

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

Application of)
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)
SPACE EXPLORATION HOLDINGS, LLC)
)
For Modification to Deploy a)
2 GHz Mobile-Satellite System)
_____)

Call Signs: S2983 and S3018

IBFS File No. SAT-MOD-_____

**APPLICATION FOR MODIFICATION TO
DEPLOY A 2 GHz MOBILE-SATELLITE SYSTEM**

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SUMMARY

SpaceX's first-generation ("Gen1") non-geostationary orbit ("NGSO") Fixed-Satellite Service ("FSS") constellation is providing unprecedented satellite broadband service to Americans in fixed locations 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. And in the same way that SpaceX proposed a second-generation ("Gen2") constellation to augment its NGSO *FSS* capabilities, with this application SpaceX proposes to augment its NGSO *MSS* capabilities with authority to provide next-generation services to mobile users in those most remote corners of the country as well.

The 2 GHz band provides a unique opportunity to put underutilized MSS spectrum to highly productive use. While DISH Network is currently licensed to operate in the band, there is scant evidence that DISH is actually providing MSS service to anyone, anywhere. Moreover, its two aging satellites, launched over a decade ago, will reach the end of their license terms in the next two years and there is no indication of plans for replacements to continue, much less enhance, its meager-at-best MSS services. While DISH is authorized to deploy a terrestrial network operating in this band, the limited reach of its long-promised network will leave large portions of the country completely unserved by 2 GHz operations—even assuming DISH will actually meet its commitments for deployment and service provision this time. By providing SpaceX with access to this rich but otherwise fallow spectrum, the Commission could jumpstart MSS service in otherwise unserved areas of the country, as well as to other parts of the world that escape the reach of existing satellite and terrestrial systems.

As SpaceX demonstrates herein, the advanced capabilities of its proposed MSS system will enable operations in the 2 GHz band without causing harmful interference to other licensed users of the band. And because SpaceX proposes to include 2 GHz NGSO MSS transceivers as an additional modular payload on its licensed Gen1 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 MSS services in this underutilized spectrum band.

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**APPLICATION FOR MODIFICATION TO
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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”) license¹ to authorize operations in the 2000-2020 MHz and 2180-2200 MHz bands (the “2 GHz band”) for the provision of Mobile-Satellite Service (“MSS”). This application identifies all changes that SpaceX requests for its current authorization. SpaceX is also filing an FCC Form 312, Schedule S, Waiver Request, and updated technical showings to account for the changes proposed. SpaceX certifies that all other information provided in its Ku/Ka-band applications, as modified, remains unchanged.² Grant of this application will enable SpaceX to augment its MSS capabilities and thereby provide next-generation services to mobile users across

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

² See 47 C.F.R. § 25.117(c). See also Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System, IBFS File No. SAT-LOA-20161115-00118 (Nov. 15, 2016); Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System Supplement, IBFS File No. SAT-LOA-20170726-00110 (July 26, 2017); Application for Modification of Authorization for the SpaceX NGSO Satellite System, IBFS File No. SAT-MOD-20181108-00083 (Nov. 8, 2018); Application for Modification of Authorization for the SpaceX NGSO Satellite System, IBFS File No. SAT-MOD-20200417-00037 (Apr. 17, 2020).

the United States and around the world, including areas underserved or currently unserved by existing networks.

DISCUSSION

I. SPACEX'S 2 GHZ MSS CONSTELLATION

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 in 2002, 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 160 more times and has reflown boosters 102 times, including up to thirteen re-flights of a single booster. In May 2020, SpaceX used its Crew Dragon capsule 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 2,600 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. The Opportunity for Revitalization of 2 GHz MSS

In the ITU's international table of allocations, the 2000-2010 MHz band and the 2180-2200 MHz band have been allocated worldwide for MSS on a co-primary basis, and the 2010-2020 MHz band has been allocated for MSS on a co-primary basis in Region 2. Under the Commission's rules, the 2000-2020 MHz and 2180-2200 MHz bands are available for use by the 2 GHz MSS in the uplink and downlink directions, respectively.³ From the time the Commission first allocated 2 GHz spectrum to MSS, it "intended for MSS to provide communications in areas where it is difficult or impossible to provide communications coverage via terrestrial base stations and at times when coverage may be unavailable from terrestrial-based networks."⁴

At present, the Commission has authorized two non-U.S. licensed MSS systems to provide service to the U.S. market using this spectrum. The first, operated by Gamma Acquisition L.L.C.

³ See 47 C.F.R. § 25.202(a)(4)(ii).

⁴ *Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands*, 27 FCC Rcd. 16102, ¶ 6 (2012) ("AWS-4 Order") (citing *Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, 16 FCC Rcd. 15532, ¶ 1 (2001)).

(“Gamma”) and licensed by Canada, operates a single geostationary orbit (“GSO”) satellite that commenced operations at the 111° W.L. orbital location on July 19, 2009.⁵ The second, operated by New DBSD Satellite Services G.P. (“DBSD”) and licensed by the United Kingdom, also operates a single GSO satellite and commenced operations at the 92.85° orbital location on May 9, 2008.⁶ Gamma and DBSD are both wholly owned subsidiaries of DISH Network Corporation (“DISH”).⁷

DISH is also the sole licensee of the terrestrial AWS-4 service in the band.⁸ When the Commission gave these terrestrial rights to DISH for free with no auction, it acknowledged that neither DBSD nor Gamma (then known as TerreStar) was making much (if any) productive use of the 2 GHz band.

Despite having MSS and ATC [Ancillary Terrestrial Component] authority and an orbiting satellite, DBSD never offered either commercial satellite or terrestrial service and TerreStar offered only minimal satellite service (partnering with AT&T to offer a non-ATC satellite/terrestrial service using AT&T terrestrial spectrum and TerreStar satellite spectrum). To date, there remains little commercial use of this spectrum for MSS and none for terrestrial (ATC) service.⁹

Notably, the Commission found that DBSD had never offered MSS service three years *after* DBSD certified that its satellite had begun operations. Nearly a decade after the Commission gave DISH the AWS-4 rights, DISH has just begun terrestrial operations in a portion of the band in selected markets—though DISH claims yet again to be on the verge of launching a new terrestrial network

⁵ See Letter from Joseph A. Godles to Marlene H. Dortch, IBFS File No. SAT-LOI-19970926-00161 (July 20, 2009).

⁶ See Letter from Suzanne Hutchings Malloy to Marlene H. Dortch, IBFS File No. SAT-LOI-19970926-00163 (May 9, 2008).

⁷ See *Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands*, 28 FCC Rcd. 1276, ¶ 5 n.12 (IB & WTB 2013) (“*DBSD/Gamma Modification Order*”).

⁸ See *id.* ¶ 2.

⁹ *AWS-4 Order* ¶ 10 (footnote omitted).

that will cover limited portions of the country.¹⁰ Moreover, there is no evidence that either Gamma or DBSD is currently offering any MSS service in the band. This is a fundamental waste of valuable MSS spectrum—but also an opportunity for another more motivated operator to use the spectrum to provide services to Americans in underserved and unserved areas. Specifically, while DISH has squatted on its spectrum rights for a decade with little to show for it, SpaceX has in just a fraction of that time launched more than 2,600 satellites and offers high-speed broadband services to Americans across the country, no matter where they live, and in more than 30 other countries around the world.

After evaluating the current use of the 2 GHz band, SpaceX has concluded that it can leverage its technology and its rapid deployment to operate an NGSO MSS system to serve consumers in the band without substantially affecting other licensed operators. There are four bases for this conclusion.

First: the grant of U.S. market access for the Gamma and DBSD MSS satellites will expire in July 2024 and May 2023—i.e., fifteen years after the satellites’ respective commencement dates.¹¹ According to DISH’s most recent annual report filed with the Securities and Exchange Commission, the MSS satellite operated by Gamma has a useful lifetime of 14.25 years—which would mean that it could be expected to be retired sometime in 2023—while the useful lifetime of the MSS satellite operated by DBSD is listed as “N/A.”¹² DISH has not announced a contract to

¹⁰ See, e.g., Linda Hardesty, *Dish explains the costly phone choice for its new 5G network*, Fierce Wireless (May 9, 2022), <https://www.fiercewireless.com/5g/dish-explains-costly-phone-choice-its-new-5g-network> (discussing DISH’s belated launch of network in Las Vegas and hope to cover 20% of the U.S. population by June 2022, though use of Band 70 (including 2000-2020 MHz) will not begin until Q3 2022).

¹¹ See 47 C.F.R. § 25.121(a)(1).

¹² See DISH Network Corporation, Annual Report Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934 for Fiscal Year Ended December 31, 2021, at F-39 (2022), <https://dish.gcs-web.com/static-files/4e8db017-b1d9-4d94-a208-1233a1770f95>.

build a replacement for either of these MSS satellites. Accordingly, these satellites will likely cease operations within the next year or two, thereby eliminating even the potential for SpaceX service in the band to pose any issue.

Second: in that same annual report, DISH revealed that in 2020 it “wrote down the fair value of the [MSS] satellites to their estimated fair value of zero.”¹³ In other words, DISH places no value on the hardware that drives its MSS business—a conclusion confirmed by the conspicuous absence of any discussion of an MSS service in that annual report or any other evidence that DISH is in fact providing a commercial MSS service in the United States. In these circumstances, there is no reason to believe that DISH would invest the hundreds of millions of dollars required to replace its aging satellites to support a non-existent service, and no reason for the Commission not to license an additional operator to step in and provide MSS services whether or not DISH has officially relinquished its MSS authorizations.

Third: even in the extremely unlikely event that DISH did launch replacement satellites, SpaceX could easily coordinate with them. 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 DISH’s MSS operations in the band (such as they are). In addition, as the Commission recognized when initially establishing the 2 GHz MSS service, there is a significant difference between the GSO satellites operated by DISH and the NGSO constellation proposed herein by SpaceX. Specifically, “NGSO systems can provide complete and continuous global coverage, whereas, a single GSO satellite, while capable of providing continuous coverage, typically only can provide regional service.”¹⁴ Accordingly, even if the

¹³ *Id.*

¹⁴ *Establishment of Policies and Service Rules for the Mobile Satellite Service in the 2 GHz Band*, 15 FCC Rcd. 16127, ¶ 14 (2000).

DISH satellites actually were providing service, they would do so at most in the United States and perhaps the nearby region—leaving the rest of the world, including underserved polar regions, unserved and in need of service from a different operator using this spectrum.

Fourth and finally: the Commission has made clear that creation of the AWS-4 service was not meant to transform the 2 GHz band into primarily terrestrial spectrum.¹⁵ The Commission clearly intended for MSS service to continue operating in the band and took steps to ensure that this would be the case. Indeed, under Section 27.1136, an AWS-4 terrestrial licensee must accept any interference received from duly authorized 2 GHz MSS operations and must protect MSS operations in the band from harmful interference—effectively preserving the interference environment and the opportunity for MSS service in the band.¹⁶ But it would appear that DISH has all but abandoned MSS service in favor of the prospect for a limited terrestrial AWS-4 network, and in the process denied Americans (especially those in underserved and unserved areas) the benefits of truly ubiquitous mobile connectivity. While DISH is already well on its way to abandoning its MSS service, there is no reason for the Commission to do the same and thereby forego the recognized public interest benefits MSS can provide based on services from a motivated and capable licensee such as SpaceX.

C. SpaceX’s Proposed 2 GHz MSS System

The SpaceX 2 GHz MSS system will leverage SpaceX’s already-authorized constellation of low Earth orbit satellites as well as existing ground equipment and user terminals. It will also add new earth-station equipment to optimize performance for consumers. This new system will be highly spectrum-efficient, able to share the 2 GHz band with conventional GSO satellite and

¹⁵ See, e.g., *AWS-4 Order* ¶ 180 (“[N]othing we do today eliminates the existing mobile satellite allocation for the 2 GHz MSS band or limits the licensees’ continued satellite use rights for this spectrum . . .” (footnote omitted)).

¹⁶ See 47 C.F.R. § 27.1136.

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 2 GHz MSS system will consist of a flown payload on the 4,408 satellites in SpaceX’s Gen1 system. The orbital configuration of the SpaceX 2 GHz MSS System will, therefore, be identical to that of the Gen1 FSS system, as illustrated below:

SpaceX 2 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°

The proposed 2 GHz MSS system will use 2 GHz spectrum for communications between satellites and user terminals. SpaceX requests authority to operate on the 2000-2020 MHz and 2180-2200 MHz bands in the uplink and downlink directions, respectively. 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 proposed 2 GHz MSS system is included in Schedule S and the Technical Attachment accompanying this application.

ii. Ground Segment

SpaceX’s 2 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 a 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 SPACE X TO OFFER NEXT-GENERATION SERVICES TO MOBILE USERS IN REMOTE AREAS OF 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.¹⁷ SpaceX has launched over 2,600 satellites so far, and this system has begun delivering truly high-speed, low-latency broadband to fixed users across the United States—including to the most remote corners and Polar Regions of the country that too often get left behind—and around the world.¹⁸ To complement this Gen1 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 of just under 30,000 satellites.¹⁹ SpaceX has also been granted its license 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.²⁰

While these assets will enable SpaceX to provide unprecedented broadband capacity from its space-based platform, Americans are increasingly demanding connectivity wherever they are,

¹⁷ See *SpaceX Authorization*, *supra* note 1, at 1.

¹⁸ See Josh Fomon, *Starlink Hits 100+ Mbps Download Speed in 15 Countries During Q4 2021*, Ookla (Mar. 16, 2022), <https://www.ookla.com/articles/starlink-hughesnet-viasat-performance-q4-2021> (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).

¹⁹ See Application for Approval for Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite System, IBFS File No. SAT-LOA-20200526-00055 (May 26, 2020); Amendment, IBFS File No. SAT-AMD-20210818-00105 (Aug. 18, 2021).

²⁰ See *SpaceX Services, Inc.*, DA 22-695 (IB rel. June 30, 2022).

whenever they want, and whatever they are doing. In particular, they have grown accustomed to being able to connect using small, hand-held devices that they can carry with them or affix to mobile platforms. In order 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 frequency (“VHF”) 137-138 MHz and 148-150.5 MSS bands.²¹ 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.

And in the same way that SpaceX proposed its Gen2 constellation to augment its NGSO *FSS* capabilities, with this application SpaceX proposes to augment its NGSO *MSS* capabilities with authority to provide next-generation services to mobile users in those most remote corners of the country as well.

The 20 x 20 MHz of MSS spectrum available in the 2 GHz band will support a range of mobile satellite services, enabling SpaceX to craft a compelling array of offerings to address the connectivity needs of Americans. Due to its low altitudes, SpaceX’s 2 GHz MSS system will provide service with latency 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

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

missions. Improving capacity and latency for these users could have significant national security benefits. All of these services are in the public interest.

Significantly, SpaceX's proposed 2 GHz MSS constellation will employ a host of cutting-edge innovations to ensure its system does not cause radiofrequency interference to others. As discussed in the Technical Attachment accompanying this application, the system will not create harmful interference to GSO satellites authorized to provide service in the 2 GHz band—even assuming such satellites continue to operate beyond their current expiration dates.²² By operating at low altitudes, the proposed SpaceX 2 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 valuable spectrum resources. 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 Gen1 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 2 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 2 GHz MSS payload so that it can be incorporated into SpaceX's Gen1 FSS satellites without materially increasing the extremely low risk that these satellites will become a source of orbital debris. It will also have no affect on the satellites' reliability on orbit or their demisability.

²² See Technical Attachment 5-6.

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 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 2 GHz MSS system will serve the public interest, and issue such grant expeditiously.

Respectfully submitted,

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