

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

Application of

SPACE EXPLORATION HOLDINGS, LLC

For Modification of Authorization for the
SpaceX V-band NGSO Satellite System

IBFS File No. SAT-MOD-_____

Call Sign S2992

**APPLICATION FOR MODIFICATION OF AUTHORIZATION
FOR THE SPACEX V-BAND NGSO SATELLITE SYSTEM**

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March 22, 2023

SUMMARY

By adding V-band spectrum to its Gen2 satellites, SpaceX seeks to fulfill the Commission's vision of more powerful next-generation satellite systems to provide high quality broadband to Americans no matter where they live, work, or play, all without increasing the total number of satellites in orbit. Specifically, in securing the grant for the Gen2 system, SpaceX committed to the Commission that it would modify its existing authorized V-band system by placing its V-band radio equipment as payloads on the space stations launched into the Gen2 system rather than operating its V-band satellites as a separate system, as previously authorized. By adding V-band frequencies to the Gen2 satellites, SpaceX will be able to reduce the number of satellites it deploys, while making its system more robust and increasing the quality of service for consumers everywhere.

With this application, SpaceX therefore requests a modification of its V-band license so that it may deploy and operate up to 7,500 V-band payloads on satellites launched into its Gen2 system. Critically, this modification will enable SpaceX to make productive and valuable use of V-band frequencies without the need to deploy the nearly 12,000 separately authorized space stations in SpaceX's current V-band license, thereby enhancing space sustainability. This modification will also allow for satellite communication with earth stations in the V-band at 40.0-42.5 GHz (downlink) and 47.2-50.2 GHz and 50.4-51.4 GHz (uplink) at a minimum elevation angle of 25 degrees rather than the currently authorized 35 degrees. This lower minimum elevation angle allows SpaceX to more efficiently operate its V-band system and serve more users.

As demonstrated herein, SpaceX can conduct its modified V-band operations without presenting a significant interference problem. Moreover, because SpaceX will include V-band radio equipment as an additional modular payload on its Gen2 system, granting SpaceX's application provides the benefits of V-band capabilities discussed above without the cost and effort

of a standalone V-band satellite system. And notably SpaceX's proposed V-band operations will not increase the number of satellites in orbit, pose an additional risk from orbital debris, or require any additional physical coordination. Accordingly, the Commission should expeditiously grant SpaceX's application for modification.

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INTRODUCTION

In this application, Space Exploration Holdings, LLC (“SpaceX”) requests modification of its V-band non-geostationary orbit (“NGSO”) Fixed Satellite Service (“FSS”) license¹ to authorize deployment and operation of V-band radio equipment as payloads on up to 7500 space stations in its currently-authorized second generation NGSO FSS system (“Gen2 system”)². The frequencies remain the same as those in its existing V-band license: 37.5-42.5 GHz (space-to-Earth); and 47.2-50.2 GHz and 50.4-51.4 GHz (Earth-to-space) (“V-band frequencies”). Granting this application will enable SpaceX to augment its broadband service capabilities and leverage its next-generation Gen2 satellite constellation for satellite internet users across the United States and throughout the world.

¹ See *Space Exploration Holdings, LLC*, 33 FCC 11434 (2018) (“*V-band Authorization*”); Stamp Grant, IBFS File No. SAT-LOA_20170301-00027 (June 9, 2020) (authorizing use of the 50.4-51.4 GHz).

² See *Space Exploration Holdings, LLC*, FCC 22-91 (rel. Dec. 1, 2022) (“*Gen2 Authorization*”).

This application identifies all changes that SpaceX requests for its V-band system. SpaceX is also filing an FCC Form 312, Schedule S, requests for waiver, and updated technical showings to account for the changes proposed. SpaceX certifies that all other information provided in its V-band application remains unchanged.³

I. SPACEX’S V-BAND SYSTEM, AS MODIFIED, WILL SERVE THE PUBLIC INTEREST BY BRINGING THE BENEFITS OF V-BAND CAPABILITIES TO AMERICANS EVERYWHERE WHILE ENHANCING SPACE SUSTAINABILITY AND WITHOUT PRESENTING A SIGNIFICANT INTERFERENCE PROBLEM

A. SpaceX Background

SpaceX is a private company revolutionizing 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 9,500 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 numerous 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. SpaceX has since landed a first-stage booster more than 170 times and has re-flown over 145 boosters, including up to 17 re-flights of a single booster. In May 2020, SpaceX used its Crew Dragon capsule, the only U.S. human-rated orbital transport spacecraft, to become the first and only commercial operator to deliver astronauts to the ISS. And by leveraging the

³ See 47 C.F.R. § 25.117(c); *see also* Application for Approval of Orbital Deployment and Operating Authority for the SpaceX V-band NGSO Satellite System, IBFS File No. SAT-LOA-20170301-00027 (May 26, 2020) (“V-band Application”).

reusability of its rockets, SpaceX has launched over 3,900 of its own satellites, which are being 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 sustainability. 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.⁴ 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. The modular nature of its V-band payload, as proposed herein, embodies this commitment, as it will permit SpaceX to deploy V-band capabilities without launching additional satellites beyond its currently authorized Gen2 system of 7,500 satellites and eliminating the 11,943 satellites authorized in its current V-band license.⁵

B. Realizing the Commission's Vision for Space Safety by Making Good on SpaceX's Commitment to Modify its V-band License

When the Commission authorized SpaceX's Gen2 system in December 2022, consisting of 7,500 satellites in orbital shells at inclinations of 33, 43, and 53 degrees, the Commission also expected SpaceX to carry through on a commitment it made to reduce the number of Commission-authorized space stations in relation to SpaceX's existing V-band license. Namely, the Commission noted and relied on SpaceX's commitment to eliminate the nearly 12,000 additional

⁴ See *SpaceX's Approach to Space Sustainability and Safety*, SpaceX (Feb. 22, 2022), <https://www.spacex.com/updates/>.

⁵ See V-band Application, Technical Attachment at 1-2 (4425 satellites at an altitude over 1100 km and 7518 satellites at altitudes from 335-346 km); see also *V-band Authorization* ¶ 3.

satellites in its existing V-band license, including 7,518 satellites at altitudes from 335-346 km, and instead, SpaceX would seek a modification of its existing V-band license to deploy V-band payloads on the 7,500 satellites in the Gen2 system:

To address concerns about orbital debris and space safety, we limit this grant to 7,500 satellites only, operating at certain altitudes, and note that SpaceX has committed to requesting modification of its previously-granted license for operations in the V-band so that it will incorporate those V-band operations into its Starlink Gen2 system, rather than operating a separate system in the V-band. This means our action today does not increase the total number of satellites SpaceX is authorized to deploy, and in fact slightly reduces it, as compared to the total number of satellites SpaceX would potentially have deployed otherwise.⁶

SpaceX now files this application for modification to make good on its commitment to deploy its V-band system as modular payloads on its Gen2 system and further demonstrate its commitment to space sustainability. This modification will reduce SpaceX's authorized V-band system from the 11,943 separate satellites in its current V-band license to a system deployed on the 7,500 space stations of its currently authorized Gen2 system.

C. Description of V-Band System Architecture, as Modified, That Will Enhance SpaceX's Ability to Provide High Speed, Low Latency Broadband Services

The SpaceX V-band system, as modified, will consist of a constellation of low Earth orbit satellites that will leverage SpaceX's existing ground equipment as well as add new equipment that aims to optimize performance for consumers. It will be spectrally efficient and capable of sharing the V-band frequencies with other NGSO systems and conventional GSO satellite and terrestrial networks without presenting a significant interference problem, as demonstrated in the

⁶ *Gen2 Authorization* ¶ 2; *see also id.* ¶ 4 & n.17 (discussing 7518 authorized V-band satellites in very low earth orbit and SpaceX's intent to modify V-band license), ¶ 19 ("We also note that SpaceX recently notified the Commission that following issuance of a Gen2 Starlink license, it intends to seek a modification of its V-band authorization to harmonize the orbital parameters of those V-band space stations with those requested in the Gen2 Starlink application and operate them using additional radio equipment to be added to a subset of SpaceX's proposed Gen2 Starlink satellites, and not as separate spacecraft. SpaceX states that this modification will not increase, and may slightly reduce, the number of V-band space stations.").

Technical Attachment accompanying this application. 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 SpaceX V-band system, as modified, will consist of a payload on the satellites currently authorized to deploy as part of SpaceX's Gen2 system, and subject to the conditions set forth in the *Gen2 Authorization* initially granting SpaceX authority to launch and operate 7,500 satellites.⁷ SpaceX intends to deploy and operate its V-band system, as modified, on up to 3,360 Gen2 satellites at an inclination of 43 degrees, up to 3,360 Gen2 satellites at an inclination of 53 degrees, and up to 780 Gen2 satellites at an inclination of 33 degrees.

The incorporation of SpaceX's V-band operations onto the satellites in its authorized Gen2 system demonstrates, yet again, SpaceX's commitment to space safety and minimizing the risk of orbital debris. No additional risk of orbital debris arises from deploying and operating V-band payloads on the satellites in its Gen2 system. Complementing this benefit, the elimination of the separate space stations authorized in SpaceX's currently licensed V-band system will dramatically enhance space safety as compared to SpaceX launching and operating those additional space stations.

SpaceX has also designed its proposed modification to allow its space stations to communicate with its earth stations at 40.0-42.5 GHz (downlink) and 47.2-50.2 GHz and 50.4-51.4 GHz (uplink) at a lower minimum elevation angle as compared to its current license—i.e., 25 degrees instead of 35 degrees—without presenting a significant interference problem. A lower elevation angle means a more efficient, more robust network with fewer outages and higher capacity, allowing SpaceX to serve even more Americans, no matter where they are. The benefits

⁷ See *Gen2 Authorization* ¶¶ 6-8.

of a lower elevation angle for SpaceX's V-band system, as modified, thereby will further enhance the groundbreaking capabilities of SpaceX's currently authorized Gen2 system, which is authorized for operations in the Ku- and Ka-bands, with a pending request to operate in the E-band as well. Notably, to achieve the benefits of lower elevation angle without presenting a significant interference problem to other authorized V-band systems, SpaceX will make appropriate reductions to its power flux density in the downlink at 40.0-42.5 GHz (by 8 dB) and to its equivalent isotropically radiated power (EIRP) in the uplink at 47.2-50.2 GHz and 50.4-51.4 GHz (by 7 dB) as compared to its current V-band license.

A more precise description of the SpaceX V-band system, as modified, including its frequency and channelization plan, is included in Schedule S and the Technical Attachment accompanying this application.

ii. Ground Segment

The SpaceX V-band system, as modified, will communicate with gateway earth stations and user terminals capable of providing broadband connectivity virtually anywhere. An aspect of the ground segment is described in the space segment section above as well, specifically reduction of uplink EIRP. While SpaceX plans to leverage its existing FSS ground infrastructure to support V-band operations, it will submit applications to the Commission as needed to request authority

for gateway earth stations and user terminals that will operate in the United States and its possessions and territories, pursuant to the Commission's rules.⁸

D. SpaceX's V-band System, as Modified, Enhances the Capabilities of its Gen2 System's Next-Generation Broadband on Behalf of Underserved and Unserved Users Across the United States and Around the World

SpaceX is dedicated to iteratively improving its systems and leveraging advancements in satellite technology to ensure that high-speed, low-latency broadband can be a reality for all people. The Commission previously granted modifications to SpaceX's first-generation constellation to facilitate greater coverage, higher capacity, and reduced latency for consumers.⁹ SpaceX has realized these objectives by launching over 3,900 operational satellites to date in that system, thereby extending true broadband connectivity across the United States—including Americans living in the most remote corners and polar regions of the country. Moreover, SpaceX continues to explore innovative approaches to expand its service capacity. For example, the Commission has authorized SpaceX to operate earth stations in motion that reflect American consumer and business realities on the ground by enabling broadband services on moving aircraft, ships, and motor vehicles.¹⁰

In the meantime, consumer demand for broadband is surging, and extending connectivity to all Americans, especially those on the wrong side of the digital divide, requires an infusion of innovative capabilities and capacity. Recognizing this, the Commission recently authorized SpaceX to deploy 7,500 satellites in its high capacity Gen2 system—a next-generation satellite network that augments its existing first-generation constellation.¹¹ The Gen2 system, as currently

⁸ See, e.g., 47 C.F.R. § 25.115.

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

¹⁰ See *SpaceX Services, Inc.*, DA 22-695 (IB, rel. June 30, 2022).

¹¹ See generally *Gen2 Authorization*.

authorized, consists of a constellation of low Earth orbit satellites, and will leverage SpaceX's existing ground equipment and user terminals, as well as add new equipment, to optimize performance for consumers.

By designing its overall system from the ground up, SpaceX can ensure that each element of its Gen2 system is optimized for performance while keeping cost-effectiveness and reliability in mind throughout the entire deployment lifecycle. Although satellites that operate in the Gen2 system will have a much greater data capacity than SpaceX's first-generation satellites, SpaceX will continue to iteratively improve its satellites over the course of the Gen2 system's multi-year deployment to further increase network capacity.

This application represents an important step in the goal for improving SpaceX's satellite systems that provide broadband service, by deploying the modified V-band system as payloads on the Gen2 satellites. The modified V-band system will enable the capacity, robustness, efficiency, and space safety advantages discussed above. And like the authorized Gen2 system, the modified V-band system will be configured to ensure frequency reuse across different satellites to further enhance the flexibility, capacity, and robustness of the overall system. Consequently, granting this application to modify SpaceX's V-band system will help meet the ever-increasing American demand for next generation broadband connectivity, no matter where those Americans are and including those Americans currently living in unserved and underserved areas, and it will do so with greater space sustainability and without presenting a significant interference problem for other V-band systems.

II. 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.

CONCLUSION

For the foregoing reasons, and for the reasons set forth in the accompanying materials, SpaceX requests that the Commission find that modifying SpaceX's V-band system to allow it to construct, deploy, and operate V-band payloads on its currently authorized Gen2 satellites will serve the public interest, and issue such grant expeditiously.

Respectfully submitted,

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