

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of)	
)	
THE BOEING COMPANY)	Call Sign: S2993
)	
Application for Authority)	File Nos. SAT-LOA-20170301-00028,
to Launch and Operate a)	SAT-AMD-20170929-00137 &
Non-Geostationary Satellite Orbit)	SAT-AMD-2018 ____ - ____
System in the Fixed Satellite Service)	

AMENDMENT

Audrey L. Allison
Senior Director, Frequency Management Services
The Boeing Company
929 Long Bridge Drive
Arlington, VA 22202
(703) 465-3215

Bruce A. Olcott
Jones Day
51 Louisiana Ave. NW
Washington, DC 20001
(202) 879-3630

Its Attorneys

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AMENDMENT

The Boeing Company (“Boeing”), pursuant to Sections 308 and 309 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 308 and 309, hereby amends its above-captioned Application to add additional frequencies for inter-satellite link (“ISL”) communications in the 65-71 GHz band. The information provided in this narrative supplements the materials already filed by Boeing in support of its Application and does not replace any of those prior materials. The Schedule S that is filed with this Amendment, however, does replace the two previous Schedule S submissions that Boeing has made in support of this Application.

The narrative portion of this Amendment addresses those sections of the Commission’s rules that are relevant to this Amendment and are required to be addressed in narrative form. The section headers in this narrative are intended to match the related section headers that were used in the narrative exhibit for Boeing’s underlying Application. In addition, this narrative requests the Commission to grant waivers of Sections 25.116 and 25.157 of the rules to the extent that the Commission concludes that such waivers are necessary in order to grant this Amendment.

I. NARRATIVE INFORMATION REQUIRED BY PART 25

* * *

§ 25.114(c)(4) Minimum G/T and 3 dB Beamwidth

Section 25.114(c)(4)(v) of the Commission’s rules requires satellite system applicants to specify for each shapeable receive beam the minimum and maximum gain-to-temperature ratio (“G/T”) within each shapeable beam’s proposed coverage area. In addition, Section 25.114(c)(4)(vi)(B) of the Commission’s rules requires satellite system applicants seeking to operate ISLs to provide the peak antenna gain and 3 dB beamwidth for each ISL beam. The form Schedule S does not appear to include input fields for minimum G/T or 3 dB beamwidth. The values for the receiving beams are therefore provided in the table below using the same beam identification numbers (“IDs”) that are included in the “Receiving Beams” and “Transmitting Beams” sections of the Schedule S. In addition, the 3 dB beamwidth for the ISL transmit beams are provided in the subsequent table below again using the same beam IDs that are included in the Schedule S.

Receive Beam ID	Minimum G/T, dB/K	3 dB beamwidth, deg
X4L0	12.0	1.7
X5L0	12.0	1.7
X4R0	12.0	1.7
X5R0	12.0	1.7
X6L0	16.5	0.9
X7L0	16.5	0.9
X6R0	16.5	0.9
X7R0	16.5	0.9
XAL1	15.8	1.0
XBL1	15.8	1.0
XAR1	15.8	1.0
XBR1	15.8	1.0
XCL1	18.6	0.7
XDL1	18.6	0.7
XCR1	18.6	0.7
XDR1	18.6	0.7

Transmit Beam ID	3 dB beamwidth, deg
X0L0	1.2
X1L0	1.2
X0R0	1.2
X1R0	1.2
X2L0	0.7
X3L0	0.7
X2R0	0.7
X3R0	0.7
X2L1	1.0
X3L1	1.0
X2R1	1.0
X3R1	1.0
X8L1	0.7
X9L1	0.7
X8R1	0.7
X9R1	0.7

§ 25.114(d)(1) System Facilities, Operations and Services and How Uplink Frequency Bands Connect to Downlink Frequency Bands

* * *

A. System Frequency Usage and Frequency Plan

* * *

6. Inter-Satellite Links

As Boeing has explained in other filings associated with its Application, Boeing is proposing to operate ISLs both between the satellites within its constellation and with satellites in geostationary satellite orbit (“GSO”) and other non-geostationary satellite orbit (“NGSO”) constellations. Boeing has requested authority to operate some of these ISLs on a secondary basis in the Ka-band between its low Earth orbit (“LEO”) constellation and the satellites of GSO networks and other NGSO systems. Boeing has also requested authority to operate ISLs and on a primary basis in the V-band frequencies of 47.2-50.2 GHz and 50.4-51.4 GHz between the LEO satellites within its constellation (*i.e.*, LEO-to-

LEO) and between its LEO constellation and Boeing inclined NGSO satellites, along with the GSO and NGSO satellites of other operators.

With this Amendment, Boeing is additionally requesting authority to operate ISLs in the 65-71 GHz band, which is allocated on a primary basis for both GSO and NGSO ISL transmissions.¹ Boeing proposes to use ISLs in the 65-71 GHz solely for transmissions between its LEO satellites. This capability will increase the efficiency and functionality of Boeing's LEO constellation, while providing much greater flexibility in the geographic location of gateway earth stations used to support Boeing's NGSO satellite system.

§ 25.114(d)(6) Public Interest Considerations

As Boeing explained in its Application, NGSO satellite systems are uniquely capable of bringing essential Internet access to those regions of the world that are removed from the fiber optic network or unreached by cell phone towers. Satellite broadband coverage is ubiquitous. Unlike other broadband technologies, the power of satellite is available to anyone with a clear line of sight to the sky overhead, whether they are on an airplane in flight, a ship in the ocean, in mountainous America, or abroad. Its reach potential and inherent technological capabilities make satellite broadband uniquely capable of resolving the most complex connectivity problems and providing a robust competitive alternative to terrestrial broadband distribution technologies.

A critical component to a broadband satellite network is adequate backhaul facilities to interconnect satellite communications with the internet backbone and end-user data processing centers. For a LEO network without ISLs, this often requires the placement

¹ See 47 C.F.R. §§ 2.106, 25.202(a)(5).

of gateway earth stations within sufficient proximity to each other so that each LEO satellite is always within view of at least one gateway earth station, with additional gateways in view to ensure signal diversity. The use of ISLs between LEO satellites enables the system to route broadband transmissions from LEO satellites that may be operating outside the view of a gateway earth station to other LEO satellites within view of the desired gateway earth station.

Boeing previously requested the use of ISLs for its LEO network using spectrum in the V-band and Ka-band (the latter on a secondary basis). Boeing, however, is uncertain whether it will be able to coordinate sufficient access to V-band and Ka-band frequencies for ISL transmissions in order to ensure uninterrupted transmissions and data access to the desired gateway earth station locations for specific transmissions.

In contrast, the addition of very high capacity LEO-to-LEO ISLs in the 65-71 GHz band could ensure that every LEO satellite in Boeing's constellation will be able to route selected broadband traffic to other LEO satellites to address situations in which the satellite is outside the view of a gateway earth station, or in which user traffic destinations ultimately lie within the coverage area of another LEO satellite. Therefore, the use of ISLs in the 65-71 GHz band by Boeing's NGSO system will serve the public interest by enabling Boeing to use its satellite system to help close the digital divide with respect to consumer groups that do not – and often cannot – be served adequately by terrestrial broadband communications systems. The Commission should therefore grant Boeing's NGSO system application as amended herein.

§ 25.116 Amendments to Applications

In support of this Amendment, Boeing requests a determination by the Commission that it may grant this Amendment without placing into question the inclusion of Boeing's underlying Application in the processing round that was initiated on November 1, 2016 for NGSO applications seeking authority to operate in the V-band.² In the alternative, Boeing requests a waiver of Section 25.116 based on the public interest benefits of its proposed Amendment.³

Section 25.116 of the Commission's rules indicates that amendments to NGSO system applications will be treated as major amendments if they change the proposed frequencies to be used.⁴ Except in certain circumstances, applications that are subject to major amendments following the cut-off deadline for an application processing round are treated by the Commission as newly filed applications.⁵ The Commission can refrain from treating an application as newly filed if the major amendment "resolves frequency

² Public Notice, *Satellite Policy Branch Information, Boeing Application Accepted for Filing in Part*, IBFS File No. SAT-LOA-20160622-00058, DA 16-1244 (Nov. 1, 2016) ("*V-Band Processing Round Public Notice*").

³ If the Commission concludes that it must treat this Amendment as a major amendment pursuant to Section 25.116 and is unable to waive this requirement, then Boeing will seek to withdraw this Amendment and will instead seek to modify its NGSO system license to add ISL frequencies in the 65-71 GHz band once the underlying Application has been granted by the Commission.

⁴ 47 C.F.R. § 25.116(b)(1).

⁵ 47 C.F.R. § 25.116(c).

conflicts with authorized stations or other pending applications but does not create new or increased frequency conflicts.”⁶

As a threshold point, Boeing questions whether the restrictions of Section 25.116 should be deemed applicable to Boeing’s Amendment. Although Boeing’s Amendment seeks to add additional frequencies for ISLs, the additional frequencies are not among those that were included in the cut-off notice that initiated the V-band processing round.⁷ Instead, Boeing is making no changes in its Application with respect to the V-band frequencies that were included in the cut-off public notice. A conclusion that Section 25.116 is not applicable to Boeing’s Amendment would also seem consistent with Section 25.156(d)(4) of the Commission’s rules, which explains that “[a]pplications for feeder-link authority or inter-satellite link authority will be treated like an application separate from its associated service band.”⁸

If the Commission concludes that Section 25.116 is applicable to Boeing’s Amendment, Boeing urges the Commission to permit the Amendment without treating the underlying Application as newly filed because the Amendment resolves frequency conflicts with other pending applications but does not create new or increased frequency conflicts.⁹

⁶ 47 C.F.R. §25.116(c)(1).

⁷ See *V-Band Processing Round Public Notice* (establishing a cut-off deadline for applications seeking authority to use the 37.5-40.0 GHz, 40.0-42.0 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz band).

⁸ 47 C.F.R. § 25.156(d)(4).

⁹ 47 C.F.R. §25.116(c)(1).

Boeing's addition of LEO-to-LEO ISLs in the 65-71 GHz band will permit Boeing to operate LEO-to-LEO ISL transmissions independently of the 47.2-50.2 GHz and 50.4-51.4 GHz bands. Such a change would enable Boeing to resolve potential frequency conflicts that might otherwise exist with respect to the operation of Boeing's LEO-to-LEO ISL transmissions in the 47.2-50.2 GHz and 50.4-51.4 GHz bands on a co-frequency basis with the other NGSO FSS satellite systems that have proposed to operate in these frequencies.

Second, the operation of very high capacity LEO-to-LEO ISLs in the 65-71 GHz band will increase Boeing's flexibility to locate its gateway earth stations for its NGSO system outside heavily populated areas and therefore will help to resolve potential frequency conflicts and avoid coordination obligations with licensees in the Commission's Upper Microwave Flexible Use Service ("UMFUS"). Boeing's proposed use of high capacity LEO-to-LEO ISLs in the 65-71 GHz band will serve to increase the proportion of its gateway earth stations that can be located in very rural areas where UMFUS licensees are unlikely to deploy.

The Commission should also permit Boeing to maintain its Application in the existing process round because Boeing's Amendment will not create any new or increased frequency conflicts. Currently, there are no satellite systems operating in the fixed-satellite service ("FSS") using the 65-71 GHz band.¹⁰ One applicant, Audacy Corporation, has requested Commission authority to operate ISLs in the 65-71 GHz

¹⁰ See Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, *et al.*, GN Docket No. 14-177, *Notice of Proposed Rulemaking*, FCC 15-138, ¶ 55 (Oct. 23, 2015) ("*Spectrum Frontiers NPRM*").

band.¹¹ Audacy has acknowledged that its proposed system can easily share the 65-71 GHz band with other NGSO satellite systems given “the small number (3) of Audacy’s links and narrow beamwidth (<0.5°)” of its proposed ISL transmissions.¹² In addition, the Commission has previously concluded that the six gigahertz of spectrum that is available for ISLs in the 65-71 GHz band can accommodate the simultaneous operation of ISL transmissions for a significant number of satellite systems.¹³ Therefore, the Commission can grant Boeing’s Amendment without creating frequency conflicts for proposed satellite systems that may operate in the future in the 65-71 GHz frequencies.

If, however, the Commission concludes that the exceptions to the major amendment rule that are included in Sections 25.116(c) are not available to Boeing’s Amendment, Boeing requests that the Commission grant Boeing a waiver of Section 25.116 in order to permit Boeing to pursue its Amendment while maintaining its Application in the current processing round. Good cause exists to grant such a waiver.

As noted above, Boeing’s Amendment seeks to add ISL frequencies that are unrelated to the frequency bands that were the subject of the cut-off deadline. Further, the addition of Boeing’s proposed ISLs in the 65-71 GHz band would relieve coordination

¹¹ Audacy Corporation, Application for Authority to Launch and Operate a Non-Geostationary Medium Earth Orbit Satellite System in the Fixed- and Inter-Satellite Services, IBFS FCC File No. SAT-LOA-20161115-00117 (March 1, 2017) (“*Audacy Application*”).

¹² *Id.* at 79.

¹³ See Amendment of Part 2 of the Commission’s Rules to Allocate Additional Spectrum to the Inter-Satellite, Fixed, and Mobile Services and to Permit Unlicensed Devices to Use Certain Segments in the 50.2-50.4 GHz and 51.4-71.0 GHz Bands, ET Docket No. 99-261, *Report and Order*, FCC 00-442, ¶ 45 (Dec. 22, 2000) (“*2000 ISL Order*”) (concluding that “the 65-71 GHz band can accommodate all pending requests by NGSO commercial licensees for ISS spectrum,” which, at the time, included numerous proposed systems).

pressure and potential frequency conflicts with respect to spectrum sharing between the various GSO and NGSO systems that have proposed to operate in the 47.2-50.2 GHz and the 50.4-51.4 GHz bands. The addition of Boeing's proposed ISLs in the 65-71 GHz band can also enable Boeing to locate more of its gateway earth stations in very rural areas, thus enhancing the ability of Boeing's NGSO satellite system to share the 37.5-40.0 GHz and the 47.2-48.2 GHz band with UMFUS licensees. Each of these factors would promote the most robust and efficient use of spectrum resources and thereby enhance the provision of broadband services to consumers. Therefore, good cause exists for the Commission to grant a waiver of Section 25.116 to Boeing.

§ 25.157 Consideration of Applications for NGSO-like Satellite Operation

Boeing herein requests a waiver of Section 25.157(c) of the Commission's rules, which indicates that applications for authority to launch and operate "NGSO-like" satellite systems must be evaluated using application cut-offs and processing rounds.⁵² As the Commission has acknowledged, the use of a cut-off and processing round is unnecessary when the proposed operations of an NGSO satellite system will not preclude entry by additional NGSO satellite systems.¹⁴ Boeing's proposed use of the 65-71 GHz band for LEO-to-LEO ISLs will not preclude the use of this spectrum for ISLs by other GSO or NGSO satellite operators.

The Commission has granted waivers of the Section 25.157 requirement on a number of occasions. For example, the Commission twice granted a waiver of Section 25.157(c) to O3b Limited ("O3b") due to the "opportunities for additional entrants to

¹⁴ See *infra* notes 15, 16 and 18.

operate” on a co-frequency basis with O3b.¹⁵ The Commission also granted a waiver of this rule to Northrop Grumman for its proposed V-band NGSO system after acknowledging that “Northrop Grumman’s NGSO satellites will employ a mechanism designed to permit multiple NGSO systems to operate in the same spectrum by limited the number of in-line interference events between NGSO systems and dividing the spectrum among the affected NGSO systems during such events.¹⁶ This approach, of course, was eventually incorporated into the Commission’s rules to ensure that co-frequency spectrum sharing can be achieved between all proposed NGSO systems.¹⁷ Waivers of the Section 25.157(c) processing round requirement have additionally been granted to other NGSO system applicants based on the Commission’s recognition that the launch of these systems would “not preclude additional entry” by other satellite systems.¹⁸

In this case, Boeing is seeking a waiver of the processing round requirement for ISL transmissions between LEO satellites operating in the 65-71 GHz band. As noted in the previous section of this Amendment, there are currently no operational FSS satellite

¹⁵ O3b Limited, *Space Station Authorization*, IBFS File Nos. SAT-LOI-20151029-00118 and SAT-AMD-20150115-00004, Attachment 1, ¶ 12 (Jan. 22, 2015); O3b Limited, *Radio Station Authorization*, IBFS File No. SES-LIC-20100723-00952, at 4 (Sept. 25, 2012) (Special Provision 90043).

¹⁶ See Northrop Grumman Space & Missions Systems Corporation, IBFS File No. SAT-LOA-19970904-00080 *et al.*, DA 09-428, *Order and Authorization*, 24 FCC Rcd 2330, 2342, ¶ 33 (Int’l Bur. 2009).

¹⁷ Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters, *Report & Order and Further Notice of Proposed Rulemaking*, 32 FCC Rcd 7809, 7825, ¶ 49 (2017).

¹⁸ Digital Globe, Inc., DA 05-2640, *Order and Authorization*, 20 FCC Rcd 15696, 15698-99, ¶¶ 6-8 (Int’l Bur. 2005); Space Imaging, LLC, IB Docket No. 02-34, *Declaratory Order and Order and Authorization*, 20 FCC Rcd 11964, ¶¶ 10, 11 (Int’l Bur. 2005).

systems using the 65-71 GHz band.¹⁹ One applicant, Audacy Corporation, has requested Commission authority to operate ISLs in the 65-71 GHz band, but Audacy has acknowledged that its spectrum requirements for ISLs will be modest.²⁰

When the Commission designated the 65-71 GHz band for ISL transmissions to support commercial satellite systems, it did so in response to applications that were filed by numerous satellite operators. The Commission concluded that the six gigahertz of spectrum that is available for ISLs in the 65-71 GHz band can accommodate the simultaneous operation of ISL transmissions for a significant number of satellite systems.²¹ Based on the IBFS database, the Commission granted ISL authorizations for 20 individual GSO satellites, the Teledesic NGSO system, and also considered applications for ISLs to support other NGSO satellite systems. None of these systems were constructed, however, and the 65-71 GHz band remains available to support ISL transmissions for a large number of satellite systems. Therefore, the Commission can grant a waiver of the processing round requirement for Boeing's Amendment without jeopardizing the ability of numerous future satellite systems to also operate ISL transmissions in the 65-71 GHz band.

Boeing observes that Audacy also requested a waiver of the processing round requirements with respect to its request to operate ISLs in the 65-71 GHz band. Although the Commission has refrained thus far from making a decision on Audacy's request, the

¹⁹ See *Spectrum Frontiers NPRM*, ¶ 55.

²⁰ *Audacy Application* at 79 (acknowledging “the small number (3) of Audacy’s links and narrow beamwidth (<0.5°)” of its proposed ISL transmissions”).

²¹ See *2000 ISL Order*, ¶ 45.

Commission did place Audacy’s application on public notice for comment.²² Numerous parties filed petitions to deny and other comments addressing Audacy’s application. None of those parties, however, raised any objection to Audacy’s proposal to operate ISLs in the 65-71 GHz band or to Audacy’s request for a waiver of the processing round requirement with respect to this aspect of Audacy’s application. The Commission should therefore appropriately conclude that good cause exists to grant the ISL authorizations of Audacy and Boeing with respect to the 65-71 GHz band without engaging in the unnecessary administrative delay and burden of initiating a processing round for NGSO-like applications seeking to also operate ISLs in the 65-71 GHz band.

§ 25.279 Inter-Satellite Service

Boeing recognizes that portions of the 65-71 GHz band are also allocated on a co-primary basis to other space services, including the Earth Exploration Satellite Service and the Radionavigation-Satellite Service, and may be used for various purposes by the U.S. Federal government. Consistent with Section 25.279 of the Commission’s rules, Boeing will coordinate the operations of its ISL transmissions with Federal users through NTIA to ensure that harmful interference does not result to Federal systems. In addition, as required by Section 25.279(b)(1)(ii), Boeing will, at the Commission’s request, provide sufficient information to evaluate the electromagnetic compatibility of its proposed ISLs with federal

²² See Public Notice, *Satellite Policy Branch Information, Applications Accepted for Filing, Cut-off Established for Additional NGSO-Like Satellite Applications or Petitions for Operations in the 12.75-13.25 GHz, 13.85-14.0 GHz, 18.6-18.8 GHz, 19.3-20.2 GHz, and 29.1-29.5 GHz Bands*, DA 17-524, at 3 (May 26, 2017) (explaining that “we have made no determination as to whether a processing round will be initiated” regarding Audacy’s request for ISL frequencies in bands including the 65-71 GHz band).

government users of the 65-71 GHz spectrum in order to show that Boeing's ISL transmissions will not cause harmful interference to authorized federal government users, based upon existing system information provided by the government.²³

²³ 47 C.F.R. § 25.279(b)(1)(ii).