

## WAIVER REQUESTS

Pursuant to Section 1.3 of the Commission’s rules, the Commission may waive its rules for good cause shown.<sup>1</sup> “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.”<sup>2</sup> In determining whether waiver is appropriate, the Commission should “take into account considerations of hardship, equity, or more effective implementation of overall policy.”<sup>3</sup> As SpaceX demonstrates below, there is good cause for the Commission to grant a waiver of Sections 2.106, 25.202(a)(1), 25.143(b)(2)(ii), 25.156(d)(4), 25.156(d)(5), 25.157(e), 25.164(b), 25.208(r), and 25.114(c)(8) of its rules, and, to the extent necessary, various limitations in the Commission’s Schedule S.

### **1. Waiver of Frequency Allocations and Assignments in Sections 2.106 and 25.202(a)(1)**

SpaceX proposes to operate in V-Band spectrum that includes the 37.5-40.0 GHz, 42.0-42.5 GHz, 50.4-51.4 GHz, and 51.4-52.4 GHz bands. However, Sections 2.106 and 25.202(a)(1) of the Commission’s rules do not, in all cases, provide for the use of these bands by FSS systems in the manner anticipated by SpaceX. To the limited extent necessary to authorize the proposed SpaceX System, waiver of these provisions would be in the public interest.

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<sup>1</sup> 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).

<sup>2</sup> *GE American Communications, Inc.*, 16 FCC Rcd. 11038, ¶ 9 (IB 2001).

<sup>3</sup> *WAIT Radio*, 418 F.2d at 1159.

### **37.5-40.0 GHz**

Under both the international and domestic allocation tables, the 37.5-40.0 GHz band is allocated on a co-primary basis to the FSS, Fixed, and Mobile services. However, nearly 20 years ago, the Commission concluded that this band could not feasibly be shared between terrestrial fixed wireless service and FSS user terminals. Therefore, it decided to adopt a “soft segmentation” approach, under which it would impose restrictions on FSS use of the 37.5-40.0 GHz band in order to encourage FSS operators to use spectrum above 40 GHz.<sup>4</sup> As part of this regime, the Commission limited FSS downlink operations in the 37.5-40.0 GHz band to only gateway earth stations.<sup>5</sup>

In the many years since the Commission first adopted its soft segmentation rules, spectrum sharing technology has advanced considerably. The SpaceX System has a variety of attributes that facilitate spectrum sharing, including narrow, steerable spot beams, operations at high elevation angles, and the ability to provide service from multiple satellites with overlapping coverage contours. These can be used individually or in combination to address interference concerns by directing energy away from terrestrial operations in order to mitigate harmful interference. For example, SpaceX’s user terminals will only communicate with satellites at angles of at least 35 degrees, meaning that transmissions from satellites to user terminals would be far off-axis from terrestrial links, which tend to be pointed approximately tangent to the surface of the Earth.

SpaceX seeks to use the 37.5-40.0 GHz spectrum for downlink communications to both user terminals and gateways. As demonstrated by the analysis in Section A.8.1 of the Technical Attachment to this application, SpaceX’s proposed operations would have a *de minimis* effect on

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<sup>4</sup> See *Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands*, 18 FCC Rcd. 25428, ¶ 23 (2003).

<sup>5</sup> See 47 C.F.R. § 25.202(a)(1) n.6.

terrestrial mobile and fixed wireless operations. Specifically, that analysis shows that, across a range of operating conditions, the SpaceX System would have no more than a 0.35 dB effect on fixed services under worst case assumptions, and an effect of 0.04 dB or less under more likely operating scenarios. The effect upon mobile services would be similarly small, with the effect upon base stations ranging from 2.03 dB under worst case assumptions to 0.25 dB under more likely conditions. The effect upon mobile handsets would range from a worst case of 0.31 dB to a more likely level of 0.03 dB.

As demonstrated in Section A.7 of the Technical Attachment, SpaceX's system will comply with the ITU PFD limits for this band. Those limits represent an international consensus that FSS operations at that level are compatible with terrestrial use of the spectrum, and will not result in harmful interference. SpaceX's analysis confirms this conclusion. In addition, the SpaceX System's receiving earth stations will not seek any interference protection from terrestrial system transmissions, and so their operation will not constrain the further development of those services in this band.

Grant of the requested waiver would also be consistent with recent developments that demonstrate a willingness to reexamine the ability of FSS user terminals and terrestrial wireless systems to coexist. For example, in its *Spectrum Frontiers* proceeding, the Commission is evaluating whether to allow deployment of FSS user terminals in this band.<sup>6</sup> Similarly, following the World Radiocommunication Conference 2015 (WRC-15), the U.S.-sponsored Resolution 159 directed an international study group to assess regulatory revisions that could improve the utility

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<sup>6</sup> *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services et al.*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd. 8014, ¶¶ 492-502 (2016) (“*Spectrum Frontiers Order and FNPRM*”).

of V-band spectrum for NGSO FSS use, including 37.5-42.5 GHz.<sup>7</sup> Because of SpaceX's unique sharing capabilities and the demonstrated likelihood that its operations would not cause harmful interference to any other user of this spectrum, the Commission should grant SpaceX's requested waiver of the user-terminal restriction codified in Section 25.202(a)(1) footnote 6.

#### ***42.0-42.5 GHz***

The ITU's Frequency Allocation Table currently includes an FSS allocation in this band for downlink transmissions. This band is of particular value to FSS operators such as SpaceX because it sits adjacent to the 37.5-40.0 and 40.0-42.0 GHz bands, both of which are currently authorized for use by FSS downlinks both internationally and in the U.S. Thus, as SpaceX's proposed frequency plan illustrates, authorizing use of the 42.0-42.5 GHz band would enable SpaceX to use a single, contiguous band (37.5-42.5 GHz) for all V-band downlink operations. This will not only promote increased spectral efficiency, but also reduce operating costs, which would in turn translate into reduced prices for consumers.

However, the Commission's rules do not conform to the international FSS allocation in this band. In 2010, the Commission proposed to correct this inconsistency. It recognized that such an allocation would provide additional spectrum for FSS, and that "V-band FSS systems could use spot beams to communicate with relatively few gateway earth stations," which would enhance the opportunities for spectrum sharing.<sup>8</sup> It recently opted not to conform to the international norm based upon the assumption that future FSS systems are unlikely to need this capacity.<sup>9</sup> This

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<sup>7</sup> See ITU-R Rec. 159 (WRC-15), "Studies of technical, operational issues and regulatory provisions for non-geostationary fixed-satellite services satellite systems in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space)."

<sup>8</sup> See *Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band*, Third Notice of Proposed Rulemaking, 25 FCC Rcd. 15663, ¶¶ 17-19 (2010).

<sup>9</sup> See *Spectrum Frontiers Order and FNPRM*, ¶ 368.

premise is flawed, given both overall broadband demand trends and recent technology innovations – such as the orbital parameters of the VLEO Constellation – that permit space-based networks to support high-capacity broadband demand in new ways.

The Commission has repeatedly questioned whether existing FSS broadband systems have sufficient downlink capacity to provide service at the speed and quality demanded by most consumers.<sup>10</sup> Authorization of domestic use of the 42.0-42.5 GHz band, in keeping with international FSS allocations, would allow NGSO operators such as SpaceX to utilize a single, contiguous band (37.5-42.5 GHz) for all V-band downlink operations. Access to this contiguous 5 GHz of spectrum, coupled with cutting edge on-orbit and ground technology, will allow NGSO systems to support a level of broadband service that is truly competitive with terrestrial alternatives, injecting much-needed competition in areas where terrestrial alternatives are few, expensive, or both.

The Commission’s allocation decision at 42.0-42.5 GHz is currently the subject of a petition for reconsideration.<sup>11</sup> Unless and until that decision is revised, SpaceX requests to operate in this band on a non-conforming, non-interference, non-protected basis. 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 operator accepts any interference

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<sup>10</sup> See, e.g., *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, 31 FCC Rcd. 699, ¶¶ 47-48 (2016); Federal Communications Commission, 2016 Measuring Broadband America Fixed Broadband Report, at 9 (Dec. 1, 2016), available at <http://data.fcc.gov/download/measuring-broadband-america/2016/2016-Fixed-Measuring-Broadband-America-Report.pdf>.

<sup>11</sup> See Petition for Reconsideration of The Boeing Company, GN Docket No. 14-177, *et al.*, at 21-22 (filed Dec. 14, 2016).

from authorized services.”<sup>12</sup> SpaceX meets both of these criteria. WRC-03 adopted PFD limits on FSS operations to protect Radio Astronomy (“RAS”) in the adjacent 42.5-43.5 GHz band.<sup>13</sup> SpaceX values the critical work of the radio astronomy community and, as explained in Section A.8.4 of the Technical Attachment, has designed the SpaceX System to comply with these international limits, ensuring that those important RAS operations within the U.S. and internationally will be properly protected. And although this band is currently allocated for Fixed and Mobile operations in the U.S. Table of Frequency Allocations, the Commission has not adopted service rules for these operations due in part to the difficulty of implementing effective measures to protect important RAS observations from interference from terrestrial operations.<sup>14</sup> A waiver of the Commission’s allocation rules, therefore, would not introduce the risk of interference to *existing* terrestrial systems. Moreover, as demonstrated in Section A.7 of the Technical Attachment, such a waiver would not pose a risk for potential terrestrial operations in the band, as SpaceX’s system can be expected to have only a *de minimis* effect.

Grant of the waiver would significantly increase the efficiency of the SpaceX System by increasing the amount of contiguous V-band spectrum available for downlink operations. In addition, the SpaceX System’s receiving earth stations will not seek any interference protection from terrestrial system transmissions, and so their operation will not constrain the further

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<sup>12</sup> See, e.g., *Fugro-Chance, Inc.*, 10 FCC Rcd. 2860, ¶ 2 (IB 1995) (authorizing non-conforming MSS in the C-band); *Motorola Satellite Communications, Inc.*, 11 FCC Rcd. 13952, ¶ 11 (IB 1996) (authorizing service to fixed terminals in bands allocated to the mobile-satellite service).

<sup>13</sup> See 47 C.F.R. § 2.106 n.5.551H. See also *id.* § 2.106 n.US211 (urging all applicants for space stations operating in the 40.5-42.5 GHz band to take all practicable steps to protect radio astronomy observations in the 42.5-43.5 GHz band from harmful interference).

<sup>14</sup> See *Spectrum Frontiers Order and FNPRM*, ¶ 401.

development of those services in this band. Accordingly, the facts justify granting a waiver to allow SpaceX to operate on a non-conforming basis.

#### ***50.4-51.4 GHz***

The 50.4-51.4 GHz band is allocated for FSS (Earth-to-space) in both the international and domestic frequency allocation tables, consistent with SpaceX's proposed use of this band. However, the Commission has not identified this band in Section 25.202(a)(1) as available for FSS uplink operations. The Commission recently proposed to eliminate the list of FSS frequencies in Section 25.202(a)(1) and rely solely on the spectrum identified in the allocation tables in order to avoid just this sort of confusion.<sup>15</sup>

In the meantime, to the extent necessary, the Commission should waive the apparently unintended limitation imposed by failing to fully reflect the spectrum allocated for FSS use in Section 25.202. SpaceX has designed the SpaceX System for unprecedented spectral efficiency, and will comply with Commission and ITU rules and recommendations adopted to protect Earth Exploration Satellite Service and RAS operations in adjacent bands. Access to the 50.4-51.4 GHz band is a crucial element in providing V-band satellite systems with sufficient capacity to address U.S. and global demand for high-speed Internet access, especially in underserved areas. This conclusion is confirmed by U.S.-sponsored ITU-R Resolution 159 (WRC-15), under which an international study group is assessing regulatory revisions that could improve the utility of V-band spectrum for NGSO FSS use, including 50.4-51.4 GHz. Resolution 159 recognizes the need for V-band rules that better facilitate efficient use of this spectrum and acknowledges the crucial role

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<sup>15</sup> See *Updates to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, 16 FCC Rcd. 13651, ¶ 14 (2016) (“*NGSO FSS Update NPRM*”).

FSS systems can play in bridging the digital divide. Accordingly, the Commission should grant a waiver to the extent necessary.

#### ***51.4-52.4 GHz***

Neither Section 2.106 nor Section 25.202(a)(1) of the Commission's rules authorize FSS uplink operations in the United States using the 51.4-52.4 GHz band. However, at least two factors make this band ideal for FSS uplink use. First, this band is almost entirely free of non-federal incumbents, and those few existing federal users appear to use this band in only a limited way, easing potential coordination concerns between commercial FSS and these federal users.<sup>16</sup> Second, this band is directly adjacent to the other spectrum allocated for commercial FSS uplink use. Thus, a waiver here would create 5 GHz of nearly contiguous FSS spectrum from 47.2 to 52.4 GHz for uplinks that would parallel the 5 GHz of downlink spectrum from 37.5 to 42.5 GHz. It is worth noting the Commission is currently considering a petition for rulemaking filed by Boeing that requests addition of a co-primary allocation for FSS in the 51.4-52.4 GHz band,<sup>17</sup> and that the ITU has initiated international study of the need for allocating this band for FSS use as well.<sup>18</sup>

This balance between uplink and downlink spectrum is crucial for any system such as SpaceX's, which uses the same spectrum for gateway and user communications. All downlink communications traffic in such a system originates as uplink traffic, and vice versa. Thus, an imbalance between the available uplink and downlink spectrum will necessarily result in less

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<sup>16</sup> See NTIA Office of Spectrum Management, *Federal Spectrum Use Summary, 30 MHz – 3000 GHz* at 78 (2010), available at [https://www.ntia.doc.gov/files/ntia/Spectrum\\_Use\\_Summary\\_Master-06212010.pdf](https://www.ntia.doc.gov/files/ntia/Spectrum_Use_Summary_Master-06212010.pdf).

<sup>17</sup> See Public Notice, Rep. No. 3051 (Sep. 16, 2016) (opening RM-11773).

<sup>18</sup> See ITU-R Res. 162 (WRC-15), "Studies relating to spectrum needs and possible allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space)."



efficient operation of the constellation as a whole, resulting in reduced quality of service and/or higher costs. For these reasons, the Commission should waive Section 2.106 and Section 25.202(a)(1), and authorize SpaceX to use the 51.4-52.4 GHz band.

## **2. Waiver of Default Geographic Coverage Requirements in Section 25.143(b)(2)(ii)**

Section 25.143(b)(2) sets the default geographic coverage requirements for all NGSO systems where band-specific rules do not apply.<sup>19</sup> That provision includes both an international and a domestic requirement. First, the system must have at least one satellite that would be visible above the horizon at an elevation angle of at least 5 degrees for at least 18 hours each day, for any location between 70° North Latitude and 55° South Latitude. Second, the system must have at least one satellite that would be visible above the horizon at an elevation angle of at least 5 degrees at all times throughout the fifty states, Puerto Rico, and the U.S. Virgin Islands.

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 of the LEO Constellation, however, will cover most but not all of the area required. Specifically, the Initial Deployment will provide continuous FSS service from approximately 60° North Latitude to 60° South Latitude. This is sufficient to cover the contiguous United States, Hawaii, Puerto Rico, the U.S. Virgin Islands, and portions of Alaska, as well as the southernmost areas covered by the rule. Continuous coverage to the northernmost areas covered by the rule (*e.g.*, the 60° to 70° North Latitudes in upper Alaska) would be satisfied once service from one of the more inclined orbital constellations is activated.

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<sup>19</sup> See 47 C.F.R. § 25.217 (identifying default rules for NGSO operations in frequencies without band-specific rules, including Section 25.143(b)(2)(ii) and (iii)).

SpaceX below requests 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,<sup>20</sup> to the extent the Commission deems such a waiver necessary.

### **3. Waiver of Separate Gateway Link Application Requirement in Section 25.156(d)(4)**

Section 25.156(d)(4) provides that the Commission will consider applications for authority to operate feeder links separately from applications to provide service. This rule may be appropriate for systems that use separate spectrum for feeder and service links. It is not, however, workable for the SpaceX System, which uses common spectrum for both gateway and service links and does not require the assignment of a separate band for each. Each SpaceX satellite can use all of the authorized spectrum to provide high-quality broadband service to customers in areas where demand is high while simultaneously using much or all of that same spectrum in other beams to communicate with gateway earth stations located in areas where user demand is low. This strategy is made possible by the system's frequency reuse and steerable beam capabilities, and enables SpaceX to optimize aggregate capacity in order to deliver services at a level that is competitive with other available broadband offerings. The system will further maximize efficiency under this approach by locating many of its gateway earth stations in areas where user density is low, ensuring that, for a given satellite, periods of high user-link utilization will not overlap with periods of

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<sup>20</sup> The Commission granted a similar waiver to O3b Limited ("O3b") permitting its 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.

communication with a gateway. The Commission should not penalize such a spectrally efficient approach.

Accordingly, the Commission should facilitate this efficient use of spectrum by granting SpaceX's requested waiver of Section 25.156(d)(4).

#### **4. Waiver of Application Bar in Section 25.156(d)(5)**

Section 25.156(d)(5) provides that:

In cases where the Commission has not adopted frequency-band specific service rules, the Commission will not consider NGSO-like applications after it has granted a GSO-like application, and it will not consider GSO-like applications after it has granted an NGSO-like application, unless and until the Commission establishes NGSO/GSO sharing criteria for that frequency band.

This provision may be interpreted to be applicable to the V-band because the Commission has not adopted specific service rules or GSO/NGSO sharing criteria for this band, and it has issued two prior authorizations for systems operating in portions of this band. The first such authorization was issued to a hybrid GSO/NGSO system,<sup>21</sup> while the second was issued to a single-satellite GSO system.<sup>22</sup> Neither system was ever deployed, however, and both licensees have since surrendered their authorizations.

When the Commission adopted Section 25.156(d)(5), it specifically stated that it would treat a hybrid GSO/NGSO system “as an NGSO-like system, with the GSO portion of the system as additional satellites” for purposes of this rule.<sup>23</sup> Thus, because the first application granted in

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<sup>21</sup> *Northrop Grumman Space & Mission Systems Corp.*, 24 FCC Rcd. 2330 (IB 2009).

<sup>22</sup> Stamp Grant, Hughes Network Systems, LLC, IBFS File No. SAT-LOA-20111223-00248 (Aug. 3, 2012).

<sup>23</sup> *See Amendment of the Commission's Space Station Licensing Rules and Policies*, 18 FCC Rcd. 10760, ¶ 58 (2003).

this band meets the NGSO-like application grant requirement, this rule should be no bar to further NGSO-like applications.

In an abundance of caution, however, SpaceX seeks a waiver in light of the fact that the Commission subsequently issued a GSO authorization. While it may be possible to read Section 25.156(d)(5) to suggest that NGSO applications are barred due to the subsequent GSO authorization, this result would be, in practice, absurd for two reasons. First, it would ignore the prior-filed NGSO/GSO hybrid system, which gave NGSO systems priority under the rule. Second, there are no satellite systems currently authorized to operate in this band. Presumably, this rule is intended to protect systems that have been or might actually be built, not to permanently bar NGSO applicants from a band devoid of any commercial operations. Clearly, the latter interpretation of Section 25.156(d)(5) would be contrary to the public interest. Moreover, the Commission has proposed to delete this aspect of the rule, on the grounds that “an applicant demonstrating that it can operate compatibly with any existing operations, either through technical demonstrations or coordination, ought not be precluded from providing service to the public while the Commission initiates and conducts a rulemaking to establish formal sharing criteria.”<sup>24</sup> SpaceX has demonstrated in its application materials that this is the case here. For all of these reasons, waiver is appropriate to the extent this rule would otherwise apply.

#### **5. Waiver of Band Segmentation Requirements in Section 25.157(e)**

In response to the filing of an application for an NGSO system operating in V-band spectrum, the Commission has initiated a processing round for competing NGSO system applications pursuant to Section 25.157 of the Commission’s rules.<sup>25</sup> In such a processing round,

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<sup>24</sup> *NGSO FSS Update NPRM*, ¶ 21.

<sup>25</sup> See Public Notice, “Boeing Petition Accepted for Filing in Part,” 31 FCC Rcd. 11957 (IB 2016).

the Commission's rules establish certain band segmentation procedures if there is not sufficient spectrum available to accommodate all qualified applicants.<sup>26</sup> 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.

In considering various approaches for intra-service sharing among NGSO FSS applicants in other bands, the Commission has rejected approaches that applied band segmentation, finding that they “are overly restrictive, and could result in insufficient spectrum for commercially viable operations.”<sup>27</sup> The Commission preferred the Avoidance of In-line Interference Events approach, under which all NGSO FSS licensees could use the entire band at issue, except in situations where two or more NGSO systems experience in-line interference, when they would have to coordinate.<sup>28</sup> 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.<sup>29</sup> 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.<sup>30</sup> It once again rejected the two band-segmentation options.

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<sup>26</sup> 47 C.F.R. § 25.157(e).

<sup>27</sup> *See Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ku-Band*, 17 FCC Rcd. 7841, ¶ 37 (2002).

<sup>28</sup> *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.

<sup>29</sup> *Id.* ¶¶ 27-38.

<sup>30</sup> *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.

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.<sup>31</sup> 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).<sup>32</sup> Yet in doing so, the Commission reaffirmed the appropriateness of the avoidance-of-inline-events approach, observing that it 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.”<sup>33</sup>

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 rigid 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. Indeed, the large number of satellites in the SpaceX System with overlapping coverage areas creates multiple options for providing service to any given customer, enabling the system to avoid in-line events in many cases. Only systems with inflexible technologies pose a problem in this respect, which the Commission will need to address.

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<sup>31</sup> See *Amendment of the Commission’s Space Station Licensing Rules and Policies*, 18 FCC Rcd. 10760 (2003) (“*Space Station Licensing Reform Order*”).

<sup>32</sup> *Ka-Band NGSO Sharing Order* ¶¶ 30-34.

<sup>33</sup> *Space Station Licensing Reform Order*, ¶ 280.

## 6. 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.<sup>34</sup> The Commission has established such milestone requirements for satellite system implementation in 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.”<sup>35</sup> 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.<sup>36</sup>

SpaceX proposes to launch and operate an NGSO system composed of thousands of satellites. Completing the full constellation over a six-year period would require an unprecedented launch cadence even for a company like SpaceX, which has demonstrated considerable launch capabilities. However, delivery of broadband services does not require full deployment of all of these satellites, nor is it necessary to reach the Final Deployment in order to demonstrate that SpaceX is “fully committed” to utilizing the granted orbital and spectrum resources.

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<sup>34</sup> 47 C.F.R. § 25.164(b).

<sup>35</sup> *Comprehensive Review of Licensing and Operating Rules for Satellite Services*, 30 FCC Rcd. 14713, ¶ 53 (2015) (“*Part 25 Second R&O*”).

<sup>36</sup> *Id.* See also *Space Station Licensing Reform Order* ¶ 173; *TerreStar Networks, Inc.*, 22 FCC Rcd. 17698, ¶ 6 (IB 2007).

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 warehousing.<sup>37</sup> 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 the LEO Constellation (32 planes with 25 satellites per plane), and continuously thereafter as additional satellites are launched and the constellation is replenished and expanded. 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.<sup>38</sup>

#### **7. Waiver of the Downlink PFD Limits in Sections 25.208(r) and 25.114(c)(8)**

Sections 25.208(r) and 25.114(c)(8) require applicants to demonstrate compliance with the Commission’s PFD limits in the 37.5-40.0 GHz band. These limits are 12 dB lower than the corresponding PFD limits imposed under the ITU’s rules,<sup>39</sup> and 12 dB more stringent than the Commission’s own limits in the adjacent 40.0-42.0 GHz band.<sup>40</sup> As explained above, these stringent limitations were designed to implement the Commission’s “soft segmentation” rules, which seek to encourage FSS use of spectrum above 40.0 GHz.<sup>41</sup> But the Commission is now in

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<sup>37</sup> See, e.g., *EchoStar Satellite Corp.*, 18 FCC Rcd. 15875, ¶ 9 (IB 2003); *Astrolink Int’l LLC*, 17 FCC Rcd. 11267, ¶ 6 (IB 2002).

<sup>38</sup> See *Part 25 Second R&O* ¶ 53.

<sup>39</sup> See ITU Radio Regulations, Article 21, Table 21-4.

<sup>40</sup> 47 C.F.R. § 25.208(s) and (t).

<sup>41</sup> See *supra* Section 1.



the process of reviewing that decision in its *Spectrum Frontiers* proceeding, and has acknowledged that this approach may no longer be warranted due to the advanced sharing capabilities of modern satellite systems.<sup>42</sup>

As demonstrated in Section A.7 of the Technical Attachment to this application, the SpaceX System will comply with the ITU PFD limits for the 37.5-40.0 GHz band, but will exceed the more restrictive limits imposed by the Commission at elevation angles above 35 degrees. Accordingly, SpaceX seeks a waiver of the PFD limits in Section 25.208(r) and 25.114(c)(8), and authorization to operate at the ITU PFD limits instead.

As SpaceX has demonstrated in Section A.8 of the Technical Attachment, operations in compliance with the ITU limit, which the Commission itself has adopted for the adjacent spectrum, would have a minimal effect on terrestrial licensees. This should not be surprising, since that limit represents an international consensus that FSS operations at that level are compatible with terrestrial use of the spectrum, and will not result in harmful interference. SpaceX's analysis confirms this conclusion.

On the other hand, application of the Commission's unnecessarily strict PFD limit in this band would hamstring SpaceX's efforts to make productive use of this spectrum for global high-speed Internet coverage. These inefficiencies would be compounded by the fact that the propagation characteristics of this band do not support terrestrial wireless networks that would provision broadband services in rural and other areas of low population density, where such services are often limited or entirely absent. Because of its wider geographic reach, the SpaceX System is designed to provide service to these underserved areas, which can help to bridge the digital divide. In other words, denying the requested waiver would create the risk that this band

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<sup>42</sup> See *Spectrum Frontiers Order and FNPRM*, ¶¶ 492-99.

would lie fallow across much of the United States, merely to avert a virtually undetectable level of interference to terrestrial licensees operating primarily in urban areas.

Applying the ITU PFD limits in this band also is justified from an operational perspective. As required by the Commission's geographic coverage rules, the SpaceX System will provide service around the globe. Thus, this international system will have to comply with the internationally-adopted PFD limits in the ITU's rules. Requiring operations at a lower power level when serving the United States alone would impose significant operational complications and inefficiencies that would undermine system performance, to the detriment of users everywhere. Accordingly, the ITU limits would better serve the public interest than would using the Commission's unnecessarily restrictive limits.

#### **8. Waiver of Limitations in Schedule S**

As required by the Commission's rules,<sup>43</sup> SpaceX has submitted with this application an electronic Schedule S, which contains certain technical information in a prescribed form. SpaceX has found that it cannot accurately describe its system in certain respects due to limitations in Schedule S itself. Below we discuss three aspects of the SpaceX System that fall into this category as well as how Schedule S was completed in light of these limitations. To the extent necessary, SpaceX requests that the Commission waive these aspects of Schedule S.

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."

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<sup>43</sup> See 47 C.F.R. § 25.114(a)(1).

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 cannot process all of the orbital parameter data for the SpaceX System. Accordingly, SpaceX will provide a sample of that data in the electronic version of Schedule S, and deliver to the Commission a database with the complete information required on Schedule S, including orbital parameters, for inclusion in the record of this application.<sup>44</sup>

Third, SpaceX intends to launch up to two extra spacecraft per plane to replenish the LEO Constellation in the event of on-orbit failures. If 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. The addition of spare satellites will not affect the PFD analyses presented in this application because these spare satellites will not operate their communications payloads, and the TT&C earth stations that communicate with the spare also communicate with a number of satellites (operational and spare) at all times. 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 in the LEO Constellation 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.

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<sup>44</sup> Because SpaceX will provide only a portion of its orbital parameter data in the Schedule S, not all aspects of the system will be accurately captured by that software. For example, the “Total Number of Satellites in the active constellation” will reflect the number provided in the sample rather than the total number in the SpaceX System.