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

In the Matter of Application By	)	
	)	
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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TABLE OF CONTENTS

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	)	
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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

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[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 two OG2 satellites 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 sixteen 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 two OG2 satellites and additional OG2 satellites

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[2] Following the successful 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.

deployed in a later launch that will be maneuvered into the same operational orbit plane as the first two. 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

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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,

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[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 its initial two satellites 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 two OG2 satellites, ORBCOMM will be able to gain valuable experience with operating these new satellites 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,

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[28] The launch is currently scheduled for November 30, 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 two 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. 26-30 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. 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/.

(1) ORBCOMM has assessed the potential for any debris to be released in a planned manner during normal OG2 satellite operations,[37] and has minimized the possibility of any such orbital debris. There are no planned intentional releases of any objects during any phase of the mission, including deployment, operations, and disposal. The OG2 satellites do not utilize any shrouds or other temporary covers to be removed upon deployment, and no shrapnel will be generated during separation from the launch vehicle.

ORBCOMM understands and appreciates that small debris and meteoroids have the potential of colliding with and doing damage to the spacecraft and spacecraft sub-systems. The satellite bus structure and other components to be employed in the OG2 satellites were designed with this in mind. No components critical for OG2 satellite bus functionality will be externally exposed. Internal components are provided with physical protection either by the bus structure, or by thermal insulation that would serve to break up any small debris or meteoroid upon impact. Any resulting debris or vapor continuing into the interior of the spacecraft is unlikely to cause damage to major components.

ORBCOMM presumes that a conservative estimate of debris size that may threaten a satellite's ability to conduct a disposal maneuver is 2 centimeters. In order to assess the likelihood of any such collisions, ORBCOMM utilized NASA's Debris Assessment Software (DAS v1.5.3), which is publicly-available. The target OG2 satellite operational orbits were inputted into the model, along with the average cross-sectional

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[37] Appendix B to this Narrative Exhibit provides a mission profile and ISS conjunction analysis for the planned launch of the first two OG2 satellites later this year as a secondary payload on a SpaceX Falcon 9 launch vehicle with a primary ISS-related mission payload.

area corresponding to the OG2 satellite design. The resulting annual collision probabilities are summarized in the table below. Based on these results, ORBCOMM believes the risk is negligible that impacts with small debris will render the spacecraft unable to conduct disposal maneuvers.

ORBCOMM Satellite Type	Nominal Inclination	Nominal Altitude	Avg Cross Sectional Area	P(Impact w/ debris >2cm)/yr
OG2	51.6^{o}	750 km	4.3 m^2	$1x10^{-4}$

(2) ORBCOMM believes there is virtually no possibility for an OG2 spacecraft to accidentally explode on-orbit. All components involved in the retention and control of energy sources have strong heritages, and energy sources will be minimized or depleted upon disposal of the spacecraft. These sources include liquid fuel tanks for propulsion, chemical batteries, and momentum wheels. All remaining fuel will be consumed in conducting disposal maneuvers, leaving fuel tanks with very little pressure and no potential for chemical combustion. Battery pressures will be minimized, and momentum wheels will be de-spun.

(3) ORBCOMM understands that other sizable objects exist in low-Earth orbit, and that there is some small possibility of physical collision with large objects (including other non-geostationary orbit ("NGSO") satellites), which would presumably generate additional orbital debris. In order to assess the likelihood of any such collisions, ORBCOMM again used NASA's Debris Assessment Software. The resulting annual probability of collision for each of the mission types is shown in the table below. ORBCOMM believes that this modeling demonstrates that the probability of catastrophic

collision over the life of the OG2 satellite mission is extremely small, and it therefore does not constitute a significant risk of further contributing to the debris environment.

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

The ORBCOMM system is comprised of relatively small NGSO satellites. As with ORBCOMM's currently operational spacecraft, there will be no formal and active collision avoidance monitoring systems in place for the OG2 satellites. ORBCOMM has participated in coordination efforts with other operators and U.S. Government organizations in recent years, however, to improve space situational awareness and avoid collisions. It is expected that ORBCOMM will continue these activities (with respect to new and existing satellites alike) to the extent that the cooperating parties find them to be mutually beneficial.

Because there are no mission requirements to do so (nor any Commission requirements to do so, unlike requirements for geostationary satellites), orbital parameters will not be maintained 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*.

(4) 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, each OG2 satellite will be shifted to a different orbit, decreasing its perigee 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 kilometers was used as the apogee altitude, and resulting perigee altitudes and required delta velocities are summarized in the table below. Sufficient fuel will be reserved on each OG2 spacecraft to perform these disposal maneuvers.

ORBCOMM Satellite Type	Apogee Alt	Ave Area/Mass	Required Perigee Altitude	Required Delta Velocity
OG2	750 km	.0269 m^2/kg	680 km	18.5 m/sec

ORBCOMM believes that the OG2 satellites will largely disintegrate and burn up upon re-entry to the atmosphere. There is a remote possibility, however, that some of the more dense internal components may survive and strike the Earth. ORBCOMM has performed a casualty analysis using the guidelines provided in FCC Public Notice DA 04-1724, Report No. SPB-208, *Clarification of 47 C.F.R. Sections 25.143(b), 25.145(c)(3), 25.146(i)(4) and 25.217(d) Regarding Casualty Risk Assessment for Satellite Atmospheric Re-entry* (the "Satellite Re-Entry Risk Assessment Notice"). While it is very likely that none of the disposed satellite mass will survive re-entry, it has been

conservatively assumed that several of the more dense components, or remains thereof, will survive and strike the ground. Specifically, the components most likely to survive to any extent include the reaction wheels and the solar array drive motor. The OG2 spacecraft each have four reaction wheels and one solar array drive. The surviving mass of each of these objects would be smaller than 0.7 kilograms in mass and less than 0.1 meter in diameter. It is conservatively presumed that each of the five fragments would be of this maximum dimension, and they were then modeled as 0.1 meter diameter spheres. The average casualty area was then computed using the equation from the Satellite Re-Entry Risk Assessment Notice as follows:

$$\text{Avg Casualty Area} = [(\text{Cross-sectional area of person})^{1/2} + (\text{Cross-sectional area of debris})^{1/2}]^2,$$

where the cross-sectional area of a person was taken to be a circular footprint with a radius of 1 meter, and the average cross-sectional area of a fragment is computed to be 7.85×10^{-3} m^2. The average casualty area then becomes 3.46 m^2. The Satellite Re-Entry Risk Assessment Notice then suggests that the casualty probability can be computed from the following formula:

$$\text{Probability of Casualty} = 1 - (1 - P_0)^N$$

where N is the number of surviving fragments, and the probability of casualty from a single fragment is,

$$P_0 = (\text{Avg Casualty Area}) \times (\text{Avg Population Density}).$$

The inclination of the orbit bounds the percentage of the Earth's surface over which the satellite may reenter. However, due to the fact that most of the world's

population resides within +/- 52º latitude, it was conservatively presumed that the entire population will be within the potential landing area. The U.S. Census Bureau website projects the global population to be roughly 9.0 billion people in 2045. This is the approximate year for reentry of the last of the OG2 satellites (assuming launch by 2014, a five-year operational life, and up to twenty-five years to de-orbit the spacecraft through an uncontrolled re-entry). The resulting casualty probability for a single fragment is then 7.7×10^{-5}, and the maximum probability of casualty per satellite is 3.9×10^{-4}. Given the small magnitude of this result coupled with the conservative assumptions made in each step of the analysis, ORBCOMM believes the OG2 satellites represent a negligible and acceptable casualty risk, in full conformance with the Commission's 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

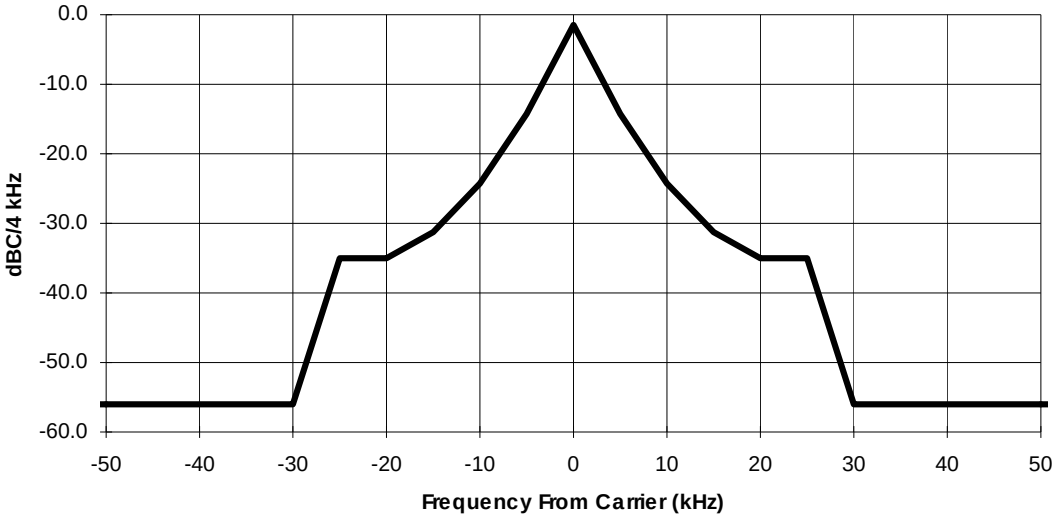
Astronomy service in the 406.1-410 MHz band. The values in the Tables below calculate PFD at the Earth's surface:

Out-of-Band Emissions into Radio Astronomy Bands

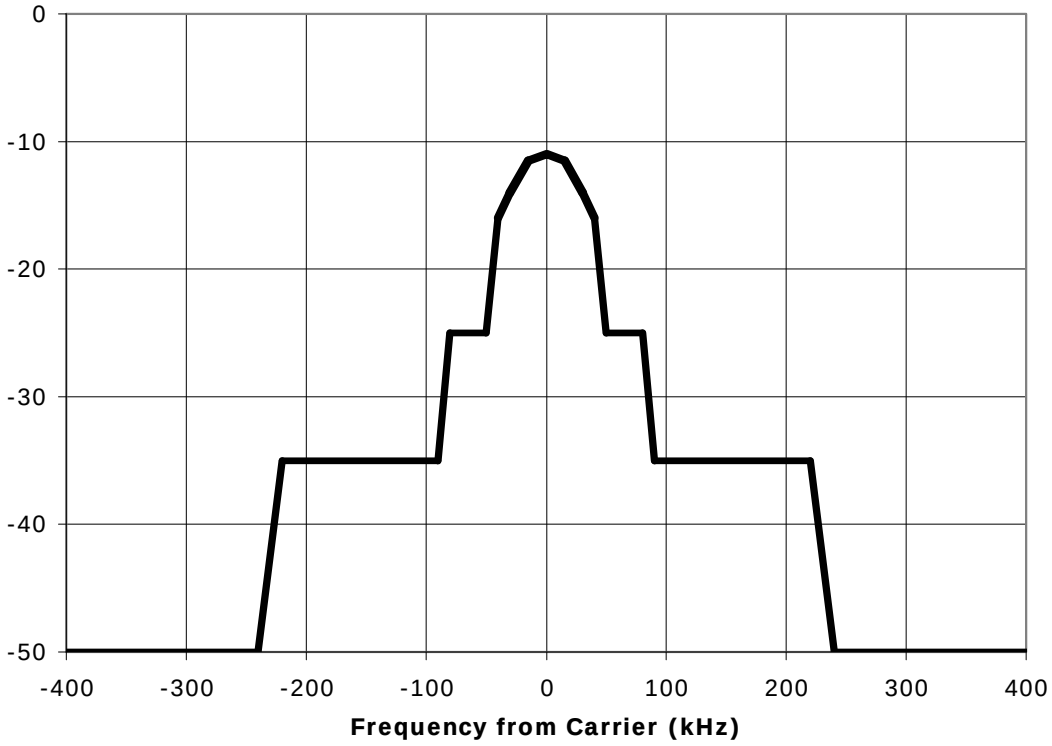
	Subscriber Downlink mode G1	**Subscriber Downlink mode G2**	**GES VHF Downlink mode G1**	**GES VHF Downlink mode G2**
EIRP at Subsatellite	3.5	3.5	-8.7	-8.7
Link Bandwidth	6.72	6.72	40.3	40.3
Spreading Loss	-128.5	-128.5	-128.5	-128.5
PFD dBW/m^2/4 kHz	-125.8	-125.8	-145.8	-145.8
Bandwidth Conversion	-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.[38] In addition,

[38] 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,

ORBCOMM previously submitted a letter unconditionally accepting all ITU cost recovery responsibilities in connection with its satellite system,[39] 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 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.[40] 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

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).

[39] *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).

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

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 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/

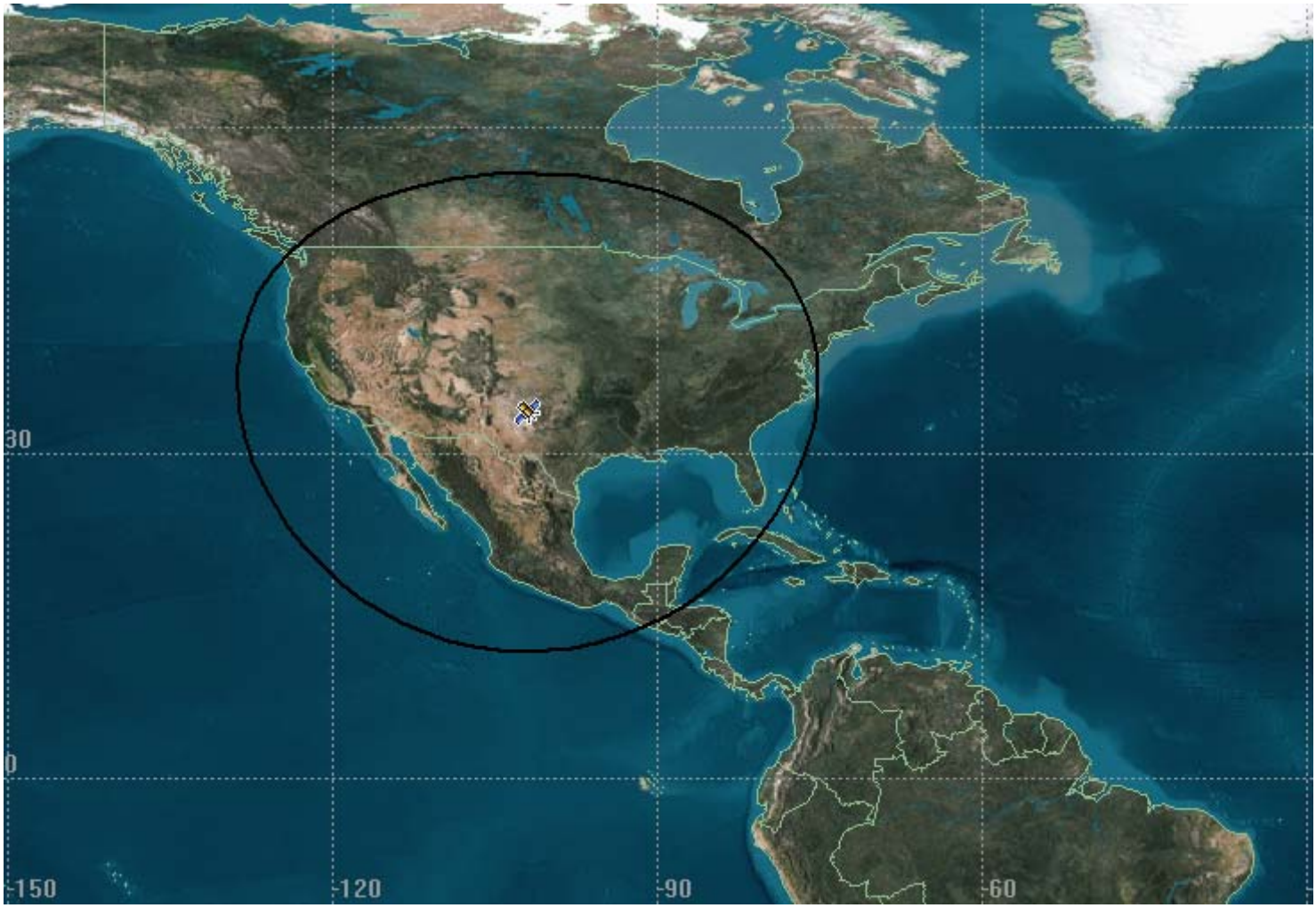
Marc J. Eisenberg
Chief Executive Officer
ORBCOMM License Corp.
2115 Linwood Avenue, Suite 100
Fort Lee, New Jersey 07024

August 1, 2011

APPENDIX A

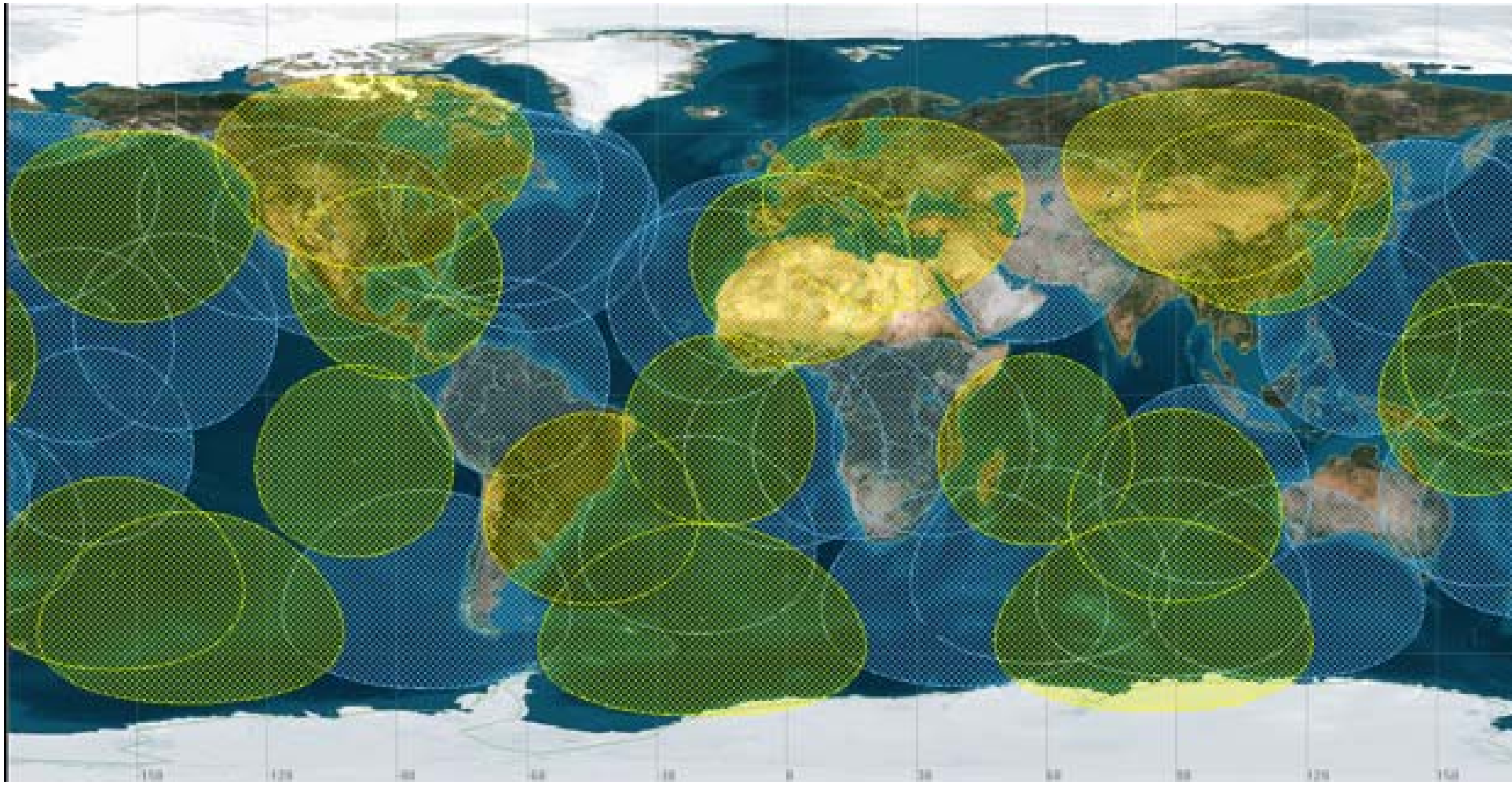
Representative Contour Maps

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



Satellite Constellation Footprints

Yellow = New Satellites Blue = Current Satellites



APPENDIX B

OG2 Satellite Launch Mission Profile

The first two ORBCOMM Generation 2 ("OG2") satellites are 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. NASA has selected the SpaceX Dragon as a candidate resupply vehicle for the International Space Station ("ISS") following the end of NASA's Space Shuttle program.[1] The mission will launch into a 51.6 degree inclined orbit to support the planned demonstration of Dragon operations in proximity to the ISS. The launch is currently scheduled for November 30, 2011.

SpaceX and ORBCOMM are in the process of completing NASA ISS Payload Safety Review Panel ("PSRP") procedures to ensure that there will be no ISS conjunction issues posed by the mission. SpaceX is completing the PSRP process with respect to the Falcon 9 launch vehicle and the primary Dragon mission. ORBCOMM has the lead in undertaking the PSRP procedures with respect to the OG2 satellites following separation from the launch vehicle.

Mission Profile

The two OG2 satellites will be mounted on a custom truss that is mated within the Falcon 9 second stage extension, below the Dragon spacecraft, as depicted in Figure 1. SpaceX will initially target a 200 km x 325 km 51.6 degree inclined orbit, where the

[1] *See, e.g.,* http://www.spacex.com/dragon.php.

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 two OG2 satellites will then be released into a 325 km x 750 km elliptical orbit. The planned Falcon 9 launch sequence is depicted in Figure 2.

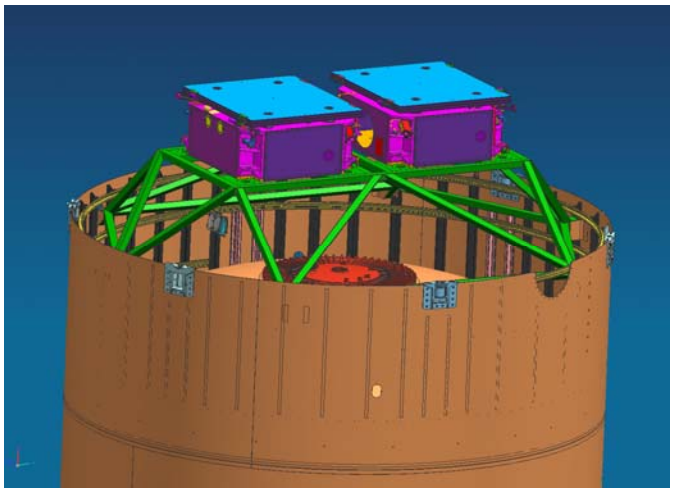


Figure 1: OG2 interface truss structure mated to Falcon 9 second stage extension

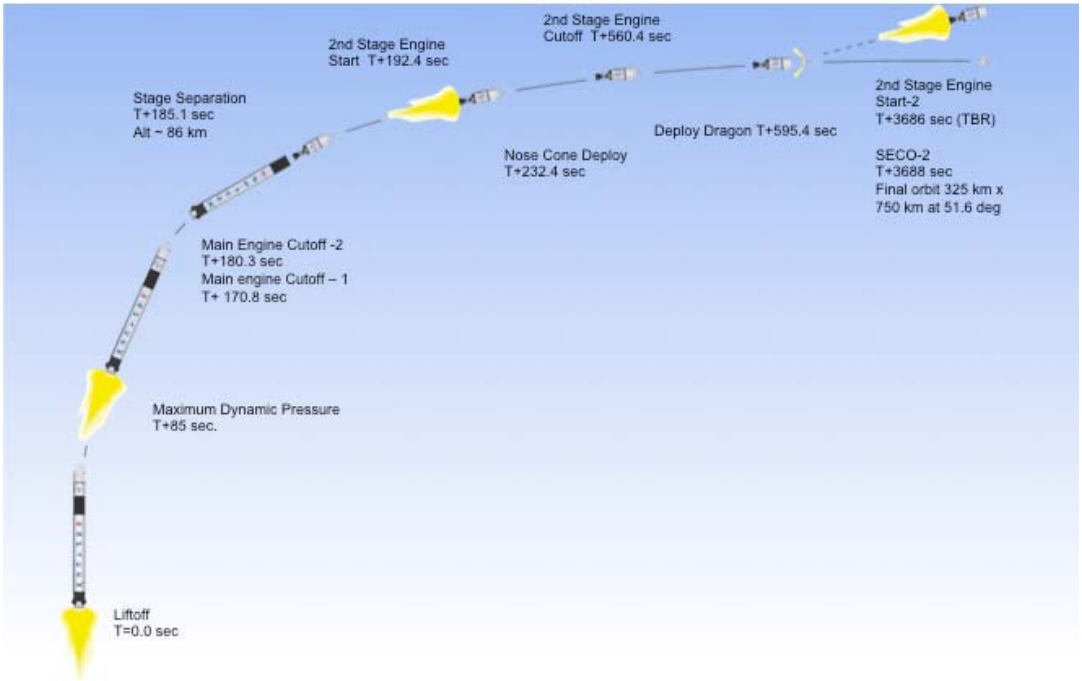


Figure 2: Falcon 9 Dragon/OG2 mission launch sequence

Following launch vehicle separation, the onboard OG2 satellite propulsion systems will be used to circularize the orbits of the two new ORBCOMM spacecraft at the target 750 km altitude. This will require a series of approximately 380 perigee-raising thrust events that will commence 3-4 days after launch vehicle separation, and are expected to take 2-3 months to complete. [2] Thrust durations can 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 post-separation maneuver plan calls for thrusts to be conducted every 1-2 orbits at apogee until the two OG2 satellites have been raised above the ISS orbit to a perigee altitude of 400 km. The frequency of maneuver thrusts will then be adjusted to allow time for in-orbit testing of the two OG2 satellites as they transition into their circular 750 km operational orbit. The entire post-separation OG2 satellite maneuver campaign is plotted in Fig. 3.

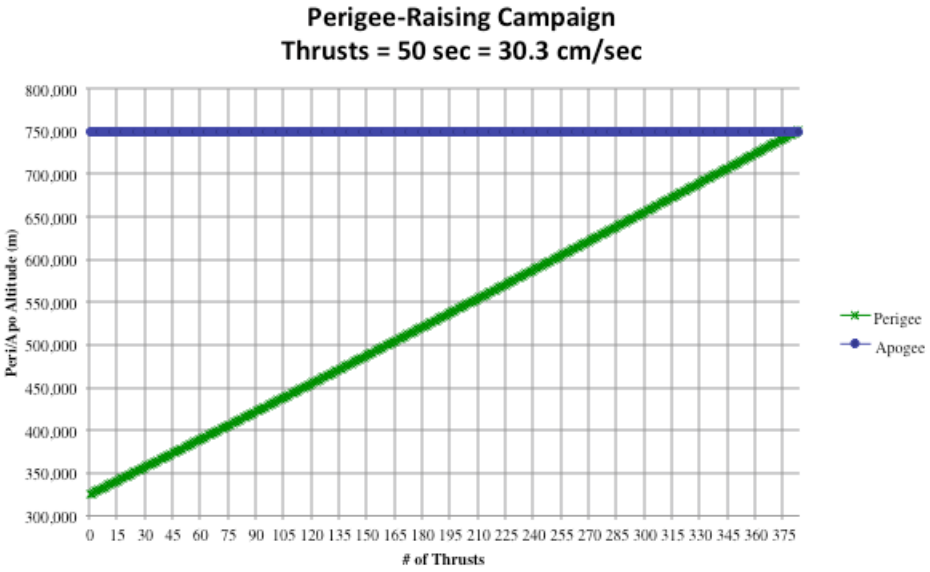


Figure 3: OG2 post-LV separation maneuver campaign to raise perigee from 325 x 750 km to circular 750 km operational orbit

[2] Shortly after the OG2 satellites reach a 400 km perigee altitude, safely above the ISS operating altitude, the maneuver campaign will be temporarily suspended for one of the spacecraft to allow the ascending nodes to separate.

Although the two OG2 satellites will pass through the ISS altitude range during the first 5-10 days of the post separation maneuver campaign, the risk of collision with ISS is negligible and is being managed in close coordination with NASA. The initial elliptical orbit that the OG2 satellites will be deployed in will assure that the two ORBCOMM spacecraft will spend very little time in the ISS altitude range. Additionally, separation between the OG2 satellites and the ISS, in both along-track and cross-track dimensions, will also be assured by final mission orbit selection. SpaceX will complete final pre-launch mission coordination in accordance with standard specified NASA procedures to ensure that along-track separation will be guaranteed by the timing of the launch. In other words, the trajectory will be designed such that the Falcon 9 launch vehicle, and the OG2 satellites at the time of separation, will be well ahead or behind of the ISS in their respective orbits (in a mean anomaly sense). Furthermore, while the initial injection orbit of the OG2 satellites will be coplanar with ISS, the semi-major axis difference between ISS and the OG2 spacecraft will result in a nodal regression rate difference in the range of 0.34–0.47/day that will rapidly take the OG2 satellites out of the ISS plane and also result in a cross-track degree of separation.

In addition to the separation provide by the trajectory design, ORBCOMM will actively monitor the location of the OG2 satellites using on-board GPS receivers, the 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 is made possible by ORBCOMM's extensive global Gateway Earth Station ("GES") network.[3] Figure 4 depicts GES satellite tracking

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

coverage at 750 km altitude. To further ensure accurate tracking of the OG2 satellites following launch vehicle separation, ORBCOMM will also actively coordinate with NASA and the Joint Space Operations Center ("JSpOC") to exchange ORBCOMM-generated ephemeris solutions and JSpOC conjunction summary messages ("CSM") as they are derived.[4]

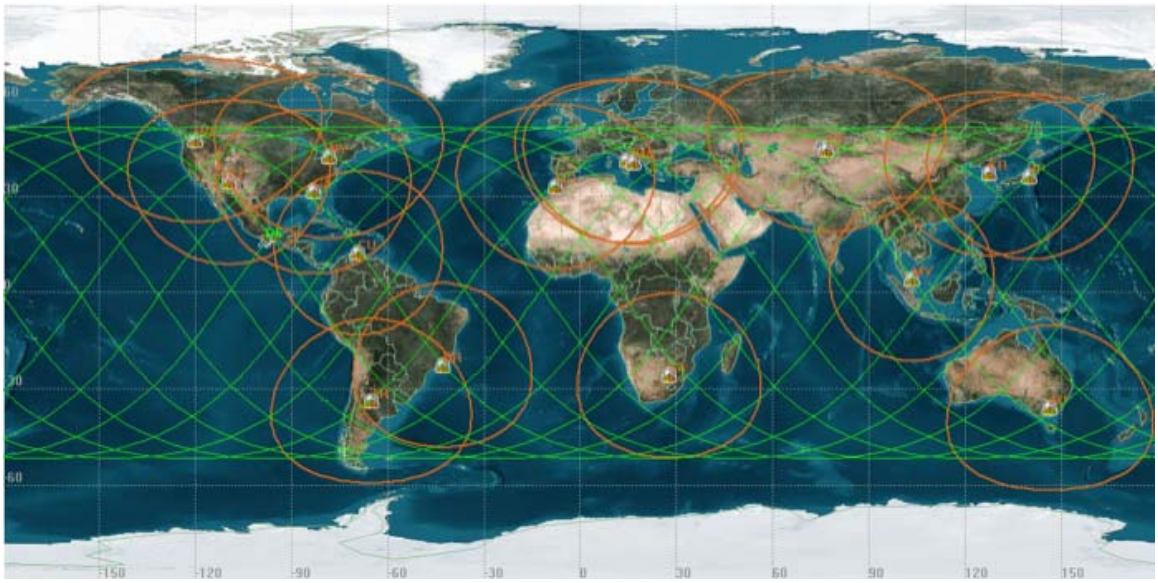


Figure 4: ORBCOMM satellite tracking coverage provided at 750 km altitude by existing worldwide ORBCOMM GES network

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 satellites carried on this 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

[4] 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.

kilometers above the ISS operational altitude, and thus, will not pose any ISS conjunction issues. ORBCOMM currently plans to launch the remaining four OG2 satellites as secondary payloads on two additional Falcon 9 ISS missions that will be coordinated in accordance with NASA procedures to avoid risk of ISS conjunction.[5]

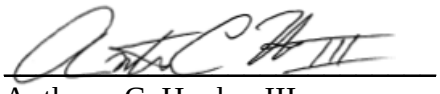
[5] ORBCOMM will also continue to investigate alternative cost-efficient launch opportunities that meet OG2 mission requirements.

APPENDIX C

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: August 1, 2011