

REQUEST FOR SPECIAL TEMPORARY AUTHORITY TO CONDUCT EXPERIMENTAL OPERATIONS

Space Exploration Holdings, LLC (“SpaceX”) requests special temporary authority (“STA”) for 180 days beginning December 10, 2023 to test its non-geostationary orbit (“NGSO”) second generation (“Gen2”) satellites¹ with direct-to-cellular communications payloads to connect unmodified cellular phones directly to SpaceX Gen2 satellites, subject to the conditions set forth in the *Gen2 Order* granting SpaceX authority to launch and operate 7,500 satellites. This experimental authority is necessary as the Commission continues to process SpaceX’s application to enable supplemental coverage from space (“SCS”) for consumers on a permanent basis.² Experimental authority would permit SpaceX to test its direct-to-cellular-enabled satellites beginning in December 2023 until such time as the Commission grants SpaceX’s modification application.

This experimental STA will permit SpaceX to connect its direct-to-cellular antennas to cellular test devices using the 1910-1915 MHz and 1990-1995 MHz bands (the “PCS G Block”) in cooperation with T-Mobile USA, Inc. and its subsidiaries (collectively, “T-Mobile”), who are the sole licensee of the PCS G Block in the United States.³ The two parties executed a spectrum manager lease pursuant to which T-Mobile granted SpaceX the right to use the PCS G Block as described in SpaceX’s underlying application and the instant request for experimental authority. SpaceX will use the PCS G Block spectrum licensed to T-Mobile for these experiments with T-Mobile’s consent.

SpaceX’s experiment will include several phases, including during the launch and early orbit phase (“LEOP”) and while at operational altitude. During the critical LEOP period, which will begin within hours of launch at an altitude between 290 km and 350 km—depending on the particulars of the specific launch—and may continue for several weeks or months, SpaceX will test the functionality of each direct-to-cellular payload and its network capabilities to ensure that they are operating as intended. Based on the outcome of these tests, SpaceX may thereafter begin the orbit-raising process to an intermediate parking orbit to conduct additional tests. Finally, SpaceX may raise its satellites to their operational altitude for ongoing operational tests. For each of these tests, SpaceX’s satellites will communicate with cellular test devices controlled by T-Mobile and/or SpaceX personnel and not by commercial T-Mobile subscribers. SpaceX will rely on its existing, authorized frequencies for its Gen2 system for the backhaul and TT&C component of these satellites.

Over the 180-day experimental STA period, SpaceX expects to operate approximately 840 satellites with direct-to-cellular payloads. At any given time, approximately 60 of these 840 payloads

¹ See *Space Exploration Holdings, LLC*, FCC 22-91 (rel. Dec. 1, 2022) (“*Gen2 Order*”).

² See Application for Modification of Authorization for the SpaceX Gen2 NGSO Satellite System to Add a Direct-to-Cellular System, ICFS File No. SAT-MOD-20230207-00021 (filed Feb. 7, 2023).

³ SpaceX has requested that the Commission waive the requirements of Section 25.115 in its application seeking authority to operate its direct-to-cellular satellite network. See Application for Modification of Authorization for the SpaceX Gen2 NGSO Satellite System to Add a Direct-to-Cellular System, ICFS File No. SAT-MOD-20230207-00021, Narrative at i, 1-2, 7-8, Technical Narrative at 1-2, 4, 13-14, Waiver Requests at 4-5, 9-10 (Feb. 7, 2023). And T-Mobile has urged the Commission to refrain from requiring licensing of subscriber units in connection with supplemental coverage from space in general. See Comments of T-Mobile USA, Inc., GN Docket No. 23-65 and IB Docket No. 22-271, at 8-10 (filed May 12, 2023); Reply Comments of T-Mobile USA, Inc., GN Docket No. 23-65 and IB Docket No. 22-271, at 9-10 (filed June 12, 2023). Accordingly, SpaceX submits this application in an abundance of caution only so that T-Mobile’s already certified and licensed subscriber devices may communicate with the SpaceX constellation while the STA remains in effect.

will be serving handsets in the United States under this experimental authorization. To ensure adequate testing and compatibility with a wide range of devices, SpaceX and T-Mobile seek authority to use 2,000 test devices. Communications will conform with the technical specifications set forth in Exhibit A. All tests will occur within 13 specific terrestrial test locations identified in Exhibit B with a radius of 100 km around each site, except as necessary to account for international borders.

In addition to these 13 sites, SpaceX also requests experimental authority to conduct tests in coordination with the National Science Foundation (“NSF”), including the National Radio Astronomy Observatory (“NRAO”). Planned testing will be conducted within the National Radio Quiet Zone (“NRQZ”) in West Virginia, where the Green Bank Telescope (“GBT”) is located, and at the Very Large Array (“VLA”) in New Mexico or Very Long Baseline Array (“VLBA”) sites, as listed in footnote US131 of the U.S. Table of Frequency Allocations.⁴ These tests will be coordinated with the NSF prior to any transmissions to ensure that radio astronomy observations are protected from the possibility of harmful interference. SpaceX will work through NSF with any other radio astronomy facilities within the United States which may be impacted.

Examples of tests under this STA could include:

1. Measuring compliance with relevant Part 25 masks;
2. Measuring in-band interference from adjacent handsets;
3. Confirming PFD levels at varying geographic locations within specified locations at a variety of satellite transmit power levels and scan angles;
4. Measuring controlled handset received signal strength and data rates in geographically diverse settings (e.g., under foliage, near structures, in valleys);
5. Measuring satellite receive signal strength, Doppler impairment measurements, and time synchronization measurements from controlled handsets at a variety of handset data rates and satellite scan angles; and
6. Testing topology software to improve coverage while meeting applicable limits;

SpaceX will operate in the PCS G Block on a non-protected, non-interference basis pursuant to the commercial agreement between SpaceX and T-Mobile. The SpaceX direct-to-cellular system will operate in the United States pursuant to a cooperative agreement with T-Mobile without impacting primary terrestrial mobile operations and will protect adjacent band and cross-border operations from harmful interference. In all cases, SpaceX dynamically plans its beams using its topology software so that it will not exceed applicable field strength limits at any downlink power level near international borders, except where those exceedances have been authorized pursuant to an approval from the regulatory authority of the appropriate border country. The contours of individual SpaceX direct-to-cell beams will depend on their elevation angle. SpaceX will place these beams to ensure that, in aggregate, they do not exceed the applicable cross-border limit. To that end, SpaceX’s topology software typically will place the center of lower-elevation angle beams farther from applicable border areas than beams at higher elevation angles.

SpaceX will observe the applicable limits, including the in-band field strength limit in Section 24.236 and the out-of-band field strength limits in Section 25.202(f) along with the cessation of emissions

⁴ See 47 C.F.R. § 2.106 n.US131.

rule in Section 25.207 and frequency tolerance in Section 25.202(e). All uplink operations from certified cellular test handsets will conform to Part 24 standards and limits. SpaceX certifies that its direct-to-cellular system will operate without causing harmful interference to or requiring protection from any other service duly licensed in these bands or adjacent bands. In the extremely unlikely event that harmful interference should occur due to transmissions to or from its spacecraft, SpaceX will take all reasonable steps to eliminate the interference. Should an issue arise, SpaceX can be reached at satellite-operators-pager@spacex.com, which links to the pagers of appropriate technical personnel 24/7.

While operating under this experimental license to communicate with SpaceX space stations, the cellular test devices on the ground will operate in the PCS G Block on a non-protected, non-interference basis. All test devices are certified to operate under Part 24 of the Commission's rules. In the extremely unlikely event that harmful interference should occur due to transmissions to or from these T-Mobile devices to SpaceX space stations, T-Mobile and SpaceX will take all reasonable steps to eliminate the interference. Should an issue arise, SpaceX can be reached at satellite-operators-pager@spacex.com, which links to the pagers of appropriate technical personnel 24/7, and will coordinate with T-Mobile as necessary.

The Commission has good cause to approve this request because it is in the public interest. Granting this experimental license will enable SpaceX to begin testing its transformative direct-to-cell technology, which will bring connectivity in areas where terrestrial mobile networks are absent or have been impacted by natural disasters. The experimental authorization would also allow SpaceX to confirm the operational status of its direct-to-cell satellites and their ability to communicate with cell phones immediately upon insertion, rather than waiting weeks while the satellites complete orbit raising to ensure proper functioning. And because SpaceX will take the steps described above to protect systems in adjacent bands and across national borders, these tests will enable SpaceX to more quickly realize the consumer benefits of its direct-to-cell technology without causing harmful interference to other licensed operators. Accordingly, SpaceX requests that the Commission expeditiously grant the experimental STA for direct-to-cellular satellite communications for 180 days to support those operations beginning in December 2023 while the Commission continues to consider its direct-to-cell application. SpaceX understands that Commission grant of the experimental authorization does not prejudice the Commission's further consideration of its direct-to-cell application.

EXHIBIT A
DIRECT-TO-CELLULAR RADIOFREQUENCY CHARACTERISTICS

Schedule S Parameters

	Receiving Beams Envelope	Transmitting Beams Envelope
Beam Type	Both Steerable and Shapeable	
Peak Gain	{ 29.0, 32.0, 35.0, 38.0 } dBi	
Antenna Pointing Error	0.1 degrees	
Antenna Rotational Error	0.1 degrees	
Polarization	Switchable	
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees	
Co- or Cross Polar Mode	C	
Service Area Description	Select test sites and radio quiet zones	
Polarization	{ V, H }	{ RHCP, LHCP }
G/T at Max. Gain Point:	{ 3.5, 6.5, 9.5, 12.5 } dB/K	
Min. Saturation Flux Density	-0.1 dBW/m ²	
Max. Saturation Flux Density	0.0 dBW/m ²	
Max. Transmit EIRP Density		{ -11.33, -8.33, -5.33, -2.33 } dBW/Hz
Max. Transmit EIRP		{ 49.0, 52.0, 55.0, 58.0 } dBW

Transmitting Beams Max. Power Flux Density (dBW/m²/MHz):

Peak Gain	0°-5°	5°-10°	10°-15°	15°-20°	20°-25°	25°-90°
29.0 dBi	-88.9	-87.2	-85.6	-84.2	-83.0	-80.0
32.0 dBi	-85.9	-84.2	-82.6	-81.2	-80.0	-80.0
35.0 dBi	-82.9	-81.2	-80.0	-80.0	-80.0	-80.0
38.0 dBi	-80.0	-80.0	-80.0	-80.0	-80.0	-80.0

EXHIBIT B TEST LOCATIONS
T-Mobile Test Locations (latitude, longitude)

Mountain View, CA

- 37.41539, -122.07180
- 37.39100, -121.48750

Kansas City, KS

- 38.91540, -94.65727
- 39.92200, -96.35200

Redmond, WA

- 47.67530, -122.12833
- 47.35394, -121.45111
- 48.05000, -120.10000

San Diego, CA

- 33.46000, -117.15000
- 33.56000, -115.88000

Reston, VA

- 38.95030, -77.37785
- 38.49230, -79.68790

Dallas, TX

- 33.10832, -96.82122

Bethel, OK

- 34.35930, -94.81236

Columbus, OH

- 39.95891, -82.99997
- 39.65233, -82.02935

Virginia Beach, VA

- 36.84400, -75.98169
- 36.62074, -76.54898

Los Angeles, CA

- 34.04462, -118.25893
- 34.31502, -118.10536

Houston, TX

- 29.75328, -95.36233
- 28.71184, -98.78858

San Diego, CA

- 33.46000, -117.15000
- 33.56000, -115.88000