

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

Application of)
)
)

SPACE EXPLORATION HOLDINGS, LLC)
)

For Approval of Orbital Deployment)
And Operating Authority for a 1.6/2.4 GHz)
Mobile-Satellite System)
_____)

Call Sign: S2983 and S3018

IBFS File No. _____

**APPLICATION FOR MODIFICATION TO
DEPLOY A 1.6/2.4 GHz MOBILE-SATELLITE SYSTEM**

David Goldman
Senior Director of Satellite Policy

SPACE EXPLORATION TECHNOLOGIES CORP.
1155 F Street, N.W.
Suite 475
Washington, DC 20004
202-649-2700 tel
202-649-2701 fax

September 6, 2022

SUMMARY

SpaceX's first-generation ("Gen1") non-geostationary orbit ("NGSO") Fixed-Satellite Service ("FSS") constellation is providing unprecedented satellite broadband service to Americans throughout even the most remote corners of the country. Not stopping there, SpaceX recently expanded its service offerings by acquiring Swarm Technologies, Inc., an NGSO satellite operator offering narrowband Mobile-Satellite Service ("MSS") for Internet-of-Things ("IoT") applications.

With this application, SpaceX is proud to announce its plans to add additional spectrum to supplement its planned mobile services being added to its tested first-generation network. By adding the 1.6/2.4 GHz bands to its mobile satellite services, SpaceX can provide even more robust mobile services beyond the reach of terrestrial data networks. By granting SpaceX access to this spectrum, the Commission can provide Americans with more options for mobile satellite services in otherwise unserved areas of the country, as well as other parts of the world, and ensure that consumers everywhere are able to fully harness the growth and development of IoT applications and devices

As SpaceX demonstrates herein, the advanced capabilities of its proposed mobile satellite system will enable operations in the 1.6/2.4 GHz bands without causing harmful interference to other licensed systems. And because SpaceX proposes to include 1.6/2.4 GHz NGSO MSS transceivers as an additional modular payload on its first-generation NGSO FSS system, grant of this application would not increase the number of satellites in orbit, pose any additional risk from orbital debris, or require any additional physical coordination. Accordingly, the Commission should expeditiously grant this application so that SpaceX can finally bring to fruition the Commission's decade-old vision of advanced mobile satellite services.

TABLE OF CONTENTS

Page

SUMMARY.....	i
DISCUSSION.....	2
I. SpaceX's 1.6/2.4 GHz MSS System.....	2
II. Grant of the Application Would Serve the Public Interest by Enabling SpaceX to Offer Next- Generation Services to Mobile Users in Remote Areas of the United States and Around the World	6
III. ITU Cost Recovery	9
IV. Eligibility and Operational Requirements.....	10
CONCLUSION	11

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

_____	)	
Application of	)	
	)	
SPACE EXPLORATION HOLDINGS, LLC	)	Call Signs: S2983 and S3018
	)	
For Modification to Deploy	)	IBFS File No. SAT-MOD-_____
a 1.6/2.4 GHz Mobile-Satellite System	)	
_____	)	

**APPLICATION FOR MODIFICATION TO
DEPLOY A 1.6/2.4 GHz MOBILE-SATELLITE SYSTEM**

In this application, Space Exploration Holdings, LLC (“SpaceX”) requests modification of its existing first-generation (“Gen1”) Ku/Ka-band non-geostationary orbit (“NGSO”) Fixed Satellite Service (“FSS”) license separate operating authority (that is, approval for orbital deployment and a station license) for use of the 1610-1617.775 MHz (Earth-to-space) and 2483.5-2500 MHz (space-to-Earth) bands as well as the 2020-2025 MHz (Earth-to-space) band for the provision of Mobile-Satellite Service (“MSS”) (collectively, the “SpaceX 1.6/2.4 GHz MSS system”). This application identifies all changes that SpaceX requests for its current authorization.¹ SpaceX is also filing an FCC Form 312, accompanying Schedule S, Waiver Request, and updated technical showings to reflect the proposed changes. Grant of this application will enable SpaceX to augment its MSS capabilities and thereby provide next-generation services to mobile users across the United States and around the world, including areas underserved or currently unserved by existing networks.

¹ See *Space Exploration Holdings, LLC*, 36 FCC Rcd. 7995 (2021) (“SpaceX Authorization”).

DISCUSSION

I. SPACEX'S 1.6/2.4 GHZ MSS SYSTEM

A. SpaceX Background

SpaceX is a private company founded in 2002 to revolutionize space technologies, with the ultimate goal of enabling humanity to become a multi-planetary species. The company designs, manufactures, and launches advanced rockets and spacecraft. It has over 9,000 employees based in the United States at the company's headquarters in Hawthorne, California and facilities located across the country.

Since its founding, SpaceX has achieved a series of historic milestones. In December 2010, SpaceX became the first private company ever to successfully launch and return a spacecraft (Dragon) from low-Earth orbit. In May 2012, the company again made history when Dragon berthed with the International Space Station ("ISS"), delivered cargo, and returned safely to Earth—a technically challenging feat previously accomplished only by governments. In December 2015, SpaceX successfully returned a first stage rocket booster to land after carrying a payload to space, and has since landed more than 175 times and has reflown boosters 114 times, including thirteen re-flights of a single booster. SpaceX used its Crew Dragon capsule in May 2020 to become the first and only commercial operator to deliver astronauts to the ISS. And by leveraging the reusability of its rockets, SpaceX has launched over 3,000 of its own Starlink satellites, which will be used to provide high-speed broadband across the country and around the world.

SpaceX's current and planned space-based activities underscore its commitment to space safety. SpaceX is proud that NASA has entrusted the company to safely carry American astronauts to and from the ISS, a more than \$100 billion multinational facility with human beings onboard. Nothing is more important to SpaceX than safely and successfully accomplishing this mission.

The company is highly experienced with space-based operations and debris mitigation practices. SpaceX maintains deep ties with the domestic and international institutions tasked with ensuring the continued safety of space operations, which facilitates aggressive and effective space-debris mitigation practices. SpaceX brings this commitment and experience to all aspects of its space-based operations.

B. Realizing the Commission's Vision for 1.6/2.4 GHz MSS

i. 1610-1617.775 MHz and 2483.5-2500 MHz

The 1610-1617.775 MHz and the 2483.5-2500 MHz bands have been allocated worldwide for MSS on a primary basis. Under the Commission's rules, these bands are available for use by MSS systems in the uplink and downlink directions, respectively.²

When the Commission first authorized MSS in these bands, it sought to establish a service that would "offer an almost limitless number of services, [...] offer Americans in rural areas that are not otherwise linked to the communications infrastructure immediate access to a feature-rich communications network... [and] extend these benefits throughout the world."³ To further these goals, the Commission established a spectrum sharing plan that would accommodate up to five systems, only two of which ultimately materialized.⁴ One of these, Globalstar, has enjoyed exclusive access to portions of the 1.6/2.4 GHz bands, even though the Commission did not

² See 47 C.F.R. § 2.106; *See Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Bands*, CC Docket No. 92-166, Report and Order, FCC 94-261, 9 FCC Rcd 5936, (1994) (*Big LEO Order*).

³ *See Big LEO Order* at ¶ 3..

⁴ *See Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Service Systems in the 1.6/2.4 GHz Bands*, Report and Order, Fourth Report and Order and Further Notice of Proposed Rulemaking, 19 FCC Rcd 13386, FCC 04-134, ¶ 3 (2004) (*Big LEO Spectrum Sharing Order*).

provide Globalstar with perpetual exclusive use of the bands.⁵ Indeed, the Commission has made changes to the bands over time to reflect the real world usage of the spectrum.⁶

While the current 1.6/2.4 GHz MSS systems provide important services, the circumstances surrounding the bands have changed once again. Although sharing between multiple co-frequency operators may have been difficult when the Commission most recently reviewed these bands 15 years ago, satellite and communication system technology has evolved significantly and shared use of satellite spectrum has advanced considerably. In particular, SpaceX has proven its ability to share spectrum to deliver on the objectives the Commission set for the 1.6/2.4 GHz bands, and can now provide expanded mobile satellite services using its proven first-generation constellation.

After evaluating the current use of the 1.6/2.4 GHz bands, SpaceX has determined that it can leverage its state-of-the-art space technology and its rapid launch cadence to deploy and operate an NGSO system to serve consumers in the band without causing harmful interference to other licensed systems. As discussed in the Technical Attachment to this application, SpaceX can use a variety of strategies enabled by the advanced capabilities of its next-generation MSS system to coexist with incumbent MSS operations in the band. SpaceX will coordinate its MSS system with incumbents as appropriate according to the Big LEO Order and Big LEO Spectrum Sharing Order to achieve an “equitable allocation of interference noise,” and ensure that the SpaceX’s MSS system does not detrimentally affect the interference environment.⁷

⁵ See *Spectrum and Service Rules for Ancillary Terrestrial Components in the 1.6/2.4 GHz Big Leo Bands/Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Service Systems in the 1.6/2.4 GHz Bands*, Second Order on Reconsideration, Second Report and Order, and Notice of Proposed Rulemaking, 22 FCC Rcd 19733, ¶ 24 (2007) (*Big Leo Spectrum Rebalancing Order*). (“the grant of spectrum to Globalstar under its license was made with the understanding that it was both to be shared with other operators and subject to modification if only one CDMA operator launched and operated a satellite system”).

⁶ *Id.* at ¶ 4 (basing the current band plan on the fact that “[t]he Commission currently has no application before it for any new Big LEO MSS system.”).

⁷ *Big LEO Spectrum Sharing Order* at ¶ 66; see also Final Report of the Majority of IWG1, at 2-2 (“It is proposed that a technical approach based on an equitable allocation of interference noise would be used in the

ii. 2020-2025 MHz

The 2020-2025 MHz band is currently allocated for MSS uplink (Earth-to-space) at the ITU for Region 2 on a co-primary basis with the Fixed and Mobile services. The U.S., however, does not currently have an MSS allocation for the band. In 2020, Kepler Communications, Inc. and Spire Global, Inc., filed a Petition for Rulemaking to add an MSS allocation to the band.⁸ SpaceX supports the Petitioners to support the growing need for uplink spectrum to for mobile satellite services. Until that Petition is addressed, SpaceX requests a waiver of the U.S. Table of Frequency Allocations to use this spectrum for uplink for its user terminals consistent with the ITU Region 2 allocation, subject to the outcome of the Kepler/Spire Petition.

C. SPACEX'S PROPOSED 1.6/2.4 GHz MSS SYSTEM

The SpaceX 1.6/2.4 GHz MSS system will consist of a constellation of low Earth orbit satellites that will leverage SpaceX's existing ground equipment as well as add new equipment to optimize performance for consumers. This new system will be highly spectrum-efficient and will be able to share the 1.6/2.4 GHz bands with conventional GSO satellite and terrestrial networks without causing harmful interference. It will operate under new network filings to be made on behalf of SpaceX at the ITU by the United States.

i. Space Segment

The proposed SpaceX 1.6/2.4 GHz MSS system will consist of a flown payload on the 4,408 satellites in SpaceX's first-generation system. The orbital configuration of the SpaceX

application of international coordination procedures set forth in Resolution 46 of the Final Acts of WARC-92.”).

⁸ Spire Global, Inc. and Kepler Communications Inc., *Petition to Revise Sections 2.106 and 25.142 of the Commission's Rules to Expand Spectrum Availability for Small Satellites by adding Mobile-Satellite Service Allocation in the Frequency Band 2020-2025 MHz*, RM-11869 (filed Oct. 30, 2020) (“Kepler/Spire Petition”) (pending).

1.6/2.4 GHz MSS system will, therefore, be identical to that of the first-generation FSS system, as illustrated below:

SpaceX 1.6/2.4 GHz MSS system					
Orbital Planes	72	72	36	6	4
Satellites per Plane	22	22	20	58	43
Altitude	550 km	540 km	570 km	560 km	560 km
Inclination	53°	53.2°	70°	97.6°	97.6°

SpaceX requests authority to operate on 1610-1617.775 MHz and 2020-2025 MHz (Earth-to-space) and 2483.5-2500 MHz (space-to-Earth). SpaceX will use the gateway spectrum assigned to its FSS constellation to provide feeder links for its MSS system.

A more precise description of the frequency and channelization plan for the SpaceX 1.6/2.4 GHz MSS system is included in Schedule S and the Technical Attachment accompanying this application.

ii. Ground Segment

The SpaceX 1.6/2.4 GHz MSS system will communicate with user terminals capable of providing connectivity virtually anywhere. While SpaceX plans to leverage its existing FSS ground infrastructure to support MSS operations, it will submit applications to the Commission as needed to request blanket authority for user terminals that will operate in the United States and its territories, pursuant to Section 25.115 of the Commission's rules.

II. GRANT OF THE APPLICATION WOULD SERVE THE PUBLIC INTEREST BY ENABLING SPACEX TO OFFER NEXT-GENERATION SERVICES TO MOBILE USERS ACROSS THE UNITED STATES AND AROUND THE WORLD

The Commission has authorized SpaceX to construct, deploy, and operate its first-generation NGSO FSS constellation consisting of 4,408 satellites operating in the 540-570 km altitude range using Ku- and Ka-band spectrum.⁹ SpaceX has launched over 3,000 satellites so far, and this system is delivering truly high-speed, low-latency broadband to fixed users across the United States—including to the most remote corners of the country that too often get left behind—and around the world.¹⁰ To complement this first-generation constellation and provide the additional capacity to meet the accelerating demand for broadband capacity, SpaceX has applied for authority to deploy a second-generation Ku/Ka/E-band NGSO system.¹¹ SpaceX has also recently received authority to operate earth stations in motion (“ESIMs”) that would enable broadband services on moving aircraft, ships, and motor vehicles that can support SpaceX’s sophisticated directional antennas.¹²

While these assets will enable SpaceX to provide unprecedented broadband capacity from its space-based platform, Americans are increasingly demanding connectivity wherever they are, whenever they want, and whatever they are doing. To expand into this mobile services arena, SpaceX recently acquired Swarm Technologies, Inc. (“Swarm”), a company authorized to deploy and operate 150 small NGSO satellites designed to provide narrowband services in the very-high

⁹ See *Space Exploration Holdings, LLC*, 36 FCC Rcd. 7995 (2021).

¹⁰ See Josh Fomon, *Starlink Hits 100+ Mbps Download Speed in 15 Countries During Q4 2021*, Ookla (Mar. 16, 2022) (reporting Starlink measured download speeds in the United States average 105 Mbps, and even higher speeds in other markets around the world, in the fourth quarter of 2021), <https://www.ookla.com/articles/starlink-hughesnet-viasat-performance-q4-2021>.

¹¹ See Application for Approval of Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite System, IBFS File No. SAT-LOA-20200526-00055 (filed May 26, 2020); Amendment, IBFS File No. SAT-AMD-20210818-00105 (filed Aug. 18, 2021).

¹² See IBFS File Nos. SES-LIC-20210309-00698, SES-AMD-20210731-01295, SES-LIC-20210803-01360, and SES-LIC-20210803-01361.

frequency (“VHF”) 137-138 MHz and 148-150.5 MSS bands.¹³ Swarm has already launched most of its authorized satellites and is offering services to customers in the agriculture, maritime, energy, environmental, and transportation sectors, among others in need of global satellite connectivity for Internet-of-things (“IoT”) devices.

In July 2022, SpaceX filed an application for modification to its first-generation system so it can deploy an MSS system using 2 GHz spectrum.¹⁴ With this application SpaceX proposes to expand its NGSO MSS capabilities to provide next-generation services across the country, including in the most remote corners of the country.

The MSS spectrum available in the 1.6/2.4 GHz bands will support a range of mobile satellite services, enabling SpaceX to craft a compelling array of offerings to address the connectivity needs of Americans wherever they are and whatever they are doing. Due to its low altitudes, SpaceX’s 1.6/2.4 GHz MSS system will provide service with latency of its transmissions below 50 milliseconds, which is nearly unnoticeable to consumers. This system will ensure that all Americans—even those in Polar Regions—enjoy the same low latency mobile services. And consumers are not the only beneficiaries of this improved service. For many Federal users, satellite service is the only communications option to support critical missions. Improving capacity and latency for these users could have significant national security benefits. All of these services are in the public’s best interests.

Significantly, as with its proposed 2 GHz MSS system, SpaceX’s proposed 1.6/2.4 GHz MSS system will employ a host of cutting-edge innovations to ensure its system does not cause spectral interference for others. As discussed in the Technical Attachment accompanying this

¹³ See Public Notice, DA 21-1238 (IB, rel. Oct. 1, 2021) (confirming authority for Swarm transfer of control to SpaceX).

¹⁴ See IBFS File No. SAT-MOD-20220725-00074

application, the system will not create harmful interference to other systems authorized to provide service in the 1.6/2.4 GHz bands.¹⁵ By operating at low and very low altitudes, the proposed SpaceX 1.6/2.4 GHz MSS system will enable small spot beams and greater satellite diversity, achieving a high degree of frequency reuse and thereby significantly enhancing the data capacity that can be made available anywhere in the world and providing efficient reuse of the valuable spectrum resource. By ensuring every user has multiple satellites in view from any given point on the ground, SpaceX's system will have flexibility to deliver robust service, even in a crowded spectrum environment. As it has done with its first-generation NGSO FSS system, SpaceX will seek in every case to reach coordination agreements that optimize spectrum efficiency and allow for the greatest operational flexibility possible among licensed systems.

Finally, SpaceX has engineered its 1.6/2.4 GHz MSS capabilities to require no additional satellites on orbit beyond those the Commission has already licensed, or any change to their orbital characteristics. SpaceX has also designed the 1.6/2.4 GHz MSS payload so that it can be incorporated into SpaceX's first-generation FSS satellites without materially increasing the extremely low risk that these satellites will become a source of orbital debris. It will also have no effect on the satellites' reliability on orbit or their demisability.

III. ITU COST RECOVERY

SpaceX is aware that, as a result of the actions taken at the 1998 Plenipotentiary Conference, as modified by the ITU Council in 2005, the ITU now charges processing fees for satellite network filings. As a consequence, Commission applicants are responsible for any and all fees charged by the ITU. SpaceX confirms that it is aware of this requirement and accepts

¹⁵ See Technical Attachment

responsibility to pay any ITU cost recovery fees associated with this application. Invoices for such fees may be sent to the contact representative listed in the accompanying FCC Form 312.

IV. ELIGIBILITY AND OPERATIONAL REQUIREMENTS

To the extent necessary, SpaceX confirms that (1) it will post a surety bond as required under Section 25.165 of the Commission's rules; (2) it will comply with the Commission's milestone requirements; and (3) it does not have any other application for an NGSO-like satellite system license on file with the Commission, or any licensed-but-unbuilt NGSO-like system, in any frequency band involved in this application.

CONCLUSION

For the foregoing reasons, and for the reasons set forth in the accompanying materials, SpaceX requests that the Commission find that granting approval for orbital deployment and a station license (i.e., operating authority) for SpaceX's proposed mobile satellite service system using 1.6/2.4 GHz will serve the public interest, and issue such grant expeditiously.

Respectfully submitted,

SPACE EXPLORATION HOLDINGS, LLC

By: /s/ David Goldman

David Goldman

Senior Director of Satellite Policy

SPACE EXPLORATION TECHNOLOGIES CORP.

1155 F Street, NW

Suite 475

Washington, DC 20004

202-649-2700 tel

202-649-2701 fax

September 6, 2022