

INTERFERENCE PROTECTION

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 FSS. Certain portions of the 10.7-12.7 GHz downlink band are shared with other commercial and government services. Notably, the proposed earth stations would not transmit in those bands and thus could not cause any interference to other operators using those bands.

Geostationary Satellite Orbit Systems

The proposed operations will protect GSO systems from harmful interference by operating within the ITU EPFD limits that apply to the SpaceX user-terminal network as a whole, which the Commission has concluded “will adequately protect GSO FSS networks.”¹ Here, the applicable ITU EPFD limits are provided in Article 22 and Resolution 76 of the ITU Radio Regulations, which require the assessment of a satellite system as a whole to demonstrate that the probabilities of emissions exceeding certain levels remain within specified regulatory limits.

In SpaceX’s application for a blanket user-terminal authorization, which the Commission granted in March 2020, SpaceX confirmed that its user-terminal network as a whole will comply with these EPFD limits, and such compliance was a condition of the Commission’s grant of that authorization.² The user terminals SpaceX seeks to operate in this application are planned to be electrically identical to the 1,000,000 user terminals the Commission has already permitted in that authorization from a radiofrequency perspective and, in all events, will operate within that previously authorized user-terminal network within those EPFD limits and will not exceed the on- or off-axis EIRP levels of those devices.³ The Commission has found that compliance with these EPFD limits is sufficient to protect GSO systems against unacceptable interference.⁴ Accordingly,

¹ *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”). See also 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).

² See Radio Station Authorization, IBFS File No. SES-LIC-20190211-00151 (granted Mar. 13, 2020) (callsign E190066).

³ *Id.* Notably, the Commission does not require the submission of antenna patterns for blanket-licensed NGSO earth stations, as the EIRP mask is sufficient to verify compliance with EPFD limits and other interference-protection benchmarks. SpaceX’s Part 25 blanket user-terminal authorization was granted on this basis. NGSO user terminals are also not required to comply with the antenna-gain limitations in Section 25.209. The Commission has granted other blanket user-terminal authorizations as well that have not included antenna patterns and which have correctly asserted that “that the Commission’s antenna performance standards contained in Section 25.209 of the Commission’s rules are not applicable to NGSO user terminals.” See Radio Station Authorization, IBFS File No. SES-LIC-20190930-01217 (granted Apr. 27, 2021) (callsign E190727).

⁴ 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

the proposed operations will satisfy the GSO interference-protection requirements that the Commission has adopted for NGSO systems in this band.

SpaceX complies with these EPFD limits by enforcing a 25-degree minimum elevation limit, GSO avoidance angle of 18 degrees, and a transmit EIRP mask on all user terminals, including those described in this application. The minimum elevation angle and the GSO avoidance angle limit the interference geometry from the terminal to the GSO and prevent terminals from transmitting to NGSO satellites that are within 18 degrees of the GSO arc. In addition, when a terminal transmits to an NGSO satellite more than 18 degrees from the GSO arc, the EIRP mask limits the power spectral density of transmissions from the terminal toward GSO satellites. The experimental earth stations in this application will comply with the same operational limits as the terminals covered under SpaceX's blanket license and therefore will not exceed the already authorized EPFD limits for the Starlink system.

In addition, the proposed operations will comply with the FCC's requirements for NGSO Earth Stations in Motion ("ESIMs") in these bands to ensure that motion of the user terminal will not cause it to inadvertently exceed interference protection limits. In particular, these earth stations will be self-monitoring and should a condition occur that causes it to exceed EIRP, EIRP density or off-axis EIRP mask limits included in the licensing conditions for the FSS NGSO network that it is using as a point of communication in the 14-14.5 GHz band, the terminal will automatically cease transmissions within 100 milliseconds and not resume transmissions until the condition that caused the experimental terminal to exceed those limits is corrected.⁵

Fixed-Service Systems

Similar to protection for GSO systems, the ITU has adopted PFD limits (codified in Article 21 of the ITU Radio Regulations) that limit the energy of satellite downlink transmissions to protect terrestrial services. The Commission has concluded that compliance with these PFD limits is sufficient to protect terrestrial fixed-service operators from harmful interference.⁶ Nothing about the operation of the proposed earth stations will affect that. As mentioned above, the 14.0-14.5 GHz band in which these earth stations transmit is allocated on a primary basis solely to FSS.

SpaceX recognizes that the 12.2-12.7 GHz band (the "12 GHz band") is not specifically listed among the bands available for ESIM operations. The Commission did not, however, affirmatively prohibit ESIM operations in this band—though it did so with respect to other

under Article 22 of the ITU Radio Regulations not to cause unacceptable interference to any GSO network."); 47 C.F.R. § 25.289 (same).

⁵ See 47 C.F.R. § 25.228(c).

⁶ *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). Section 25.228(i) provides another set of PFD limits for ESIMs, but they apply only to earth stations aboard aircraft and so are not relevant to this application.

spectrum.⁷ Rather, the Commission did not include the 12 GHz band because it had not been included in the proceeding and thus “the record is insufficient for us to consider use of these bands for ESIMs communications with NGSO FSS satellites.”⁸ But to repeat, the proposed earth stations will only *receive* in this band, and thus cannot cause any interference to other authorized users. Moreover, the Commission’s rules specifically contemplate that experimental authorizations may be issued for operations inconsistent with existing frequency allocations so long as they are on a non-interference basis.⁹

NGSO Systems

The SpaceX NGSO FSS system, including operations under the authorization requested herein, will at all times comply with Section 25.261(c), which governs spectrum sharing between NGSO operators. Beyond the requirements of Section 25.261, the SpaceX system uses steerable and shapable beams as well as satellite diversity, which will often allow SpaceX to choose from multiple satellites capable of serving any one point on the ground. These advanced capabilities will allow SpaceX to minimize the potential for in-line events involving these or any other SpaceX earth stations.

TDRSS and Radio Astronomy

SpaceX will comply with its obligations pursuant to conditions placed on its blanket user-terminal authorizations to avoid and/or coordinate with NASA TDRSS and radioastronomy facilities as necessary and to avoid harmful interference to these services.¹⁰

⁷ See 47 C.F.R. § 25.115(f)(2) (prohibiting ESIM operations in the 28.35-28.4 GHz band).

⁸ *Facilitating the Communications of Earth Stations in Motion with Non-Geostationary Orbit Space Stations*, 35 FCC Rcd. 5137, ¶ 46 (2020).

⁹ See 47 C.F.R. § 2.102(b)(3) (“Experimental stations, pursuant to part 5 of this chapter, may be authorized the use of any frequency or frequency band not exclusively allocated to the passive services” on a non-interference basis).

¹⁰ 47 C.F.R. § 25.228(j) covers operation with TDRSS and Radio Astronomy. For these experimental operations, SpaceX will not operate within radio line of sight of the listed facilities unless SpaceX has coordinated its operations.