

WAIVER REQUESTS

Pursuant to Section 1.3 of the Commission's rules, the Commission may waive its rules for good cause shown.¹ "Waiver is appropriate if special circumstances warrant a deviation from the general rule and such deviation would better serve the public interest than would strict adherence to the general rule," including "more effective implementation of overall policy."² In determining whether waiver is appropriate, the Commission should "take into account considerations of hardship, equity, or more effective implementation of overall policy."³ As shown below, there is good cause for the Commission to grant a waiver of Sections 25.202(a)(1), 25.202(g)(1), 25.157(e), 25.164(b), 25.208(e), 25.145(c)/25.146(i), 25.146(a), and, to the extent necessary, any restriction in Section 2.106 on SpaceX's proposed use of the 17.8-18.6 GHz band and various limitations in the Commission's Schedule S.

1. Waiver of Gateway Restriction in Section 25.201(a)(1) for the 10.7-11.7 GHz Band

SpaceX requests a waiver of the Commission's policy of authorizing only gateway earth stations in the 10.7-11.7 GHz band.⁴ SpaceX proposes to operate its user terminal earth stations in this band on a non-conforming, non-interference, non-protected basis.⁵ In considering requests for non-conforming spectrum uses, the Commission has indicated that it would generally grant such waivers "when there is little potential for interference into any service authorized under the Table of Frequency Allocations and when the non-conforming

¹ 47 C.F.R. § 1.3. See also *WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969), *cert. denied*, 409 U.S. 1027 (1972); *Northeast Cellular Telephone Co., LP v. FCC*, 897 F.2d 1164 (D.C. Cir. 1990).

² *GE American Communications, Inc.*, 16 FCC Rcd. 11038, ¶ 9 (Int'l Bur. 2001).

³ *WAIT Radio*, 418 F.2d at 1159.

⁴ See 47 C.F.R. § 25.202(a)(1), n.6 ("Use of this band by NGSO FSS systems is limited to transmissions to or from gateway earth stations").

⁵ The Commission has granted a similar waiver in the past. See, e.g., *PanAmSat Licensee Corp.*, 20 FCC Rcd. 14642, ¶ 10 (Int'l Bur. 2005); *EchoStar KuX Corp.*, 20 FCC Rcd. 942, ¶ 13 (Int'l Bur. 2004).

operator accepts any interference from authorized services.”⁶

SpaceX’s request satisfies both of those conditions. The SpaceX System’s satellite downlink transmissions in the 10.7-11.7 GHz band to these earth stations will comply with the Commission’s power flux-density (“PFD”) limits as demonstrated in Section A.7 of the Technical Attachment. These PFD limits are intended to protect terrestrial Fixed Service (“FS”) systems from potential interference from satellite downlinks, and the Commission has determined that meeting such limits is sufficient for this purpose.⁷ In addition, the SpaceX System’s receiving earth stations will not seek any interference protection from FS transmissions, and so their operation will not constrain the further development of that service in this band.

There are several sound technical reasons to support the use of SpaceX user terminals in the 10.7-11.7 GHz downlink band on a non-protected basis with respect to the FS, as follows:

- **Directionality:** The potentially interfering FS transmitters typically radiate in a horizontal or near-horizontal direction using narrow beam antennas. SpaceX receiving user terminals only have significant gain in high elevation directions and low gain towards the horizon, because the SpaceX System is designed to provide service to user terminals at elevation angles at or in excess of 40 degrees. As a result, a SpaceX user terminal will have sufficient separation distance from the highly directional FS transmit antennas in this frequency band. In addition, further

⁶ See, e.g., *Fugro-Chance, Inc.*, 10 FCC Rcd. 2860, ¶ 2 (Int’l Bur. 1995) (authorizing non-conforming MSS in the C-band); *Motorola Satellite Communications, Inc.*, 11 FCC Rcd. 13952, ¶ 11 (Int’l Bur. 1996) (authorizing service to fixed terminals in bands allocated to the mobile-satellite service).

⁷ See, e.g., *Amendment of Parts 2, 25 of the Commission’s Rules to Permit the Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band*, 18 FCC Rcd. 2324, ¶ 2 (2003) (finding that “power flux density (‘PFD’) limits for NGSO FSS in the 10.7-11.7 GHz band are sufficient to protect services in the band without the need for individual coordination”).

angular separation may be gained based on the physical siting of the FS transmitter and SpaceX user terminals. FS links tend to be located on towers or relatively tall buildings, with a “local” horizon of tens or hundreds of feet above the ground. In contrast, most SpaceX user terminals are expected to be sited closer to the ground, adding separation between the transmit FS site’s main pointing direction to the receiving FS site, and a given victim SpaceX user terminal.

- **Wide Downlinks:** The SpaceX user terminals receive downlink transmissions of around 250 MHz bandwidth, wider than any likely interfering signal from an FS transmitter, which are typically no wider than 40 MHz. This will further reduce the effect of the interfering FS carrier.
- **Alternate Bands:** In the unlikely event of problematic FS interference in the 10.7-11.7 GHz band for service at a particular user terminal location, SpaceX has the option to transmit to user(s) at that specific location predominantly in the 11.7-12.2 GHz band, which is not shared with the FS.
- **Repositioning:** Where necessary, SpaceX can also achieve further interference mitigation for an affected user terminal by repositioning a given user terminal to another side of a natural or man-made obstacle (*e.g.*, a building) to block the interfering FS signal.

Accordingly, the Commission should grant the waiver and authorize SpaceX to operate its user terminal earth stations in the 10.7-11.7 GHz band on a non-conforming, non-interference, non-protected basis.

2. Waiver of Section 25.202(g)(1) for TT&C Operations in the 13.75-14.0 GHz Band

Section 25.202(g)(1) anticipates that satellite systems will conduct telemetry, tracking and command (“TT&C”) operations using spectrum at the edge of or within their assigned bands.⁸ SpaceX proposes to conduct its TT&C uplink transmissions using a portion of the 13.75-14.0 GHz band – specifically, 13.85-14.00 GHz. This spectrum is at the upper part of the 13.75-14.0 GHz band, which is included in the ITU network filings made on behalf of SpaceX but not included in the bands for which authorization of communications transmissions has been sought in this application. This band is also immediately adjacent to the 14.0-14.5 GHz band used by the SpaceX System for user terminal uplink transmissions. To the extent necessary, SpaceX requests a waiver to permit its use of this spectrum for TT&C.

The Commission has restricted FSS deployment in the 13.75-14.0 GHz band to gateways only, which it has specifically defined to include TT&C operations.⁹ In addition, under footnotes to both the U.S. and international frequency allocation tables, NGSO FSS earth stations operating in this band must have a minimum diameter of 4.5 meters and the EIRP of any emission should be at least 68 dBW and should not exceed 85 dBW.¹⁰ The SpaceX System will comply with these requirements, and will not claim protection from radiolocation transmitting stations operating in accordance with the U.S. Table of Frequency Allocations. SpaceX anticipates that it will provide TT&C from only two locations in the U.S. (on the East and West Coasts, respectively), which will further minimize any potential impact.

⁸ See 47 C.F.R. § 25.202(g)(1).

⁹ See *Amendments of Parts 2 and 25 of the Commission’s Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, 16 FCC Rcd. 4096, ¶ 29 (2000) (“*Ku-Band NGSO Order*”); 47 C.F.R. § 25.103 (definition provides that an “NGSO FSS gateway earth station may also be used for telemetry, tracking, and command transmissions and is not for the exclusive use of any customer”).

¹⁰ See 47 C.F.R. § 2.106, nn.5.502 and US356.

3. Waiver of Band Segmentation Requirements in Section 25.157(e)

In response to the filing of an application for an NGSO system, the Commission has initiated a processing round for competing NGSO system applications pursuant to Section 25.157 of the Commission's rules.¹¹ In such a processing round, the Commission's rules establish certain band segmentation procedures if there is not sufficient spectrum available to accommodate all qualified applicants.¹² However, band segmentation appears to be inconsistent with the "avoidance of in-line interference events" approach that the Commission adopted for Ku- and Ka-band NGSO systems over a decade ago and which was recently reaffirmed as applicable by the International Bureau.¹³ For the reasons discussed below, SpaceX submits that the in-line avoidance approach would better serve the public interest and requests that the Commission waive the band segmentation requirements of Section 25.157(e) to the extent necessary.

The Commission considered various approaches for intra-service sharing among NGSO FSS applicants in the Ku-band when it adopted the *Ku-band NGSO Sharing Order* in 2002.¹⁴ The four approaches considered were (1) Flexible Band Segmentation; (2) Dynamic Band Segmentation; (3) Avoidance of In-line Interference Events; and (4) Homogeneous Constellations. The Commission preferred the Avoidance of In-line Interference Events approach, under which all NGSO FSS licensees could use the entire Ku-band spectrum at issue

¹¹ See Public Notice, "OneWeb Petition Accepted for Filing," 31 FCC Rcd. 7666 (Int'l Bur. 2016).

¹² 47 C.F.R. § 25.157(e).

¹³ See *International Bureau Provides Guidance Concerning Avoidance of In-Line Interference Events Among Ku-Band NGSO FSS Systems*, 30 FCC Rcd. 11534 (Int'l Bur. 2015) ("Clarification PN") (clarifying that the criteria for avoidance of in-line interference events for Ku-band NGSO systems would be applied in the same manner as they are for Ka-band systems under Section 25.261 of the Commission's rules).

¹⁴ See *Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ku-Band*, 17 FCC Rcd. 7841 (2002) ("Ku-band NGSO Sharing Order"). For this purpose, "Ku-band" refers to the 10.7-12.7 GHz, 12.75-13.25 GHz, and 13.75-14.5 GHz frequency bands.

except in situations where multiple NGSO systems experience in-line interference, when they would have to coordinate.¹⁵ The Commission found that this approach would best meet its goals of allowing equal access to the available spectrum, avoiding spectrum warehousing, and encouraging system flexibility to promote spectrum coordination.¹⁶ In doing so, it explicitly rejected the two approaches that applied band segmentation, finding that they “are overly restrictive, and could result in insufficient spectrum for commercially viable operations.”¹⁷ Although the in-line avoidance approach was never codified in the Commission’s rules, the International Bureau has recently clarified that this approach will continue to be applied to NGSO authorizations.¹⁸

A year later, the Commission considered the same four options and came to the same conclusion when it adopted the *Ka-band NGSO Sharing Order*: an approach requiring avoidance of in-line interference events would best serve the public interest.¹⁹ The Commission found that satellite system operations in the Ku- and Ka-bands would be “quite similar,” and that therefore the adoption of similar sharing rules would be “operationally appropriate and offers the benefit of administrative efficiency and may enhance the development of technology applicable to both services.”²⁰ It once again rejected the two band segmentation options. The Commission codified this sharing approach in Section 25.261.

¹⁵ *Id.* ¶¶ 39-52. For those NGSO systems operators that are unable to reach a coordination agreement, the Commission adopted a default sharing approach based on frequency isolation. *Id.* ¶¶ 53-55.

¹⁶ *Id.* ¶¶ 27-38.

¹⁷ *Id.* ¶ 37.

¹⁸ *See Clarification PN.*

¹⁹ *See Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ka-Band*, 18 FCC Rcd. 14708, ¶¶ 18-21 (2003) (“*Ka-band NGSO Sharing Order*”). For this purpose, “Ka-band” refers to the 18.8-19.3 GHz and 28.6-29.1 GHz frequency bands.

²⁰ *Id.* ¶ 18.

During the period between adoption of the in-line avoidance approach for Ku-band and Ka-band NGSO systems, the Commission revised its process for satellite licensing generally.²¹ Among many other revisions, the Commission adopted modified processing rounds as the mechanism for resolving competing applications for NGSO-like systems, including the band segmentation approach to spectrum sharing codified in Section 25.157(e).²² Yet in doing so, the Commission saw “no reason to impose a band-splitting approach on the Ka-band NGSO applicants if they believe that they can share the spectrum,” and specifically found that the then-pending Ka-band NGSO sharing proceeding would “determine which licensing method is best suited for the Ka-band NGSO applications.”²³ Consequently, the Commission directed the International Bureau “to award Ka-band licenses pursuant to the processing mechanism adopted in the [*Ka-band NGSO Sharing Order*] proceeding.”²⁴

Since that time, all Ka-band NGSO FSS system authorizations issued by the Commission have been conditioned upon compliance with the avoidance of in-line interference events requirement rather than the band segmentation requirements of Section 25.157(e).²⁵ Indeed, although Section 25.261 by its terms applies only to specific Ka-band frequencies, the Commission has applied this in-line avoidance sharing technique in other portions of the Ka-

²¹ See *Amendment of the Commission’s Space Station Licensing Rules and Policies*, 18 FCC Rcd. 10760 (2003) (“*Space Station Licensing Reform Order*”).

²² *Id.* ¶¶ 30-34.

²³ *Id.* ¶ 280.

²⁴ *Id.*

²⁵ See, e.g., *Radio Station Authorization of O3b Limited*, IBFS File No. SES-LIC-20100723-00952, Condition 90043 (Sep. 25, 2012); *Northrop Grumman Space & Missions Systems Corp.*, 24 FCC Rcd. 2330, ¶ 116 (Int’l Bur. 2009) (“*Northrop Grumman*”); *contactMEO Communications, LLC*, 21 FCC Rcd. 4035, ¶ 64 (Int’l Bur. 2006) (“*contactMEO*”).

band as well rather than applying Section 25.157(e).²⁶ Moreover, the Commission has also issued all Ku-band NGSO FSS system authorizations with a similar condition based on avoidance of in-line events rather than band segmentation.²⁷ The Commission went so far as to issue a public notice to clarify “that the text in Section 25.261 for Ka-band NGSO FSS systems also describes the same sharing criteria the Commission adopted for Ku-band systems.”²⁸

The Commission should not now revert to imposing the automatic band segmentation approach upon the participants in this NGSO processing round. Rather, the Commission should waive the band segmentation requirements of Section 25.157(e) to the extent necessary. Successful coordination among NGSO systems will yield much more productive use of valuable spectrum and orbital resources than would a simple band segmentation approach. To this end, SpaceX has designed its system with advanced technology and operational flexibility to coordinate responsibly and thus facilitate spectrum sharing. Only systems with inflexible technologies pose a problem in this respect, which the Commission will need to address.

4. Partial Waiver of Final Implementation Milestone in Section 25.164(b)

Section 25.164(b) of the Commission’s rules provides that the recipient of an initial license for an NGSO satellite system “must launch the space stations, place them in the assigned orbits, and operate them in accordance with the station authorization no later than six years after the grant of the license,” unless a different schedule is established by the Commission.²⁹ The Commission has established such milestone requirements for satellite system implementation in

²⁶ See *Northrop Grumman*, ¶¶ 32-33 (extending in-line avoidance sharing technique to 19.7-20.2 GHz and 29.5-30.0 GHz bands).

²⁷ See *SkyBridge L.L.C.*, 20 FCC Rcd. 12389, ¶ 74 (Int’l Bur. 2005); *Virtual Geosatellite, LLC*, 21 FCC Rcd. 14687, ¶ 91 (Int’l Bur. 2006).

²⁸ See *Clarification PN*, *supra* n.13.

²⁹ 47 C.F.R. § 25.164(b).

order to deter warehousing, which in this context “refers to the retention of preemptive rights to use spectrum and orbital resources by an entity that does not intend to bear the cost and risk of constructing, launching, and operating an authorized space station, is not fully committed to doing so, or finds out after accepting the license that it is unable to fulfill the associated obligations.”³⁰ The rules are intended to offset the incentives for warehousing that could harm both competition and consumers, while also encouraging the rapid deployment of new spacecraft and the optimal utilization of scarce orbital and spectrum resources.³¹

SpaceX proposes to launch and operate a constellation of over 4,400 satellites, divided into an Initial Deployment of 1,600 satellites and a Final Deployment of 2,825 satellites. Final deployment of all of these satellites is not necessary to commence delivery of broadband services, nor is it necessary to demonstrate SpaceX’s intention to utilize the granted orbital and spectrum resources. Completing the full constellation over a six-year period would require a launch cadence of more than 60 satellites per month, beginning on the day the Commission grants a license. This is an aggressive pace even for a company like SpaceX, which has demonstrated considerable launch capabilities.

In these circumstances, the Commission should grant a limited waiver to apply its implementation milestone requirement to the Initial Deployment of the SpaceX System, to the extent necessary. A waiver structured in this way clearly would not undermine the purpose of the milestone requirements, as it would not result in, facilitate, or encourage spectrum

³⁰ *Comprehensive Review of Licensing and Operating Rules for Satellite Services*, 30 FCC Rcd. 14713, ¶ 53 (2015) (“Part 25 Second R&O”).

³¹ *Id.* See also, e.g., *Space Station Licensing Reform Order*, ¶ 173; *TerreStar Networks, Inc.*, 22 FCC Rcd. 17698, ¶ 6 (Int’l Bur. 2007).

warehousing.³² Within the time allotted for the Initial Deployment, SpaceX will manufacture, launch and bring into service more satellites than any other company currently has in operation. Additionally, it will begin providing commercial broadband services in the U.S. and globally once it has deployed the first 800 satellites of its constellation (32 planes with 25 satellites per plane), and continuously thereafter as additional satellites are launched and the constellation is replenished. Designing, constructing, and deploying these assets will require a very significant investment of resources – considerably more than reasonably sufficient to demonstrate that the company is “fully committed” to bearing the cost and risk of operating its authorized system.³³

5. Waiver of the Downlink PFD Limits in Section 25.208(e)

As shown in the Technical Attachment, the SpaceX System does not comply with the PFD limits established in Section 25.208(e) for very low elevation angles using the flawed interference calculation methodology applied in the rule. As explained in the Technical Attachment, the calculation methodology was not designed for (and did not contemplate) larger constellations, and assumes downlink energy from all satellites in operation, not just those that are visible from a particular location that could meaningfully be expected to contribute to interference to a terrestrial FS system.³⁴ The methodology also fails to discount interference from those satellites that are switched off at a particular time or designed not to serve a location at such a low elevation angle. When the calculation methodology is revised to reflect more reasonable operating assumptions for larger systems, it becomes clear that the SpaceX System

³² See, e.g., *EchoStar Satellite Corp.*, 18 FCC Rcd. 15875, ¶ 9 (Int’l Bur. 2003); *Astrolink Int’l LLC*, 17 FCC Rcd. 11267, ¶ 6 (Int’l Bur. 2002).

³³ See *Part 25 Second R&O*, ¶ 53.

³⁴ See Technical Attachment, Section A.7 (citing discussion in Director, Radiocommunication Bureau, “Report of the Director on the Activities of the Radiocommunication Sector, Part 2 – Experience in the Application of Procedures and Other Related Matters (rev. 1),” at 29 (Sep. 29, 2015), available at <http://www.itu.int/md/R15-WRC15-C-0004/en>). SpaceX hereby incorporates the discussion from the Technical Attachment herein.

would not be expected to cause harmful interference into terrestrial FS systems that share the band.³⁵ Accordingly, the Commission should grant the requested waiver in recognition of the technical limitations of the methodology underlying the rule.³⁶

6. Waiver of U.S. Table of Frequency Allocations and Ka-band Plan in the 17.8-18.6 GHz Band

SpaceX proposes to use the 17.8-18.6 GHz band for downlink transmissions from its satellites to a relatively small number of gateway earth stations, and to use the 18.55-18.6 GHz band for downlink transmissions to an even more limited number of TT&C facilities. Internationally, this entire band is allocated to FSS on a co-primary basis. Domestically, however, the Ka-band Plan³⁷ adopted by the Commission and codified in the U.S. Table of Frequency Allocations (47 C.F.R. § 2.106) is materially different. The lower portion of this band, from 17.8-18.3 GHz, is allocated on a primary basis to FS, with no allocation for FSS. While the upper portion of this band, from 18.3-18.6 GHz, is allocated to FSS on a primary basis, a footnote in the allocation table limits its use to GSO systems only.³⁸ Accordingly, SpaceX seeks a waiver of Section 2.106 of the Commission's rules to permit its use of this spectrum on a non-conforming basis – *i.e.*, on a non-harmful interference, non-protected basis relative to any service allocated in the band.

³⁵ SpaceX has recently submitted revised ITU network filings for its system, and believes that the ITU will conclude that the system as revised complies with the relevant international PFD limits in Article 21 once it has had the opportunity to apply its analysis.

³⁶ To the extent necessary, SpaceX requests that the Commission also waive the parallel PFD provisions in Article 21 of the ITU Radio Regulations.

³⁷ The Commission issued a series of related orders in CC Docket No. 92-297 and IB Docket No. 98-172 establishing a designation plan for use of the Ka-band by non-Federal users, which is referred to herein as the “Ka-band Plan.” *See Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission’s Rules to Redesignate the 27.5-29.5 GHz Frequency Band*, 11 FCC Rcd. 19005 (1996), *modified*, 12 FCC Rcd. 22310 (1997); *Redesignation of the 17.7-19.7 GHz Frequency Band*, 15 FCC Rcd. 13430 (2000).

³⁸ *See* 47 C.F.R. § 2.106 n.NG164 (“The use of this band by the FSS is limited to GSO systems only.”).

The Commission has previously authorized NGSO use of the 17.8-18.3 GHz band on a non-conforming basis, based on the applicant's showing that it would comply with all applicable downlink PFD limits.³⁹ As shown in the Technical Attachment,⁴⁰ SpaceX will meet the PFD limits at the Earth's surface prescribed by the ITU to ensure that NGSO downlink transmissions do not cause unacceptable interference to the terrestrial FS systems operating in the band.⁴¹ In addition, because SpaceX gateways will receive in this band, their operations do not present a risk of interference. In the unlikely event that FS operations cause interference to one or more gateway earth stations, SpaceX will accept such interference and take appropriate measures to prevent it from degrading earth station operations.

With respect to the 18.3-18.6 GHz band, the Commission has allowed NGSO systems to make similar non-conforming use of FSS frequencies in the Ka-band downlink allocated to GSO on a primary basis where applicants are prepared to accept interference from primary operations and can demonstrate that their proposed operations are not likely to cause harmful interference to primary operations.⁴² SpaceX's waiver request is consistent with these precedents. As shown in the Technical Attachment,⁴³ SpaceX will operate downlink transmissions in this band within the downlink equivalent power flux-density limits (EPFD_{down} and EPFD_{is}) developed by the ITU.⁴⁴ The ITU considers an NGSO FSS system that meets these EPFD limits to be fully coordinated

³⁹ See *Letter to Ms. Suzanne Malloy*, 31 FCC Rcd. 342, 343-44 (Int'l Bur. 2016).

⁴⁰ See Technical Attachment, Section A.7.

⁴¹ See Rec. ITU-R SF.1483, at 4 ("Extensive studies have provided ample technical justification that the pfd limits of *recommends 1* are certainly adequate to protect the FS systems from aggregate interference from the satellites of multiple, co-frequency non-GSO FSS systems operating in the 17.7-19.3 GHz band.").

⁴² See, e.g., *id.*; *Northrop Grumman*, ¶¶ 74-75; *contactMEO*, ¶¶ 25-26.

⁴³ See Technical Attachment, Section A.8.1.2 and Annex 2.

⁴⁴ See ITU Radio Regs., Nos. 22.5C and 22.5F.

with respect to any GSO FSS network, and any interference by the NGSO FSS system into the GSO FSS network is acceptable.⁴⁵

As stated above, in considering requests for non-conforming spectrum uses, the Commission will generally grant such waivers when there is little potential for interference into any service authorized under the Table of Frequency Allocations and when the non-conforming operator accepts any interference from authorized services. SpaceX acknowledges that it has no protection against interference from U.S.-licensed FS and GSO FSS networks in these bands, and its compliance with the relevant PFD and EPFD limits ensure that no harmful interference will result from operation of the SpaceX System. Accordingly, waiver of the Ka-band Plan and the U.S. Table of Frequency Allocations is warranted here.

7. Waiver of Geographic Service Requirements in Sections 25.145(c) and 25.146(i)

Section 25.145(c) and Section 25.146(i) establish geographic coverage requirements for NGSO systems operating in the Ka-band and Ku-band, respectively. They are essentially the same for both frequency bands, and require the applicant to demonstrate that:

- (1) the proposed system is capable of providing Fixed-Satellite Service on a continuous basis throughout the fifty states, Puerto Rico and the U.S. Virgin Islands; and
- (2) the proposed system is capable of providing Fixed-Satellite Services to all locations as far north as 70° North Latitude and as far south as 55° South Latitude for at least 75 percent of every 24-hour period.

Once fully deployed, the SpaceX System will satisfy these requirements, as it will provide full-time coverage to virtually the entire planet. The Initial Deployment, however, will cover most but not all of the area required. Specifically, the Initial Deployment will provide continuous FSS

⁴⁵ See ITU Radio Regs., No. 22.5I. See also *contactMEO*, ¶ 26.

service from approximately 60° North Latitude to 60° South Latitude. This is sufficient to cover the contiguous United States, Hawaii, Puerto Rico, and the U.S. Virgin Islands, as well as the southernmost areas covered by the rule. However, the system will not provide continuous coverage to the northernmost areas covered by the rule (*e.g.*, the 60° to 70° North Latitudes in upper Alaska) until service from one of the more inclined orbital constellations is activated.

SpaceX has requested above a partial waiver of the final system implementation milestone such that it would apply to the Initial Deployment only. Although SpaceX fully expects to meet all coverage requirements at Final Deployment, out of an abundance of caution, SpaceX requests a corresponding waiver of the geographic service requirements for the operation of the Initial Deployment specifically,⁴⁶ to the extent the Commission deems such a waiver necessary.

8. Waiver of Source Code Requirements in Section 25.146(a)

Section 25.146(a) of the Commission's rules requires each applicant for authority to operate an NGSO FSS system in the 10.7 GHz to 14.5 GHz bands to demonstrate that its proposed system will not exceed the validation EPFD_{down} and EPFD_{up} limits specified in Section 25.208 of the Commission's rules.⁴⁷ Where a computer program has not yet been approved by the ITU for this purpose – and no such program is available or approved at this time – Sections 25.146(a)(1)(iii) and 25.146(a)(2)(iii) require each applicant to provide to the Commission a computer program for the EPFD_{down} and EPFD_{up} validation, along with the source code and executable file of the validation program. SpaceX has used commercially available EPFD

⁴⁶ The Commission granted a similar waiver to O3b Limited (“O3b”) permitting its Ka-band NGSO FSS system to access the U.S. market, finding that waiver was appropriate because “due to look angle constraints, there is a limitation on the northernmost and southernmost latitudes that can be served by its system.” *See* O3b Limited, Stamp Grant, IBFS File Nos. SAT-LOI-20141029-00118 and SAT-AMD-20150115-00004, at condition 14 (Call Sign S2935) (Jan. 22, 2015). Thus, the Commission balanced the NGSO satellite operator's constellation design decision with the policy desire to maximize coverage. To the extent necessary, it should do the same in this case as well.

⁴⁷ *See* 47 C.F.R. § 25.146(a).

testing software created by Transfinite Systems (“Transfinite”) to validate its EPFD compliance showing, and has provided an executable copy of the latest version of that program. However, for the reasons set forth below, SpaceX requests a waiver of the source code requirement in Section 25.146(a).

The Commission requires NGSO applicants to submit EPFD validation programs so that it can evaluate the EPFD showing and ensure that proposed NGSO FSS systems comply with the applicable EPFD limits designed to protect GSO satellite networks. Although the ITU has not yet approved a computer program for determining compliance with the single-entry EPFD_{down} and EPFD_{up} validation limits, it has engaged two companies to develop such software – Transfinite and Agenium.⁴⁸ The Transfinite software is apparently nearing completion, and is available to the public for purchase. Thus, the Commission will be able to use Transfinite’s EPFD validation program to evaluate the SpaceX System’s compliance with the applicable EPFD limits without the source code, and SpaceX will provide the Commission any assistance that is necessary to enable its successful use.

The source code of Transfinite’s EPFD validation program is the proprietary information of that company, and SpaceX does not have access to that source code. Moreover, Transfinite could suffer substantial competitive injury if that source code were made available to the public, including its potential customers and competitors. Given that Transfinite’s source code is not necessary for SpaceX to demonstrate, or for the Commission to conclude, that the SpaceX System will comply with the applicable EPFD limits, a waiver would not undermine the

⁴⁸ See generally ITU-R Space Workshop, “EPFD Verification Software Status and Perspective” (available at <https://www.itu.int/en/ITU-R/space/workshops/2016-NGSO/SiteAssets/Pages/programme2/Workshop%20Software%20Slides.pdf>).

underlying purpose of Sections 25.146(a)(1)(iii) and 25.146(a)(2)(iii). Accordingly, SpaceX requests that Commission grant a waiver of the source code requirement in those rules.

9. Waiver of Limitations in Schedule S

As required by the Commission's rules,⁴⁹ SpaceX has submitted with this application a completed Schedule S, which contains certain technical information in a prescribed form. The current version of Schedule S only recently became effective,⁵⁰ and this is the first NGSO processing round in which the new version has been used. SpaceX has found that it cannot accurately describe its system in certain respects due to limitations in Schedule S itself. Below we discuss four aspects of the SpaceX System that fall into this category as well as how the Schedule S was completed in light of these limitations. To the extent necessary, SpaceX requests that the Commission waive these aspects of Schedule S in light of these limitations.

First, Section 25.114(c)(4)(v) requires both the minimum and maximum saturation flux density ("SFD") values for each space station receive antenna that is connected to transponders. The concept of SFD only applies to "bent pipe" satellite systems, and thus is not relevant to the SpaceX System. However, the Schedule S software does not allow an entry of "not applicable." Instead, it requires a numerical entry for SFD, which must be different for the maximum and minimum values. In order to accommodate this requirement, SpaceX has entered values of "0" and "-0.1" in Schedule S with respect to these parameters.

Second, Schedule S requires that the maximum transmit EIRP density value for a beam be greater than 0 dBW. However, the maximum transmit EIRP density for the Ku-band TT&C downlink beams on the SpaceX System is a negative value: -6.67 dBW. In order to

⁴⁹ See 47 C.F.R. § 25.114(a)(1).

⁵⁰ See Public Notice, "International Bureau Announces the Launch of a New Web-Based Satellite Space Station Electronic Filing System," 31 FCC Rcd. 7755 (2016).

accommodate this limitation, SpaceX has entered a value of “0” in Schedule S with respect to this parameter, and stated the correct value in its Technical Attachment.

Third, Schedule S requires that the maximum PFD value for any given angle of arrival for NGSO systems operating in the 12.2-12.7 GHz band be greater than -200.0 dBW/m²/BW. Although the Schedule S instructions indicate that the permissible range for this parameter is between -1000 and -50 dBW/m²/BW, the validation functions built into the form itself require the higher minimum value of -200.0 dBW/m²/BW. The maximum PFD value for SpaceX’s Ku-band TT&C downlink beam, identified on the Schedule S as TTD3, is -200.2 dBW/m²/4kHz at angles of arrival between 0 and 1 degrees. In order to accommodate this limitation, SpaceX has entered a value of “-200.0 dBW/m²/4kHz” in Schedule S with respect to this parameter.

Fourth, SpaceX will provision to launch up to two extra spacecraft per plane to replenish the constellation in the event of on-orbit failures. If a case arises wherein a spare is not immediately needed, it will remain dormant in the same orbit and will perform station-keeping and debris avoidance maneuvers along with the rest of the active constellation. Because these spare satellites will not operate their communications payloads, and the TT&C facilities communicate in turn with a fixed number of satellites at all times, the addition of spare satellites will not affect the PFD and EPFD analyses for TT&C operations presented in this application. Unfortunately, Schedule S does not have a means to reflect this sort of system architecture for spare satellites. Thus, for purposes of this application, SpaceX hereby identifies the location of its spare satellites as sharing the location of the active satellite in each plane with the minimum mean anomaly in that plane at the orbit epoch date and/or the location 180° away. SpaceX will continue to optimize the arrangement of its spare satellites and alert the Commission should its plans change in the future.