Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands	)	GN Docket No. 13–185
	)	
Service Rules for Advanced Wireless Services in the 2155-2175 MHz Band	)	WT Docket No. 07-195 (Proceeding Terminated)
	)	
Service Rules for Advanced Wireless Services in the 1915-1920 MHz, 1995-2000 MHz, 2020-2025 MHz, and 2175-2180 MHz Bands	)	WT Docket No. 04-356 (Proceeding Terminated)
	)	
Applications for License and Authority to Operate in the 2155-2175 MHz Band	)	WT Docket No. 07-16 (Proceeding Terminated)
	)	
Petitions for Forbearance Under 47 U.S.C. § 160	)	WT Docket No. 07-30 (Proceeding Terminated)

To: The Commission

COMMENTS OF ERICSSON

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EXECUTIVE SUMMARY

Ericsson fully supports the Federal Communications Commission's ongoing efforts and objectives to make additional spectrum available for mobile broadband use. Reliably managed spectrum access enables the kind of connectivity that consumers demand. Whether accessing streaming video on the go, teleconferencing with HD voice, or being diagnosed remotely via a telemedicine app, the benefits to individuals and society of exclusive use spectrum are clear. These services, and many others, depend on a managed network using licensed spectrum, not one with opportunistic access to spectrum where priority services compete equally, or at a lower priority, with the incumbent. Ericsson urges the Commission to redouble its efforts to allocate additional spectrum on an exclusive-use basis, if at all possible, because exclusive-use spectrum is the lifeblood of the mobile broadband revolution.

Ericsson's primary focus in these comments is to support the pairing of cleared and licensed spectrum to expand the existing AWS–1 band from 2×45 MHz by an additional 2×40 MHz by pairing 1755-1780 MHz with 2155-2180 MHz and pairing 1695-1710 MHz with 2095-2110 MHz. Ericsson encourages the Commission to investigate the potential to accommodate *both* BAS and federal operations in the 2025-2095 MHz band while permitting access to the 2095-2110 band for commercial services.

Ericsson also urges the Commission to look at the broader spectrum picture when allocating the band identified in the *Notice*. We also suggest the Commission consider further expanding the AWS ecosystem beyond that being considered today. Specifically, Ericsson asks the Commission to analyze the possibilities of allocating spectrum in the 1780-1850 MHz band for commercial use and to look at creating an "AWS-5" band consisting of paired spectrum between 1675-1695 MHz and 2075-2095 MHz.

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To: The Commission

COMMENTS OF ERICSSON

Ericsson hereby submits these comments in response to the Commission's *Notice of Proposed Rulemaking and Order on Reconsideration* ("*Notice*") which proposes rules to make available for commercial use spectrum in the 1695-1710, 1755-1780, 2020-2025, and 2155-2180 MHz bands.[1]

[1] Amendment of the Commission's Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands, GN Docket 13-185, *Notice of Proposed Rulemaking and Order on Reconsideration*, FCC 13-102, 28 FCC Rcd 11479 (Jul. 23, 2013).

INTRODUCTION

Ericsson fully supports the Commission's goal of reallocating the 60 MHz of spectrum identified in this proceeding for commercial mobile broadband use. Exclusive-use spectrum is the lifeblood of today's mobile revolution.

As Ericsson's own studies have demonstrated, demand for wireless broadband services and the network capacity associated with those services is surging, resulting in an ever growing demand for spectrum. In 2013, overall mobile data traffic is expected to continue the trend of doubling each year.[2] North America is characterized by early growth in LTE, and Ericsson predicts LTE will represent the majority of subscriptions in North America by 2016, growing to around 70 percent in 2018. This fast growth in LTE subscriptions is driven by strong competition and consumer demand.[3]

The growth in mobile broadband and the benefits it confers on society are primarily enabled through the licensing of exclusive-use spectrum. As the Commission notes, Congress made clear in the *Spectrum Act* its preference for exclusive-use spectrum over shared spectrum:

> In evaluating a band of frequencies for possible reallocation for exclusive non-Federal or shared use, the NTIA shall give priority to options involving reallocation of the band for exclusive non-Federal use and shall choose options involving shared use only when it determines . . . that relocation of a Federal entity from the band is not feasible because of technical or cost constraints.[4]

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2 *Ericsson Mobility Report on the Pulse of the Networked Society* at 10 (June 2013), available at http://www.ericsson.com/res/docs/2013/ericsson-mobility-report-june-2013.pdf ("Ericsson Mobility Report"); *see also Interim Update, Ericsson Mobility Report*, at 4 ("Data traffic almost doubled between Q2 2012 and Q3 2013."), available at http://www.ericsson.com/res/docs/2013/emr-august-2013.pdf.

3 *See Ericsson Mobility Report* at 8.

4 Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, 126 Stat. 156 (2012) ("*Spectrum Act*") § 6701(a), codified at 47 U.S.C. § 923(j)(1); *see also Notice* at ¶ 11.

Each of the spectrum bands raised in the *Notice* comes with its own set of challenges, whether it is, for example, coexisting with existing satellite operations, or determining whether carrier aggregation/pairing options might exist to make a particular slice of spectrum useful. Ericsson asks the Commission to consider the following points, which we detail further herein:

- Exclusive use spectrum should be the goal. As stated above, the *Spectrum Act* clearly expresses Congress's priority for relocation of Federal uses over sharing.
- Ericsson's focus is the pairing of licensed spectrum to expand the existing AWS–1 band from 2×45 MHz by an additional 2×40 MHz.
- Maintain the goal of relocating federal services out of the entire 1755-1780 MHz band within ten years.
- Pair the 1695-1710 MHz band (uplink/mobile operations) with 2095-2110 MHz band (downlink/base station operations). Ericsson asks that the technical rules for 1695-1710/2095-2110 MHz be similar to those established for the AWS-1 band.
- Pair the 1755-1780 MHz band (uplink/mobile operations) with the 2155-2180 MHz band (downlink/base station operations). The technical rules for 1755-80/2155-80 MHz should be similar to those established for the AWS-1 band.
- Ericsson supports the use of new technologies and services for BAS/CARS to consolidate its spectrum usage.
- A determination of the duplex direction of the 2020-2025 MHz band should be delayed pending a determination on issues raised in a recent waiver petition.

I. Spectrum Sharing

As Ericsson has stated previously, the Commission's goal should be the auction of exclusively licensed spectrum.[5] Reliably managed spectrum access enables "always-on" connectivity and supports bandwidth sensitive applications such as streaming video, high quality voice telephony, telemedicine, etc. Such services depend on a managed network using licensed spectrum, not one with opportunistic access to spectrum where priority services compete equally, or at a lower priority, with the incumbent.[6]

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[5] *See, e.g.*, Comments of Ericsson, *Spectrum Task Force Requests Information on Frequency Bands Identified by NTIA as Potential Broadband Spectrum*, ET Docket No. 10-123, at 10 (filed Apr. 22, 2011).

[6] *See id.* at 11.

The recent reports from the Commerce Spectrum Management Advisory Committee ("CSMAC") Working Groups suggest methods for sharing spectrum in the 1755-1850 MHz band.[7] However, most of the reports were only just released in August of this year, [8] and while the frameworks for sharing with incumbent government users outlined in the reports may be promising, they have yet to be tested in the real world. Several members of the CSMAC stressed that their vote to approve the reports and recommendations of several Working Groups does not endorse the assumptions or technologies contained in the analyses, and that they believe that "many of the current analysis results *do not represent the real-world interference environment* between Federal and commercial users."[9]

Ericsson recognizes that sharing during a relocation transition period, or in some cases where exclusive use is not possible, "will require establishment of clear regulatory mechanisms prior to any auction to ensure appropriate protection of federal operations and acknowledgement by industry of its status with respect to potential interference from federal operations."[10] However, as stated by the signatories to the Separate Statement:

> [B]ecause only limited technical data was shared about Federal systems with the working groups, participants were not able to fully engage in the type of informed discussion of the analysis and underlying assumptions necessary to verify the accuracy of the information. We believe that the process recently initiated to allow the release of more Federal system technical characteristics to parties signing non-disclosure agreements will

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7 *See infra* Section II.C for a summary of the reports of the CSMAC Working Groups.

8 The reports of the CSMAC Working Groups are available at http://www.ntia.doc.gov/category/spectrum-management.

9 *Statement Concerning Working Group Reports for the 1755-1850 MHz Band*, Dated Aug. 29, 2013, available at http://www.ntia.doc.gov/files/ntia/publications/csmac_separate_statement-aug_29-rev2.pdf ("Separate Statement") (emphasis added).

10 *An Assessment of the Viability of Accommodating Wireless Broadband in the 1755-1850 MHz Band*, U.S. Dep't of Commerce, at vi (March 2012), available at http://www.ntia.doc.gov/files/ntia/publications/ntia_1755_1850_mhz_report_march2012.pdf.

better inform the commercial parties to understand what can be done to better model an analysis of real-world effects.[11]

Ericsson asks, consistent with the concerns described in the Separate Statement and in the directive contained in the Presidential Memorandum on Wireless Innovation, that federal government agencies share more operational data with private industry.[12] Doing so will better allow the commercial mobile wireless industry to assess the value of potential shared spectrum in terms of business models and the price to be bid on the spectrum at auction.

The priority stated in the *Spectrum Act* for exclusive use spectrum over shared spectrum is clear and additional efforts are needed to reallocate spectrum for commercial use. Nonetheless, sharing can—in some cases—*complement* traditional allocation processes and provide a mechanism to enable use of spectrum that might otherwise remain unavailable for commercial use. The success of the sharing model has not been tested and will rely on the sharing parameters (*e.g.*, time, protection zones, power levels, etc.) and enforcement mechanisms associated with specific shared spectrum bands.

II. AWS-3

The following figure illustrates the proposed pairing of AWS-3 and a proposed future spectrum pair, "AWS-5," which would consist of downlink spectrum between 1675-1695 MHz and uplink between 2075-2095 MHz. In Ericsson's past comments, we have noted that an important feature of the spectrum in the 2 GHz band is its proximity to the AWS–1 band (the AWS-1 band constitutes spectrum between 1710 and 1755 MHz paired with spectrum between

[11] Separate Statement.

[12] *See infra* at 16.

2110 and 2155 MHz).[13] The extension of the AWS–1 band has the potential to address expeditiously a significant part of the nation's mobile broadband needs. The National Broadband Plan recognized the importance of the AWS–1 spectrum in this regard and supported supplementation of the spectrum in this band with nearby spectrum as a key element of any plan addressing projected industry demands for wireless broadband capacity.[14]

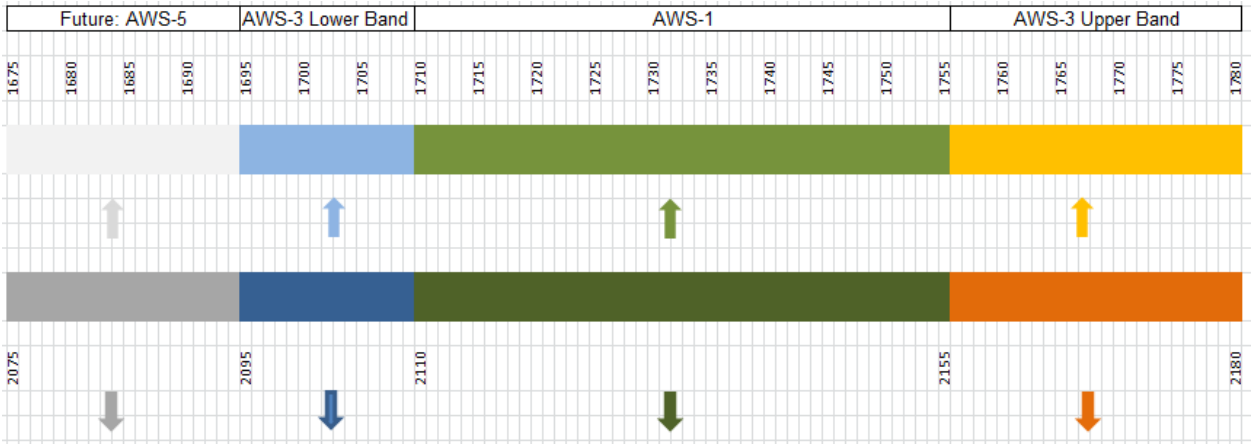

Figure A. AWS-3 and AWS-5

A. Technical Rules

The *Notice* suggests an EIRP limit of only 20 dBm (100 mW) for mobile devices operating in the 1695-1710 and 1755-180 bands.[15] Ericsson notes that Part 27 AWS rules specify a power limit of 1 Watt equivalent isotropically radiated power ("EIRP") for the AWS-1 uplink band.[16] The lower power limit for the AWS-1 band was intended to simplify coordination with

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[13] *See* Comments of Ericsson Inc, *Request for Information on Use of 1675-1710 MHz Band*, WT Docket No. 10-123, at 7-9 (filed June 28, 2010).

[14] Connecting America: The National Broadband Plan at 86-87 ("National Broadband Plan"), available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296935A1.pdf.

[15] *See Notice* at ¶ 103.

[16] *See* 47 C.F.R. § 27.50(d)(4). The former ATC rules originally specified a power limit of 1 dBW (1.25 watts) EIRP in a bandwidth of 1.23 MHz for mobiles operating in 2000-2020 MHz. 47 C.F.R. § 25.252(b)(1) (2003).

Government operations that would remain in the 1710-1755 MHz band.[17] However, the uplink bands 1695-1710 MHz and 1755-1780 MHz bands do *not* present the same concerns. An EIRP limit of 20 dBm (100 mW) for mobiles and portables (handhelds) operating in the 1695-1710 MHz and 1755-1780 MHz bands is therefore not necessary. Assuming there are 27 sites to protect covering only 10% of the population,[18] it is recommended that the power limit be set at 25 dBm EIRP with a slightly larger burden of coordination. The base station can configure a maximum allowed user equipment ("UE") uplink power < 25 dBm (conducted) in a cell where interference to other services occurs. The benefits of this higher power limit would outweigh the increased burden of having to coordinate more commercial operations with Federal incumbents.

Ericsson suggests base and fixed (downlink), but not mobile, operations in the 2155-2180 MHz band. Such operations are compatible with similar downlink operations in the adjacent AWS-1 band (2110-2155 MHz) and AWS-4 band (2180-2200 MHz). By designating new downlink spectrum adjacent to existing downlink, the industry avoids having to add guard bands or impose significant technical limits between adjacent services, thereby increasing the amount and utility of usable spectrum. Ericsson further supports mobile transmit operations (and the prohibition of high-power fixed and base station operations) in the 1695-1710 MHz, and 1755-1780 MHz bands.

B. 1695-1710 / 2095-2110 MHz

Ericsson has offered extensive comments in the past about the feasibility of using a band larger than what is proposed by the Commission's *Notice*. Specifically, Ericsson has advocated

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[17] *See* Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, WT Docket No. 02-353, Report and Order, 18 FCC Rcd 25162, 25178 ¶ 98 (2003) ("AWS-1 Service Rules R&O").

[18] *See infra* at 9.

clearing the 1675-1710 MHz band to be paired with the 2075-2110 band.[19] While Ericsson would prefer that the maximum amount of spectrum be cleared for wireless use, we recognize the urgency of bringing spectrum to market quickly and support the Commission's efforts to reallocate the 1695-1710 MHz band to be paired with the 2095-2110 MHz band.

There are certain characteristics of the 1675–1710 MHz band that support further consideration of this spectrum for commercial use. For example, it is adjacent to the AWS–1 band, which creates some synergies that would make it suitable for mobile broadband services. Specifically, service providers and equipment manufacturers may be able to use or adapt existing AWS–1 band equipment for spectrum that effectively could be an extension of that band. Further, placing "like" services in adjacent spectrum bands reduces the risk of harmful interference between licensees. While Ericsson supports identifying 2095-2110 MHz as the additional 15 megahertz required by the *Spectrum Act*,[20] additional efforts should be made to investigate extending mobile operations *below* 1695 MHz and 2095 MHz to further extend the AWS ecosystem.[21]

In Ericsson's past comments, we have noted that an important feature of the spectrum in the 2 GHz band is its proximity to the AWS–1 band (the AWS-1 band constitutes spectrum between 1710 and 1755 MHz paired with spectrum between 2110 and 2155 MHz). The extension of the AWS–1 band has the potential to address expeditiously a significant part of the

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[19] *See, e.g.*, Comments of Ericsson, *Request for Information Use of 1675-1710 Band*, WT Docket No. 10-123 (filed June 28, 2010). Ericsson also submitted comments regarding the 1675-1710 MHz band in response to the Spectrum Task Force's 2011 Public notice. Comments of Ericsson, *Spectrum Task Force Invites Technical Input on Approaches to Maximize Broadband Use of Fixed/Mobile Spectrum Allocations in the 2 GHz Range*, ET Docket 10-142, at 4-5 (filed July 8, 2011).

[20] *See Spectrum Act* §6401(b)(2)(E).

[21] *See supra at 5.*

nation's mobile broadband needs. As stated above, The National Broadband Plan similarly recognized the value of adding spectrum adjacent to the AWS-1 band.[22]

The CSMAC was given the task of developing recommendations for reallocating/sharing of spectrum currently allocated for purely Federal use. Working Group 1 of the CSMAC ("WG-1") was given the specific task of developing recommendations for use of the 1695-1710 MHz band for commercial services while protecting Federal meteorological earth stations from harmful interference.[23] Based on input from WG-1, the anticipated separation distance between which an LTE-based mobile wireless system would be expected to potentially cause interference into a meteorological satellite receiver has been significantly reduced from the previous analysis contained in the NTIA's Fast Track Report. WG-1 reported to the CSMAC that its analysis to compute protection distances for the new sites and consolidated sites with overlapping zones reduced the number of new sites to nine (for a total of 27 sites) that require protection.[24]

Industry participants in WG-1 have noted that access to the 1695-1710 MHz band in the top 100 market areas would be of tremendous value to the mobile broadband industry and consumers.[25] There are a relatively small number of Government satellite receive locations in or near these market areas that impact the availability of the spectrum for commercial wireless use.[26] Industry has proposed examining the feasibility of relocating these receive locations to less populated areas to enable use of the spectrum for broadband services in more densely populated

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22 *See supra* at 6.

23 *See* Commerce Spectrum Management Advisory Committee Final Report Working Group 1 – 1695-1710 MHz Meteorological-Satellite Rev.1, at 1, available at http://www.ntia.doc.gov/files/ntia/publications/wg1_report_07232013.pdf.

24 *See id.* at Appendix 1.1-1.

25 *See id.* at 7.

26 *See id.* at 5.

areas. The Commission's goal should be to create an environment with fewer restrictions on commercial use of the band within the Protection Zones. To date, the feasibility and costs associated with such relocation have not been analyzed, but Ericsson would support this study activity.

If the Commission and NTIA determine that sharing is necessary in the 1695-1710 MHz band, the framework structure in Appendix 1 of the WG-1 Report for sharing the band appears to be a workable proposal.[27] The proposal would establish the FCC and NTIA-led Working Group to begin developing the coordination, testing, monitoring, and compliance processes, and roles and responsibilities for commercial use of the band alongside satellite operations.[28]

The framework in Appendix 1 of the WG-1 Report is conditioned on Protection Zones surrounding satellite earth station operations that will be based on the NTIA interference analysis and protection criteria, *including aggregate Interference Power Spectral Density (IPSD) limits*, to be determined for each receiver location. In this case, Ericsson supports protection zones based on aggregate IPSD limits to be determined for each receiver location—including procedures for implementing on-going real-time monitoring—to ensure IPSD limits are not being exceeded. Additionally, Ericsson supports the establishment of a testing program to demonstrate the viability and effectiveness of proposed protection and mitigation methods before commercial licensees may begin operations within a Protection Zone.

Ericsson further supports the establishment of processes[29] that will monitor the size of coordination zones around incumbent receivers, and we recognize that in certain cases, the size of these zones may need to be expanded to protect the incumbent. In the same vein, those

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27 *See id.* at Appendix 1.

28 *See id.* at Appendix 1-1.

29 *See Notice* at ¶ 64.

processes could also lead to *reductions* in the size of the coordination zone based on evidence that LTE deployment closer to satellite earth stations does not endanger incumbent system operations.

1. Pairing the 1695-1710 MHz band with the 2095-2110 MHz band

Section 6401 of the *Spectrum Act* requires the Commission to identify an additional 15 MHz of contiguous spectrum for commercial use.[30] Both Ericsson and CTIA have advocated designating 15 MHz of spectrum currently allocated for the Broadcast Auxiliary Service ("BAS").[31]

Ericsson's candidate band for paring with the 1695-1710 MHz band is the 2095-2110 MHz band. As Ericsson and CTIA have noted, the 2095-2110 MHz band is ideal for pairing with the 1695-1710 MHz band because it is a contiguous band with propagation characteristics ideally suited for mobile broadband and is adjacent to current mobile broadband spectrum.[32]

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30 *See Spectrum Act* at § 6401.

31 *See* Letter from Steve Largent, President, CTIA, to Julius Genachowski, Chairman, FCC, GN Docket No. 09-51 (dated Mar. 13, 2013).

32 *See supra* at 8.

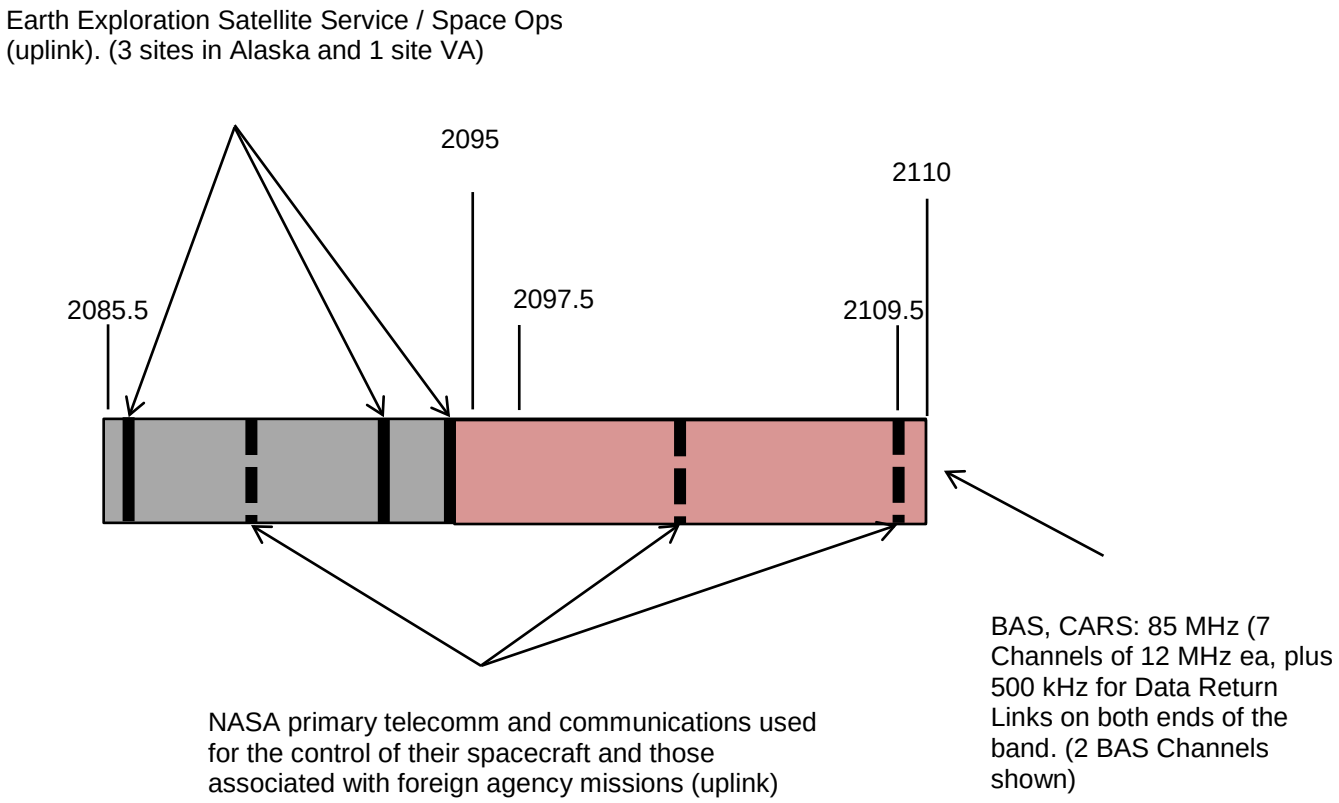

Figure B. BAS/CARS

Services in the entire 2025-2110 MHz band are a mix of commercial (BAS and Cable Access Relay Service [“CARS”]) and non-commercial (NASA telemetry and Earth Exploration Satellite Service/Space Operations uplink). Operation of unlicensed Part 15 Devices is permitted between 2025 and 2110 MHz. Some frequencies are shared by federal and non-federal users, and use of those frequencies must be coordinated with the NTIA. NASA operates its primary telecommunications and communications in the control of their spacecraft and those associated with foreign space agency missions.

Figure B illustrates the spectrum occupancy of frequencies between 2085.5 – 2110 MHz. This range of spectrum includes two of the seven channels allocated for BAS and CARS in the 2

GHz band and also includes the Data Return Link at 2109.5-2110 MHz. Ericsson proposes to reallocate two BAS/CARS channels (2085.5-2109.5) for mobile broadband service. Reallocating 2095-2110 MHz would not require relocating the entire BAS channel located at 2085.5-2097.5. The remainder of this channel could help facilitate the Department of Defense request for relocation spectrum for federal services from 1755-1780 MHz.[33]

Ericsson proposes the use of new technologies and consolidated spectrum usage to supplant the current fixed service ("FS") usage of the 2095-2110 MHz band. Specifically:

- BAS and CARS services can benefit from the development of new technologies, which could provide broadcasters with new mechanisms to support their electronic news gathering functions in the future. One specific example is the delivery of HD video in real-time using off-the-shelf LTE equipment. The very high uplink and downlink speeds that LTE enables can provide a potential alternative to the services currently offered in the dedicated 2025-2110 MHz band today.

- The ongoing shift from analog to digital transmission has accelerated the erosion of technical distinctions between BAS, CARS, and Part 101 FS, and the use of consistent procedures for fixed stations in all of those services has played a vital role in the Commission's efforts to accommodate the increasing demand for closely-packed microwave links in urban areas.

- The Commission amended Parts 74 and 78 of its rules to harmonize many of the rules governing BAS and CARS with rules that already applied to FS licensees under Part 101, thereby allowing the use of digital transmissions. Thus, steps are already being taken to remove the need for allocations based on content or service. Some Part 101 FS operators are involved in video newsgathering or video coverage of other live events, so the need for as much dedicated spectrum maybe limited. Ericsson notes that the 6,875 – 7,125 MHz band has been opened for sharing with CARS and BAS services.

Ericsson urges the FCC to begin a process to address impediments to making the 2095-2110 MHz band available for commercial mobile use.

[33] *See* Letter from Karl B. Nebbia to Julius P. Knapp (July 22, 2013) (GN Docket No. 09-51, ET Docket 10-123) Enclosure 1 (Letter from Teresa M. Takai to Lawrence E. Strickling, July 17 2013).

2. NASA-Sponsored Study of sharing/coexistence in the 2025-2110 MHz band

The 2025-2110 MHz band is also the primary command and control band for U.S. civil space programs.[34] Systems that use this band include the Tracking and Data Relay Satellite System (TDRSS), Space Research services, and the International Space Station.[35] The National Aeronautics and Space Administration (NASA), recognizing the interest in the potential for use of the band for wireless broadband, performed a compatibility study examining the potential for commercial broadband systems employing LTE technology to coexist, on a shared basis, with forward link transmissions from NASA geostationary TDRSS satellites to some typical Leo Earth Orbit ("LEO") satellite users.[36] The NASA Study concluded that sharing/coexistence is not feasible due to excessive interference generated by LTE systems to the TDRSS space-to-space forward links.[37] However the absence of detailed modeling information and certain model parameters contained in the NASA Study makes it difficult to assess the validity of modeling of propagation, antenna characteristics and LTE system characteristics.

The NASA Study assumed a uniform distribution of macro base stations, operating at a power level of 40 Watts per sector,[38] to cover large cities referenced in Appendix 4 of the

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[34] *See* Letter from Karl B. Nebbia to Julius P. Knapp, GN Docket No. 09-51, ET Docket No. 10-123 (filed July 22, 2013) Enclosure 2 (Feasibility Assessment for Accommodation of Mobile Broadband Long Term Evolution (LTE) Systems in the 2025-2110 MHz band) ("NASA Study") at 3.

Ericsson is aware that revisions to the NASA Study were circulated on Monday, September 15, 2013. While some revisions may partially address the concerns we outline below, there was simply not enough time to review the new document prior to filing the instant Comments.

[35] *See* NASA Study at 1.

[36] *See* Letter from Karl B. Nebbia to Julius P. Knapp, GN Docket No. 09-51, ET Docket No. 10-123 (filed July 22, 2013) at 2.

[37] *See* NASA Study at 16-17 (stating that the results of the study show that high-density terrestrial base stations or user equipment operating co-frequency in the 2025-2110 MHz band will exceed established protection criteria for the TDRSS spaceborne receivers by an average of 16.4 dB to 40.7 dB).

[38] *See* NASA Study at 11.

study.[39] In the real world, however, networks are much more diverse in terms power levels, inter-site distances, antenna gains considerations for terrain and clutter and degree of tilt toward the ground. Thus, using a uniform 40 Watt per sector power level likely does not account for real-world conditions. For example, the clutter loss would be significant for sectors not oriented toward the satellite. In addition, the current trend in the wireless industry is to make increasing use of small cells and distribute antenna array (DAS) systems to provide coverage. These types of systems have much lower EIRP levels.

The NASA Study also seems to have modeled base station tilt towards the ground.[40] However, the validity of that model to account for effects in the azimuthal and elevation patterns needs to be established. For example, the shape of the gain pattern varies according to the maximum gain of the satellite, but the orientation of this receive array with respect to the relay satellite is not clear and should be verified to account for the direction to the TDRSS satellite.

The use of a single virtual antenna modeled as a point source for each city is acceptable assuming the average effect of orientation of base station antennas towards the horizon is modeled randomly with respect to the satellite track. Doing so will lower the total transmitted power by a factor of around 4.8 dB for a typical three-sector deployment. Moreover, the antenna tilt of the base station towards the ground, which is normally in the range of 6° to 10° in suburban and urban scenarios, must also be accounted for beyond the 3° tilt typically used in rural scenarios.

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[39] *See id.* at 26-28.

[40] LTE base station technical characteristics, tabulated in Table 2, identified the sector antenna pointing elevation as 3° down tilt for each sector antenna whereas the recommendation from ITU WP5D recommended to JTG 4-5-6-7 in their preparation of WRC2015 agenda item 1.1 the use of 10° down tilt for each sector antenna.

In the context of the CSMAC Working Group reports, the U.S. wireless industry provided technical parameters for commercial broadband LTE systems for analyzing spectrum sharing scenarios in the 1695-1710 MHz and 1755-1850 MHz bands. These parameters were used in the NASA Study considering both base station and UE operations in the 2025-2110 MHz bands. In contrast to the CSMAC study, however, the industry focus for the 2095-2110 MHz band is for downlink operation *only*, rather than both uplink and downlink operations. Therefore section 3.2.2 of the NASA study, which provides an overview of technical characteristics for LTE UE, relies on data that are beyond the scope of the intended commercial usage in the band.

The NASA Study is quite complex, and to fully review it requires an understanding of the direction of the main beam and details of the LEO orbits. Industry access to the simulation, including the main beam direction and LEO orbit details, would be useful. Ericsson notes that the Presidential Memo, *Expanding America's Leadership in Wireless Innovation*, directs agencies to work more collaboratively with industry and specifically mentions sharing data with the private sector.[41]

There are a number of TDRSS satellites that operate in the 2109.49 MHz band. This band is in close proximity to base station operations in the AWS-1 band (2110-2155 MHz). The protection criteria used in the NASA study, as specified in Recommendation ITU-R SA.1154, is an aggregate interfering signal power density from mobile systems in the band 2025-2110 MHz of -184 dB (W/kHz) at the DRS receiving antenna port, not to be exceeded for more than 0.1%

[41] *See* Presidential Memorandum—Expanding America's Leadership in Wireless Innovation (June 14, 2013) ("The Secretary of Commerce, working through NTIA, has been facilitating discussions between agencies and nonfederal entities that have produced an unprecedented level of information-sharing and collaboration. . . . The NTIA shall continue to facilitate these discussions and the sharing of data to expedite commercial entry into these bands where possible…"); *see also* Separate Statement.

of the time.[42] The NASA Study concludes that co-existence with LTE is not possible based on the ITU recommended power density. However, if the assumptions made in the analysis are correct, one would have expected interference *today* into TDRSS satellite operations in the 2109.49 MHz band from AWS-1 base stations. Ericsson is not aware of any complaints, nor has NASA said publicly, that such interference exists. The absence of any real-world interference suggests that NASA's assumptions are overly conservative.

The protection limits used in NASA's study are taken from Recommendation ITU-R SA.1154.[43] While that Recommendation may have been accepted in the ITU, a prudent and rational approach to determining acceptable interference levels—more consistent with the capability of individual subsystems—may well allow less stringent rules that are acceptable to NASA and to the mobile industry. For example, individual systems may be capable of operating at higher interference levels. Receiver technologies and coding techniques have considerably improved since the adoption of the Recommendation. Real-time testing and updated software changes, where possible, may allow lower bit error rate reception in higher interference conditions. Specifically, some LEO systems may be capable of improved performance after software upgrades.

In the absence of detailed modeling information about the NASA commissioned study, it is difficult to assess the validity of modeling of signal propagation, antenna characteristics, and LTE system characteristics, even if the principles agreed to within CSMAC were adhered to with diligence. Moreover the close proximity of AWS-1 downlink operations to the TDRSS forward

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[42] The ITU-R recommended threshold for interference from Mobile System Transmitters should not exceed -184 dBW/kHz no more than 0.1% of the time. *See* Recommendation ITU-R SA.1154, Provisions to protect the space research (SR), space operations (SO) and Earth exploration-satellite services (EES) and to facilitate sharing with the mobile service in the 2025-2110 MHz and 2 200-2 290 MHz bands, recommends 1.2, at 3 ("Recommendation ITU-R SA.1154").

[43] *See* Recommendation ITU-R SA.1154 at 7-9.

link, and the absence of reports of interference from existing mobile operations to the AURA, CONNECT-HGA, GPM, SWIFT and TERRA forward link, strongly supports the need for a detailed examination of the study. In addition, the ITU-R interference limits for aggregate interference power spectral density less than -184 dB(W/kHz) for 99.9% or more of the time may bear revisiting.

Thus, Ericsson recommends cooperation between NASA and industry to conduct a review of the Excelis study, and, further, to share the simulation tool with industry. Also, a joint effort between NASA, the principal investigators, and various industry partners will help validate the models, establish real-time testing, and, ultimately, reach agreement on the conclusions of the study. Specifically, signal level measurements are needed from the various LEO operations, preferably co-channel to AWS-1 and on the International Space Station (ISS), with a view to examine the interference threshold of -184 dB(W/kHz) for 99.9% or more of the time as reasonable criteria. Lastly, investigate interference mitigation if and where necessary.

C. 1755-1780 / 2155-2180 MHz

The commercial mobile wireless industry has prioritized the 1755-1780 portion of the larger 1755-1850 MHz band to pair with the 2155-2180 MHz band and there has been substantial activity[44] by all interested parties to repurpose this band. The activity includes the development of the "Industry Roadmap," filed by T-Mobile, which provides a guide for NTIA to identify the method to transition services in the band in order to facilitate commercial use of the

[44] *See, e.g.*, Fostering Innovation and Investment in the Wireless Communications Market, GN Docket Nos. 09-157 and 09-51, Comments of Ericsson Inc, at 15.

band.[45] Ericsson supports the ultimate goal of relocating all federal services from the 1755-1780 MHz band within 10 years.[46]

The Pentagon *has* stated its intention to relinquish the 1755-1780 MHz band. In its letter to the NTIA, Department of Defense ("DoD") Chief Information Officer Teresa Takai stated that the proposal provides access to the 1755-1780 MHz band most desired by the commercial wireless industry.[47] To accomplish this repurposing, DoD proposes that Satellite Operations (SA TOPS), Electronic Warfare (EW), Air Combat Training System (ACTS) (where required), and Joint Tactical Radio System (JTRS) at 6 sites will share spectrum with commercial users in the 1755-1780 MHz band. DoD will compress remaining operations into 1780 -1850 MHz. DoD has also identified the need for shared access to 2025-2110 MHz. DoD will modify the remaining systems to operate in other existing Federal bands as identified: Precision Guided Munitions to 1435-1525 MHz, Point-to-Point Microwave Links to 7125-8500 MHz, and DoD Video surveillance/Robotics to 4400-4940 MHz.[48]

This is a positive development that Ericsson believes is crucial in the development of the 1755-1780 MHz band for commercial broadband services. However, we note that the DoD is not committing to fully exiting the 1755-1780 MHz band, and indeed has identified *a wider* range of spectrum to relocate its 1755-1780 MHz uses (it proposes to relocate operations that currently use 25 MHz of spectrum into the 85 MHz of spectrum located between 2025-2110 MHz.). Thus,

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[45] *See* Letter from Steve Sharkey, T-Mobile U.S., Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket Nos. 10-123, 07-195 (dated Jun. 24, 2013), Attachment, Industry Roadmap to Assessing the 1755-1850 MHz Band.

[46] *See* An Assessment of the Viability of Accommodating Wireless Broadband in the 1755 – 1850 MHz Band, U.S. Dep't of Commerce (March 2012) at 4.

[47] *See* Letter from Karl B. Nebbia to Julius P. Knapp (July 22, 2013) (GN Docket No. 09-51, ET Docket 10-123) Enclosure 1 (Letter from Teresa M. Takai to Lawrence E. Strickling, July 17 2013).

[48] *See id.*

not only would the 1755-1780 MHz remain encumbered, but the proposed relocation band (2025-2110 MHz) would likely impact the pairing of 1695-1710 MHz with 2095-2110 MHz. In light of these concerns, Ericsson encourages the Commission to investigate the potential to accommodate *both* BAS and federal operations in the 2025-2095 MHz band while permitting access to the 2095-2110 band for commercial services.

1. 1755-1780 MHz – CSMAC Working Groups

Ericsson has commented on the use of the 1755-1780 MHz band in response to a 2010 public notice, stating that reallocating the band could provide additional spectrum for commercial broadband services as envisioned by the National Broadband Plan. Ericsson also noted that this band could be paired with the 2155-2180 MHz band.[49]

In March 2012, the NTIA released a detailed analysis of the federal government services currently in use in the 1755-1850 MHz band.[50] This report outlined the challenges of repurposing the entire band for commercial use, and estimated the total cost of doing so at $18 Billion.[51] The CSMAC convened several Working Groups to work collaboratively with federal government representatives to develop recommendations to facilitate the transition of spectrum in the 1695-1710 MHz and 1755-1850 MHz bands from federal use to commercial broadband.

2. Working Group 2 – 1755-1850 MHz Law Enforcement Video, Explosive Ordnance Disposal, and other short distance links

The NTIA March 2012 report identified three types of video systems operating in the 1755-1850 MHz band: mobile law enforcement; fixed or transportable high resolution video

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[49] *See* Request for Information on Use of 1675-1710 Band, WT Docket No. 10-123, Comments of Ericsson Inc (June 28, 2010).

[50] *See* An Assessment of the Viability of Accommodating Wireless Broadband in the 1755-1850 MHz Band, March 2012.

[51] *See* id. at iii.

operations; and land robotics. Currently, agencies with video surveillance systems in the 1755-1850 MHz band plan to transition operations from the 1755-1780 MHz band within five years, once funding and comparable spectrum is available.

Working Group 2 has issued a final report,[52] which the full CSMAC adopted on February 21, 2013.

Ericsson supports the recommended prioritized list of geographies contained in the report according to industry implementation priorities.[53]

3. Working Group 3 – 1755-1850 MHz Satellite Control and Electronic Warfare

CSMAC Working Group 3 was established to focus on recommendations to optimize industry access to the 1755-1850 MHz band while protecting federal operations. Deliverables include recommendations regarding definition and specification for sharing techniques with satellite operations (including any interference acceptance rules and coordination zones) and improved coordination rules and procedures for electronic warfare.[54]

WG-3 determined that Space Ground Link Sub-system (SGLS) should remain in place and operate throughout the 1755-1850 MHz band:

- Interference from commercial mobile devices into satellite receivers shows that interference is acceptable.
- Based on current analysis there will be zones around the satellite earth terminals where interference into commercial base stations is above the acceptable levels.
- Mitigation methods can significantly reduce the zone of interference, both geographically and in time.[55]

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[52] Commerce Spectrum Management Advisory Committee (CSMAC) Working Group 2: 1755-1850 MHz Law Enforcement Surveillance, Explosive Ordnance Disposal, and other short distance links, Final Report (Jan. 2013).

[53] *See id.* at 6.

[54] Commerce Spectrum Management Advisory Committee (CSMAC) Working Group 3 (WG 3) Report on 1755-1850 MHz Satellite Control and Electronic Warfare, at 2, available at http://www.ntia.doc.gov/files/ntia/Working_Group_3_Final.pdf.

[55] *See id.* at 7-8.

Working Group 3 also found that Electronic Warfare (EW) should continue to operate on a secondary, non-interfering basis.[56] DoD requests a *more formalized coordination and EW operating procedure* that would permit EW testing and training in and around DOD ranges, and other approved operating areas when required.[57]

Ericsson supports similar protection zone procedures described for 1695-1710 MHz with a view to ensure protection for the incumbent while permitting commercial operation in the protection zones.

Ericsson supports the establishment of processes that will monitor the size of coordination zones around incumbent receivers, and the ability for expansion of the size of these zones to protect the incumbent as well as a reduction in the coordination zone based on evidence that LTE deployment closer to the satellite earth station does not endanger incumbent system operations. Ericsson also supports additional steps, including relocating earth stations to remote areas.

4. Working Group 4 – 1755-1850 MHz Tactical Radio Relay, Fixed Microwave, and ground-based software defined radios

The systems that Working Group 4 was responsible for assessing were Fixed Point-to-Point, Microwave, Tactical Radio Relay (TRR), and ground-based Joint Tactical Radio Systems (JTRS). WG-4 made the following conclusions about those systems:

- Relocate Fixed Point-to-Point Microwave Systems.
- Vacate TRR systems from the 1755-1780 MHz band into the 1780-1850 MHz band and into alternate spectrum.
- Develop a sharing approach to permit commercial wireless broadband deployment in Protection Zones for both TRR (there are a total of 13 high-priority training areas where relocation is not feasible) and JTRS.

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[56] *See id.* at 9.

[57] *See id.* at 11-12.

- Allow TRR systems to remain in the 1755-1850 MHz band in regions where there is little or no commercial deployment. [58]

Ericsson supports additional sharing approaches to those TRR sites that cannot be relocated. Otherwise, TRR systems should be transitioned from the band.

5. Working Group 5 – 1755-1850 MHz Airborne Operations (Air Combat Training Systems, Unmanned Aerial Vehicles, Precision Guided Munitions, airborne software defined radios, and Aeronautical Telemetry)

Working Group 5 addressed Aeronautical Mobile Telemetry (AMT); Small Unmanned Aircraft Systems (SUAS); Air Combat Training System (ACTS); and Precision-Guided Munitions (PGMs) and other miscellaneous airborne systems. WG-5 was to explore ways to lower the repurposing costs and/or improve or facilitate industry access while protecting federal operations from adverse impact and tasked with producing "written outputs recommending to the CSMAC concerning approaches to sharing, transition and/or relocation of the band that will determine the steps that will have to be taken and any factors that may reduce the projected costs, or limitations or restrictions on spectrum availability."[59]

Ericsson supports the Federal government relinquishing spectrum in the 1755-1780 MHz band with a focus on clearing all Federal services from the band. Ericsson understands that additional study is required. A Trusted Agent Process, a mechanism that ensures protection of information, has been implemented that should enable industry and government to access the same information for upcoming discussions. Those discussions will lead to a technical feasibility

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[58] Commerce Spectrum Management Advisory Committee (CSMAC) Working Group 4: 1755-1850 MHz Point-to-Point Microwave, Tactical Radio Relay (TRR), Joint Tactical Radio System / Software Defined Radio (JTRS/SDR), Final Report (Jul. 24, 2013) at 3, available at http://www.ntia.doc.gov/files/ntia/publications/wg4_final_report_072413.pdf.

[59] *See* Commerce Spectrum Management Advisory Committee (CSMAC) Working Group 5 (WG-5) 1755-1850 MHz Airborne Operations (Air Combat Training System, Small Unmanned Aircraft Systems, Precision-Guided Munitions, Aeronautical Mobile Telemetry), Final Report (Sept. 16, 2013) at 1, available at http://www.ntia.doc.gov/files/ntia/publications/wg5_1755-1850_final_reportl-09-16-2013.pdf.

analysis with the goal of reducing exclusion zones in the band. Therefore no conclusions can be made until such information has been studied. In general Ericsson recommends that additional review is needed, optionally as part of the transition plan process, to ensure that all studies performed by for the 1755-1780 MHz are not overly conservative and that where necessary a refinement of the analysis is performed. Ericsson is concerned that the *Spectrum Act* mandates for the band must be met in the very near term, but the study process has still not concluded.

D. 2020-2025 MHz

The 2020-2025 MHz band is already allocated for non-Federal fixed and mobile services, and is a portion of the 35 MHz (between 1990 and 2025 MHz) that the Commission repurposed from BAS to emerging technologies such as PCS, AWS, and MSS in 2000.

The 2020-2025 MHz band is also adjacent to the AWS-4 uplink band at 2000-2020 MHz and BAS/CARS/NASA uses at 2025-2110 MHz band. These adjacent uses create challenges with respect to the allocation of this spectrum for mobile broadband.

According to a recent filing,[60] DISH proposes action to ensure better utilization of the AWS-4 band. Specifically, DISH requests that the "Commission to grant in its entirety DISH's waiver request to be able to elect to utilize the 2000-2020 MHz band for downlink operations . . . ."[61] Ericsson is concerned that the Commission's proposed duplex direction of the 2020-2025 MHz band could create coexistence issues in the 2000-2020 MHz band depending on the outcome of the DISH waiver petition.

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[60] *See* letter from Jeffrey H. Blum, DISH Network Corp., to Chairwoman Mignon Clyburn, FCC (Sept. 10, 203).

[61] *Id.*

CONCLUSION

For the reasons stated above, Ericsson asks the Commission to allow commercial wireless operations in the bands referred to in the *Notice*. While our strong preference is for exclusive-use spectrum, in cases where that is not possible, Ericsson asks that commercial wireless users share spectrum with incumbent government users, *but urges the Commission to work with NTIA to make more data available to the private sector*. Spectrum sharing is an enormously complex task, and only with a high degree of certainty about the sharing parameters can it be accomplished in a manner that allows for high quality mobile broadband.

In the near future, Ericsson urges the Commission and NTIA to continue analyzing the possibilities for allocating spectrum for commercial broadband in the 1780-1850 MHz band. Finally, the creation of an "AWS-5" band, consisting of paired spectrum between 1675-1695 MHz and 2075-2095 MHz, bears serious consideration given its proximity to the AWS-3 band.

Respectfully submitted,

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