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

In the Matter of	)	
	)	
Use of Spectrum Bands Above 24 GHz For Mobile Radio Services	)	GN Docket No. 14-177
	)	
Amendment of the Commission's Rules Regarding the 37.0-38.6 GHz and 38.6-40.0 GHz Bands	)	ET Docket No. 95-183 (Terminated)
	)	
Implementation of Section 309(j) of the Communications Act – Competitive Bidding, 37.0-38.6 GHz and 38.6-40.0 GHz Bands	)	PP Docket No. 93-253 (Terminated)
	)	
Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band	)	RM-11664

COMMENTS OF FIBERTOWER SPECTRUM HOLDINGS, LLC

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EXECUTIVE SUMMARY

FiberTower applauds the Commission for opening this proceeding to examine the use of spectrum bands above 24 GHz for mobile radio services. Permitting mobile uses of these bands is critical to driving research and development, and the resulting technological innovation, which will fuel the creation of Fifth Generation ("5G") mobile services in the United States. There are key roles for designated licensed and unlicensed spectrum blocks. As discussed in detail below, global leadership in 5G has yet to be fully determined, and much is at stake for the regions seeking to win the 5G mantle. The conditions optimizing industry leadership in advancing innovative, market-demanded solutions in the millimeter wave spectrum bands are known, and they involve encouraging significant investment, research and development, and real-world product launches.

To foster and accelerate this innovation and investment by FiberTower and other industry-leading stakeholders, the Commission should (i) permit mobile services in the wide-area, exclusively licensed bands (in particular, the 24 GHz through 39 GHz bands) using as guidance the same power flux density limit and border coordination standards already in place for the ongoing fixed wireless service operations in those bands; and (ii) adopt a regulatory framework that provides the flexibility necessary to facilitate and accommodate future innovations, as well as the regulatory predictability necessary to encourage industry investment. This includes instituting license renewal policies that recognize significant investments in research and development, and innovative solutions for making millimeter wave services and spectrum widely available on a market-demand basis. By so doing, the Commission can accelerate innovation and investment in the millimeter wave spectrum, and ensure that the United States remains the global leader in the development of cutting-edge broadband that supports next-generation mobile services and the infrastructure undergirding such services.

TABLE OF CONTENTS

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COMMENTS OF FIBERTOWER SPECTRUM HOLDINGS, LLC

FiberTower Spectrum Holdings, LLC ("FiberTower") hereby submits comments in response to the Notice of Inquiry of the Federal Communications Commission (the "Commission") in the above-captioned proceeding.[1] FiberTower applauds the Commission for opening this proceeding to examine the use of spectrum bands above 24 GHz for mobile radio services. Permitting mobile uses of these bands is critical to driving research and development, and the resulting technological innovation, which will fuel the creation of Fifth Generation ("5G") mobile services in the United States. There are key roles for designated licensed and unlicensed spectrum blocks. As discussed in detail below, global leadership in 5G has yet to be fully determined, and much is at stake for the regions seeking to win the 5G mantle. The conditions optimizing industry leadership in advancing innovative, market-demanded solutions in the millimeter wave spectrum

[1] *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, et al.,* GN Docket No. 14-177, *et al.*, Notice of Inquiry, 29 FCC Rcd 13020 (2014) ("NOI").

bands are known, and they involve encouraging significant investment, research and development, and real-world product launches.

To foster and accelerate this innovation and investment by FiberTower and other industry-leading stakeholders, the Commission should (i) permit mobile services in the wide-area, exclusively licensed bands (in particular, the 24 GHz through 39 GHz bands) using as guidance the same power flux density limit and border coordination standards already in place for the ongoing fixed wireless service operations in those bands; and (ii) adopt a regulatory framework that provides the flexibility necessary to facilitate and accommodate future innovations, as well as the regulatory predictability necessary to encourage industry investment. This includes instituting license renewal policies that recognize significant investments in R&D, and innovative solutions for making millimeter wave services and spectrum widely available on a market-demand basis. By so doing, the Commission can accelerate innovation and investment in the millimeter wave spectrum, and ensure that the United States remains the global leader in the development of cutting-edge broadband that supports next-generation mobile services and the infrastructure undergirding such services.

I. THE COMMISSION SHOULD PUT MARKET STABILIZATION AND ACCELERATION MEASURES IN PLACE QUICKLY AS THE $1 TRILLION 5G MARKET RACE IS UNDERWAY, AND THE STAKES FOR THE UNITED STATES ARE HIGH.

The NOI asks the right questions. It asks, from multiple angles, for information about how to promote mobile broadband innovation, and research and development, in the 24 GHz and above bands. The NOI recognizes the strong relationship between the coming 5G networks and the bandwidth, propagation, and latency advantages that the millimeter wave bands can offer those networks.

The NOI also comes at a time of great importance, as global leadership in the $1 trillion 5G market is now being defined, and heavy investments in the millimeter wave bands are already underway. Significant investments and advancements were announced in 2014 by many global

companies, including Samsung, Huawei, NTT, Ericsson, and Nokia. The Wall Street Journal has reported on how Europe and Asia are working hard to win the 'race to 5G'.[2] There also are signals that there are historic time compressions in the 5G development cycle. In other words, the standard time periods for developing and moving networks from 2G to 3G, and from 3G to 4G, are predicted by some to be shorter for 4G to 5G.[3] This is due to many factors, including the fact that the basic underpinnings of a 5G millimeter wave mobile network will be in some ways less complex to administer than current low band mobile networks.[4] That is because, in large part, known millimeter band point-to-multipoint technology advances are ready-made for adapting to 5G mobility architectures, and also have proven spectrum management models that are easier to administer than in the lower bands (*i.e.*, 700MHz to 3 GHz). It also is due to the fact that the backhaul systems (fiber, microwave and especially millimeter wave) that will support small cell networks are suitable infrastructure for supporting future 5G access points.

The path to accelerating innovation and deployments in these millimeter wave bands is ready to be taken. In particular, as it relates to the 24 GHz and 39 GHz bands, measures can be implemented to more tightly focus the willingness of the investment community, operators, licensees, manufacturers, tower and property owners, and customers to provide additional resources toward meeting the goal of establishing mobile broadband access.

FiberTower's path is instructive. FiberTower was founded in 2000 to provide fixed wireless backhaul and related services. Through a merger in 2006, the company acquired hundreds of spectrum licenses in the 24 and 39 GHz bands, covering substantially all of the continental United

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[2] The Race to 5G: Europe & Asia [Source: Wall Street Journal, *EU, South Korea to Lay Out Plan for 5G Networks Deal Could be Crucial for EU, Which Is Trailing Its Rivals in Mobile Internet* (June 15, 2014).

[3] *See* IEEE IMS, June 2014, Tampa, Florida.

[4] *Id.*

States. FiberTower became the country's leading alternative provider of fixed wireless backhaul, investing over $300 million to provide reliable, state-of-the-art wireless backhaul service nationwide in the 24 and 39 GHz bands, whenever and wherever the demand materialized. As the Commission has recognized, the availability of reliable backhaul is critical for the deployment of next-generation mobile services.[5] Fixed wireless backhaul, in particular to small cells, will be an essential component to the successful development and deployment of 5G access mobile services in the millimeter wave spectrum.[6]

As with mobile systems, not all fixed wireless backhaul is the same. There are very specific needs for very specific types of backhaul. Some of those needs require lower spectrum bands while other needs require higher bands. Some require wide-area exclusive licenses, and some require point-to-point licensing or an unlicensed environment. Some require lower latency and higher signal availability while others have specific bandwidth and tele-density capabilities. In other words, the fixed wireless bands are not all interchangeable, nor will be the 5G mobile access bands.

Lower band microwave services (*e.g.,* 2 GHz, 4-6 GHz, or 10-11 GHz) historically featured a need to cover large distances for a specific link. For example, the first real competitor to AT&T in the modern age was Microwave Communications, Inc., which used fixed wireless backhaul to deliver voice and data over long distances. Now, the premium is not on distance; it is in tele-density.

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[5] *Amendment of Part 101 of the Commission's Rules to Facilitate the Use of Microwave for Wireless Backhaul*, WT Docket No. 10-153, Report and Order, Further Notice of Proposed Rulemaking, and Memorandum Opinion and Order, 26 FCC Rcd 11614, ¶ 2 (2011) ("A robust broadband ecosystem … relies, at least in part, on access to adequate and cost-efficient backhaul.. … By enabling more flexible and cost-effective microwave services, the Commission can help accelerate deployment of fourth-generation (4G) mobile broadband infrastructure across America.").

[6] *See* "Developments in Small Cells and Non-Line-of-Sight (NLOS)," National Spectrum Managers Association, at 24-25, 47, 54-72 (May 13, 2014), *available at* http://www.nsma.org/docs/conferences/2014/NSMA-2014-Small-Cell-NLOS-Joe-Sandri.pdf; *see also* "Samsung Says New Superfast 5G Works With Handsets in Motion", MIT Technology Review (June 13, 2013).

Through its investments, FiberTower has taken significant steps to develop and deploy the network infrastructure and equipment necessary to enable innovative uses of the wide-area licensed 24 and 39 GHz bands, and to support the deployment of next-generation wireless solutions. Despite regulatory setbacks,[7] FiberTower has continued its work as an industry leader dedicated to driving innovation, research and development, and real-world product launches in the millimeter wave spectrum. Since its acquisition of licenses in 2006, FiberTower has developed and launched a number of products and services. In March 2014, FiberTower completed a court-ordered reorganization and is now privately-held. Its continuing innovative work includes installing a lab in January 2015 where it recently conducted the first known successful U.S. mobile broadband and non-line-of-sight ("NLOS") tests in the 24 GHz band.

Other examples of FiberTower's work include using point-to-point wireless licenses in the 6, 11, 18 and 23 GHz bands, and the wide-area licensed 24 and 39 GHz bands, to build out the then largest fixed wireless backhaul network in the country, before the termination of many of FiberTower's 24 and 39 GHz licenses. Today, FiberTower continues to provide services over an area defined by 46 wide-area licenses in the 24 GHz and 39 GHz band.[8]

FiberTower has worked closely with vendors to develop viable wireless backhaul equipment for use in the 24 and 39 GHz bands. This equipment included small-cell systems – containing LTE base stations – that could be placed on light poles and were intended to address the technical

[7] FiberTower's efforts were set back by the determination of the Wireless Telecommunications Bureau in 2012 that FiberTower had failed to adequately demonstrate substantial service for many of its licenses in the 24 and 39 GHz bands. FiberTower subsequently filed an application for review of the Bureau's decision. FiberTower's application for review, as well as its subsequent petition for reconsideration were denied by the Commission; currently, FiberTower has an appeal pending before the United States Court of Appeals for the District of Columbia.

[8] *See* http://www.fibertower.com/spectrumservices.

problems relating to the deployment of wireless backhaul services in congested urban areas. FiberTower also helped develop equipment that delivers a high-speed wireless link that can be used to replace or supplement fiber-optic network cables or other more expensive or less available methods of carrying voice and data from the cell tower back to the wireless carrier's switch. These efforts have been essential to the development of equipment for use in the 24 and 39 GHz bands that is reliable, reasonably sized, cost-effective, and easy to install.

Also in partnership with equipment vendors, including DragonWave, JRC and BridgeWave, FiberTower has put its licensed spectrum to use through ready-to-deploy packages called "spectrum-in-a-box" systems. The spectrum-in-a-box programs enable rapid deployment of operating links in the 24 and 39 GHz spectrum by allowing customers to purchase broadband radio equipment, together with the use of FiberTower spectrum. For example, one carrier purchased a "spectrum-in-a-box" solution from DragonWave, one of FiberTower's partners, resulting in over 40 built links. Another partner, BridgeWave, sold similar packages to customers, including Apple, Pacom and STC. These developments, facilitated by FiberTower's "spectrum-in-a-box" programs, led to significant advances, including the construction of the nation's first 1 Gbps system in the 24 GHz band, which was deployed at various locations.[9]

FiberTower's spectrum-in-a-box programs also facilitated the development of the nation's first point-to-multipoint ("PMP") unit in the 24 GHz, LMDS, and 39 GHz bands that was a fully integrated all-outdoor unit with power of Ethernet (POE). These low profile units are easily deployable. The subscriber node is 7" x 7" x 3". They do not require climate-controlled cabinets or any indoor unit rack space. The subscriber nodes can also operate in a point-to-point (PTP) configuration.

[9] Such system subsequently was torn down when the licenses in use were cancelled by the Commission.

Importantly, FiberTower took steps to make its spectrum available for use where it is needed, partnering with two of the country's leading spectrum brokers – Spectrum Bridge and Comsearch – to ensure that its 24 and 39 GHz licenses were available for secondary market leasing arrangements. Doing so not only allowed the spectrum to be put to its most efficient use wherever needed, but also stimulated demand for additional wireless backhaul services by affording major carriers a cost-effective way to test the use of the 24 and 39 GHz bands.

Furthermore, FiberTower has engaged in a number of innovative tests and deployments in the millimeter wave spectrum. The company conducted the nation's first all-outdoor unit low profile POE PTP deployments at 24 GHz. Such deployments are useful for small cell backhaul, as well as broadband connectivity to schools, libraries, and other institutions[10]

On January 14, 2015, FiberTower successfully conducted what it believes to be nation's first (i) mobile test at 24 GHz, and (2) non-line-of-sight test at 24 GHz. Both tests were conducted in the Washington, D.C. area. In both tests, FiberTower utilized 24 GHz PMP technology. The baseline was to validate the amount of throughput, if any, of a mobility deployment (and then a NLOS deployment) as compared to a standard stationary fixed wireless deployment. This test utilized a low profile system that normally delivers 21Mpbs upload and 11Mbps download. The results were then extrapolated to a 180 Mbps full duplex PMP system and a 1 Gbps full duplex PMP system, as shown below. The following graphics and charts contain illustrations and data from these tests.

[10] *See* National School Health Library Broadband Coalition (SHLB Symposium 2014), FiberTower/Nexterra Presentation, *available at* http://www.shlb.org/index.cfm?action=page&page=109.

24GHz TEST

90 Degree Sectoral Antenna

Fixed and Mobile LOS and NLOS Test Sites

Mobility test at 24 GHz:

TABLE 1: Mobile deployments at 24GHz using standard PMP equipment calibrated to a maximum 11 Mbps download and 21 Mbps upload in stationary optimal conditions.

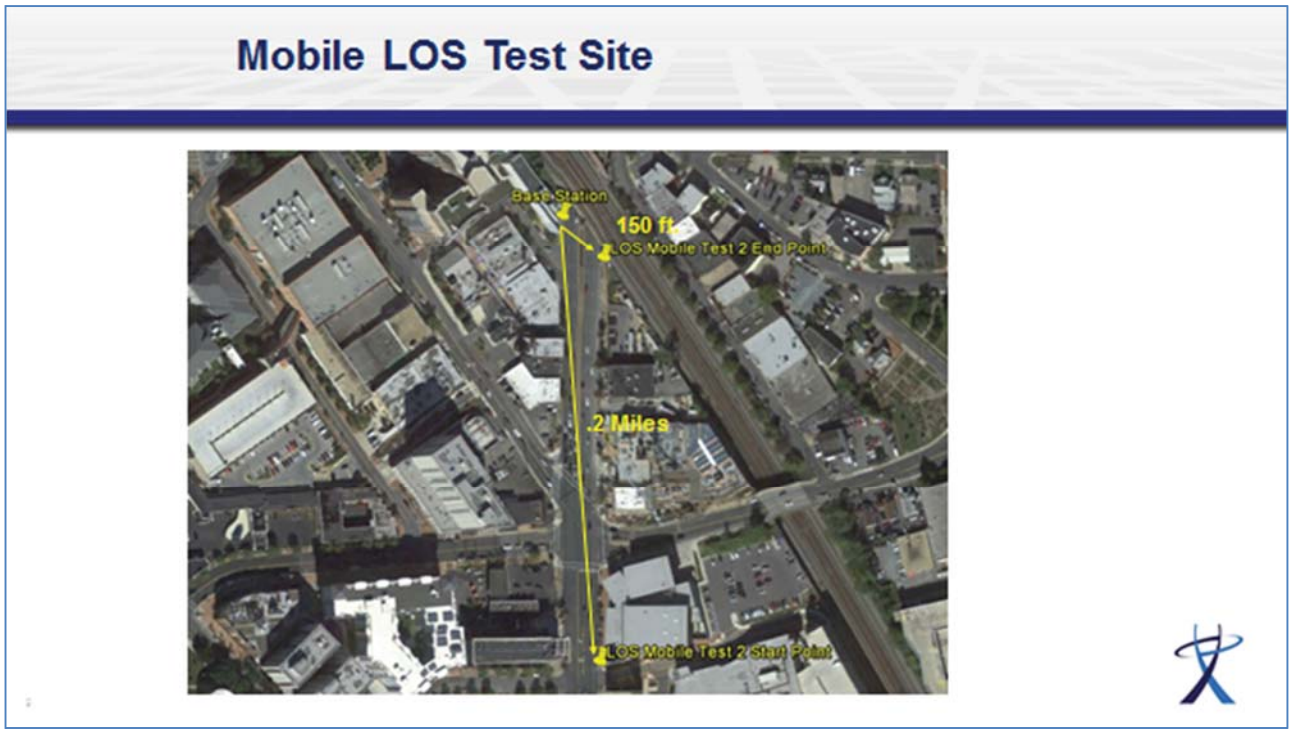
MODE	**MAXIMUM FUNCTIONALITY AS PERTAINS TO AVERAGE LINK SPEED (Mbps)**	**PERCENTAGE RELATED TO OPTIMAL STATIONARY FIXED CONDITIONS**
Normal line-of-sight connectivity	**11 Mbps avg. download; 21 Mbps avg. upload**	**100%**
Remote unit traveling at 6 miles per hour over 0.2 miles in line-of-sight conditions. State highway 28: Georgia Avenue, Silver Spring, Maryland.	5.3 Mbps avg. download; 14 Mbps avg. upload.	Download: 48.18% Upload: 66.67%
Remote unit traveling 1-2Mph backwards and forward 215 feet from base station, across railroad tracks and state highway.	9.5 Mbps avg. download; 20 Mbps avg. upload.	Download: 86.36% Upload: 95.24%

TABLE 2: Mobile 24GHz: Extrapolation to 180 Mbps full duplex system utilizing data from Table 1 actual mobility test.

MODE	**MAXIMUM FUNCTIONALITY AS PERTAINS TO AVERAGE LINK SPEED (Mbps)**	**PERCENTAGE RELATED TO OPTIMAL STATIONARY FIXED CONDITIONS**
Normal line-of-sight connectivity	**180 Mbps avg. download; 180 Mbps avg. upload**	**100%**
Remote unit traveling at 6 miles per hour over 0.2 miles in line-of-sight conditions. State highway 28: Georgia Avenue, Silver Spring, Maryland.	103.365 Mbps full duplex	Download: 48.18% Upload: 66.67% Combined for average 57.425%
Remote unit traveling 1-2Mph backwards and forward 215 feet from base station, across railroad tracks and state highway.	163.44 Mbps full duplex	Download: 86.36% Upload: 95.24% Combined for average 90.8%

TABLE 3: Mobile 24GHz: Extrapolation to 1 Gbps full duplex system utilizing data from Table 1 actual mobility test.

MODE	**MAXIMUM FUNCTIONALITY AS PERTAINS TO AVERAGE LINK SPEED (Mbps)**	**PERCENTAGE RELATED TO OPTIMAL STATIONARY FIXED CONDITIONS**
Normal line-of-sight connectivity	**1 Gbps avg. download; 1 Gbps avg. upload**	**100%**
Remote unit traveling at 6 miles per hour over 0.2 miles in line-of-sight conditions. State highway 28: Georgia Avenue, Silver Spring, Maryland.	572.5 Mbps full duplex	Download: 48.18% Upload: 66.67% Combined for average 57.25%
Remote unit traveling 1-2Mph backwards and forward 215 feet from base station, across railroad tracks and state highway.	908 Mbps full duplex	Download: 86.36% Upload: 95.24% Combined for average 90.8%



Non-Line-of-Sight (NLOS) Deflection Test at 24 GHz:

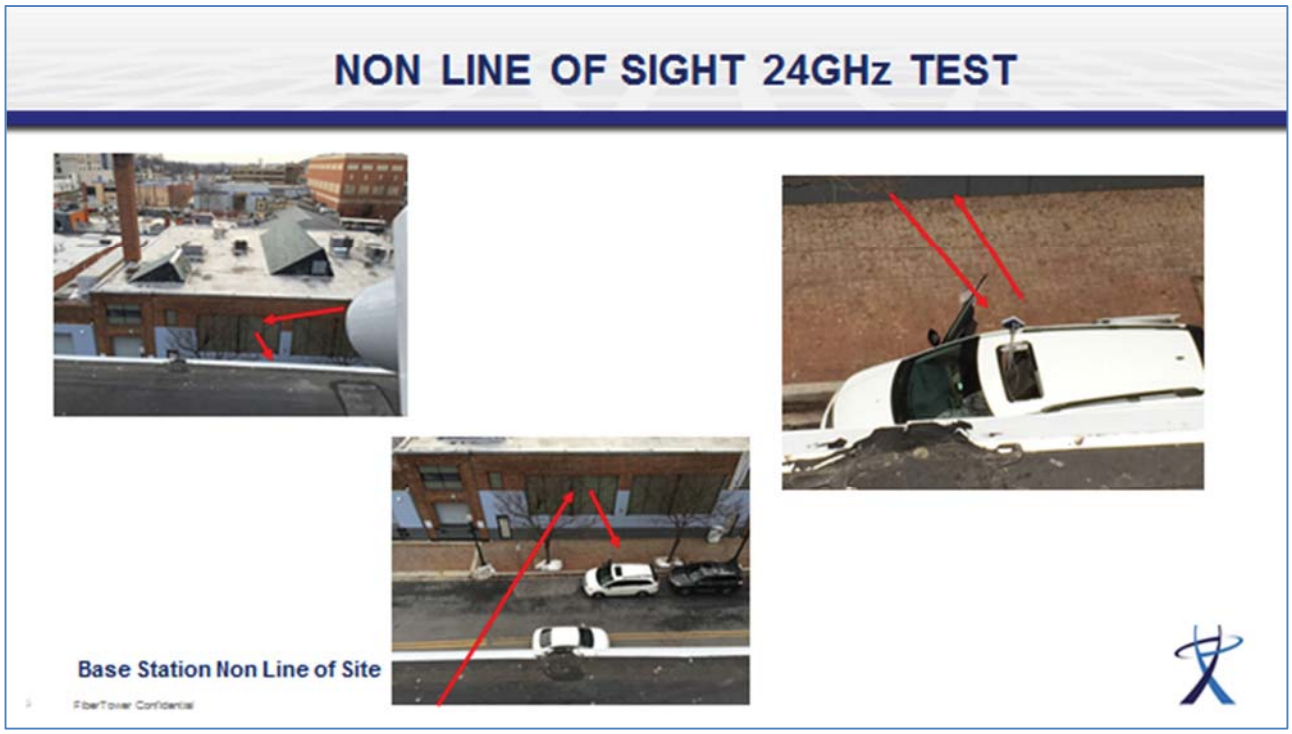


TABLE 4: Non-Line-of-Sight (NLOS) deployment at 24 GHz using standard PMP equipment calibrated to a maximum 11 Mbps download and 21 Mbps upload in stationary optimal conditions.

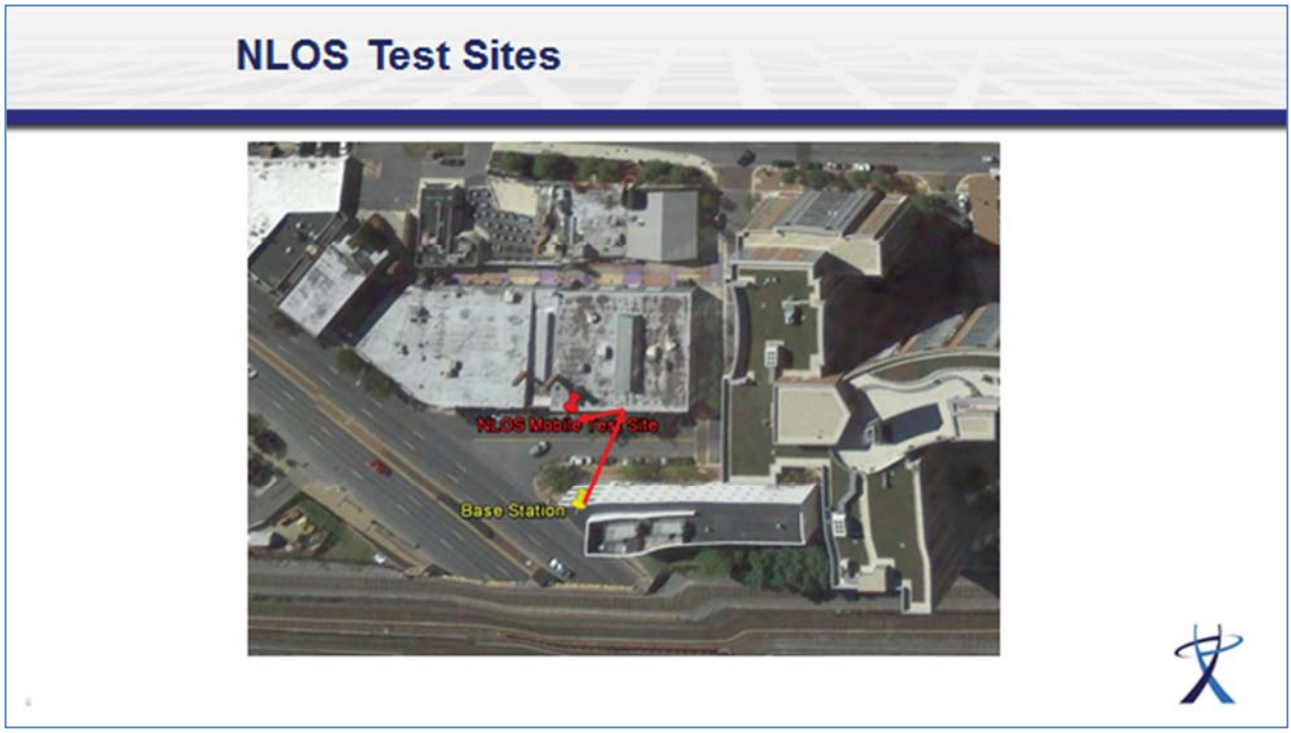
MODE	**MAXIMUM FUNCTIONALITY AS PERTAINS TO AVERAGE LINK SPEED (Mbps)**	**PERCENTAGE RELATED TO OPTIMAL STATIONARY FIXED CONDITIONS**
Normal line-of-sight connectivity	**180 Mbps avg. download; 180 Mbps avg. upload**	**100%**
NLOS PMP signal deflected off building across the street and down to street level stationary vehicle.	9 Mbps avg. download; 21 Mbps avg. upload.	Download: 81.18% Upload: 100%

TABLE 5: Non-Line-of-Sight (NLOS) 24GHz: Extrapolation to 180Mbps full duplex systems utilizing data from Table 4 NLOS deployment.

MODE	**MAXIMUM FUNCTIONALITY AS PERTAINS TO AVERAGE LINK SPEED (Mbps)**	**PERCENTAGE RELATED TO OPTIMAL STATIONARY FIXED CONDITIONS**
Normal line-of-sight connectivity	**180 Mbps avg. download; 180 Mbps avg. upload**	**100%**
NLOS PMP signal deflected off building across the street and down to street level stationary vehicle.	163.06 Mbps	Download: 81.18% Upload: 100% Combined: 90.59%

TABLE 6: Non-Line-of-Sight (NLOS) 24GHz: Extrapolation to 1 Gbps full duplex systems utilizing data from Table 4 NLOS deployment.

MODE	**MAXIMUM FUNCTIONALITY AS PERTAINS TO AVERAGE LINK SPEED (Mbps)**	**PERCENTAGE RELATED TO OPTIMAL STATIONARY FIXED CONDITIONS**
Normal line-of-sight connectivity	**1 Gbps avg. download; 1 Gbps avg. upload**	**100%**
NLOS PMP signal deflected off building across the street and down to street level stationary vehicle.	905.9 Mbps	Download: 81.18% Upload: 100% Combined: 90.59%



Finally, FiberTower continues to stay interested in, and at the forefront of United States national spectrum policy for the microwave and millimeter wave spectrum bands. For example, FiberTower recently worked with Alcatel Lucent to co-author a core submission to the 2015 World Radiocommunication Conference regarding developments in these spectrum bands.[11] FiberTower also has conducted research and published or presented its findings regarding 4G small cell and 5G solutions at various leading spectrum policy institutions including the National Spectrum Managers Association, The School, Health & Libraries Broadband Coalition, and the Telecommunications Industry Association.

As FiberTower's record makes clear, it has been, and continues to be, an industry leader in driving the investment, research and development, and technological innovation that will give rise to innovative, next-generation uses of spectrum above 24 GHz.

[11] *See* Exhibit A.

II. THE COMMISSION SHOULD PERMIT MOBILE WIRELESS SERVICES IN BANDS ABOVE 24 GHZ FOR MOBILE WIRELESS SERVICES WHILE CONTINUING TO PERMIT FIXED, WIRELESS BACKHAUL SERVICES.

FiberTower urges the Commission to foster and accelerate innovation by permitting the use of bands above 24 GHz for advanced mobile services. Doing so will be technologically feasible because, as demonstrated herein by mobile feasibility studies, standard PMP equipment is capable of mobility, existing FCC certified coordination procedures for PMP deployments over wide-area licenses already exist, and license holders are in the best position to self-protect fixed, fixed-portable and mobile operations within their license borders.

At the same time, it is critical that the Commission continue to permit the use of the 24 and 39 GHz bands for fixed, wireless backhaul given that small cell backhaul is the fundamental infrastructure from which 5G mobile networks will eventually be deployed. In the NOI, the Commission specifically inquires about the utility of the millimeter wave bands for backhaul and recognizes that "availability of economical backhaul solutions for small cell deployment is a challenge in today's environment and expects it to continue to be a challenge for access point deployment in the future."[12] The Commission seeks comment on the extent to which it is feasible to use bands above 24 GHz for backhaul, particularly NLOS backhaul, which may be necessary for dense cell deployments."[13]

FiberTower's research and development, and real-world product launches, illustrate that the 24 and 39 GHz bands contain superior characteristics for providing more efficient, higher-capacity spectrum use compared to lower bands, including the 700 MHz, 2.4 GHz, 3.5 GHz, and 5.8 GHz bands. As demonstrated by a Comsearch study commissioned by FiberTower,[14] antennae operating

[12] NOI, ¶ 45.

[13] *Id.*

[14] *See* Exhibit B.

in the 24 and 39 GHz bands are more directional making it possible to utilize a channel repeatedly within the same geographic area. The 24 GHz and 39 GHz bands also have lower propagation characteristics than spectrum operations in lower bands. Channels in the 24 and 39 GHz bands are wider and can typically carry more data than thinner channels at 700 MHz, 2.4 GHz, etc. Thus, channels in the 24 GHz and 39 GHz bands can more easily be reused within a geographic area to accommodate more bits per channel than the lower bands. Additionally, the 24 and 39 GHz operations typically have higher signal gain and lower latency than the lower bands, which facilitates premium spectrum use in the millimeter wave bands.

III. THE COMMISSION SHOULD ADOPT A REGULATORY FRAMEWORK THAT PROVIDES THE FLEXIBILITY AND REGULATORY PREDICTABILITY NECESSARY TO ACCELERATE INNOVATION, RESEARCH AND DEVELOPMENT, AND INVESTMENT IN BANDS ABOVE 24 GHZ.

FiberTower supports the Commission's goal of "develop[ing] flexible rules that accommodate as wide a variety of services as possible" and "promote coexistence between different services" in bands above 24 GHz.[15] In order to achieve this objective and continue to encourage innovation in these bands, it is essential that the Commission adopt a regulatory framework that provides service flexibility but also sufficient regulatory predictability to spur investment in research and development, and deployment of next-generation technologies. To this end, the Commission should adopt a regulatory framework that (i) ensures that both mobile services and fixed, wireless backhaul services can co-exist in the bands; (ii) permits incumbents in these bands to begin mobile uses; (iii) licenses vacant spectrum in these bands by auctioning exclusive rights to geographic areas; and (iv) implements performance and license renewal requirements that encourage investment while ensuring efficient use of the spectrum.

[15] NOI, ¶ 15.

A. The Commission Should Adopt Rules to Ensure That Both Mobile Services and Existing Fixed Wireless Backhaul Services Can Co-Exist in the 24 and 39 GHz Bands.

Maintaining existing fixed wireless backhaul services in the 24 and 39 GHz bands, while also permitting mobile wireless services in this spectrum, is technologically feasible due to the similarity between fixed PMP and mobile millimeter wave architectures, and due to established border coordination procedures and PFD limits in the 24 GHz and 39 GHz bands. The key is to leave that choice to the licensee. The Commission has previously indicated that a Notice of Proposed Rulemaking ("NPRM") is recommended for the 39 GHz band, and due to the similarities in the regulatory and propagation structures in both bands, it is certainly feasible and recommended for 24 GHz. Publishing an NPRM in the near future to further refine such standards is recommended.

B. The Commission Should Permit Incumbent Licensees in Bands Above 24 GHz to Begin Mobile Uses Based on Current Interference and Coordination Standards.

The Commission seeks comment on whether and, if so, how the Commission should authorize incumbent licensees that are currently licensed to provide fixed service, to begin mobile operations in these bands.[16] To the extent mobile deployments in the 24 and 39 GHz bands are not currently permitted under Commission rules,[17] the Commission should permit incumbent licensees

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[16] *See* NOI, ¶ 88.

[17] With respect to the 24 GHz band, the Commission explains: "There is no mobile allocation in either of the 24 GHz band segments. In the *24 GHz Report & Order*, the Commission found that it would be premature to allow mobile operations in the 24 GHz bands but reserved the discretion to revisit that issue if it is presented with technical information demonstrating that such operations would be technical feasible without generating interference to fixed operations and BSS feeder links in 24 GHz band segments." NOI, ¶ 85 (citations omitted).

With respect to the 39 GHz band, the NOI explains: "This band has a co-primary allocation for fixed and mobile services. The Commission provided licensees the flexibility to provide mobile services and stated the belief that "the issue of technical compatibility of fixed and mobile operations within a service area is one that can and should be resolved by the licensee." The Commission declined to permit mobile operations, however, until it conducted a separate

to provide mobile services pursuant to their existing geographic licenses using as guidance the same border interference and coordination standards that are currently in place. For example, Channels 35 through 39 are licensed in the 24 GHz service by Economic Areas for any digital fixed service. Channels may be used at either nodal or subscriber station locations for transmit or receive but must be coordinated with adjacent channel and adjacent area users in accordance with the provisions of 47 C.F.R. Section 101.509.

As noted herein, the highly portable small profile fixed wireless PTP and PMP technologies already in place in these bands essentially are the same technology platform that will be utilized when advanced mobile services are deployed in these bands.[18]

C. The Commission Should License Vacant Spectrum in Bands Above 24 GHz by Auctioning Exclusive Rights to Geographic Areas.

The Commission also seeks comment on how it should assign any new or unassigned rights for mobile use in bands above 24 GHz. FiberTower urges the Commission to adopt the licensing mechanism proposed in Option 1 of the NOI, which is to license vacant spectrum by auctioning exclusive rights to geographic service areas. As the Commission notes, this licensing approach already is used in the 24 GHz, LMDS, and 39 GHz bands, and similar geographic licenses are also already used for mobile wireless services in the bands below 3 GHz. FiberTower agrees with the Commission that this licensing mechanism would provide licensees seeking to deploy advanced mobile services with maximum flexibility within a geographic license area to deploy base stations as demand grows. Additionally, this licensing approach would help to ensure that licensees could prevent harmful interference to other providers since interference would need to be managed only along the perimeters of large service areas.

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proceeding to resolve inter-licensee and inter-service interference issues." NOI, ¶ 58 (citations omitted).

[18] *See generally* IEEE IMS, June 2014, Tampa, Florida.

To address the Commission's concern that, under this licensing approach, portions of license areas outside of high-traffic areas could end up lying fallow. The Commission should encourage licensees who may experience low-use regions within their license areas to make their spectrum available for lease, partitioning, or disaggregation through the secondary spectrum market proceeding processes.

D. The Commission Should Adopt New Performance and License Renewal Requirements in Bands Above 24 GHz That Encourage Investment and Ensure Efficient Use of Spectrum.

FiberTower strongly encourages the Commission to adopt its proposal that it adjust performance requirements to ensure maximum utilization of spectrum. As the Commission explains, licensees in the 24 GHz, LMDS, and 39 GHz bands currently must demonstrate substantial service at renewal, and a license automatically terminates if the licensee fails to demonstrate substantial service. The Commission's current standard, however, is too rigid, taking into account only actual construction of facilities and transmission of service in the license area, rather considering other forms of critical investments made by the licensee to place it in a position to eventually develop its spectrum on a nationwide or regional basis. Currently, critical investments in fiber, real estate, equipment warehousing, distribution networks, and the development of relationships with vital equipment partners are not taken into account by the Commission when evaluating compliance with substantial service requirements – even though such necessary, long-term investments often represent more than 90% of the actual costs of providing service. Additionally, under the current standard, if a licensee fails to meet the substantial service requirement, the entire license is automatically canceled.

As a result, the current standard discourages stakeholders from making the significant upfront investments necessary to drive innovation in the millimeter wave spectrum. Especially of concern are the lack of mechanisms for further encouraging the research and development of long-

term market-based solutions. Indeed, as emphasized by the Fixed Wireless Communications Coalition, the Commission's present renewal requirements "can have the perverse effect of actually hindering build-out. A company that fails to meet the requirements, and thereby loses its license, will have to walk away from whatever investment it has made in the band. A prudent licensee will refrain from making the substantial upfront investment … if it perceives a risk that it may lose its license before reaching the stage of profitable returns." Moreover, a millimeter wave license cancelled for these reasons may take years to relicense and put into use under the Commission's current rules, resulting in inefficient investment and use of the spectrum.

In the NOI, the Commission seeks comment on what type of performance requirements it should adopt in bands above 24 GHz. Maintaining the current requirements would only serve to discourage investment and hinder, rather than accelerate, innovation in the millimeter wave bands, thus allowing other countries and regions to move ahead of the U.S. in defining 5G services. This outcome would be directly contrary to the objectives shared by the Commission, FiberTower and other innovative stakeholders, and would be to the detriment of the U.S. economy. Instead, to more effectively encourage investment and build-out, FiberTower urges the Commission to adopt performance and license renewal requirements that more broadly evaluate whether a licensee is realistically prepared to offer service on a reasonable schedule to those who request it. Specifically, the Commission should measure the extent to which licensees are (i) actively engaged in research and development, (ii) working with manufacturers to bring new products to market, (iii) investing in systems for distributing equipment, (iv) training and contracting with network deployment personnel, (v) offering spectrum for use on the secondary spectrum markets, and (vi) offering to build network with an industry-standard timeline upon reasonable service request from customers.

IV. CONCLUSION.

FiberTower strongly supports the Commission exploring innovative uses of the spectrum bands above 24 GHz. Permitting mobile uses of these bands will spur research and development, and the resulting technological innovation, which will fuel the creation of 5G mobile services in the U.S. As an industry leader in developing innovative solutions in the millimeter wave spectrum bands through significant investment, research and development, and real-world product launches, FiberTower encourages the Commission to permit mobile services in the bands above 24 GHz while also continuing to permit critical fixed, wireless backhaul services in the 24 and 39 GHz bands. The Commission should adopt a regulatory framework that provides the flexibility necessary to facilitate and accommodate future innovations, as well as the regulatory predictability necessary to encourage industry investment. This regulatory framework should include, among other components, new performance and license renewal requirements that drive investment, encourage research and development, reward the building of systems that can respond to customer demands for millimeter band services within an industry-standard deployment timeline, and encourage offering services on the secondary spectrum markets. All these suggestions help ensure efficient use of the spectrum. By taking these steps, the Commission can accelerate innovation and investment in the millimeter wave spectrum, and ensure that the United States is a global leader in the development of cutting-edge, next-generation mobile services in the small cell and 5G markets.

Respectfully submitted,

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EXHIBIT A

ITU-R FACT SHEET

Working Party: WP 5C Document:USWP5C-14-02/01Rev.4_for NC

Date: 9 October 2014

Document Title: Proposed revisions to preliminary draft new Report ITU-R F.[FS USE-TRENDS], Annex 6 to Document 5C/298

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Purpose/Objective: To provide proposed revisions to Preliminary Draft New Report ITU-R F.[FS USE-TRENDS]

Abstract: This contribution provides US proposals for revisions which include the following:

1) Examples of point-to-multipoint systems
2) Discussion of spectrum requirements in section 5

Fact Sheet Preparer: Rick Krock

United States of America

Proposed Revisions to Preliminary Draft New Report ITU-R F.[FS USE-TRENDS], "Fixed service use and future trends"

Introduction

Preliminary draft new Report ITU-R F.[FS USE-TRENDS] has been under development in ITU-R Working Party 5C (WP 5C) in meetings and via a Correspondence Group for some time.

Discussion

In examining the current version of the preliminary draft new Report (Annex 6 of 5C/298), the United States noted some further areas for improvement. In order to advance work on this document, the United States proposes two revisions and the incorporation of supporting hyperlinks.

In particular, at the previous meeting, two items were identified that required further development:

1) the material the United States had provided in 5C/281 for Section 5.2 'Capacity and spectrum requirements' was substantially modified during the meeting. The United States reserved its right to come back to that text with further modifications. This material is included via editorial modifications, the addition of a footnote, and an additional sentence at the end of Section 5.2; and
2) the United States was asked to provide examples of point-to-multipoint systems. This material is included via a footnote to Appendix 1 of the preliminary draft new Report.

The United States notes the significant progress that was made at the previous meeting in addressing the Editor's Notes and outstanding issues. The United States is open to considering this document, with the revisions proposed herein, for elevation and consideration at Study Group 5.

Proposal

The United States proposes that WP 5C consider the proposed revisions reflected in the Attachment in order to advance work on the preliminary draft new Report ITU-R F.[FS USE-TRENDS].

Attachment: Proposed revisions to preliminary draft new Report ITU-R F.[FS USE-TRENDS] in Section 5.2 and Appendix 1. (Only modified portions are reproduced in the Attachment.)

Attachment
Proposed revisions to preliminary draft new Report
ITU-R F.[FS USE-TRENDS]
in Section 5.2 and Appendix 1.
(Only modified portions are reproduced in the Attachment.)

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5.2 Capacity and spectrum requirements

Although there has been an order of magnitude increase in mobile capacity requirements and new spectrum being sought for mobile broadband applications over the last decade, it is currently too early to tell definitively how the overall corresponding fixed service spectrum requirements are likely to change in the future. As broadband network topologies change and capacity requirements increase a corresponding shift to higher capacity fixed links will also become necessary, potentially placing more challenges on the available spectrum, particularly in hot spot areas. Advances in technology and different architectures such as 'C-RAN' and 'Fronthaul' where baseband data is transported could also lead to significant step changes in the amount of data being required to be transported via a given link (e.g. 10 GBits / s and possibly higher), leading to wider channels and increased spectrum use. NLOS systems could also become a more significant feature of network planner's requirements with the associated spectrum being necessary to be identified. These areas all require further study in order to better quantify the changing spectrum requirements for the future.

In addition the other aspect to the spectrum question is the corresponding current spectrum *supply* for the fixed service and whilst currently spanning a wide range of bands from the UHF frequencies up to the higher mmWave bands this could also change in the future depending on the new applications or services that are looking for access in the higher bands, currently used by fixed service systems. For example mobile broadband systems are currently being considering in a range of bands above 6GHz, which may impact the availability of the spectrum for the FS in the future.[11bis] This may be partly mitigated by advances in technology enabling the fixed links to

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[11bis] [Footnote 11bis] Some bands allocated and used for the fixed service are also being considered for future mobile use. See:

- *FCC Announces Tentative Agenda for 10/17/2014 Meeting,* (Including a *Notice of Inquiry* about use of bands above 24GHz for mobile) FCC Release 9/26/2014: http://transition.fcc.gov/Daily_Releases/Daily_Business/2014/db0926/DOC-329610A1.pdf . "Spectrum Frontiers NOI: The Commission will consider a Notice of Inquiry to explore innovative developments in the use of spectrum above 24 GHz for mobile wireless services, and how the Commission can facilitate the development and deployment of those technologies."

- *Nokia Networks' Moiin on the pillars of 5G and the likelihood of a new air interface,* Fierce Wireless, 10/2/2014: http://www.fiercewireless.com/tech/special-reports/nokia-networks-moiin-pillars-5g-and-likelihood-new-air-interface

- Fierce Wireless *FCC Explores Wireless Operations Above 24GHz, Presaging 5G Network, 9/29/2014*: http://www.fiercewireless.com/story/fcc-explore-wireless-operations-above-24-ghz-presaging-5g-networks/2014-09-29

correspondingly increase throughput and reliability and the addition, of new fiber projects that have increased fixed station access, in urban and suburban locations, obviating the need for previous fixed backhaul from those locations. However, it still currently remains uncertain how these will develop in different regions of the world and the associated impact on the spectrum used by fixed service systems. Further uncertainty is added to the determination of spectrum requirements as not all of the spectrum allocated to the Fixed Service in the Radio Regulations has been made available for such use on a national basis. Making this already-allocated spectrum available for use by fixed service systems may address a significant portion of any national/regional spectrum requirements.

6 Future subjects for the development of FWS applications

Future subject for the development of FWS applications are considered from the view of the following elements:

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- *The 5G Channel: Path to 5G,* TIA with Samsung, Dragonwave, Current Analysis & FiberTower, 9/17/2014*: https://www.youtube.com/watch?v=XQZsQWUM0dg*

- *Scientists Twist Radio Beams to Send Data: Transmission Speeds Reach 32 Gigabits Per Second,* 9/16/2014 http://pressroom.usc.edu/scientists-twist-radio-beams-to-send-data/

- *The 5G Roadmap: How Do We Prepare for Tomorrow's Wireless Networks?,* 9/06/2014, Fierce Wireless video panel with AT&T, Verizon, Ericsson, Intel, 4G Americas & Nokia: http://www.fiercewireless.com/pages/5g-roadmap-how-do-we-plan-tomorrows-wireless-networks

APPENDIX 1 [of Annex 6 of 5C/298]

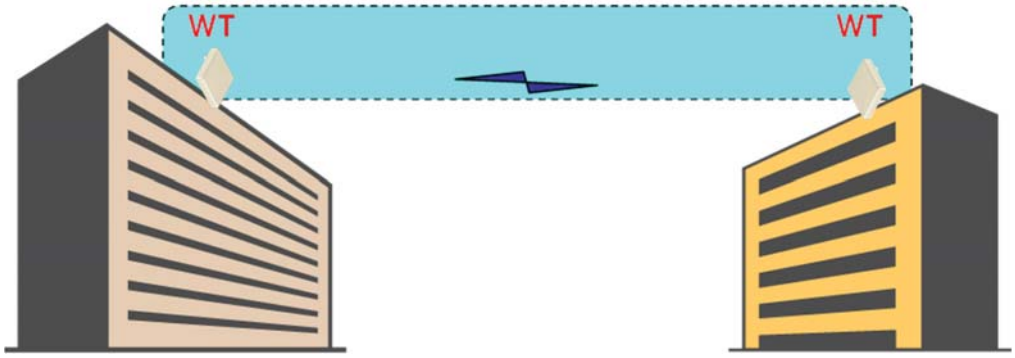
Applications making use of FWA equipment

While FWA systems are designed as access networks, such equipment can be also used for various other applications. Figure 27 depicts examples of such applications.

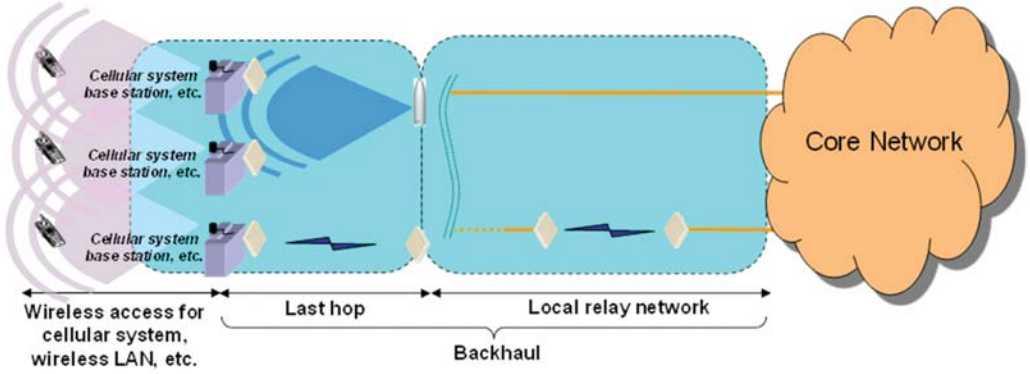
FIGURE 27

Examples of applications making use of same equipment as FWA

(a) Bridging two local/private area networks between separate buildings



(b) P-P and P-MP backhaul[1]



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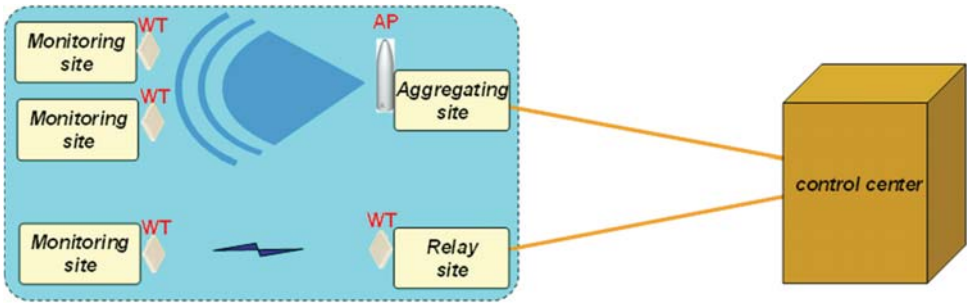
[1] Fixed service, millimeter band, point-to-multipoint systems are in the marketplace and additional systems are under development.:

(i) http://www.jrcamerica.com/img/products/wipas/brochure/JRC%20FWA%20WIPAS.pdf

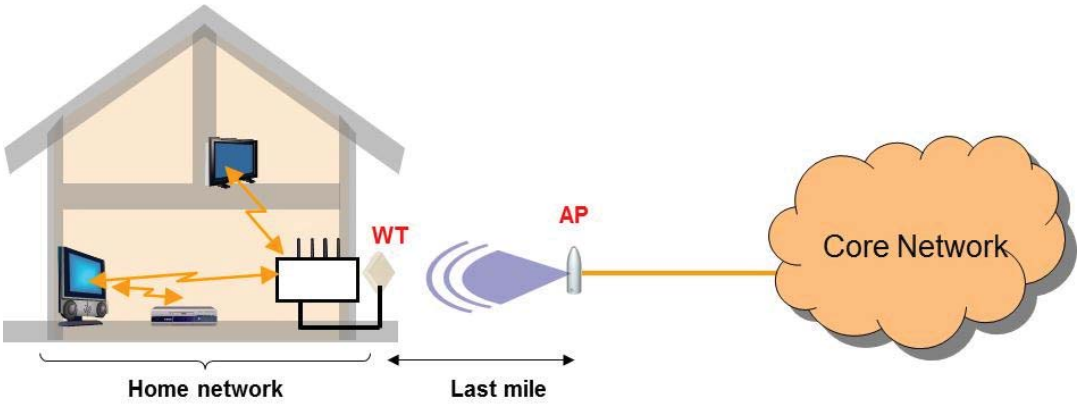
(ii) Federal Communications Commission (FCC) Radio Station Authorization, Call Sign: WPOH633: http://wireless2.fcc.gov/UlsApp/UlsSearch/license.jsp?licKey=8653

(iii) https://apps.fcc.gov/oetcf/els/reports/STA_Print.cfm?mode=current&application_seq=60763&RequestTimeout=1000

(c) Machine type communications



(d) Home networks connected to FWA systems



One example of such application is to bridge two local/private networks between separate buildings. These networks are usually IP-based networks and sometimes operated by private entities. A link bridging networks using FWA systems can be installed rapidly and economically making use of the advantage aspects listed in section 2. Additionally, as demand for IP communication increases same as the demand for ordinary FWA systems, broadband IP communication interfaces are also required for this application.

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EXHIBIT B

Typical Channel Bandwidth (MHz)	Band	Modulation	Bandwidth	Theoretical Bandwidth Efficiency (bps/Hz)	Practical Bandwidth Efficiency (bps/Hz)	Typical Channel Throughput (Mbps)
6 MHz	700 MHz	128 QAM	6	7	6	36
22 MHz	2.4 GHz	128 QAM	22	7	6	132
10 MHz	3.5 GHz	128 QAM	10	7	6	60
20 MHz	5.8 GHz	128 QAM	20	7	6	120
40 MHz	11 GHz	128 QAM	40	7	6	240
40 MHz	24 GHz	128 QAM	40	7	6	240
50 MHz	38 GHz	128 QAM	50	7	6	300