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

In the Matter of Application of	)	
	)	
ORBCOMM License Corp.	)	
	)	File No.
For Authority to Modify its Non-Voice, Non-Geostationary Satellite Service Space Segment License (S2103) to Revise the Next-Generation Satellite Deployment Plan	)	

MODIFICATION APPLICATION OF ORBCOMM LICENSE CORP.

NARRATIVE DESCRIPTION

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MODIFICATION APPLICATION OF ORBCOMM LICENSE CORP.

By this application (the "Application"), ORBCOMM License Corp. ("ORBCOMM") hereby applies under Sections 25.114, 25.117, and 25.142 of the Commission's Rules for authority to modify its non-voice, non-geostationary mobile satellite service ("NVNG MSS") space segment license (FCC Call Sign S2103) to revise the deployment plan and otherwise update the specification for the currently authorized ORBCOMM Generation 2 ("OG2") satellites.[1] The revised OG2 satellite deployment plan set forth in this Application addresses changed circumstances, new launch options and advances in technology that have arisen since issuance of the Next-Generation Space Segment License, and will allow ORBCOMM to continue the seamless integration of the next-generation satellites with the existing constellation.

The Commission's timely grant of this Application will allow ORBCOMM to continue the augmentation, replenishment and eventually replacement of its first

[1] *See*, *In the Matter of Applications by ORBCOMM License Corp. For Authority to Modify its Non-Voice, Non-Geostationary Satellite System*, Order & Authorization, DA 08-633 (March 21, 2008), 23 FCC Rcd 4804 (2008) (the "Next-Generation Space Segment License").

generation system, as well as expand the capacity and capabilities of its "Little LEO" offerings, and thereby enhance service to the public.[2]

The Next-Generation Space Segment License currently authorizes ORBCOMM to deploy eighteen OG2 satellites into three planes of six satellites each, at a target inclination of 48.5º and a target altitude of 750 kilometers. By this Application, ORBCOMM requests authorization to modify the deployment plan for the eighteen OG2 satellites to permit the launch and operation of the first OG2 satellite with a target inclination of 51.6° and a target operational altitude of 750 kilometers. This first launch will be followed by the deployment of the seventeen additional currently authorized OG2 satellites so that the eighteen OG2 satellites will be deployed for operation in four evenly spaced orbit planes, each with a target inclination of 51.6° and a target operational altitude of 750 kilometers. Two of those planes will consist of five satellites each, and two of the planes will consist of four satellites each. One of the four resulting satellite planes will be comprised of the first OG2 satellite and additional OG2 satellites deployed

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[2] Following the deployment of the eighteen currently authorized OG2 satellites, ORBCOMM continues to anticipate that it will construct and launch additional "technically identical" OG2 spacecraft to replace older ORBCOMM satellites as they are retired from services. However, at this time we cannot predict when that substitution of satellites that are "technically identical" to the OG2 satellites will occur, so this Application addresses only the eighteen currently authorized OG2 satellites. ORBCOMM believes that any such additional OG2 satellites would be covered by Section 25.142(a)(5) of the Commission's Rules, 47 C.F.R. § 25.142(a)(5), which allows ORBCOMM to launch "technically identical" replacement satellites without prior Commission approval. Moreover, such an approach to maintaining ORBCOMM's fleet of satellites will allow ORBCOMM to maximize the useful life of its in-orbit assets based on actual conditions as they evolve, instead of artificially imposed timelines. ORBCOMM's pioneering experience in operating a commercial low-Earth orbit constellation has proven that "design life" and actual operational life in orbit are two very different benchmarks. The ability to manage the constellation flexibly and cost-efficiently is essential to the ongoing success of ORBCOMM's business.

in a later launch that will be maneuvered into the same operational orbit plane as the first OG2 satellite. The Commission's policy is normally to allow the licensee to modify and update the technical design of its satellite system.[3] ORBCOMM notes, moreover, that all eighteen currently authorized OG2 satellites will still be launched within the milestone schedule specified in the Next-Generation Space Segment License.[4]

This narrative description and attachments include the information specified in the Commission's Rules, and accompanies a completed Form 312 and Schedule S. Together, these materials are intended to include all of the information required by the Commission's Rules. Portions of the Commission's Rules and the required Schedule S for the Form 312 are not formulated to readily accommodate a low-Earth orbit satellite system incorporating on-board processing as proposed herein, however, and thus, to the extent necessary, ORBCOMM requests a waiver of any of those requirements that are inapplicable and/or irrelevant. Strict application of the Rules is unnecessary to serve the

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[3] *See, e.g.*, *Applications of GE American Communications, Inc*., DA 99-2519, released November 12,1999 at ¶ 5 (footnotes omitted):

> The Commission has historically recognized that licensees may for a variety of reasons reasonably request changes to a current authorization and has provided for such changes in our rules. Our expressed policy regarding the licensing of satellites is to carry out this process in a manner that promotes competition, flexibility, and technical innovation. To this end, the Commission attempts, when possible, to leave spacecraft design decisions to the space station licensee because the licensee is in a better position to determine how to tailor its system to meet the particular needs of its customers. Consequently, the Commission will generally grant a licensee's request to modify its system provided there are no compelling countervailing public interest considerations.

[4] *See*, 47 C.F.R. § 25.164(b). In addition, ORBCOMM has complied with the Commission's Rules with respect to furnishing a bond for these new satellites, and nothing in this modification request affects that obligation. 47 C.F.R. § 25.165(a)(1).

purpose of those Rules, which is to ensure that the Commission has all *relevant* information to evaluate an application. Thus, there is good cause for a waiver.[5]

The modifications to ORBCOMM's plans for augmentation and replenishment of the current ORBCOMM satellite constellation proposed in this Application will allow ORBCOMM to enhance service to the public, facilitate critical homeland security offerings, and compete more effectively against the myriad terrestrial and mobile satellite systems offering messaging and tracking services today. As demonstrated in this Application, ORBCOMM is fully qualified, and grant of this modification of the Next-Generation Space Segment License as proposed herein will well serve the public interest, convenience and necessity.

INTRODUCTION

ORBCOMM pioneered commercial low-Earth orbit satellite services when it filed its application and petition for rulemaking in February, 1990. ORBCOMM's filings triggered a number of regulatory developments, including domestic and international allocations for narrowband, mobile satellite services.[6] In addition, following the Commission's inaugural Negotiated Rulemaking, the Commission promulgated licensing and service rules for what was termed the Non-Voice, Non-Geostationary Mobile

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[5] 47 C.F.R. § 1.3; 47 C.F.R. § 25.113(b)(1). *See,* pp. 31-32, *infra*.

[6] *Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum to the Fixed-satellite Service and the Mobile-Satellite Service for Low-Earth Orbit Satellites*, 8 FCC Rcd 1812 (1993).

Satellite Service.[7] Not long thereafter, the Commission granted ORBCOMM a license to construct, launch and operate a constellation of thirty-six satellites, four gateway Earth stations in the United States, and a blanket license for mobile earth stations (referred by ORBCOMM to as "Subscriber Communicators").[8] ORBCOMM successfully launched its initial two satellites in 1995, and completed launch of its remaining satellites over the ensuing four years. Since that time, ORBCOMM has provided a wide array of services to a growing number of customers in the United States and other countries around the world using its first generation low-Earth orbit satellite system.

Subsequent to the initial Little LEO licensing proceeding, the Commission initiated a second processing round to accommodate later applicants. There were originally eight applicants in the second round, although as a result of consolidations and companies dropping out and/or returning their licenses, the Commission was eventually able to authorize three new NVNG MSS licensees (as well as accommodating ORBCOMM's request for a small amount of additional spectrum and additional satellites for a total of forty-eight satellites).[9] However, none of those three new second-round

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[7] *Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Non-Voice, Non-Geostationary Mobile-Satellite Service,* 8 FCC Rcd 8450 (1993)(hereafter cited as the "*1993 NVNG Service Rule Order*").

[8] The initial processing round also resulted in the licensing of a spread spectrum system proposed by Starsys, and a two-satellite humanitarian satellite system for Volunteers in Technical Assistance (VITA). Starsys never did construct its system, and ultimately returned its license. *See*, *Starsys Global Positioning System, Inc*., 17 FCC Rcd 16381 (2002) at n. 5, referencing its withdrawal letter dated August 4, 1997. VITA managed to launch a single satellite, but subsequently returned its license -- *Public Notice*, DA 05-3278, released December 22, 2005 (notice of VITA returning its license).

[9] *ORBITAL COMMUNICATIONS CORPORATION*, 13 FCC Rcd 10828 (1998); *E-SAT, INC. Authorization to Construct, Launch and Operate a Non-Voice, Non-Geostationary Mobile Satellite System in the 137-138 and 148-150.05 MHz Frequency Bands, 13 FCC Rcd 10859 (1998); Final Analysis Communication Services, Inc.*

licensees constructed their satellite systems, and they either turned back their authorization or had their license revoked.[10] Thus, ORBCOMM remains the only successful, commercial NVNG MSS system authorized by the Commission.

While the ORBCOMM system remains robust and reliable, a small number of the satellites have experienced anomalies, and the system as a whole will be approaching the end of its operational life over the next several years (even taking into account some "fixes" ORBCOMM has implemented to extend the life of the satellites). The Next-Generation Space Segment License authorizes a phased replacement, replenishment, and augmentation of the ORBCOMM system with new higher throughput capacity fuel-stabilized satellites and access to additional NVNG MSS frequencies.[11] As the Commission agreed, the modifications to the ORBCOMM system authorized by the Next-Generation Space Segment License will provide manifold benefits to subscribers in the United States and throughout the world.[12] As explained below, ORBCOMM now

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Application for Authorization to Construct, Launch and Operate a Non-Voice, Non-Geostationary Mobile Satellite System in the 148-150.05, 400.15-401 MHz, and 137-138 MHz Bands, Order and Authorization, 13 FCC Rcd 6618 (1998); *Application of LEO ONE USA CORPORATION; For Authorization to Construct, Launch and Operate a Non-Voice, Non-Geostationary Mobile Satellite System in the 137-138, 148-150.05 and 400.15-401 MHz Frequency Bands*, 13 FCC Rcd 2801 (1998).

[10] Leo One voluntarily returned its license (*Leo One Worldwide, Inc.*, 19 FCC Rcd 5369 (2004)), and the FCC declared null and void the licenses issued to E-Sat and Final Analysis for failure to meet the construction milestone conditions in their authorizations (*E-Sat, Inc.*, 18 FCC Rcd 7662 (2003); *Final Analysis Communication Services, Inc.*, 19 FCC Rcd 4768 (2004)). The Commission indicated that these licenses are now available for new applicants on a first-come, first-served basis. *E.g.*, *Leo One Worldwide, Inc.*, 19 FCC Rcd 5369 (2004) at n. 1.

[11] *See,* Next-Generation Space Segment License.

[12] *Id*. at ¶ 7.

seeks authorization to modify the deployment plan for its OG2 satellites to take advantage of new launch options and satellite maneuvering capabilities.

SECTION 304 WAIVER

ORBCOMM hereby waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise.

INFORMATION REQUIRED BY THE COMMISSION'S RULES

The information required by Section 25.114(c) of the Commission's Rules is contained in the Form 312 and Schedule S submitted herewith. [13] The information required by Sections 25.114(d) and 25.142 of the Commission's Rules is set forth below:

Section 25.114 (d) Information

§ 25.114(d)(1) General description of overall system facilities, operations and services:

In accordance with the Next Generation Space Segment License, ORBCOMM's replenished and enhanced Next-Generation system will be comprised of a constellation

[13] *See, Also, ORBCOMM License Corp, Application For Authority to Modify its Non-Voice, Non-Geostationary Satellite System License to Launch a Next-Generation System*, FCC Call Sign S2103, File Nos. SAT-MOD-20070531-00076 & SAT-AMD-20071116-00161 (2007)(the "Next-Generation Space Segment License Modification Application"). The license modifications proposed in this Application are quite limited, and thus do not alter much of the information ORBCOMM provided in the Next-Generation Space Segment License Modification Application. Accordingly, to avoid redundancy, the showings provided in the Next-Generation Space Segment License Modification are incorporated herein by reference, to the extent such showings are required by the Commission's Rules and do not conflict with or contradict the license modifications proposed in this Application. *See,* 47 C.F.R. § 25.117(d)(1).

consisting of a total of up to forty-eight (48) operational low-Earth orbit satellites – a combination of new next-generation satellites and the pre-existing on-orbit satellites. The Schedule S submission accompanying this Application provides all required information regarding the proposed modifications to the currently authorized OG2 satellite deployment plan.

The ORBCOMM system is controlled by the ORBCOMM Network Control Center in Dulles, Virginia ("NCC"). TT&C for the constellation is supervised by the NCC, although commands to the spacecraft can be transmitted from any gateway Earth station. TT&C transmissions are carried on the "in-band" feeder links (also referred to as gateway links).

In the United States, communications between the satellites and the terrestrial network is facilitated via ORBCOMM's four currently licensed gateway Earth stations in Ocilla, Georgia (Call Sign E940536); East Wenatchee, Washington (Call Sign E940538); St. Johns, Arizona (Call Sign E940537) and Arcade, New York (Call Sign E940535). Subscriber Communicators operating in the United States are separately authorized under an FCC "blanket" Earth station license (Call Sign E940534), which currently allows ORBCOMM to operate up to one million terminals. The ORBCOMM satellites receive transmissions from the Subscriber Communicators in the 148-150.05 MHz band.[14]

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[14] The Next-Generation Space Segment License permits ORBCOMM to operate subscriber transceivers across the entire uplink band until another FCC-licensed system begins to operate in the United States. *Next-Generation Space Segment License*, at ¶ 11. It is also well-settled that the Commission only applies frequency sharing arrangements among its NVNG MSS licensees to domestic operations within the United States to allow for maximum flexibility for licensees, or their affiliates, seeking operating authorizations in other countries. *See, e.g., 1993 NVNG Service Rule Order*, at ¶ 28; *Orbital Communications Corporation*, 9 FCC Rcd 6476 (1994) at ¶ 15; *Orbital Communications Corporation*, 13 FCC Rcd 10828 (1998) at ¶ 31.

The OG2 satellites are specifically designed so as to be "backwards compatible" with ORBCOMM's present system, so that current customers will be able to continue using their Subscriber Communicators. This ensures that customers will not be left with a "stranded investment", and that continuity of service will be maintained for the hundreds of thousands of Subscriber Communicators that have come to rely on the ORBCOMM system for critical messaging, asset tracking and other needs.

Finally, ORBCOMM operates its NVNG MSS satellite system on a non-common carrier basis.[15]

§ 25.114(d)(2) The feeder link and inter-satellite service frequencies requested for the satellite:

To the extent necessary, ORBCOMM hereby requests authorization to add a feeder uplink channel centered at 150.025 MHz to the currently authorized feeder link frequency plan for the ORBCOMM system. All technical parameters for uplink operations on the requested additional feeder link channel will be identical to those currently authorized. ORBCOMM's search of the Commission's records reveals no existing assignments in the 149.9 – 150.05 MHz band frequency allocation block that could result in harmful interference to any other Commission licensee from the proposed new feeder link channel assignment. Addition of the proposed feeder link uplink channel will allow ORBCOMM to implement required increases in feeder link uplink throughput capacity and coverage. Unlike the 148 – 149.9 MHz band, the 149.9 – 150.05 MHz band is not allocated in the United States or internationally for terrestrial service use, so it is

[15] *Orbital Communications Corporation*, 9 FCC Rcd 6476 (1994) at ¶ 27.

much less difficult to coordinate and ensure interference protection for feeder link uplink operations in this band.[16]

The ORBCOMM system does not utilize inter-satellite links, and thus ORBCOMM has not been authorized, and is not hereby requesting authorization to operate inter-satellite links.

§ 25.114(d)(3) Predicted space station antenna gain contour(s) for each transmit and each receive antenna beam and nominal orbital location requested:

The revised OG2 satellite deployment plan proposed in this Application will not alter the antenna transmit and receive gain contours authorized under the Next-Generation Space Segment License. ORBCOMM is deploying its Next-Generation satellites in low-Earth orbit, and thus, requesting a nominal orbit location is not applicable because the ORBCOMM space segment is deployed in a constellation of constantly moving satellites relative to the surface of the Earth. Appendix A includes a revised depiction of the satellite constellation "footprint" at one point in time to demonstrate typical service coverage for the constellation as a whole under the proposed modified OG2 satellite deployment plan.

25.114(d)(4) A description of the types of services to be provided, and the areas to be served:

As fully explained in the Next-Generation Space Segment License Modification Application,[17] the ORBCOMM network is a satellite-based system that provides narrow

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[16] Commission grant of the proposed additional 150.025 MHz feeder uplink assignment should allow ORBCOMM to mitigate coverage restrictions on ORBCOMM's current 149.61 MHz feeder link uplink assignment that can result from international coordination to protect terrestrial service assignments in other countries.

[17] *See,* FN 13, *supra.*

band two-way digital messaging, data communications, and geo-positioning services, typically in a machine-to-machine ("M2M") mode. ORBCOMM normally does not provide satellite communications services to end-users, but instead those services are combined with industry- or customer-specific applications developed by ORBCOMM's Value-Added resellers ("VARs"), who in turn provide a "total solution" service offering to end-user customers.[18] ORBCOMM continues to offer the same roster of non-common carrier services. ORBCOMM also provides Automatic Identification System ("AIS") monitoring services (subject to the availability of on-orbit AIS reception capability, which will be substantially enhanced with the deployment of the OG2 satellites) authorized under the Next-Generation Space Segment License. The OG2 satellites will provide all of these current services, and in addition will be able to provide higher data rate transmission capabilities, with subscriber downlink speeds of up to 9.6 kbps, subscriber uplink speeds of up to 4.8 kbps, gateway links operating at up to 86.4 kbps in the uplink, and up to 172.8 kbps in the downlink.[19] More importantly, the modified OG2 satellite deployment plan proposed in this Application will improve overall network coverage and capacity (particularly in mid and higher latitude coverage areas) so that ORBCOMM can meet the expected increased demand for its services.

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[18] ORBCOMM intends to continue operating on a non-common carrier basis, where ORBCOMM generally does not sell services directly to the public, but instead sells service to valued-added resellers, who utilize ORBCOMM's satellite offerings, along with various enhancements, to provide customized solutions to customers' tracking, monitoring and messaging needs. Any sales directly to end users are conducted only pursuant to customer-specific contracts, not generalized offerings.

[19] The currently specified OG2 satellite maximum gateway downlink transmission rate has been increased to 172.8 kbps from the maximum speed of 86.4 kbps originally specified in the Next-Generation Space Segment License Modification Application. *See,* FN 13, *supra*.

The Schedule S submission accompanying this Application provides all required technical information on the OG2 satellites, updated to reflect the license modifications requested herein. The increased data rates indicated in this Application will be achieved through the use of advance modulation techniques, and thus will not change the OG2 link budgets previously filed with the Commission at Appendix B of the Narrative Description Exhibit to the Next-Generation Space Segment License Modification Application.[20] Accordingly, the previously submitted link budgets are incorporated in this Application by reference.

§ 25.114(d)(5) Calculation of power flux density levels within each coverage area and of the energy dispersal, if any, needed for compliance with §25.208:

Section 25.208 of the Commission's Rules is not applicable to the frequency bands used for ORBCOMM system downlink operations. Because the modified OG2 satellite deployment plan proposed in this Application does not entail any change to the radio frequency emission characteristics or the 750 km target operating altitude for the OG2 satellites authorized in the Next-Generation Space Segment License, ORBCOMM will continue to comply with the power flux density limits for the NVNG MSS.[21] In addition, ORBCOMM's downlink PFD will continue to be less than the ITU-specified coordination trigger of -125 dB ($W/m^2/4$ kHz) at the Earth's surface.[22]

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[20] *See,* FN 13, *supra.*

[21] *See,* pp. 26-28, *infra*.

[22] *See, e.g.*, 47 C.F.R. § 2.106 at International Footnotes 5.208 and 5.264, and ITU Radio Regs, Appendix 5, Annex 1 ¶ 1.1.1.

§ 25.114(d)(6) Public interest considerations in support of grant:

In response to ORBCOMM's original Petition for Rulemaking, the Commission initiated a rulemaking and ultimately agreed with ORBCOMM's claims that it would enhance the public interest to allocate a relatively small amount of spectrum for a new, low-Earth orbit satellite service.[23] As the Commission observed in Paragraph 9 of that decision:

> We conclude that LEOs offer an affordable means to meet a growing demand for low-cost mobile communications services. Due to the low power requirements of LEO space stations and their associated portable transceivers, we believe that LEOs will offer a variety of services and features at low cost. The comments demonstrate that demand exists for low cost data and radiolocation services and that LEOs offer a viable approach for providing these services. For example, the American Petroleum Institute (API) states that LEO satellites potentially are more versatile than the very small aperture terminals (VSATs) that now are used for controlling pipeline valves and also contends that LEOs will provide a low-cost alternative for monitoring very remote industrial complexes and other facilities located in environmentally sensitive areas where terrestrial telephone service is not available or practical. API also states that LEOs will prove beneficial in responding to industry emergencies.
>
> The Commission's (and ORBCOMM's) predictions have proven true.

ORBCOMM has been able to provide many unique and beneficial services, and the rapid growth in the number of subscribers has demonstrated that the marketplace highly values these "Little LEO" services.[24] Grant of this Application to modify ORBCOMM's Next-

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[23] *In the Matter of Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum to the Fixed-Satellite Service and the Mobile-Satellite Service for Low-Earth Orbit Satellites*, 8 FCC Rcd 1812 (1993).

[24] Indeed, ORBCOMM was granted a modification of its blanket subscriber communicator license to increase the maximum number of transceivers from 200,000 to 1 Million because the number of subscribers on its system had been rapidly approaching that initial limit. *Public Notice*, Report No. SES-00839, released July 19, 2006. As of the end of the first quarter 2011, ORBCOMM had more than 575,000 subscribers.

Generation Space Segment License will generate these same public benefits, while allowing ORBCOMM to adapt to changed circumstances.

Valuable Services

ORBCOMM currently provides a number of valuable non-voice services using its low-Earth orbit satellite system. The ORBCOMM system design is optimized to provide these services within the framework of the duty-cycle limits and other operating constraints that govern NVNG MSS operations.[25] ORBCOMM offers two-way messaging, M2M communications, asset tracking and monitoring services. ORBCOMM uses a number of VARs that develop service applications using the ORBCOMM system targeted to specific industry needs. These include tracking, monitoring and messaging for trucking and heavy construction equipment fleets, weather reports and fleet monitoring for the fishing industry, and fixed asset monitoring of sensors in remote areas, such as oil pipelines and propane tanks.

One of the benefits of a low-Earth orbit constellation is the availability of ORBCOMM's services nearly everywhere on the planet. ORBCOMM is able to provide these services in very remote areas that are otherwise underserved by communications capabilities. Indeed, many of ORBCOMM's Supervisory Control and Data Acquisition ("SCADA") services are provided in remote areas where there are few, if any cost-effective alternatives. In addition, the ORBCOMM system is ideally suited to tracking a vehicle or piece of equipment that travels between countries or transoceanic. Moreover, within the United States the ORBCOMM system can augment terrestrial mobile tracking,

[25] *See*, 47 C.F.R. § 25.142(b)(1) and 47 C.F.R. § 2.106 footnote US323.

messaging and M2M offerings as a supplement in territories not served by cellular, paging or other terrestrial wireless services.

The modifications proposed in this Application will allow for the further expansion of the utility and capabilities of the ORBCOMM system, while also taking advantage of new launch options, an opportunistic launch opening and enhanced satellite maneuvering capabilities. In light of the duty cycle limits on the duration and frequency of transmissions from each subscriber transmitter,[26] ORBCOMM is constrained in the amount of data that can be transmitted by a subscriber. The higher data rate channels in the OG2 satellites, together with the addition of the second gateway uplink channel requested herein, will allow subscribers to send and receive larger data streams, while still complying with the Commission's NVNG MSS operating constraints.[27] For many of ORBCOMM subscribers' applications, the current message length limits are adequate, but the enhanced capability of the new satellites will increase the utility of the ORBCOMM system for current and new subscribers.

The deployment of the OG2 satellites will improve M2M data delivery performance throughout the worldwide coverage area of the ORBCOMM system. This improved capability will make the ORBCOMM network suitable for a wider range of applications than those supported by the current constellation. Thus, grant of this Application will allow ORBCOMM, and its many VARs, to provide expanded service offerings to existing customers. The added capabilities of ORBCOMM's OG2 satellites

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[26] 47 C.F.R. Sec. 2.106 footnote US323.

[27] At the same time, ORBCOMM has designed all of the new satellites so that they will still provide "backwards compatible" services, and as a result, current customers need not prematurely replace their subscriber communicators or any of their application-specific software.

that will be afforded by grant of this Application will also allow for deployment of higher capacity applications that will permit entry into new market segments.

Enhanced Reliability

ORBCOMM is seeking authority to modify the Next-Generation Space Segment License in order to reap the benefits of new launch options for placing small satellites into low-Earth orbit. ORBCOMM would like to be able to take advantage of an opportunistic launch for the first OG2 satellite on a Space Exploration Technologies ("SpaceX") Falcon 9 launch currently scheduled for later this year.[28] The ability to utilize this launch opportunity will enhance reliability in two respects.

First, by accelerating the deployment of the first OG2 satellite, ORBCOMM will be able to gain valuable experience with operating this first new OG2 satellite on-orbit. While testing in laboratories under simulated conditions is helpful, the ability to conduct tests and operations under actual on-orbit conditions will allow ORBCOMM to determine whether any changes are necessary to the remaining OG2 satellites before they are launched. Some anomalies only become apparent under actual operating conditions, and there are only limited options for addressing them on-orbit. Repairs or modifications are much easier to perform while the satellites are still on the ground. ORBCOMM's long experience in operating a low-Earth orbit constellation has demonstrated that addressing issues before launch is particularly important in the operation of a large satellite fleet comprised of multiple spacecraft of common design and construction. Furthermore,

[28] The launch is currently scheduled to occur as early as December 27, 2011. The primary payload will be a SpaceX Dragon reusable spacecraft. The primary mission will launch into a 51.6 degree inclined orbit to support the planned demonstration of Dragon operations in proximity to the International Space Station ("ISS"). Appendix B to this Narrative Exhibit provides a detailed mission profile for the planned launch.

ORBCOMM will be able to use enhanced maneuvering capabilities of the OG2 satellites to place the later-deployed OG2 satellites into the desired constellation planes, so that the proposed early launch of the first OG2 spacecraft will not disrupt the revised final four-plane deployment plan for the OG2 satellites.

Second, by obtaining launch services from a relatively new provider, ORBCOMM is helping to support the entry of an additional competitor into this currently limited market.[29] Having additional launch options will allow ORBCOMM (as well as others) to replace or replenish satellites more quickly and more efficiently, thus enhancing system reliability. Moreover, because this new launch provider is a U.S. company, it will also have the added benefit of sustaining and creating jobs in this country. Indeed, such U.S.-based launch capabilities also enhance national security.[30]

Enhanced Competition

While ORBCOMM at present is the only NVNG MSS system licensed by the Commission,[31] ORBCOMM faces substantial direct competition from a number of other

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[29] *See generally*, CSIS Report "National Security and the Commercial Space Sector," (July, 2010), attached to the Joint Comments of Echostar, Intelsat, SES World Skies and Telesat Canada submitted in IB Docket No. 10-99, filed August 23, 2010.

[30] *Id.*

[31] The other first round NVNG MSS licensees - Starsys and VITA – voluntarily relinquished their licenses. *See*, *Starsys Global Positioning System, Inc*., 17 FCC Rcd 16381 (2002) at n. 5, referencing its withdrawal letter dated August 4, 1997)), and *Public Notice*, DA 05-3278, released December 22, 2005 (notice of VITA returning its license). The three other second processing round NVNG MSS licensees besides ORBCOMM -- E-Sat, Final Analysis and Leo One – also no longer hold FCC licenses. Leo One voluntarily returned its license (*Leo One Worldwide, Inc.*, 19 FCC Rcd 5369 (2004)), and the FCC declared null and void the licenses issued to E-Sat and Final Analysis for failure to meet the construction milestone conditions in their authorizations (*E-Sat, Inc.*, 18 FCC Rcd 7662 (2003); *Final Analysis Communication Services, Inc.*, 19 FCC Rcd 4768 (2004)).

terrestrial and satellite operators. The improved and enhanced next-generation satellite system proposed in this Application will allow ORBCOMM to maintain its ability to compete effectively against other service providers in the evolving marketplace. Such enhanced competition will inure to the benefit of the public in the form of more and better services and lower prices.

Various other mobile satellite system operators currently offer services that compete with ORBCOMM. For example, Globalstar offers a range of one and two-way data transmission services.[32] Inmarsat provides asset tracking and fleet monitoring services.[33] Iridium also offers a short burst data service.[34] Moreover, each of the above-referenced competing mobile satellite systems (as well as numerous other such systems) has access to significantly more spectrum than ORBCOMM -- by an order of magnitude[35] -- and moreover do not operate under the same duty cycle and burst limits. Terrestrial service providers are likewise competing against ORBCOMM, albeit without the same global coverage as the ORBCOMM system. Many major cellular companies are aggressively marketing M2M and other tracking and messaging services.[36] These

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[32] *See, e.g.,* http://www.globalstar.com/en/index.php?cid=5510&sidenav=218.

[33] *See, e.g.,* http://www.inmarsat.com/Services/Tracking/IsatM2M.

[34] *See, e.g.,* http://www.iridium.com/ProductList.aspx?productCategoryID=14.

[35] Each of those MSS systems has access to 20 MHz or more of spectrum, whereas ORBCOMM at present has exclusive use of less than 1 MHz of non-contiguous downlink spectrum, and shared access to just over 2 MHz of spectrum in the 148-150.05 MHz band for the subscriber uplinks. In addition, ORBCOMM must use portions of its assigned spectrum in the 137-138 MHz and 149.9-150.05 MHz bands for its feeder links.

[36] *See, e.g.,* http://www.business.att.com/enterprise/Family/mobility-services/machine-to-machine/, http://www.verizonwireless.com/pdfs/mvno_brochure.pdf,

examples are only a very small sampling of the formidable direct competition that ORBCOMM currently faces in the United States and in overseas markets. Grant of this Application will provide ORBCOMM with the reliability, capacity and capability to compete more effectively against a growing myriad of satellite and terrestrial service providers.

For all of these reasons, grant of this Application will well serve the public interest, convenience and necessity.

§ 25.114(d)(9) Applications to license multiple space station systems in the non-voice, non-geostationary mobile-satellite service under blanket operating authority shall also provide all information specified in §25.142:

The information specified in §25.142 of the Commission's Rules is set forth below at pp. 29-33 of this Narrative Description being submitted with ORBCOMM's Application.

§ 25.114(d)(14) A description of the design and operational strategies that will be used to mitigate orbital debris:

This showing set forth below revises and updates the Section 25.114(d)(14) compliance information provided in the Next-Generation Space Segment License Modification Application.[37] As demonstrated below, the ORBCOMM Next-Generation space segment, as modified in accordance with this Application, will remain in compliance with the Commission's orbital debris mitigation Rules and policies.

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http://m2m.sprint.com/, http://www.totaltele.com/view.aspx?ID=466127, http://enterprise.vodafone.com/products_solutions/machine_to_machine/.

[37] 47 C.F.R. § 25.114(d)(14). *See, also*, FCC Public Notice DA 05-2698, Report No. SPB-112, *Disclosure of Orbital Debris Mitigation Plans, Including Amendment of Pending Applications* (Rel. October 13, 2005).

(1) OG2 Spacecraft Hardware Design. ORBCOMM has assessed the potential for any debris to be released into the space environment in connection with the OG2 satellite program,[38] and has taken all possible spacecraft hardware design and operational planning measures to minimize the possibility of any such orbital debris. There are no planned intentional releases of any objects during any OG2 mission phase, including deployment, operations, and disposal. The OG2 satellite design does not utilize any shrouds or other temporary covers to be removed upon deployment, no shrapnel will be generated as a result of antenna and solar array deployments, and the specified OG2 satellite launch vehicle separation system uses non-explosive actuators with a cup-and-cone design that retains all separation hardware.

ORBCOMM understands and appreciates that small debris and meteoroids have the potential of colliding with and doing damage to spacecraft components. Such impacts pose a risk to a satellite's mission, its ability to maintain control, and its ability to perform post-mission disposal maneuvers. Using NASA's Debris Assessment Software (DAS v2.0.1), ORBCOMM has assessed the probability of OG2 satellite collisions with untrackable particles larger than one centimeter. At the operational orbital altitude of 750 km and with a 51.6 deg inclination, DAS produces the annual collision probability for OG2 satellites of 1.6×10^{-4}, as summarized in the table below.

ORBCOMM Satellite	Nominal Inclination	Nominal Altitude	Avg Cross Sectional Area	P(Impact w/ debris >1cm)/yr
OG2	51.6^{o}	750 km	4.3 m^2	1.6×10^{-4}

[38] Appendix B to this Narrative Exhibit provides a description of the mission profile and ISS conjunction coordination for the first planned OG2 satellite launch later this year, which will be a secondary payload on a SpaceX Falcon 9 launch vehicle with a primary International Space Station ("ISS") mission payload.

It is unknown what the minimum particle size is that could potentially cause critical damage to an OG2 satellite in the event of an impact. Among other things, that threshold would vary depending on impact location, angle, and velocity. Due, however, to the fact that the debris population increases logarithmically with decreased debris size, the probability of impact similarly increases above 10^{-4} when debris smaller than one centimeter are considered.

The OG2 satellites have been designed to be as impact-tolerant as possible, with particular focus on minimizing the vulnerability of critical systems to small debris impacts. For example, external exposure is minimized for components critical to OG2 functionality. Additionally, internal components are provided with physical protection, either by the bus structure or thermal insulation that serves to break up small debris or meteoroids upon impact. It is also important to note that OG2 spacecraft use the same subsystems (*e.g.,* propulsion system) for operation and disposal, so the disposal operation is no more susceptible to small debris impacts than normal operational functions. These design features minimize to the greatest extent possible the probability of critical component damage resulting from any impacting debris or vapor penetrating the interior of an OG2 spacecraft during all phases of deployment, mission operations, and end-of-life disposal.

In summary, the risk of and OG2 satellite being disabled by debris smaller than 1 cm is negligible, and there is a low rate of probable impact of small debris larger than 1 cm. Protective OG2 spacecraft design measures substantially further minimize the

likelihood that small debris impacts would disable an OG2 spacecraft or render it unable to conduct disposal maneuvers.

(2) Minimizing Accidental Explosions. There is virtually no possibility that an OG2 spacecraft will accidentally explode on-orbit, either during normal operations or during end-of-life disposal. As discussed more fully below, all components involved in the retention and control of energy sources are space-qualified, and energy sources will be managed autonomously, minimized, or depleted upon disposal of the spacecraft. These sources include pressurized fuel tanks for propulsion, chemical batteries, and momentum wheels. To further support this showing, ORBCOMM is concurrently submitting under separate cover with a Request For Confidential Treatment copies of hazard analyses, related presentation materials prepared by the OG2 satellite manufacturer, and information presented to NASA during the Falcon 9 ORBCOMM mission safety coordination process.[39]

Each OG2 satellite will carry up to 10.03 kg of hydrazine fuel at launch. Propellant will be used during all phases of the mission, from attaining the initial operational orbit, to performing maintenance thrusts throughout the operational life, and through end-of-life disposal maneuvering. While fuel is budgeted for disposal, any additional fuel remaining after an OG2 satellite reaches the target disposal altitude will be consumed while continuing to lower the orbit, and thereby the orbital lifetime. Thus, OG2 satellite fuel tanks will be left with very small, residual amounts of fuel, very little

[39] Appendix C to this Narrative Exhibit is a copy of ORBCOMM's Request For Confidential Treatment of these submission materials (the "Confidential Materials"). Due to the nature and content of the documents containing the Confidential Materials, it is not feasible to separate any non-confidential portion of the documents that could be submitted as a redacted version. Accordingly, no redacted version of the documents containing the Confidential Materials can be filed in the public record. 47 C.F.R. § 0.459(a)(1).

pressure, and no potential for chemical combustion. The thermal management devices used to maintain the hydrazine fuel temperature during operations are not capable of causing the hydrazine to disassociate. Fuel tank heaters will not heat the hydrazine to a point where it will be a hazard, even in the presence of a failure that sets the fuel heaters to the full-on setting.

OG2 satellite batteries use lithium-ion cells. The satellites have a hard-coded protection load disconnect switch mechanism ("LDS") that triggers at low voltage to prevent total battery depletion and avoid premature mission failure. The LDS disconnects the satellite bus and payload from the battery and connects all solar array strings to the battery to optimize power recovery in the event of very low battery state of charge. Once an OG2 satellite battery has reached a state of charge that supports minimum satellite operations (by drifting through an attitude that illuminates the solar arrays sufficiently), the LDS reconnects the satellite bus and payload to the battery. This feature cannot be disabled.

For the case of battery/cell overcharge, the cells of the battery have a mechanical overcharge disconnect and a leak-before-burst architecture. In the event that an individual lithium-ion cell in the battery is being overcharged, the cell will disconnect itself from the battery pack, thus preventing a hazardous overcharge condition. In the event that an overcharge condition is realized, the pressure disc integrated into the battery cell will burst and vent/leak before a catastrophic burst of the battery occurs. At the end of satellite life, a randomly tumbling satellite will keep the batteries at a low state of charge and will reconnect the spacecraft bus and payload if the battery is sufficiently charged, avoiding an overcharge condition.

Finally, the principal source of internal kinetic energy is the satellite's suite of four momentum wheels. There are no credible failure scenarios in which this rotational kinetic energy could become sufficient to fragment the spacecraft.

(3) Safe Flight Profiles. ORBCOMM recognizes that there is some small possibility of physical collision with large objects in low-Earth orbit (including other operational satellites, spent hardware, and debris). Such a collision would clearly generate additional orbital debris. While ORBCOMM is unaware of other operators currently occupying or planning to occupy orbits identical to its own operational orbit, 750 km is a relatively populated region of LEO, and objects will most certainly be passing through this altitude regime.

To assess the likelihood of colliding with objects large enough to render an OG2 satellite a source of debris, ORBCOMM again turned to NASA's Debris Assessment Software. The calculated annual collision probability with objects larger than 10 cm for the OG2 operational orbit is shown in the table below. This debris size corresponds roughly with the lower size threshold for cataloged objects in LEO and is in keeping with the analysis requirement for large debris specified in the US Government Orbital Debris Mitigation Standard Practices (Objective 3-1). The risk threshold identified in DAS is 10^{-3} for the orbital life of any individual OG2 spacecraft. The accumulated risk over 30 years (five operational and up to 25 for disposal) for each OG2 spacecraft comes to $6x10^{-4}$. It should be noted that this is a conservative estimate. The analysis presumed an altitude of 750 km for the entire 30-year span. In fact, OG2 satellites will spend a majority of the 30 year analysis period at lower altitudes, where the debris population is smaller.

Based on these findings, OG2 satellites do not constitute a significant risk of further contributing to the debris environment. The low probability of catastrophic collision over the life of the OG2 satellite mission satisfies the intent of the Commission's orbital debris mitigation Rules and policies.

ORBCOMM Satellite	Nominal Inclination	Nominal Altitude	Avg Cross Sectional Area	P(Impact w/ debris >10cm)/yr
OG2	51.6^{o}	750 km	4.3 m^2	$2x10^{-5}$

Because there are no mission requirements to do so (nor any Commission requirements to do so, unlike requirements for geostationary satellites), no active measures are necessary to maintain OG2 satellite orbital parameters to any prescribed accuracy. During the operational life of the OG2 satellites, the orbit altitude is expected to decay less than 10 kilometers. The inclinations should remain stable at the specified operational inclinations, and the eccentricity will exhibit small oscillations above its target value of zero. The ascending node and true anomaly will obviously take on all possible values as they secularly and continuously precess. Nonetheless, as reflected in the table above, the risk of collision in the selected target altitude and inclination is *de minimis*.

Despite the low collision probabilities demonstrated above, ORBCOMM obviously has a clear business interest in protecting its on-orbit assets. ORBCOMM also takes very seriously the potential environmental impact that collisions can have in LEO. In this regard, with respect to the OG2 satellites, ORBCOMM intends to continue its established practice of coordinating with U.S. Government organizations and other

satellite operators to improve space situational awareness and avoid physical collisions. For example, ORBCOMM currently receives daily conjunction summary messages ("CSM"s) from the Joint Space Operations Command ("JSpOC"), identifying conjunctions predicted 72 hours into the future between any ORBCOMM asset and any tracked object. ORBCOMM, in turn, provides JSpOC with high-accuracy ephemeris predictions for involved assets, as available, and keeps JSpOC informed of all anticipated maneuvering plans. This enables JSpOC to provide more accurate warning services to the entire operator community regarding the location of ORBCOMM satellites.

ORBCOMM also coordinates directly with other operators. For example, established lines of communication are maintained with Iridium and Radarsat, both of whom operate assets in the same altitude regime as ORBCOMM's current satellite constellation. Informal coordination arrangements among LEO satellite operators have proven quite effective, due among other things, to the mutually beneficial incentives for cooperation. Typically, if an operator has a concern over an upcoming conjunction, contact is initiated with the other affected operator to jointly review the severity of the situation and coordinate any maneuvering plans that may be deemed warranted. ORBCOMM definitely intends to continue this practice with regard to OG2 satellite operations.

One final example of collision avoidance coordination is the much more formal collaboration being undertaken among ORBCOMM, SpaceX, and the Trajectory Operations Office ("TOPO") at NASA's Mission Operations Directorate ("MOD") relating to the first OG2 launch as a secondary payload on the next SpaceX Falcon 9 NASA Commercial Orbital Transportation Services ("COTS") demonstration mission.

The primary payload, the SpaceX Dragon capsule, will be deployed into a low orbit allowing it to rendezvous with ISS. The F-9 second stage will then execute an engine burn to boost ORBCOMM into a 325 km x 750 km orbit. Because this initial orbit crosses the ISS altitude, special attention is being paid to minimize any collision hazard OG2 poses to ISS. A more complete description of the mission and the process of pre-mission safety coordination being undertaken with NASA is given in Appendix B of this Narrative Exhibit.

(4) End-Of-Life Disposal. ORBCOMM recognizes that responsible disposal of post-mission hardware is the most practical and effective means of preserving the orbital environment for future use. Upon completion of its mission, the perigee altitude of each OG2 satellite will be lowered using its on-board propulsion system to facilitate a more rapid, uncontrolled re-entry into the atmosphere. In each case, the perigee of the satellite will be lowered sufficiently to ensure that following completion of the disposal maneuver, the orbital lifetime of the hardware will be less than the Commission's guideline of twenty-five years.

In order to determine the required target disposal perigee altitude, ORBCOMM again utilized NASA's DAS software. The operational altitude of 750 km was used as the apogee altitude, and the required disposal perigee altitude and corresponding delta velocity are given in the table below.

ORBCOMM Satellite	Apogee Alt	Ave Area/Mass	Required Perigee Altitude	Required Delta Velocity
OG2	750 km	.0269 m^2/kg	680 km	18.47 m/sec

Sufficient fuel is being budgeted on each OG2 spacecraft to perform these disposal maneuvers. The propulsion system uses hydrazine fuel, with an Isp of 222 sec. Thus, from the following equation, the average fuel efficacy ratio of 13.6 m/sec per kg is derived, and the nominal disposal reserve is to be 18.47/13.6 = 1.36 kg.

$$dV = Isp \times g \times \ln(M_{initial}/M_{final})$$

Fuel levels during the mission will be closely monitored both through direct measurement of tank pressure and temperature and by tracking usage. Comparing two measurement techniques will provide a check on expected fuel efficacy and fuel gauging uncertainty during the course of the mission. It is expected that inefficiencies from nozzle misalignment, CG misalignment, and ACS pointing error will sum to less than one percent loss, and unusable residual will be inconsequential. Nevertheless, a margin of 5% is added to the nominal disposal reserve to account for inefficiencies and gauging uncertainties, yielding a total disposal reserve of 1.43 kg.

DAS modeling of the basic OG2 satellite physical elements indicates that, upon atmospheric re-entry, the OG2 satellites will completely disintegrate and burn up, with no elements of the spacecraft surviving to hit the surface of the Earth. In general, spacecraft components that are most likely to survive re-entry are those that are protected by multiple layers of material (e.g., those inside a box that is inside another …), or of particularly high density (e.g., solid metal reaction wheels). Therefore, it was not necessary to construct a minutely detailed OG2 satellite model to conduct the DAS re-entry analysis. Focus was placed instead on the "nested-ness" and density of representative components. Toward this end, ORBCOMM created a satellite model consisting of an OG2 outer bus structure with the following internal components: the fuel

tank; structural pylons; reaction wheels; and an internal electronics box. External spacecraft elements, such as the solar array and the antenna were not included in the model, as these components will most certainly disintegrate early in the re-entry phase.

The OG2 fuel tank was included because of the unique aerodynamics characteristics that spherical tanks possess. The structural pylons and reaction wheels were included because of their density, and because they are the most solid elements on and OG2 spacecraft. Finally, the internal box was chosen as being representative of the multiple internal OG2 satellite structures that house circuit cards and other smaller components.

The DAS analysis indicated that the OG2 outer bus will yield at an altitude of 78 km, exposing internal components to aerodynamic forces and heating. None of the modeled components were predicted to survive to an altitude of lower than 49 km. Because no OG2 component will survive to strike the ground, no casualty assessment is necessary. It can be concluded, therefore, that the OG2 satellite end-of-life disposal plan fully complies with the Commission's orbital debris mitigation Rules and policies.

Section 25.142(a) Information

§ 25.142(a)(1) A showing, based on existing system information publicly available at the Commission at the time of filing, that they will not cause unacceptable interference to any non-voice, non-geostationary mobile-satellite service system authorized to construct or operate:

Because there are presently no other FCC licensed NVNG MSS systems, it is not possible for ORBCOMM to demonstrate an absence of harmful interference to any such

non-existent systems. Based on its previous experiences, ORBCOMM is confident that it should be able to coordinate with other NVNG MSS systems when or if they are licensed.

§ 25.142(a)(2) Power Flux Densities at the Surface of the Earth and Protection of Radio Astronomy Services:

The revised OG2 satellite deployment plan proposed in this Application will not change the radio frequency emission characteristics or target operating altitude for the OG2 satellites currently authorized in the Next-Generation Space Segment License. Accordingly, the power flux density produced at the Earth's surface in the 137-138 MHz band will still be less than the -125 dB (W/m^2/4 kHz) coordination trigger specified by the ITU. Following are the maximum power flux density values for the OG2 satellite downlinks:

Power Flux Density Values

	Elevation Angle at max	Subscriber Downlink	Gateway Downlink	Units
Max EIRP	5	13.5	1.3	dBW
Max PFD	90	-125.8	-145.8	dBW/m^2 /4 kHz
Frequency Band		137-138	137-138	MHz

With respect to the radio astronomy service, ORBCOMM will limit its satellite out-of-band emissions to protect the radio astronomy service in the 150.05-153 MHz and 406.1-410 MHz bands from harmful interference. The factors providing protection include spectrum roll-off, diplexer or filter attenuation and the path loss between the satellites and radio telescopes.

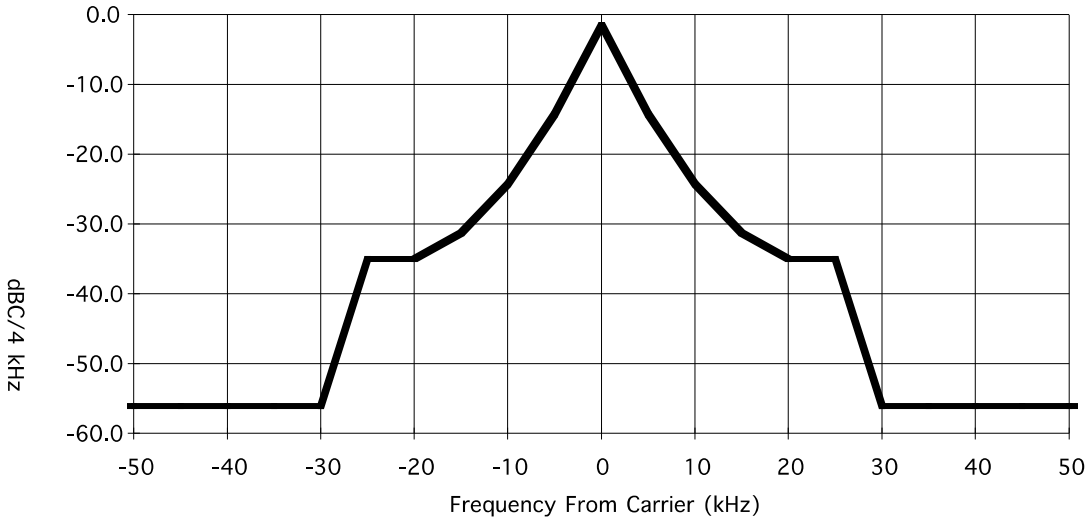
The OG2 satellites are designed to be very quiet in the 148-150.05 MHz band to facilitate optimum performance of their VHF uplink receivers. As a result, the new satellites will also be quiet in the neighboring 150.05-153 MHz Radio Astronomy band. The diplexer and filter isolations reflected in the Table below are minimum isolation values measured at 153 MHz. At other intermediate points between 150.05-153 MHz the isolation is even greater. The OG2 satellite downlinks will also comply with all applicable out-of-band limits to protect against harmful interference to the Radio Astronomy service in the 406.1-410 MHz band. The values in the Tables below calculate PFD at the Earth's surface:

Out-of-Band Emissions into Radio Astronomy Bands

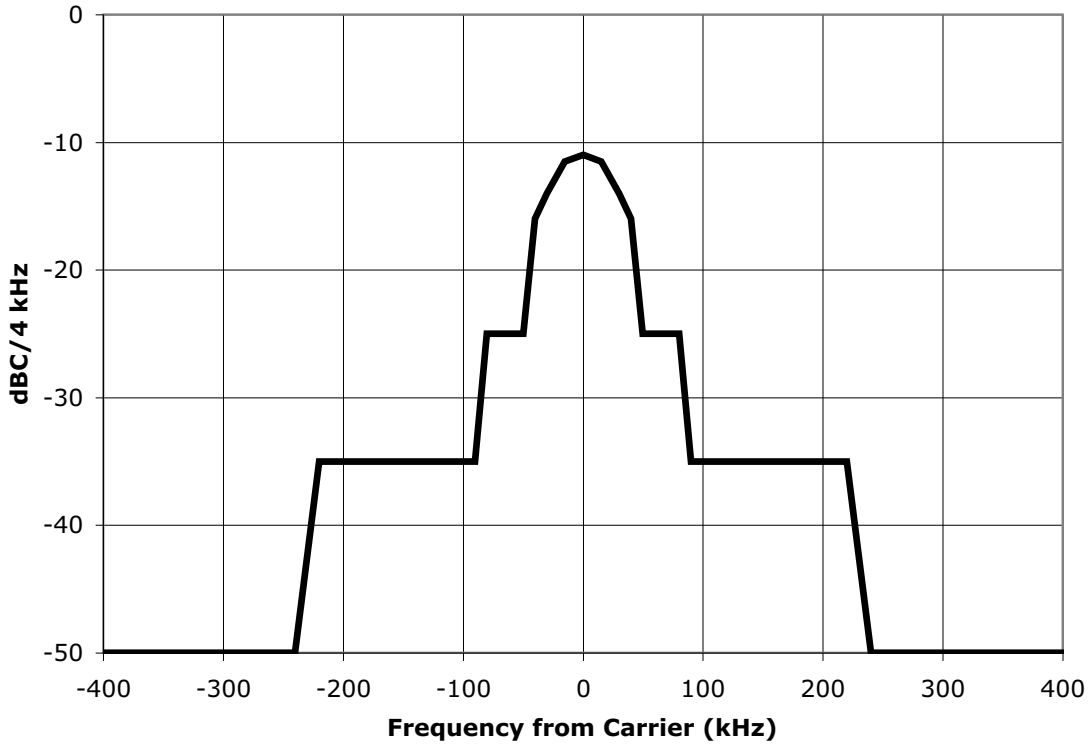
	Subscriber Downlink mode G1	**Subscriber Downlink mode G2**	**GES VHF Downlink mode G1**	**GES VHF Downlink mode G2**
EIRP at Subsatellite	3.5	3.5	-8.7	-8.7
Link Bandwidth	6.72	6.72	40.3	40.3
Spreading Loss	-128.5	-128.5	-128.5	-128.5
PFD dBW/m^2/4 kHz	-125.8	-125.8	-145.8	-145.8
Bandwidth Conversion	-36	-36	-36	-36
Spectrum Rolloff Mask	-55	-55	-50	-50
System Filtering	-45	-45	-28	-28
Pwr Density	-261.8	-261.8	-259.8	-259.8
Band	151	151	151	151
RAS Protection Criteria dBW/m^2/Hz	-259	-259	-259	-259

§ 25.142(a)(3) Emission limitations:

Below are the specified spectrum masks for the OG2 satellite subscriber downlinks and the gateway downlinks. These spectrum masks demonstrate that the OG2 satellites will comply with the out-of-band emission limitations specified in Section 25.202(f) of the Commission's Rules.



Subscriber Downlink Output Spectrum Mask



Gateway Downlink Output Spectrum Mask

In addition to compliance with the out-of-band emission limits of Section 25.202(f) demonstrated above, the ORBCOMM satellites also comply with Section 25.142(a)(3)(ii) of the Commission's Rules. Under that provision, NVNG MSS applicants must demonstrate that no signal received by a satellite from a source outside of the system shall be retransmitted by the satellite. The ORBCOMM satellites incorporate on-board processing, and thus do not make use of traditional "bent-pipe" transponders. All of the signals paths through the spacecraft require that the satellite received signal be demodulated on-board the satellite and re-modulated prior to transmission towards the Earth. It is therefore impossible for signals, transmitted by an ORBCOMM satellite, to originate from sources outside of the ORBCOMM system.

ITU Filing Materials

The Commission undertakes all necessary international advance publication, coordination and notification efforts on behalf of U.S. space station licensees in accordance with the International Telecommunication Union's ("ITU's") frequency assignment registration procedures. ORBCOMM believes that much, if not all, of the information needed for these purposes is included in this Application. ORBCOMM commits to furnish the Commission with whatever additional materials or assistance may be necessary to complete the necessary ITU frequency registration process for the modifications to the OG2 satellites proposed in this Application.[40] In addition, ORBCOMM previously submitted a letter unconditionally accepting all ITU cost recovery responsibilities in connection with its satellite system,[41] and that commitment is unaffected by this requested modification.

Waivers

As explained above (at pp. 4-5), the NVNG MSS system proposed by ORBCOMM differs in many respects from the Geostationary satellites typically

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[40] The Commission's Rules specify the technical information that must be submitted with a space station application, but do not mandate that a space station applicant furnish any necessary ITU materials at the time its application is filed. *Cf.*, *Amendment of the Commission's Space Station Licensing Rules and Policies*, FCC 03-154, released July 8, 2003, at ¶ 12 ("The Appendix 4 information is in separate forms, which *may* be provided to Commission staff at the same time the application is filed.") (emphasis added).

[41] *See,* Letter to Robert Nelson, Chief, FCC International Bureau Satellite Division, from Jerome B. Eisenberg, Chief Executive Officer, ORBCOMM License Corp. (May 30, 2007) (filed with Next-Generation Space Segment License Modification Application). *See, also, FCC Public Notice*, DA-01-2435 (October 19, 2001).

addressed by the Commission's satellite application Rules. Thus, to the extent necessary, ORBCOMM requests a waiver of those application requirements that are inapplicable, because such information is not necessary or pertinent to the evaluation of the technical merits of the proposed NVNG MSS license modification. The Commission may grant a waiver of its rules in a particular case if the relief requested would not undermine the policy objective of the rule in question, and would otherwise serve the public interest.[42] That is the situation here.

For example, the Schedule S requests information on the satellite transponders, but the ORBCOMM satellites employ on-board processing, and do not utilize "transponders" in the sense that most traditional satellites do. Nevertheless, ORBCOMM did include figures in the Schedule S where it requested information on "transponders." ORBCOMM is doing so to provide all information specified by the Commission's Rules and policies in as practical and informative a manner as possible, despite the fact that the current version of Schedule S does not readily accommodate NVNG MSS system characteristics. Likewise, the ORBCOMM satellites do not rely on cross-polarization. Rather, ORBCOMM Subscriber Communicators are linearly polarized, and ORBCOMM relies on them being separated in time and frequency, not polarization, in order to discriminate between the signals. As a result, the requested information on cross-polarization is also irrelevant.

Similarly, to the extent necessary, ORBCOMM seeks a waiver of 47 C.F.R. 25.114(d) (depiction of antenna gain contours). This provision is intended to provide the

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42 *See WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969).

Commission information on the areas served (or not served) and the "roll-off" of the antenna footprint, and is thus not applicable to an NGSO satellite system like ORBCOMM's. Each ORBCOMM satellite is designed to have a uniform coverage pattern, but the resulting "footprint" constantly changes relative to the surface of the Earth as the satellite orbits. Thus, this provision of Section 25.114(d) is not relevant to NGSO satellites. ORBCOMM is providing (in Appendix A) an example "snapshot" of the "footprint" of an individual satellite, as well as a rendering of the "footprint" of the constellation, so as to provide the Commission with a clear depiction of the coverage that will be provided by the modified constellation.

CONCLUSION

As demonstrated herein and in the accompanying technical information, ORBCOMM remains qualified to hold the ORBCOMM System space segment license, and the modifications to the OG2 satellites proposed in this Application will comply fully with the Commission's Rules. Moreover, the public interest would be well served by expeditious grant of this Application. ORBCOMM thus respectfully requests that the Commission promptly grant this Application to allow ORBCOMM to modify its NVNG MSS satellite constellation as described above.

Respectfully submitted,

/S/

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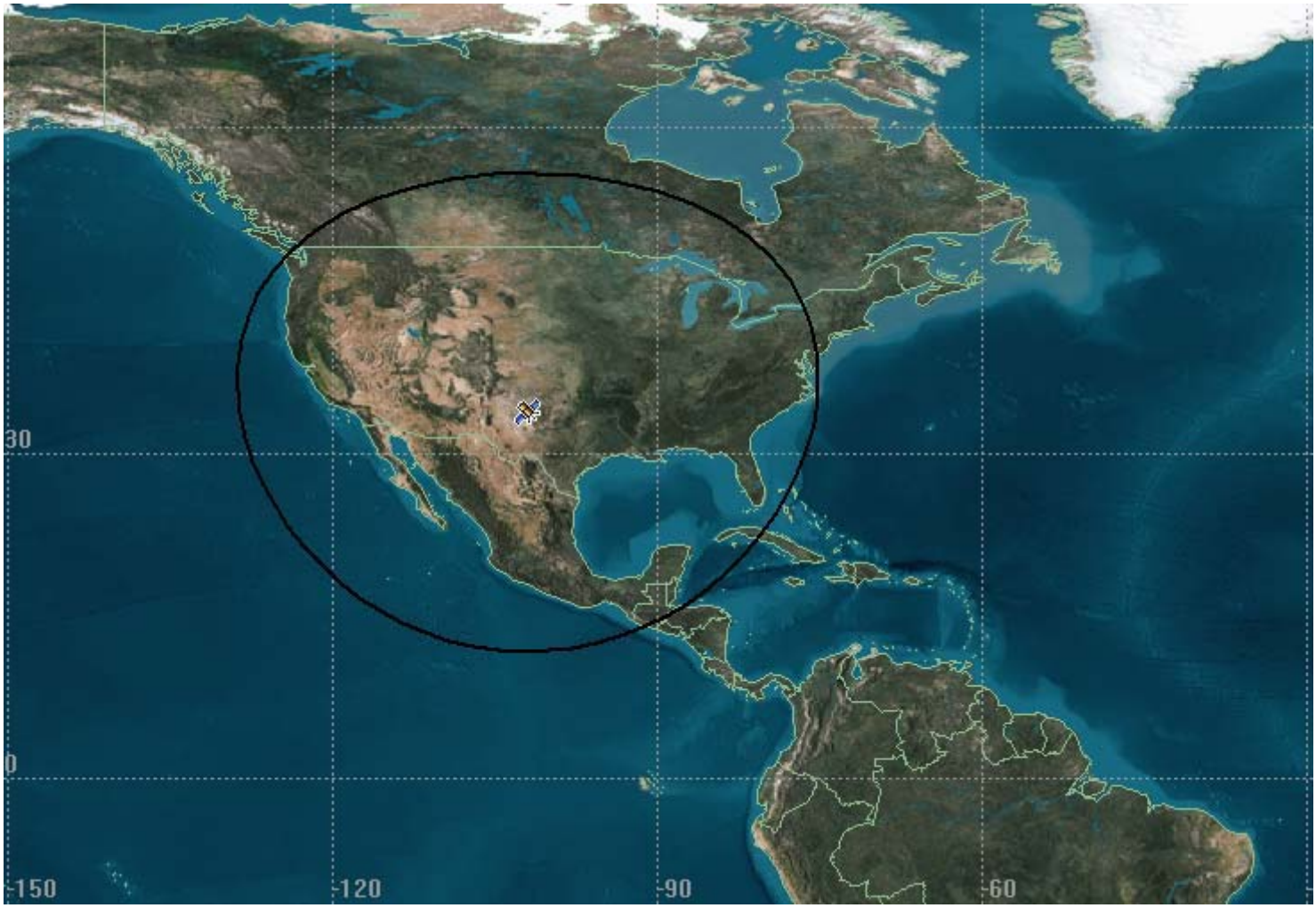
Fort Lee, New Jersey 07024

October 21, 2011

APPENDIX A

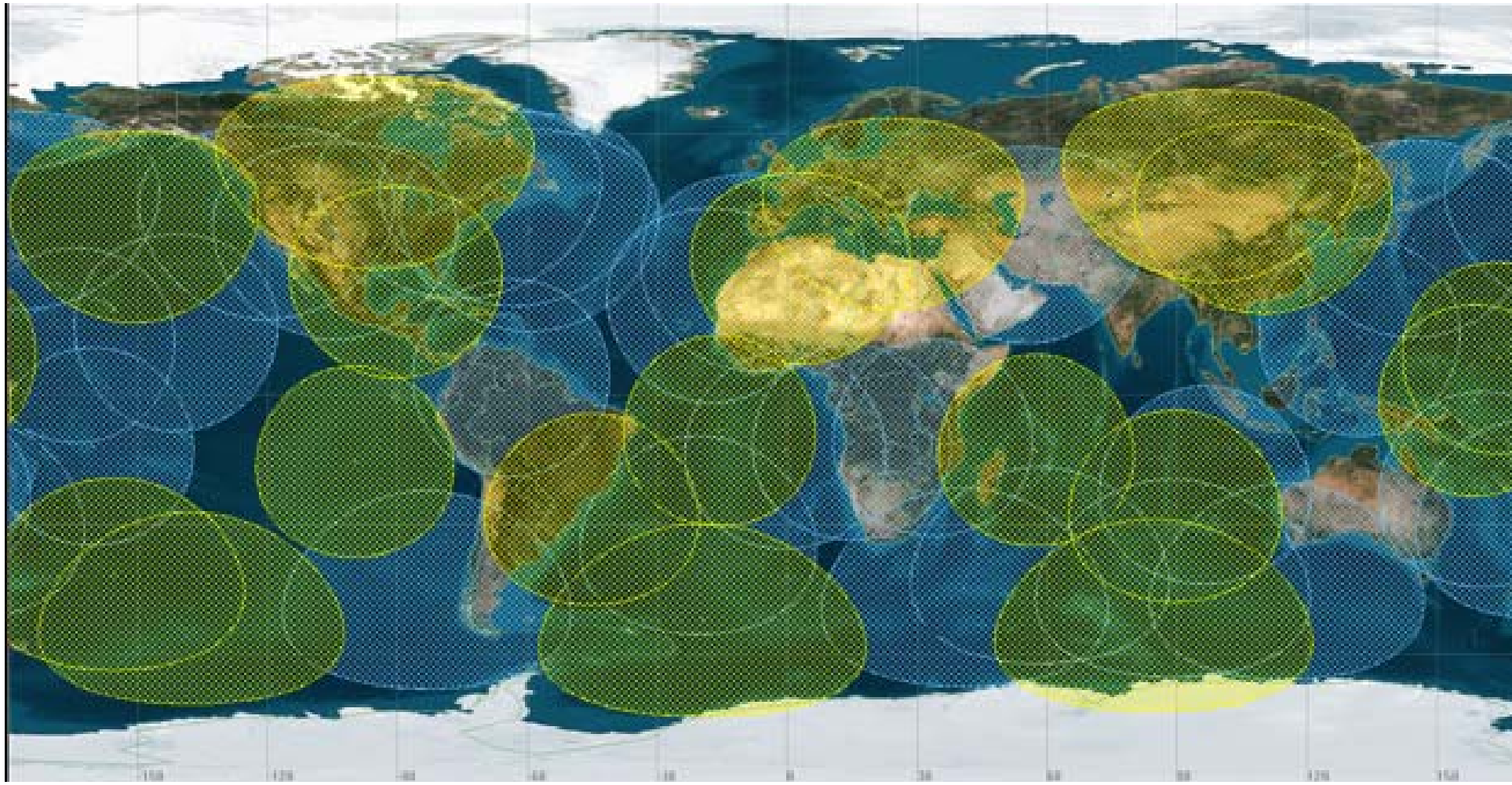
Representative Contour Maps

Representative Satellite Footprint
Altitude = 750 km, User Elevation Mask = 5 deg above horizon



Satellite Constellation Footprints

Yellow = New Satellites Blue = Current Satellites



APPENDIX B

Details of ORBCOMM OG2 Satellite SpaceX Falcon 9 Launch Profile and ISS Collision Avoidance Coordination

The first ORBCOMM Generation 2 ("OG2") satellite is planned to be launched as a secondary payload on a Space Exploration Technologies ("SpaceX") Falcon 9 launch vehicle. The primary payload will be a SpaceX Dragon reusable spacecraft. This will be the second Dragon demonstration mission conducted in connection with NASA's Commercial Orbital Transportation Services ("COTS") program.

SpaceX and ORBCOMM have participated in a series of NASA safety review Technical Interchange Meetings ("TIMs") to ensure, among other things, that there will be no International Space Station ("ISS") conjunction issues posed by the mission. SpaceX is coordinating with NASA's Trajectory Operations Office ("TOPO") directly on ISS safety with respect to the Falcon 9 launch vehicle and the primary Dragon mission. ORBCOMM has the lead in establishing coordination procedures with TOPO regarding the OG2 spacecraft following separation from the launch vehicle.

Mission Profile

The OG2 spacecraft will be mounted on a custom truss that is mated within the Falcon 9 second stage extension, below the Dragon spacecraft as depicted in the actual photo of the Falcon 9 second stage and accompanying illustration provided in Figure 1. SpaceX will initially target a 200 km x 325 km, 51.6 degree inclined orbit, where the Dragon spacecraft will be deployed. The Falcon 9 second stage will then be reignited for

1.6 seconds at apogee to boost the perigee from 200 km to 750 km. The OG2 spacecraft will then be released into a 325 km x 750 km elliptical orbit, and onboard propulsion will then be utilized to climb to the designated operational altitude of 750 km circular. The planned Falcon 9 launch sequence is depicted in Figure 2.

Figure 1: OG2 interface truss structure mated to Falcon 9 second stage extension

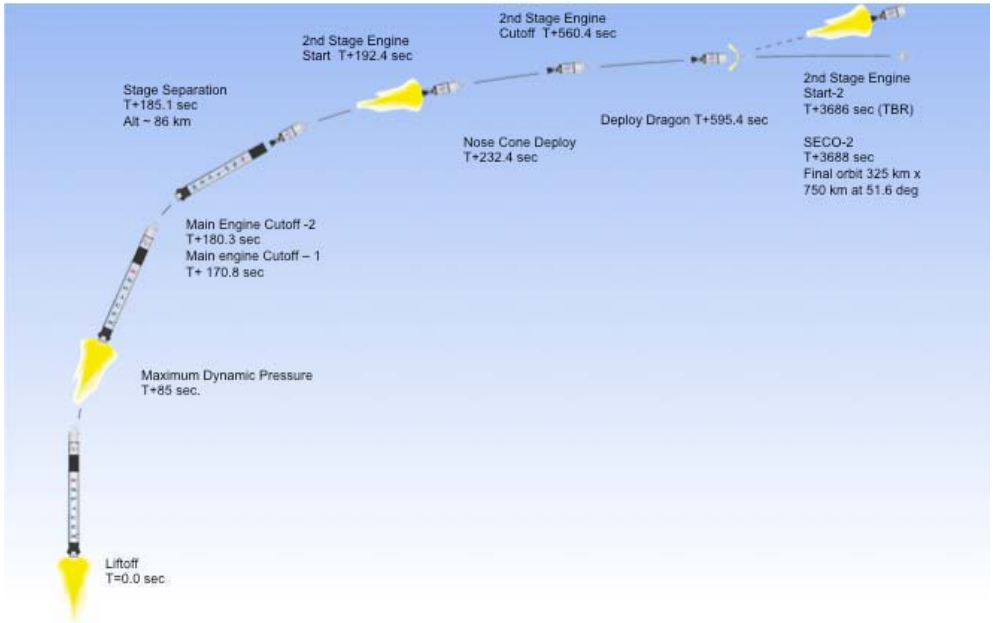


Figure 2: Falcon 9 Dragon/OG2 mission launch sequence

Following launch vehicle separation, the OG2 spacecraft will undergo a preliminary sequence of in-orbit-tests prior to commencing a maneuvering campaign to raise the perigee. The first thrusts are expected no sooner than 3-4 days after launch, which will provide adequate time to establish the health status and determine precise ephemeris information of the OG2 spacecraft. Once begun, the priority of the thrust campaign will be to raise the perigee to 400 km (above ISS) as quickly as possible to minimize any threat of collision with ISS. Thrust durations may be varied, but nominal durations of 50 sec will produce velocity changes of 30.3 cm/sec, resulting in increases 1.07 km with each maneuver. The initial phase of the OG2 satellite maneuver plan calls for thrusts to be conducted every 1-2 orbits at apogee. It will require 70-100 individual thrusts and take up to two weeks to raise the perigee above 400 km.

Once above 400 km, two additional launch and early orbit phases ("LEOPs") are anticipated. The OG2 spacecraft will be subjected to a more complete battery of functional testing, and a less intensive campaign of thrusting will raise the perigee from 400 km to 750 km. These two phases likely will be executed concurrently to some extent and are expected to take 2-3 months to fully complete. The entire post-separation OG2 satellite maneuver campaign is plotted in Figure 3.

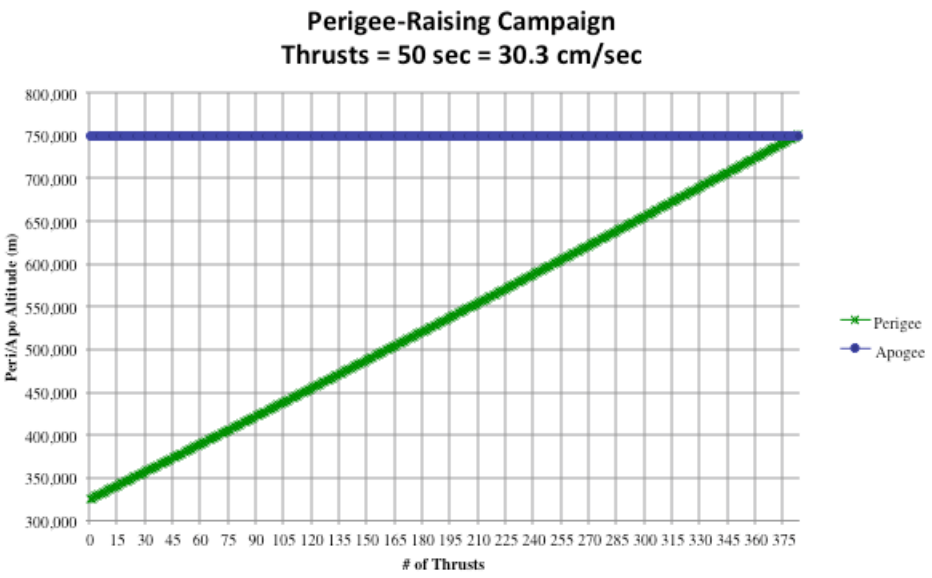


Figure 3: OG2 post-LV separation maneuver campaign to raise perigee from 325 x 750 km to circular 750 km operational orbit

Collision Avoidance Coordination

Although the OG2 spacecraft will pass through the ISS altitude for only a few weeks following LV separation, the ISS collision risk is being minimized and managed in close coordination with NASA through a series of technical interchange meetings and the establishment of formal information exchange procedures.[1]

NASA has indicated that ISS requires 56 hours to evaluate pending conjunctions and make necessary preparations if the ISS is required to maneuver. Therefore, SpaceX and NASA/TOPO are establishing launch window criteria that will ensure comfortable ISS separation distances from all objects associated with the launch that will pass through ISS's altitude within 56 hours of launch. This is being accomplished via trajectory

[1] ORBCOMM's point of contact within MOD/TOPO is Bryan Corley, DM33/ISS Trajectory Operations, ph: (281) 483-8013, email: bryan.m.corley@nasa.gov.

analysis, and the net result is expected to be a small cut-out of injection phase angles for Dragon that effectively translate to minor launch window timing restrictions.[2]

Collision risk mitigation beyond this initial 56-hour period will be accomplished through operational coordination rather than purely through pre-launch analysis. The Falcon 9 second stage will be treated by NASA as is any other uncontrollable, tracked object, but OG2 spacecraft trajectories will be managed actively to avoid ISS conjunctions. The specific procedural details are still being finalized, but the general process of coordination with NASA has been agreed and established. Maneuver plans will be created in advance and shared with NASA and JSpOC along with ephemeris predictions and characterizations of related uncertainties. These plans will be assessed by NASA, and any anticipated ISS safety perimeter violations will be investigated and cleared, or thrust plans will be modified to assure adequate separation. Thrusts will then be executed and confirmed, and post-maneuvering ephemerides will be provided to NASA and JSpOC.

It should be noted that even unmanaged, ORBCOMM/ISS conjunctions are not likely to occur often, if at all. The initial OG2 elliptical orbit following separation from the launch vehicle will assure that the ORBCOMM spacecraft will spend very little time in the ISS altitude range. Additionally, this initial orbit will not be exactly coplanar with the ISS orbit. Deploying Dragon into a proper rendezvous orbit requires a small initial difference in ascending node between OG2 and ISS, and this difference will grow over time at the rate of approximately 0.34 deg/day, owing to the higher mean altitude of the initial OG2 orbit. This will rapidly provide an increasing cross-track degree of separation

[2] Exhibit 1 to this Appendix B is a document provided by SpaceX that describes in more detail the ISS collision risk mitigation procedures that are being undertaken with respect to the initial 56 hour period following the SpaceX Falcon 9 launch.

that further reduces the probability that OG2 spacecraft will penetrate ISS's safety perimeter.

Furthermore, the initial difference in period between OG2 and ISS causes ISS to overtake OG2 in-track (in a lapping sense, that is) approximately every two days. This means there is only one opportunity every two days for a conjunction to exist, and a safety perimeter violation would only occur if OG2 is also within +/-2 km in altitude AND within +/-25 km cross-track at the same time.[3]

In addition to the initial safety provided by the trajectory design, ORBCOMM will use on-board GPS receivers to actively monitor the location of the OG2 spacecraft, and produce and share ground-based orbit determination solutions derived from this telemetry. Early GPS data will be taken at high rates to assure rapid and accurate orbit solutions, and timely downloading of this telemetry will be made possible by ORBCOMM's extensive worldwide Gateway Earth Station ("GES") network.[4] Figure 4 depicts GES satellite tracking coverage at 750 km altitude. To further ensure accurate tracking of the OG2 spacecraft following launch vehicle separation, ORBCOMM will also actively coordinate with NASA and JSpOC to exchange maneuver plans and confirmations thereof, ORBCOMM-generated ephemeris solutions, and JSpOC conjunction summary messages ("CSM") as they are derived.[5]

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[3] The periodicity of altitude/cross-track alignments is on the order of four weeks, making a three-dimensional convergence an unlikely event during the relatively brief time that OG2's perigee is below the ISS altitude.

[4] There are currently sixteen (16) ORBCOMM GESs deployed throughout the world.

[5] ORBCOMM and JSpOC have had a long-established relationship, and regularly exchange JSpOC CSM and internally generated ephemeris data for the operational ORBCOMM satellite constellation.

It should be noted that ORBCOMM has an established internal operations policy for responding to close conjunctions that is adhered to during all phases of ORBCOMM satellite operations (*i.e.*, during initial maneuvering campaigns, in operational orbit, and during disposal maneuvering). No fuel needs to be specifically allocated for collision avoidance during orbit raising or disposal maneuvering, however, as any such maneuvers are typically planned to coincide with the orbit-raising/lowering objectives.

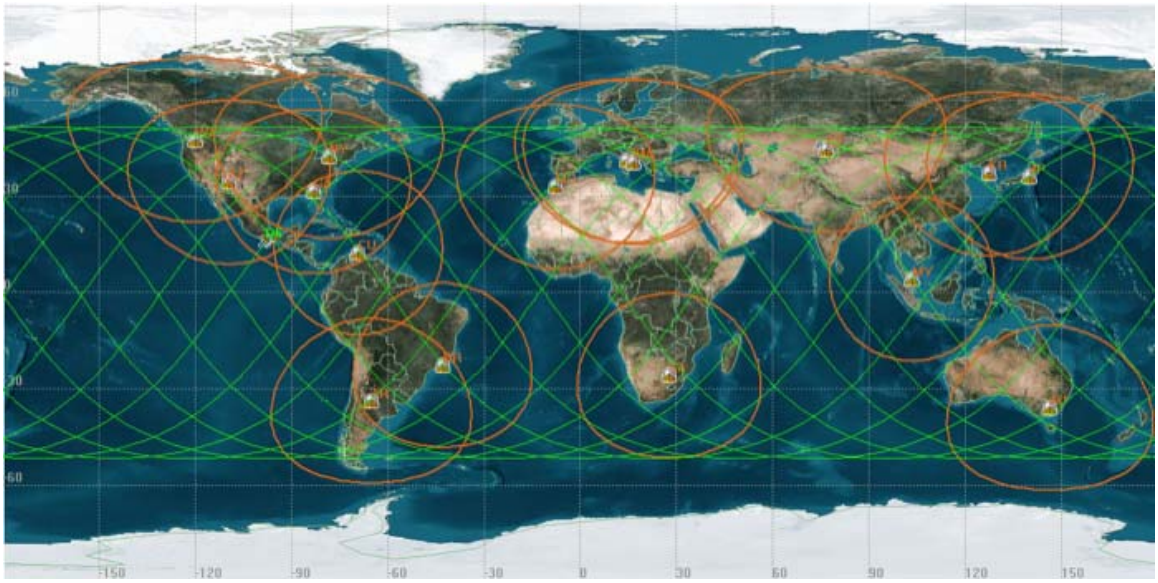

Figure 4: ORBCOMM satellite tracking coverage provided at 750 km altitude by existing worldwide ORBCOMM GES network

Following the first above-described OG2 Falcon 9 launch mission, ORBCOMM currently plans to launch as many as twelve additional OG2 satellites as the primary payload on a subsequent Falcon 9 mission. The OG2 spacecraft carried on this later Falcon 9 launch will be inserted directly into the 750 km circular operational orbit, or at a lower parking altitude that will facilitate separating satellites into different nodal planes for operational deployment. In either case, this planned launch will be conducted several

hundred kilometers above the ISS operational altitude, and thus, will not pose any ISS conjunction issues. ORBCOMM currently plans to launch the remaining OG2 satellites as secondary payloads on two additional Falcon 9 ISS missions that will be coordinated with NASA to avoid risk of ISS conjunction.[6]

[6] ORBCOMM will also continue to investigate alternative cost-efficient launch opportunities that meet OG2 mission requirements.

SPACEX

Space Exploration Technologies

APPENDIX B

EXHIBIT 1

1. Concerning collision avoidance between the second stage of the SpaceX launch vehicle and the International Space Station, please indicate whether Orbcomm or its launch provider are undertaking operator-to-operator coordination with NASA, and in particular with respect to operations of the second stage following separation of the Dragon capsule.

SpaceX Response:

SpaceX has worked closely with NASA's Trajectory Operations Officers (TOPO) within the Mission Operations Directorate (MOD) to establish tracking and conjunction criteria, as well as mitigate any threats to the ISS. Initially, NASA TOPO identified a period in the ISS standard debris avoidance process whereby the ISS would be unable to mitigate any conjunction prior to 56 hours after launch. SpaceX then performed analyses to show that for all planned launch opportunities, no probability of conjunction exists during this time period. To make this true, SpaceX will implement a small phase angle cut-out slightly limiting launch opportunities. This has been discussed and has a negligible impact on launch planning due to other launch constraints. After the 56-hour period concludes, ISS standard debris analysis screening applies and no further action is necessary by SpaceX.

SpaceX analysis also covers Orbcomm for the 56-hour period as no operational maneuvers are planned by Orbcomm. After the 56 hour period concludes, Orbcomm will begin operator-to-operator coordination with NASA TOPO to coordinate orbital maneuvers to reach their final operational orbit.

Additionally, SpaceX performed standard launch vehicle-to-spacecraft (Dragon and Orbcomm) re-contact analyses for the Falcon9/Orbcomm mission. This same type of analysis has been successfully employed for Falcon 1 flight 5 for the Razaksat satellite, and on Falcon 9 flight 2 for the Dragon Spacecraft and eight secondary payloads (PPODs). The results of this analysis for the Falcon9/Orbcomm mission show that the deployment strategy is robust and no risk of re-contact exists.

1 Rocket Road Hawthorne CA 90250
p 310.363.6000 f 310.363.6001
spacex.com

APPENDIX C

REQUEST FOR CONFIDENTIAL TREATMENT OF SUPPORTING DOCUMENTATION

ORBCOMM

October 21, 2011

HAND DELIVERED

Robert Nelson, Chief
Satellite Division
International Bureau
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: Application of ORBCOMM License Corp. For Authority to Modify its Non-Voice, Non-Geostationary Satellite Service Space Segment License (S2103) to Revise the Next-Generation Satellite Deployment Plan

File No. _____

REQUEST FOR CONFIDENTIAL TREATMENT

Dear Mr. Nelson:

Pursuant to Sections 0.457(d) and 0.459 of the Commission's Rules, 47 C.F.R. §§ 0.457(d) & 0.459, the Freedom of Information Act, 5 U.S.C. 552 ("FOIA"), and the Trade Secrets Act, 18 U.S.C. § 1905, ORBCOMM Inc. and its wholly-owned subsidiary ORBCOMM License Corp. (collectively "ORBCOMM") respectfully request that the information submitted herewith (the "Confidential Materials") not be placed in the public file and otherwise be withheld from public inspection. The Confidential Materials are being submitted in connection with the above-referenced Application of ORBCOMM License Corp. For Authority to Modify its Non-Voice, Non-Geostationary Satellite Service Space Segment License (S2103) to Revise the Next-Generation Satellite Deployment Plan (the "ORBCOMM License Modification Application"). The Confidential Materials consist of the following items:

2115 Linwood Avenue, Suite 100, Fort Lee, NJ 07024
Telephone: 201-363-4900
Facsimile: 703-433-6400

22265 Pacific Boulevard, Suite 200, Dulles, VA 20166
Telephone: 703-433-6300
Facsimile: 703-433-6400

Exhibit	Description
1	Sierra Nevada Corporation Hazard Report No. 101 *Explosion, Ignition or Leakage of Battery*
2	Sierra Nevada Corporation Hazard Report No. 102 *Explosion, Ignition or Leakage of Propulsion System*
3	Sierra Nevada Corporation Hazard Report No. 103 *Rupture or Explosion of Heat Pipes*
4	Sierra Nevada Corporation Range Safety Presentation August 9, 2011
5	Sierra Nevada Corporation Range Safety Presentation September 9, 2011
6	Space Exploration Technologies Corp. Falcon F9 ORBCOMM Mission NASA PSRP Presentation – September 13, 2011 (Excerpt)

Due to the nature and content of the documents containing the Confidential Materials, it is not feasible to separate any non-confidential portion of the documents that could be submitted as a redacted version. Accordingly, a copy of this Request For Confidential Treatment is being filed as Appendix C of the ORBCOMM Modification Application Narrative Exhibit, but no redacted version of the documents containing the Confidential Materials can be filed in the public record.[1] ORBCOMM requests that the Confidential Materials be withheld from public disclosure by the Commission for an indefinite period, or for the maximum permissible time.

[1] 47 C.F.R. § 0.459(a)(1).

ORBCOMM has a proprietary right in its confidential commercial information. ORBCOMM has expended substantial financial and in-kind resources to organize and develop its business. ORBCOMM also has taken significant precautionary steps and measures to maintain and safeguard its confidential information, including the information contained in the Confidential Materials.

The Confidential Materials contain specific, highly sensitive proprietary technical and commercial trade secret information relating to ORBCOMM's Generation 2 ("OG2") satellite program, including but not limited to details regarding OG2 spacecraft technical designs and specifications, and manufacturing processes. None of the information contained in the Confidential Materials has previously been publicly disclosed.

As the owner and operator of the ORBCOMM satellite system, ORBCOMM is subject to substantial worldwide competition from other satellite and terrestrial service providers. Public disclosure of the Confidential Materials could allow ORBCOMM's competitors ready access to extremely sensitive proprietary company information, which, under normal business circumstances, is not and would not be publicly disclosed. Among other things, such disclosure could cause substantial economic harm to ORBCOMM, or otherwise enable unfair competition with ORBCOMM. Accordingly, public disclosure of any of the information contained in the Confidential Materials is likely to cause competitive injury and substantial irreparable harm[2] to ORBCOMM, and is therefore exempted from mandatory disclosure under FOIA Exemption 4,[3] and Section 0.457(d) of the Commission's rules, 47 C.F.R. § 0.457(d).

The Confidential Materials are also subject to statutory disclosure restrictions to prevent unauthorized export pursuant to Arms Export Control Act ("AECA")[4] and the associated provisions of the International Traffic in Arms Regulations ("ITAR").[5] The Commission's public records are readily accessible to foreign persons[6] that cannot be readily identified for purposes of export control compliance. Accordingly, the AECA & ITAR controlled Confidential Materials should not be placed in the Commission's public file and should be otherwise withheld from public inspection pursuant to FOIA Exemption 3, which is invoked with respect to information prohibited from disclosure by another statute.[7]

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[2] *See, e.g.,* National Parks and Conservation Association v. Morton, 498 F.2d 765 (D.C. Cir. 1974).
[3] 5 USC § 552(b)(4). *See, e.g., Public Citizen Health Research Group v. FDA,* 704 F.2d 1280, 1290-91 (D.C. Cir. 1983).
[4] 22 U.S.C. § 2778.
[5] 22 C.F.R. §§ 120-129. Technical data relating to commercial satellites is AECA & ITAR controlled technical data. 22 C.F.R § 121.1.
[6] 22 C.F.R § 120.16.
[7] 5 USC § 552(b)(3).

For all the above-stated reasons, the Commission should grant ORBCOMM's instant Request For Confidential Treatment, and should not place the Confidential Materials in the public file and otherwise should withhold the Confidential Materials from public inspection.[8]

Kindly direct any inquiries concerning this submission to the undersigned.

Respectfully submitted,

/s/

Walter H. Sonnenfeldt, Esq.
Vice President, Regulatory Affairs
ORBCOMM Inc.
Direct Tel: (585) 461-3018
E-Mail: sonnenfeldt.walter@orbcomm.com

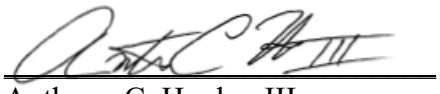
[8] ORBCOMM requests immediate Commission notification of any request for disclosure of the Confidential Materials so that ORBCOMM can oppose such request or take other actions as deemed necessary.

APPENDIX D

ENGINEERING CERTIFICATION

I, Anthony C. Hopko, III, Technical Program Manager for ORBCOMM, certify under penalty of perjury that:

I am the technically qualified person with overall responsibility for preparation of the technical information contained in ORBCOMM's Application for Authority to Modify its Non-Voice, Non-Geostationary Satellite System License to Revise the Next-Generation Satellite Deployment Plan. I am familiar with the requirements of Part 25 of the Commission's Rules, and the information in the application is true and correct to the best of my belief.



Anthony C. Hopko, III

Dated: October 21, 2011