

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of )
Space Exploration Holdings, LLC ) IBFS File No. SAT-MOD-20190830-00087
Request for Modification of the Authorization for ) Call Signs S2983 and S3018
the SpaceX NGSO Satellite System )

ORDER AND AUTHORIZATION

Adopted: December 19, 2019

Released: December 19, 2019

By the Chief, International Bureau:

I. INTRODUCTION

1. In this Order and Authorization (Order), we grant the application<sup>1</sup> of Space Exploration Holdings, LLC (SpaceX) to further modify its previously authorized 4,425 non-geostationary orbit (NGSO) fixed-satellite service (FSS) satellite constellation using Ku- and Ka-band spectrum.<sup>2</sup> Specifically, we authorize SpaceX to increase the number of orbital planes authorized for operations of SpaceX's satellites at the 550 kilometer (km) orbital shell, to reduce the number of satellites in each orbital plane, and to reconfigure existing satellites in its constellation accordingly. In doing so, we deny petitions to deny or defer SpaceX's application.<sup>3</sup> Grant of this application will allow SpaceX to accelerate the deployment of its satellite constellation to deliver broadband service throughout the United States, especially to those who live in areas underserved or unserved by terrestrial systems.

II. BACKGROUND

2. On April 26, 2019, the International Bureau (Bureau), granted SpaceX's request to modify its initial authorization and allowed SpaceX to: (1) reduce the number of satellites in the constellation from 4,425 to 4,409; (2) operate 1,584 satellites previously authorized to operate at an altitude of 1,150 km at the lower altitude of 550 km; and (3) make related changes to the operations of the

<sup>1</sup> Space Exploration Holdings, LLC, Request for Modification of the Authorization for the SpaceX NGSO Satellite System, IBFS File No. SAT-MOD-20190830-00087, filed August 30, 2019 (SpaceX Second Modification Application).

<sup>2</sup> See Space Exploration Holdings, LLC, Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System, Memorandum Opinion, Order and Authorization, 33 FCC Rcd 3391 (2018) (SpaceX Authorization).

<sup>3</sup> Petition to Defer of SES Americom and O3b Limited (filed Oct. 15, 2019) (SES/O3b Petition); Letter from Nickolas G. Spina, Counsel to Kepler Communications, Inc., to Marlene H. Dortch, Secretary, FCC (filed Oct. 15, 2019) (Kepler Letter). Kepler's Letter comprises (1) a petition for reconsideration of the SpaceX First Modification Order (as defined in n.4 below) (Kepler Letter, Recon Petition) (2) a petition to defer or deny this SpaceX Second Modification Application (Kepler Letter, Second Mod Petition), and (3) a petition to defer or deny SpaceX's request for special temporary authority to launch its second tranche of satellites (Kepler Letter, STA Petition).

satellites in this new lower shell of the constellation.<sup>4</sup>

3. On August 30, 2019, SpaceX filed the current application seeking to further modify the lower shell of its constellation to: (1) increase the number of orbital planes from 24 to 72; (2) decrease the number of satellites per orbital plane from 66 to 22; and (3) make related changes to the deployment and operations of the satellites in these orbital planes.<sup>5</sup> SpaceX also provides updated analyses addressing interactions between its system as modified and other licensed systems, but SpaceX does not seek to change the number of satellites in its constellation or their altitude, inclination, operational characteristics, or orbital debris implications.<sup>6</sup> SpaceX proposes to operate in the same Ku- and Ka-band frequencies in which it was previously licensed to operate: 10.7-12.7 GHz (space-to-Earth), 12.75-13.25 GHz (Earth-to-space), 13.85-14.5 GHz (Earth-to-space), 17.8-18.6 GHz (space-to-Earth), 18.8-19.3 GHz (space-to-Earth), 19.7-20.2 GHz (space-to-Earth), 27.5-29.1 GHz (Earth-to-space), and 29.5-30 GHz (Earth-to-space).<sup>7</sup> In connection with its application, SpaceX requests waivers of various limitations in the Commission's Schedule S software.<sup>8</sup>

4. On September 13, 2019, the SpaceX Second Modification Application was accepted for filing.<sup>9</sup> Kepler Communications, Inc. (Kepler), filed a petition to defer or deny.<sup>10</sup> SES Americom and O3b Limited (SES/O3b) also filed a petition to defer.<sup>11</sup> WorldVu Satellites Limited (OneWeb) filed a written *ex parte* communication in connection with this application.<sup>12</sup> Hughes Network Systems, LLC; Intelsat License LLC; AT&T Services, Inc.; and Inmarsat, Inc. (the GSO Satellite Operators) collectively filed reply comments responding to SES/O3b and Kepler.<sup>13</sup> SpaceX filed a consolidated opposition responding to Kepler's and SES/O3b's comments and also filed separate reply comments to the GSO Satellite Operators, incorporating the comments in its consolidated reply by reference.<sup>14</sup> SES/O3b also filed reply comments to SpaceX.<sup>15</sup>

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<sup>4</sup> See *Space Exploration Holdings, LLC, Request for Modification of the Authorization for the SpaceX NGSO Satellite System*, Order and Authorization, 34 FCC Rcd 2526 (IB 2019) (*SpaceX First Modification Order*). A number of petitions to reconsider or condition were filed. See Petition for Reconsideration and Petition to Condition of WorldVu Satellites Limited, IBFS File Nos. SAT-MOD-20181108-00083, SES-LIC-20190402-00425 through -00427, SES-LIC-20190402-00450, -00451, and -00454 (filed May 28, 2019) and SES-AMD-20190410-00520 through 00525 (filed May 31, 2019) (OneWeb Petition for Reconsideration); Kepler Letter, Recon Petition at 1-2, 5-13. These petitions remain pending.

<sup>5</sup> See SpaceX Second Modification Application, Legal Narrative at 3.

<sup>6</sup> See *id.*, Legal Narrative at 1.

<sup>7</sup> See *id.* Frequencies Requested at 1.

<sup>8</sup> See *id.*, Legal Narrative at 1.

<sup>9</sup> Policy Branch Information, Space Stations Accepted for Filing, Public Notice, Report No SAT-01412 (IB Sat. Div. Sept. 13, 2019).

<sup>10</sup> Kepler Letter, Second Mod Petition at 14.

<sup>11</sup> See SES/O3B Petition.

<sup>12</sup> See Notice of Written Ex Parte of WorldVu Satellites Limited (filed Oct. 17, 2019) (OneWeb Ex Parte).

<sup>13</sup> See Letter from the GSO Satellite Operators to Marlene H. Dortch, Secretary, FCC (dated Oct. 30, 2019) (GSO Satellite Operators Letter).

<sup>14</sup> See Consolidated Opposition to Petitions of SpaceX, IBFS File No. SAT-MOD-20190830-00087 (filed Oct. 30, 2019) (SpaceX Consolidated Opposition); Letter from William M. Wiltshire, Counsel to SpaceX, to Marlene H. Dortch, Secretary, FCC, dated Nov 12, 2019.

<sup>15</sup> See Reply of SES Americom and O3b Limited, filed Nov 12, 2019 (SES/O3b Reply).

### III. DISCUSSION

5. After review of the record, we conclude that grant of the SpaceX Second Modification Application will serve the public interest, subject to the requirements and conditions specified herein. Below, we address the various outstanding issues raised by commenters.

6. *Kepler's Petitions.* Kepler petitioned the Commission to reconsider the *SpaceX First Modification Order* and to defer or deny the Second Modification Application.<sup>16</sup> Kepler argues that SpaceX's instant modification should not be considered until a decision has been reached on all petitions for reconsideration of the first modification.<sup>17</sup> We disagree with this argument. The Commission's rules do not require the Bureau to address a pending petition for reconsideration prior to considering a pending modification of the same license. Although decisions taken on the pending petitions for reconsideration may impact the approval of further modifications to SpaceX's constellation, our action today is without prejudice to any future action we take on the pending petitions. In addition, because SpaceX's satellites have propulsion systems, SpaceX will be able to reconfigure its satellites to its system as initially authorized, in the event that the Bureau were to reconsider the *SpaceX First Modification Order*. Furthermore, delaying consideration of SpaceX's second modification until we act on the petitions for reconsideration would result in uncertainty for SpaceX as it prepares to orbit-raise its second tranche of satellites and will ultimately delay SpaceX's delivery of broadband services. Accordingly, there is no reason to delay SpaceX's proposed operations while the reconsideration of the initial modification grant is pending.

7. Kepler also bases its petition to defer or deny on the grounds that SpaceX has not submitted a filing with the International Telecommunication Union (ITU) for the orbital parameters involved in this second modification and that the additional planes proposed in this modification could increase SpaceX's rate of intra-constellation conjunctions in the sub-600 km low-Earth orbit environment.<sup>18</sup> With regard to Kepler's concerns about SpaceX's ITU filing, SpaceX replies that the Commission placed a condition on its authorization requiring submission of the information necessary for Advance Publication, Coordination, and Notification of the frequency assignments of its constellation and that this information may be submitted after grant of the license.<sup>19</sup> We agree that it is established Commission practice to grant space station authorizations subject to a condition requiring submission of a filing with the ITU for coordination of the authorized operations.<sup>20</sup> Therefore, SpaceX is already obligated to submit this information for filing with the ITU, even if it has not done so already, and Kepler's concerns do not justify deferral or denial of this modification request. As to Kepler's claims of increased intra-constellation conjunctions, SpaceX responds that Kepler's claims are unfounded, and that Kepler supplies no analysis to support these claims, nor any rationale why it believes this might occur.<sup>21</sup> We also agree that, without further analysis, Kepler has not provided a sufficient basis to deny this modification due to increased collision risk among SpaceX satellites. SpaceX's satellites utilize propulsion to maneuver, and according to current licensing practices, a satellite with propulsive capabilities is assumed to have a collision risk of zero because of the satellite's ability to conduct collision

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<sup>16</sup> See Kepler Letter, Recon Petition at 5-13, Kepler Letter Second Mod Petition at 14.

<sup>17</sup> Kepler Letter, Second Mod Petition at 14. OneWeb also filed a petition to reconsider or condition the *SpaceX's First Modification Order*, see OneWeb Petition for Reconsideration, and filed an *ex parte* letter in support of Kepler's Petition. See OneWeb Ex Parte at 4.

<sup>18</sup> See Kepler Letter, Second Mod Petition at 14.

<sup>19</sup> See SpaceX Consolidated Opposition at 6 (citing *SpaceX First Modification Order* at para. 32a).

<sup>20</sup> See, e.g., SpaceX First Modification Order, para. 32a; *Telesat Canada*, 32 FCC Rcd 9663, 9666-67, 9674, paras. 6, 27a; *Space Norway AS*, 32 FCC Rcd 9649, 9652, 9659, paras. 6, 23a; see also 47 CFR § 25.111(b).

<sup>21</sup> See SpaceX Consolidated Opposition at 8.

avoidance maneuvers.<sup>22</sup> In its petition to deny or defer, Kepler does not explain why increasing the number of orbital planes by itself would affect SpaceX's ability to utilize propulsion to avoid collisions among its own satellites. For these reasons, we deny Kepler's petition to defer or deny this SpaceX Second Modification Application.

8. *Petitioners' Comments on EPFD Limits.* SES/O3b cite concerns about the lack of information on SpaceX's compliance with applicable equivalent power flux density (EPFD) limits.<sup>23</sup> Because the Commission granted a waiver of the requirement that SpaceX receive a favorable or qualified favorable finding from the ITU regarding the EPFD characteristics of its constellation, SES/O3b requests that the Commission require more than simple assertions from SpaceX that it will comply with ITU EPFD limits.<sup>24</sup> SES/O3b states that this more robust showing is necessary both to protect the integrity of existing GSO systems and to allow NGSO systems to successfully coordinate to meet aggregate EPFD limits.<sup>25</sup> SES/O3b further requests that the Commission reinstate the requirement that SpaceX receive a favorable or qualified favorable finding from the ITU prior to commencing operations or, at a minimum, that the Commission require SpaceX to submit the data used as input to the ITU-approved validation software to allow SES/O3b to make an independent analysis regarding SpaceX's EPFD compliance.<sup>26</sup> The GSO Satellite Operators and OneWeb support the objections and recommendations of SES/O3b.<sup>27</sup> The GSO Satellite Operators also express concern that the current modification application does not request or offer any justification for extending the partial waiver of section 25.146(c) granted in the *SpaceX First Modification Order*.<sup>28</sup>

9. In its Consolidated Opposition, SpaceX states that SES/O3b will have all necessary information to conduct its own EPFD analysis, because much of that information is already publicly available.<sup>29</sup> SpaceX also provided SES/O3b and the GSO Satellite Operators with the EPFD input data for the Second Modification Application.<sup>30</sup> Because SpaceX has provided the GSO Satellite Operators and SES/O3b with the requested information, the concerns of the GSO Satellite Operators and SES/O3b are moot. However, as we did in the recent SpaceX STA grant, wherein we authorized SpaceX to perform certain orbit-raising and testing operations for this second tranche of satellites, we will impose the condition that SpaceX must provide its EPFD input data to any requesting party.<sup>31</sup>

10. The GSO Satellite Operators expressed concern that SpaceX did not justify the lack of a request for extension of the partial waiver of requirement that SpaceX receive a favorable or qualified favorable finding from the ITU prior to commencing operations. SpaceX responds that while the *SpaceX*

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<sup>22</sup> *Mitigation of Orbital Debris in the New Space Age*, Notice of Proposed Rulemaking, 33 FCC Rcd 11352, 11361, para. 26 (2018) (noting that current licensing practice has been to consider collision risk to be zero or near zero during the period of time in which the spacecraft is maneuverable, absent contrary information, but also seeking comment on this issue).

<sup>23</sup> See SES/O3b Petition.

<sup>24</sup> *Id.* at 2-7.

<sup>25</sup> *Id.* at 2-3, 5-6.

<sup>26</sup> *Id.* at 6-7; see also 47 CFR § 25.146(c).

<sup>27</sup> See GSO Satellite Operators Letter; OneWeb Ex Parte, at 3-4.

<sup>28</sup> See GSO Satellite Operators Letter.

<sup>29</sup> See SpaceX Consolidated Opposition at 4-6, n.13.

<sup>30</sup> See Letter from William M. Wiltshire, Counsel to SpaceX, to Suzanne Malloy, Petra Vorwig, and Noah Cherry, Counsel to SES/O3b, IBFS File No. SAT-MOD-20181108-00083 (filed Oct. 30, 2019); Letter from William M. Wiltshire, Counsel to SpaceX, to Marlene H. Dortch, Secretary, FCC, (filed Nov. 12, 2019).

<sup>31</sup> See Space Exploration Holdings, LLC, Request for Special Temporary Authority, IBFS File No. SAT-STA-20190924-00098 (granted Nov 7, 2019), Condition 5.

*First Modification Order* waived the requirement that SpaceX receive a favorable or “qualified favorable” finding from the ITU with respect to its compliance with applicable EPFD limits *prior to* commencing operations, it retained the requirement that SpaceX receive such a finding from the ITU at some point and adjust its operations as necessary to satisfy ITU requirements, essentially allowing SpaceX to proceed only at its own risk, and thus there was no need for SpaceX to seek a waiver of the no-longer-applicable condition that it receive an ITU finding before commencing operations.<sup>32</sup> We find that because SpaceX must still comply with the ITU requirements, a further waiver is unnecessary and thus we deny the GSO Satellite Operators’ request.

11. SES/O3b acknowledges that SpaceX has provided them with the input data used to calculate its EPFD emissions in the ITU-approved validation software,<sup>33</sup> but that, due to both the complexity of the information and the inability of SES/O3b to review and analyze the information because the qualified personnel are not available, it requests additional time to evaluate the EPFD input data SpaceX submitted and reserves the right to comment further.<sup>34</sup> We find that SpaceX reasonably accommodated SES/O3b’s request for the EPFD input data and the fact that SES/O3b’s staff is not available to analyze the data, while unfortunate, does not justify a delay in the processing of this application, because, among other reasons, there is no legal requirement that third parties evaluate the sufficiency of EPFD data inputs prior to deployment of an NGSO system, and, more importantly, this delay would unfairly prejudice SpaceX’s timely implementation of its new system. Furthermore, SpaceX correctly states that this data would not normally be submitted to the ITU until after the grant of the modification, and therefore SES/O3b’s request for delay is unreasonable and unnecessary. Thus, SES/O3b’s request for additional time to review this data prior to action on this modification application is denied.

12. *SES/O3b’s Comments on Increased Interference.* SES/O3b expresses concern over the lack of information concerning the impact of the SpaceX modification on the overall radio frequency interference environment, and requests that the Commission impose conditions to prevent SpaceX from worsening the interference environment and to protect the participants of the Ku/Ka-band NGSO processing round.<sup>35</sup> Citing SpaceX’s own analysis showing a slight increase in interference to other NGSO operators, and the lack of any analysis regarding susceptibility of SpaceX’s own satellites to interference, SES/O3b argues that the Commission cannot perform the required analysis to determine if SpaceX’s modification necessitates a new processing round. Therefore, SES/O3b argues that the Commission require SpaceX to: (1) alter its proposed operations to eliminate any increase in interference to other NGSO systems resulting from the changes sought in the present modification and (2) accept any additional interference from other NGSO networks due to SpaceX’s multiple revisions of the constellation design the Commission approved in the *SpaceX Authorization*.<sup>36</sup>

13. SpaceX opposes the imposition of the conditions suggested by SES/O3b, stating that it agrees with SES/O3b that the appropriate approach for resolving the full range of spectrum sharing issues is through coordination between the parties, and is currently engaged in that process, and that the Commission should not unbalance the scales as SES/O3b requests by imposing conditions only on SpaceX due merely to SpaceX’s redistribution of satellites within orbital planes at its existing authorized altitude.<sup>37</sup> SpaceX argues that its proposed modification will not result in any significant radiofrequency

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<sup>32</sup> SpaceX Consolidated Opposition at 4 and n.8.

<sup>33</sup> See SES and O3b Reply, at 5-6.

<sup>34</sup> *Id.* (stating that the required personnel are in Egypt attending the World Radiocommunications Conference (WRC) 2019). WRC-2019 concluded on November 22, 2019.

<sup>35</sup> See *SES/O3B Petition* at 7-10.

<sup>36</sup> See *id.* at 7-9 (citing *SpaceX First Modification Order* at paras. 9, 12-15).

<sup>37</sup> See SpaceX Consolidated Opposition at 8.

interference, explaining that the analyses conducted in support of its application show that while there may be some instances of increased interference to O3b's system, most variances in interference caused by its modification would result in a decrease in interference, and on the whole the SpaceX modification in fact slightly lessens interference in the overall environment.<sup>38</sup> SES/O3b states that "Maintaining the interference environment ... is not a matter of averaging out the pluses and minuses, as the prospect that the risk of interference may be lower at some future time or stage of deployment would not cancel out the adverse effects O3b would experience during times of increased interference,<sup>39</sup> and that an express condition is preferable to the suggestions proffered in the grant of SpaceX's first modification, as it will allow SpaceX to implement its proposed changes and conduct its operations while preserving the current interference environment."<sup>40</sup>

14. With regard to SES/O3b's claim that SpaceX has not provided analysis of any increased susceptibility of its own satellites to interference, SpaceX states that SES/O3b has provided no reason why SpaceX's satellites would be susceptible to increased interference, given that SpaceX is simply redistributing its satellites among orbital planes and is not modifying the number of satellites or their orbital altitude, inclination, or operational characteristics.<sup>41</sup>

15. The *SpaceX First Modification Order* addressed the matter of whether placing 1,584 satellites of the SpaceX constellation at a lower orbit altitude would alter the interference environment vis-à-vis other NGSO systems. With respect to any changes to this interference environment, what must be considered when addressing the second SpaceX modification application is whether increasing the number of planes in which these 1,584 satellites would be deployed alters the interference environment. Given that there is no change in orbit altitude and in the number of satellites, we conclude there is no material change to the interference environment. We recognize however, that there are pending petitions for reconsideration of the *SpaceX First Modification Order*, and concerns similar to those expressed by SES/O3b are therein raised.<sup>42</sup> As stated above, petitions for reconsideration of that Order will be addressed separately.

16. *Waiver Request.* As part of our grant, we also address SpaceX's waiver request.<sup>43</sup> Generally, the Commission may waive any rule for good cause shown.<sup>44</sup> Waiver is appropriate where the particular facts make strict compliance inconsistent with the public interest.<sup>45</sup> In making this determination, we may take into account considerations of hardship, equity, or more effective implementation of overall policy on an individual basis.<sup>46</sup> Waiver is therefore appropriate if special circumstances warrant a deviation from the general rule and such deviation will serve the public interest.<sup>47</sup>

17. As required by the Commission's rules, SpaceX submitted a completed Schedule S for its

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<sup>38</sup> See *id.* at 7-8.

<sup>39</sup> See SES/O3b Reply at 3.

<sup>40</sup> See *id.* at 3-4 (citing SES/O3b Petition at 9).

<sup>41</sup> See SpaceX Consolidated Opposition at 8. SES/O3b replies that it does not need to provide a reason for why SpaceX's system would be more susceptible to interference, because it is not SES/O3b's burden to conduct that analysis for SpaceX. See SES/O3b Reply at 3.

<sup>42</sup> See, e.g., OneWeb Petition for Reconsideration.

<sup>43</sup> See SpaceX Second Modification Application, Legal Narrative at 1.

<sup>44</sup> 47 CFR § 1.3.

<sup>45</sup> *Northeast Cellular Tel. Co. v. FCC*, 897 F.2d 1164, 1166 (D.C. Cir. 1990).

<sup>46</sup> *WAIT Radio v. FCC*, 418 F.2d 1153, 1159 (D.C. Cir. 1969), *cert. denied*, 409 U.S. 1027 (1972); *Northeast Cellular*, 897 F.2d at 1166.

<sup>47</sup> *Northeast Cellular*, 897 F.2d at 1166.

application, 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. SpaceX cites five limitations in Schedule S that affected how the Schedule S was completed: (1) the impracticability of submitting complete orbital parameter data for the SpaceX system using the Schedule S web form; (2) the inability to enter “not applicable” for section 25.114(c)(4)(v), which requires both the minimum and maximum saturation flux density (SFD) values for each space station receive antenna that is connected to transponders; (3) the inability to enter a maximum transmit EIRP value for its downlink beams that is 0 dBW or less; (4) the inability to enter the begin and end angle for the active service arc with respect to the ascending node for each orbital plane if that angle consists of more than two digits; and (5) the inability to enter the maximum EIRP for transmit beams for values less than zero. Given that SpaceX has implemented a workaround for each of these limitations to allow entry of the required information,<sup>48</sup> we find that a waiver of the requirement to complete certain aspects or fields of Schedule S is warranted.

#### IV. ORDERING CLAUSES

18. Accordingly, IT IS ORDERED, that the Second Modification Application filed by Space Exploration Holdings, LLC (SpaceX) and accepted for filing, IS GRANTED, as set forth in this Order and Authorization, pursuant to section 309(a) of the Communications Act of 1934, as amended, 47 U.S.C. § 309(a).<sup>49</sup>

19. IT IS FURTHER ORDERED that this authorization is subject to the following requirements and conditions:

a. SpaceX must timely provide the Commission with the information required for Advance Publication, Coordination, and Notification of the frequency assignment(s) for this constellation, including due diligence information, pursuant to Articles 9 and 11 of the ITU Radio Regulations. This authorization may be modified, without prior notice, consistent with the coordination of the frequency assignment(s) with other Administrations. *See* 47 CFR § 25.111(b). SpaceX is responsible for all cost-recovery fees associated with the ITU filings. 47 CFR § 25.111(d).

b. Operations in the 10.7-11.7 GHz (space-to-Earth) frequency band are authorized up to the applicable power flux-density limits in 47 CFR § 25.208(b), and up to the equivalent power flux-density requirements of Article 22 of the ITU Radio Regulations, as well as Resolution 76 (Rev. WRC-15) of the ITU Radio Regulations.

c. In the 10.7-11.7 GHz band, operations must be coordinated with the radio astronomy observatories listed in 47 CFR § 2.106, n.US131, to achieve a mutually acceptable agreement regarding the protection of the radio telescope facilities operating in the 10.6-10.7 GHz band. For the purposes of coordination with these listed facilities or the National Radio Quiet Zone, correspondence should be directed to the National Science Foundation Spectrum Management Unit (Email: [esm@nsf.gov](mailto:esm@nsf.gov)).

d. Operations in the 11.7-12.2 GHz (space-to-Earth) frequency band are authorized up to the power flux-density limits in Article 21 of the ITU Radio Regulations, and up to the equivalent power flux-density requirements of Article 22 of the ITU Radio Regulations, as well as Resolution 76 (Rev. WRC-15) of the ITU Radio Regulations.

e. Operations in the 12.2-12.7 GHz (space-to-Earth) frequency band are authorized up to the power flux-density limits in 47 CFR § 25.208(o) and Article 21 of the ITU Radio Regulations, and up to

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<sup>48</sup> *See* SpaceX Second Modification Application, Waiver Requests.

<sup>49</sup> As with SpaceX’s earlier modification, we note that most of the conditions outlined below are included in the *SpaceX Authorization*. The International Bureau finds it appropriate to include these conditions in SpaceX’s modification order as they continue to apply to SpaceX’s entire constellation. Certain conditions were modified as needed to reflect changes based on our approval of modified system parameters.

the equivalent power flux-density requirements of Article 22 of the ITU Radio Regulations, as well as Resolution 76 (Rev. WRC-15) of the ITU Radio Regulations.

f. Operations in the 12.75-13.25 GHz (Earth-to-space) frequency band must be in accordance with footnote 5.441 to the U.S. Table of Frequency Allocations, 47 CFR § 2.106, n. 5.441, which states that operations in this band are subject to application of the provisions of No. 9.12 for coordination with other non-geostationary-satellite systems in the fixed-satellite service. Non-geostationary-satellite systems in the fixed-satellite service shall not claim protection from geostationary-satellite networks in the fixed-satellite service operating in accordance with the Radio Regulations. Non-geostationary-satellite systems in the fixed-satellite service in the 12.75-13.25 GHz (Earth-to-space) frequency band shall be operated in such a way that any unacceptable interference that may occur during their operation shall be rapidly eliminated.

g. Operations of non-geostationary-satellite systems in the 12.75-13.25 GHz (Earth-to-space) frequency band are restricted to individually licensed earth stations in accordance with footnote NG57 to the U.S. Table of Frequency Allocations, 47 CFR § 2.106, NG57. In the 13.85-14.5 GHz (Earth-to-space) frequency band reception is permitted for levels up to the equivalent power flux-density requirements of Article 22 of the ITU Radio Regulations.

h. In the 14.47-14.5 GHz band, operations are subject to footnote US342 to the U.S. Table of Frequency Allocations, 47 CFR § 2.106, US342, and all practicable steps must be taken to protect the radio astronomy service from harmful interference.

i. Space-to-Earth operations in the 17.8-18.6 GHz, 18.8-19.3 GHz, and 19.7-20.2 GHz frequency bands must complete coordination with U.S. Federal systems, in accordance with footnote US334 to the United States Table of Frequency Allocations, 47 CFR § 2.106, prior to being used. The use of space-to-Earth operations in the 17.8-18.6 GHz, 18.8-19.3 GHz, and 19.7-20.2 GHz bands must be in accordance with any signed coordination agreement between SpaceX and U.S. Federal operators. Two weeks prior to the start of any operations in the 17.8-18.6 GHz, 18.8-19.3 GHz, and 19.7-20.2 GHz bands, SpaceX must provide contact information for a 24/7 point of contact for the resolution of any harmful interference to Jimmy Nguyen, Email: [Jimmy.Nguyen@us.af.mil](mailto:Jimmy.Nguyen@us.af.mil).

j. Operations in the 18.8-19.3 GHz (space-to-Earth) frequency band are authorized up to the power flux-density limits in Article 21 of the ITU Radio Regulations.

k. In the 27.5-28.6 GHz and 29.5-30 GHz (Earth-to-space) frequency bands reception is permitted at levels up to the applicable equivalent power flux-density requirements of Article 22 of the ITU Radio Regulations.

l. Operations in the 27.5-28.35 GHz (Earth-to-space) frequency band are secondary with respect to Upper Microwave Flexible Use Service (UMFUS) operations, except for FSS operations associated with earth stations authorized pursuant to 47 CFR § 25.136 and will comply with any determinations set forth in the Spectrum Frontiers proceeding.

m. Operations in the 28.35-28.6 GHz and 29.5-30 GHz (Earth-to-space) frequency bands are on a secondary basis with respect to GSO FSS operations.

n. Under 47 CFR § 25.146(a), SpaceX must receive a favorable or “qualified favorable” finding in accordance with Resolution 85 (WRC-03) with respect to its compliance with applicable equivalent power flux-density limits in Article 22 of the ITU Radio Regulations and, in case of an unfavorable finding, adjust its operation to satisfy the ITU requirements.

o. SpaceX must cooperate with other NGSO FSS operators in order to ensure that all authorized operations jointly comport with the applicable limits for aggregate equivalent power flux-density in the space-to-Earth direction contained in Article 22 of the ITU Radio Regulations, as well as Resolution 76 (WRC-03) of the ITU Radio Regulations.



p. SpaceX must make available to any requesting party the data used as input to the ITU-approved validation software to demonstrate compliance with applicable Equivalent Power Flux Density (EPFD) limits.

q. Upon finalization of its space station design and prior to initiation of service, SpaceX must seek and obtain the Commission's approval of a modification containing an updated description of the orbital debris mitigation plans for its system for any satellites other than those that will be operated at an altitude of 550 km as proposed in this modification.

r. This authorization is subject to modification to bring it into conformance with any rules or policies adopted by the Commission in the future.

20. IT IS FURTHER ORDERED that SpaceX is subject to the rules regarding the sharing of ephemeris data in section 25.146(e) of the Commission's rules, 47 CFR § 25.146(e).

21. IT IS FURTHER ORDERED that this authorization is also subject to the following requirements:

a. SpaceX must post a surety bond in satisfaction of 47 CFR §§ 25.165(a)(1) & (b) no later than **April 30, 2018**,<sup>50</sup> and thereafter maintain on file a surety bond requiring payment in the event of a default in an amount, at minimum, determined according to the formula set forth in 47 CFR § 25.165(a)(1); and

b. SpaceX must launch 50 percent of the maximum number of proposed space stations, place them in the assigned orbits, and operate them in accordance with the station authorization no later than **March 29, 2024**, and SpaceX must launch the remaining space stations necessary to complete its authorized service constellation, place them in their assigned orbits, and operate each of them in accordance with the authorization no later than **March 29, 2027**. 47 CFR § 25.164(b).<sup>51</sup>

22. Failure to post and maintain a surety bond will render this grant null and void automatically, without further Commission action. Failure to meet the milestone requirements of 47 CFR § 25.164(b) may result in SpaceX's authorization being reduced to the number of satellites in use on the milestone date. Failure to comply with the milestone requirement of 47 CFR § 25.164(b) will also result in forfeiture of SpaceX's surety bond. By **April 15, 2024**, SpaceX must either demonstrate compliance with its milestone requirement or notify the Commission in writing that the requirement was not met. 47 CFR § 25.164(f).

23. IT IS FURTHER ORDERED that operations must comply with spectrum sharing procedures among NGSO FSS space stations specified in 47 CFR § 25.261 with respect to any NGSO system licensed or granted U.S. market access pursuant to the processing rounds initiated in Public Notice, DA 16-804 and Public Notice, DA 17-524. Spectrum sharing between SpaceX's operations and operations of NGSO systems granted U.S. market access, where such operations do not include communications to or from the U.S. territory, are governed only by the ITU Radio Regulations and are not subject to section 25.261.

24. IT IS FURTHER ORDERED that the request for waiver of the requirement to complete certain aspects or fields of Schedule S IS GRANTED for the reasons set forth herein.

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<sup>50</sup> We note that SpaceX filed the required bond on April 23, 2018 and filed a rider to that bond on March 25, 2019 that increases the maximum penal sum of the original surety bond in compliance with the Commission's rules and the terms of SpaceX's authorization.

<sup>51</sup> We note that the *NGSO FSS Order* modified section 25.164(b) to offer additional flexibility and requires launch and operation of 50 percent of an authorized system within six years of grant and the remaining satellites within nine years of grant.

25. IT IS FURTHER ORDERED that Kepler's Petition to Defer or Deny SpaceX's Second Modification Application IS DENIED.

26. IT IS FURTHER ORDERED that the Petition to Defer of SES Americom and O3b Limited IS DENIED.

27. IT IS FURTHER ORDERED that grant of this Second Modification Application is without prejudice to any action we take on the pending petitions for reconsideration of the *SpaceX First Modification Order*. 34 FCC Rcd 2526 (IB 2019).

FEDERAL COMMUNICATIONS COMMISSION

Thomas Sullivan  
Chief, International Bureau