Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Expanding Flexible Use of the 3.7 to 4.2 GHz Band	)	GN Docket No. 18-122
	)	
	)	
Petition for Rulemaking to Amend and Modernize Parts 25 and 101 of the Commission's Rules to Authorize and Facilitate the Deployment of Licensed Point-to-Point Fixed Wireless Broadband Service in the 3.7-4.2 GHz Band	)	RM-11791
	)	
	)	
Fixed Wireless Communications Coalition, Inc., Request for Modified Coordination Procedures In Band Shared Between the Fixed Service and the Fixed Satellite Service	)	RM-11778

REPLY COMMENTS OF ERICSSON

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Ericsson submits these reply comments in response to the Notice of Proposed Rulemaking ("*NPRM*") in the above-captioned proceeding to make all or part of the 3.7-4.2 GHz band available for 5G, Internet of Things ("IoT"), and other advanced wireless services.[1]

I. INTRODUCTION AND SUMMARY.

In the initial round of comments, Ericsson and others urged the Commission to move quickly to repurpose spectrum in the 3.7-4.2 GHz band, or the C-band, for 5G, as the 3.7-4.2 GHz band presents the only mid-band opportunity that has a sufficient amount of spectrum for

[1] *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, Order and Notice of Proposed Rulemaking, 33 FCC Rcd 6915 (2018) ("*NPRM*").

macro 5G operations.[2] Further, because 5G services will require gigabit-level speeds that demand wide channel bandwidths (*i.e.*, on the order of 100 MHz), many commenters recommended that the Commission repurpose the vast majority (if not all) of the C-band for terrestrial, flexible use service, to ensure that sufficient spectrum is available to multiple carriers.[3]

A key objective of the *NPRM* is to "secure U.S. leadership in the next generation of wireless services,"[4] and given international developments, U.S. leadership on 5G must include securing a substantial amount of mid-band spectrum for 5G.[5] That, in turn, can only be achieved

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[2] Comments of Ericsson, GN Docket No. 18-122, at 8-9 (filed Oct. 29, 2018) ("Ericsson Comments"). *See also* Comments of T-Mobile USA, Inc., GN Docket No. 18-122, at 3 n.4 (filed Oct. 29, 2018) ("T-Mobile Comments"); Joint Comments of Intel Corporation, Intelsat License LLC, and SES Americom, Inc., GN Docket No. 18-122, at 5 (filed Oct. 29, 2018) ("Intel *et al.* Comments").

[3] Ericsson Comments at 9-10. *See also* Comments of CTIA, GN Docket No. 18-122, at 3, 8-9 (filed Oct. 29, 2018) ("CTIA Comments"); Comments of Nokia, GN Docket No. 18-122, at 9 (filed Oct. 29, 2018) ("Nokia Comments"); Comments of Verizon, GN Docket No. 18-122, at 9-10 (filed Oct. 29, 2018) ("Verizon Comments"); Comments of United States Cellular Corporation, GN Docket No. 18-122, at 8 n.19 (filed Oct. 29, 2018) ("USCC Comments"); Comments of Competitive Carriers Association, GN Docket No. 18-122, at 6 (filed Oct. 29, 2018) ("CCA Comments"); Comments of Qualcomm Incorporated, GN Docket No. 18-122, at 5 (filed Oct. 29, 2018) ("Qualcomm Comments"); Comments of AT&T Services, Inc., GN Docket No. 18-122, at 7 (filed Oct. 29, 2018) ("AT&T Comments").

[4] *NPRM* ¶ 1.

[5] *See* Verizon Comments at 3 ("For the United States, the path to maintain global leadership in wireless goes through 5G, and to win the race to 5G, the United States must quickly introduce a significant swath of licensed, flexible use mid-band spectrum."); *id.* at 4 ("Other nations are already assigning licenses of 100 megahertz each in the 3 GHz band, and the United States should take decisive action here to avoid being left behind.") (footnote omitted); Ericsson Comments at 6-7 (discussing international mid-band developments); T-Mobile Comments at 3 n.4 ("By 2020, nearly thirty countries, including Australia, Japan, and the majority of European countries, will have allocated at least some mid-band spectrum for terrestrial mobile services.") (citation omitted).

if the majority of the C-band is made available for 5G service. Consistent with its leadership mandate, the Commission should maximize opportunities for 5G service in the C-band, subject to appropriate technical rules and a fair and reasonable process for clearing incumbents out of that spectrum. Indeed, the record shows that commenters of every kind do not seek to terminate or jeopardize the services provided by C-band incumbents.[6]

As to technical issues, Ericsson continues to support the Commission's proposed power levels for base stations in the C-band, although the Commission should refrain from imposing a cap on total base station power summed over all antennas. Ericsson does not object to the proposed out-of-band emission ("OOBE") limit of -13 dBm/MHz at the band edges and attaches to these reply comments a technical assessment in support of a graduated OOBE limit of -40 dBm/MHz at the upper edge of the guard band between mobile broadband and FSS earth station operations, with the guard band on the order of 20-25 megahertz. In its initial comments, the C-Band Alliance proposed power levels and OOBE limits that are too restrictive and not grounded in reality; in reply comments filed only a few days ago, the C-Band Alliance offers new power and OOBE levels with new technical analysis. Ericsson will continue to review the C-Band Alliance's updated technical submission, as well as the recent Nokia filing on OOBE limits.[7]

Finally, many commenters call on the Commission to adopt a flexible use service that supports both mobile and fixed deployments and refrain from introducing a new, dedicated fixed

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[6] *See, e.g.*, Ericsson Comments at 14 ("The Commission can repurpose significant 3.7-4.2 GHz spectrum while ensuring that traffic that currently is delivered via C-band earth stations *is still provided*.") (emphasis added).

[7] Reply Comments of the C-Band Alliance, Technical Annex, GN Docket No. 18-122 (filed Dec. 7, 2018) ("C-Band Alliance Reply Comments"); Letter from Brian Hendricks, Government Relations, Nokia, to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 18-122 (filed Dec. 3, 2018) ("Nokia Dec. 3 Letter").

point-to-multipoint ("P2MP") service into the C-band.[8] The Commission should avoid picking winners and losers and creating new encumbrances rather than clearing the band.

II. THE COMMISSION SHOULD REPURPOSE AS MUCH C-BAND SPECTRUM AS POSSIBLE, AND FAR MORE THAN THE 180 MEGAHERTZ PROPOSED BY THE C-BAND ALLIANCE.

Ericsson shares CTIA's view that "the Commission should set an aggressive benchmark in the hundreds of megahertz so multiple licensees will have an opportunity to deliver on the full promise of 5G in the mid-band range."[9] As Ericsson noted in its initial comments, the amount of spectrum necessary to repurpose the C-band is dictated by two factors: the wide-channel bandwidth requirements needed to support 1 gigabit speeds for 5G use cases, and the need to accommodate multiple providers in C-band spectrum.[10] To that end, as the Competitive Carriers

[8] Ericsson Comments at 17. *See also, e.g.*, AT&T Comments at 13; Comments of the C-Band Alliance, GN Docket No. 18-122, at 39-49 (filed Oct. 29, 2018) ("C-Band Alliance Comments"); CTIA Comments at 4, 25-27; Comments of Digital Networks, LLC, GN Docket No. 18-122, at 4-5 (filed Oct. 30, 2018); Comments of Extreme Reach, Inc., GN Docket No. 18-122, at 5 (filed Oct. 29, 2018); Comments of GCI Communication Corp., GN Docket No. 18-122, at 21, 23 (filed Oct. 29, 2018); Intel *et al.* Comments at 4, 8; Comments of Linkup Communications Corporation, GN Docket No. 18-122, at 5-6 (filed Oct. 29, 2018); Comments of Luken Communications, LLC, GN Docket No. 18-122, at 4 (filed Oct. 29, 2018); Comments of National Public Radio, Inc., GN Docket No. 18-122, at 13-14 (filed Oct. 29, 2018); Nokia Comments at 9-10; Comments of Olympusat, Inc., GN Docket No. 18-122, at 4 (filed Oct. 18, 2018); Qualcomm Comments at 6-7; Comments of QVC, Inc. and HSN, Inc., GN Docket No. 18-122, at 9-10 (filed Oct. 29, 2018); Comments of the Satellite Industry Association, GN Docket No. 18-122, at 31-33 (filed Oct. 29, 2018) ("Satellite Industry Association Comments"); T-Mobile Comments at 20-22; Comments of the Telecommunications Industry Association, GN Docket No. 18-122, at 8-9 (filed Oct. 29, 2018) ("TIA Comments"); Comments of World Teleport Association, GN Docket No. 18-122, at 3-4 (filed Oct. 29, 2018).

[9] CTIA Comments at 9-10. *See also* AT&T Comments at 7 ("[C]onfiguring a reallocation of the C-band with optimal utility for terrestrial 5G—and thereby maximizing the market value of the C-band—will depend upon a reallocation substantial enough to provide multiple licensees with the opportunity to obtain significant spectrum depth in the band.").

[10] Ericsson Comments at 10.

Association asserts, "it is imperative that the FCC identify a substantial amount of spectrum" that will "promote greater competition by increasing the likelihood of a number of licenses in the band."[11]

The C-Band Alliance's active engagement is acknowledged, but its proposal of 180 megahertz for flexible use spectrum (*i.e.*, 200 megahertz less a 20 megahertz guard band) is far less than what is necessary to sustain a robust 5G service.[12] T-Mobile states that the 180 MHz is "less than what is required to meet the critical wireless broadband needs for mid-band spectrum,"[13] while Verizon observes that "other nations [are] assigning 3 GHz licenses of 100 megahertz each."[14] And the 180 megahertz is just 15 percent of the 1.2 gigahertz of spectrum that the Commission proposes to make available for *unlicensed* use in the 6 GHz band.[15] As

[11] CCA Comments at 6.

[12] C-Band Alliance Comments at 25.

[13] T-Mobile Comments at 3 (footnote omitted).

[14] Verizon Comments at 9-10 (footnote omitted); *see also* USCC Comments at 8 n.19. *See also* Joseph Waring, *China releases 5G spectrum to state-run operators*, Mobile World Live (assigning 100 megahertz each to China Telecom and China Unicom), https://www.mobileworldlive.com/asia/asia-news/china-releases-5g-spectrum-to-state-run-operators/ (last visited Dec. 11, 2018).

[15] *See Unlicensed Use of the 6 GHz Band*, Notice of Proposed Rulemaking, FCC 18-147 (rel. Oct. 24, 2018). While Ericsson remains a firm supporter of unlicensed use of spectrum, the mobile industry requires large blocks of licensed spectrum to support 5G, particularly in the mid-bands. Ericsson thus urges the FCC to entertain the possibility of making the upper portion of the 6 GHz band available for licensed use. *See* Letter from Jared M. Carlson, Vice President, Government Affairs and Public Policy, Ericsson, to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket Nos. 17-183 & ET Docket No. 18-295 (filed Oct. 15, 2018).

CTIA concludes, "the Commission should go further and require more than that – hundreds of megahertz – be repurposed on a nationwide basis."[16]

III. THE COMMISSION SHOULD ADOPT REASONABLE TECHNICAL RULES THAT ALLOW WIRELESS SERVICES TO FLOURISH WHILE PROTECTING REMAINING SATELLITE OPERATIONS.

As noted above, the C-Band Alliance submitted reply comments with a technical annex proposing revised power levels and OOBE limits on December 7, and Ericsson will continue to review the proposals therein. Initial review, however, indicates that the C-Band Alliance's updated technical assessment rests on a generic model for co-existence that applies conservative assumptions which would create additional protection criteria beyond what appears necessary (*e.g.*, every earth station location is protected at the lowest earth station elevation angle, without regard to the actual elevation angle, and every earth station is protected as if a 13-meter antenna were installed at that location, regardless of the actual antenna size). Ericsson will continue to study the technical annex.

A. Power Limits.

Ericsson and others supported the *NPRM*'s proposal for base station power of 1640 watts per megahertz for emission bandwidths greater than one megahertz (*i.e.*, 62 dBm/MHz, or 82 dBm/100 MHz) and double that in rural areas.[17] Ericsson does not support the original proposal put forth by the C-Band Alliance in its comments for a more restrictive power level of 46 dBm/MHz (66 dBm/100 MHz), which is 16 dB less than that proposed in the *NPRM*.[18]

[16] CTIA Comments at 9.

[17] Ericsson Comments at 19-20; Nokia Comments at 11-12; CTIA Comments at 23; Verizon Comments at 23; T-Mobile Comments at 32; AT&T Comments at 19.

[18] C-Band Alliance Comments, Technical Annex at 9.

That proposal had many flaws, largely because it calculated a power limit value based on an assumed saturation level of the earth station Low Noise Block converter (LNB) of -59 dBm (meaning that a protection level of -59 dBm would be required to protect C-band earth stations from being overloaded by adjacent band base stations).[19] As discussed below, the -59 dBm level is far too conservative for any realistic interference protection regime.

Nearly 25 years ago, in a report examining adjacent band interference between radars and C-band earth stations, NTIA found that radar peak power ranged from 860 kilowatts to 4 megawatts (much higher than the 1640 W/MHz proposed in the *NPRM*).[20] NTIA also found that some earth stations performed much better than others in rejecting signals that may cause overload interference, with C-band earth stations experiencing gain compression where received radar signal levels range between -55 dBm and -40 dBm.[21] The 1994 NTIA Report thus recommended that RF front-end preselection filters be included in new C-band earth station installations, to preclude receiver front-end overload caused by strong adjacent-band radar signals.[22]

The C-Band Alliance asserts that it "will also use several tools to protect FSS operations while clearing C-band Downlink spectrum [including] . . . fitting C-band earth stations with band-pass filters to prevent terrestrial 5G signals in adjacent cleared spectrum from saturating

[19] *Id.*, Technical Annex at 5.

[20] U.S. Department of Commerce, *Analysis of Electromagnetic Compatibility Between Radar Stations and 4 GHz Satellite Earth Station*, NTIA Report 94-313, at 33 (July 1994).

[21] *Id.* at 52.

[22] *Id.* at 54.

[LNBs]."[23] And as shielding is added, inefficient earth station components, at least in urban areas, should be upgraded to facilitate better use of this scarce spectrum resource.[24] Specifically, there is no reason to base protection levels on protecting earth stations with the poorest performing LNBs. The -59 dBm protection level requested by the C-Band Alliance is derived from assuming a required protection level of -55 dBm, along with a -4dB safety margin.[25] NTIA's study showed that there were better performing LNBs 25 years ago. Accordingly, as earth station equipment upgrades are necessary to repurpose the C-Band, new LNBs that operate at the higher end of the performance range seen by NTIA 25 years ago should be used. As a result, a protection level of -59 dBm (and thus the C-Band Alliance's proposed power limit of 46 dBm/MHz) is not necessary to protect C-band earth stations from base station interference.

Separately, CTIA joined Ericsson in opposing the proposal to restrict the total power of a base station to 75 dBm EIRP, summed over all antenna elements.[26] A cap on total power potentially limits the 5G applications that could be provided in the C-band, as it would negatively affect coverage area and throughput. Ericsson thus continues to urge the Commission not to adopt a cap on the total power of a base station.

Finally, several commenters urged the Commission to permit mobile and portable units to operate above 1 Watt to facilitate robust and high-performance 5G deployment, especially for

[23] C-Band Alliance Comments at 19.

[24] In the Technical Annex of its Comments, the C-Band Alliance noted that some LNB equipment has been in the field for decades. *See id.*, Technical Annex at 8.

[25] *Id.*, Technical Annex at 5.

[26] Ericsson Comments at 19; CTIA Comments at 23.

novel 5G applications that may require more power.[27] Ericsson does not oppose these higher levels.

B. Out-of-Band Emission Limits.

Ericsson does not object to the Commission's proposal to adopt the longstanding out-of-band emission ("OOBE") limit of -13 dBm/MHz,[28] and in response to the question of whether to adopt more stringent limits beyond the band edge, Ericsson submits the attached exhibit in support of a graduated limit of -40 dBm/MHz at the upper edge of the guard band between mobile broadband and FSS earth station operations.[29] Nokia now recommends an OOBE limit of -3 dBm/MHz with additional graduated OOBE levels,[30] which Ericsson will consider, but the attached exhibit provides support for a graduated OOBE level of -40 dBm/MHz at 20-25 megahertz from the new terrestrial, flexible use band edge.

First, the -13 dBm/MHz OOBE limit at the CBRS band edge is appropriate, as the CBRS rules already impose a -13 dBm/MHz OOBE limit for CBRS devices within the CBRS band.[31] Thus, the CBRS devices authorized to operate near the CBRS/C-band band edge – GAA will operate in the 3650-3700 MHz band – will be designed to tolerate that level of emissions from other devices.

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[27] CTIA Comments at 24. T-Mobile Comments at 32. Qualcomm Comments at 8.

[28] *NPRM* ¶ 168.

[29] Ericsson Comments at 21. *See also* Exhibit 1 hereto.

[30] *See* Nokia Dec. 3, 2018 Letter.

[31] 47 C.F.R. § 96.41(e)(1).

Second, the CBRS proceeding is also instructive for setting the appropriate OOBE limit to protect FSS earth station operations. In its 2015 *CBRS Report and Order*, the Commission studied the OOBE emission limits necessary for protection of C-band earth stations from mobile broadband systems operating in the CBRS band and adopted an OOBE level of -40 dBm/MHz at frequencies greater than 20 MHz from the band edge.[32] The Commission affirmed its decision in an Order on Reconsideration in 2016,[33] and concluded there was no reason to revisit its prior findings in its 2018 CBRS Report and Order.[34] The C-Band Alliance proposal thus is not consistent with the Commission's findings in the CBRS proceeding.[35] Ericsson therefore continues to recommend that the OOBE limit at the upper edge of the guard band between mobile broadband and FSS earth station operations be the same -40 dBm/MHz value that the Commission has already adopted in the CBRS context.

And third, Ericsson does not support the C-Band Alliance proposal that user equipment have OOBE limits more stringent than OOBE limits for base stations.[36] The Commission noted that handsets "operate at lower power levels and their size could restrict the implementation of

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[32] *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959, 4017-18 ¶ 184 (2015); 47 C.F.R. § 96.41(e)(2).

[33] *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Order on Reconsideration and Second Report and Order, 31 FCC Rcd 5011, 5037 ¶ 95 (2016).

[34] *Promoting Investment in the 3550-3700 MHz Band*, Report and Order, FCC 18-149, ¶134 (rel. Oct. 24, 2018).

[35] C-Band Alliance Comments, Technical Annex at 9.

[36] *See id.*, Technical Annex at 9-10. The C-Band Alliance Reply Comments do not appear to address user equipment OOBE limits.

more stringent emission limits that would require nonstandard filtering."[37] Ericsson agrees with the Commission's observation. In addition to these points, user equipment is typically located very close to the ground compared to base stations, and thus emissions are less likely to cause interference due to increased propagation losses created by cluttered environments that are likely to be encountered at such low antenna heights.

C. Guard Band.

In the *NPRM*, the Commission noted that a previous Intelsat/SES proposal included a 40 to 60 MHz guard band between flexible use and FSS earth station operations in the C-band, and sought comment as to whether this is necessary to ensure coexistence between the two.[38] In initial comments, Ericsson commented that a guard band should be on the order of 25 megahertz,[39] and Ericsson finds that the 20 megahertz guard band recommended by Verizon, Nokia and the C-Band Alliance is not inconsistent with its proposal.

Ericsson previously submitted a preliminary study on the feasibility of adjacent channel sharing between terrestrial wireless base stations and C-band earth stations which applied an OOBE level of -13 dBm/MHz.[40] Ericsson has since updated its analysis using an assumed OOBE level of -40 dBm/MHz, consistent with the CBRS OOBE requirements.

Ericsson submits as Exhibit 1 its updated adjacent channel study that confirms that adjacent channel coexistence is feasible with a 20 megahertz guard band and an OOBE limit of

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[37] *NPRM* ¶ 171.

[38] *Id.* ¶ 172.

[39] Ericsson Comments at 21.

[40] *See* Ericsson, Adjacent Channel Sharing Assessment, *appended as* Att. A to Comments of Ericsson, GN Docket Nos. 18-122 & 17-183 (filed May 31, 2018).

-40 dBm/MHz at the far edge of the guard band. The study assumes earth station shielding and also confirms that higher FSS earth station elevation angles and relative height differentials between FSS earth stations and the IMT base station antennas can facilitate adjacent channel co-existence.

These Ericsson findings are largely consistent with the extensive simulations that Nokia summarized in its initial comments, which examined representative deployment scenarios for locations in Chicago and New York.[41] These simulations rely on data from IBFS and show that most base stations will be located at heights lower than the earth stations considered in the study area.[42] The Nokia studies conclude that a 20 MHz guard band plus filtering would protect earth stations from adjacent channel (or nearby) interference caused by mobile broadband operations at closer separation distances.[43] Ericsson accordingly agrees with the Nokia studies with respect to a guard band.[44] As noted above, Ericsson will continue to consider the Nokia studies with respect to out-of-band emission limits.

IV. THE COMMISSION SHOULD REJECT A DEDICATED FIXED P2MP SERVICE IN THE C-BAND.

The Commission should reject the Broadband Access Coalition ("BAC") proposal and all others like it.[45] The flexible use licenses envisioned here will allow the introduction of fixed

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[41] Nokia Comments, Technical Appendix.

[42] *Id.*, Technical Appendix at 1. The Nokia studies also reaffirm Ericsson's skepticism that large-scale co-channel sharing among wireless broadband systems and C-band earth stations is achievable or prudent. *See id.*, Technical Appendix at 15; Ericsson Comments at 11.

[43] Nokia Comments, Technical Appendix at 15.

[44] *Id.*

[45] *See, e.g.*, Comments of the Broadband Access Coalition, GN Docket No. 18-122, at 3, 33 (filed Oct. 29, 2018); Comments of Frontier Communications Corporation and Windstream

wireless broadband offerings, so there is no need to establish a dedicated service.[46] P2MP use would be permitted under the same flexible use licenses that permit mobile broadband, and Ericsson has proposed a new "transportable" class of device that would have appropriate technical characteristics to provide this type of service under a flexible use license. Also, authorizing a dedicated P2MP service in the C-band would add encumbrances and, even if limited to the repacked FSS band, would restrict the Commission's ability to repurpose that spectrum if appropriate at a later juncture for mobile broadband use.[47] And, allowing opportunistic P2MP use of the flexible use spectrum would create unnecessary uncertainty for those acquiring flexible use licenses (whether via a private market mechanism or auction).

Ericsson is joined by several commenters raising substantial concerns in the record about the BAC proposal.[48] Those interested in provision of flexible use services cite the impact P2MP operations will have on band clearing and repurposing of the spectrum. CTIA, for instance, observes that "[f]urther encumbering the band at this point is not prudent, as it will only complicate repacking and further repurposing."[49] T-Mobile states that "[t]he premise for

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Services, LLC, GN Docket No. 18-122, at 4-5 (filed Oct. 29, 2018) (calling for the Commission to dedicate at least 320 MHz for fixed P2MP service on a primary basis, above the flexible use portion of the C-band); Comments of Microsoft Corporation, GN Docket No. 18-122, at 2, 9-11 (filed Oct. 29, 2018) (recommending that the Commission make only 100 megahertz of flexible use spectrum available in the bottom of the band, afford P2MP operations opportunistic use of the flexible use spectrum prior to deployment of flexible use services and in the guard band, and permit shared FSS/P2MP use in the remaining spectrum).

[46] Ericsson Comments at 17; T-Mobile Comments at 22; Verizon Comments at 17.

[47] Ericsson Comments at 17; TIA Comments at 8.

[48] *See supra* note 8 and the comments cited therein.

[49] CTIA Comments at 26.

additional P2MP use – that it can be successfully shared with satellite services – is contrary to what should be the principal purpose of this proceeding, which is to clear the band of satellite operations to the maximum extent feasible so that the band can be used for 5G wireless broadband services. . . . It would be short-sighted to adopt rules permitting greater P2MP use of the band today only to later conclude that those rules have made it problematic to have mobile services in the band."[50]

Satellite interests, moreover, cite the serious interference ramifications of having FSS and P2MP operations share spectrum. CBS Corporation *et al.* point out that P2MP transmissions necessarily emit higher-powered signals in many directions, which would severely complicate frequency coordination and increase the potential for harmful interference to reception of video downlinks.[51] And, the Satellite Industry Association concludes that the harms associated with adding P2MP service greatly outweigh any benefits, and in any event earth stations would make the possibilities for new P2MP uses "few and very far between."[52]

In sum, given what is at stake in this proceeding, there is no public interest justification for the Commission to authorize a dedicated fixed P2MP service in the C-band.

[50] T-Mobile Comments at 22.

[51] Comments of CBS Corporation *et al.*, GN Docket No. 18-122, at 10-11 (filed Oct. 29, 2018).

[52] Satellite Industry Association Comments at 31-33. *See also* Comments of Comcast Corporation and NBCUniversal Media, LLC, GN Docket No. 18-122, at 36 (filed Oct. 29, 2018) ("Proponents of P2MP use have yet to adequately demonstrate in the record that sharing is feasible while still allowing earth stations to adjust their operational parameters quickly and without advance notice in order to maintain continuity of service.").

V. CONCLUSION.

For the reasons set forth in these reply comments and in Ericsson's initial comments, Ericsson urges the Commission to promptly act in this rulemaking to advance U.S. prospects for macro 5G deployments by making mid-band spectrum available quickly.

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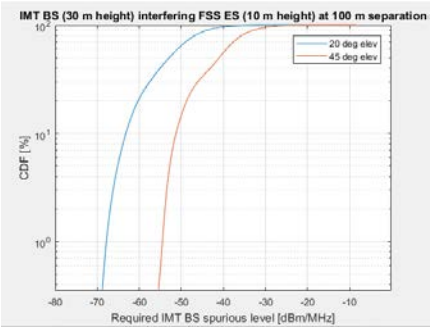
EXHIBIT 1

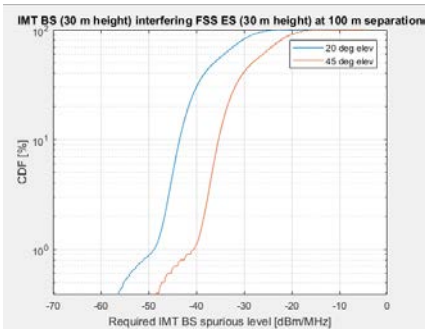
UPDATED ADJACENT CHANNEL SHARING ASSESSMENT
GN Docket No. 18-122
December 11, 2018

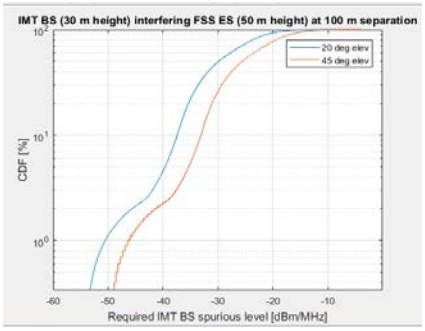
Ericsson previously submitted to the Commission a preliminary study on the feasibility of adjacent channel sharing between IMT wireless base stations and C-band earth stations. This study indicated that adjacent-channel sharing between IMT base station (BS) transmitters and FSS earth station (ES) receivers was feasible in the C-band (3.7-4.2 GHz). Ericsson also determined that the interference from a IMT BS towards a satellite earth station receiver is expected to meet the interference thresholds (*i.e.*, Interference-to-noise ratio) at the satellite receiver with various mitigation techniques such as separation distances, lower transmit power in adjacent frequencies or in some cases guard bands. Ericsson originally used an unwanted emission level of -13 dBm/MHz. Ericsson has since updated its analysis based on a more stringent out-of-band emission (OOBE) level of -40 dBm/MHz at the upper edge of the guard band between mobile broadband and FSS earth station operations, which was selected to minimize separation distances and establish consistency with CBRS emission level requirements. Ericsson filter simulations conclude that a guard band of 20-25 MHz is needed to meet the emission limit of -40 dBm/MHz from the IMT BS to the adjacent FSS ES band.

In this current study, Ericsson based its model characteristics on its previous study but with an assumed OOBE of -40 dBm/MHz, and calculated the needed separation distance (free space model) in various use cases of urban/suburban/rural deployments. We have studied multiple urban and rural scenarios with intersite distances (ISD) of 200 meters, 450 meters, 1 kilometer and 2 kilometers. The modeling assumed an additional loss of 10 dB (this could be from FSS ES shielding (as discussed in *NPRM*), or some assumed clutter loss between BS and ES).

The results of our new study verified that higher FSS ES elevation angles and relative height differentials between the FSS ES and the IMT BS antennas heights can facilitate adjacent channel co-existence. This can be seen in the following graphs where the IMT BS antenna has a static height of 30 meters, and the FSS ES antenna height is graphed at heights of 10 meters, 30 meters and 50 meters. We also assumed an ISD of 200 meters; 100 meter separation between FSS ES and IMT BS; and 10% probability of interference. The charts indicate that going from a 10 meter ES antenna height to a 50 meter ES antenna height can lower interference levels by approximately17 dB. Also, a change in the FSS ES antenna elevation from a 20 degree angle to a 45 degree angle at 100 meters separation can lower interference levels by approximately12 dB (-60 to – 48 dBm).







Further, in dense urban areas (downtown), placing satellite earth stations on rooftops, which is typically the case as was shown in Nokia Chicago loop and Manhattan study, and using satellites as high in the geostationary arc as possible can significantly reduce the guard band requirements between ES and IMT BS.

In the horizontal plane, the model assumed an IMT network utilizing 3 sector cells, so FSS ES is either pointing towards (within +/- 15 degrees in azimuth) the IMT BS or pointing away from the IMT BS. If an FSS ES antenna bore sight is pointed directly into the IMT BS antenna, adjacent channel co-existence sharing will not be feasible. In addition, network planners should avoid situations where the IMT BS antenna beam is steering in the direction of

an FSS ES antenna. This will avoid interference to ES sidelobes from the IMT BS antenna main beam and reduce interference by approximately 10 to 15 dB. This mitigation would need specific analysis per IMT cell and could be possible in some situations.

Table 1 below tabulates the results of Ericsson's simulations for each use case: urban/dense-suburban and rural/suburban with ISD at 200 meters, 450 meters, 1 kilometer and 2 kilometers. In the urban/dense-suburban environment the receiving FSS ES antennas are expected to be at rooftop level (*i.e.*, at same or higher level than IMT BS antenna height). In the rural/suburban environment, the FSS ES receiver antennas are simulated both above and below the IMT BS antenna and with higher elevation and lower elevation angles, respectively. Values in Table 1 assume a -40 dBm/MHz emission level plus an additional 10 dB shielding or clutter loss at the FSS ES antenna.

As shown in the table under ISD=200 meters, the needed separation distances are reduced to under 20 meters (assuming 40 degree elevation angles) as opposed to 40 meters (when assuming 20 degree elevation angles). These separation distances would make adjacent channel sharing feasible (albeit with some site engineering).

For ISD=1 kilometer and 2 kilometers, sharing distances are improved when the FSS ES antenna is at greater height when compared with the IMT BS antenna and when higher elevation angles are assumed.

IMT BS ISD (Urban/Dense-suburban)	Separation distances (assuming FSS ES antenna above IMT BS antenna height and FSS ES elevation angle of 20 degrees)	Separation distances (assuming FSS ES antenna above IMT BS antenna height and FSS ES elevation angle of 40 degrees)
200	<40m	<20m
450	<55	<25

IMT BS ISD (rural/suburban)	Separation distances (assuming and for lower elevation angl**e**s) FSS ES antenna at lower or equal height as IMT BS antenna	Separation distances (assuming FSS ES antenna above IMT BS antenna height and for higher elevation angl**e**s)
1km	<250m	<100m
2km	<270m	<120m

Table 1. Separation Distances for various use cases (10 dB extra shielding for FSS ES assumed).