

APPLICATION FOR BLANKET LICENSED HIGH PERFORMANCE FIXED EARTH STATIONS

I. OVERVIEW

The Commission has authorized Space Exploration Holdings, LLC (“SpaceX”) to launch and operate a constellation of more than 4,400 non-geostationary orbit (“NGSO”) satellites (call sign S2983/S3018) using Ku- and Ka-band spectrum.¹ In doing so, the Commission recognized that the SpaceX NGSO system “will improve the experience for users of the SpaceX service, including in often-underserved polar regions” and “enable[] a better user experience by improving speeds and latency,” including for those in areas previously underserved or even totally unserved by other broadband solutions.² In May 2019, SpaceX began launching satellites to populate its constellation, and has launched more than 1,900 satellites in orbit.

The Commission has also granted a sister company, SpaceX Services, Inc. (“SpaceX Services”), two blanket licenses for operation of first- and second-generation end-user customer earth stations that communicate with SpaceX’s NGSO constellation.³ Since securing those authorizations, SpaceX has continued to develop and refine innovative user terminal models. Like their predecessors, these new units employ advanced phased-array beam-forming and digital processing technologies to make very efficient use of Ku-band spectrum resources by supporting highly directive antenna beams that point and track the system’s low-Earth orbit satellites. But these high-performance (“HP”) models will operate with higher gain and lower transmit power

¹ See *Space Exploration Holdings, LLC*, 33 FCC Rcd. 3391 (2018) (“*SpaceX Authorization*”). The Commission recently granted a request to modify SpaceX’s license. See *Space Exploration Holdings, LLC*, FCC 21-48 (rel. Apr. 27, 2021) (“*SpaceX Modification*”). These authorizations anticipate that Ku-band spectrum would be used for communications with subscribers.

² *SpaceX Modification* ¶ 12.

³ See Radio Station Authorization, Call Sign E210127 (issued Nov. 10, 2021); Radio Station Authorization, Call Sign E190066 (issued Mar. 13, 2020).

(thus maintaining a consistent EIRP compared to other SpaceX Services user terminals), a higher scan angle, and features that ruggedize the unit for use in harsh environments.

In this application, SpaceX Services seeks a blanket license authorizing operation of next-generation HP end-user earth stations for deployment and operation from fixed locations throughout the contiguous United States, Alaska, Hawaii, Puerto Rico, and the U.S. Virgin Islands. Consistent with SpaceX's space station authorization, these HP terminals will transmit in the 14.0-14.5 GHz band and receive in the 10.7-12.7 GHz band. The Commission's rules specifically contemplate blanket licensing for earth stations operating in these frequency bands.⁴

Below, we discuss the service to be provided by these HP terminals as well as certain spectrum sharing issues relevant to their operation. We then demonstrate that grant of this application would serve the public interest. Lastly, we provide technical information to supplement the information provided in Schedule B to Form 312 filed with this narrative application.⁵ To support its ambitious timetable for offering ever more diverse and innovative satellite broadband services, SpaceX Services requests that the Commission grant the requested blanket license as expeditiously as possible.

II. THESE HIGH-PERFORMANCE USER TERMINALS WILL ENHANCE SPACEX'S INNOVATIVE BROADBAND SATELLITE SERVICE, ESPECIALLY IN CHALLENGING ENVIRONMENTS

SpaceX Services' HP terminals will communicate with those SpaceX satellites that are visible on the horizon above a minimum elevation angle of 25 degrees. The proposed phased array user terminal will track SpaceX's NGSO satellites passing within its field of view. As the terminal

⁴ See *id.* § 25.115(f)(2).

⁵ 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.

steers the transmitting beam, it automatically changes the power to maintain a constant level at the receiving antenna of its target satellite to the extent possible, compensating for variations in antenna gain and path loss associated with the steering angle. Compared to other user terminals SpaceX Services has been authorized to deploy, the HP model has been ruggedized to handle harsher environments so that, for example, it will be able to continue to operate at greater extremes of heat and cold, will have improved snow/ice melt capabilities, and will withstand a greater number of thermal cycles.

At the phased array's equivalent of an "antenna flange," the highest transmit power is 4.0 W⁶ while the highest EIRP for all carriers is 38.2 dBW. The antenna gain is highest at boresight (35.8 dBi and 37.2 dBi for the receive and transmit antennas, respectively) and lowest at maximum slant (31.5 dBi and 32.2 dBi for the receive and transmit antennas, respectively).⁷

Table 1 summarizes the technical specifications of the proposed HP terminals.⁸

Link Type	Frequency	Modulation	Emission Designator	Maximum EIRP
Broadband Downlink (space-to-Earth)	10.7-12.7 GHz	Up to 64 QAM	240MD7W	N/A
Broadband Uplink (Earth-to-space)	14.0-14.5 GHz	Up to 64 QAM	60M0D7W	38.2dBW

Table 1. HP Terminal Specifications

⁶ There is no difference in transmit power between HP terminals at the center or edge of the spot or between clear sky or heavy rain conditions.

⁷ For purposes of Form 312 accompanying this application, SpaceX Services has supplied the highest transmit power and EIRP figures to present worst-case conditions.

⁸ The Commission's rules do not require applicants to submit a maximum number of user terminals to be deployed in the Ku band because, as the Commission concluded, the number of terminals "will not significantly affect any necessary coordination." *Comprehensive Review of Licensing and Operating Rules for Satellite Services*, 30 FCC Rcd. 14713, ¶ 291 (2015). However, Form 312 Schedule B requires a number of antennas to be entered. To satisfy this technical form-validation requirement, SpaceX Services has entered a value of "0" on the accompanying Form 312 Schedule B, Item E29. However, this is strictly to satisfy the form-validation requirements and is not intended to establish a maximum number of units that SpaceX Services may deploy.

The EIRP masks for these HP terminals, for co-polarized and cross-polarized signals, are set forth in Exhibit A hereto. In addition, SpaceX Services has submitted with this application a radiation hazard analysis to demonstrate that these earth stations are compliant with and will not result in exposure levels exceeding the applicable radiation hazard limits established by the Commission.

To the extent an HP terminal will exceed the 1.0 mW/cm² radiation exposure limit, SpaceX Services will ensure installation by qualified installers who have an understanding of the antenna's radiation environment and the measures best suited to maximize protection of the general public and persons operating in an occupational environment.

III. SPECTRUM SHARING ISSUES

The Commission has allocated the Ku-band that SpaceX Services proposes to use for uplink communications (14.0-14.5 GHz) from these blanket-licensed earth stations on a primary basis only to the fixed-satellite service ("FSS"). Nonetheless, SpaceX Services recognizes that its earth station operations will be subject to certain sharing conditions.⁹ Certain portions of the 10.7-12.7 GHz downlink band are shared with other commercial and government services. Notably, the proposed SpaceX Services HP terminals would not transmit in those bands and thus could not cause any interference to other operators using those bands. Moreover, 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. In addition, its system is capable of immediately ceasing operations in the unlikely event it is notified that harmful interference has occurred.

⁹ See, e.g., 47 C.F.R. §§ 25.115(f)(2), 25.208(o), 101.1409, 2.106 nn.5.487A & US342. In addition, pursuant to Section 25.115(i), SpaceX Services hereby certifies that it is planning to use a contention protocol (TDMA/FDMA), and such protocol usage will be reasonable.

SpaceX Services understands that its operations in the 10.7-11.7 GHz band would be authorized on an unprotected basis with respect to current and future systems operating in the fixed service.¹⁰

SpaceX is aware of its obligations under its authorization to protect terrestrial and space systems in these shared bands, and has certified that it will comply with the applicable equivalent power flux-density (“EPFD”) limits set forth in Article 22 and Resolution 76 of the ITU Radio Regulations.¹¹ SpaceX has also demonstrated that it will comply with the applicable PFD limits in the Ku-band set forth in the Commission’s rules and Article 21 of the ITU Radio Regulations.¹² The Commission has found that compliance with these EPFD and PFD limits is sufficient to protect GSO systems and terrestrial systems, respectively, against unacceptable interference.¹³

SpaceX is confident that the highly advanced and flexible capabilities of its NGSO system, including the HP terminals proposed by SpaceX Services herein, will be able to comply with the limitations discussed above. Nonetheless, in the extremely unlikely event that harmful interference should occur due to transmissions to or from its HP terminals, SpaceX Services can be reached at its Starlink network operations center via phone at (360) 780-3103 or email at satellite-operators-pager@spacex.com, which links to the pagers of appropriate technical personnel with authority and ability to cease all transmissions from these HP terminals on a 24/7 basis.

¹⁰ See *id.* § 25.115(f)(2).

¹¹ See Application for Modification of Authorization for the SpaceX NGSO Satellite System, IBFS File No. SAT-MOD-20200417-00037, Technical Attachment at 15 (Apr. 17, 2020) (“Modification Application”); 47 C.F.R. § 25.115(f)(1) (incorporating certification requirement in 47 C.F.R. § 25.146(a)(2)).

¹² See Modification Application, Technical Attachment at 10-12.

¹³ See, e.g., *Updates to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, 32 FCC Rcd. 7809, ¶ 32 (2017) (“NGSO Update Order”) (“Any NGSO FSS system operating in compliance with these [EPFD] limits is considered as having fulfilled its obligation under Article 22 of the ITU Radio Regulations not to cause unacceptable interference to any GSO network.”); 47 C.F.R. § 25.289 (same); *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).

IV. GRANT OF THIS APPLICATION WOULD SERVE THE PUBLIC INTEREST AND PROVIDE SERVICE IN AREAS OTHERWISE UNSERVED OR UNDERSERVED BY HIGH-THROUGHPUT, LOW-LATENCY BROADBAND IN CHALLENGING ENVIRONMENTS

Over the last two years, SpaceX has deployed over 1,900 satellites, sufficient to support introduction of its high-capacity, low-latency broadband services in most of the United States—including the most remote corners and Polar Regions of the country that too often get left behind. The demand for more broadband is surging and the need for connections has never been more important. Granting this application would serve the public interest by authorizing a new class of ground-based component for SpaceX’s satellite system that will enhance the range of broadband capabilities available throughout the United States—and most particularly, to those in challenging environments where ruggedization is appropriate. 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 continues to grow, with one report estimating more traffic in 2022 alone than in the 32 years combined since the Internet started, and more than six out of ten people in the world being online.¹⁴ Another report estimates that annual global Internet protocol traffic will grow from 1.5 zettabytes in 2017 to 4.8 zettabytes in 2022.¹⁵ Similarly, the average Internet user will generate 84.6 gigabytes of Internet traffic per month by 2022, compared to 28.8 gigabytes in 2017.¹⁶

Moreover, consumers are interacting with broadband platforms in an increasing variety of ways. In many cases, these users lack any true high-throughput, low-latency options. To close this gap, SpaceX has deployed an innovative, cost-effective and spectrum-efficient satellite system

¹⁴ See *Cisco Predicts More IP Traffic in the Next Five Years Than in the History of the Internet*, CISCO (Nov. 27, 2018), <https://newsroom.cisco.com/press-release-content?type=webcontent&articleId=1955935>.

¹⁵ See *VNI Complete Forecast Highlights*, CISCO, 1 (2018), https://www.cisco.com/c/dam/m/en_us/solutions/service-provider/vni-forecast-highlights/pdf/Global_2022_Forecast_Highlights.pdf.

¹⁶ *Id.* at 5.

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 a new generation of HP terminals that will enable the extension of that network to a range of much more challenging environments. Operation under the requested blanket license will provide the first option for some and promote competition for others in the market for broadband services, to the benefit of consumers in the United States and abroad—especially those in areas underserved or entirely unserved by terrestrial alternatives. These services will enhance the user experience and allow customers to access services that enable increased productivity. Accordingly, an expeditious grant of this application would serve the public interest.

Respectfully submitted,

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EXHIBIT A – EIRP MASK

