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

In the Matter of:	)	
	)	
Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz	)	GN Docket No. 17-183
	)	
	)	

COMMENTS OF AT&T SERVICES, INC.

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AT&T Services, Inc. ("AT&T"), on behalf of the subsidiaries and affiliates of AT&T Inc. (collectively, "AT&T"), hereby submits the following comments in response to the Federal Communications Commission's ("Commission") *Notice of Inquiry* in the above-captioned proceeding.[1] The *Notice* seeks input on expanding licensed and unlicensed use of spectrum between 3.7 GHz and 24 GHz ("mid-band" spectrum) to accommodate continued growth in mobile broadband.[2] Given the importance of spectrum as an input to the mobile broadband market, AT&T commends the FCC for undertaking to develop a spectrum pipeline capable of accommodating future demand. AT&T also believes that the Lower C-Band warrants further investigation and holds some promise for flexible use. The 6 GHz microwave bands, on the other hand, are not compatible with expanded flexible uses, nor would the terrestrial microwave

[1] *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, FCC 17-104, GN Docket No. 17-183 (Aug. 3, 2017) ("*Notice*").

[2] The *Notice* specifically seeks comment on the potential for terrestrial mobile use of the 3.7-4.2 GHz band ("Lower C-Band"), the 5.925-6.425 GHz band ("Lower 6 GHz Band"), and the 6.425-7.125 GHz band ("Upper 6 GHz Band" and, collectively with the Lower 6 GHz Band, the "6 GHz Bands"), but also solicits input on the use of other bands from 3.7 GHz to 24 GHz. In such regard, AT&T has tried in these Comments to utilize "Lower C-Band" when referring specifically to the downlink portion of the C-Band satellite allocation, and has referred to use of satellite transmissions involving both the uplink and downlink bands as either "C-Band" or "C-Band FSS."

links using this spectrum be good candidates for relocation to other frequencies. AT&T urges the Commission to consider alternatives, including lesser used spectrum above 7 GHz, as an alternative.

I. INTRODUCTION AND SUMMARY

AT&T agrees with the Commission that mobile broadband "represents a critical component of economic growth, job creation, public safety, and global competitiveness."[3] The *Notice* appropriately recognizes that pro-active consideration of future expansion bands is a necessary predicate to the "goal of establishing comprehensive, sound, and flexible spectrum policies, enabling innovations and investment to keep pace with technological advances, and maintaining U.S. leadership in deployment of next-generation services in the long term."[4] Having been on the front lines of the mobile data revolution for almost four decades, AT&T can attest that future growth in mobile broadband connections—and exponential growth in the consumption of data by those connections—can only be accommodated by regular infusions of additional spectrum. AT&T therefore strongly supports the Commission's efforts to extend the horizon of spectrum policy planning with this *Notice*.

By now, the explosive growth in demand for mobile broadband is a well-documented fact. The Commission's recently adopted *20th Mobile Competition Report* notes that not only did the number of wireless mobile subscriber connections grow 5 percent over the last reported year, but also "wireless data volumes totaled 13.7 trillion MB in 2016, an increase of approximately 42 percent from 9.6 trillion MB in 2015, and an increase of approximately 238 percent from the

[3] *Notice* at ¶5.

[4] *Id.* at ¶1.

4.1 trillion MB reported in 2014."[5] The number of connections is expected to explode as the "Internet of Things" takes advantage of fifth generation ("5G") technology and technical enhancements to the 4G network to bring the benefits of mobile interactivity to an array of connected objects. And, as higher and higher data speeds are rolled out at lower and lower latencies, new applications are expected to take advantage of these capabilities to drive data demands even higher.

AT&T recognizes that spectrum to support this demand will not come easily; nearly every megahertz of reallocated spectrum is likely to create dislocation, to require more efficient architectures, to require more extensive sharing, and to precipitate significant changes in spectrum usage across a range of industries. AT&T, for its part, is already engaged in such efforts, including its FirstNet public/private partnership, its efforts to realize bi-lateral sharing with U.S. Government operations, its work to re-purpose commercial bands with more efficient and higher valued uses,[6] and its ongoing work to employ its existing spectrum holdings more efficiently. For example, after extensive joint testing, AT&T recently was able to conclude an innovative Memorandum of Understanding with the Department of the Navy that permitted a significant reduction in the protection zones for AWS-1 licensees near Marine Air Corps Stations in Cherry Point, North Carolina and Yuma, Arizona.[7] AT&T has also been at the forefront of working with Federal agencies to leverage commercial technologies in mission critical

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[5] *Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, Twentieth Report, FCC 17-126, WT Docket No. 17-69 at ¶5 (Sept. 27, 2017) ("*20th Competition Report*").

[6] *See, e.g.*, "Smart Grid Finds a Home in WCS Band," AT&T Public Policy Blog (Mar. 30, 2016); available at: https://www.attpublicpolicy.com/fcc/smart-grid-finds-ahome-in-the-wcs-band/ (last visited Sept. 25, 2017).

[7] *See Notice of Ex Parte Communication*, ET Docket 00-258 (filed July 18, 2017).

applications, such as its work with the Department of the Army to upgrade their Combat Training Centers with 4G LTE.[8] AT&T has also been at the forefront of re-inventing its own wireless network, re-farming spectrum and transitioning to newer air interfaces; implementing carrier aggregation, MIMO and other intra-generational network enhancements; densifying its network and adding distributed antenna systems and pico-cells; and deploying technologies like LTE License Assisted Access ("LAA") to leverage unlicensed spectrum with licensed networks to further enhance spectral efficiency.

With that backdrop, AT&T is encouraged by—and supports—the *Notice*, but cautions that there are significant challenges inherent in reallocation or sharing of the candidate bands identified by the Commission. AT&T is a substantial user of the Lower C-Band for fixed satellite services ("FSS"), as well as a major licensee in the 6 GHz microwave bands. While AT&T agrees that the Lower C-Band warrants further investigation and may at some future point be appropriate for expanded use, the band is not a carbon copy of other FSS/terrestrial sharing scenarios the FCC has addressed or is addressing in the *Spectrum Frontiers* proceeding.[9] AT&T also believes the 6 GHz microwave bands are not suitable candidates for either shared mobile use or for relocation—these bands are densely populated and serve societally beneficial requirements that cannot technically be satisfied using other microwave bands or alternative transmission technologies. AT&T therefore believes it may be more pragmatically feasible to consider bands above 7 GHz bands for shared terrestrial mobile use or relocation.

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[8] ARMY Magazine at 47 (Feb. 2014); available at: http://ausar-web01.inetu.net/publications/armymagazine/archive/2014/Pages/February.aspx (last visited Sept. 25, 2017).

[9] *See Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014 (2016) ("*Spectrum Frontiers*") at ¶¶43-69, 384.

II. AT&T SUPPORTS FURTHER INVESTIGATION INTO LOWER C-BAND SHARING TO PROVIDE ADDITIONAL LICENSED BROADBAND SPECTRUM

The *Notice* has suggested the potential use of the Satellite Lower C-Band—3.7-4.2 GHz—for broadband mobile use, seeking comment on the potential for both licensed and unlicensed sharing. AT&T uses the incumbent C-Band FSS systems to support video distribution for its DirecTV and U-Verse operations, as well as within its long haul telecommunications plant. As AT&T discusses below, C-Band FSS has technical characteristics that cannot be readily shifted to the Ku-Band. Moreover, the more dynamic nature of the Lower C-Band earth station deployments means that terrestrial sharing is not as straightforward as in the 24 GHz band (where AT&T is also a licensee) or the 28 GHz band—implementing a workable sharing scheme will be much more complicated than similar actions taken or being taken in the *Spectrum Frontiers* bands. With those caveats, AT&T does believe that the Lower C-Band sharing warrants further investigation and, at a minimum, the FSS rules should be revised to promote efficiency in view of the evolution of the C-Band.

A. AT&T Makes Extensive Use of the C-Band for Both Video Distribution and Long Haul Telephone Services

AT&T utilizes the C-Band as a crucial component of both its video distribution networks—DirecTV and U-Verse—as well as within its telecommunications plant. C-Band FSS, in fact, is one of the principal distribution mechanisms for video content owners to transmit programming to MVPDs, such as DirecTV and U-Verse. And DirecTV and U-Verse alone serve nearly 47 million consumer video connections, which underscores the importance of these facilities to the American public.[10] DirecTV maintains four C-Band facilities, each with multiple C-Band antennas: (i) a Los Angeles Broadcast Center ("LABC") within the Los Angeles

[10] "2Q 2017 AT&T by the numbers," available at: https://www.att.com/Common/about_us/pdf/att_btn.pdf (last visited Sept. 25, 2017).

metropolitan area;[11] (ii) a California Broadcast Center ("CBC") in El Segundo, California; (iii) a facility in Castle Rock, Colorado; and (iv) a facility in Winchester, Virginia. U-Verse, for its part, has a cluster of 25 C-Band antennas in Mission, Kansas. While some of these facilities are rural, or quasi-rural, both the LABC and the CBC are in densely populated areas that are not naturally (or otherwise) shielded—both facilities are in flat areas resembling parking lots without space for earthen berms or other radiofrequency barriers. The LABC situation is further complicated by its adjacency to residential buildings.

Figure 1: Google Earth Satellite View of DirecTV's LABC Antenna Farm

[11] One journalist noted that "[s]tepping into DIRECTV's Los Angeles Broadcast Center (LABC) is like checking into the television equivalent of the largest airport you've ever seen." "DIRECTV's Los Angeles Broadcast Center Serves as Tech Nerve Center," SVG News (Nov. 11, 2014), available at: https://www.sportsvideo.org/2014/11/11/directvs-los-angeles-broadcast-center-serves-as-tech-nerve-center/ (last visited Sept. 25, 2017).

Figure 2: Google Earth Satellite View of AT&T U-Verse Mission, KS Lower C-Band Antenna Farm

Although the use of C-Band by DirecTV and U-Verse appears relatively static, it is also relatively inflexible. Specifically, while many programming content providers now offer fiber transmission of programming, many content producers continue to utilize C-Band FSS for distribution or redundancy, so C-Band FSS use supporting video content distribution does not appear to be decreasing. Among available satellite bands, C-Band is particularly prized for cable and IP video transmission, since signal quality and uptime are critical issues. Weather impacts, such as fog, particles and rain, cause signal fade in the Ku-Band, and make the C-Band a better choice for these types of applications. And even where fiber optic transmission is used, C-Band is often also deployed for redundancy. While fiber is highly reliable, fiber systems can be subject to cable cuts—or "backhoe fade"—and AT&T has found that C-Band availability therefore often exceeds that of fiber. As a final matter, while AT&T is the operator of many fixed earth stations receiving video programming for distribution, the choice of how to transmit

the content—including the band, satellite and transponder used—are not under the exclusive control of the MVPD, but rather dictated by the content provider or subject to joint negotiation.

Not all C-Band FSS use is stationary, however. While DirecTV and U-Verse C-Band systems are typically large, fixed dish applications where coordination might be feasible, the C-Band is also used for highly important temporary, transient video applications. Videocast events—whether news, sports or entertainment—can occur almost anywhere. In situations where the event is pre-planned, the C-Band is the transmission technology of choice. While the Ku-Band is also used on occasion, use of Ku-Band earth stations is disfavored for remote transmission unless rapid deployment is of paramount importance—which generally means the event is late-breaking news where the public is more tolerant of video transmission anomalies and artifacts like sparkling or freeze-framing.

C-Band earth stations are also used by AT&T within its telecommunications plant. One key use is for circuit restoration in natural disasters, such as efforts undertaken following Hurricanes Harvey and Irma this year. AT&T's disaster response teams maintain auto-deploy C-Band systems for such restoration work because the low cost and ample market capacity in C-Band is often crucial to bringing communications back on-line expeditiously. For example, during Hurricanes Harvey and Irma, most of the Ku-Band transponders were sold out, yet C-Band transponders were readily available and allowed AT&T to establish 150-200 Mbps links to its deployables in Texas and Florida.

AT&T also has 15 C-Band earth stations, located in California, Georgia, Hawaii, Pennsylvania and West Virginia, that are used to support its international telecommunications operations. While this use has neither increased nor decreased significantly over that past few years, these facilities are critical to U.S. telecommunications infrastructure capabilities.

As a final matter, AT&T Alascom has a mix of 183 fixed and transportable earth stations to provide basic PSTN telecommunications for remote villages in Alaska. The interconnectivity provided by these facilities is essential for the safety and well-being of residents at these locations because it is often the only communications infrastructure available to the local communities. Given the relatively static nature of these operations—or their remoteness—AT&T has been able to coordinate use of these facilities with, for example, nationwide non-exclusive license holders in the 3.65-3.7 GHz band.

B. The FCC Should Investigate Further the Potential for Terrestrial Mobile Sharing in the Lower C-Band, Including Conducting A Rigorous Audit of C-Band Use

Despite its usage and reliance on C-Band satellite systems, AT&T believes there may be opportunities for sharing the Lower C-Band with terrestrial operations. The characteristics of Lower C-Band use, however, are unlike the sharing scenarios the Commission has previously addressed in the 24 GHz and 28 GHz millimeter wave bands. The millimeter wave bands involve a very stable or just emerging environment, a very small number of existing FSS users, and coordination with FSS in uplink—Earth-to-space—bands. By contrast, the Lower C-Band not only involves many more earth station facilities, including earth stations located proximate to very densely populated areas, but it also involves a requirement to accommodating new facilities, including earth stations that may have to be rapidly deployed at temporary locations to support restoration after natural disasters or transient broadcast events. The Lower C-Band is also a downlink—space-to-Earth—band, which complicates sharing because of the broad spot beams and large coverage areas used by geosynchronous satellites in the band. Nonetheless, AT&T believes there is the potential for some dynamic sharing of the band, given the coordinated nature of the earth stations in the bands. AT&T therefore believes the FCC should take further steps to investigate flexible use, starting with conducting a rigorous audit of C-Band use, and the

interference susceptibility of such uses, and working with industry to develop protocols for interference tests in the lab and in real world environments.

As an initial matter, as the FCC is well aware, there are a vast number of Lower C-Band receive-only ("RO") earth stations that are registered in the FCC's databases, and therefore are entitled to interference protection, that may not actually be in use. Indeed, many of these dishes were used for reception of video programming in an era where paid content was transmitted over the C-Band "in the clear." That type of use peaked in the 1980s, but has declined since then—now that much of the satellite-transmitted content is encrypted, many of these dishes may not be used for any purpose at all. AT&T therefore supports auditing the C-Band registration database to identify RO stations that are actually being used, as opposed to those where the owner has simply neglected to take the initiative to de-register.

Similarly, while C-Band licenses are auto-terminated if the station is removed, the regulatory scheme continues to offer protection for facilities that may still be constructed, but which have no operational use. In many terrestrial services, auto-termination occurs after a period of non-use, whether the physical facilities remain in place or not.[12] While a strict discontinuance rule may not be appropriate for Lower C-Band earth stations, AT&T would support rule changes designed to de-authorize facilities that are no longer in use.. Any such rule would have to recognize that C-Band earth stations are often used for redundant, backup circuits for critical communications, which may be intermittent, as well as the need for rapidly deployable facilities for natural disasters and itinerant operations that may have irregular operational requirements but still serve valuable functions. Both of these situations might be

[12] *See, e.g.*, 47 C.F.R. §101.65 (defining automatic forfeiture for voluntary discontinuation of 30 days or more, and involuntary discontinuation for a period of one year).

addressed with a use requirement that is broad enough to accommodate "hot standby" operation and testing, or some form of qualification for temporary fixed operational status.

As a final matter, the Fixed Wireless Communications Coalition, Inc. ("FWCC") and others have noted that the satellite facilities in the Lower C-Band are typically protected on a "full band, full arc" basis, which allegedly creates needless inefficiencies in band sharing.[13] Even if an earth station is only using a single 36 MHz transponder, its potential use of the entire band is protected and may preclude other uses. Similarly, even though an earth station may be pointed at a single satellite orbital slot, the potential use of the earth station to reach a satellite in any visible geosynchronous orbital slot is protected. As FWCC observed,[14] however, there are situations where such protection is warranted. For example, certain satellite outages may require a carrier or video content provider to switch transponders or even switch satellites. Some C-Band earth stations must be in a position to respond to those changes by re-pointing to a different orbital location or retuning. In AT&T Alascom's case, the satellite currently being used is nearing its end-of-life, which means that replacement capacity will need to be brought online, which may also require retuning or repointing. At the same time, there are undoubtedly narrower uses of the band that do not require full band, full arc reservations. Thus, while AT&T submits that full band, full arc protection is beneficial and should be retained where appropriate and reasonable, an audit to separate inappropriate and inefficient use should be undertaken.

Thus, there are several measures that the FCC could take in the near term to better understand the facilities that exist in the Lower C-Band and the protection such facilities should

[13] Fixed Wireless Communications Coalition, Inc. Petition for Rulemaking, RM-11778 (Oct. 11, 2016).

[14] *Id*. at 2 (noting "[a] subset of earth stations, such as teleports, must be able to access multiple satellites and to add and change satellites on short notice").

be accorded. Once the range of uses is fully understood and characterized, AT&T believes workable sharing mechanisms might be explored that would permit the continuation of important C-Band functions while still permitting some terrestrial mobile use in the band. At a minimum, further understanding of the extent of actual Lower C-Band use may ultimately allow the FCC to adopt measures that would permit more efficient shared use of the band among existing services.

III. GIVEN THE IMPORTANCE OF 6 GHz MICROWAVE, SHARING OR RELOCATION OF EXISTING USES DOES NOT APPEAR FEASIBLE

A. The 6 GHz Microwave Bands Are Heavily Populated with Key Components of the National Telecommunications Infrastructure

The 6 GHz microwave bands—the 5.925-6.425 GHz band and the 6.425-7.125 GHz band—serve critically important functions and are densely populated spectrum bands. The *Notice* recognizes as much, noting that there are approximately 27,000 licenses issued for the lower 6 GHz band and 22,900 for the upper 6 GHz band.[15] Because the FCC issues authorizations for the endpoints of microwave links, a single license can be associated with multiple paths, and therefore the number of licenses issued somewhat understates actual use. AT&T has reviewed the ULS database and found a comparable number of licensees in these bands,[16] but found that those licenses supported over 100,000 discrete transmitter/receiver links. AT&T alone holds 8,138 licenses supporting backhaul for its wireless network and main telecommunications links for its landline network.

As shown in *Figure 3* and *Figure 4* below, the links defy geographic classification—there are links with both endpoints in urban areas, links backhauling rural traffic to urban centers, and extensive rural networks with both endpoints in remote areas. These links are critical to our

[15] *Notice* at ¶¶25, 35.

[16] Based on September ULS data, AT&T found 27,960 active licenses in the lower 6 GHz band and 22,505 in the upper band.

telecommunications infrastructure, and AT&T—along with other users—have forecasted increased reliance on these bands as cellular networks continue to densify.

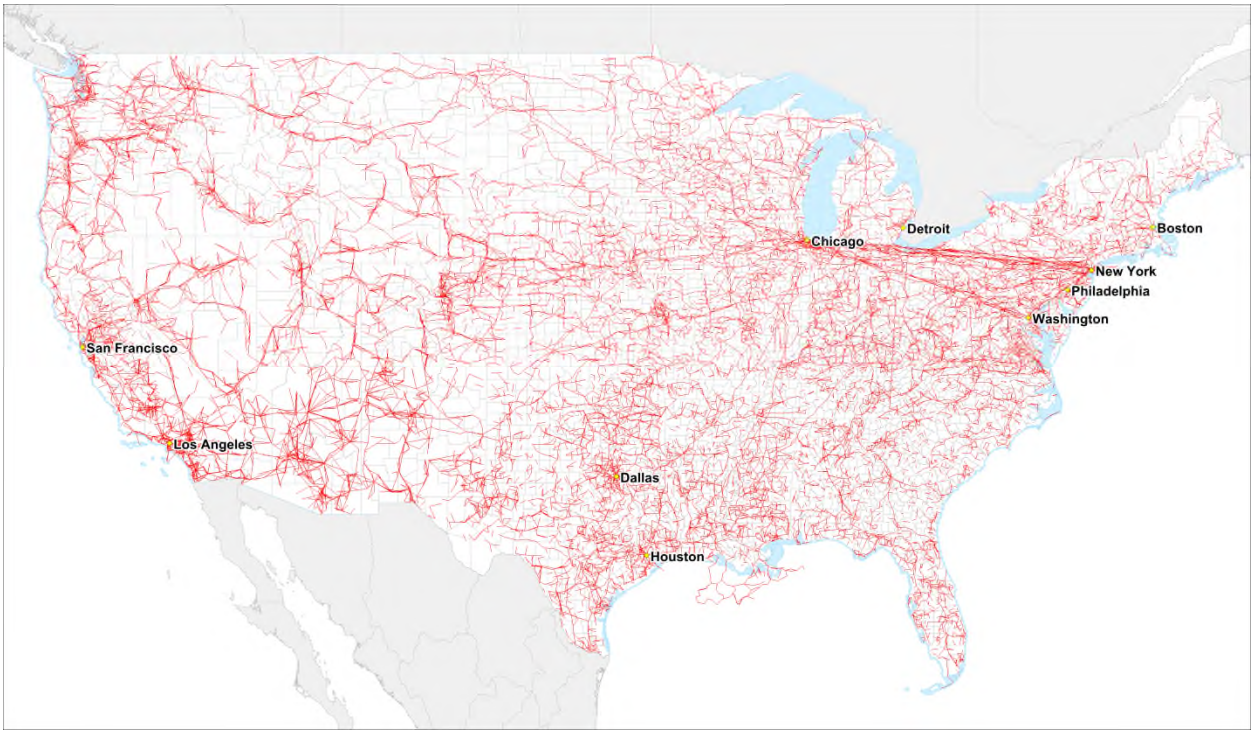

Figure 3: Continental U.S. Links in the Lower 6 GHz Microwave Band

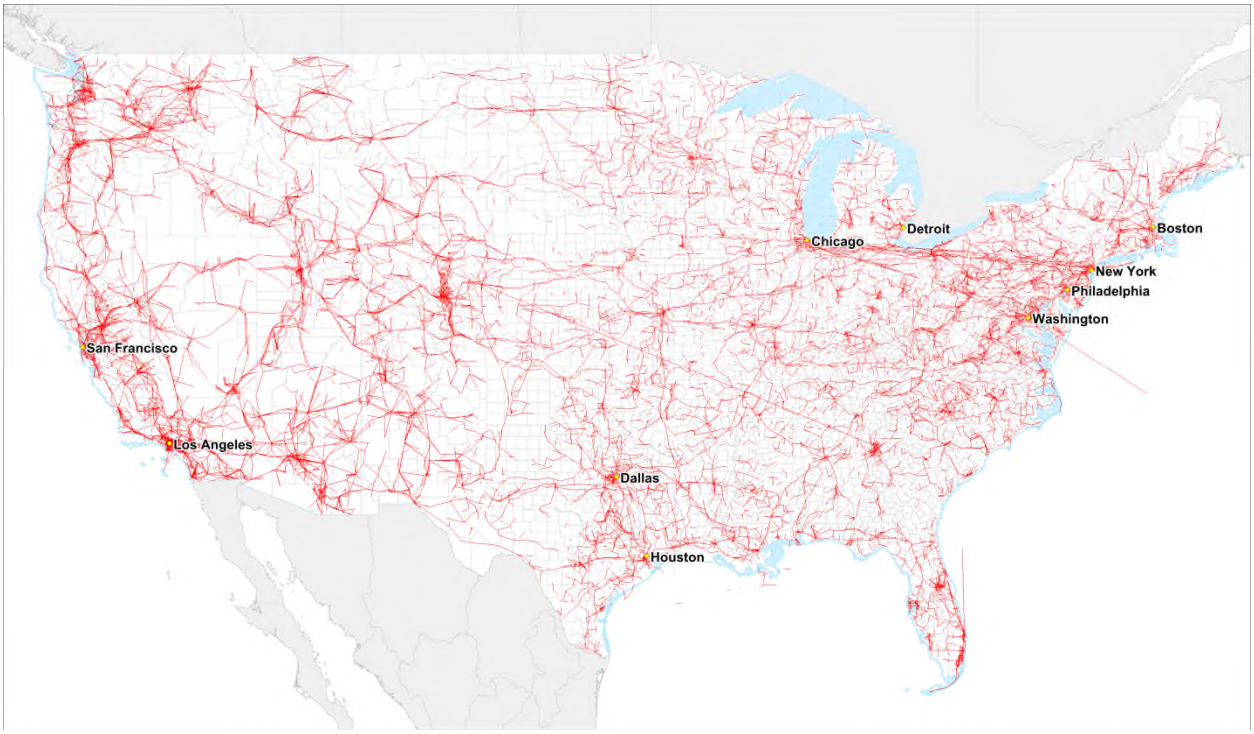

Figure 4: Continental U.S. Links in the Upper 6 GHz Microwave Band

There is a long list of technical reasons why 6 GHz microwave remains a critical component of the Nation's communications networks. First, 6 GHz is a rapidly deployable option for circuits where fiber optic transmission is not available. And in many cases, 6 GHz microwave can reach locations fiber cannot—or where fiber cannot reach under reasonable financial constraints (*e.g.*, mountain tops). Second, the 6 GHz Band is the last significant band allocated for commercial microwave use that is relatively unaffected by rain fade—a phenomenon that is typically viewed to begin at about 10 GHz. Microwave links in this band are usually engineered with "five nines" of availability—uptimes that are 99.999%, or outages on the order of approximately 30 seconds per month. The added fade resulting from atmospheric weather conditions prevailing above 10 GHz would be unlikely to allow engineering of links of similar length with this class of availability. Third, 6 GHz microwave is not susceptible, like fiber, to cable cuts, which makes it a uniquely important asset for critical communications on a standalone basis or as a backup to fiber—and many of these links backhaul traffic from cell sites and therefore are integral to the proper functioning of the Nation's 9-1-1 system. While 6 GHz antennas are not immune to disaster, 6 GHz systems are also typically some of the fastest systems to be brought back on-line in any post-disaster restoration effort.

AT&T believes its use, and use by other carriers, of 6 GHz microwave use will grow significantly with 5G and the continued densification of networks. For example, RCR Wireless reported, based upon an analysis by SNL Kagan, that "[d]riven by the spike in mobile data use, by 2025 tower sites will grow at a CAGR of 3.9%," and that "there could be more than 200,000 towers and over 400,000 sites in use in the next 10 years."[17] While the *Notice* notes that the

[17] Report Predicts Tower, Small Cell Outlook Through 2025, RCR Wireless (July 15, 2015); available at: https://www.rcrwireless.com/20150715/cell-tower-news/report-predicts-tower-trends-through-2025-tag20 (last visited Sept. 27, 2017).

upper 6 GHz band is subject to less use than the lower band—700 MHz supporting 22,900 licenses as compared to 500 MHz supporting 29,000 licenses—the upper band is increasingly being used to accommodate links that cannot—because of congestion—be accommodated in the lower 6 GHz band.[18] Indeed, the lower 6 GHz band has typically been favored because it allows for larger bandwidths that are more desirable for the types of applications AT&T and other carriers need. AT&T, in fact, believes that the Commission should initiate a proceeding to conform the upper band technical rules with the lower band's rules to better accommodate the demand that cannot be met in the lower band.

Under these circumstances, continued access to 6 GHz microwave spectrum for carriers should be viewed as essential. Many of the 6 GHz paths are built in that band because of its ability to reach long distances without intermediate hops. The average distance of a 6 GHz microwave link, for example, is approximately 30 km—twice the average distance of an 11 GHz microwave link. Independent of the financial feasibility of splitting the 100,000 links in the 6 GHz band into 200,000 links, the links may use 6 GHz because they traverse areas where intermediate hops are infeasible. Indeed, even if a suitable alternative did exist that would not require splitting single 6 GHz hops into multiple hops and was unaffected by rain fade, the sheer magnitude of the relocation task seems insurmountable. The notion that these paths can simply be migrated to alternative media or higher bands misapprehends the reason why the 6 GHz bands are so intensively used today.

B. Unlicensed Terrestrial Mobile Use Cannot Feasibly Co-Exist with 6 GHz Microwave

While AT&T has been an advocate of sharing where feasible, attempting to shoe-horn unlicensed use into the 6 GHz band poses grave dangers. As a pure matter of engineering, point-

[18] *Notice* at ¶¶25, 35.

to-point microwave paths typically use very high gain antennas oriented at elevations that are horizontal, or near horizontal. And while microwave beams are narrow, the area within the boresight of the antenna is typically very large, given the length of the links—the surface area where potential interferers could be covers many square miles. Indeed, when coordinating microwave links in the 6 GHz band, interference potential is assessed at distances up to 125 in all directions and 250 miles in the main beam.[19] Any mobile operation within the reception area of the microwave receiver will be received by the microwave system, causing interference.

Compounding the difficulty of sharing, to a microwave link, interference caused by a mobile is indistinguishable from atmospheric or environmental fade. Even very weak signals will create interference, which will reduce the effectiveness of the link's engineered fade depth. Microwave systems are most vulnerable to interference when the signal is faded to just above the receiver threshold due to propagation anomalies—a condition that rarely occurs given the high availability of the links. Interference that degrades the receiver threshold by 10 dB would increase the outage time due to multipath fading of that link by a factor of ten from its intended design value. Thus, current engineering practices require that interference power from all sources degrade a point-to-point radio threshold level by less than 1 dB. This requirement means that the interference power be at least 6 dB below the radio receiver's noise floor. In fact, mobiles operating 3 km from a victim point-to-point receiver will need to have at least 46.5 dB of terrain obstruction loss and antenna discrimination to avoid interference to the link—and that margin increases to 66.5 dB for mobiles within 300 m of the victim receiver.[20]

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[19] *See* Coordination Contours For Terrestrial Microwave Systems, National Spectrum Managers Association, Recommendation WG 3.90.026 (Apr. 1992); available at: http://nsma.org/wp-content/uploads/2016/05/WG3.90.026.pdf (last visited Sept. 27, 2017).

[20] The theoretical noise floor level (kTB) of a 6 GHz radio system using a 30 MHz channel is about -99.2 dBm. Assuming the noise figure of the receiver is just over 3 dB, its actual noise

Because interference caused by mobiles will look to the microwave systems like fade, and because these links are not engineered to monitor for this type of interference, there also will be no ability for the microwave licensee to identify that interference is occurring—they will simply find that statistically the performance of their path decreases. Even if a device was malfunctioning or being operated in a malicious manner, the microwave licensee would never be able to identify the source of the interference—the itinerant nature of most unlicensed activity, even if it was identified as causing interference, means that the device may never be located, since it may be transmitting only intermittently and is likely to be in motion. These fears are compounded when the potential exists for additive interference from a large number of devices, as most unlicensed technologies intend.

AT&T thus believes unlicensed devices pose a significant risk to the operation of 6 GHz microwave and should not be considered in these bands. Not only is the prospect for interference high, the interference would be effectively untraceable and irremediable. Ultimately, the key communications needs supported in the bands would become wasting assets as the quality of service erodes without any feasible recourse by the licensees.

IV. THE FCC SHOULD INVESTIGATE THE POTENTIAL TO REALLOCATE OTHER MID-BAND SPECTRUM FOR MOBILE BROADBAND

AT&T encourages the FCC to continue to investigate the potential for reallocation of other mid-band spectrum options for flexible use and sharing. As AT&T has previously noted,

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floor is around -96 dBm. And therefore the acceptable interference level into the receiver, under current engineering practice, is about -102 dBm. Consider now a single co-channel mobile device operating 3 Km from the point-to-point receiver antenna that happens to be in its main beam and has clear line-of-sight back to it. The free space loss of a 3 Km path at 6 GHz is about 117.5 dB. Furthermore, if the mobile device transmit power is 250 mW (+24 dBm), has no antenna gain towards the point-to-point receiver (0 dBi gain) and the point-to-point system is using the smallest category A antenna with 38 dBi gain, the interference power comes in at around 55.5 dBm. This would clearly be an unacceptable situation as the interference power is 46.5 dB.

there are no bands that promise simple relocation of incumbents, and the degree of difficulty in repurposing spectrum bands has increased substantially. At the same time, the efficacy of sharing mechanisms has increased, as has the technology to allow mobile deployment in bands that were thought unusable—only a short while ago, the idea of mobile broadband use of millimeter wave spectrum would have been unthinkable. With the rapid pace of development in radio system characterization and sharing, the quest to address future spectrum needs must be rigorous.

In such regard, AT&T urges the FCC to continue to work with NTIA to investigate the potential expanded use of other shared Federal and non-Federal bands. Reviewing the Table of Allocations, and setting aside the 3.7-4.2 GHz and 5.925-7.125 GHz bands already identified in the *Notice*, almost 72 percent of the spectrum between 3.5 GHz and 24 GHz is either Federal exclusive or Federal/non-Federal shared. As a practical matter, NTIA, and the government agencies that use these bands, must be partners in any discussion about further mid-band use, including efforts to increase spectral efficiency generally among all spectrum users. AT&T encourages further transparency into Federal use—both the number of systems that are active in these bands, as well as the characteristics of such systems and the potential for interference to and from those systems. AT&T also encourages the development of more flexible mechanisms that would allow agencies more options for transitioning to alternative media, or for negotiating interference mitigation solutions that promote the highest and best use of spectrum assets.

Moreover, scrutinizing all of the mid-band spectrum for potential reallocation, there are comparative criteria that favor some bands over others. In the near term, at least, the spectrum at 7.125-8.4 GHz appears to have some sub-bands with uses that are comparable to the types of uses within the 6 GHz microwave bands, but have far fewer licensees. The FCC may want to

consider whether it is more feasible to consider introducing licensed or unlicensed mobile broadband technologies into those bands as an alternative to the 6 GHz microwave bands. Indeed, to the extent that there are existing uses of those bands that are incompatible with unlicensed or licensed broadband mobile use, it may be more practically and financially feasible to find ways of relocating those uses to alternative media or other bands, including, possibly, the upper 6 GHz microwave band.

V. CONCLUSION

AT&T supports the Commission's effort to develop a spectrum pipeline that will allow licensed and unlicensed broadband services to keep pace with the explosive growth in consumer and business data demands. As the Commission has recognized, the continued evolution of mobile data networks carries massive economic and social benefits, and maintaining U.S. leadership in this area is critical. AT&T also supports efforts to further investigate the potential for sharing in the 3.7-4.2 GHz band, although it cautions that Lower C-Band/terrestrial mobile sharing may be considerably more complex than other FSS/terrestrial sharing scenarios addressed previously. AT&T does not, however, support measures to open the 6 GHz microwave bands to shared use. The 6 GHz microwave bands are critical assets in the Nation's communications infrastructure because they serve very specific needs that are not capable of

being satisfied using alternative technologies or higher spectrum bands. Instead, AT&T encourages the Commission to consider whether other, more lightly populated bands would be more pragmatically feasible for shared use.

Respectfully submitted,

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