

PROJECT DESCRIPTION, STA File No. 1637-EX-ST-2021

Note: This application requests an extension of the authority granted under call sign WS9XKI. Other than the dates of operation, all technical details are the same as those described in File No. 1000-EX-ST-2021, which was granted on July 23, 2021.

The Commission has authorized Space Exploration Holdings, LLC (“SpaceX”) to launch and operate a constellation of over 4,400 non-geostationary orbit (“NGSO”) satellites (call sign S2983/S3018) using Ku- and Ka-band spectrum.¹ SpaceX has launched over 1,700 satellites and continues to deploy its system. The Commission has also granted a blanket license for operation of up to one million end-user customer earth stations that communicate with SpaceX’s NGSO constellation.² These user terminals employ advanced phased-array beam-forming and digital processing technologies to make highly efficient use of Ku-band spectrum resources by supporting highly directive antenna beams that point and track the system’s low-Earth orbit satellites. The Commission has previously granted experimental authority to test these same user terminals at various locations within the United States, including on vehicles, vessels, and aircraft.³

To expand its assessment of the end-to-end capabilities of its satellite system, SpaceX seeks authorization to expand these operations to include special temporary authority to operate user terminals on board vehicles and vessels near Hawthorne, CA and Redmond, WA. These operations would occur on vehicles within 250 km of each city as well as aboard seagoing vessels within U.S. territorial waters within 250 km. This authority would enable SpaceX to obtain critical data regarding the operational performance of its user terminals and the SpaceX NGSO system under SpaceX’s user-terminal blanket license with respect to its radiofrequency emissions and, in all events, will not exceed the on- or off-axis EIRP levels of those devices.

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. Most of these bands are available

¹ See *Space Exploration Holdings, LLC*, 33 FCC Rcd. 3391 (2018) (“*SpaceX Authorization*”); *Space Exploration Holdings, LLC*, 34 FCC Rcd. 2526 (IB 2019).

² See Radio Station Authorization, IBFS File No. SES-LIC-20190211-00151 (granted Mar. 13, 2020) (call sign E190066). The Commission’s rules specifically contemplate blanket licensing for earth stations operating in these frequency bands. See 47 C.F.R. § 25.115(f)(2). The overall height of these antennas above ground level (or above existing structures) will not exceed six meters.

³ See, e.g., Experimental Authorization, ELS File No. 0955-EX-CN-2020 (granted June 4, 2021); Special Temporary Authorization, ELS File No. 0566-EX-ST-2021 (granted June 1, 2021); Experimental Authorization, ELS File No. 0388-EX-CN-2019 (granted Aug. 27, 2019); Experimental Authorization, ELS File No. 0517-EX-CN-2019 (granted Aug. 27, 2019); Experimental Authorization, ELS File No. 0566-EX-ST-2021 (granted June 1, 2021).

for use by earth stations in motion communicating with NGSO FSS systems.⁴ The Commission has allocated the Ku-band uplink band (14.0-14.5 GHz) that SpaceX proposes to use for these earth stations on a primary basis only to FSS. However, certain portions of the downlink band are shared with other commercial and government services.⁵ Notably, these earth stations would not transmit in those bands and thus could not cause any interference to other operators using those bands. Although the Commission's rules provide for blanket licensing of NGSO earth stations operating in the 12.2-12.7 GHz band (the "12 GHz band"), this spectrum is not specifically listed among the bands available for ESIM operations.⁶ The proposed ESIMs will only receive in the 12 GHz band, and SpaceX will operate its satellites in compliance with the EPFD and PFD limits that the Commission has found sufficient to protect GSO and terrestrial systems, they present no risk of interference to other authorized spectrum users. Additional information regarding interference protection can be found in a separate attachment to this application.

SpaceX is confident that the highly advanced and flexible capabilities of its NGSO system, including the earth stations proposed by SpaceX herein, will be able to comply with the limitations discussed above. Nevertheless, in the extremely unlikely event that harmful interference should occur due to transmissions to or from its earth stations, SpaceX will take all reasonable steps to eliminate the interference. Should an issue arise, SpaceX can be reached at:

Starlink Network Operations Center
satellite-operators-pager@spacex.com
+1 (360) 780 - 3103

SpaceX's user terminals will communicate only with those SpaceX satellites that are visible on the horizon above a minimum elevation angle of 25 degrees. The proposed flat phased array user terminal will track SpaceX's NGSO satellites passing within its field of view. As the terminal steers the transmitting beam, it automatically changes the power to maintain a constant level at the receiving antenna of its target satellite, compensating for variations in antenna gain and path loss associated with the steering angle. At the phased array's equivalent of an "antenna flange," the highest transmit power (4.06 W) occurs at maximum slant, while the lowest transmit power (0.76 W) occurs at boresight. Similarly, the highest EIRP for all carriers (38.2 dBW) occurs at maximum slant and the lowest level (33.4 dBW) occurs at boresight. Conversely, the antenna gain is highest at boresight (33.2 dBi and 34.6 dBi for the receive and transmit antennas, respectively) and lowest at maximum slant (30.6 dBi and 32.0 dBi for the receive and transmit antennas, respectively). For purposes of the STA Form accompanying this application, SpaceX has supplied the higher transmit power figures and lower gain figures in order to present worst-case conditions.

⁴ See 47 C.F.R. § 25.202(a)(10)(ii).

⁵ The operating area proposed in this application does not implicate the NASA TDRSS facilities and radio astronomy observatories for which ESIMs must observe special limitations. See 47 C.F.R. § 25.228(j)(1)-(3).

⁶ The Commission did not affirmatively prohibit ESIM operations in this band—though it did so with respect to other spectrum. See 47 C.F.R. § 25.115(f)(2) (prohibiting ESIM operations in the 28.35-28.4 GHz band).

For reference, Table 1 summarizes the technical specifications of SpaceX's proposed earth station terminals.

Link Type	Frequency	Modulation	Emission Designator	Maximum EIRP	Half Power Beamwidth
Broadband Downlink (space-to-Earth)	10.7-12.7 GHz	Up to 64 QAM	240MD7W	N/A	3.5° (boresight) 5.5° (at slant)
Broadband Uplink (Earth-to-space)	14.0-14.5 GHz	Up to 64 QAM	60M0D7W	38.2 dBW	2.8° (boresight) 4.5° (at slant)

Table 1. User Terminal Specifications

The EIRP masks for these proposed earth stations, for co-polarized and cross-polarized signals, are set forth below.

