

APPLICATION FOR GATEWAY EARTH STATION

I. OVERVIEW

The Commission has authorized Space Exploration Holdings, LLC (“SpaceX”) to launch and operate a constellation of 4,425 non-geostationary orbit (“NGSO”) satellites (call sign S2983/S3018) using Ku- and Ka-band spectrum.¹ In doing so, the Commission recognized that granting the SpaceX Authorization would “enable SpaceX to bring high-speed, reliable, and affordable broadband service to consumers in the United States and around the world, including areas underserved or currently unserved by existing networks.”² SpaceX intends to begin launching satellites to populate its constellation later this year.

This application, filed by a sister company, SpaceX Services, Inc. (“SpaceX Services”), is one of six applications for authority to operate gateway earth stations that SpaceX will use to deliver broadband data between the first-generation satellites of its NGSO system and terrestrial Internet exchange points. Consistent with SpaceX’s space station authorization, these earth stations will transmit in the 14.0-14.5 GHz band and receive in the 10.7-12.7 GHz band.

Below, we discuss certain spectrum sharing 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 on 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.

¹ See *Space Exploration Holdings, LLC*, 33 FCC Rcd. 148 (2018) (“SpaceX Authorization”). SpaceX recently filed a modification application in which it proposes to relocate 1,584 satellites previously authorized to operate at an altitude of 1,150 km to an altitude of 550 km, and to make related changes to the operations of the satellites in this new lower shell of the constellation. See Application, IBFS File No. SAT-MOD-20181108-00083 (Nov. 8, 2018).

² SpaceX Authorization, ¶ 1.

II. SPECTRUM SHARING ISSUES

The Commission has allocated the Ku-band uplink band (14.0-14.5 GHz) that SpaceX Services proposes to use for this gateway earth station on a primary basis only to FSS. However, certain portions of the downlink band are shared with other commercial and government services. SpaceX has engineered its NGSO system design to achieve a high degree of flexibility to facilitate spectrum sharing with other authorized satellite and terrestrial systems. SpaceX is aware of its obligations under its Authorization to protect terrestrial and space systems in these shared bands, particularly the applicable equivalent power flux-density (“EPFD”) limits set forth in Article 22 and Resolution 76 of the ITU Radio Regulations and the applicable power flux-density (“PFD”) limits set forth in the Commission’s rules and Article 21 of the ITU Radio Regulations.³ The Commission has found that compliance with these EPFD and PFD limits is sufficient to protect GSO systems and terrestrial systems, respectively, against harmful interference.⁴ In addition, SpaceX Services recognizes that its earth station operations will be subject to certain sharing conditions.⁵ SpaceX is confident that the highly advanced and flexible capabilities of its NGSO system, including the earth station proposed by SpaceX Services herein, will be able to comply with these limitations.

³ See SpaceX Authorization, ¶¶ 40(b), (d), and (e); 47 C.F.R. § 25.115(f)(1) (incorporating certification requirement in 47 C.F.R. § 25.146(a)(2)).

⁴ See, e.g., *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, 16 FCC Rcd. 4096, ¶ 77 (2000) (concluding that implementation of EPFD limits “will adequately protect GSO FSS networks”); 47 C.F.R. § 25.289 (NGSO satellite systems that comply with EPFD limits will be deemed not to cause unacceptable interference to any GSO network); *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, 16 FCC Rcd. 4096, ¶ 42 (2000) (observing PFD limits should protect terrestrial systems in the band).

⁵ See, e.g., 47 C.F.R. §§ 25.115(f)(2); 25.208(o); and 101.1409.

III. GRANT OF THIS APPLICATION WOULD SERVE THE PUBLIC INTEREST

Granting this application would serve the public interest by helping to speed broadband deployment throughout the United States by authorizing the ground-based component of SpaceX's satellite system. U.S. and worldwide demand for broadband services and Internet connectivity continues to increase with escalating requirements for speed, capacity, and reliability and ongoing adaptations for usage. 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 last year.⁶

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.⁷ 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. SpaceX has already secured U.S. authority for the space station components of its NGSO system. This application takes the next step by seeking authority for one of the gateway earth stations that

⁶ See Cisco Visual Networking Index: Forecast and Methodology, 2017-2022, at 1 (Nov. 26, 2018), available at <https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-741490.html>.

⁷ 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), available at <http://broadbandcommission.org/Documents/publications/HLPF-July2016.pdf>. See also BROADBAND COMMISSION FOR SUSTAINABLE DEVELOPMENT, “The State of Broadband 2015,” at 8 (Sep. 2015), available at <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.” (footnotes omitted)).

will connect the satellite system to the terrestrial Internet. Accordingly, an expeditious grant of this application would serve the public interest.

Respectfully submitted,

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TECHNICAL ANNEX

In this Technical Annex, 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.¹

A. Minimum Elevation Angle

SpaceX Service's gateway earth stations will communicate only with those SpaceX satellites that are visible on the horizon above a minimum elevation angle. In the very early phases of constellation deployment and as SpaceX first initiates service, this angle may be as low as 25 degrees, but this will return to 40 degrees as the constellation is deployed more fully and more satellites are in view of a given gateway site. For purposes of this application, SpaceX Services has supplied the lower angle in order to capture the full potential range of service.

B. Antenna Patterns

Section 25.209 of the Commission's rules imposes reference antenna pattern requirements for certain satellite earth stations. Most of these relate to earth stations communicating with GSO systems, as the rule was developed to facilitate GSO-to-GSO sharing where a constant level of interference is present.² However, Section 25.209(h) specifies performance standards for transmitting antennas in a gateway earth station communicating with NGSO FSS satellites in the 10.7-11.7 GHz and 14.4-14.5 GHz bands.³ Over the last two decades, the Commission has repeatedly declined to adopt similar antenna reference pattern for use in licensing NGSO user

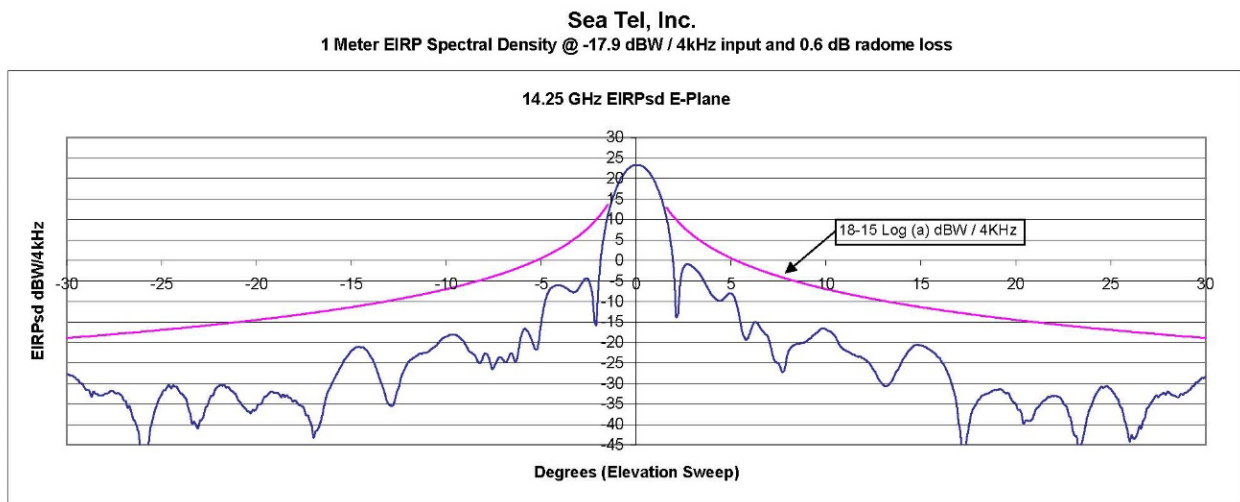
¹ To the extent relevant, SpaceX Services hereby incorporates the technical information submitted with SpaceX's space station applications. See IBFS File Nos. SAT-LOA-20161115-00118, SAT-LOA-20170726-00110, and SAT-MOD-20181108-00083.

² See *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, 16 FCC Rcd. 4096, ¶ 81 (2000) ("*Ku-Band NGSO Order*"). But see 47 C.F.R. § 25.209(h) (specifying performance standards for transmitting gateway earth stations operating with Ku-band NGSO systems).

³ See 47 C.F.R. § 25.209(h).

terminals. The Commission recently confirmed that it “has not yet determined what off-axis gain envelopes might be appropriate for earth stations operating with NGSO FSS space stations, either to facilitate NGSO-to-NGSO or NGSO-to-GSO interference protection.”⁴ Accordingly, in this application, SpaceX Services has requested a waiver of Section 25.209(h).

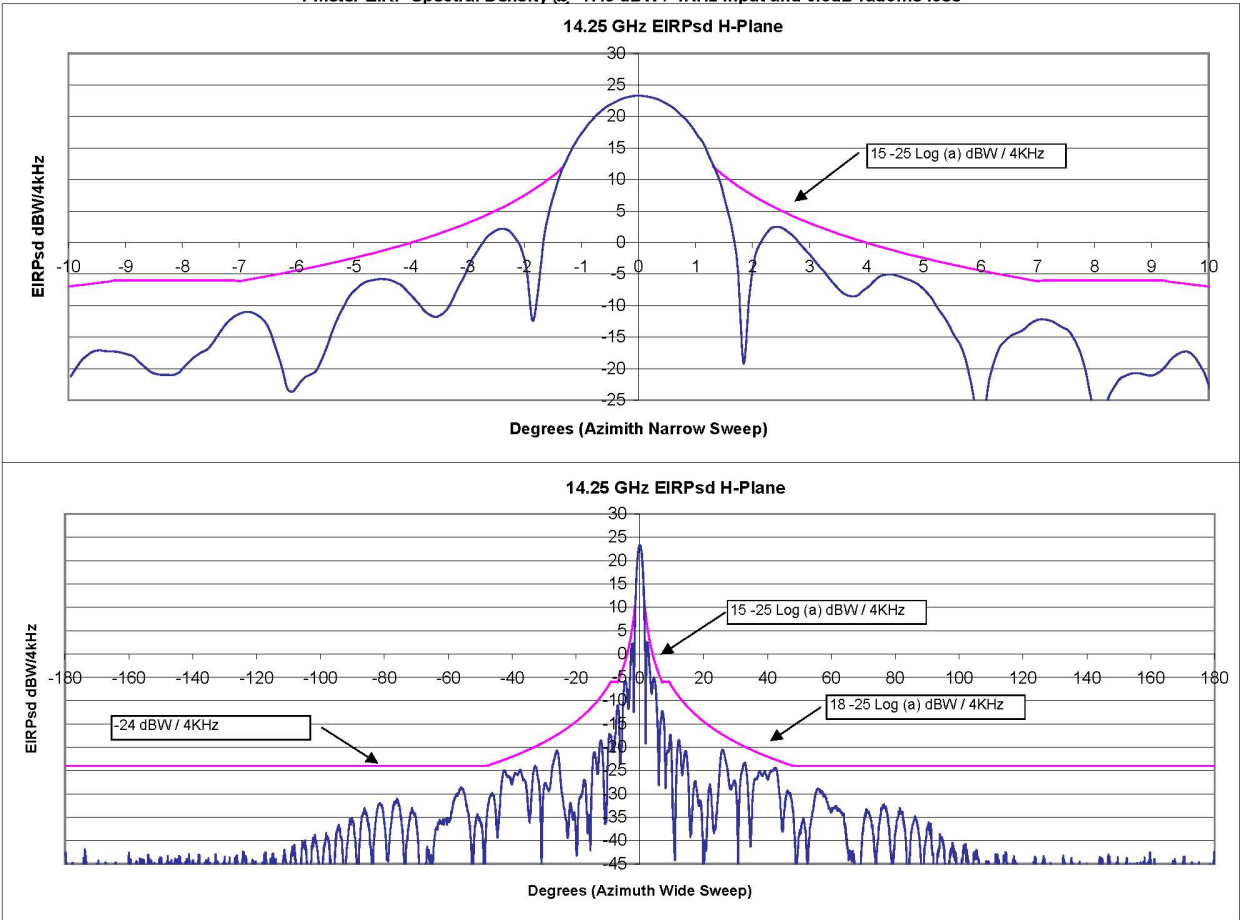
In support of its application, SpaceX Services (1) states that the half power beamwidth for its proposed gateway earth station is 1.4 degrees at 14.5 GHz, and (2) provides below information on the EIRP mask for its proposed gateway earth station, for both co-polarized and cross-polarized signals.



⁴ *Comprehensive Review of Licensing and Operating Rules for Satellite Services*, 30 FCC Rcd. 14713, ¶ 213 (2015). See also *Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, 32 FCC Rcd. 7809, ¶¶ 54-55 and n.121 (2017) (declining to adopt NGSO earth station antenna performance standards).

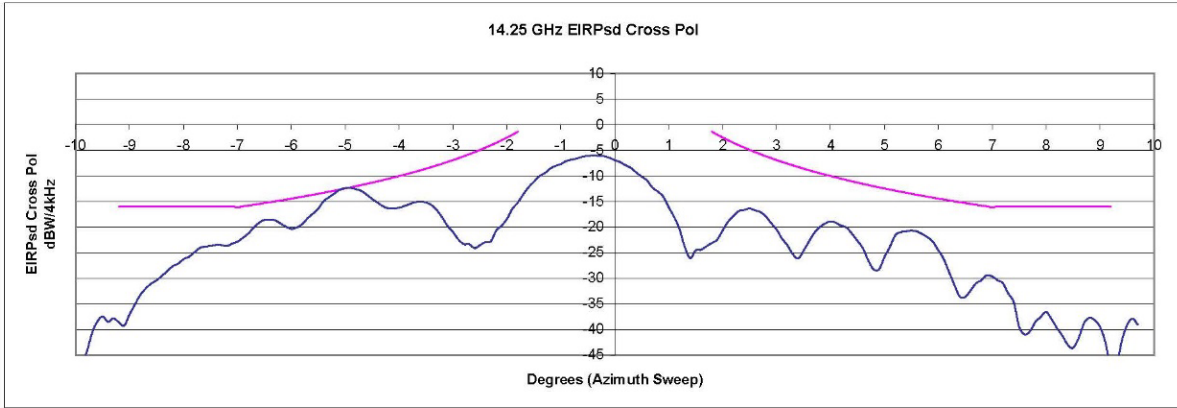
Sea Tel, Inc.

1 Meter EIRP Spectral Density @ -17.9 dBW / 4KHz input and 0.6dB radome loss



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