

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)
Swarm Technologies, Inc.) IBFS File No. SAT-LOA-20181221-00094
Application for Authority to Deploy and Operate) Call Sign: S3041
a Non-Voice, Non-Geostationary Lower Earth)
Orbit Satellite System in the Mobile-Satellite)
Services)

MEMORANDUM OPINION, ORDER AND AUTHORIZATION

Adopted: October 17, 2019

Released: October 17, 2019

By the Chief, Satellite Division, International Bureau:

I. INTRODUCTION

1. In this Memorandum Opinion, Order and Authorization we grant, with conditions, the application of Swarm Technologies, Inc. (Swarm) to construct, deploy, and operate a constellation of 150 technically identical non-voice, non-geostationary (NVNG) satellites in the low earth orbit (LEO) for the provision of mobile-satellite services (MSS).1 Swarm proposes to operate the satellites using frequencies in portions of the 137-138 MHz (space-to-Earth) and 148-149.95 MHz (Earth-to-space) bands. In authorizing Swarm’s application, we address a Petition to Dismiss, Deny, or Hold in Abeyance filed by ORBCOMM License Corp. We also address comments filed by Space Exploration Holdings, LLC and note numerous comments filed in support of Swarm’s application.

II. BACKGROUND

2. Application. Swarm requests authority to deploy a NVNG MSS constellation of small two-way communications satellites using Very High Frequency (VHF) bands for global services, including the conterminous United States, Alaska, Hawaii, and U.S. Territories.2 Each satellite has a total mass ranging from 0.31 to 0.45 kilograms, and dimensions of 11x11x.2.8 cm, excluding the deployable antennas.3 Swarm proposes use of inclinations ranging from equatorial to polar, deployment altitudes ranging from 400-550 kilometers, and operational altitudes ranging from 300-550 kilometers.4 Swarm

1 NVNG MSS is a mobile-satellite service reserved for use by non-geostationary satellites in the provision of non-voice communications. At the 1992 World Administrative Radio Conference, the 137–138 MHz, 148–150.05 MHz, and 400.15–401 MHz frequency bands were allocated on a worldwide primary shared basis to the mobile-satellite service, limited to non-geostationary satellite systems. The Commission classified satellites providing NVNG in MSS frequencies below 1 GHz as Little LEOs. Review of 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 13357, at para. 1, n.1 (2004).

2 Swarm Technologies, Inc., IBFS File No. SAT-LOA-20181221-00094 (Swarm Application), Narrative at 6.

3 Id. at 2.

4 Swarm identifies four “desired” and “representative” orbits at inclinations of 10, 45, 97.4, and 97.6 degrees. Swarm Application, Exhibit A at 3. Swarm estimates that 506 satellites will need to be deployed during the fifteen-year license term to maintain a constellation of 150 operational satellites. Id. at 7.

proposes to operate in portions of the 137-138 MHz and 148-149.95 MHz band that are not assigned to ORBCOMM, a current NVNG MSS licensee.

3. *Responses to Public Notice.* Swarm's application was placed on public notice on March 1, 2019.⁵ In response, ORBCOMM filed a Petition to Dismiss, Deny, or Hold in Abeyance.⁶ ORBCOMM alleges that Swarm's proposal does not conform to the Commission's rules for NVNG MSS. In addition, ORBCOMM claims that Swarm has made no effort to coordinate its system and will interfere with ORBCOMM's system.⁷ ORBCOMM also asserts that it has primary interference protection rights throughout the entire 148-150.05 MHz band, and therefore Swarm's claim that it will not be sharing any frequencies with ORBCOMM is erroneous.⁸

4. Space Exploration Holdings, LLC (SpaceX) filed comments to Swarm's application, particularly addressing concerns with Swarm's orbital debris mitigation plan.⁹ In addition, over 20 entities filed letters in support of granting Swarm's application. These entities plan to utilize Swarm's network to provide a variety of communications services in support of agribusiness, transportation, and academic and scientific research.¹⁰

III. DISCUSSION

5. After review of the record, we conclude that grant of Swarm's application, as conditioned, will serve the public interest. Below we discuss the various issues raised by Swarm's application and ORBCOMM's opposition, and conditions imposed on Swarm's authorization. Where appropriate, we defer matters pending the outcome of applicable rulemaking proceedings.

6. *137-138 MHz bands.* Under the U.S. Table of Frequency Allocations, the 137-138 MHz band is allocated for downlinks in Federal and non-Federal uses on a co-primary basis to the space operation service (space-to-Earth), meteorological satellite service (space-to-Earth), and the space research service (space-to-Earth). In addition, sub-bands of the 137-138 MHz band are also allocated to the MSS (space-to-Earth), either on a co-primary or secondary basis, in both the Federal and non-Federal Tables, but are limited to NVNG satellite systems. Swarm proposes to use frequencies in this band in conformance with the allocation.¹¹ We note that operations in the downlink band in the MSS are subject to a number of service rules to protect NOAA meteorological satellite systems and condition Swarm's authorization accordingly.¹² In addition, technical information provided by Swarm in its application indicates that the power flux density on the Earth generated by downlink transmissions from one of its space stations will not exceed -175 dB(W/m²)/4kHz in frequencies below 136.9875 MHz.¹³ We therefore impose this power-flux density limit as a condition of this grant.

⁵ *Public Notice*, Satellite Policy Branch Information, Report No. SAT-01374 (March 1, 2019).

⁶ ORBCOMM License Corp., Petition to Dismiss, Deny, or Hold in Abeyance (filed April 1, 2019) (ORBCOMM Petition).

⁷ *Id.* at 6.

⁸ *Id.* at ii, 9-10.

⁹ Comments of Space Exploration Holdings, LLC filed April 1, 2019 (SpaceX Comments).

¹⁰ See Letters in support filed in IBFS File No. SAT-LOA-20181221-00094 and listed in Attachment A to this Order.

¹¹ See Letter to Marlene Dortch, Secretary, FCC, from Edward A. Yorkgitis, Jr., Counsel for Aviation Spectrum Resources, Inc. (Oct. 7, 2019) (summary of discussions with Swarm addressing Swarm's operations in the 137.025-137.175 MHz band and protections to adjacent band aviation safety services).

¹² 47 CFR § 25.259.

¹³ Swarm Application, Narrative at 22.

7. *The 148-150.05 MHz band.* Swarm proposes to use frequencies in the 148-150.05 MHz band, which is allocated to the MSS (Earth-to-space) on a primary basis in the Federal and non-Federal Tables and is also limited to NVNG satellite systems. The 148-149.9 MHz frequency band is allocated by footnote to the space operation service (Earth-to-space) on a co-primary basis in the Federal and non-Federal Tables.¹⁴ The 148-149.9 MHz frequency band is also allocated to the fixed service (FS) and mobile service (MS) on a co-primary basis for Federal use.¹⁵ The 149.9-150.05 MHz band is also allocated to the radionavigation-satellite service (RNSS) on a co-primary basis in the Federal and non-Federal Tables.¹⁶

8. ORBCOMM filed a Petition to Dismiss, Deny, or Hold in Abeyance Swarm's application.¹⁷ In considering the issues raised by ORBCOMM, it is beneficial to review the initial Little LEO licensing process pursuant to which ORBCOMM received its license. In 1997 and 1998, the 137-138 MHz and 148-150.05 MHz bands were part of a series of processing rounds and rulemaking actions, which resulted in the grant of several licenses for the provision of MSS in these bands.¹⁸ Originally, the Commission issued three satellite system licenses.¹⁹ Later, the Commission concluded that there was sufficient spectrum available to authorize additional Little LEO systems. As a result of the second processing round, there were five participants, including ORBCOMM, that agreed to a sharing plan using specific sharing techniques and interference avoidance technologies. In subsequent years, all the Little LEO licensees either lost or surrendered their licenses, except ORBCOMM. ORBCOMM has been operating since 2007.²⁰ ORBCOMM's authorization was modified several times and at present, it is authorized to operate in specific sub-bands in the 137-138 MHz and 148-150.05 MHz bands on a primary basis.²¹ ORBCOMM was also granted authority to operate throughout the 137-138 MHz and 148-150.05 MHz frequency bands until commencement of operations by another U.S.-licensed NVNG MSS system.²² To date, no other NVNG MSS systems have operated in these frequency bands under part 25 rules,

¹⁴ Under an international footnote, space operation service operations in the 148-149.9 MHz band are subject to agreement obtained under No. 9.21 of the ITU Radio Regulations. The bandwidth of any individual transmission shall not exceed ± 25 kHz.

¹⁵ Under an international footnote, MSS operations in the 148-149.9 MHz band must be coordinated under No. 9.11A of the ITU Radio Regulations and use of the band by the MSS shall not constrain the development and use of the fixed, mobile and space operation services in this band.

¹⁶ Under an international footnote, MSS operations in the 149.9-150.05 MHz band must be coordinated under No. 9.11A of the ITU Radio Regulations and use of the band by the MSS shall not constrain the development and use of the band by the radionavigation satellite-service.

¹⁷ ORBCOMM states that if the Commission does not deny or dismiss Swarm's application, it should hold the application in abeyance until Swarm amends the application to demonstrate compliance with the Commission's requirements for NVNG MSS applicants. ORBCOMM Petition at 12.

¹⁸ For an overview, see *Amendment of Part 25 of the Commission's Rules to Establish Rules and Policies Pertaining to the Second Processing Round of the Non-Voice, Non-Geostationary Mobile Satellite Service*, Report and Order, 13 FCC Rcd 9111 (1997) (*Second Processing Round Order*).

¹⁹ See *Orbital Communications, Corp.*, Order and Authorization, 9 FCC Rcd 6476 (Int'l Bur. 1994); *Starsys Global Positioning, Inc.*, Order and Authorization, 11 FCC Rcd 1237 (Int'l Bur. 1995); and *Volunteers in Technical Assistance*, Order and Authorization, 11 FCC Rcd 1358 (Int'l Bur. 1995).

²⁰ *Applications by ORBCOMM License Corp.*, Order and Authorization, 23 FCC Rcd 4804 (IB, OET 2008) (*ORBCOMM 2008 Order*).

²¹ See *ORBCOMM 2008 Order*, 23 FCC Rcd at 4812-13; ORBCOMM License Corp., SAT-MOD-20111021-00207, SAT-AMD-20130212-00020, and SAT-AMD-20151223-00087 (partial grant of Apr. 25, 2013 and partial grant of Dec. 17, 2015).

²² *ORBCOMM 2008 Order*, 23 FCC Rcd at 4808.

although a handful of applications for experimental licenses, including from Swarm, have been submitted in these frequency bands.²³

9. ORBCOMM does not object to Swarm's proposed use of downlink frequencies in the 137-138 MHz band. It maintains, however, that ORBCOMM was granted primary interference protection rights throughout the entire 148-150.05 MHz uplink band.²⁴ ORBCOMM states that Swarm does not comply with the requirements for all NVNG MSS licensees to incorporate specific co-frequency spectrum sharing technologies and techniques in their respective satellite systems, as proposed by the applicants and adopted by the Commission in the *Second Processing Round Order*.²⁵ ORBCOMM states that Swarm failed to demonstrate how it would comply with these "long established spectrum sharing requirements."²⁶

10. ORBCOMM also states that Commission rules specifically address coordination between incumbents and new licensees. ORBCOMM asserts that Swarm has made no effort to contact ORBCOMM to coordinate the Swarm system, as required by the Commission's rules. ORBCOMM states that Swarm's claim that it will not share frequencies, and therefore not interfere with ORBCOMM's system, is erroneous.²⁷ In addition, ORBCOMM claims that Swarm's proposed system does not comply with interservice co-primary sharing requirements, specifically noting Footnote US323 to the U.S. Table of Frequency Allocations.²⁸

11. In its response, Swarm reiterates that it has applied to use only those sub-bands where ORBCOMM has secondary rights, not those portions of the 148-150.05 MHz band where ORBCOMM is assigned on a primary basis.²⁹ Consequently, ORBCOMM has no basis to claim interference protection rights across the entire band, or require that Swarm use a particular interference avoidance technology that was developed for systems in the second processing round, over 25 years ago.³⁰ Instead, Swarm states it should be able to determine the technologies that work best for its system and utilize the advancements in satellite technology. Swarm asserts that ORBCOMM's claims essentially expand its rights to use the entire 148-150 MHz band, effectively modifying its authorization without an application process. Instead, argues Swarm, ORBCOMM must vacate frequencies that it was not assigned on a

²³ See e.g., Swarm Technologies, File No. 0158-EX-CN-2019 Granted July 19, 2019.

²⁴ ORBCOMM Petition at 9.

²⁵ *Id.* In adopting a spectrum sharing plan in the *Second Processing Round Order*, the Commission utilized defined "Systems" based on the needs of several new applicants and the incumbent licensees, including ORBCOMM. Specifically, the Commission stated that one new Little LEO applicant could operate a system (System 1) in the 148-150.05 MHz (uplink) band, and the 137-137.025 MHz, 400.15-400.505 MHz and 400.645-401 MHz (downlink) bands. A second new Little LEO applicant could operate a system ("System 2") in the 148-150.05 MHz (uplink) and the 400.15-401 MHz and 137-138 MHz (downlink) bands. The spectrum available to Systems 1 and 2 would be used most efficiently with FDMA/TDMA transmission techniques. A third new Little LEO applicant could operate a system ("System 3") in the 148-148.905 MHz (uplink) and the 137.0725-137.9275 MHz (downlink) spectrum using a spread spectrum system to accommodate NOAA. Further, the Commission anticipated that ORBCOMM would operate in accordance with DCAAS/FDMA transmission techniques to minimize interference among its system, System 1 and System 2. *Second Processing Round Order*, 13 FCC Rcd at 9135.

²⁶ ORBCOMM Petition at 4.

²⁷ *Id.* at 3.

²⁸ 47 CFR § 2.106, Footnote US323, providing in part that "individual mobile earth stations in the band that do not avoid frequencies actively being used by the fixed and mobile services shall not exceed a power density of -16dBW/4 kHz and shall transmit no more than 0.25% of the time during any 15-minute period.

²⁹ Swarm Technologies Inc., Consolidated Opposition and Response filed April 15, 2019 (Swarm Consolidated Response) at 2.

³⁰ *Id.* at 10.

primary basis.³¹ Swarm also responds that ORBCOMM's concerns regarding Swarm's compliance with Footnote US323 are premature, and that it will address its earth stations' compliance with the Commission's rules when it applies for the ground segment of its network.³² We agree with Swarm and will address its compliance with Footnote US323 in the context of its earth station applications. Nonetheless, we include a condition in this authorization requiring Swarm's transmit earth station operations to comply with the Footnote US323.

12. In the *Second Processing Round Order* the Commission designated specific sub-bands for use among the applicants in the 148-150.05 MHz band.³³ ORBCOMM was subsequently authorized to modify its system by adding "System 1" frequencies.³⁴ The Commission also, to put otherwise vacant frequencies to use, allowed ORBCOMM to use frequencies other than its primary assignments on a non-harmful interference basis with respect to other lawful operations.³⁵ The Commission stated that "[u]pon commencement of operations by another U.S.-licensed Little LEO system ORBCOMM may operate only in its primary assigned frequency bands..."³⁶ In these statements, the Commission made clear that ORBCOMM does not have exclusive rights to the entire 148-150.05 MHz band and that, upon the commencement of operations by a qualified licensee, ORBCOMM must limit operations to its primary assigned bands consistent with the plan adopted in the *Second Processing Round Order*.³⁷ Swarm has not requested use of any of the bands assigned to ORBCOMM on a primary basis vis-à-vis other MSS systems. Consequently, we disagree with ORBCOMM's assertion that Swarm is disregarding ORBCOMM's spectrum rights.

13. We also find unconvincing ORBCOMM's claims that Swarm's application should be denied because it does not comply with the sharing schemes and technologies developed in the *Second Processing Round Order*.³⁸ In that Order, the Commission stated that with appropriate transmission techniques, coordination, and time sharing, there was sufficient spectrum to issue five licenses. The

³¹ *Id.* at 11.

³² *Id.* at 18.

³³ *Second Processing Round Order*, 13 FCC Rcd at 9132. It also stated that the objective in the *Second Processing Round Order* was to foster an environment that promotes competition through new entry... and to produce new and innovative Little LEO service offerings to the public. *Id.* at 9117.

³⁴ ORBCOMM 2008 Order, 23 FCC Rcd at 4807.

³⁵ *Id.* at 4808. Operators using spectrum on a secondary basis may not cause harmful interference to or claim protection from harmful interference caused by operations on a primary basis.

³⁶ *Id.* Specifically, the Commission authorized operations in the 148-148.25 MHz, 148.75-148.855 MHz, and 148.905-149.9 MHz uplink frequency bands, and the 137.175-137.3275 MHz, 137.4225-137.4725 MHz, 137.535-137.585 MHz, 137.650-137.750 MHz and 137.7875-137.8125 MHz downlink frequency bands and additional frequency bands described as "System 1" in the *Second Processing Round Order*, generally including the 148-148.25 MHz, 148.75-148.855 MHz, 148.905-149.81, and 150.05 MHz uplink frequency bands, and the 137-137.025 MHz, and 400.15-400.505, and 400.645-401 MHz downlink frequency bands, on a primary basis. Operations on other frequencies in the 137-138 MHz and 148-150.05 MHz bands are "authorized subject to ORBCOMM Licensee Corp. operating using only frequency bands assigned to it on a primary basis, consistent with the spectrum sharing plan adopted by the Commission in that *Report and Order*, upon commencement of operations by another U.S.-licensed non-voice, non-geostationary mobile satellite system." *Id.* at 4812.

³⁷ *Id.*

³⁸ ORBCOMM Petition at 8; see also Letter from Walter H. Sonnenfeldt, Regulatory Counsel, ORBCOMM License Corp., to Marlene H. Dortch, Secretary, FCC, (July 1, 2019) (ORBCOMM July 2019 *Ex Parte* Letter) (arguing that ORBCOMM is not required to vacate spectrum to accommodate Swarm's proposed narrowband FDMA satellite system).

Commission recognized that allowing the applicants to develop a spectrum sharing plan would promote competition and a more efficient use of the spectrum.³⁹

14. Accordingly, the Commission adopted the plan agreed to by the parties that accommodated three new Little LEO systems and allowed two existing licensees, including ORBCOMM, to expand their systems. Importantly the Commission noted that the licensing scheme and service rules it was adopting were “applicable to *second processing* round Little LEO licensees.”⁴⁰ The applicants were directed to amend their applications to comply with the plan and rules adopted by the Commission, and their authorizations were granted consistent with the plan.⁴¹ ORBCOMM, however, interprets the Commission’s adoption of the plan as applying to any licensee seeking to use NVNG MSS frequencies regardless of the time of licensing.⁴² We disagree. We do not expect or require a NVNG MSS system that did not participate in the sharing plan, mutually agreed to by the second-round applicants, to be bound by the plan that in any case was intended to apply to a processing round closed more than 20 years ago.⁴³ Thus, Swarm is not required to incorporate any particular sharing technique agreed to in the second processing round for its proposed operations.

15. *SpaceX comments.* SpaceX requests that Swarm be required to provide a more detailed risk analysis as it understated the orbital debris risk posed by its constellation.⁴⁴ SpaceX identifies several shortcomings, including that Swarm failed to account for antenna size in its calculations. SpaceX also maintains that Swarm’s system poses a risk to the International Space Station (ISS). It states that Swarm should be required to coordinate with NASA, and to incorporate technologies to guarantee it can avoid the ISS. Finally, SpaceX comments that any authorization should be conditioned to conform with any rules adopted in the Commission’s orbital debris proceeding.⁴⁵ In response, Swarm submitted supplemental materials to address these concerns, including an analysis accounting for deployed antennas.⁴⁶ Swarm also committed to comply with future rulemakings, and to coordinate operations with the ISS and other approved operators.⁴⁷ We find that Swarm has taken the appropriate steps to address SpaceX’s concerns, and condition Swarm’s application on compliance with the outcome of the Commission’s Orbital Debris proceeding.⁴⁸

16. *Waiver.* As part of its application, Swarm seeks waivers of the Commission’s processing round procedure set forth in section 25.157 of the Commission’s rules.⁴⁹ The Commission may waive

³⁹ *Second Round Processing Order*, 13 FCC Rcd at 9118.

⁴⁰ *Id.* at 9117 (emphasis added) and 9122 (“We remind the applicants that this Report and Order adopts a licensing scheme and service rules that will be applicable to second processing round Little LEO licenses.”).

⁴¹ See e.g., *LEO One USA Corporation*, Order and Authorization, 13 FCC Rcd 2801 (Int’l Bur. 1998) (“LEO One is authorized ... to provide mobile satellite service ... in accordance with the frequency bands designated for System 1 in the spectrum sharing plan adopted in the [Second Processing Round Order]”).

⁴² ORBCOMM Petition at 9; ORBCOMM July 2019 *Ex Parte* Letter at 2.

⁴³ The rules adopted in the *Second Round Processing Order* did not include the specific details of the sharing mechanisms agreed for the various Systems. The only element of these sharing mechanisms incorporated in the rules was section 25.142(e). However, this section was subsequently deleted as obsolete. *Comprehensive Review of Licensing & Operating Rules for Satellite Services*, Report and Order, 28 FCC Rcd 12403, 12451–52 (2013).

⁴⁴ SpaceX Comments at 3.

⁴⁵ *Id.* at 5.

⁴⁶ Swarm Consolidated Response at 24, and Appendix A.

⁴⁷ Swarm Consolidated Response at 30.

⁴⁸ SpaceX Comments at 5; *Mitigation of Orbital Debris in the New Space Age*, Notice of Proposed Rulemaking, 33 FCC Rcd 11352 (2018).

⁴⁹ 47 CFR § 25.157.

any rule for good cause shown.⁵⁰ Waiver is appropriate if special circumstances warrant a deviation from the general rule and such a deviation will serve the public interest.⁵¹ We find good cause to grant Swarm's request. To accommodate multiple NGSO systems, which generally cannot operate on shared spectrum, the processing round procedure employs frequency band segmentation to assign spectrum among operators. The purpose of the processing round procedure is to prevent one applicant from unreasonably precluding additional entry by other operators in the requested frequency band.⁵² Swarm states it is only using a fraction of the spectrum allocated for Little LEO NVNG services and there will be ample spectrum for another entrant.⁵³ Currently, there are four other NVNG MSS applications on file and none of those include proposals to use the frequencies requested by Swarm.⁵⁴ Swarm also states that after the prior processing rounds, NVNG MSS spectrum was made available on a first-come, first-served basis.⁵⁵ ORBCOMM opposes Swarm's request for a waiver of processing round rules stating that circumstances have changed since its license modification was granted on a first-come, first-served basis in 2007, when there was little likelihood of additional applicants.⁵⁶

17. The Commission has granted several waivers of the processing round rules for NGSO satellites, including small satellites.⁵⁷ Swarm has stated that while it uses a Carrier-Sense Multiple Access (CSMA) protocol it is also capable of sharing channels using TDMA, and geographic sharing. In sum, Swarm asserts that its system is capable of sharing with future networks in a variety of ways.⁵⁸ To the extent that authorizing Swarm to operate in certain sub-bands of the NVNG MSS spectrum does not preclude other NVNG MSS systems from operating in these bands, we grant Swarm's request for a waiver. We note, however, that granting Swarm's application before any possible future applications for the same frequencies does not confer on Swarm a higher status with respect to later authorized systems, unlike the first-come, first-served system specified in the Commission's rules for GSO-like satellite operations. Moreover, depending on the number of any such applications and their ability to effectively share spectrum, a processing round, including Swarm, may be initiated in the future to resolve mutual exclusivity concerns.

⁵⁰ 47 CFR § 1.3.

⁵¹ *Northeast Cellular Tel. Co. v. FCC*, 897 F.2d 1164 (D.C. Cir. 1990).

⁵² *See Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 7809, 7829 (2017) ("The purpose of the recent processing rounds was to establish a sharing environment among NGSO systems, to provide a measure of certainty in lieu of adopting an open-ended requirement to accommodate all future applicants.").

⁵³ *Ex Parte* Letter to Marlene H. Dortch, Secretary, FCC, from Kalpak Gude, General Counsel, Swarm Technologies, Inc., at 2 (May 17, 2019) (Swarm May 17 Letter).

⁵⁴ *See* Hiber Inc., IBFS File No. SAT-PDR-20180910-00069, and Myriota Pty Ltd., IBFS File No. SAT-PDR-20190328-00020, requesting U.S. market access for NVNG MSS operations in the 399.9-400.05 MHz and 400.15-401 MHz bands, and Spire Global, Inc, IBFS File Nos. SAT-PDR-20190321-00018 and SAT-LOA-20151123-00078, proposing operations in the 399.9-400.05 MHz band.

⁵⁵ *See* Policy Branch Information, Actions Taken, 20 FCC Rcd 20273 (2005). "The [NVNG MSS] spectrum formerly licensed to VITA is now available to new applicants. Applications for this spectrum will processed under the first-come, first served procedure..."; *see also* Policy Branch Information, Spectrum Available, 19 FCC Rcd 4804 (2004).

⁵⁶ ORBCOMM Petition at 10.

⁵⁷ Planet Labs, Inc., IBFS File No. SAT-LOA-20130626-00087 (granted Dec. 3, 2013); Space Imaging LLC, *Declaratory Order and Order and Authorization*, DA 05-1940 (Int'l. Bur., released July 6, 2005).

⁵⁸ Swarm May 17 Letter, at 2.

IV. ORDERING CLAUSES

18. Accordingly, IT IS ORDERED that the Application filed by Swarm Technologies, Inc. is GRANTED, as set forth in this Memorandum Opinion, Order and Authorization, pursuant to section 309(a) of the Communications Act of 1934, as amended, 47 U.S.C. § 309(a). Swarm Technologies, Inc. is AUTHORIZED to construct, deploy, and operate 150 satellites capable of operating in the 137-138 MHz (space-to-Earth) and in the 148-149.95 MHz (Earth-to-space) bands in accordance with the technical specifications set forth in its application and in compliance with the Commission's rules, unless waived herein, and subject to the following conditions:

- a. Swarm is authorized to operate in the following sub-bands: 137.0250-137.1750 MHz, 137.3275-137.3750 MHz, 137.4725-137.5350 MHz, 137.5850-137.6500 MHz, and 137.8125-138.0000 MHz (space-to-Earth); and 148.2500-148.5850 MHz, 148.6350-148.7500 MHz, and 149.9000-149.9500 MHz (Earth-to-space).
- b. Swarm's operations in the frequency range 137.825-138.0000 MHz (space-to-Earth) will be conducted on a secondary basis.
- c. Swarm must coordinate its operations in the bands listed above with U.S. Government systems operating in the same bands.
- d. Swarm's operations must comply in general with the emission limitations set forth in section 25.202(f) of the Commission's rules. However, in frequencies below 136.9875 MHz, the power flux density on the Earth generated by downlink transmissions from a Swarm space station must not exceed $-175 \text{ dB(W/m}^2\text{)/4kHz}$.
- e. The total number of satellites deployed during the license term, including technically identical replacement satellites deployed pursuant to 47 CFR § 25.113(i), must not exceed 600. Swarm must report within 30 days, by submission to the International Bureau Filing System, if at any point the percentage of satellites that have failed prior to their planned end of life at approximately 300-kilometer altitude exceeds ten percent (excluding any satellites lost due to launch failures).
- f. Swarm's operations in the frequency band 137-138 MHz will be conducted in accordance with any coordination agreement between Swarm and the Department of Commerce Frequency Management Office to protect NOAA meteorological satellite systems operating within this frequency band.

19. IT IS FURTHER ORDERED that this authorization IS SUBJECT to the following requirements:

- a. Swarm must post a surety bond in satisfaction of 47 CFR §§ 25.165(a)(1) & (b) no later than November 16, 2019, and thereafter maintain on file a surety bond requiring payment in the event of a default in an amount, at minimum, determined according to the formula set forth in 47 CFR § 25.165(a)(1); and
- b. Swarm must launch 50 percent of the maximum number of proposed space stations, place them in the assigned orbits, and operate them in accordance with this authorization no later than October 17, 2025, and must launch the remaining space stations necessary to complete its authorized service constellation, place them in their assigned orbits, and operate them in accordance with the authorization no later than October 17, 2028. 47 CFR § 25.164(b).
- c. Failure to post and maintain a surety bond will render this authorization null and void automatically, without further Commission action. Failure to meet the milestone requirements of 47 CFR § 25.164(b) may result in Swarm's authorization being reduced to the number of satellites in use at the milestone date. Failure to comply with the milestone requirements of 47 CFR § 25.164(b) will also result in forfeiture of Swarm's

surety bond. By November 1, 2025, Swarm must either demonstrate compliance with this milestone requirement or notify the Commission in writing that the requirement was not met. 47 CFR § 25.164(f).

20. Swarm Technologies, Inc. must timely provide the Commission with the information required for Advance Publication, Coordination, and Notification of the frequency assignment(s) for this constellation, including due diligence information, pursuant to Articles 9 and 11 of the ITU Radio Regulations. This authorization may be modified, without prior notice, consistent with the coordination of the frequency assignment(s) with other Administrations, 47 CFR § 25.111(b). Swarm is responsible for all cost-recovery fees associated with the ITU filings, 47 CFR § 25.111(d).

21. IT IS FURTHER ORDERED that this authorization and any earth station licenses granted in the future are subject to modification to bring them into conformance with any rules or policies adopted by the Commission in the future, including *Mitigation of Orbital Debris in the New Space Age*, Notice of Proposed Rulemaking, 33 FCC Rcd 11352 (2018).

22. IT IS FURTHER ORDERED that Swarm Technologies' earth stations are subject to the requirements of Footnote US323 of the U.S. Table of Frequency Allocations, 47 CFR § 2.106, Footnote US323.

23. IT IS FURTHER ORDERED that the request of Swarm Technologies, Inc for a waiver of the processing round procedures specified in section 25.157 IS GRANTED.

24. IT IS FURTHER ORDERED that the Petition to Deny, Dismiss, or Hold in Abeyance filed by ORBCOMM Licensee Corporation is DENIED.

25. IT IS FURTHER ORDERED that Swarm Technologies, Inc. is afforded 30 days from the date of release of this Order to decline this authorization as conditioned. Failure to respond within that period will constitute formal acceptance of the authorization as conditioned.

26. IT IS FURTHER ORDERED that this Order is issued pursuant to section 0.261 of the Commission's Rules, 47 CFR § 0.261. Petitions for reconsideration under section 1.106 or applications for review under section 1.115 of the Commission's Rules, 47 CFR §§ 1.106 and 1.115, may be filed within 30 days of the date of public notice of this Order.

FEDERAL COMMUNICATIONS COMMISSION

Jose P. Albuquerque
Chief, Satellite Division
International Bureau

ATTACHMENT

The following entities filed letters in support of granting Swarm's application, IBFS File No. SAT-LOA-20181221-00094:

Aclima

Arable, Inc.

Arch Systems, Inc.

Autnomic

Bluetown

Brush New Zealand, Ltd.

Droneseed

Ford Smart Mobility, LLC

Foss Marine Company

Greeneridge Sciences, Inc.

Heather Mariash, PhD

Hopkins Marine Station

Lower Yukon School District

Social Capital

Sofar Ocean Technology

Sweet Sense, Inc.

The Freshwater Trust

Tule Technologies

University of Houston

Vodafone Group Service