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

In the Matter of	)	
	)	
Space Exploration Holdings, LLC	)	ICFS File Nos.:
	)	SAT-LOA-20200526-00055
Request for Orbital Deployment and Operating	)	SAT-AMD-20210818-00105
Authority for the SpaceX Gen2 NGSO Satellite	)	SAT-AMD-20221216-00175
System	)	
	)	Call Sign: S3069

ORDER AND AUTHORIZATION

Adopted: March 8, 2024 **Released: March 8, 2024**

By the Deputy Chief, Space Bureau, Chief, Wireless Telecommunications Bureau, and Chief, Office of Engineering and Technology:

I. INTRODUCTION

1. In this Order and Authorization (Order), we grant in part, with conditions, and defer in part the amended application of Space Exploration Holdings, LLC (SpaceX) to construct, deploy, and operate a constellation of non-geostationary orbit (NGSO) satellites, to be known as its "second-generation" Starlink constellation (Gen2 Starlink), to provide fixed-satellite service (FSS).[1] Specifically, our grant here is limited to authorizing SpaceX to conduct communications in the 71.0-76.0 GHz (space-to-Earth) and 81.0-86.0 GHz (Earth-to-space) frequency bands (collectively, E-band), with the 7,500 Gen2 Starlink satellites that the Commission previously authorized in the first partial grant of this application.[2] This Order does not authorize SpaceX to construct, deploy, or operate any additional satellites beyond those authorized to date. Grant of this portion of SpaceX's request will serve the public interest by allowing SpaceX to utilize the full capacity of its more advanced Gen2 Starlink satellites, which will improve the broadband service that SpaceX is bringing to U.S. customers, including those in unserved and underserved areas of the country. We continue to defer consideration of the remainder of SpaceX's request, including SpaceX's ongoing use of emergency beacons, which is the subject of a

[1] *See* Space Exploration Holdings, LLC, Application for Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite System, ICFS File No. SAT-LOA-20200526-00055 (filed May 26, 2020) (SpaceX Gen2 Application); Space Exploration Holdings, LLC, Amendment to Pending Application for the SpaceX Gen2 NGSO Satellite System, ICFS File No. SAT-AMD-20210818-00105 (dated Aug. 18, 2021) (SpaceX Gen2 First Amendment); Space Exploration Holdings, LLC, Amendment to Pending Application for the SpaceX Gen2 NGSO Satellite System, ICFS File No. SAT-AMD-20221216-00175 (filed Dec. 16, 2022) (SpaceX Gen2 Second Amendment).

[2] *See Space Exploration Holdings, LLC, Request for Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite System*, Order and Authorization, 37 FCC Rcd 14882 (2022) (*SpaceX Gen2 First Partial Grant*), *appeals pending sub nom International Dark-Sky Association v. FCC*, No. 22-1337 (D.C. Cir. filed Dec. 29, 2022), *Dish Network Corp. v. FCC*, No. 23-1001 (D.C. Cir. filed Jan. 3, 2023). Two parties have also filed petitions for reconsideration regarding the *SpaceX Gen2 First Partial Grant*. *See* Petition for Reconsideration of LeoLabs, Inc., ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (filed Dec. 30, 2022); Petition for Clarification of Viasat, Inc., ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (filed Jan. 3, 2023).

second amendment to SpaceX's application,[3] as well as the remaining 22,488 satellites SpaceX proposed in its application, as amended.

II. BACKGROUND

2. On May 26, 2020, SpaceX filed its application[4] as part of the processing round initiated by the Satellite Division[5] for the 10.7-12.7 GHz, 12.75-13.25 GHz, 13.85-14.5 GHz, 17.7-18.6 GHz, 18.8-20.2 GHz, and 27.5-30 GHz bands by NGSO FSS systems (the 2020 Ku/Ka-band Processing Round).[6] On August 18, 2021, SpaceX amended its application to modify the configuration of Gen2 Starlink.[7] The Satellite Division found the SpaceX application, as amended, acceptable for filing and placed it on public notice on December 23, 2021,[8] and the SpaceX application, as amended, has generated an expansive and complex record of petitions, comments, letters, and ex parte filings from interested parties, including other government agencies, other satellite operators, environmental groups, astronomers, students, and members of the general public.[9] In its application, as amended, SpaceX proposes to operate a total constellation of 29,988 Gen2 Starlink satellites operating between 340 km and 614 km.[10] SpaceX proposes operations in the 10.7-12.75 GHz, 17.8-18.6 GHz, 18.8-19.3 GHz, 19.7-20.2 GHz, and 71.0-76.0 GHz (space-to-Earth) and 12.75-13.25 GHz, 14.0-14.5 GHz, 27.5-29.1 GHz, 29.5-30.0 GHz, and 81.0-86.0 GHz (Earth-to-space) bands.[11] SpaceX also proposes telemetry, tracking, and command (TT&C) operations in the 12.15-12.25 GHz (space-to-Earth), 18.55-18.60 GHz (space-to-Earth), and 13.85-14.0 GHz (Earth-to-space) bands.[12] On December 16, 2022, SpaceX filed a second amendment to the pending portion of its Gen2 Starlink application, seeking authorization to operate tracking beacons on some of its satellites, which would communicate in the 137.00-138.00 MHz (Earth-to-space) and 148.00-150.05 MHz (space-to-Earth) bands.[13] During the public comment cycle and on the

[3] *See* SpaceX Gen2 Second Amendment.

[4] *See generally* SpaceX Gen2 Application.

[5] On January 4, 2023, the Commission adopted an Order that established the Space Bureau to handle the policy and licensing matters related to satellite communications and other in-space activities formerly handled by the International Bureau, which the Order eliminated. *See Establishment of the Space Bureau and the Office of International Affairs and Reorganization of the Consumer and Governmental Affairs Bureau and the Office of the Managing Director*, MD Docket No. 23-12, Order, 38 FCC Rcd 608, paras. 1-2 (2023). The Space Bureau officially launched on April 11, 2023. *See* Press Release, FCC, FCC Space Bureau & Office of International Affairs to Launch Next Week (April 7, 2023), https://docs.fcc.gov/public/attachments/DOC-392418A1.pdf. All references in this document to the International Bureau and the Satellite Division refer to filings made with, or actions taken by, the International Bureau prior to the establishment of the Space Bureau.

[6] *See Cut-Off Established for Additional NGSO FSS Applications or Petitions for Operations in the 10.7-12.7 GHz, 12.75-13.25 GHz, 13.8-14.5 GHz, 17.7-18.6 GHz, 18.8-20.2 GHz, And 27.5-30 GHz Bands*, *Satellite Policy Branch Information*, Report No. SPB-279, DA 20-325 (rel. March 24, 2020) (2020 Ku/Ka-band Processing Round Public Notice).

[7] *See generally* SpaceX Gen2 First Amendment.

[8] *Satellite Policy Branch Information, Space Station Applications Accepted for Filing*, Report No. SAT-01598 (Dec. 23, 2021).

[9] *See SpaceX Gen2 First Partial Grant*, 37 FCC Rcd at 14887-88, 14889-93, paras. 6, 9, n.35, n.51, n.52, n.54, n.55, n.56, n.57, n.58, n.59, n.60, n.61 (fully describing the record to date before the Commission adopted the *SpaceX Gen2 First Partial Grant*).

[10] *See* SpaceX Gen2 First Amendment, Narrative at 5.

[11] *Id.*, Frequencies Requested.

[12] *See* SpaceX Gen2 Application, Technical Attachment at 4.

[13] *See* SpaceX Gen2 Second Amendment; Letter from David Goldman, Director, Space Exploration Technologies Corp., to Marlene H. Dortch, Secretary, FCC, ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-

(continued….)

record developed subsequently, only one party, Viasat, Inc. (Viasat), raised concerns about SpaceX's use of the E-band.[14]

3. On November 29, 2022, the Commission granted in part and deferred in part SpaceX's application, as amended, authorizing SpaceX to construct, deploy, and operate up to 7,500 Gen2 Starlink satellites, communicating in the Ku- and Ka-bands, subject to a number of conditions.[15] The *SpaceX Gen2 First Partial Grant* also granted certain SpaceX waiver requests, including waivers of the in-band TT&C requirement; the downlink power flux density (PFD) limits and associated certification requirement; the requirement to obtain an International Telecommunication Union (ITU) finding of compliance with equivalent power flux density (EPFD) limits prior to initiation of service; and the requirement to complete certain aspects or fields of Schedule S to account for various limitations in the Commission's software.[16] The *SpaceX Gen2 First Partial Grant* also authorized SpaceX to conduct communications during orbit-raising and deorbit of its satellites for launch and early-orbit phase (LEOP) operations and communications testing.[17] The *SpaceX Gen2 First Partial Grant* deferred consideration of SpaceX's use of the E-band frequencies and use of tracking beacons as well as the remaining 22,488 satellites in SpaceX's request.[18] Two parties have appealed the *SpaceX Gen2 First Partial Grant* to the D.C. Circuit Court of Appeals and two additional parties have submitted petitions for reconsideration to the Commission, all of which remain pending.[19] The Space Bureau has also granted a series of authorizations for special temporary authority for SpaceX to begin operations using E-band frequencies on a limited number of its authorized Gen2 Starlink satellites.[20]

4. On October 13, 2023, the Space Bureau granted, with conditions, SpaceX's request to modify its authorization for a separate constellation of satellites operating with V-band frequencies to instead add V-band capabilities to SpaceX's Gen2 Starlink satellites (*SpaceX V-band Modification Order*).[21] This modification was consistent with commitments made on the record in the Gen2 Starlink

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20210818-00105 at 6, n.17 (dated Aug. 19, 2022) (SpaceX August 19, 2022 Letter); Letter from David Goldman, Senior Director, Satellite Policy, Space Exploration Technologies Corp., to Marlene H. Dortch, Secretary, FCC, ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 at 2, Exhibit A (dated Oct. 4, 2022) (SpaceX October 4, 2022 Letter).

[14] *See* Petition of Viasat, Inc., ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105, at 5, N.6 (filed Feb. 8, 2022) (Viasat Petition).

[15] *See generally SpaceX Gen2 First Partial Grant*, 37 FCC Rcd 14882.

[16] *Id.* at 14899-901, paras. 22-25.

[17] *Id.* at 14927-28, paras. 90-91.

[18] *Id.* at 14883, para. 1; *see also* SpaceX Gen2 Second Amendment.

[19] *International Dark-Sky Association v. FCC*, No. 22-1337 (D.C. Cir. filed Dec. 29, 2022), *Dish Network Corp. v. FCC*, No. 23-1001 (D.C. Cir. filed Jan. 3, 2023); *see* also Petition for Reconsideration of LeoLabs, Inc., ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (filed Dec. 30, 2023); Petition for Clarification of Viasat, Inc., ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (filed Jan. 3, 2023).

[20] *See e.g.*, *Space Exploration Holdings, Request for Special Temporary Authority, Grant Stamp*, ICFS File No. SAT-STA-20221228-00180 (authorizing SpaceX to conduct communications with E-band frequencies for a period of 60 days, including a condition limiting the number of satellites communicating in the E-band that SpaceX may bring into use in the first year after grant of this special temporary authorization to 1,500 satellites); *Space Exploration Holdings, Request for Special Temporary Authority, Grant Stamp*, SAT-STA-20230412-00085 (granted May 4, 2023); *Space Exploration Holdings, Request for Special Temporary Authority, Grant Stamp*, SAT-STA-20230523-00123 (granted Jul. 13, 2023); *Space Exploration Holdings, Request for Special Temporary Authority, Grant Stamp*, SAT-STA-20230906-00217 (granted Sept. 28, 2023)

[21] *See Space Exploration Holdings, LLC., Application for Modification of Authorization of the SpaceX V-band NGSO Satellite System, Grant stamp*, ICFS File No. SAT-MOD-20230322-00062 (granted-in-part/dismissed-in-part Oct. 13, 2023) (*SpaceX V-band Modification Order*).

proceeding.[22] The Space Bureau has also granted-in-part and deferred-in-part SpaceX's request to modify its Gen2 authorization to add supplemental coverage from space (SCS) capabilities to its Gen2 Starlink satellites (*SpaceX SCS Modification Partial Grant*).[23] SpaceX's request to modify its Gen2 authorization to add mobile-satellite system capabilities to its Gen2 satellites remains pending.[24]

III. DISCUSSION

5. After our review of the record, we conclude that an additional grant in part of the SpaceX Gen2 Starlink application, as amended, authorizing SpaceX to conduct communications in the E-band, subject to the requirements and conditions specified herein, will serve the public interest. Below, we address the various outstanding issues raised by commenters on SpaceX's application pertaining to its use of the E-band. Where appropriate we defer matters of general applicability to ongoing or potential future rulemakings.

6. SpaceX proposes to operate in the E-band for communications between satellites and gateway earth stations.[25] SpaceX recognizes that the Commission has not yet adopted service rules for satellite use of the E-band frequencies, though SpaceX states it will operate in these frequencies consistent with the U.S. Table of Frequency Allocations.[26] SpaceX therefore proposes to operate consistent with the Commission's applicable default service rules, in accordance with section 25.289 of the Commission's rules, until the Commission adopts service rules for this band, at which time SpaceX will be obligated to come into compliance with those rules.[27]

7. Specifically, SpaceX proposes transmissions from its satellites in the E-band with a minimum antenna gain of 42 dBi and a maximum gain of 52 dBi.[28] SpaceX also states its maximum equivalent isotropic radiated power (EIRP) density for its E-band beams will vary from 22.2 dBW/MHz to 25.8 dBW/MHz depending on the operating altitude.[29] SpaceX also states that two E-band beams are

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[22] *See SpaceX Gen2 First Partial Grant*, 37 FCC Rcd at 14883, 14896, paras. 2, 19 (noting that because of SpaceX's commitment to modify its V-band authorization to add V-band capabilities to the 7,500 Gen2 Starlink satellites authorized in the first partial grant, the number of satellites authorized was slightly less than the number of satellites SpaceX potentially would have deployed if it had deployed a separate V-band constellation).

[23] *See Space Exploration Holdings, LLC., Application for Modification of the Authorization for the SpaceX Gen2 NGSO Satellite System, Grant Stamp*, ICFS File No. SAT-MOD-20230207-00021, GN Docket No. 23-135 (granted-in-part/deferred-in-part Dec. 1, 2023) (*SpaceX SCS Modification Partial Grant*), petition for reconsideration pending. The Space Bureau authorized SpaceX to deploy a modified version of the previously authorized 7,500 Gen2 Starlink satellites with the capability to operate in certain frequencies in the 1429 MHz to 2690 MHz range and to operate these satellites on frequencies within the 1910-1915 MHz (Earth-to-space) and 1990-1995 MHz (space-to-Earth) frequency bands for limited on-orbit check out of the antennas immediately following deployment of each satellite for a period of 10 days or less, to ensure initial functionality of the satellite antenna. *Id.* The remainder of SpaceX's request to conduct commercial SCS operations in the 1910-1915 MHz (Earth-to-space) and 1990-1995 MHz (space-to-Earth) frequency bands within the United States and to conduct SCS operations outside the United States in the 1429 MHz to 2690 MHz frequency range remains pending.

[24] *See* Space Exploration Holdings, LLC., Application for Modification of the Authorization for the SpaceX Gen2 NGSO Satellite System, ICFS File No. SAT-MOD-20230207-00022 (filed Feb. 7, 2023). Specifically, SpaceX requests to modify the authorization for its Gen2 Starlink satellites to add Mobile-Satellite Service communications in the 1610-1617.775 MHz, 2000-2020 MHz, and 2020-2025 MHz (Earth-to-space) and 2180-2200 MHz and 2483.5-2500 MHz (space-to-Earth) frequency bands.

[25] *See* SpaceX Gen2 Application, Narrative at 10.

[26] *Id.*, Technical Attachment at 4.

[27] *Id.* at 4-5 (citing 47 CFR §§ 25.217(b), (e), 25.289).

[28] *Id.* at 13.

[29] *See* SpaceX Gen2 First Amendment, Technical Attachment at 9. We note that SpaceX originally proposed maximum EIRP densities from 21.9 dBW/MHz to 29.7 dBW/MHz, depending on the operating altitude of its

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transmitted at the same frequency per satellite, right hand and left hand circular polarization, and up to 32 satellites can transmit to a single gateway at once, for a maximum number of 64 co-frequency beams transmitting to the same earth station at any one time.[30] SpaceX states its gateway earth stations will generally operate with a minimum elevation angle of 25 degrees but will operate with a minimum elevation angle of 5 degrees in regions with latitudes greater than 62 degrees.[31] SpaceX also states it may conduct TT&C operations using E-band frequencies, and in accordance with section 25.202(g)(1), SpaceX will ensure that TT&C operations not conducted at a band edge will cause no greater interference and will require no greater interference protection than SpaceX's communications with gateway earth stations.[32] In addition, SpaceX notes the registered terrestrial Fixed Service (FS) stations operating in the E-band, and states that it has deployed its gateway earth stations so far in rural areas, which are unlikely to be located near these registered links, and since SpaceX licenses its gateways on an individual basis, it can coordinate with a terrestrial FS station operating in the E-band should a gateway be located close to that operator.[33]

8. We grant SpaceX authority to conduct communications in the E-band. As an initial matter, we note that the E-band frequencies are the subject of an ongoing Commission rulemaking proceeding to allow for new uses of the 71–76 GHz, 81–86 GHz, 92–94 GHz, and 94.1–95 GHz bands (collectively, the 70/80/90 GHz bands).[34] These bands are currently allocated on a co-primary basis for federal and nonfederal operations in the fixed-satellite service, fixed service, mobile service, and mobile-satellite service, among other allocations.[35] The recent *70/80/90 GHz Report and Order* adopted rules to authorize certain point-to-point links between fixed locations and endpoints in motion in the 71-76 GHz (70 GHz band) and 81-86 GHz (80 GHz band) bands to facilitate the use of these frequencies for access to broadband services on aircraft and ships.[36] The Commission also modified its rules to permit the use of smaller and lower cost antennas to facilitate the provision of 5G backhaul service in the 70 GHz and 80 GHz bands and mandated a channelization plan in those bands.[37] The *70/80/90 GHz Report and Order* did not alter the non-federal FSS allocation in these bands and established rules to protect future satellite use of these bands from certain links between fixed locations and endpoints in motion.[38] We condition this grant such that SpaceX must modify its operations if necessary to come into compliance with the

satellites. *See* SpaceX Gen2 Application, Technical Attachment at 14.

[30] *See* SpaceX Gen2 Application, Technical Attachment at 14-15.

[31] *Id.* at 13; Letter from William M. Wiltshire, Counsel, Space Exploration Holdings, LLC., to Karl A. Kensinger, Chief, Satellite Division, International Bureau, FCC, ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 at 4 (dated Jan. 7, 2022) (SpaceX January 7, 2022, Response to Satellite Division Information Request).

[32] *See* SpaceX Gen2 Application, Technical Attachment at 16.

[33] *Id.* at 33-34.

[34] *See Modernizing and Expanding Access to the 70/80/90 GHz Bands*, WT Docket No. 23-133, Report and Order and Further Notice of Proposed Rulemaking, FCC 24-16 (rel. Jan. 26, 2024) (*70/80/90 GHz Report and Order*, or when referring solely to the further notice, *70/80/90 GHz Further Notice*).

[35] *See* 47 CFR § 2.106.

[36] *70/80/90 GHz Report and Order* at paras. 2, 12-23.

[37] *Id.* at paras. 2, 56-67.

[38] *Id.* at paras. 35-42 The Commission did, in the *70/80/90 GHz Further Notice*, seek comment on two issues for which the record was not sufficient to make a final determination: (1) whether to permit ship-to-aerostat transmissions as part of the maritime service otherwise authorized in the *70/80/90 GHz Report and Order*; and (2) whether to include FSS earth stations in the existing third-party database registration regime modified in the *70/80/90 GHz Report and Order*, and if so, under what protection criteria, EIRP and out-of-band emission limits they should be included. *70/80/90 GHz Further Notice* at paras. 85-91.

recent *70/80/90 GHz Report and Order*, and any future rules developed in the ongoing 70/80/90 GHz rulemaking proceeding.

9. As part of its Petition to Deny or Hold in Abeyance the SpaceX Gen2 application, as amended, Viasat argues that the Gen2 Starlink constellation would generally preclude other operators' access to spectrum because of the sheer size of the proposed constellation.[39] In the *SpaceX Gen2 First Partial Grant*, we addressed Viasat's general concerns regarding the Gen2 Starlink constellation's impact on the public interest.[40] Viasat also specifically argued that the preclusive effects of SpaceX's proposal to use the E-band are unknown, and so the Commission should open an E-band processing round before considering this part of SpaceX's application.[41]

10. Sections 25.156 and 25.157 of the Commission's rules set forth procedures for consideration of applications for NGSO satellite authorizations.[42] In most cases,[43] applications not filed in response to a public notice initiating a processing round will be considered lead applications, and the Commission will initiate a new processing round and establish a cut-off date for the filing of competing applications.[44] SpaceX filed its Gen2 application in response to the processing round initiated in March 2020 for the 10.7-12.7 GHz, 12.75-13.25 GHz, 13.85-14.5 GHz, 17.7-18.6 GHz, 18.8-20.2 GHz, and 27.5-30 GHz bands by NGSO FSS systems (the 2020 Ku/Ka-band Processing Round),[45] but the E-band frequencies SpaceX requests are not included in that processing round, and this portion of SpaceX's application would therefore normally initiate a new processing round for applications for satellites operating in the E-band. The Satellite Division did not initiate an E-band processing round when it placed the SpaceX Gen2 application, as amended, on public notice, and deferred consideration of SpaceX's request to operate using E-band frequencies in the *SpaceX Gen2 First Partial Grant*.[46]

11. In considering SpaceX's request to operate in the E-band now, we note that the Commission has declined, in certain circumstances, to open a processing round for NGSO FSS operations.[47] For example, in 2018 and 2021, the Commission authorized Audacy Corporation (Audacy) and the Boeing Company (Boeing), respectively, to operate in the NGSO FSS using frequencies assigned as part of processing rounds, but also authorized the licensees to operate intersatellite links in the 65-71 GHz band, in both cases without initiating a new processing round for those particular frequencies.[48] In those instances, the Commission found that both Audacy's and Boeing's operations in the requested 65-71 GHz band would not create new spectrum conflicts with other operators and that, given the set of

[39] *See* Viasat Petition at I-II, 4-9.

[40] *See SpaceX Gen2 First Partial Grant*, 37 FCC Rcd at 14897-99, paras. 20-21.

[41] *See* Viasat Petition at 5, N.6.

[42] *See* 47 CFR §§ 25.156(d)(1), 25.157.

[43] *See, e.g.*, 47 CFR § 25.157(b), (i) (applications for replacement satellites and applications filed under the streamlined process for small satellites or small spacecraft under sections 25.122 and 25.123 of the Commission's rules are not subject to the Commission's processing round framework).

[44] *See* 47 CFR § 25.157(c)(2).

[45] *See 2020 Ku/Ka-band Processing Round Public Notice*; *see also SpaceX Gen2 First Partial Grant*, 37 FCC Rcd at 14886-87, para. 5.

[46] *See SpaceX Gen2 First Partial Grant*, 37 FCC Rcd at 14920, para. 69.

[47] *See*, *e.g.*, *Audacy Corporation, Application for Authority to Launch and Operate a Non-Geostationary Medium Earth Orbit Satellite System in the Fixed- and Inter-Satellite Service*, Order and Authorization, 33 FCC Rcd 5554, 5562, para. 21 (2018) (*Audacy Order*); *The Boeing Company, Application for Authority to Launch and Operate a Non-Geostationary Satellite Orbit System in the Fixed-Satellite Service*, Order and Authorization, 36 FCC Rcd 16067, 16075-76, paras. 21-23 (2021) (*Boeing Order*).

[48] *See Audacy Order*, 33 FCC Rcd at 5562, para. 21; *Boeing Order*, 36 FCC Rcd at 16075-76, paras. 21-23.

operations requested, it was more efficient to authorize the requested operations with conditions than to initiate a processing round for those frequencies.[49]

12. We decline to open an E-band processing round at this time for similar reasons, and we waive the processing round procedures in sections 25.156 and 25.157 related to the request for E-band frequencies on our own motion.[50] Generally, the Commission may waive any rule for good cause shown.[51] Waiver is appropriate where the particular facts make strict compliance inconsistent with the public interest.[52] In making this determination, we may take into account considerations of hardship, equity, or more effective implementation of overall policy on an individual basis.[53] Waiver is therefore appropriate if special circumstances warrant a deviation from the general rule and such deviation will serve the public interest.[54]

13. Like the operations proposed by Audacy and Boeing in their applications, we find SpaceX's proposed operations in the E-band present no new or increased frequency conflicts with other satellite operations. SpaceX proposes solely to conduct gateway operations in the E-band with gateway earth stations having a minimum elevation angle of 25 degrees (except with a minimum elevation angle of 5 degrees in regions with latitudes greater than 62 degrees north), rather than service links, and SpaceX is also already authorized to conduct gateway operations in Ka-band frequencies, so its operations are not solely dependent on use of the E-band. Moreover, only one other satellite operator, WorldVu Satellites Ltd. (OneWeb), has requested authority to operate in the E-band.[55] Consequently, we find that SpaceX's limited gateway operations in the E-band will not preclude other operators from entering the band in the future. We find that these limited, non-preclusive operations, conditioned below on compliance with sharing requirements of a potential future processing round constitute the special circumstances contemplated in the waiver standard. We also find that it is more efficient and in the public interest to authorize SpaceX's requested operations for an additional band for gateway operations, which will benefit consumers by expanding the capacity of its Gen2 Starlink system, than it would be to initiate a processing round for E-band frequencies at this time. Given these special circumstances and benefits to the public interest, we find that waiver of the Commission's processing round rules is in the public interest. However, we condition this grant to require SpaceX to coordinate with any and all existing and future FSS operators in these bands, including OneWeb should it be authorized to operate in the E-band. Consistent with these conditions, we emphasize that granting this portion of SpaceX's application outside of a processing round does not confer on SpaceX a higher status with respect to later authorized systems, unlike the first-come, first-served system specified in the Commission's rules for GSO-like satellite

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[49] *See Audacy Order*, 33 FCC Rcd at 5562, para. 21; *Boeing Order*, 36 FCC Rcd at 16075-76, paras. 21-22.

[50] A waiver is appropriate only if both (1) special circumstances warrant a deviation from the general rule, and (2) such deviation better serves the public interest. *NetworkIP, LLC v. FCC*, 548 F.3d 116, 125-128 (D.C. Cir. 2008) (citing *Northeast Cellular Telephone Co.*, 897 F.2d 1164, 1166 (1990)). Generally, the Commission may waive any rule if there is good cause to do so and, in making this determination, may take into account considerations such as hardship, equity, or more effective implementation of overall policy on an individual basis. 47 CFR § 1.3. *See Northeast Cellular*, 897 F.2d at 1166 ("[A] waiver is appropriate only if special circumstances warrant a deviation from the general rule and such deviation will serve the public interest. The agency must explain why deviation better serves the public interest and articulate the nature of the special circumstances to prevent discriminatory application and to put future parties on notice as to its operation."); *WAIT Radio v. FCC*, 418 F.2d 1153, 1159 (D.C. Cir. 1969) ("The agency's discretion to proceed in difficult areas through general rules is intimately linked to the existence of a safety valve procedure for consideration of an application for exemption based on special circumstances.").

[51] 47 CFR § 1.3.

[52] *Northeast Cellular Tel. Co. v. FCC*, 897 F.2d 1164, 1166 (D.C. Cir. 1990).

[53] *WAIT Radio v. FCC*, 418 F.2d 1153, 1159 (D.C. Cir. 1969); *Northeast Cellular*, 897 F.2d at 1166.

[54] *Northeast Cellular*, 897 F.2d at 1166.

[55] *See* ICFS File No. SAT-MPL-20211104-00144, Narrative at 8.

operations. Moreover, depending on the number of any such applications for operations in this frequency band, and their ability to effectively share spectrum, a processing round, which would include SpaceX, may be initiated in the future to resolve mutual exclusivity concerns. We therefore also condition this grant on SpaceX's compliance with any sharing requirements adopted as part of a future E-band processing round. Additionally, SpaceX may need to modify its operations in the event that additional FSS operators seek to operate in these frequency bands to the extent necessary to ensure the protection of adjacent band services. In other words, SpaceX's operations in the E-band are at its own risk—this authorization does not guarantee that SpaceX will always be permitted to operate as it currently proposes.

14. SpaceX must coordinate its operations in the 81.0-86.0 GHz band with the radio astronomy observatories contained in footnote US161 to the United States Table of Frequency Allocations.[56] The 81.0-86.0 GHz band is allocated on a co-primary basis to federal and nonfederal operations in the fixed and mobile services, fixed-satellite and mobile satellite services, space research, and radio astronomy.[57] In addition, SpaceX's operations in the 81.0-86.0 GHz band are also subject to footnote US342 of the United States Table of Frequency Allocations. Therefore, SpaceX must take all practicable steps to protect the radio astronomy service from harmful interference.[58]

15. Additionally, we observe that the adjacent 76-81 GHz band is allocated, inter alia, to the radiolocation service on a primary basis. Vehicular radar systems operate in the 76-81 GHz band under this allocation. We anticipate that existing emission limits would allow adjacent band co-existence between SpaceX operations and vehicular radars.[59]

16. SpaceX is also required to complete coordination with federal operators utilizing the 86-92 GHz band for passive services prior to SpaceX commencing operations. The 86-92 GHz band is allocated to the Earth exploration-satellite service (passive), radio astronomy service, and space research service (passive). The Commission has previously noted that the 86-92 GHz passive band may require additional technical constraints imposed on adjacent-band active services to ensure interference protection, including Federal operations in that band.[60] In accordance with footnote US246,[61] no station may transmit in the 86-92 GHz band. The Commission will consider coordination to have been completed when SpaceX and affected federal operators (including NASA, NOAA, DOD, and NSF) have concluded a coordination agreement or agreements.[62] We also note that, should other FSS operators seek to operate in the 81.0-86.0 GHz band, or if additional services are allowed in the band pursuant to the ongoing 70/80/90 GHz rulemaking proceeding, SpaceX may be required to adjust its operations to further reduce out-of-band emissions in order to ensure the appropriate interference protection criteria are met when considering aggregate effects from multiple systems and services.

17. When conducting communications in the E-band, SpaceX must also comply with the default service rules in section 25.217, which include coordination with NTIA to achieve compatible operations with authorized Federal Government users.[63] SpaceX must also coordinate with all radio astronomy stations as discussed above. Should the Commission develop service rules specific to these frequency bands, SpaceX must modify its operations to come into compliance with those rules. Prior to

[56] *See* 47 CFR § 2.106(c)(161).

[57] *See* 47 CFR § 2.106.

[58] *See* 47 CFR § 2.106(c)(342).

[59] *See* 47 CFR § 25.202(f)(3).

[60] *See Modernizing and Expanding Access to the 70/80/90 GHz Bands*, Notice of Proposed Rulemaking, 35 FCC Rcd 6039, 6056 (2020) (*70/80/90 GHz NPRM*).

[61] *See* 47 CFR § 2.106(c)(246).

[62] Until completion of the coordination agreement(s), SpaceX may operate using E-band frequencies only pursuant to any conditional authorizations for special temporary authority. *See*, *supra*, para. 3, n.19.

[63] *See* 47 CFR § 25.217(b)(2).

filing an application for an E-band gateway earth station, the default service rules require SpaceX to coordinate with all affected terrestrial fixed licensees. Under the Commission's rules, non-Federal terrestrial licensees in the 71.0-76.0 GHz and 81.0-86.0 GHz bands are issued nationwide, non-exclusive licenses and each terrestrial fixed link is authorized upon successful registration in a third-party database. Accordingly, SpaceX must consult the third-party database and complete coordination with the licensees of all affected non-Federal fixed terrestrial links registered or pending in the third-party database.[64] The Commission's rules for authorization of proposed non-Federal fixed terrestrial links in the 71.0-76.0 GHz and 81.0-86.0 GHz bands do not address co-band, non-Federal FSS earth stations and thus non-Federal terrestrial licensees are not required to analyze the potential for harmful interference to or from a proposed link to non-Federal gateway earth stations previously authorized or pending in the International Communications Filing System (ICFS) under the default service rules.[65] We note that the Commission recently proposed to require registrations for new FS links submitted on or after January 26, 2024 (the release date of the *70/80/90 GHz Further Notice*) to demonstrate protection of FSS earth stations with a final authorization prior to the submission date of the new FS registration.[66] Today's action is based on the Commission's current rules and in no way prejudges the outcome of the Commission's pending proposal.

18. As part of its application, as amended, SpaceX requests to communicate in the E-band for operations during transition phases before and after reaching its authorized operational altitudes.[67] This would include authority to perform TT&C functions during orbit-raising and de-orbit maneuvers, as well as authority for testing communications equipment performance during the orbit-raising process, which would be conducted on a non-protected, non-harmful interference basis.[68] We grant SpaceX authority to communicate in the E-band during transition phase operations, subject to the same conditions we imposed in the *SpaceX Gen2 First Partial Grant* for SpaceX's Ku- and Ka-band communications during transition phase operations. Specifically, during launch and early orbit phase operations, payload testing, and deorbit of its satellites, SpaceX must operate on a non-harmful interference basis, i.e., SpaceX must not cause harmful interference and must accept any interference received. In the event of any harmful interference under this grant, SpaceX must immediately cease operations upon notification of such interference and inform the Commission, in writing, of such an event.

19. Finally, we continue to condition our authorization of the Gen2 Starlink constellation to require SpaceX to operate consistent with the technical specifications provided to the Commission, including any supplemental specifications, in connection with this application, as amended, for its Gen2 Starlink constellation. These specifications include antenna beam patterns; GSO avoidance angle;

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[64] We note that SpaceX states that it followed this approach for 21 recent E-band gateway earth station applications. *See* ICFS File Nos. SES-LIC-20221229-01539-01543, 01545-01560.

[65] Satellite operations were not yet permitted in the E-band in 2003 when the Commission adopted the license/registration approach for non-Federal terrestrial links. *Allocations and Service Rules for the 71-76 GHz, 81-86 GHz and 92-95 GHz Bands*, WT Docket No. 02-146, Report and Order, 18 FCC Rcd 23318, 23344, para. 62 (2003). The Commission recognized, however, that there were co-primary satellite allocations in various portions of the E-band and decided to maintain multiple services in the allocation table and address possible sharing criteria in the future stating that "all terrestrial 71-76 GHz and 81-86 GHz band entities are hereby made aware that future operations of satellite and satellite earth stations could be permitted in the 71-76 GHz and 81-86 GHz bands. Once the Commission considers and adopts technical standards for terrestrial and satellite operations to share this spectrum, all licensees will be expected to satisfy these and any other Part 101 requirements." *Id*., 18 FCC Rcd at 23344, para. 63. *See also id*. para. 61 (Commission noted that "[it] must take further action under Part 25 of our Rules for earth stations to operate in the 71–76 GHz (downlink) and 81–86 GHz (uplink) bands").

[66] *See 70/80/90 GHz Further Notice* at para. 90.

[67] SpaceX Gen2 Application, Technical Attachment at 2.

[68] *See* 47 CFR §§ 25.282, 25.283.

physical characteristics; frequencies used for satellite communications, including outside the United States; and other technical information.

IV. ORDERING CLAUSES

20. Accordingly, IT IS ORDERED, that the Gen2 Starlink Application, as amended, filed by Space Exploration Holdings, LLC (SpaceX), IS GRANTED-IN-PART and DEFERRED-IN-PART to the extent set forth above, pursuant to sections 0.51 and 0.261 of the Commission's rules, 47 CFR §§ 0.51 and 0.261, and section 309(a) of the Communications Act of 1934, as amended, 47 U.S.C. § 309(a).

21. IT IS FURTHER ORDERED that this authorization of SpaceX's Gen2 Starlink application, as amended, is subject to all requirements and conditions specified in prior orders authorizing operations of its Gen2 system,[69] as well as the new conditions specified at paragraphs 22mm-tt.

22. 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. In connection with the provision of service in any particular country, SpaceX is obliged to comply with the applicable laws, regulations, rules, and licensing procedures of that country.

c. 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.

d. In the 10.7-11.7 GHz band, operations must be coordinated with the radio astronomy observatories listed in 47 CFR § 2.106(c)(131), 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).

e. 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.

f. 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 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.

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[69] *See*, *e.g.*, conditions contained in the *SpaceX Gen2 First Partial Grant*, the *SpaceX V-band Modification Order*, and the *SpaceX SCS Modification Partial Grant*. We note that SpaceX has previously satisfied some of these conditions. We also note that our decision to specify all of the conditions included in the *SpaceX Gen2 First Partial Grant* in this authorization is without prejudice to the pending petitions for reconsideration and clarification on that order. *See* Petition for Reconsideration of LeoLabs, Inc., ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (filed Dec. 30, 2023); Petition for Clarification of Viasat, Inc., ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (filed Jan. 3, 2023).

g. Operations in the 12.2-12.7 GHz (space-to-Earth) frequency band are subject to the condition that SpaceX may not use more than one satellite beam from any of its authorized Gen2 Starlink satellites in the same frequency in the same or overlapping areas at a time.

h. 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(b)(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.

i. Operations of non-geostationary-satellite systems in the 12.75-13.25 GHz (Earth-to-space) frequency band with earth stations in the United States are restricted to individually licensed earth stations in accordance with footnote NG57 to the U.S. Table of Frequency Allocations, 47 CFR § 2.106(d)(57). Licensing of earth stations (i.e. filed after Sept. 19, 2022) for operations in the 12.75-13.25 GHz band will be subject to the filing freeze on applications for new or modified authorizations for use of the 12.7-13.25 GHz band. *See* Public Notice, DA 22-974 (released Sept. 19, 2022); *Expanding Use of the 12.7-13.25 GHz Band for Mobile Broadband or Other Expanded Use*, Notice of Inquiry and Order, GN Docket No. 22-352, FCC 22-80 (rel. Oct. 28, 2022).

j. 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.

k. SpaceX's operations in the 13.85-14.0 GHz band must comply with footnotes 5.502 and US356 to the International and United States Table of Frequency Allocations, 47 CFR § 2.106(b)(5.502), (c)(356).

l. 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(c)(342), and all practicable steps must be taken to protect the radio astronomy service from harmful interference. Prior to commencing operations in the 14.47-14.5 GHz band, SpaceX must certify that it has updated its coordination agreement with the National Science Foundation to protect the radio astronomy service from harmful interference.

m. SpaceX's operations in the Ku-band are limited to minimum elevation angles of 25 degrees for all user terminals located below 62 degrees north latitude and minimum elevation angles of 5 degrees for user terminals located at or above 62 degrees north latitude.

n. 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(c)(334), 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.

o. 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.

p. Operations in the 19.7-20.2 GHz frequency band are subject to the condition that SpaceX may not use more than one satellite beam from any of its authorized Gen2 Starlink satellites in the same frequency in the same or overlapping areas at a time.

q. 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.

r. 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.

s. 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.

t. 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. SpaceX must communicate the ITU finding to the Commission, and in case of an unfavorable finding, SpaceX must adjust its operation to satisfy the ITU requirements. 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.

u. 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, including the data that combine the Gen2 Starlink satellites into one consolidated file.

v. SpaceX operations in the Ku- and Ka-band frequencies 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 2020 Ku/Ka-band processing round initiated in Public Notice DA 20-325. 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.

w. Prior to commencing operations in the Ku- and Ka-band frequency bands, SpaceX must certify that it has made a coordination agreement with, or make a showing to the Commission demonstrating and certifying that its operations will not cause harmful interference to, any operational system licensed or granted U.S. market access in the NGSO FSS processing rounds referred to in Public Notices DA 16-804, 31 FCC Rcd 7666 (IB 2016) and DA 17-524, 32 FCC Rcd 4180 (IB 2017). SpaceX may commence operations at its own risk, on a non-interference, unprotected basis with respect to any operations authorized in earlier processing rounds for which coordination has not been completed, prior to the approval of its showing by the Commission.

x. Operations in the 37.5-40.0 GHz band are unprotected with respect to the non-federal fixed and mobile services, except as authorized pursuant to 47 CFR § 25.136.

y. Operations in the 37.5-40.0 GHz band are authorized up to the power flux-density limits in 47 CFR § 25.208(r)(1). Prior to starting operation in this band, SpaceX must present the showing described in Section 25.114(c)(8) to confirm compliance with these power flux-density limits.

z. Operations in the 37.5-38.0 GHz and 40.0-40.5 GHz bands must be successfully coordinated with Federal Space Research Service (SRS) facilities, pursuant to Recommendation ITU-R SA.1396, "Protection Criteria for the Space Research Service in the 37-38 GHz and 40.0-40.5 GHz Bands."

aa. Operations in the 40-42 GHz band are authorized up to the power-flux density limits in 47 CFR § 25.208(s) and (t). We note that as part of the modification to its original V-band authorization,

SpaceX reduced its power flux density by 8 dB in the 40.0-42.0 GHz (space-to-earth) frequency band.[70] Therefore, SpaceX must operate its system consistent with this reduced PFD in the 40.0-42.0 GHz band.

bb. In accordance with 47 CFR § 2.106(c)(211), SpaceX is urged to take all practicable steps to protect radio astronomy observations in the adjacent bands from harmful interference from its operations in the 40.5-42 GHz band.

cc. Operations in the 47.2-48.2 GHz band must provide interference protection to the fixed and mobile services, except as authorized pursuant to 47 CFR § 25.136.

dd. Any future grant of earth station licenses for operations with the SpaceX system will be subject to the following condition, unless the condition is satisfied prior to such license grant: in the 48.94-49.04 GHz band, operations must be coordinated with radio astronomy stations operating on a co-primary basis in this band. Operations in the 47.2-50.2 GHz band are subject to rules adopted in the *Spectrum Frontiers Proceeding*, GN Docket 14-177.

ee. In accordance with 47 CFR § 2.106(c)(342), SpaceX is urged to take all practicable steps to protect radio astronomy observations from harmful interference from its operations in the 48.94-49.04 GHz band.

ff. Unwanted earth station emissions into the 50.2-50.4 GHz band, as measured at the antenna port, must comport with either of the applicable limits contained in ITU-R Resolution 750 (REV. WRC-19):

i. −42 dBW into the 200 MHz of the EESS (passive) band for earth stations not employing uplink power control, or

ii. −42 dBW into the 200 MHz of the EESS (passive) band at zenith increasing to a maximum level of −35 dBW into the 200 MHz of the EESS (passive) band at a minimum elevation angle of 15° for earth stations employing uplink power control.

gg. Operations in the 50.4-51.4 GHz band (Earth-to-space) must provide interference protection to the fixed and mobile services, except for earth stations authorized pursuant to 47 CFR § 25.136.

hh. Operations in the 50.4-51.4 GHz band (Earth-to-space) must not cause unacceptable interference to, or claim protection from, a geostationary satellite orbit (GSO) fixed satellite service or GSO broadcast satellite service network. These operations must comply with ITU Radio Regulations Nos. 22.5L and 22.5M.

ii. We note that as part of the modification to its original V-band authorization, SpaceX reduced its equivalent isotropic radiated power (EIRP) in the 47.2-50.2 GHz and 50.4-51.4 GHz (Earth-to-space) frequency bands.[71] Therefore, SpaceX must operate its system in accordance with this reduced EIRP in the 47.2-50.2 and 50.4-51.4 GHz bands.

jj. SpaceX may conduct operations in the 40.0-42.0 GHz (space-to-Earth) and 47.2-50.2 GHz and 50.4-51.4 GHz (Earth-to-space) frequency bands down to a minimum elevation angle of 25 degrees. SpaceX may conduct operations in the 37.5-40.0 GHz band (space-to-Earth) frequency band down to a minimum elevation angle of 35 degrees.

kk. SpaceX operations in V-band frequencies must comply with the 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 round initiated in Public Notice,

[70] *See* Space Exploration Holdings, LLC, Application for Modification of the Authorization for the SpaceX V-band NGSO Satellite System, ICFS File No. SAT-MOD-20230322-00062, Legal Narrative at 10 (filed Mar. 22, 2023).

[71] *Id.*

DA 16-1244. 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 U.S. territory, are governed only by the ITU Radio Regulations and are not subject to Section 25.261.

ll. SpaceX operations in V-band frequencies shall not cause interference to, and shall not claim protection from, GSO networks operating in the FSS and BSS in accordance with Section 25.289 of the Commission's rules, 47 CFR § 25.289. In the event that relevant EPFD limits or procedures related to sharing between GSO and NGSO networks are adopted by the Commission or the ITU, operations must be in conformance with such limits and procedures.

mm. SpaceX must coordinate its proposed frequency use for operations in the 71.0-76.0 GHz (space-to-Earth) and 81.0-86.0 GHz (Earth-to-space) frequency bands with any existing U.S. licensees or U.S. market access grantees in the Fixed-Satellite Service whose facilities could be affected by SpaceX's E-band operations, in terms of frequency interference or restricted capacity, and SpaceX must cooperate fully with other future co-frequency Fixed-Satellite Service satellites or satellite systems in coordinating operations in these bands.

nn. SpaceX must comply with any sharing requirements adopted as part of a future E-band processing round that includes the 71.0-76.0 GHz and 81.0-86.0 GHz bands.

oo. Operations in the 71.0-76.0 GHz (space-to-Earth) and 81.0-86.0 GHz (Earth-to-space) frequency bands must comply with the default service rules in section 25.217 of the Commission's rules, 47 CFR § 25.217. Should the Commission develop service rules specific to these frequency bands, SpaceX must come into compliance with those rules.

pp. Prior to filing an application for a gateway earth station for operations in the 71.0-76.0 GHz and 81.0-86.0 GHz bands, SpaceX must complete coordination with Federal users and non-federal terrestrial licensees (47 CFR § 101.1523) in accordance with the provisions in 47 CFR § 25.203(c) for links registered or pending in the third-party database.

qq. In the 81.0-86.0 GHz band, operations must be coordinated with the radio astronomy observatories listed in 47 CFR § 2.106(c)(161).

rr. In the 81.0-86.0 GHz band, operations are subject to footnote US342 to the U.S. Table of Frequency Allocations, 47 CFR § 2.106(c)(342), and all practicable steps must be taken to protect the radio astronomy service from harmful interference. Prior to commencing operations in the 81.0-86.0 GHz band, SpaceX must certify that it has updated its coordination agreement with the National Science Foundation to protect the radio astronomy service from harmful interference.

ss. Prior to commencing operations of downlink and uplink operations in the 71.0-76.0 GHz and 81.0-86.0 GHz frequency bands, respectively, SpaceX must demonstrate compliance with operational conditions as prescribed and coordinated with NTIA and the U.S. Federal Fixed Satellite Service (FSS) systems. Downlink and uplink operations in the 71.0-76.0 GHz and 81.0-86.0 GHz frequency bands, respectively, must be in accordance with any signed coordination agreement between SpaceX and U.S. Federal FSS operators. Two weeks prior to the start of any operations in the 71.0-76.0 GHz and 81.0-86.0 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.

tt. In the 86.0-92.0 GHz band, operations are subject to footnote US246 to the U.S. Table of Frequency Allocations, 47 CFR § 2.106(c)(246). Prior to commencing operations in the 81.0-86.0 GHz band, SpaceX must certify that it has a signed coordination agreement or agreements with U.S. federal operators utilizing the 86-92 GHz band for passive services.

uu. All operations by SpaceX for the limited on-orbit check out[72] in the 1910-1915 MHz (Earth-to-space) and 1990-1995 MHz (space-to-Earth) bands shall be on an unprotected and non-harmful interference basis, i.e., SpaceX shall not cause harmful interference to, and shall not claim protection from interference caused to it, by any lawfully operating station.

vv. In the event of any harmful interference during SpaceX's limited on-orbit check out for operations in the 1910-1915 MHz (Earth-to-space) and 1990-1995 MHz (space-to-Earth) frequency bands, SpaceX shall cease operations immediately upon notification of such interference, and shall inform the Commission, in writing, immediately of such an event.

ww. SpaceX shall coordinate with any potentially affected operators, including operators authorized to use the 1910-1915 MHz (Earth-to-space) and 1990-1995 MHz (space-to-Earth) frequency bands, before operating in those bands for its planned on-orbit check out. SpaceX must provide to the other operator(s) the dates of the testing and a stop-buzzer point of contact in the event that harmful interference occurs.

xx. Any action taken or expense incurred as a result of operations pursuant to the *SpaceX SCS Modification Partial Grant* is solely at SpaceX's own risk. That grant in part only addresses operations in the 1910-1915 MHz and 1990-1995 MHz bands for purposes of limited on-orbit checkout with authorized earth station(s) in the United States. SpaceX must obtain additional approval from the Commission before conducting any operations with its satellites in the 1429 MHz to 2690 MHz frequency range with any locations outside the United States. Neither the *SCS Modification Partial Grant* nor this grant authorize SpaceX to provide service, perform any launch and early orbit phase (LEOP) operations other than the limited satellite check out specified in the scope of grant, conduct testing, or send or receive any other transmissions in the 1429 MHz to 2690 MHz range.[73]

yy. During launch and early orbit phase operations, payload testing, and deorbit of its satellites, SpaceX must operate on a non-harmful interference basis, i.e., SpaceX must not cause harmful interference and must accept any interference received. In the event of any harmful interference under this grant, SpaceX must immediately cease operations upon notification of such interference and inform the Commission, in writing, of such an event.

zz. SpaceX must operate consistent with the technical specifications provided to the Commission, including any supplemental specifications, in connection with this application, as amended, for its Gen2 Starlink constellation, including antenna beam patterns; GSO avoidance angle; physical characteristics; frequencies used for satellite communications, including outside the United States; and other technical information. Should SpaceX wish to alter these technical specifications, it must apply for a license modification from the Commission.

aaa. SpaceX shall maintain full control of its satellites at all times and shall operate its satellites in accordance with any existing coordination agreements.

bbb. SpaceX must provide a semi-annual report, by January 1 and July 1 each year, covering the preceding six-month period, respectively, from June 1 to November 30 and December 1 to May 31. The report should include the following information:

i. The number of conjunction events identified for Starlink satellites during the reporting period, and the number of events that resulted in an action (maneuver or coordination

[72] The scope of the *SpaceX SCS Modification Partial Grant* included authorization for a limited on-orbit check out of the antennas immediately following deployment of each satellite for a period of 10 days or less, to ensure initial functionality of the satellite antenna. *See SpaceX SCS Modification Partial Grant*, Scope of Grant.

[73] Accordingly, the *SpaceX SCS Modification Partial Grant* does not address considerations associated with any operations in these frequency bands, including the need for any waivers of the Table of Frequency Allocations, section 2.106(a) of the Commission's rules. 47 CFR § 2.106(a).

with another operator), as well as any difficulties encountered in connection with the collision avoidance process and any measures taken to address those difficulties.

ii. Satellites that, for purposes of disposal, were removed from operation or screened from further deployment at any time following initial deployment, and identifying whether this occurred less than five years after the satellite began regular operations or were available for use as an on-orbit replacement satellite,

iii. Satellites that re-entered the atmosphere,

iv. Satellites for which there was a disposal failure, i.e., a satellite that loses the capability to maneuver effectively after being raised from its injection, including a discussion of any assessed cause of the failure and remedial actions. For each such satellite, SpaceX shall report an estimated orbital lifetime for the satellite following the failure, and for the Gen2 Starlink constellation the cumulative number of failed satellite object years,

v. Identification of any collision avoidance system outages or unavailability, either on a system-wide basis or for individual satellites. An "outage" would include any individual satellite anomaly that results in a satellite not achieving targeted risk mitigation via maneuver.

ccc. In the event of satellite failures resulting in more than 100 post-failure object years, SpaceX may not deploy any additional satellites until the Commission has approved a license modification that includes an updated orbital debris mitigation plan addressing reduction in the failure rate or mitigation of the risk of satellite failures.

ddd. SpaceX must maintain satellite orbits so as to operate all of its satellites at or below 580 km.

eee. SpaceX may not deploy any satellites designed for operational altitudes below the International Space Station.[74] SpaceX must communicate and collaborate with NASA to ensure that deployment and operation of its satellites does not unduly constrain deployment and operation of NASA assets and missions, supports safety of both SpaceX and NASA assets and missions and preserves long-term sustainable space-based communications services. SpaceX must report on the progress of its communications and collaboration efforts to the Commission in its regular reports specified in condition bbb.

fff. SpaceX may not deploy any satellites authorized for its Gen2 system directly to their operational altitude.[75]

ggg. Upon receipt of a conjunction warning from the 18th Space Control Squadron or other source, SpaceX must review and take all possible steps to assess the collision risk and mitigate collision risk if necessary. As appropriate, steps to assess and mitigate should include, but are not limited to: contacting the operator of any active spacecraft involved in such warning; sharing ephemeris data and other appropriate operational information with any such operator; modifying spacecraft attitude and/or operations.

hhh. SpaceX must continue to coordinate and collaborate with NASA to promote a mutually beneficial space environment that would minimize impacts to NASA's science missions involving astronomy.

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[74] *See SpaceX Gen2 First Partial Grant*, 37 FCC Rcd. at 14888-89, para. 7 (describing SpaceX's request for some satellites to be deployed in orbital shells centered at altitudes from 340 km to 360 km (below the ISS). *See also id.* at 14952-53, para. 135bb. Language change from the initial ordering clause is to avoid any confusion with respect to FAA's role in launch collision avoidance.

[75] *Id.* at 14927-28, para. 91.

iii. SpaceX must coordinate with NSF to achieve a mutually acceptable agreement to mitigate the impact of its satellites on optical ground-based astronomy. SpaceX must submit an annual report to the Commission, by January 1st each year covering the preceding year containing the following information: (1) whether it has reached a coordination agreement with NSF addressing optical astronomy; and (2) any steps SpaceX has taken to reduce the impact of its satellites on optical astronomy, including but not limited to darkening, deflecting light away from the Earth, attitude maneuvering, and provision of orbital information to astronomers for scheduling observations around satellites' locations.

jjj. SpaceX must follow its commitment to work with the scientific community to explore methods to collect observational data on formation of alumina from satellite reentry, to implement reasonable methods that are discovered to the extent practicable, and to report findings from these measurements taken to the Commission, as part of its annual report specified in condition lll.

kkk. This authorization is subject to modification to bring it into conformance with any rules or policies adopted by the Commission in the future. Accordingly, any investments made toward SpaceX's Gen2 operations, including but not limited to any operations in bands authorized in this Order, assume the risk that operations may be subject to additional conditions or requirements as a result of any future Commission actions. This includes, but is not limited to, any conditions or requirements resulting from any action in the proceedings associated with IB Docket 22-271 and IB Docket 18-313,[76] WT Docket 20-443,[77] WT Docket 20-133,[78] IB Docket 21-456,[79] GN Docket 22-352,[80] and GN Docket 23-65.[81]

lll. All operations of the Gen2 Starlink system must also comport with any additional terms and conditions contained in the *SpaceX Gen2 First Partial Grant*, the *SpaceX V-band Authorization Order*, and the *SpaceX SCS Modification Partial Grant*.[82]

23. 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).

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

a. Applicable to SpaceX Gen2 satellites:

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[76] *See generally Mitigation of Orbital Debris in the New Space Age*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 4156 (2020); *Space Innovation; Mitigation of Orbital Debris in the New Space Age*, Second Report and Order, 37 FCC Rcd 11818 (2022); *Mitigation of Orbital Debris in the New Space Age*, Order on Reconsideration, FCC 24-6 (Jan. 26, 2024).

[77] *See generally Expanding Flexible Use of the 12.2-12.7 GHz Band et. al.*, WT Docket No. 20-443, Notice of Proposed Rulemaking, 36 FCC Rcd 606 (2021).

[78] *See generally 70/80/90 GHz NPRM*, 35 FCC Rcd at 6039.

[79] *See generally Revising Spectrum Sharing Rules for Non-Geostationary Orbit, Fixed-Satellite Service Systems; Revision of Section 25.261 of the Commission's Rules to Increase Certainty in Spectrum Sharing Obligations Among NGSO FSS Systems*, IB Docket No. 21-456, Order and Notice of Proposed Rulemaking, 36 FCC Rcd 17871 (2021).

[80] *See generally Expanding Use of the 12.7-13.25 GHz Band for Mobile Broadband or Other Expanded Use*, GN Docket No. 22-352, Notice of Inquiry and Order, 37 FCC Rcd 13427 (2022).

[81] *See generally Single Network Future: Supplemental Coverage from Space*, Notice of Proposed Rulemaking, FCC 23-22, (Mar. 17, 2023).

[82] *See generally SpaceX Gen2 First Partial Grant*; *SpaceX V-band Modification Order*; *SpaceX SCS Modification Partial Grant*.

i. SpaceX must post a surety bond in satisfaction of 47 CFR §§ 25.165(a)(1) & (b) no later than **December 31, 2022**,[83] 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

ii. SpaceX must launch 50% 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 **December 1, 2028**, 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 **December 1, 2031**. 47 CFR § 25.164(b).[84]

b. Applicable to SpaceX operations in the V-band[85]:

i. SpaceX must post a surety bond in satisfaction of 47 CFR §§ 25.165(a)(1) & (b) no later than **December 19, 2018**,[86] 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

ii. SpaceX must launch 50 percent of the maximum number of proposed space stations with V-band capabilities, place them in the assigned orbits, and operate them in accordance with this grant no later than **November 19, 2024**, and must launch the remaining space stations necessary to complete its authorized V-band system, place them in their assigned orbits, and operate them in accordance with the authorization no later than **November 19, 2027**. 47 CFR § 25.164(b).

c. Failure to post and maintain a surety bond will render this grant null and void automatically, without further Commission action.

d. 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 at the milestone date. Failure to comply with the milestone requirements of 47 CFR § 25.164(b) will also result in forfeiture of SpaceX's surety bond. SpaceX must either demonstrate compliance with each of the milestone requirements or notify the Commission in writing, within 15 days after the specified deadline, if the particular requirement was not met. 47 CFR § 25.164(f).

25. IT IS FURTHER ORDERED that we waive sections 25.156 and 25.157 of the Commission's rules on our own motion, 47 CFR §§ 25.156, 25.157, to authorize SpaceX's operations in the 71.0-76.0 GHz and 81.0-86.0 GHz frequency bands outside of a processing round, subject to the conditions set forth above.

26. This authorization is granted without prejudice to enforcement action in connection with any operations outside the scope of SpaceX's license grant in ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 or grant of special temporary authority in ICFS File Nos. SAT-

[83] SpaceX has satisfied this part of the condition by posting the surety bond for its Gen2 satellites operating in the Ku-, Ka-, and E-band frequencies. *See* Bond of Space Exploration Holdings LLC, ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (filed Dec. 30, 2022).

[84] We note that the *NGSO FSS Order* modified section 25.164(b) to offer additional flexibility and requires launch and operation of 50% of an authorized system within six years of grant and the remaining satellites within nine years of grant.

[85] *See SpaceX V-band Modification Order*. The separate milestones applicable to SpaceX's V-band operations are consistent with SpaceX's original V-band authorization.

[86] SpaceX has satisfied this part of the condition by filing of its filed its surety bond in accordance with the condition on its original V-band authorization on December 3, 2018. *See* Bond of Space Exploration Holdings, LLC, ICFS File No. SAT-LOA-20170301-00027 (filed Dec. 3, 2018)

STA-20221228-00180, SAT-STA-20230412-00085, SAT-STA-20230523-00123, SAT-STA-20230906-00217, and SAT-STA-20231204-00300.

27. This grant is without prejudice to any future action taken in connection with ICFS File Nos. SAT-LOA-20200526-00055, SAT-AMD-20210818-00105, SAT-AMD-20221216-00175, SAT-MOD-20230207-00021, and SAT-MOD-20230207-00022.

28. This grant does not alter the license term for the SpaceX Starlink Gen2 satellite system.

FEDERAL COMMUNICATIONS COMMISSION

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