

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

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

COMMENTS OF T-MOBILE USA, INC.

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T-Mobile USA, Inc. (“T-Mobile”)^{1/} submits these comments in response to the May 5, 2015, Public Notice (“*Public Notice*”) issued by the Office of Engineering and Technology and Wireless Telecommunications Bureau (together “the Bureaus”) in the above-referenced proceeding. The *Public Notice* seeks comment on LTE-Unlicensed (“LTE-U”) and Licensed Assisted Access (“LAA”) technologies and the techniques they will implement to share spectrum with existing unlicensed operations.^{2/} T-Mobile appreciates the Bureaus’ efforts to facilitate a transparent dialogue about LTE-U and LAA technologies. While these technologies are still being developed, current available data and studies suggest that LTE-U and LAA can be “good neighbors” with other unlicensed technologies, including Wi-Fi.

I. INTRODUCTION AND SUMMARY

T-Mobile, including the MetroPCS brand, offers nationwide wireless voice, text, and data services to approximately 56.8 million subscribers.^{3/} T-Mobile continues to be the fastest growing wireless company in the Nation, with 1.8 million net additions in the first quarter of

^{1/} T-Mobile USA, Inc. is a wholly-owned subsidiary of T-Mobile US, Inc., a publicly traded company.

^{2/} See *Office of Engineering and Technology and Wireless Telecommunications Bureau Seek Information on Current Trends in LTE-U and LAA Technology*, Public Notice, ET Docket No. 15-105, DA 15-516 (rel. May 5, 2015) (“*Public Notice*”).

^{3/} See T-Mobile News Release, *T-Mobile US Reports First Quarter 2015 Results* (Apr. 28, 2015), available at <http://newsroom.t-mobile.com/media-kits/q1-2015-earnings.htm>.

2015 – marking the eighth consecutive quarter in which we have generated more than one million net customer additions.^{4/} Our network expansion is also progressing at an accelerated pace. In fact, our 4G Long-Term Evolution (“LTE”) network – the Nation’s fastest 4G LTE network – already covers 275 million Americans and is on pace to reach 300 million by the end of 2015.^{5/}

T-Mobile also continues to be an active supporter of unlicensed spectrum. T-Mobile was the first carrier to offer its customers cutting-edge technologies like nationwide Voice over LTE (“VoLTE”) and next-generation Wi-Fi calling.^{6/} In 2007, T-Mobile introduced calling over Wi-Fi with HotSpot @Home™, which uses Unlicensed Mobile Access technology in the 2.4 GHz band.^{7/} More recently in September 2014, T-Mobile released Un-carrier 7.0 “Wi-Fi Un-leashed,” a program that ensures all new smartphones in T-Mobile stores are capable of Wi-Fi calling and texting and that all T-Mobile customers will be able to obtain a Wi-Fi calling and texting capable smartphone.^{8/} This ground-breaking program allows T-Mobile customers to make free Wi-Fi calls, including from anywhere outside the country, and provides seamless

^{4/} See *id.*

^{5/} See T-Mobile News Release, *T-Mobile Agrees. Never Settle . . . for Verizon* (May 4, 2015), available at <http://newsroom.t-mobile.com/news/news-never-settle-for-verizon.htm>.

^{6/} See *id.*

^{7/} See T-Mobile News Release, *T-Mobile Introduces Unlimited Calling Over Wi-Fi With the National Launch of T-Mobile HotSpot @Home* (Jun. 27, 2007), available at http://www.t-mobile.com/company/PressReleases_Article.aspx?assetName=Prs_Pr_20070627&title=T-Mobile+Introduces+Unlimited+Calling+Over+Wi-Fi+With+the+National+Launch+of+T-Mobile+HotSpot+@Home.

^{8/} See T-Mobile News Release, *T-Mobile Launches Un-carrier 7.0; Un-leashes Wi-Fi Worldwide* (Sept. 10, 2014), available at <http://newsroom.t-mobile.com/news/t-mobile-launches-un-carrier-7.htm>.

handover between Wi-Fi and VoLTE. T-Mobile customers now average more than 9.4 million Wi-Fi calls per day.^{9/}

A. Regulation of Unlicensed Spectrum Should Continue to be Technology Neutral

The hallmark of spectrum in which the FCC has permitted unlicensed devices has been the innovation that those bands have fostered. What began as bands used by baby monitors and garage door openers has evolved into spectrum supporting, for example, critical carrier offload and backhaul. While T-Mobile supports the Bureaus' inquiry into unlicensed spectrum technologies and standards, they should ensure that innovation continues to flourish in unlicensed spectrum. What may be the dominant technology and use of unlicensed spectrum today may not be the same tomorrow. The Commission should therefore continue its longstanding current approach of technology neutrality and ensure that bands designated for unlicensed operations support a broad range of technologies, products, and services. As the Commission has recognized, its longstanding policies promoting technological neutrality can engender a wide diversity of network deployments, including by some non-traditional entrants.^{10/} This not only fosters competition, but also produces benefits for consumers in the form of better network performance and greater choices.

The most appropriate rules for unlicensed spectrum are those that specify basic technical parameters permitting the use of any technology. Those rules should not, however, specify the use of particular co-existence mechanisms, as they do not today. Although T-Mobile recognizes

^{9/} See T-Mobile, *T-Mobile 2014 Annual Report*, at 3 (2015), available at http://explore.t-mobile.com/AnnualReport/TMUS_2014AnnualReport.PDF?icid=WMD_TM_Q215ANLRLP_X0MC4TJX2WW2148.

^{10/} See *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, GN Docket No. 12-354, FCC 15-47, ¶ 228 (rel. Apr. 21, 2015).

that it is in the public interest for technologies using unlicensed spectrum to incorporate some co-existence capability, there is no need to specify that mechanism in the rules. As discussed in further detail below, inclusion of co-existence mechanisms is expected to be a fundamental feature of both LTE-U and LAA; no further FCC intervention is necessary.

B. Wireless Carriers Continue to Rely on Wi-Fi

Wireless carriers have been and will continue to be highly motivated to foster successful co-existence among unlicensed technologies. As T-Mobile has explained, unlicensed spectrum is becoming increasingly important in carriers' networks to complement other spectrum to satisfy coverage and capacity needs.^{11/} Not only have wireless carriers deployed thousands of Wi-Fi hotspots nationwide, but several carriers also offer consumer Wi-Fi calling options – all of which carriers seek to preserve.^{12/}

T-Mobile has a particularly strong incentive – because of its leadership in integrating Wi-Fi and licensed technologies – to ensure effective co-existence. As noted above, T-Mobile has a long history of using Wi-Fi as a critical component of its network. In addition to ensuring that all T-Mobile customers will be able to obtain mobile devices with Wi-Fi calling and texting capabilities, T-Mobile's Wi-Fi Un-leashed features the T-Mobile "Personal CellSpot," a new device that enables T-Mobile customers to put the capabilities of a personal T-Mobile tower in

^{11/} See, e.g., Comments of T-Mobile USA, Inc., GN Docket No. 12-354, at 1-2 (filed Jul. 14, 2014); see also T-Mobile USA, Inc. Response to House White Paper on Modernizing U.S. Spectrum Policy, at 5 (filed Apr. 25, 2014), available at http://energycommerce.house.gov/sites/republicans.energycommerce.house.gov/files/analysis/CommActUpdate/WP2_Responses_43-58.pdf.

^{12/} See, e.g., AT&T Wi-Fi Hotspots, <http://www.att.com/shop/wireless/wifi.html> (last visited Jun. 1, 2015) (stating that AT&T provides access to more than 30,000 hotspots); Sprint Wi-Fi Calling, https://shop.sprint.com/mysprint/services_solutions/details.jsp?detId=sprint_wi-fi_calling&catId=service_communication&catName=Communication&detName=Sprint%20Wi-Fi%20Calling&specialCat=#/ (last visited Jun. 1, 2015).

their house.^{13/} The Personal CellSpot delivers a “full-bars” T-Mobile experience, with unique patent-pending technology that prioritizes voice calls to first use 5 GHz band Wi-Fi for crystal clear high-definition voice, and is provided free of charge (with a \$25 refundable deposit) to all eligible T-Mobile customers.^{14/}

T-Mobile is also active in the 3GPP process and is on the board of the Wi-Fi Alliance.^{15/} In fact, there is a meaningful overlap among wireless carriers in the membership of both organizations as well as with IEEE 802.11, the working group within IEEE dedicated to wireless local area networks.^{16/} Through these organizations, T-Mobile and other carriers have consistently demonstrated a strong commitment to both licensed and unlicensed technologies.

C. Carriers Will Use Wi-Fi and LTE-Based Unlicensed Technologies

While T-Mobile and others remain committed to Wi-Fi, technology that can be used with unlicensed spectrum using LTE protocols will also be beneficial to carriers by providing additional capacity in areas where carriers have licensed LTE spectrum. LTE-U and LAA are especially attractive technologies because they will allow carriers to expand their capacity using unlicensed spectrum while still ensuring that they can rely on stable licensed spectrum for a high quality of service. Consistent with the FCC’s own philosophy, carriers should be allowed to use an “all of the above” approach for such network capacity expansion and management.^{17/}

^{13/} See T-Mobile News Release, *T-Mobile Launches Un-carrier 7.0; Un-leashes Wi-Fi Worldwide* (Sept. 10, 2014), available at <http://newsroom.t-mobile.com/news/t-mobile-launches-un-carrier-7.htm>.

^{14/} See *id.*

^{15/} See 3GPP Membership, <http://www.3gpp.org/about-3gpp/membership> (last visited Jun. 1, 2015); Wi-Fi Alliance Member Companies, <http://www.wi-fi.org/who-we-are/member-companies> (last visited Jun. 1, 2015).

^{16/} See IEEE 802.11, Working Group Membership List, <http://www.ieee802.org/11/Voters/votingmembers.htm> (last visited Jun. 1, 2015).

^{17/} See *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, et al.*, Notice of Inquiry, 29 FCC Rcd. 13020, at Statement of Chairman Tom Wheeler (2014) (“An effective spectrum strategy requires an all-of-the-above approach.”).

In response to the Bureaus' inquiries, T-Mobile notes below that: (1) LTE-U and LAA are similar technologies that are designed to expand capacity while sharing unlicensed spectrum with others; (2) both LTE-U and LAA are under active development; (3) several entities – *i.e.*, 3GPP, IEEE 802, and Wi-Fi Alliance – are collaboratively evaluating the co-existence of LTE-U and LAA with other technologies; (4) LTE-U and LAA can support standard LTE channel bandwidths and will employ multiple co-existence mechanisms; (5) testing demonstrates that LTE-U can currently co-exist with Wi-Fi; (6) both LTE-U and LAA will integrate licensed and unlicensed spectrum, with licensed spectrum serving as the “anchor” carrier; (7) new chipsets will be required to implement LTE-U and LAA; (8) LTE-U and LAA can be deployed in a variety of frequency bands; and (9) commercial deployment of LTE-U is anticipated in 2016, with the implementation of LAA following the completion of discussions on and standardizations for LAA.

II. RESPONSES

A. Variations of LTE

The *Public Notice* asks what variations of LTE in unlicensed spectrum (*e.g.*, LTE-U and LAA) are under active development or on a roadmap for future development.^{18/} It also seeks comment on how LTE-U and LAA relate to one another in terms of technology, potential use, and timing of availability.^{19/}

LTE-U represents a protocol based on efforts taken by several companies – *i.e.*, the LTE-U Forum, which includes Verizon, Alcatel-Lucent, Ericsson, Qualcomm Technologies, and Samsung – to integrate LTE with unlicensed spectrum.^{20/} LTE-U is intended to extend the

^{18/} See *Public Notice* at 2.

^{19/} See *id.*

^{20/} See LTE-U Forum, <http://www.lteuforum.org/> (last visited Jun. 1, 2015).

benefits of LTE and LTE Advanced (versions of LTE based on Release 10 and later) to unlicensed spectrum by enabling mobile operators to offload data traffic onto unlicensed frequencies more efficiently and effectively.^{21/} Both LTE-U and LAA operate with an “anchor” licensed carrier and use the carrier aggregation feature of LTE Advanced, which allows for the aggregation of multiple carriers, to integrate licensed and unlicensed spectrum.^{22/} Several entities are considering the deployment of LTE-U as a “pre-standard” version of the next 3GPP release – Release 13.^{23/} LAA similarly allows for the aggregation of licensed and unlicensed carriers using LTE technology. It is expected to be a standard incorporated in 3GPP in its Release 13.^{24/}

B. State of Development

The *Public Notice* requests input on the current state of development as well as the anticipated schedule for completion of the LTE-U and LAA standards.^{25/} The LTE-U Forum recently announced that it has completed its first technical report evaluating the use of LTE in unlicensed spectrum.^{26/} It has also released coexistence specifications, discussed in further detail

^{21/} See *id.*

^{22/} See Qualcomm, LTE Advanced, <https://www.qualcomm.com/invention/technologies/lte/advanced> (last visited Jun. 1, 2015).

^{23/} See *Public Notice* at 2.

^{24/} See Letter from Steve B. Sharkey, Chief Engineering and Technology Policy, Federal Regulatory Affairs, T-Mobile, to Ms. Marlene H. Dortch, Secretary, FCC, GN Docket No. 12-354, at Presentation at 6 (filed Mar. 13, 2015); Ericsson, *LTE License Assisted Access*, at 5 (Jan. 2015) (“T-Mobile March 2015 Ex Parte”), available at http://www.ericsson.com/res/thecompany/docs/press/media_kits/ericsson-license-assisted-access-laa-january-2015.pdf.

^{25/} See *Public Notice* at 2.

^{26/} See PR Newswire News Release, *LTE-U Forum Explores Technical Possibilities of LTE in Unlicensed Spectrum* (Mar. 2, 2015), available at <http://www.prnewswire.com/news-releases/lte-u-forum-explores-technical-possibilities-of-lte-in-unlicensed-spectrum-300043401.html>; LTE-U Forum, *LTE-U Technical Report: Coexistence Study for LTE-U SDL V1.0 (2015 -02)* (2015) (“LTE-U Technical Report”), available at http://www.lteuforum.org/uploads/3/5/6/8/3568127/lte-u_forum_lte-u_technical_report_v1.0.pdf.

below, to ensure fair sharing of spectrum between LTE-U and Wi-Fi users as well as between different operators deploying LTE-U.^{27/} Adoption of LAA specifications will occur inside the 3GPP consensus-based process. Work has begun on this feature and is expected to be completed approximately in the first quarter of 2016.^{28/}

C. Coordination Among Organizations

The *Public Notice* seeks comment on the status of coordination between 3GPP and the IEEE 802.11 on LTE-U and LAA.^{29/} It also seeks comment on the process for coming to agreement on appropriate sharing characteristics to ensure co-existence with the IEEE 802.11 family of standards.^{30/}

As noted above, there is meaningful overlap in the membership of 3GPP, IEEE 802.11, as well as the Wi-Fi Alliance. IEEE 802 and 3GPP in particular have collaborated on the co-existence of LAA and Wi-Fi, both making several presentations to one another.^{31/} In addition to that informal information exchange, the two groups communicate more formally through Liaison Statements (“LS”). For example, IEEE 802 recently sent two LS to 3GPP that, among other things, include recommendations to 3GPP on the simulations that 3GPP should use for evaluating the co-existence of LAA and Wi-Fi as well as for defining “fairness” and fair access

^{27/} See LTE-U Forum, *LTE-U SDL Coexistence Specifications V1.0 (2015-02)* (2015) (“LTE-U Co-Existence Specifications”), available at http://www.lteuforum.org/uploads/3/5/6/8/3568127/lte-u_forum_lte-u_sdl_coexistence_specifications_v1.0.pdf.

^{28/} See 3GPP Presentation, *3GPP & Unlicensed Spectrum*, at 9 (2015), available at http://www.3gpp.org/ftp/Information/presentations/presentations_2015/2015_01_3GPP_unlicensed_Dino_Flore.pdf (explaining that 3GPP is targeting completion of LAA in Release 13, which is scheduled to freeze in March 2016).

^{29/} See *Public Notice* at 2.

^{30/} See *id.*

^{31/} See Steve J. Crowley, P.E., *IEEE 802 and 3GPP Step Up Collaboration on LAA* (2015), available at <http://stevencrowley.com/2015/03/23/ieee-802-and-3gpp-step-up-collaboration-on-laa/>.

to spectrum.^{32/} Both entities are expected to continue the exchange of LS as they continue to collaborate. The Wi-Fi Alliance has also formed a working group to study co-existence mechanisms that enable shared use of unlicensed spectrum.^{33/} Some of the members of the Wi-Fi Alliance, such as T-Mobile, are also actively engaged in 3GPP activities.

D. Anticipated Technical Characteristics

The *Public Notice* asks what the anticipated technical characteristics (*e.g.*, bandwidth(s), listen-before-talk, transmission durations, etc.) will be of LTE-U and LAA.^{34/} Both LTE-U and LAA are expected to utilize the carrier aggregation feature of LTE Advanced to aggregate multiple carriers in licensed and unlicensed spectrum using the standard LTE channel bandwidths for licensed spectrum – 1.4 megahertz, 3 megahertz, 5 megahertz, 10 megahertz, 15 megahertz, and 20 megahertz – as well as the typical channel bandwidths in unlicensed spectrum of up to 20 megahertz per carrier.^{35/} Both LTE-U and LAA are also expected to implement similar channel selection and adaptive channel occupancy processes for sharing unlicensed spectrum with Wi-Fi and other technologies. In particular, it is anticipated that both LTE-U and LAA will use “Channel Selection,” which will select the “cleanest” channel based on Wi-Fi and LTE measurements.^{36/}

^{32/} See *id.*; Letter from Paul Nikolich, Chairman, IEEE 802 LAN/MAN Standards Committee, to Dino Flore, 3GPP TSG RAN Chair, and Satoshi Nagata, Chairman, 3GPP TSG WG RAN1 (Mar. 18, 2015), available at <http://ieee802.org/secmail/pdfZ4CFSik5XM.pdf>.

^{33/} See Wi-Fi Alliance, Current Work Areas, <http://www.wi-fi.org/who-we-are/current-work-areas> (last visited Jun. 1, 2015).

^{34/} See *Public Notice* at 2.

^{35/} See LTE-U Forum, *eNB Minimum Requirements for LTE-U SDL V1.0 (2015-02)*, at 14-15 (2015), available at http://lteuforum.org/uploads/3/5/6/8/3568127/lte-u_forum_enb_minimum_requirements_for_lte_u_sdl_v1.0.pdf.

^{36/} See Qualcomm, *Qualcomm Research, LTE in Unlicensed Spectrum: Harmonious Coexistence with Wi-Fi*, at 5 (Jun. 2014) (“Qualcomm Research”), available at <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&cad=rja&uact=8&ved=0CB4QFjAA&url=https%3A%2F%2Fwww.qualcomm.com%2Fmedia%2Fdocuments%2Ffiles%2Flte->

However, LTE-U and LAA are expected to differ in channel availability assessment. LTE-U will likely use a Carrier-Sensing Adaptive Transmission (“CSAT”) algorithm, based on long-term carrier sensing of co-channel Wi-Fi activities, to ensure that LTE-U can share fairly with Wi-Fi.^{37/} LAA will likely use a “Clear Channel Assessment,” based on channel availability sensing and adapting the transmission duration on a fine timescale, for its listen-before-talk implementation.^{38/} 3GPP discussions are ongoing for LAA contention mechanisms, including transmission duration and listen-before-talk. As noted above, those discussions are expected to be completed as part of the standard anticipated to be announced in the first quarter of 2016. Co-existence through adaptive “on/off” transmissions based on channel utilization measurements are envisioned for both solutions.^{39/} And, both LTE-U and LAA are expected to turn “off” when unlicensed spectrum is no longer needed.^{40/}

E. Testing

The *Public Notice* asks whether any tests or analyses have been performed to understand the impact of LTE-U and LAA on the existing commercial wireless and unlicensed ecosystems.^{41/} While the LTE-U Forum released a technical report on the co-existence between

unlicensed-coexistence-whitepaper.pdf&ei=GQltVeu_MceWyAS06YCgCw&usq=AFQjCNHHP-iRjiB9M82LfxcwppRzym9tnw&sig2=say1ef75lWhVjgNLyj0CLQ; Ericsson Research Blog, *Licensed Assisted Access: Operation Principles* (Feb. 26, 2015), available at <http://www.ericsson.com/research-blog/lte/license-assisted-access/>; Ericsson Research Blog, *Licensed Assisted Access: Practical Coexistence Solutions* (Feb. 27, 2015) (“Ericsson Coexistence Research”), available at <http://www.ericsson.com/research-blog/lte/laa-principals-practical-applications-fair-sharing-pt-2/>.

^{37/} See Qualcomm Research at 6.

^{38/} See Qualcomm, LTE-U/Wi-Fi Coexistence, <https://www.qualcomm.com/invention/research/projects/lte-unlicensed/lte-u-wi-fi-coexistence> (last visited Jun. 1, 2015).

^{39/} See *id.*; Ericsson Coexistence Research.

^{40/} See LTE-U Co-Existence Specifications at 7; Ericsson Coexistence Research.

^{41/} See *Public Notice* at 2.

Wi-Fi and LTE-U, testing remains ongoing for both LAA and LTE-U. Nonetheless, the LTE-U Forum’s simulations to date suggests that fair co-existence is possible. As the report indicates, “[f]or a given Wi-Fi deployment, if part of the nearby Wi-Fi nodes are replaced by LTE-U nodes, the remaining Wi-Fi nodes throughput [are] no worse than before, and, in many cases, improve comparing to the baseline case where all nodes are Wi-Fi.”^{42/} Current simulations also suggest that LAA can be implemented without a detrimental impact to Wi-Fi operations.^{43/}

F. Licensed and Unlicensed Integration for LAA

The *Public Notice* solicits input on how LAA will integrate licensed and unlicensed carriers, particularly with regard to controlling access to spectrum.^{44/} It also seeks comment on the extent to which a standalone form of LTE-U – *i.e.*, a form that can operate without a licensed primary channel – is being developed.^{45/}

As explained above, both LTE-U and LAA will utilize the carrier aggregation feature of LTE Advanced to integrate licensed and unlicensed spectrum. The unlicensed carrier will only be used to supplement the licensed carrier when additional capacity is required. Unlike other uses of the bands, LTE-U and LAA will *not* utilize unlicensed spectrum on a continual basis; they will use unlicensed spectrum only on an intermittent basis to boost capacity when licensed

^{42/} LTE-U Technical Report at 43.

^{43/} See, e.g., 3GPP, *Coexistence Performance of DL-Only LAA*, R1-152729 (May 2015), available at http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Docs/; 3GPP, *Coexistence Performance of DL-Only LAA with VoIP*, R1-152730 (May 2015), available at http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Docs/; 3GPP, *Further Coexistence Evaluation Results for DL-Only LAA*, R1-152863 (May 2015), available at http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Docs/.

^{44/} See *Public Notice* at 2.

^{45/} See *id.*

spectrum is insufficient. LTE-U and LAA will turn “off” when unlicensed spectrum is no longer needed.^{46/}

Operation of LTE-U will not be possible without a licensed carrier. While the initial version of LAA is expected to feature aggregation of licensed and unlicensed carriers, a standalone form of LAA might be possible, and T-Mobile has no objection to exploring standalone capability. However, as discussed above, the standardization process for LAA remains ongoing. In any case, although the licensed carrier will be the anchor carrying necessary control channel information, co-existence in the unlicensed band will be performed at the local level by the LTE-U or LAA access point. As the LTE-U Forum technical report indicates, the secondary cell channel selection in the unlicensed spectrum is based on selection of the least interfering channel; monitoring channel usage periodically; re-selection of new channels, if necessary; and avoiding the channels with strong LTE-U links of other operators to the maximum extent possible.^{47/}

G. Software Upgrade Capability

The *Public Notice* invites input on whether existing devices are capable of software upgrades to implement LTE-U and LAA.^{48/} Because both LTE-U and LAA would require new chipsets, software upgrades could not be used to implement LTE-U and LAA in existing devices.

H. Frequency Bands

The *Public Notice* asks what frequency bands are envisioned for deployment of LTE-U and LAA.^{49/} The current focus for the deployment of LTE-U and LAA channels is on the 5 GHz

^{46/} See LTE-U Co-Existence Specifications at 7.

^{47/} See LTE-U Technical Report at 42.

^{48/} See *Public Notice* at 2.

^{49/} See *id.*

band. However, as T-Mobile has suggested, other bands such as the 3.5 GHz band should be evaluated for LTE-U and LAA use, particularly since the 3.5 GHz band has been viewed as an “innovation band” and could serve as an ideal test bed for compatibility development among multiple technologies and services.^{50/} Other bands envisioned for unlicensed spectrum use in the future may also be considered. LTE-U and LAA can be aggregated with channels in any standard LTE band.

I. Pre-Standard Deployment

Finally, the *Public Notice* seeks comment on carriers’ and manufacturers’ plans for pre-standard deployment of LTE-U and LAA equipment, including possible upgrades to 3GPP-based LTE-U or LAA.^{51/} It further asks how co-existence issues would be addressed relative to pre-standard versions of LTE-U and LAA.^{52/} As indicated above, preliminary test results suggest that LTE-U could be deployed as a pre-standard prior to the release of LAA. T-Mobile and others are continuing to evaluate LTE-U and are collaborating on LAA with the goal of commercial deployment capabilities in 2016.

^{50/} See T-Mobile March 2015 Ex Parte at Presentation at 4, 7.

^{51/} See *Public Notice* at 2.

^{52/} See *id.*

III. CONCLUSION

While T-Mobile and other carriers will continue to be a significant user and supporter of Wi-Fi technologies, the Bureaus should ensure that spectrum policies remain sufficiently flexible to accommodate a range of technology platforms in unlicensed spectrum. Work to date suggests that both LTE-U and LAA in particular can provide valuable supplemental capacity to carrier networks without threatening existing unlicensed technologies such as Wi-Fi. T-Mobile looks forward to working with the Bureaus as they further evaluate these technologies.

Respectfully submitted,

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