APPLICATION FOR GATEWAY EARTH STATION

I. OVERVIEW

The Commission has authorized Space Exploration Holdings, LLC ("SpaceX") to launch and operate its first-generation ("Gen1") constellation of 4,408 non-geostationary orbit ("NGSO") satellites (call sign S2983/S3018) using Ku- and Ka-band spectrum.[1] In May 2019, SpaceX began launching satellites to populate the Gen1 constellation. In May 2020, SpaceX filed an application to launch and operate a constellation of second-generation ("Gen2") NGSO satellites (call sign S3069) using Ku-, Ka-, and E-band spectrum.[2] The Commission granted the Gen2 application in part on December 1, 2022.[3] In so doing, the Commission found that granting the Gen2 application would "help to address the pressing need for improved broadband connectivity, including in unserved and underserved areas of the United States," and "further the US leadership in space-based services, facilitating coverage globally and helping the efforts to close the digital divide around the world."[4]

This application, filed by a sister company, SpaceX Services, Inc. ("SpaceX Services"), seeks authority to operate an E-band gateway earth station that SpaceX will use to deliver broadband data between the satellites of its Gen2 NGSO system and terrestrial Internet exchange points. Specifically, SpaceX Services seeks authority for 32 technically identical 1.85-meter antennas in Niland, CA (the "Niland Gateway"). Consistent with SpaceX's application for its Gen2 constellation, these earth stations will transmit in the 81-86 GHz band and receive in the 71-76 GHz band.

Below, we discuss certain spectrum coordination issues relevant to the operation of these earth stations. We then demonstrate that grant of this application would serve the public interest. Lastly, we provide technical information to supplement the information provided in Form 312. To support its ambitious timetable for launching satellites and deploying broadband services, SpaceX Services requests that the Commission grant the requested license as expeditiously as possible.

II. COORDINATION WITH CO-PRIMARY SERVICES

The Federal Communication Commission has allocated E-band on a co-primary basis to the Fixed Satellite Service (FSS). Under the Commission's default service rules, the Commission may authorize an NGSO FSS operator for earth stations using frequencies that have been allocated to FSS in the U.S. Table of Frequency Allocations, prior to the development of frequency-band-specific service rules.[5] Where the FSS shares a frequency band with terrestrial wireless services,

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1 *See Space Exploration Holdings, LLC*, 33 FCC Rcd. 3391 (2018) ("SpaceX Authorization"); *Space Exploration Holdings, LLC*, 34 FCC Rcd. 2526 (IB 2019) ("SpaceX Modification"). These authorizations anticipate that Ka-band spectrum would be used for gateway communications.

2 Initial filing (May 2020): SAT-LOA-20200526-00055; Subsequent amendment (August 2021): SAT-AMD-20210818-00105

3 *See Space Exploration Holdings, LLC*, FCC 22-91 (rel. Dec. 1, 2022).

4 *See id.* ¶ 21.

5 47 CFR § 25.217. In addition, the Commission has confirmed that it may grant earth station licenses on a case-by-case basis in bands that have not been specifically identified for earth station use, provided there is an allocation in the U.S. Table of Frequency Allocations and such use is in the public interest. See *SpaceX*

the default service rules specify that the FSS operator must comply with the Commission's general coordination rules under 47 CFR § 25.203(c).

Under the existing framework for fixed terrestrial E-band links, terrestrial operators with a blanket license register individual links on a first-come, first-served basis through a third-party link registration database. The third-party link registration database manager uses its database and a federal database to ensure that the new link will not cause interference to any previously-registered links, and to ensure that the new link is not located within any of the keep-out zones specified by the Commission in 47 CFR § 2.106 US 161 and US 389.

To ensure that the Niland Gateway will not cause harmful interference to existing operators, SpaceX strategically selected the gateway site location and conducted a comprehensive interference analysis, which demonstrated that there will be no harmful interference with existing non-federal operators. Furthermore, SpaceX will coordinate with federal users and passive services including radio astronomy and earth exploration satellite service to protect against harmful interference.

SpaceX conducted an interference analysis in accordance with the procedures set forth in 47 CFR § 25.251 and the interference protection criteria for 70/80 GHz terrestrial links in Part 101. To conduct the analysis, SpaceX began with a complete dataset of existing terrestrial links from the 70/80/90 GHz link registration database. This dataset is updated every other week, and includes coordinates, operating frequencies, antenna gain, altitude, and other information about existing links. SpaceX then generated a great circle coordination distance contour in accordance with the procedures set forth in 47 CFR § 25.251 and Appendix 7 of the ITU-R Radio Regulations. SpaceX used this analysis to identify the fixed-service licensees that must be notified under Section 25.203(c)(2).[6] For each known receiver within the coordination contour, SpaceX calculated the expected interference/noise ratio (I/N) to the receiver, assuming the worst-case EIRP density toward the horizon as the transmitter power, and negligible out-of-band interference. According to 47 CFR § 101.105(a)(5)(i), interference is not permitted to cause more than 1.0 dB of degradation to the static threshold of the protected receiver. SpaceX ensured that this interference threshold is not exceeded, such that none of the notified licensees will experience harmful interference. SpaceX's analysis also ensures that the gateway is not located within the keep out zones specified in 47 CFR § 2.106 US 161 and US 389.

Services, Inc. Application for Blanket Authorization of Next-Generation Ku-Band Earth Stations in Motion, Order and Authorization, DA 22-695, ¶ 10 (rel. June 30, 2022) (citing 47 CFR § 25.202(b)).

[6] Unlike many other bands, the ITU-R Rad. Reg. Appendix 7 does not produce a single contour for E-band coordination. Rather, in the E-Band, the Appendix 7 methodology identifies "minimum" and "maximum" coordination contours. SpaceX applied this methodology in the context of Section 25.203 of the FCC's rules by 1) notifying all relevant licensees within the "minimum" contour and 2) notifying all relevant licensees with receivers located between the minimum and maximum coordination contours where a worst-case FSPL analysis showed any theoretical possibility of exceeding 1.0 dB of degradation at the fixed receiver.

III. GRANT OF THIS APPLICATION WOULD SERVE THE PUBLIC INTEREST

Granting this application would serve the public interest by helping to speed deployment of next-generation broadband to more American consumers in more places. U.S. and worldwide demand for high-quality broadband services continues to increase with escalating consumer and businesses requirements for speed, capacity, and reliability to support real-time applications that have become so critical for participation in the modern economy. Indeed, the volume of traffic flowing over the world's networks has exploded, with one report estimating that annual global Internet protocol traffic reached 1.5 zettabytes in 2017 – meaning that approximately 1,500 billion gigabytes of data were exchanged worldwide that year.[7]

Yet, as the Commission has recognized, many communities across the United States and the world still lack access to reliable broadband connectivity, preventing them from fully participating in economic, social, and civic activities.[8] To help close this digital divide, SpaceX is designing, constructing, and deploying an innovative, cost-effective and spectrum-efficient satellite system capable of delivering robust broadband service to customers around the world. It has demonstrated its ability to do so with the launch and operation of its first-generation constellation, and is seeking to expand its positive impact through the authorization of the Niland gateway to support its second-generation constellation, which will connect even more American consumers and businesses to high-speed, low-latency broadband. Accordingly, an expeditious grant of this application would serve the public interest.

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[7] *See* Cisco Visual Networking Index: Forecast and Methodology, 2017-2022, at 1, CISCO (Nov. 26, 2018), https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paperc11-741490 html.

[8] *See, e.g., Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, 33 FCC Rcd. 1660, ¶ 50 (2018) (noting that "over 24 million Americans still lack fixed terrestrial broadband at speeds of 25 Mbps/3 Mbps," and that "the gap in rural and Tribal America remains notable: 30.7 percent of Americans in rural areas and 35.4 percent of Americans in Tribal lands lack access to fixed terrestrial 25 Mbps/3 Mbps broadband"). Internationally, the disparities between broadband access and absence are even greater, with 4.2 billion people (or 57% of the world's population) offline. *See* BROADBAND COMMISSION FOR SUSTAINABLE DEVELOPMENT, "Open Statement from the Broadband Commission for Sustainable Development to the UN High-Level Political Forum (HLPF)" (July 11, 2016), http://broadbandcommission.org/Documents/publications/HLPF-July2016.pdf. *See also* BROADBAND COMMISSION FOR SUSTAINABLE DEVELOPMENT, "The State of Broadband 2015," at 8 (Sep. 2015), http://www.broadbandcommission.org/Documents/reports/bb-annualreport2015.pdf ("A large body of evidence has now been amassed that affordable and effective broadband connectivity is a vital enabler of economic growth, social inclusion and environmental protection.").

Respectfully submitted,

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TECHNICAL APPENDIX

In this Technical Appendix, SpaceX Services provides additional information on the proposed operations of its gateway earth station to supplement the data provided in Schedule B to Form 312 filed with this narrative application.[9]

A. Minimum Elevation Angle

SpaceX Service's gateway earth station in Niland will communicate only with those SpaceX satellites that are visible on the horizon above a minimum elevation angle. This angle may be as low as 25 degrees, and thus SpaceX Services has used this minimum elevation angle in its analysis in order to capture the full potential range of service.

B. Antenna Patterns

SpaceX's earth station will comply with the following antenna-gain limits. As with Section 25.209(a)(3), "[t]his envelope may be exceeded by up to 3 dB in 10% of the range of θ angles from ±7-180°, and by up to 6 dB in the region of main reflector spillover energy." The mask can be stated as follows:

$29-25\log_{10}\theta$	dBi	for $2° \leq \theta \leq 7°$.
8	dBi	for $7° < \theta \leq 9.2°$.
$32-25\log_{10}\theta$	dBi	for $9.2° < \theta \leq 25°$.
-4	dBi	for $25° < \theta \leq 180°$.

Consistent with Section 25.209(a)(3), "[t]his envelope may be exceeded by up to 3 dB in 10% of the range of θ angles from ±7-180°, and by up to 6 dB in the region of main reflector spillover energy." [10] In addition, the half power beamwidth for the proposed antenna is 0.5 degrees at 30 GHz.

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[9] To the extent relevant, SpaceX Services hereby incorporates the technical information submitted with SpaceX's space station applications. *See* IBFS File Nos. SAT-LOA-20161115-00118, SAT-LOA-20170726-00110, SAT-MOD-20181108-00083, and SAT-MOD-20200417-00037.

[10] *Id.* § 25.209(a)(3).