

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

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

REPLY COMMENTS OF T-MOBILE USA, INC.

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November 15, 2017

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T-Mobile USA, Inc. (“T-Mobile”)^{1/} submits the following reply comments in response to comments regarding the *Notice of Inquiry* (“*NOI*”) in the above-referenced proceeding.^{2/} The comments in this proceeding make it clear that significant opportunity exists to make spectrum available for flexible broadband use as part of an overall review of the 3.7-24 GHz band. In particular, the 3.7-4.2 GHz band is critical to the growth of the mobile wireless industry and Fifth Generation wireless (“5G”) leadership, and the Commission should proceed quickly to make that spectrum available for licensed use. The Commission should employ its usual highly-successful, market-driven auction methodology for licensing spectrum in the band, coupled with relocation of incumbent licensees to other technologies or spectrum as required. Proposals that rely purely on incentives do not provide the certainty necessary to maximize the 5G opportunity and are not suitable for this band, given fundamental differences in how satellite systems are licensed versus other bands and services where incentive-based approaches are appropriate and effective. Other parties agree with T-Mobile that the Commission must protect licensed

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

^{2/} See *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, GN Docket No. 17-183, Notice of Inquiry, 32 FCC Rcd 6373 (2017) (“*NOI*”). The deadline for submitting reply comments in this proceeding was extended to November 15, 2017. See *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, GN Docket No. 17-183, Order, DA 17-1024 (rel. Oct. 18, 2017).

operations in the 5.925-6.425 GHz band if that spectrum is dedicated for unlicensed use, that the 6.425-7.125 GHz band should be considered for licensed operations, and that the Commission must evaluate additional mid-band segments, not identified in the *NOI*, for terrestrial operations.

I. THE 3.7-4.2 GHz BAND SHOULD BE DESIGNATED FOR EXCLUSIVE WIRELESS USE ON A FLEXIBLE BASIS

A. The Record Supports Designating the 3.7-4.2 GHz Band for Mobile Terrestrial Operations.

The *NOI* sought comment on “the potential for more intensive use of the 3.7-4.2 GHz band for wireless broadband”^{3/} and whether “the 3.7-4.2 GHz band is well-suited for future mobile broadband deployments.”^{4/} As the record makes clear, providing access to the band for mobile broadband operations will help meet demand for additional capacity for wireless networks providing 5G technologies, harmonize the band with international designations, and complement spectrum already, or soon to be, available for mobile wireless broadband. The Commission should seize this opportunity.

First, mobile wireless broadband services need additional mid-band spectrum to support next generation wireless technology, and the 3.7-4.2 GHz band is ideally positioned to meet that need. The demand for licensed spectrum for wireless broadband is increasing with no signs of stopping. As Verizon highlights, wireless carriers “continue to experience staggering consumer demand for wireless data,”^{5/} which is driven by “[m]obile applications . . . consuming massive amounts of bandwidth.”^{6/} Other commenting parties agree. The Mid-Band Spectrum Coalition

^{3/} *NOI* ¶ 16.

^{4/} *Id.* ¶ 19.

^{5/} Comments of Verizon, GN Docket No. 17-183, at 2 (filed Oct. 2, 2017).

^{6/} *Id.* at 4.

argues that the 3.7-4.2 GHz band is best allocated for mobile broadband,^{7/} given that “terrestrial networks bear the brunt of growth in data communications and will continue to do so.”^{8/}

Commenters concur that mid-band spectrum – particularly in the 3.7-4.2 GHz band – is integral for 5G technology deployment for which technology and standards development continue to progress.^{9/} For example, Huawei notes that ongoing 5G trials in the band show potential for fast connections and low latency.^{10/} CTIA agrees that “[f]rom a technical standpoint, the 3.7-4.2 GHz band offers promising attributes for wireless broadband in a 5G world.”^{11/}

Second, international efforts are well underway to make mid-band spectrum available for 5G operations, and the 3.7-4.2 GHz band is becoming globally harmonized. As CTIA points out, “[a]cross the globe, mid-band spectrum is increasingly viewed as a key component to unlocking the economic and societal benefits of 5G connectivity.”^{12/} Several countries already have designated some or all of the band for wireless mobile broadband.^{13/} Global spectrum harmonization of the band for 5G deployments will be beneficial for the mobile wireless ecosystem. As Ericsson notes, “the U.S. Government should endeavor to be [a] party to any global spectrum harmonization effort – including in the mid-band. Spectrum harmonization

^{7/} Comments of Mid-Band Spectrum Coalition, GN Docket No. 17-183, at 5 (filed Oct. 2, 2017) (“Coalition members fundamentally agree: mid-band spectrum is an essential component to enable support of wireless broadband innovation, and to support U.S. leadership in next-generation wireless technologies.”).

^{8/} See Mid-Band Spectrum Coalition Comments at 7.

^{9/} *Id.* at 9; see also Comments of Huawei, GN Docket No. 17-183, at 3 (filed Oct. 2, 2017).

^{10/} Huawei Comments at 6.

^{11/} Comments of CTIA, GN Docket No. 17-183, at 6 (filed Oct. 2, 2017).

^{12/} *Id.* at 1-2; see Verizon Comments at 2 (The 3.7-4.2 GHz band “likely will be harmonized for next generation terrestrial mobile services throughout much of the world.”).

^{13/} See Comments of CompTIA, GN Docket No. 17-183, at 2 (filed Oct. 2, 2017) (“Countries in both Europe and Asia are already looking at this band for future mobile use, and opening up this band in the U.S. will help achieve global harmonization for its usage.”).

translates directly into readily accessible, more affordable equipment and quicker deployment.”^{14/} Nokia agrees that international spectrum harmonization “helps to achieve economies of scale, enables global roaming, reduces equipment design complexity and improves spectrum efficiency,” which “ultimately reduces costs for consumers” and “aids in addressing cross border coordination.”^{15/} In order to establish the United States’ global leadership in 5G and “maintain its competitive advantages,”^{16/} the Commission should expeditiously allocate the 3.7-4.2 GHz band for mobile broadband use.

Third, the 3.7-4.2 GHz band is important to fill the gap between low-band and high-band spectrum and is a critical addition to the mid-band spectrum the Commission is already considering for 5G use. Several commenters agree with T-Mobile that the propagation characteristics of mid-band spectrum, particularly the 3.7-4.2 GHz band, make it “highly complementary to low-band and high-band” spectrum recently opened for mobile broadband.^{17/} Commenters also note the 3.7-4.2 GHz band’s proximity to other spectrum being evaluated for mobile broadband use. When combined with immediately adjacent spectrum, the 3.7-4.2 GHz band presents a contiguous spectrum block that can accommodate wide bandwidths needed for 5G technology.^{18/}

^{14/} Comments of Ericsson, GN Docket No. 17-183, at 5 (filed Oct. 2, 2017); *see also* Huawei Comments at 8-9 (Global harmonization of the band will “enable beneficial services to U.S. consumers through global interoperability roaming, and market opportunities for U.S. industry stakeholders to sell products and services outside the United States.”).

^{15/} Comments of Nokia, GN Docket No. 17-183, at 4 (filed Oct. 2, 2017).

^{16/} Verizon Comments at 10.

^{17/} Comments of the Telecommunications Industry Association, GN Docket No. 17-183, at 1 (filed Oct. 2, 2017).

^{18/} *See* Comments of Information Technology Industry Council, GN Docket No. 17-183, at 4 (filed Oct. 2, 2017); Nokia Comments at 4.

B. Existing Use of the 3.7-4.2 GHz Band Can Be Accommodated by Other Technologies, with Limited Continued Use in Rural Areas.

Incumbent use of the 3.7-4.2 GHz band need not preclude the Commission from dedicating the spectrum for wireless mobile broadband use. Existing use of the 3.7-4.2 GHz band is declining¹⁹ and remaining use of the band may be overstated in any case. Some satellite operators argue against claims of overstatement because the Commission’s rules do not require registration of Fixed Satellite Service (“FSS”) receive-only stations in the Commission’s International Bureau Filing System (“IBFS”) database.^{20/} But even taking that into account, two other factors provide compelling evidence of overstated use.

First, as Google points out “approximately one-third of IBFS-registered C-band FSS sites *or more* . . . either do not exist or are not in operation.”^{21/} Nokia also argues that satellite operations in the band are overstated by more than 25%.^{22/} So, while there may be some unregistered stations not included in the Commission’s database, there may be even more that are in the database that are not in use. *Second*, as has been demonstrated by multiple other parties, the Commission’s current full-band, full-arc coordination policy also causes use of the band to be overstated. Use of a single transponder requires 36 megahertz of spectrum. Yet, because of the full-band, full-arc policy, “frequency coordinators must assume” that C-band earth stations continuously use the entire 500 megahertz between 3.7 GHz and 4.2 GHz, overstating use of the band.^{23/} By coordinating more spectrum than is actually being used –

^{19/} CTIA Comments at 8.

^{20/} *See, e.g.*, Comments of SES Americom, Inc., GN Docket No. 17-183, at 6 (filed Oct. 2, 2017); *see also* Comments of iHeart Media, GN Docket No. 17-183, at 3 (filed Oct. 2, 2017).

^{21/} Comments of Google and Alphabet Access, GN Docket No. 17-183, at 5 (filed Oct. 2, 2017).

^{22/} Nokia Comments at 8.

^{23/} Comments of Broadband Access Coalition, GN Docket No. 17-183, at 6 (filed Oct. 2, 2017).

“regardless of whether or not they are using, or have plans to use, those frequencies and satellite positions” – the full-band, full-arc policy exaggerates use of the band.^{24/} Notably, Intel/Intelsat demonstrate that use of the band is overstated by suggesting how existing operations can be accommodated in less than the full band. In particular, Intel/Intelsat propose that existing operations can be relocated to a subset of the band.^{25/}

In addition to overstated FSS use of the 3.7-4.2 GHz band, there is little incumbent Fixed Service (“FS”) use in the band.^{26/} CTIA notes that the substantial decrease in FS use of the band “is primarily the result of point-to-point microwave operations migrating to fiber or other bands that do not have the same FSS earth station coordination concerns.”^{27/} Indeed, the Commission’s own findings show that FS operations in the band have also steadily declined for the last two decades.^{28/} And as T-Mobile noted in its comments, the Commission should investigate other spectrum – in particular the 7.125-8.4 GHz band – that may be used to accommodate microwave operations in the 6.425-7.125 GHz band.^{29/} That same spectrum can be used to relocate microwave operations from the 3.7-4.2 GHz band, if necessary.

In any case, incumbent operations can be relocated to comparable facilities, consistent with well-developed past practices.^{30/} Most current FSS use of the band can be replaced by fiber

^{24/} Verizon Comments at 12.

^{25/} Comments of Intelsat and Intel, GN Docket No. 17-183, at 16-17 (filed Oct. 2, 2017).

^{26/} Ironically, part of the reason that FS operations in the band are light is because of FSS full-band, full-arc coordination, which makes it appear that spectrum may not be available, when it is. *See* Comments of the Fixed Wireless Communications Coalition, GN Docket No. 17-183, at 2 (filed Oct. 2, 2017).

^{27/} CTIA Comments at 9.

^{28/} *NOI* ¶ 15.

^{29/} Comments of T-Mobile USA, Inc., GN Docket No. 17-183, at 17-19 (filed Oct. 2, 2017).

^{30/} *Id.* at 15.

or by migration to other spectrum bands, with remaining receive sites in remote, rural areas protected.^{31/} Verizon agreed, pointing out that FSS earth stations in urban and suburban areas used for video content distribution potentially can be transitioned to fiber, freeing spectrum for terrestrial wireless use.^{32/} Nokia concurred that the Commission can improve the band's efficiency by relocating satellite operations from the band to "[a]lternative transmission platforms like fiber."^{33/} Even Intelsat and Intel note that other alternatives to fully sharing the band are available, despite the fact that they seek to preserve potential use of the band for satellite operations. They argue that FSS operations in the band "could relocate antennas outside the geographic area and make use of wired or wireless alternatives, *e.g.*, using fiber to bring the transmission back inside the area from the earth station facility."^{34/} FS operations in the band can be easily relocated to other bands because "these incumbents are fewer and have more naturally aligned incentives for facilitating flexible use in the band."^{35/}

Required relocation is consistent with Commission precedent. For example, the Personal Communications Service ("PCS") and AWS-1 relocation processes were highly successful, and they can be used to relocate satellite incumbents in this instance.^{36/} Incumbent licensees argue

^{31/} *Id.*

^{32/} Verizon Comments at 18.

^{33/} Nokia Comments at 12.

^{34/} Intelsat and Intel Comments at 17.

^{35/} Verizon Comments at 20.

^{36/} *See Amendment of the Commission's Rules to Establish New Personal Communications Services*, Fourth Memorandum Opinion and Order, 10 FCC Rcd 7955, GN Docket No. 90-314 (rel. May 12, 1995); *Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems*, Ninth Report and Order, FCC 06-45, ET Docket No. 00-258 (rel. Apr. 21, 2006).

that relocation would be a time-consuming process that would disrupt their existing operations.^{37/} But past relocation efforts were no less complicated and were effectively achieved. Required relocation processes are generally a multi-year effort, and entities seeking to acquire spectrum in the 3.7-4.2 GHz band understand that when they bid in an auction, taking the availability timeline into effect.

Contrary to the suggestion of the Satellite Industry Association (“SIA”), non-registered earth stations should not be protected or reimbursed for relocation to a different band or technology.^{38/} SIA acknowledges that some earth station operators do not complete the Commission’s registration process because “the benefits of registration do not justify the costs.”^{39/} Those benefits include protection from later-filed applications for terrestrial service. If earth station operators previously decided that their operations did not require protection in the past, they should not now be permitted to decide that protection is necessary now. Alternatively, the Commission may wish to issue a Public Notice when it releases a Notice of Proposed Rulemaking in this proceeding, providing users of non-registered earth stations an opportunity to submit registrations. That process will provide the Commission with a more accurate assessment of the type and cost of relocation that may be required and meet the concerns that SIA has expressed.

C. Boeing Does Not Provide Any Technical Evidence of Potential Harmful Interference to Adjacent Band Altimeter Operations.

The Commission should reject Boeing’s argument that mobile use of the 3.7-4.2 GHz band could interfere with aircraft radio altimeters and aircraft communication systems in the

^{37/} See, e.g., Comments of the National Association of Broadcasters, GN Docket No. 17-183, at 7 (filed Oct. 2, 2017).

^{38/} See Comments of Satellite Industry Association, GN Docket No. 17-183, at 4 (filed Oct. 2, 2017).

^{39/} *Id.* at 18.

adjacent 4.2-4.4 GHz band. Boeing has not supported its claim with any technical analysis, but suggests only hypothetical scenarios in which interference could occur.^{40/} Boeing's suggestion that terrestrial use of the 3.7-4.2 should be limited to provide a guardband to protect in-aircraft communications systems in the adjacent band is also unwarranted. The Commission should study any potential coexistence issues and determine appropriate technical requirements, but it is poor policy to severely limit use of adjacent spectrum if the aircraft communications are not designed to coexist in today's increasingly congested radio environment.

In any event, as T-Mobile's comments pointed out, the 4.2-4.4 GHz band was the subject of NTIA's "Fast Track" analysis, and the altimeters in question may be relocated away from the adjacent spectrum, avoiding potential interference issues altogether.^{41/} NTIA's analysis specifically states that "[t]he limited data available to NTIA indicated that the transmitter emissions for the radio altimeters used on commercial aircraft appear to be concentrated in a range of ± 25 MHz to ± 70 MHz around the center frequency of 4300 MHz."^{42/} NTIA also observed that an ITU-R report stated that "new or alternative techniques might provide the same accuracy in a smaller bandwidth."^{43/} The Fast Track analysis specifically observed that the Federal Aviation Administration and other federal agencies should conduct a survey of the technical characteristics of altimeters in order to, among other things, assess potential allocation

^{40/} Comments of Boeing, GN Docket No. 17-183, at 3, 5 (filed Oct. 2, 2017).

^{41/} T-Mobile Comments at 20-21; *see also* AN ASSESSMENT OF THE NEAR-TERM VIABILITY OF ACCOMMODATING WIRELESS BROADBAND SYSTEMS IN THE 1675-1710 MHZ, 1755-1780 MHZ, 3500-3650 MHZ, AND 4200-4220 MHZ, 4380-4400 MHZ BANDS, DEPARTMENT OF COMMERCE 2-6 (Oct. 2010), https://www.ntia.doc.gov/files/ntia/publications/fasttrackevaluation_11152010.pdf.

^{42/} AN ASSESSMENT OF THE NEAR-TERM VIABILITY OF ACCOMMODATING WIRELESS BROADBAND SYSTEMS IN THE 1675-1710 MHZ, 1755-1780 MHZ, 3500-3650 MHZ, AND 4200-4220 MHZ, 4380-4400 MHZ BANDS, DEPARTMENT OF COMMERCE 2-6 (Oct. 2010), https://www.ntia.doc.gov/files/ntia/publications/fasttrackevaluation_11152010.pdf.

^{43/} *Id.*

changes in the band.^{44/} NTIA’s analysis demonstrates the utility of evaluating whether radio altimeters can be relocated within the band to permit full use of the 3.7-4.2 GHz band without concern for adjacent band interference.

D. Licensing Spectrum for Flexible Use Is Consistent with the Commission’s Goals.

Reserving spectrum for particular wireless applications, such as point-to-multipoint operations as the Broadband Access Coalition and others suggest, is contrary to the public interest and the Commission’s approach to allow licensees to provide a variety of services.^{45/} As Commissioner O’Rielly recently stated, proposals that “favor fixed operations in the band . . . [are] counter to flexible use policies and [are] not appropriate.”^{46/} The Commission should instead opt for flexible use licensing through auctions in the 3.7-4.2 GHz band, which will allow the maximum amount of spectrum to be made available for mobile broadband use. CTIA and CompTIA agree.^{47/} Auctions for flexible use licenses will allow licensees to choose their service and technology. Licensees will be able to use auctioned spectrum as they deem best, consistent with the technical limitations that the Commission establishes to protect adjacent channels and adjacent area operations. Auctions best fulfill the Commission’s mandate to manage spectrum in the public interest.

^{44/} *Id.* at 1-4.

^{45/} *See, e.g.*, Broadband Access Coalition Comments at 4; Comments of Frontier, Windstream, and Consolidated Communications, GN Docket No. 17-183, at 3 (filed Oct. 2, 2017); Comments of GeoLinks, GN Docket No. 17-183, at 2 (filed Oct. 2, 2017).

^{46/} Remarks of FCC Commissioner Michael O’Rielly Before 5G Americas’ “Technology Briefing,” FCC (Oct. 5, 2017), http://transition.fcc.gov/Daily_Releases/Daily_Business/2017/db1005/DOC-347083A1.pdf.

^{47/} CTIA Comments at 6; CompTIA Comments at 2.

II. SPECTRUM SHOULD BE MADE AVAILABLE THROUGH AUCTIONS ON A GEOGRAPHIC AREA BASIS

A. The 3.7-4.2 GHz Band Should Not Be Burdened with Complicated Sharing Mechanisms.

Some commenters argue that the Commission should adopt the Spectrum Access System (“SAS”) or similar database sharing approaches used in other spectrum bands for the 3.7-4.2 GHz band.^{48/} T-Mobile agrees with Ericsson that “[d]atabase approaches for managing access to licensed spectrum are not advisable.”^{49/} Database approaches are still in development and have yet to be proven effective. There are two bands where access to spectrum through a database remains under development – the 3.5 GHz Citizens Broadband Radio Service and the 600 MHz white spaces. But neither has produced any measurable success. And as the Commission is expected to find in the *Second Report and Order* in the *Spectrum Frontiers* proceeding, SAS and similar database access mechanisms may be appropriate in instances where there is complex sharing among different classes of users.^{50/} That is not the case for the 3.7-4.2 GHz band if the Commission dedicates the band for flexible use, including wireless mobile broadband. In contrast to further experimentation with SAS and similar mechanisms, the Commission has an opportunity to use in the 3.7-4.2 GHz band the same type of licensing scheme – exclusive geographic area licensing – that has made U.S. wireless networks the envy of the world. Use of

^{48/} See, e.g., Comments of Federated Wireless, Inc., GN 17-183, at 5 (filed Oct. 2, 2017); Comments of Microsoft Corporation, GN Docket No. 17-183, at 9 (filed Oct. 2, 2017); Comments of Vivint, GN Docket No. 17-183, at 3 (filed Oct. 2, 2017).

^{49/} Ericsson Comments at 6.

^{50/} See *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5- 28.35 GHz and 37.5-40 GHz Bands*, GN Docket No. 14-177, Draft Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, FCC-CIRC1711-02, ¶ 49 (rel. Oct. 26, 2017) (“Given that [the 47.2-48.2 GHz] band does not involve sharing among multiple classes of primary users, we conclude that is not necessary to develop the functionality of an SAS for this band.”) (“*Spectrum Frontiers Draft Orders*”).

database mechanisms would instead hobble U.S. leadership in 5G by subjecting use of the band to burdensome requirements not applicable in other countries.

Even if spectrum sharing mechanisms were not untested, the underlying premise for their use – potential shared use of the band between satellite and terrestrial licensees – would diminish the utility of the band for much needed mid-band wireless mobile broadband capacity. T-Mobile agrees with the National Spectrum Management Association that sharing in the band is currently not technically feasible.^{51/} As the satellite commenters state, unlimited satellite earth station operations will require protection that will prevent any meaningful use of the band for mobile broadband use.^{52/} Indeed, the Commission is expected to recognize that the protection needed for satellite operations – end-user terminals – would foreclose shared terrestrial and satellite use.^{53/} Additionally, satellite operators believe that their downlink operations are extremely sensitive to interference from terrestrial wireless operations.^{54/} If the Commission believes that sharing is possible, any sharing approach or interference protection that the Commission implements for the band must be adequately examined and analyzed to ensure that it does not impede the utility of the spectrum for 5G operations.

^{51/} Comments of National Spectrum Management Association, GN Docket No. 17-183, at 7 (filed Oct. 2, 2017) (“Currently the engineering practices necessary to [e]nsure the successful coexistence among the various fixed service services have been developed over several years. It is not clear if adding mobile services to these fixed service bands is practical. If it is, the development of appropriate practices, which currently do not exist, would need to be developed. This will take a significant industry effort and will not occur quickly.”).

^{52/} See Satellite Industry Association Comments at 35.

^{53/} *Spectrum Frontiers Draft Orders*, ¶ 181.

^{54/} See, e.g., Comments of General Communication, Inc., GN Docket No. 17-183, at 2 (filed Oct. 2, 2017).

B. The Commission Should Reject Incumbent-Driven Access Approaches.

Regardless of whether technical impediments to shared use of the 3.7-4.2 GHz band between incumbent FSS licensees and mobile wireless operations can be overcome, Intel/Intelsat's approach to permitting access to the 3.7-4.2 GHz band is flawed. Intel/Intelsat argue that incumbent licensees can operate on a co-primary basis in the band through commercial arrangements.^{55/} Under Intel/Intelsat's approach, FSS satellite operators would identify geographic areas where the band could be cleared and then enter into agreements with terrestrial users that, theoretically, would consider relocation costs and enable continued FSS operations in required areas.^{56/} This sharing proposal should be rejected by the Commission.

First, the approach that Intel/Intelsat offer will not be successful in the 3.7-4.2 GHz band. Intel/Intelsat argue that their approach will result in quicker use of the spectrum for wireless mobile broadband use.^{57/} But there is no guarantee that the spectrum will *ever* be used for that purpose. Because every satellite operator has access to the full 500 megahertz, it would be necessary for every satellite operator to agree on how much and where the spectrum would be available. However, it is unlikely that every FSS licensee would participate, and because the process would be voluntary, there is no way to ensure that the *same* spectrum would be available across the country or that any particular *amount* of spectrum will be made available. The Intel/Intelsat proposal would therefore produce no better than a patchwork quilt of spectrum. Such a result would draw no meaningful investment in the band for wireless mobile broadband use. Accordingly, use of an approach that permits incumbent licensees to dictate the licensing

^{55/} Intelsat and Intel Comments at 7.

^{56/} *Id.* at 7-8.

^{57/} *Id.* at 18.

process would frustrate the Commission’s primary purpose with respect to the 3.7-4.2 GHz band – to create mid-band capacity for mobile wireless broadband operations, fostering 5G leadership.

Second, as outlined below, Intel/Intelsat do not offer an efficient market approach because satellite operators will be able to engage in monopoly pricing, to the detriment of wireless providers and, ultimately, the public. By transferring all the terrestrial use rights to the satellite incumbents to manage, they will fully control this limited resource and will be able to charge monopoly prices and limit the supply of spectrum. Not only does this approach give the satellite industry a multi-billion dollar reward for using spectrum inefficiently, it creates tremendous uncertainty regarding the availability of this spectrum for mobile broadband services and will likely result in inefficient reallocation of spectrum.

CTIA relatedly believes that sharing can occur through incentive auctions.^{58/} Under CTIA’s approach, new terrestrial mobile licensees would be required to pay relocation costs for satellite incumbents and build new and comparable facilities for their operations.^{59/} CTIA argues that this type of approach would replicate the Commission’s highly successful broadcast incentive auction.^{60/} But, there are key differences between the incentive auction and the approaches suggested by Intel/Intelsat and CTIA. In the incentive auction, the FCC, and not third parties, controlled the process by which spectrum was assigned. It designed a band plan that could accommodate varying amounts of broadcast spectrum made available in the reverse auction. As a result, there was a nationwide framework for the spectrum, including a consistent

^{58/} CTIA Comments at 3.

^{59/} *Id.* at 6.

^{60/} *Id.* at 3-6; *see also* Intelsat and Intel Comments at 4 (discussing the broadcast incentive auction).

amount of spectrum across the country in the same spectrum bands.^{61/} Having a nationwide band plan and framework was a critical element to driving interest and value in the 600 MHz band. The Commission contemplated that some, but not all, broadcasters would participate in the incentive auction, requiring, among other things, a Commission-mandated post-auction band plan and repacking process. That architecture is completely absent from the Intel/Intelsat, licensee-directed plan. Critical to the success of the broadcast incentive auction was that each broadcaster controlled only a small percentage of the spectrum in the band, and the Commission's post-auction repacking process meant that broadcast licenses were essentially fungible. This resulted in a structure in which a relatively small number of broadcasters had to participate to make it a success.

These conditions are completely absent in the 3.7-4.2 GHz band. In this case there are multiple satellite licensees, each of which has rights to the entire 500 megahertz of spectrum. Accordingly, in any incentive auction or incumbent-driven structure, every satellite licensee would have to agree to participate and not charge a monopoly price. Even if every provider agrees to participate, the level of participation among licensees may vary greatly. Because every licensee controls all of the spectrum, there is a real possibility that all licensees would charge as though they were a monopolist, leading to a price even higher than a monopoly price and substantially increasing the risk that an inefficiently small amount of spectrum would be redeployed to higher value use. This is very different from the incentive auction where the large pool of essentially fungible spectrum provided significant protection against monopoly pricing. The Commission has no similar flexibility here and there is a high likelihood that spectrum will

^{61/} The Commission's plan included provisions to accommodate impairments when necessary, but the level and exact nature of the impairments were known to forward auction participants prior to bidding.

not be made available, or too little of it would be available, or that it or would be available in a fragmented and inefficient way.

Intel/Intelsat and CTIA explain that market forces will prompt FSS licensees to sell terrestrial rights at market prices, just as broadcasters received market value for spectrum they vacated in the incentive auction.^{62/} But the incentive auction featured multiple broadcasters potentially selling spectrum in a market and essentially competing with each other – creating a fair market value for wireless buyers. However, a private auction of FSS spectrum would be plagued by a “monopoly problem” with sellers that can demand prices that a truly competitive market would not support.

The Intel/Intelsat proposal does correctly suggest that a licensee with sufficient incentive may be able to clear spectrum and find alternative means for meeting service requirements more quickly and efficiently than an incumbent forced to clear pursuant to a mandate. Accordingly, it may be beneficial to consider mechanisms that preserve an incentive for incumbents to clear spectrum but that also provide the certainty necessary to make the band available in a way that drives investment and deployment of services. Those mechanisms must eliminate the potential for monopoly pricing or actions by a single licensee to block access to the band. Accordingly, the Commission may consider a hybrid approach in making the 3.7-4.2 GHz band available for wireless mobile broadband use. The following are guidelines toward a hybrid approach that could be more fully developed in a Notice of Proposed Rulemaking in this proceeding:

- *Design a post-auction band plan and auction the majority of the spectrum.* In order to ensure that the band is attractive for licensed use, the Commission should designate the spectrum that will be available for mobile wireless broadband operations and auction that spectrum. This would create some immediate and certain relief to the spectrum shortages identified above, generate revenue for U.S. taxpayers, and provide consistent spectrum available across the country for wireless mobile broadband. With most of the spectrum

^{62/} Intelsat and Intel Comments at 8; CTIA Comments at 13.

auctioned for wireless mobile broadband, the Commission will create a market for the remaining spectrum that the FSS licensees would control.

- *Pair market rights to the remaining spectrum with band clearing.* Incumbents could retain market rights to the non-auctioned portion of the spectrum if they agreed to clear the portion of the spectrum that was auctioned within a specified period of time. As Intel/Intelsat recognized, not all of the 3.7-4.2 GHz band is required today to support satellite user operations. Once a satellite operator's customers were cleared from the auctioned band, they would be afforded market rights to the non-auctioned spectrum for which they remained licensed. Licensees that failed to clear the band would lose market rights and the systems would be cleared through a traditional relocation.
- *Impose a post-auction reporting requirement.* In order to ensure that incumbent licensees take advantage of their market rights and use the spectrum for either shared satellite/terrestrial or only terrestrial use, establish a reporting requirement for incumbent licensees to show how the spectrum is being used efficiently to serve the public.
- *Provide payments to incumbent FSS licensees.* In order to facilitate relocation, the Commission should require that auction winners pay a designated percentage of their winning bids to FSS licensees on a *pro rata* basis (or to a third party designated by the Commission that would distribute the funds). Incumbent licensees could use as much of this payment as needed to relocate users and can retain the rest. The remainder of the winning bid amount would be paid directly to the U.S. Treasury.

T-Mobile looks forward to working with the Commission and other stakeholders to more fully develop this approach.

III. FURTHER EVALUATION IS REQUIRED FOR THE USE OF THE 6 GHz BAND

A. The Record Reflects Concerns Regarding Incumbent Use of the 5.925-6.425 GHz Band.

Commenters agree with T-Mobile that the Commission should permit unlicensed operations in the 5.925-6.425 GHz band, so long as incumbent use of the band is protected.

Commenters note that the band may be appropriate for unlicensed operations because it is adjacent to the 5.15-5.35 GHz and 5.47-5.725 GHz bands, which are currently used by

Unlicensed National Information Infrastructure (“U-NII”) devices. Verizon notes that the 5.925-

6.425 GHz's band proximity to these bands "makes it particularly attractive for unlicensed use."^{63/}

Any unlicensed use of the band, however, must also consider the significant number of FS licensees that occupy the band for public safety and other critical communications needs. Commenters agree with T-Mobile that any unlicensed devices using the band must adequately protect and not cause harmful interference to incumbent services. Current licensed users of the band express concern about potential interference and urged the Commission to ensure that they are protected. For example, the Lower Colorado River Authority argues that opening the band for unlicensed use would increase the potential for risk of harmful interference to licensed fixed, point-to-point operations.^{64/} And the National Public Safety Telecommunications Council points out that interference in the band is unacceptable, and it is concerned whether the Commission could ensure that the band's critical services are not adversely impacted by spectrum sharing.^{65/} Similarly, the National Spectrum Management Association argues that if incumbent services coexist with other services, appropriate sharing practices must be developed to guarantee that incumbents would be protected from interference.^{66/} If the Commission permits unlicensed operations in the band, the Commission must ensure that technical rules and operational limits – that have been shown through testing to protect licensed services – are in place.

^{63/} Verizon Comments at 21.

^{64/} Comments of the Lower Colorado River Authority, GN Docket No. 17-183, at 4 (filed Oct. 2, 2017); *see also* Google and Alphabet Access Comments at 13.

^{65/} Comments of the National Public Safety Telecommunications Council, GN Docket No. 17-183, at 7 (filed Oct. 2, 2017).

^{66/} National Spectrum Management Association Comments at 6-7.

B. The 6.425-7.125 GHz Band Should Be Considered for Licensed Use.

Commenters also agree with T-Mobile that the Commission should evaluate whether some or all of the upper portion of the 6 GHz band – 6.425-7.125 GHz – should be opened for licensed mobile services. Ericsson recognizes the band’s potential for terrestrial wireless uses, noting that the band “could serve as a great complement to the millimeter wave band for use cases in urban core and densely populated areas, and beyond.”^{67/} In order to open the band for terrestrial wireless uses, the 6.425-7.125 GHz band should be cleared and auctioned. To accomplish this, Ericsson, like T-Mobile, suggests that the Commission relocate non-federal FS incumbents “either to another band or to fiber, with a particular focus [on] transitioning uses in more urban and suburban areas.”^{68/}

AT&T and others argue that the Commission should preserve incumbent use of the 6.425-7.125 GHz band because of “continued densification of networks.”^{69/} According to AT&T, “the upper band is increasingly being used to accommodate links that cannot – because of congestion – be accommodated in the lower 6 GHz band.”^{70/} But as T-Mobile pointed out, licensed operations in the upper 6 GHz band need not be relocated to the lower 6 GHz band. Instead, the Commission should explore use of the 7.125-8.4 GHz band for shared federal/non-federal use that would support relocation of microwave systems. This spectrum has already been designated for FS use by federal agencies that have or will be relocated from AWS-3

^{67/} Ericsson Comments at 10; *see also* Comments of the Information Technology Industry Council, GN Docket No. 17-183, at 5 (filed Oct. 2, 2017).

^{68/} Ericsson Comments at 10.

^{69/} Comments of AT&T, GN Docket No. 17-183, at 18-19 (filed Oct. 2, 2017); *see also* Verizon Comments at 22 (“Verizon believes that, while this band may hold promise for future flexible use, the Commission must also take a measured approach and ensure adequate protections to incumbent and future microwave deployments.”).

^{70/} AT&T Comments at 15.

spectrum.^{71/} Because FS operations are highly coordinated, non-federal FS use in the band can be easily accommodated.

T-Mobile similarly disagrees with other commenters that suggest alternative uses of the 6.425-7.125 GHz band. Several commenters argue that the band should be made available for unlicensed use, sharing the spectrum with current licensed operations.^{72/} Hewlett Packard argues that unlicensed operations are well-suited for sharing with Broadcast Auxiliary Service (“BAS”) and Cable Television Relay Service (“CARS”) incumbents.^{73/} Similarly, Google argues that the Commission should consider the band “for flexible-use sharing by broadband systems, with studies to establish the conditions under which new entrants could operate without causing harmful interference to incumbents.”^{74/} Hewlett Packard and Google, however, fail to take into account that incumbent operations can be relocated. As noted above, microwave operations may be able to use the 7.125-8.4 GHz band, while BAS and CARS licensees can already use the 12.7-13.2 GHz band, and, as T-Mobile pointed out, commercial technology.^{75/}

^{71/} See *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands*, Report and Order, GN Docket No. 13-185, 29 FCC Rcd 4610 ¶¶ 34-39 (rel. Mar. 31, 2014).

^{72/} Comments of All Points Broadband, Amplex, Apple, Blaze, Broadcom, Cambium, Cisco, Cypress, Dell, Extreme, Facebook, Fire2Wire, Google, Hewlett-Packard, Intel, Joink, MediaTek, MediaLINK, Microsoft, NewWave, Pixius, QUALCOMM, Rise, Ruckus, Snappy, Sony, Western, WISP Association, Wisper, GN Docket No. 17-183, at 11-13 (filed Oct. 2, 2017); Comments of the Bluetooth Special Interest Group, GN Docket No. 17-183, at 3 (filed Oct. 2, 2017).

^{73/} Comments of Hewlett Packard Enterprises, GN Docket No. 17-183, at 10-11 (filed Oct. 2, 2017); see also Comments of Charter Communications, GN Docket No. 17-183, at 3-4 (filed Oct. 2, 2017) (noting Charter’s CARS and microwave licenses in the 6 GHz band).

^{74/} Google and Alphabet Access Comments at 13.

^{75/} See 47 C.F.R. §§ 74.602; 78.18; *Network Convergence Platform for Mobile Operators*, CARNEGIE TECHNOLOGIES, https://www.carnegietechnologies.com/mobileoperators/?gclid=Cj0KCQjwruPNBRCKARIsAEYNXIjTbXX2a0V8PktEd9RXOWQCfFM61imOZobZ XI6LNral7kY2_YEjD4kaAltWEALw_wcB (last visited Nov. 12, 2017); see also *Multiply your Internet Speed & Reliability by bonding up to 12 broadband modems*, MUSHROOM NETWORKS, https://www.mushroomnetworks.com/marketing/broadband_bonding_mushroom/?utm_source=google&u

Other commenters argue that the Commission should provide access to the entire 6 GHz band by unlicensed operations.^{76/} As T-Mobile noted, unlicensed spectrum is an important part of its operations and plays an important role in delivery of broadband services generally, but the Commission must preserve a rational balance between spectrum designated for licensed and unlicensed use. Calls to make no more than 500 megahertz of spectrum available in the 3.7-4.2 GHz band for licensed use while seeking to designate 1200 megahertz of spectrum for unlicensed operations skew this balance far too heavily in favor of unlicensed spectrum – ultimately harming the ability of the U.S. to meet mobile broadband requirements and effectively compete globally.^{77/} The Commission should seek to address the needs of both licensed and unlicensed requirements by considering the designation of the upper 6 GHz band for licensed use.

IV. THE COMMISSION SHOULD EVALUATE OTHER MID-BAND SPECTRUM FOR TERRESTRIAL WIRELESS USE

In our comments, T-Mobile argued that the Commission should look beyond the 3.7-4.2 and 6 GHz band and make other mid-band spectrum available for wireless mobile broadband use. We noted in particular that the Commission should work with NTIA to make the 7.125-8.4 GHz band available for FS operations, thereby freeing other bands for mobile broadband use. It should also continue to explore whether at least some of the 4.2-4.4 GHz band can be made

tm_medium=cpc&utm_campaign=Boosting-generic-line_Aggregation&utm_content=Bond-your-WANconnections (last visited Nov. 12, 2017).

^{76/} Comments of CompTIA, at 2, Comments of Microsoft Corporation, GN Docket No. 17-183, at 11 (filed Oct. 2, 2017); Comments of NCTA – The Internet & Television Association, GN Docket No. 17-183, at 5-6 (filed Oct. 2, 2017), Comments of Charter Communications, GN Docket No. 17-183, at 3 (filed Oct. 2, 2017).

^{77/} And the Commission recently designated an additional 7 gigahertz of spectrum in the millimeter wave bands for unlicensed use, making a total of 14 gigahertz of spectrum available for unlicensed operations in those bands. See *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al.*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014 (2016).

available for wireless mobile use. Other commenters agree that Commission should target that spectrum for further evaluation. AT&T states that the Commission should consider whether mobile broadband could be introduced in the 7.125-8.4 GHz band,^{78/} and Ericsson urges the Commission to coordinate with NTIA to evaluate whether the band can be transitioned to a shared band for federal and non-federal mobile services.^{79/} In addition to the 7.125-8.4 GHz and 4.2-4.4 GHz bands, T-Mobile noted that the Commission should continue to examine other bands for potential wireless mobile broadband use, including the 4.940-4.990 GHz band, 12.2-12.7 GHz band, and FS bands at 7 GHz, 11 GHz, 18 GHz, and 23 GHz.^{80/} The Commission should use this proceeding to further develop the record regarding the potential use of those bands for wireless mobile operations.

V. CONCLUSIONS

T-Mobile strongly supports the Commission's review of the 3.7-24 GHz band to make spectrum available for broadband services. In particular, the Commission should move quickly to make more licensed spectrum resources in the 3.7-4.2 GHz band available for mobile wireless broadband operations. To ensure that the spectrum in the band is put to its most efficient use, the Commission should (i) designate the band for exclusive wireless use on a flexible basis, and (ii) make spectrum resources in the band available through Commission-directed auctions on a geographic basis. The Commission should also evaluate current use of the 6 GHz band and ensure that if unlicensed operations are permitted, incumbent operations are fully protected. It should also consider designating some of the 6 GHz for licensed use. Finally, the Commission

^{78/} AT&T Comments at 18-19.

^{79/} Ericsson Comments at 9-10. Ericsson's comments request that the Commission explore use of the 7.125-8.5 GHz band.

^{80/} T-Mobile Comments at 21-23.

should consider whether other mid-band spectrum, including the 7.125-8.4 GHz and 4.2-4.4 GHz bands, should be made available for terrestrial wireless use or to further the availability of spectrum for mobile broadband use.

Respectfully submitted,

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November 15, 2017