions at the right time. The proposed deployment by the licensed carriers of LTE-U and LAA—which lack the effective sharing mechanisms that have powered the success of WiFi—threatens to substantially diminish the quality and usability of unlicensed spectrum in America, eliminating a viable customer alternative to the licensed carriers for wireless broadband service.

Millions of consumers use WiFi in the unlicensed spectrum bands every day. They depend on a growing array of devices—including computers, tablets, handsets, and new technologies soon to come with the advent of the Internet of Things—that connect to each other in public spaces, businesses, and homes. Billions of these consumer devices successfully coexist in unlicensed spectrum because WiFi has sharing built into its DNA. Deploying LTE-U and LAA before carriers develop a coexistence strategy therefore threatens millions of WiFi consumers and the competing services that rely on unlicensed spectrum.

Unlicensed spectrum is a crucial platform for American innovators who rely on WiFi's low barriers to entry to develop and deploy new products and services that foster competition and benefit the American public and businesses. Increased use of unlicensed spectrum begets more innovation, and today, we are witnessing an exponential proliferation of devices, services, and tools that rely on WiFi entirely and do not depend on the cellular providers as wireless broadband gatekeepers.

No service provider has done more to expand the availability and relevance of WiFi to its customers than Cablevision. Beginning in 2007, Cablevision launched "Optimum WiFi," a

network of outdoor and indoor WiFi hotspots located across its service area in New York, New Jersey, and Connecticut. This network will reach 1.6 million hotspots by the end of this year. Optimum WiFi is free, fast, and unlimited for Cablevision's customers. Densely deployed in urban, exurban, outdoor, and indoor locations, Optimum WiFi gives customers the convenience of wireless access to the applications and entertainment they want outside of the home, but allows them to avoid the punishing fees, penalties, and confusion of cellular data offerings. Recent network upgrades have made Optimum WiFi more consistent, available, reliable, and capable—able to maintain session continuity for video, VoIP, and other applications across the network at high speed and low latency. Optimum WiFi is engineered to offer a superior consumer experience when compared to cellular-based data offerings. This capability has resulted in an explosion of use: average customers use Optimum WiFi to consume about 2 GB of data each week.

This spring, Cablevision launched Freewheel, a WiFi-only calling service. Freewheel offers unlimited voice, data, and text to customers for less than $10 a month, providing a competitive, low-cost alternative to the plans offered by the dominant licensed carriers. But competitive data and voice products like Optimum WiFi and Freewheel—and those of other competitors—depend on unlicensed spectrum as an essential input.

The licensed carriers may dismiss WiFi's potential as a full substitute for cellular, but increasingly, they are aware that it gives their customers choice.[1] In this context, the introduction of LTE-U and LAA without coexistence technologies is therefore a threat not only to consumers' WiFi devices, but also to the disruptive competition provided by Cablevision and

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[1] *See* Paul Barbagallo and Tim McElgunn, *WiFi, Once a Lifeline for Mobile Carriers, Is Now a Threat*, Bloomberg Bureau of Nat'l Affairs (May 28, 2014), http://www.bna.com/wifi-once-lifeline-n17179890780/ ("WiFi, Once a Lifeline for Mobile Carriers, Is Now a Threat").

other "WiFi-first" providers that depend on access to unlicensed spectrum. But, to be abundantly clear, the potential disruption caused by LTE-U and LAA is to the *consumer*. The WiFi ecosystem is long established as a consumer-accessible communications medium, and *industries* must respect and preserve this medium.

The deployment of LTE-U and LAA by licensed carriers merits the Commission's special attention, because licensed carriers have an economic incentive to use LTE-U and LAA not only to advance their own service capability, but also to undermine new WiFi-powered competition. If carriers can use their licensed spectrum to exploit unlicensed bands while simultaneously polluting those bands for others, they will have expanded their resources and depleted the resources of a new competitor.

Current plans for LTE-U and LAA suggest that their proponents are doing exactly this. By skirting the normal standards-setting process and refusing to employ industry-standard sharing mechanisms, a group of manufacturers and licensed carriers is poised to deploy LTE-U in a way that will significantly undermine WiFi. And while the proponents of LTE-U and LAA pay lip service to the need to share spectrum with the unlicensed technologies consumers rely on, their standard for "coexistence" prefers LTE-U and LAA and leaves other technologies to contend with what is left. Indeed, even with gigabit WiFi capabilities becoming a reality as the Commission makes available new unlicensed spectrum suited for WiFi, the proponents of LTE-U and LAA consider sharing "fair" so long as WiFi can deliver 4 MB/s[2]—a fraction of what consumers are enjoying today and an insult to WiFi's near-term potential. Cablevision welcomes the Commission's attention to the threat posed to consumers and competition.

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[2] LTE-U FORUM, *LTE-U SDL Coexistence Specifications* (Feb. 2015), http://www.lteuforum.org/uploads/3/5/6/8/3568127/lte-u_forum_lte-u_sdl_coexistence_specifications_v1.0.pdf ("LTE-U SDL Coexistence Specifications").

Commission oversight must ensure that the traditional standards-setting process produces *effective* sharing between LAA and WiFi—and that non-standard LTE-U deployments do not undermine the public interest before coexistence mechanisms are in place. If oversight proves inadequate, the Commission must step in to ensure that carriers do not use their FCC licenses to unjustly and unreasonably disrupt consumer services and products and undermine competition.

II. CABLEVISION IS A WIFI INDUSTRY LEADER, AND A COMPETITOR TO LICENSED MOBILE SERVICES

WiFi has grown to become a central part of the American economy. It allows millions of U.S. consumers to access information and entertainment wirelessly both in and outside of their homes. American employees and customers of businesses of all sizes can now connect easily in the office and out. And unlicensed spectrum is a crucial tool for American innovators who rely on WiFi's low barriers to entry to develop and deploy new products and services.

Today more than 63% of American homes have WiFi networks,[3] which consumers use both to maximize the value of other services and to provide a platform for cutting-edge new technologies. This figure is expected to increase even further to 86% by 2017.[4] Consumers use WiFi to deliver bandwidth-intensive content like streaming video—putting an end to the days when television and Internet access were tethered to a customer's physical cable Internet connection. Consumers also rely on WiFi for latency-sensitive applications such as online gaming and real-time voice and video communications. And the unlicensed bands form the

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[3] WIFIFORWARD, *New Study Released by WifiForward Finds Unlicensed Spectrum Generated $222 Billion in Value to the U.S. Economy in 2013 and Contributed $6.7 Billion to U.S. GDP* (Feb. 10, 2015), *available at* http://www.wififorward.org/wp-content/uploads/2014/01/Value-of-Unlicensed-Spectrum-to-the-US-Economy-overview.pdf.

[4] *Id*.

basic infrastructure for cutting-edge technologies such as the Internet of Things, including technologies like ZigBee and product lines like Philips Hue smart lighting and Nest thermostats.

Unlicensed technologies also provide consumers with the opportunity to save money by offloading traffic from costly mobile data plans provided by traditional licensed carriers.[5] Forty-six percent of all mobile data traffic globally was offloaded onto WiFi in 2014, and this share is expected to continue growing.[6] WiFi offloading alone generates $12.6 billion in value for consumers, and contributes $3.2 billion annually to the GDP of the United States.[7]

Cablevision has promoted and expanded WiFi's value to its customers. Indeed, as it has in many other American businesses, WiFi has come to play a crucial role in the products and services that Cablevision's customers enjoy every day. First, every Cablevision Optimum Internet subscription includes a free WiFi router. Customers use this free router—or, if they prefer, their own WiFi router—to access their Optimum service throughout their homes. WiFi use in the home—its deployment, support, troubleshooting, and expansion—is now a key element of Cablevision's service proposition. Part of that value is manifest in the "Optimum App." The Optimum App allows customers to watch all of the live and on-demand content included in their cable television package, browse television listings using an advanced channel

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[5] As the Cisco Visual Networking Index explains: "For users with fixed broadband and Wi-Fi access points at home, or for users served by operator-owned femtocells and picocells, a sizable proportion of traffic generated by mobile and portable devices is offloaded from the mobile network onto the fixed network . . . . Offloading occurs at the user/device level when one switches from a cellular connection to Wi-Fi/small-cell access."

[6] CISCO, *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2014–2019 White Paper*, at 2, 22 (Feb. 3, 2015), http://www.cisco.com/c/en/us/solutions/collateral/s ervice-provider/visual-networking-index-vni/white_paper_c11-520862.pdf ("Cisco Visual Networking Index Global Traffic Forecast Update").

[7] *Id*.

guide, and schedule DVR recordings anywhere in the home using an IP-enabled device—all over WiFi. This complements all the other in-home WiFi applications and devices, including high-definition video streaming on Netflix and Apple TV (and others), multiplayer gaming, and other Internet-based services like automated thermostats, security systems, video cameras and monitors, and other devices that knit together the connected home.

Second, every Cablevision Optimum customer gets free access to Optimum WiFi. These 1.2 million Optimum WiFi hotspots are deployed in places like shopping centers, restaurants, cafes, train stations, parks, and marinas—making widely available the WiFi services that customers now expect and enjoy.

Third, Cablevision is offering new services that allow consumers to exploit the value of WiFi *in lieu* of not just cellular services, but cable television as well. Cablevision recently launched its "cord-cutter" and "everyday low price" packages, which provide high-speed Internet service, WiFi, and voice services to consumers without a cable television subscription. These packages are designed to help Cablevision customers save money on their cellular data plans by offloading their traffic onto WiFi, and consuming non-cable video services—like Netflix, Hulu, YouTube, and others—on their WiFi and broadband connection instead of cellular.[8]

Fourth, Cablevision is expanding and improving WiFi. In addition to filling out the network to cover 1.6 million hotspots in 2015, Cablevision has partnered with other providers in

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[8] OPTIMUM, *Cord-cutters Offer $44.90*, http://www.optimum.com/tv/digital-antenna44.jsp (last visited May 28, 2015) (explaining that Optimum WiFi will help customers "help you save gigs of cellular data, all at no additional cost"); OPTIMUM, *Cord-cutters Offer $34.90*, http://www.optimum.com/tv/digital-antenna34.jsp (last visited June 5, 2015) (explaining that Optimum WiFi will help customers "save up to $20 per month on your cellular data plan"); OPTIMUM, *What are Optimum WiFi Hotspots?*, https://www.optimum.net/internet/about-hotspots (last visited May 28, 2015) ("Instead of racking up unnecessary cellular data overages, Optimum WiFi users can enjoy free WiFi in the places they go every day.").

a “WiFi roaming” program that allows Cablevision customers to access complementary high-speed WiFi throughout much of the United States. Optimum WiFi served as an important connectivity tool for its customers in the immediate aftermath of Superstorm Sandy. Even as some cellular networks failed or were overwhelmed, Optimum’s outdoor WiFi network remained resilient.[9]

Finally—and of equal importance when considering the impact of LTE-U—earlier this year, Cablevision announced “Freewheel,” an innovative, new WiFi calling service that competes directly with traditional licensed mobile carriers. Freewheel allows customers to use standard mobile-phone handsets to place voice calls and transfer data using any available WiFi network. The service leverages the immense installed base of WiFi access points and home routers, including Cablevision’s extensive Optimum WiFi network, to offer voice, text, and data service that is simpler and less expensive than service from a licensed mobile carrier. With most consumers spending more than 85% of their days within the coverage of WiFi, a WiFi-only voice, text, and data service is a compelling choice for many consumers.

Freewheel and Optimum WiFi are obvious competitive alternatives to the services offered by licensed carriers. They are simple, and eliminate much of the confusion and expense associated with licensed carrier service, where consumers must choose between complex combinations of voice, text, and data plans often structured to make it nearly impossible for consumers to understand what they are buying or to comparison shop, and structured to imperil customers’ actual use of the services with a cliff of penalties and “overage” fees.

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[9] *See* Comments of Cablevision Systems Corp. at 3, ET Docket No. 13-49 (filed May 28, 2013).

Freewheel, and other newly launched WiFi calling services, have therefore begun to fill the role that the Commission envisioned for them in its Mobile Competition Report as "new competition to mobile wireless service providers,"[10] improving consumer choice in the highly concentrated mobile wireless industry. As licensed carriers become increasingly consolidated, and access to licensed spectrum has become a huge barrier to entry, WiFi data and WiFi-based services have emerged as an important and growing source of competition.

III. INCUMBENT LICENSED CARRIERS HAVE AN ECONOMIC INCENTIVE TO USE LTE-U AND LAA TO UNDERMINE COMPETITION

Despite the Commission's efforts to promote mobile competition, the national licensed mobile carriers have remained largely insulated from robust competition because of the limited availability and high price of licensed spectrum. WiFi has emerged as a promising market substitute for licensed mobile service.[11] Although WiFi has long served as an alternative to mobile data use in a limited number of locations, a combination of new WiFi technologies that facilitate seamless hand-off between access points and WiFi operators' investment in carrier-grade WiFi networks has allowed WiFi operators to supply retail wireless services that compete directly with licensed mobile wireless providers. Importantly, industry data show that more of Americans' data flow over WiFi than over all licensed wireless technologies today—and

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[10] *Implementation of Section 6002(B) of the Omnibus Budget Reconciliation Act of 1993 - Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, Sixteenth Report, FCC 13-34, 28 FCC Rcd. 3700, ¶ 372 (2013) ("Sixteenth Report").

[11] WiFi, Once a Lifeline for Mobile Carriers, Is Now a Threat; *U.S. Cable & Telecom: Occam's Router [the Cable WiFi Story]*, MOFFETTNATHANSON (Oct. 5, 2014).

forecasts further show that, within the next three years, more of Americans' *voice minutes* will be carried over WiFi than over LTE.[12]

WiFi-based providers of competitive voice, text, and data services have harnessed the power of unlicensed spectrum bands and the immense popularity of consumer WiFi and WiFi networks to compete with licensed providers. The emergence of these competitors makes it easier for subscribers to licensed carriers to use their dual-mode devices, 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. It also means that consumers can significantly reduce the cost of wireless service by using WiFi-only devices or subscribing to a "WiFi-first" provider as a substitute for licensed plans.

Reliable access to unlicensed spectrum is an essential input for these competitors' product offerings. Companies such as Republic Wireless, FreedomPop, and Cablevision's Freewheel can charge significantly lower prices than licensed incumbents. This not only creates affordable new options for customer connectivity, but also places downward pricing pressure on existing licensed providers.

The ability to use unlicensed spectrum to compete with licensed carriers threatens to eliminate the major barrier to entry that has allowed licensed carriers to dominate the mobile voice and data market: access to adequate spectrum. Accordingly, LTE-U and LAA offer two benefits to licensed carriers: they expand the spectrum that carriers can use for their licensed mobile wireless services, and they simultaneously degrade competing services that operate in the same unlicensed spectrum and use WiFi technology. Carrier efforts appear initially designed for 5 GHz unlicensed spectrum, which is critically important to the future of WiFi for enabling faster

[12] Cisco Visual Networking Index Global Traffic Forecast Update at 24.

broadband speeds and offsetting the congestion in the workhorse 2.4 GHz band. Since the licensed carriers cannot foreclose competition by *buying* unlicensed spectrum, they can exclude rivals' use of that spectrum by consuming it. This tactic involves a form of anticompetitive foreclosure of rivals, and merits scrutiny from policymakers, as it could result in fewer choices or higher prices for consumers than would otherwise prevail.[13]

Licensed carriers not only have an incentive to do this, they also have the means. The licensed carriers have made the calculated decision not to develop the LTE-U standard through, or in cooperation with, the Institute of Electrical and Electronics Engineers ("IEEE"), the typical body for the development of standards for unlicensed communications technologies. Instead, they have diverted the standards work, in the case of LAA, to the 3GPP, where the licensed carriers are dominant. Moreover, to the extent that 3GPP might require too much sharing or proceed too slowly, the carriers have created a new standards group, the LTE-U Forum, which they control entirely.

The 3GPP's rejection of "stand-alone" LTE-U reveals that the licensed carriers have a potential anticompetitive interest in the development of LAA. A stand-alone LTE-U would have allowed unlicensed users to use the standard without having to make use of licensed spectrum. However, a set of carriers and their suppliers acted in concert to explicitly prevent this "disintermediation" of licensed carriers,[14] at the expense of potential unlicensed competitors.

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[13] *See, e.g.*, Carl Shapiro, *Setting Compatibility Standards: Cooperation or Collusion*, *in* EXPANDING THE BOUNDARIES OF INTELLECTUAL PROPERTY: INNOVATION POLICY FOR THE KNOWLEDGE SOCIETY, at 81, 91 (Rochelle Cooper Dreyfuss, Diane Leenheer Zimmerman & Harry First, eds.) (2001) ("Setting Compatibility Standards: Cooperation or Collusion").

[14] Licensed carriers determined that making LAA usable by unlicensed carriers could send the "wrong message on the primacy of Licensed spectrum" and risked the "possible disintermediation of cellular operators due to standalone operation." 3GPP WORKING GROUP 1, *WF on Precluding Standalone Access of LTE on Unlicensed Carriers*, at slide 2 (Apr. 20-

By anchoring LTE-U and LAA in their licensed holdings, there is less technical need for LTE-U and LAA proponents to include meaningful coexistence features. Unlicensed technologies such as WiFi and Bluetooth are designed to be as polite as possible because when these and other unlicensed technologies are densely deployed, they face a serious risk of self-interference. If, for example, WiFi were not an extremely polite protocol, the value of all WiFi devices would be reduced due to rampant self-interference. 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.

LTE-U and LAA, however, are different. First, LTE-U and LAA are centrally controlled by a small number of major operators. Thus, LTE-U and LAA materials suggest that these technologies will avoid the problem of self-interference by relying on coordination between the operators themselves.[15] Second, by insulating important LTE control channel functions in licensed spectrum, LTE-U and LAA operators can ensure that interference from other unlicensed systems will affect only, or primarily, payload data. This renders LTE-U and LAA less susceptible to interference in the unlicensed bands than unlicensed technologies—not only are LTE-U and LAA largely exempted from solving the problem of interference to control data, but LTE-U and LAA operators also have the unique option of being able to shift other traffic onto

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24, 2015), http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_80b/Docs/R1-152374.zip ("3GPP WF on Precluding Standalone Access of LTE on Unlicensed Carrier").

[15] HUAWEI, *U-LTE: Unlicensed Spectrum Utilization of LTE*, at 14-15, http://www.huawei.com/ilink/en/download/HW_327803 ("An agreement could be reached between multiple operators for orthogonal/exclusive use of the unlicensed spectrum within a given region . . . . [F]lexible and efficient occupancy/ release of the unlicensed carriers requires some dynamic coordination and information exchange between operators.").

licensed bands as congestion in the unlicensed bands increases. While, from a technical perspective, the LTE-U and LAA control channels themselves might appear no more resistant to interference than WiFi and other unlicensed technologies if operated in the unlicensed band, by placing control functions primarily in licensed spectrum, the carriers are able to protect themselves from the interference that they cause. Thus, not only have carriers insulated the LTE-U and LAA standards-making processes from the normal coordination and economic pressures that come with developing standards within a diverse group of stakeholders, but they also insulated their technologies from the engineering incentives that guide IEEE to build protocols that share fairly with others.

From an economic perspective, joint setting of rules or standards by industry groups that disadvantage competitors and thus result in anticompetitive harm to consumers involves a form collusive foreclosure of rivals that makes it unique among the interference challenges in shared spectrum.[16] The FCC, by opening this proceeding, is asking the right questions to understand the status of the standards-setting process.

IV. LTE-U AND LAA THREATEN CONSUMERS' EXISTING WIFI DEVICES AND THE EMERGENCE OF WIFI-POWERED COMPETITION

The FCC's Mobile Competition Report has found that today's mobile wireless market is "highly concentrated,"[17] with the number of competitors decreasing, instead of increasing.[18] But,

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[16] For an economic perspective, *see generally*, Setting Compatibility Standards: Cooperation or Collusion.

[17] *Implementation of Section 6002(B) of the Omnibus Budget Reconciliation Act of 1993 - Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, Seventeenth Report, FCC 13-135, 29 FCC Rcd. 15,311, ¶ 32 (2014).

[18] *Id*.

as the Commission has recognized, small operators "primarily relying on local WiFi networks for customers' voice and data services, may bring significant competition to traditional mobile wireless operators."[19] As discussed above, WiFi-first competitors are beginning to provide competition to fill the void left by industry consolidation and incumbents' efforts to corner the market for licensed spectrum resources. But now, just as WiFi-based services appear poised to exert pressure through disruptive pricing and all-you-can-eat data plans, the licensed carriers have announced plans to deploy LTE-U in a manner that threatens to undermine their competitors' access to the only spectrum bands with low enough barriers to entry to permit competitive entry.

As well as undermining competition in the mobile wireless market, interference from LTE-U will harm consumers by degrading the performance of all WiFi, Bluetooth, ZigBee, and other unlicensed devices. LTE-U and LAA picocells deployed inside consumers' homes, as well as LTE-U cells deployed in dense urban areas, for example, will have a dramatic effect on in-home network performance, limiting consumers' ability to stream video wirelessly within the home, and interfering with cutting-edge Internet of Things devices that rely on unlicensed technologies.

a. LTE-U and LAA Currently Lack Effective Sharing Mechanisms and Will Severely Interfere with Consumer WiFi Devices

Licensed carriers have begun developing two different, but closely related technologies for introducing LTE operations to the unlicensed bands: LTE-U and LAA. LAA is a technology that 3GPP is considering standardizing, to be deployed in the unlicensed bands worldwide by

[19] Sixteenth Report ¶ 383.

licensed carriers as a part of LTE release 13. Few details of the technology have been finalized, and even fewer made public. But as of this date, no standard formally proposed to 3GPP requires carriers to employ any mechanism designed to share spectrum with WiFi or other unlicensed technologies.

LTE-U typically refers to a technology being developed by an ad hoc group of carriers called the LTE-U Forum, to be deployed in the United States and other jurisdictions that impose no sharing requirements in the unlicensed bands.[20] Although the 3GPP standardization process for LAA is still pending, LTE-U proponents have decided to act outside of the standards process, and have established a parallel process to deploy LTE in the unlicensed bands before any standards body has properly considered its ramifications.

While the two technologies present different degrees of risk, either could seriously harm consumers and competition by stranding consumers' investment in WiFi devices and degrading the quality of competitive services that rely on unlicensed spectrum. The proponents of these technologies have not disclosed basic technical details regarding how these technologies would protect consumers' existing equipment. Some LTE-U/LAA proponents have indicated that they are considering a range of options for avoiding interference, and they have raised some of these ideas at 3GPP, but there is no indication that any of these options will become part of the final standard.

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[20] LTE-U FORUM, *LTE-U Technical Report—Coexistence Study for LTE-U SDL*, at 42-43 (Feb. 2015) http://www.lteuforum.org/uploads/3/5/6/8/3568127/lte-u_forum_lte-u_technical_report_v1.0.pdf ("It should be noted that this recommendation is targeted for LTE-U deployment in markets where [listen-before-talk] is not required.") ("LTE-U Technical Report").

The so-called sharing mechanisms that are being considered at 3GPP and by the LTE-U Forum would be ineffective.[21] For example, LTE-U, as it is currently planned, includes three "coexistence features" in name only: (1) channel selection, (2) opportunistic deactivation, and (3) duty cycling.[22] Channel selection and opportunistic deactivation do not address coexistence between LTE-U and other unlicensed technologies in the most important sharing scenario—when the two services are actually operating co-channel—and therefore will do little to protect consumers from service degradation. These features provide only that an LTE-U cell will select the channel with the least interference and that the cell can turn off when it is not in use. The fact that LTE-U proponents seek to portray an LTE-U cell's ability to turn off when not in use as a sharing mechanism merely highlights how token LTE-U's sharing features really are.

The remaining feature, duty cycling—essentially the ability to periodically turn on and off—could theoretically serve as a rudimentary spectrum sharing feature. But, in reality, it is incompatible with the industry standard sharing features used by WiFi and other unlicensed technologies, and will do little to limit interference to those services.[23] The fundamental problem is that, while other unlicensed technologies work *dynamically* to ensure that each user gets its fair share of airtime in the band, millisecond-by-millisecond, LTE-U's duty cycling relies on longer, *pre-scheduled* blocks of activity. Under LTE-U's duty cycling approach, the LTE-U cell

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[21] *See* 3GGP, *Study on Licensed-Assisted Access to Unlicensed Spectrum*, at slide 11 (May 10-15, 2015) https://mentor.ieee.org/802.19/dcn/15/19-15-0042-00-0000-study-on-licensed-assisted-access-to-unlicensed-spectrum.pdf; CABLELABS, *Impact of LTE in Unlicensed Spectrum on Wi-Fi* (July 15, 2014) https://mentor.ieee.org/802.19/dcn/14/19-14-0037-02-0CUB-impact-of-lte-in-unlicen sed-spectrum-on-wi-fi.pptx ("Impact of LTE in Unlicensed Spectrum on Wi-Fi"); Comments of the National Cable & Telecommunications Association at 18-26, ET Docket No. 15-105 (filed June 11, 2015) ("NCTA Comments").

[22] LTE-U Technical Report at 42-43.

[23] NCTA Comments at 20-22.

would switch on and off according to its unilaterally determined transmission schedule, without regard to the impact that these pre-scheduled transmissions would have on the more dynamic mechanisms used by WiFi and others. Indeed, these long periods of uninterrupted traffic would signal to a WiFi device that there is far more traffic in the band than there really is, in effect turning a WiFi device's politeness features against it.

LTE-U's duty cycling serves, instead, as a mechanism for exerting *more* control over the band, permitting the LTE-U operator to unilaterally dictate which portion of the available airtime services other than LTE-U may use. Even worse, crucial parameters, such as the mechanism by which an LTE-U device will decide how much airtime to give itself, and other important sharing parameters, are cryptically marked "proprietary" in the LTE-U Forum technical materials.[24] And, of course, if this proprietary mechanism allows for adjustment by carriers in the field, one may expect that LTE-U devices will be configured to give as much airtime to themselves, and as little airtime to others, as possible; increasing one's own airtime will inevitably increase performance where there is no cost to the LTE-U devices for increasing interference to other unlicensed services. As discussed above, the licensed carrier using LTE-U would also competitively benefit from increasing such interference.

Notably, LTE-U proponents' disregard for sharing with existing users of unlicensed spectrum is even reflected in the LTE-U Forum's stated sharing goals. In designing LTE-U's sharing features and testing its coexistence with WiFi, the LTE-U Forum has stipulated that LTE-U shares fairly so long as a nearby WiFi network remains capable of transmitting no less than 4 Mb/s.[25] But this is a plainly unacceptable speed even for casual use on in-home WiFi, let

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[24] LTE-U Technical Report at 9.

[25] LTE-U SDL Coexistence Specifications at 9.

alone a carrier-grade WiFi network used to support WiFi calling, video, and the developing Internet of Things. Furthermore, LTE-U ignores other crucial WiFi performance metrics like latency. With hundreds of millions of dollars invested to provide customers WiFi well in excess of 4 Mb/s, reducing WiFi to speeds 4 Mb/s and limiting its utility for latency-sensitive applications and services represent potential value destruction on a significant scale.

Contrary to the claims of LAA and LTE-U proponents, however, both LAA and LTE-U will cause massive interference with WiFi networks in the same channel. Multiple WiFi networks, and other unlicensed services such as Bluetooth, are able to share spectrum fairly with one another. But the presence of LTE-U cells in a given WiFi channel can render that channel unusable for many uses, especially the carrier-grade WiFi required for a latency-sensitive service like Freewheel. For example, under a duty cycling approach where LTE-U dominates the band for 30% of the on-air time, and switched on and off every 100 ms, WiFi throughput is reduced by nearly 50%, and latency nearly doubles.[26] For longer duty cycle periods, such as those proposed by Qualcomm and ZTE, and where the LTE-U cell allocates to itself more than 30% of the airtime, the situation would be even worse: for example, if the LTE-U cell is on-air for 70% of the time, cycling with a period of 500 ms, throughput will drop by 80% and latency will skyrocket by an additional 400 ms.[27] Proposed variants of LAA that incorporate only basic listen-before-talk functionality fare little better. With only the listen-before-talk features under consideration at 3GPP enabled, studies have shown that performance of a busy WiFi network would be reduced by 88%.[28]

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[26] Impact of LTE in Unlicensed Spectrum on Wi-Fi at slide 9; NCTA Comments at 20-22.

[27] Impact of LTE in Unlicensed Spectrum on Wi-Fi at 9; NCTA Comments at 20-22.

[28] Joey Padden, *Wi-Fi vs EU LBT: Houston, We have a Problem*, CABLELABS, http://www.cablelabs.com/wi-fi-vs-eu-lbt-houston-we-have-a-problem/.

b. Carriers Have Sought to Block Stand-Alone LTE-U to Protect their "Value Chain"

Finally, not only will LTE-U and LAA cause massive interference to consumer WiFi devices, but carriers also have worked to block access to LTE technologies (such as a version of LAA that would have both the control and data channels in unlicensed spectrum) by anyone other than a user with access to licensed spectrum. This limitation is not due to any technical impediment. Rather, it is a result of licensed carriers' intentional decision not to allow a "stand-alone" mode, in an effort to disadvantage unlicensed competitors.

In an eye-opening exchange at the April 24, 2015, 3GPP meeting in Belgrade, Serbia, 3GPP unashamedly evaluated how best to preclude unlicensed carriers from using LTE-U. In a document entitled "[Way Forward] on precluding standalone access of LTE on unlicensed carriers,"[29] a set of licensed carriers determined that enabling a stand-alone mode "implies drastically different business models from nowadays and might impact the value chain."[30] To make LTE-U usable by unlicensed carriers, they determined, could send the "wrong message on the primacy of licensed spectrum" and risks the "possible disintermediation of cellular operators due to standalone operation."[31] In other words, the licensed carriers opposed future work on a version of LTE-U that would be open to all precisely *because* it would be open to all. The carriers' report then goes on to detail the technical mechanisms that could be *added* to LTE-U to ensure that a competitor can never use an unlicensed channel as a control channel.[32]

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[29] 3GPP WF on Precluding Standalone Access of LTE on Unlicensed Carrier.

[30] *Id*.

[31] *Id*. at slide 2.

[32] *Id*. at slide 3-4.

V. CONCLUSION

LTE-U and LAA, without effective sharing mechanisms, threaten billions of consumer WiFi devices, hundreds of millions of WiFi users, and nascent WiFi-powered competition, like Optimum WiFi and Freewheel. By using a licensed control channel to foreclose anyone without licensed spectrum from employing LTE technology on unlicensed spectrum bands, LTE-U/LAA proponents have distorted the historical, healthy dynamics of the unlicensed bands, using their FCC licenses to unjustly and unreasonably exploit unlicensed spectrum, harm consumers, and undermine an essential input for their competitors. The Commission therefore must either ensure that the long-standing practice of working through an independent, unbiased standards-setting organization to produce effective sharing leads to an acceptable result, or it must step in to protect consumers and competition.

Respectfully submitted,

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June 11, 2015