EXHIBIT C

LETTER OF INTENT

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

In the Matter of Letter of Intent of Inmarsat Hawaii Inc. for Authority to Access the U.S. Market Using a Ka-Band Satellite at the Nominal 63° W.L. Orbital Location	))))))	File No. _________________

LETTER OF INTENT OF INMARSAT HAWAII INC.

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Ka-Band Satellite at the Nominal 63° W.L.	)	
Orbital Location	)	

LETTER OF INTENT OF INMARSAT HAWAII INC.

Inmarsat Hawaii Inc. ("Inmarsat Hawaii" and, together with its affiliates, "Inmarsat"), pursuant to Section 25.137 of the Commission's rules and the Commission's *Space Station Licensing Reform Order*,[1] hereby files this Letter of Intent seeking to use a satellite to be launched and operated under the authority of the United Kingdom (the "INMARSAT-KA 63W" satellite) to access the United States market using portions of the Ka-band at the nominal 63° W.L. orbital location to provide fixed satellite service ("FSS"). More specifically, these portions include the 18.3-19.3 GHz and 19.7-20.2 GHz downlink bands, and the 28.1-29.1 GHz and 29.5-30.0 GHz uplink bands. Inmarsat provides in this Letter of Intent the information required by 47 C.F.R. § 25.137 for applicants seeking U.S. market access for non U.S.-licensed spacecraft.

I. GRANT OF INMARSAT'S LETTER OF INTENT WILL SERVE THE PUBLIC INTEREST

Inmarsat is a leading provider of L-band satellite services, and operates a global fleet of spacecraft, including some of the most advanced commercial communications satellites now in orbit. Examples of the users that rely on Inmarsat services for their critical

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1 *See Amendment of the Commission's Space Station Licensing Rules and Policies*, First Report and Order and Further Notice of Proposed Rulemaking, 18 FCC Rcd 10760, at ¶ 294 (2003) ("*Space Station Licensing Reform Order*").

communications needs include: the U.S. military, the Federal Aviation Administration, Department of Homeland Security (including the Federal Emergency Management Agency (FEMA) and the Coast Guard), U.S. Executive Branch officials, the New York City Fire Department, CNN, ABC, CBS, National Public Radio, the Red Cross, and nearly every major airline and shipping line throughout the world.

Traditionally, Inmarsat has focused on the provision of mobile satellite services ("MSS") using L-band spectrum. In order to expand its service offerings, Inmarsat seeks to operate a FSS spacecraft in the Ka band. Inmarsat's proposed Ka-band operations promise to bring new and innovative satellite services to users in the United States. Namely, Inmarsat proposes to use the INMARSAT-KA 63W satellite to provide a variety of two-way communications services to small (~60 cm) user terminals. In particular, through the use of efficient satellite design, Inmarsat's proposed system will play a vital role in providing affordable high-data rate communications services. These services will include broadband Internet access, as well as multimedia, voice, and other data applications. Grant of the requested market access will help further the Commission's goals of enhancing competition and promoting the growth and development of cost-effective satellite service, while also serving the goals of the National Broadband Plan.

All capacity on the INMARSAT-KA 63W satellite will be made available to Inmarsat's direct customers (including Inmarsat affiliates) through individually negotiated contracts on a non-common carrier basis.[2] These customers may, in turn, use this capacity to serve end users on such terms and conditions as the customers may establish.

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[2] See Amendment to the Commission's Regulatory Policies Governing Domestic Fixed Satellites and Separate International Satellite Systems, 11 FCC Rcd 2429, at ¶¶ 46-50 (1996) (no longer a need to require the provision of satellite capacity on a common carrier basis) ("DISCO I").

II. DISCO II SHOWING – SECTION 25.137(A)

The INMARSAT-KA 63W satellite will operate under the authority of the United Kingdom.[3] Consequently, the Commission's *DISCO II* framework applies to this Letter of Intent.[4] The *DISCO II* analysis includes consideration of a number of factors, such as the effect on competition in the United States, spectrum availability, eligibility requirements, technical requirements, national security, law enforcement, foreign policy and trade concerns.[5] Each of these factors weighs in favor of granting this Letter of Intent.

A. Effect on Competition in the United States

In *DISCO II*, the Commission established a rebuttable presumption that it will further competition in the United States to allow non-U.S. satellites authorized by WTO Members to provide services covered by the U.S. commitments under the WTO Basic Telecommunications Agreement.[6] The United Kingdom, the licensing administration for the INMARSAT-KA 63W satellite, is a WTO Member. Further, Inmarsat seeks to use the requested spectrum to provide satellite services that are covered by the WTO Basic Telecommunications Agreement.[7] Accordingly, the presumption in favor of entry applies to INMARSAT-KA 63W.

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[3] The United Kingdom has submitted on behalf of Inmarsat an ITU filing under the filing name INMARSAT-KA 63W, as published by the ITU in CR/C/2826/2693/3.5.11, 06.02.11.

[4] Amendment of the Commission's Regulatory Policies to Allow Non-U.S. Licensed Satellites Providing Domestic and International Service in the United States, Report and Order, 12 FCC Rcd 24094, at ¶¶ 30-49 (1997) ("DISCO II").

[5] See e.g., Telesat Canada, Petition for Declaratory Ruling for Inclusion of Anik F2 on the Permitted Space Station List, Petition for Declaratory Ruling to Serve the U.S. Market Using Ka-band Capacity on Anik F2, Order, 17 FCC Rcd 25287, at ¶ 6 (2002).

[6] *DISCO II* at ¶ 39; *see also* 47 C.F.R. § 25.137(a)(2).

[7] Inmarsat does not propose to use this spacecraft to provide direct-to-home ("DTH") services, which are not covered by the United States' commitment under the WTO Basic Telecommunications Agreement.

Allowing Inmarsat to serve the U.S. with INMARSAT-KA 63W will help fulfill the promise of the WTO Basic Telecommunications Agreement with respect to satellite communications services. Grant of this Letter of Intent will enhance competition in the United States by facilitating the introduction of Inmarsat's satellite services, thereby stimulating lower rates, improving service quality, increasing service options, and fostering technological innovation. The Commission consistently has relied on these same public interest benefits in granting similar requests.[8]

B. Spectrum Availability

The INMARSAT-KA 63W satellite will use Ka-band spectrum in the 18.3-19.3 GHz and 19.7-20.2 GHz downlink bands, and the 28.1-29.1 GHz and 29.5-30.0 GHz uplink bands, from the nominal 63° W.L. orbital location. As Inmarsat demonstrates in the attached Technical Annex,[9] Inmarsat's proposal is fully compliant with the Commission's two-degree spacing requirements, will not cause harmful interference to any other authorized user of the spectrum, and is compatible with future Ka-band assignments that are consistent with the Commission's rules. Therefore, this request is fully consistent with the procedures set forth by the Commission in the *Space Station Licensing Reform Order* regarding the processing of GSO-like services.[10]

18.8-19.3 GHz Band. Inmarsat seeks authority to use spectrum in the 18.8-19.3 GHz band for gateway downlinks. The 18.8-19.3 GHz band is allocated for NGSO FSS operations on a primary basis, with no secondary allocation for GSO FSS operations.

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8 See, e.g., Digital Broadband Applications Corp., 18 FCC Rcd 9455 (2003); Pegasus Development Corp., 19 FCC Rcd 6080 (2004); DIRECTV Enterprises, LLC, Request for Special Temporary Authority for the DIRECTV 5 Satellite, 19 FCC Rcd 15529 (2004).

9 *See* Attachment A, Technical Annex at 10-14.

10 See Space Station Licensing Reform Order at ¶ 113.

Accordingly, Inmarsat requests a waiver of Section 2.106 of the Commission's rules, and specifically footnote NG165 thereto, to permit Inmarsat to operate its GSO FSS system in this band on a non-conforming, non-interference basis.[11]

Grant of this waiver is appropriate because such grant "would better serve the public interest than strict adherence to the general rule."[12] Inmarsat proposes to provide new and innovative two-way communications services using small user terminals. In particular, Inmarsat will provide broadband services using technologies that make efficient use of currently unutilized spectrum from the nominal 63° W.L. orbital location.

Moreover, the attached Technical Annex contains a quantitative demonstration of how Inmarsat will protect NGSO FSS systems in the 18.8-19.3 GHz band from harmful interference. As demonstrated therein, Inmarsat's operations would not cause harmful interference to any NGSO FSS systems. The Commission has permitted GSO FSS operations in the 18.8-19.3 GHz band where an operator has provided such showings of non-interference.[13] As explained in the attached Technical Annex, the INMARSAT-KA 63W satellite and its associated earth stations will cease transmissions in this band during interference conditions (*i.e.,* in-line events), and will rely on geographic separation and gateway diversity to ensure that

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[11] *See* 47 C.F.R. § 2.106 & n.NG165.

[12] *See also WAIT Radio v. FCC*, 418 F.2d 1153, 1157 (D.C. Cir. 1969); *Northeast Cellular Tel. Co. v. FCC*, 897 F.2d 1166 (D.C. Cir. 1990) (waiver appropriate where "the relief requested would not undermine the policy objective of the rule in question and would otherwise serve the public interest."); *Fugro-Chance, Inc.*, 10 FCC Rcd 2860, at ¶ 2 (IB 1995) (waiver of U.S. Table of Allocations appropriate "when there is little potential for interference into any service authorized under the Table of Frequency Allocations and when the non-conforming operator accepts any interference from authorized services.").

[13] *See contactMEO Communications, LLC*, Order and Authorization, 21 FCC Rcd 4035, at ¶ 35 (2006); *Northrop Grumman Space & Mission Systems Corporation*, Order and Authorization, 24 FCC Rcd 2330, at ¶¶ 73-75 (2009).

interference protection techniques can be implemented without causing service outages in the Inmarsat network.[14]

Notwithstanding the minimal risk of harmful interference into NGSO FSS operations, Inmarsat will cease operations in the 18.8-19.3 GHz band in the event of any harmful interference into any NGSO FSS operations. Inmarsat will also accept interference from NGSO FSS operations.

28.1-28.35 MHz Band. Inmarsat seeks authority to use spectrum in the 28.1-28.35 GHz band to support gateway uplink operations on a secondary basis. The 28.1-28.35 GHz band is allocated for LMDS operations on a primary basis and GSO FSS operations on a secondary basis. Inmarsat intends to use spectrum in the 28.1-28.35 GHz band to support gateway uplink operations, which are consistent with the Commission's intended use of the secondary allocation for FSS in this band.[15] Inmarsat's planned ground network will incorporate a limited number of gateway earth stations, and Inmarsat currently anticipates that at least one of these gateway earth stations will be located in the United States. The gateway stations operating on a secondary basis will employ interference mitigation techniques, such as shielding, and/or will be deployed in a manner that will avoid interference into LMDS stations. The applications

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[14] *See* Amended Letter of Intent of ViaSat, Inc., IBFS File No. SAT-AMD-20080623-00131, Technical Annex at 16 (granted Aug. 18, 2009) (approving proposal to facilitate sharing with NGSO FSS operations "by ensuring that both ground earth stations and the VIASAT-IOM spacecraft disable operations in the 28.6-29.1 GHz uplink band (and thus the corresponding 18.8-19.3 GHz downlink band) when conditions warrant.") ("ViaSat LOI").

[15] See Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, To Reallocate the 29.5-30.0 GHz Frequency Band, To Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services, 12 FCC Rcd 12545, at ¶ 45 (1998) ("At 27.5 – 28.35 GHz we designate 850 MHz for LMDS on a primary basis. GSO/FSS . . . will be permitted on a non-interference basis . . . for the purpose of providing limited gateway-type services.").

for those earth stations will include a technical analysis demonstrating that the proposed operations will not cause harmful interference into any licensed LMDS spectrum.[16]

The Commission has previously authorized secondary gateway operations in this band, and has recognized that such operations may coexist with primary LMDS operations.[17] Consistent with the secondary nature of the GSO FSS allocation, satellite network operations in the 28.1-28.35 GHz band will not be protected from harmful interference from LMDS, and transmissions from earth stations in the 28.1-28.35 GHz band will cease in the event of harmful interference to LMDS operations.

28.6-29.1 GHz Band. Inmarsat requests authority to use spectrum in the 28.6-29.1 GHz band to support gateway uplink operations. The 28.6-29.1 GHz band is allocated for NGSO FSS operations on a primary basis and GSO FSS operations on a secondary basis. The attached Technical Annex contains a quantitative demonstration of how Inmarsat will protect NGSO FSS systems in the 28.6-29.1 GHz band from harmful interference. As explained in the attached Technical Annex, the INMARSAT-KA 63W satellite and its associated earth stations will cease transmissions in this band during interference conditions (*i.e.,* in-line events), and will rely on geographic separation and gateway diversity to ensure that interference protection techniques can be implemented without causing service outages in the Inmarsat network.

Notwithstanding the minimal risk of harmful interference into NGSO FSS operations, Inmarsat will cease operations in the 28.6-29.1 GHz band in the event of harmful

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16 *See Teledesic Corporation*, 14 FCC Rcd 2261, at ¶ 19 (1999) (recognizing that in granting space station authority in the LMDS band, issues regarding how earth stations would successfully operate on a secondary, non-interference basis should be resolved as part of future earth station applications).

17 *See, e.g.,* ViaSat LOI, *supra* n. 14; *see also Teledesic Corporation*, 12 FCC Rcd 3154, at ¶ 19 (1997).

interference into NGSO operations, consistent with the secondary status of GSO FSS in the band. Inmarsat will also accept interference from NGSO FSS operations.

C. National Security, Law Enforcement, and Public Safety Matters

Grant of this Letter of Intent is consistent with U.S. national security, law enforcement and public safety considerations. Inmarsat's operations in the United States are subject to a network security agreement between Inmarsat on the one hand and the U.S. Department of Justice and the Department of Homeland Security on the other, dated September 23, 2008, as amended (the "Agreement"). Pursuant to the terms of the Agreement, any FCC authorizations granted to Inmarsat must be conditioned on compliance with the terms of the Agreement. Inmarsat requests that the Commission adopt the following condition in granting this Letter of Intent:

> This authorization and any licenses related thereto are subject to compliance with the provisions of the Agreement between Inmarsat on the one hand and the U.S. Department of Justice (DOJ) and the Department of Homeland Security (DHS) on the other, dated September 23, 2008.

III. LEGAL AND TECHNICAL INFORMATION – SECTION 25.137(B)

A. Legal Qualifications

Inmarsat's legal qualifications are set forth in this Letter of Intent and in the attached Form 312. In addition, this Letter of Intent, the associated Technical Annex, and the attached Form 312 demonstrate Inmarsat's satisfaction of the applicable requirements for space station applicants set forth in Section 25.114 of the Commission's rules.[18]

B. Technical Qualifications

Included with this Letter of Intent are a Technical Annex (including an orbital debris mitigation showing) and Schedule S for INMARSAT-KA 63W with the required Part 25

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[18] *See* 47 C.F.R. § 25.114.

technical information. As discussed in further detail in the Technical Annex, in order to reduce the risk of in-orbit collisions with other satellites located at the same nominal location, Inmarsat proposes to operate at an offset location to eliminate any station-keeping volume overlap with other satellites. No ground spare is currently planned.

IV. ADDITIONAL REQUIREMENTS – SECTION 25.137(D)

A. Milestones and Bond Requirement

Inmarsat plans to implement the INMARSAT-KA 63W satellite in compliance with the Commission's milestones established in the *Satellite Licensing Reform Order*.[19] Because the INMARSAT-KA 63W satellite has not yet been launched or constructed, it will be subject to the bond requirement for GSO satellites.

B. Reporting Requirements

Inmarsat will comply with all applicable reporting requirements for INMARSAT-KA 63W.

C. Spectrum Usage

Inmarsat has no pending or granted spectrum reservation requests involving unbuilt spacecraft to which the limits of Section 25.137(d)(5) of the Commission's rules would apply.

D. Ownership Information

Inmarsat Hawaii, a Hawaii corporation with its principal place of business in the United States, is wholly owned by Inmarsat U.S. Holdings, Inc., a Delaware corporation with its principal place of business in the United States. Inmarsat U.S. Holdings, Inc. is wholly owned by Inmarsat Services Ltd. Inmarsat Services Ltd. is wholly owned by Inmarsat Ventures Ltd. Inmarsat Ventures Ltd. is wholly owned by Inmarsat Investments Ltd. Inmarsat Investments

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[19] See 47 C.F.R. § 25.137(d)(4). See also Space Station Licensing Reform Order at ¶ 311.

Ltd. is wholly owned by Inmarsat Group Ltd. Inmarsat Group Ltd. is wholly owned by Inmarsat Holding Ltd. Inmarsat Holding Ltd. is wholly owned by Inmarsat plc. Information about the ownership and management of Inmarsat plc is on file with the Commission, and Inmarsat Hawaii incorporates that information by reference.[20] With the exception of Inmarsat Hawaii and Inmarsat U.S. Holdings, Inc., each of the Inmarsat entities described above is formed under the laws of England and Wales and has its principal place of business in the United Kingdom.

The officers and directors of Inmarsat Hawaii are as follows:

Name	Position(s)	Citizenship
Diane Cornell	Director and President	United States
Perry Melton	Director and President	United States
Leo Mondale	Director	United States
Alison Horrocks	Secretary/Treasurer	United Kingdom

Each of these officers and directors can be reached care of Inmarsat at 1101 Connecticut Avenue, NW, Suite 1200, Washington, DC 20036.

V. REQUESTS FOR WAIVER

As discussed above, Inmarsat seeks authority to use spectrum in the 18.8-19.3 GHz band, which is allocated for NGSO FSS operations on a primary basis, for GSO FSS downlinks. Accordingly, Inmarsat requests a waiver of Section 2.106 of the Commission's rules, and specifically footnote NG165 thereto, to permit Inmarsat to operate its GSO FSS system in this band on a non-conforming, non-interference basis.[21] The basis for the requested waiver is set forth in Section II.B, *supra*.

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20 *See* IBFS File No. ISP-PDR-20090818-00006; ULS File No. 0004040346. *See also* IBFS File No. SES-LIC-20090217-00184 (application granted Oct. 22, 2009), at Exhibit B (requesting a declaratory ruling that it would serve the public interest to allow up to 100 percent indirect non-U.S. ownership of Inmarsat Hawaii).

21 *See* 47 C.F.R. § 2.106 & n.NG165.

In addition, Inmarsat's consulting engineer has reported that it is not feasible to embed in the Schedule S form the large number of GXT files that Inmarsat must provide with this application.[22] Accordingly, Inmarsat is instead: (i) e-mailing these files to IBFSINFO@fcc.gov, pursuant to instructions provided on FCC Form 312; and (ii) filing these GXT files as an attachment to the application, in ZIP format. Inmarsat requests any waiver necessary to permit the submission of the GXT files in this alternative manner.

VI. WAIVER PURSUANT TO SECTION 304 OF THE COMMUNICATIONS ACT

In accordance with Section 304 of the Communications Act of 1934, as amended, Inmarsat 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.

VII. CONCLUSION

For the foregoing reasons, granting Inmarsat's Letter of Intent seeking to access the U.S. using a Ka-band satellite operated under the authority of the United Kingdom at the nominal 63° W.L. location will serve the public interest, convenience and necessity. Inmarsat respectfully requests that the Commission promptly grant this Letter of Intent.

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[22] *See* Application of SkyTerra Communications, Inc., IB File No. SAT−LOA−20050214−00038, Attachment A at 34 (granted Apr. 19, 2005).

Respectfully submitted,

/s/ John P. Janka

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Attachment A

TECHNICAL ANNEX

A.1 Scope and Purpose

The purpose of this Attachment is to provide the Commission with the technical characteristics of the INMARSAT-KA 63W satellite, as required by 47 C.F.R. §25.114 and other sections of the FCC's Part 25 rules, that cannot be captured by the Schedule S software.

A.2 General Description of Overall System Facilities, Operations and Services (§25.114(d)(1))

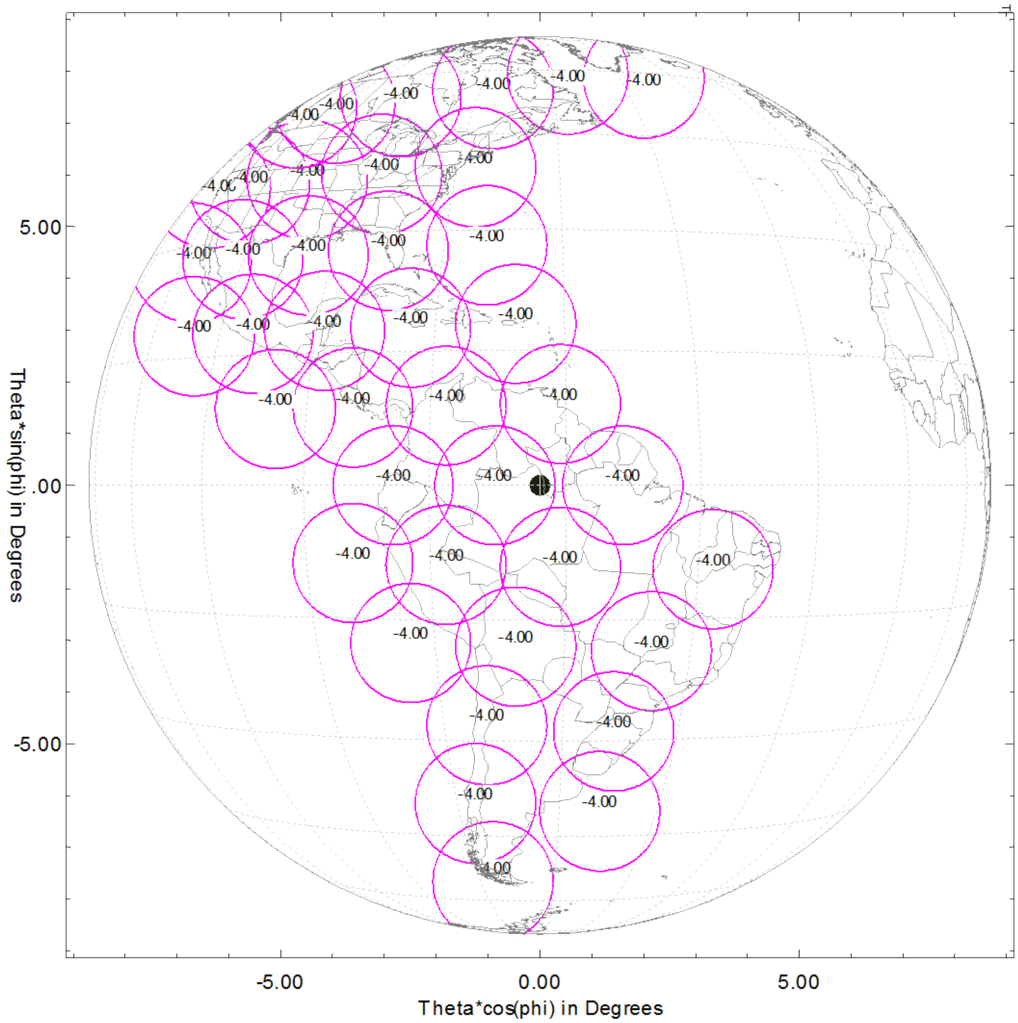
The INMARSAT-KA 63W satellite will operate at the nominal 63° W.L. orbital location and will provide fixed-satellite service ("FSS") to North, Central and South America, as well as the Caribbean.

In order to avoid physical collision with the TELSTAR 14R (ESTRELA DO SUL 2)satellite which is currently operating at 63° W.L. orbital location, Inmarsat proposes to offset the INMARSAT-KA 63W satellite by 0.15° from 63° W.L. and to centre the station-keeping box at 62.85° W.L.

The INMARSAT-KA 63W satellite will operate in the 28.1-29.1 GHz and 29.5-30.0 GHz bands (Earth-to-space) and the 18.3-19.3 GHz and 19.7-20.2 GHz bands (space-to-Earth). The satellite will employ forward links (gateway-to-end user transmissions) and return links (end user-to-gateway transmissions) in separate portions of these frequency bands.

Gateway coverage will be provided through two identical steerable gateway spot beams, each capable of providing all the necessary gateway communications for the satellite. The use of two such gateway beams and associated gateway earth stations provides redundancy in the event of failure as well as the ability to provide gateway diversity and hence the ability to avoid causing interference to, or receiving interference from, non-geostationary satellite systems operating in the 28.6-29.1 GHz and 18.8-19.3 GHz bands. The final locations of the gateway earth stations have not yet been determined although they will be located sufficiently far from each other that gateway diversity can be effective. Coverage will be provided for end-user communications through 40 fixed-coverage spot beams, which are shown (for information only) in Figure A.2-1 below.

Figure A.2-1. User Link Spot Beams



Inmarsat does not anticipate that any TT&C earth stations will be located within U.S. territory and therefore is not requesting that this authorization cover TT&C operations at this time.

However, information concerning the TT&C aspects of the INMARSAT-KA 63W satellite is provided in this application. TT&C transmissions will occur in the Ka-band for both on-station operation and during transfer orbit and emergency purposes.

A.3 Predicted Space Station Antenna Gain Contours (§25.114(d)(3))

The INMARSAT-KA 63W satellite antenna gain contours for the receive and transmit beams, as required by §25.114(d)(3), are given in GXT format. Due to the number of GXT files associated with the INMARSAT-KA 63W satellite, the GXT files have not been embedded in the Schedule S form, but rather are being provided to the Commission in a separate data package.

Note that for the two steerable gateway spot beams, the GXT files provide gain contours for representative beam pointing directions, although the beams may be independently steered to any point on the visible Earth.

A.4 Frequency and Polarization Plan (§25.114(c)(4)(i))

Detail of the INMARSAT-KA 63W satellite's frequency plan is given in the associated Schedule S submission. For additional clarification these frequency plans are shown diagrammatically in Figures A.4-1 and A.4-2 below for the forward (gateway-to-end user) and return (end user-to-gateway) links. All channels are nominally 32 MHz useful bandwidth. The spectrum accessed by the gateway earth stations is shown in blue and that accessed by the end-user terminals is shown in yellow.

The gateway spectrum employs full frequency re-use by means of orthogonal polarizations. The end-user link spectrum employs an average four-fold frequency re-use by spatial separation of co-frequency beams.

The gateway links operate in Right Hand Circular Polarization (RHCP) and Left Hand Circular Polarization (LHCP) on both uplink and downlink. The end-user links operate in RHCP on the uplink and LHCP on the downlink.

Figure A.4-1. Forward Link Frequency Plan

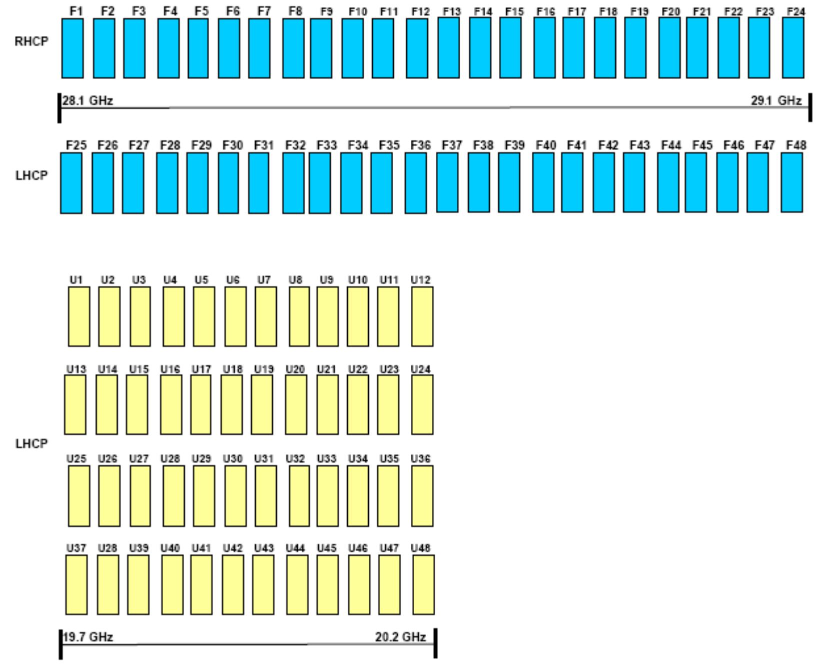
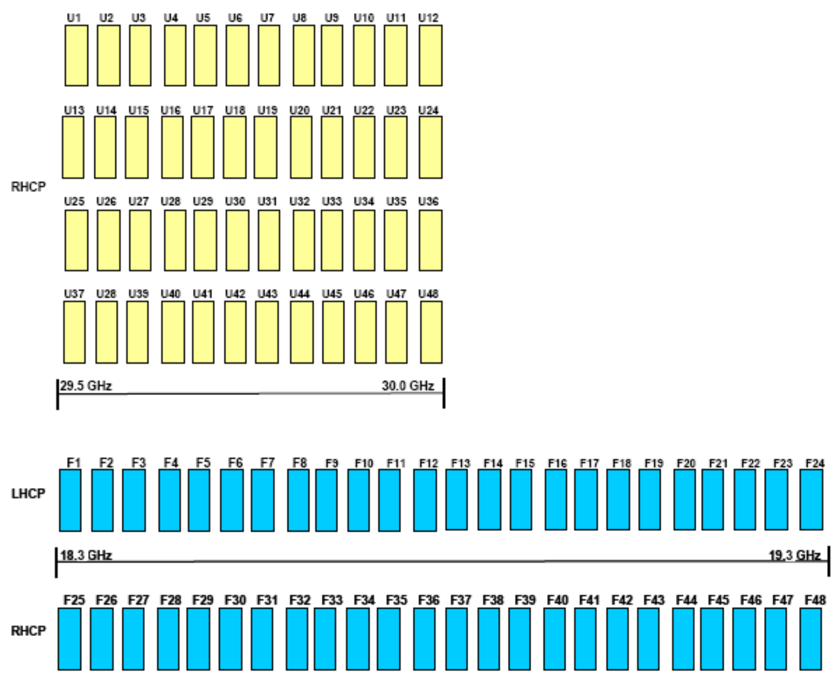


Figure A.4-2. Return Link Frequency Plan



As shown in Figures A.4-1 and A.4-2 above there are 48 channels available in the forward link direction and 48 in the return link direction. These 48 channels in each direction can be flexibly allocated to the 40 user link spot beams such that up to three channels may be used in each user beam and connected to either of the two gateway beams. This flexible arrangement is defined in the associated Schedule S, giving rise to 240 channel-beam routings in the forward direction and 240 channel-beam routings in the return direction.

A.5 Transponder Configuration

In the forward link direction (gateway-to-user) each channel is dedicated to one active TWTA (Travelling Wave Tube Amplifier) in the satellite. In the return link direction (user-to-gateway) four channels are shared by each active TWTA due to the lower required downlink EIRP towards the gateway earth stations. There are therefore a total of 60 simultaneously active TWTAs, excluding TT&C functions.

Note in the associated Schedule S the term "transponder" refers to the 32 MHz bandwidth spectrum channel and not to the number of active TWTAs.

A.6 Services to be Provided (§25.114(d)(4))

The INMARSAT-KA 63W satellite will provide a variety of two-way communications services to small user terminals including broadband Internet access, multimedia, voice and other data applications.

Representative link budgets, which include details of the transmission characteristics, performance objectives and earth station characteristics, are provided in the associated Schedule S submission.

Typical earth stations will consist of:

- End-user terminals which will employ antennas in the range of 60 cm antenna diameter.

- Gateway earth stations, the locations of which have not yet been determined, that will have antenna diameters in the 7-13 meter range.

A.7 TT&C Characteristics (§25.114(c)(4)(i) and §25.114(c)(9))

As noted above in Section A.2, Inmarsat does not anticipate that any TT&C earth stations will be located within U.S. territory, and therefore is not requesting that this authorization cover TT&C operations at this time. Inmarsat is providing the following description of INMARSAT-KA 63W TT&C operations for informational purposes only. The information complements that provided in the associated Schedule S submission.

The TT&C sub-system provides for communications during pre-launch, transfer orbit and on-station operations, as well as during spacecraft emergencies. The TT&C sub-system will operate at the edges of the 30/20 GHz frequency bands during all phases of the mission (i.e., on-station operations as well as launch and early orbit phases and spacecraft emergencies).

During transfer orbit and on-station emergencies the TT&C subsystem employs a composite omni-directional antenna configuration. During normal on-station operation, the telecommand transmissions will be received via one of two uplink gateway beams.

A summary of the TT&C subsystem characteristics is given in Table A7-1.

Table A7-1: TT&C Performance Characteristics

Command/Ranging Frequencies	29,505.0 MHz 29,507.5 MHz
Uplink Flux Density (Minimum)	Omni Rx antennas: > -70 dBW/m^2 Comms Rx antenna: >-90 dBW/m^2
Satellite Receive Antenna Types and Modes of Operation	Omni antennas during transfer orbit and on-station emergencies, and for telecommand from earth stations other than the gateways. Communications antenna during on-normal on-station operations for telecommand from gateway/TT&C earth stations.
Polarization of Satellite Rx/Tx Antennas	RHCP for omni Rx antennas LHCP for omni Tx antennas RHCP for communications Rx antenna LHCP for communications Tx antenna
Telemetry/Ranging Frequencies	19,705.0 MHz 19,707.5 MHz
Satellite Transmit Antenna Types and Modes of Operation	Omni antennas during transfer orbit and on-station emergencies and for telemetry to earth stations other than gateways. Communications antenna during on-normal on-station operations for telemetry to gateway/TT&C earth stations.
Maximum Downlink EIRP	21.1 dBW (Omni antennas) 44.0 dBW (Communications antenna)

A.8 Satellite Transponder Frequency Responses (§25.114(c)(4)(vii))

The predicted receive and transmit channel filter response performance is given in Table A8-1 below. The receive response is measured from the satellite receive antenna up to the input of the TWTA. The transmit response is measured from the input of the TWTA to the satellite transmit antenna.

Table A8-1 - Typical Receiver and Transmitter Filter Responses

Frequency offset from channel center	Gain relative to channel center frequency (dB)		Comments
	Receive	Transmit	
CF±7 MHz	0.15	0.1	In-Band Value does not exceed these p-p values
CF±9.5 MHz	0.2	0.15	
CF±12 MHz	0.3	0.2	
CF±15 MHz	1	0.4	
CF±16 MHz	2		
CF±20 MHz	-3		Out-of-Band Attenuation is not less than these values
CF±25 MHz		-3	
CF±33 MHz		-25	
CF±36 MHz	-30		

A.9 Cessation of Emissions (§25.207)

All downlink transmissions can be turned on and off by ground telecommand, thereby causing cessation of emissions from the satellite, as required.

A.10 Power Flux Density at the Earth's Surface (§25.208(c))

§25.208(c) contains PFD limits that apply in the 18.3-18.8 GHz band. The PFD limits of §25.208(c) are as follows:

- -115 dB(W/m^2) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;
- -115+(δ-5)/2 dB(W/m^2) in any 1 MHz band for angles of arrival δ (in degrees) between 5 and 25 degrees above the horizontal plane; and
- -105 dB(W/m^2) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

In addition, §25.208(d) contains PFD limits that apply in the 18.6-18.8 GHz band produced by emissions from a space station under assumed free-space propagation conditions as follows:

- -95 dB(W/m^2) for all angles of arrival. This limit may be exceeded by up to 3 dB for no more than 5% of the time.

§25.208 does not contain any PFD limits that apply in the 18.8-19.3 GHz band for GSO satellite networks, however it is noted that Article 21 of the ITU Radio Regulations does include PFD limits applicable to GSO satellites using the 18.8-19.3 GHz band and these limits are identical to those in §25.208(c).

§25.208 similarly does not contain any PFD limits that apply in the 19.7-20.2 GHz band for GSO satellite networks, and it is noted also that Article 21 of the ITU Radio Regulations does not have any PFD limit that applies in this band.

Compliance with all applicable FCC and ITU PFD limits is demonstrated below using a simple worst-case methodology. The maximum downlink EIRP density that the INMARSAT-KA 63W satellite will transmit is 56 dBW in an occupied bandwidth of 32 MHz, which translates into 41 dBW in 1 MHz.[1] The shortest distance from the satellite to the Earth is 35,786 km, corresponding to a spreading loss of 162.06 dB. Therefore the maximum possible PFD at the Earth's surface at an elevation angle of 90° will not exceed -121.06 dBW/m^2 in 1 MHz (i.e., 41 - 162.06). This is less than the -115 dBW/m^2/MHz PFD limit value that applies at elevation angles of 5° and below. Therefore compliance with the PFD limits is assured.

In addition, §25.208(d) provides an additional aggregate PFD limit in the 200 MHz wide band 18.6-18.8 GHz of -95 dBW/m^2. In the worst case, this would correspond to a PFD limit of -118 dBW/m^2/MHz (i.e., -95-10*log(200)). As demonstrated in the previous paragraph, downlink transmissions from the INMARSAT-KA 63W satellite will not exceed -121.06 dBW/m^2/MHz at any angle of arrival and therefore compliance with §25.208(d) is also assured.

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[1] The maximum downlink EIRP density of the telemetry transmissions from the INMARSAT-KA 63W satellite will also not exceed -121 dBW/m^2/MHz, as provided in the Schedule S.

A.11 Two Degree Compatibility (§25.138)

No transmissions in the INMARSAT-KA 63W satellite network will exceed the uplink off-axis EIRP density and downlink PFD levels of §25.138, regardless of whether the frequency band used is subject to §25.138.

A.11.1 Frequency Bands Subject to §25.138

§25.138 of the Commission's rules defines the uplink and downlink parameters that permit routine blanket licensing of Ka-band earth stations in certain frequency bands, and therefore which define the acceptable levels of adjacent satellite interference permitted in the Ka-band by the FCC, absent specific coordination agreements with neighboring satellites. The frequency bands planned to be used by the INMARSAT-KA 63W satellite network, which are subject to §25.138, are as follows:

- Uplink: 28.35-28.6 GHz and 29.5-30.0 GHz
- Downlink: 18.3-18.8 GHz and 19.7-20.2 GHz

For these frequency bands compliance with the Commission's two-degree spacing policy is ensured provided:

- The uplink off-axis EIRP density levels given in §25.138(a)(1) of the Commission's rules are not exceeded;
- The maximum downlink PFD levels given in §25.138(a)(6) of the Commission's rules are not exceeded.

The clear sky uplink off-axis EIRP density limits of §25.138(a)(1) are equivalent to a maximum uplink input power density of -56.5 dBW/Hz. Table A.11-1 compares the uplink input power densities derived from the uplink link budgets that are contained in the Schedule S with the clear sky limits of §25.138 (a)(1). It can be seen that in all cases the clear sky uplink power limits are met.

Table A.11-1. Demonstration of Compliance with the Uplink Power limits of §25.138 (a)(1)

Uplink Antenna Diameter	Maximum Clear Sky Uplink Input Power Density from Link Budgets (dBW/Hz)	Clear Sky Uplink Input Power Density Limit of §25.138 (a)(1) (dBW/Hz)	Margin (dB)
7.5 m	-62.7	-56.5	6.2
60 cm	-60	-56.5	3.5

Section A.10 above demonstrates that the maximum PFD that could be transmitted by the INMARSAT-KA 63W satellite, at an elevation angle of 90 degrees, is -121.06 dBW/m^2/MHz and therefore the PFD levels at other elevation angles will necessarily be lower due to the increased spreading loss. All downlink transmissions from the INMARSAT-KA 63W satellite will therefore have at least a 3 dB margin relative to the -118 dBW/m^2/MHz limit set forth in §25.138 (a)(6) of the Commission's rules.

A.11.2 Frequency Bands Not Subject to §25.138

The portions of Ka-band spectrum planned to be used by the INMARSAT-KA 63W satellite network, which are not subject to §25.138, are as follows:

- Uplink: 28.1-28.35 GHz and 28.6-29.1 GHz
- Downlink: 18.8-19.3 GHz

This section demonstrates that transmissions in these bands are two-degree compatible. In order to demonstrate two-degree compatibility, the transmission parameters of the INMARSAT-KA 63W satellite have been assumed as both the wanted and victim transmissions.

Table A.11-2 provides a summary of the uplink and downlink transmission parameters. These parameters were derived from the INMARSAT-KA 63W link budgets that are embedded in the

Schedule S form and were used in the interference analysis. The interference calculations assumed a 1 dB advantage for topocentric-to-geocentric conversion, all wanted and interfering carriers are co-polarized and all earth station antennas conform to a sidelobe pattern of 29-25log(θ).

Note that the bands 18.8-19.3 GHz, 28.1-28.35 GHz and 28.6-29.1 GHz bands are planned for gateway links only in the INMARSAT-KA 63W satellite network. The C/I calculations thus consider only the gateway uplink and gateway downlink interference.

Table A.11-3 shows the results of the interference calculations in terms of the C/I margins. The format is similar to that of the output of the Sharp Adjacent Satellite Interference Analysis program. It can be seen that the C/I margins are positive in all cases.

Table A.11-2. INMARSAT-KA 63W transmission parameters.

Uplink

Carrier ID	Emission Designator	Occupied BW (kHz)	Tx Antenna Gain (dBi)	Uplink EIRP (dBW)	C/I Criterion (dB)	Uplink EIRP density (dBW/kHz)
1	32M0G7W	32000	64	76.4	18.7	31.3

Downlink

Carrier ID	Emission Designator	Occupied BW (kHz)	Rx Antenna Gain (dBi)	Downlink EIRP (dBW)	C/I Criterion (dB)	Downlink EIRP density (dBW/kHz)
1	3M78G7W	3780	61	33.8	17.8	-2.0

Table A.11-3. Summary of the C/I margins (dB)

Uplink

	Interfering Carrier	
Wanted Carrier	Carrier ID	1
	1	24.8

Downlink

	Interfering Carrier	
Wanted Carrier	Carrier ID	1
	1	22.7

A.12 Sharing with NGSO FSS in the 28.6-29.1 GHz and 18.8-19.3 GHz Bands

The 28.6-29.1 GHz uplink band is allocated to NGSO FSS on a primary basis and it is allocated to GSO FSS on a secondary basis according to the FCC rules. Stations operating in a secondary service cannot cause harmful interference to or claim protection from harmful interference from stations of a primary service.

The 18.8-19.3 GHz downlink band is allocated exclusively to NGSO FSS. In bands designated for exclusive use, non-conforming services may be provided only on a non-harmful interference basis to any licensed service provided in accordance with the Table of Allocations, and may not claim interference protection from other authorized services.

In order to prevent the INMARSAT-KA 63W satellite network from causing harmful interference into NGSO satellite networks using the 28.6-29.1 GHz and 18.8-19.3 GHz bands, the INMARSAT-KA 63W satellite and its associated earth stations will cease transmissions in these bands during interference conditions. The highest interference levels that could occur into NGSO networks from the INMARSAT-KA 63W network are when there is an "in-line" event. On the uplink for example, an in-line event occurs when the NGSO satellite, the GSO satellite and the interfering GSO earth station are all in a line. As the NGSO satellite continues to move within its orbit, an angle between the NGSO satellite and the GSO satellite, subtended at the

GSO earth station, is created. As long as the GSO earth station does not transmit when the NGSO satellite is within a certain angle, no harmful interference to the NGSO satellite will occur. A similar situation exists on the downlink. The amount of angular separation required will be dependent on the parameters of the NGSO FSS networks and their interference criteria.

Note that the existence of two geographically separated and redundant gateways in the INMARSAT-KA 63W satellite network provides for gateway diversity. This diversity permits the NGSO interference protection technique described in the preceding paragraph, which is only necessary in frequency bands used for gateway links in the INMARSAT-KA 63W satellite network, to be implemented without causing service outages in the Inmarsat network. In the U.S., only such gateway operations are proposed in the 28.6-29.1 GHz and 18.8-19.3 GHz bands in which NGSO operations are primary.

Currently there are no NGSO networks authorized by the Commission to use the 28.6-29.1 GHz and 18.8-19.3 GHz bands. Northrop Grumman Space and Mission Systems Corp. ("Northrop Grumman") had previously received Commission authorization for its Global EHF Satellite Network ("GESN") and ATCONTACT Communications, LLC ("ATCONTACT") had previously received Commission authorization for its NGSO network. Both networks were to utilize highly elliptical orbits ("HEO"). In the absence of a current authorization for an NGSO network, and in order to demonstrate compatibility between the INMARSAT-KA 63W network and NGSO networks, the parameters of the GESN and ATCONTACT NGSO networks have been used.

Table A.12-1 summarizes the salient parameters of the GESN and ATCONTACT HEO satellite networks for the purpose of this interference assessment. These parameters are identical to those used by Northrop Grumman and ATCONTACT to demonstrate independently that their GSO operations in the 28.6-29.1 GHz and 18.8-19.3 GHz bands were compatible with the other's proposed NGSO operations. It can be seen that the two networks' orbital and transmission parameters are identical, which allows a single interference analysis to be performed.

Table A.12-1. GESN and ATCONTACT HEO satellite characteristics.

	GESN	ATCONTACT
Orbital parameters		
• # of satellites	3	3
• # of planes	3	3
• # of satellites per plane	1	1
• Inclination	63.4°	63.4°
• Apogee	39352 km	39352 km
• Perigee	1111 km	1111 km
• Minimum Tx altitude	16000 km	16000 km
Satellite Rx gain	46.5 dBi	46.5 dBi
Satellite Rx system noise temp.	504 K	504 K
Earth station uplink input power density	-63.45 dBW/Hz	-63.45 dBW/Hz
Satellite downlink EIRP density	-18 dBW/Hz	-18 dBW/Hz
E/S Rx system noise temperature	315 K	315 K

In order to demonstrate compatibility with these two NGSO networks, a worst case, static analysis is performed. The smallest possible angle will occur when the GSO satellite, the NGSO satellite and the relevant earth station are all on the same longitude and the earth station is at a high latitude. Assuming a minimum 10° elevation angle for the GSO earth station, this sets the latitude to 71.4°N. The GESN and ATCONTACT satellites do not transmit when they are at an altitude below 16000 km, which translates to a latitude of 31.9°N. With this information, the smallest possible angular separation is then calculated to be 27.4 degrees. Both the transmitting GSO earth station (uplink calculation) and the victim NGSO earth station (downlink calculation) have been assumed to be at a latitude of 71.4°N.

Table A.12-2 shows the results of interference calculations from the INMARSAT-KA 63W networks into the GESN and ATCONTACT networks and vice versa. The calculated $\Delta T/T$ values in all cases are much less than 1%, indicating the technical compatibility of the INMARSAT-KA 63W satellite network with the GESN and ATCONTACT networks.

The compatibility of these networks is largely due to the fact that the two NGSO networks do not communicate with earth stations when their satellites cross the equatorial plane, thus in-line events with a GSO network do not occur. For other types of NGSO constellations that do communicate with earth stations when the satellites pass through the equatorial plane, an in-line interference event can occur. In order to protect such systems, Inmarsat will cease transmissions from the relevant beam of the INMARSAT-KA 63W satellite, and its associated earth station that is causing the in-line event, such that a minimum amount of angular separation with the NGSO network is always maintained. As discussed above, the existence of two geographically separated and redundant gateways in the INMARSAT-KA 63W satellite network provides for gateway diversity, allowing for interference protection to be implemented without causing service outages in the Inmarsat network. In the U.S., only such gateway operations are proposed in the 28.6-29.1 GHz and 18.8-19.3 GHz bands in which NGSO operations are primary.

Inmarsat will coordinate with future NGSO operators in these band segments to determine the minimum angular separation required to protect any NGSO system. The FCC has authorized O3b Limited to operate a gateway earth station in Hawaii to access the U.K.-authorized O3b NGSO system, which will consist of a constellation of satellites in a circular equatorial orbit of altitude 8,062 km. *See* IBFS File No. SES-LIC-20100723-00952. The O3b system operates in various portions of the Ka-band, including the 28.6-29.1 GHz and 18.8-19.3 GHz bands where NGSO systems are primary under FCC rules. Because of the geometry of the O3b orbit in relation to the GSO, no in-line events can occur between O3b and a GSO network except for earth stations operating at or very close to the equator. Therefore, from the location of the O3b gateway in Hawaii, and in fact from all US territory, sufficient angular separation should exist between the O3b orbit and the INMARSAT-KA 63W satellite to prevent mutual interference. Inmarsat is confident that it will be possible to reach a mutually satisfactory coordination agreement with O3b.

Table A.12-2. Worst case interference calculations.

Victim network		GESN / ATCONTACT	INMARSAT-KA-63W
Interfering network		INMARSAT-KA-63W	GESN / ATCONTACT
Uplink:			
Frequency band	GHz	29	29
Interfering uplink input power density	dBW/Hz	-62.65	-63.45
Angular separation	degrees	27.4	27.4
Slant range (Interfering path)	km	21046	40586
Space loss (Interfering path)	dB	208.2	213.9
Atmospheric & scintillation losses	dB	1.2	1.2
Victim satellite receive antenna gain	dBi	46.5	39
Victim satellite Rx system noise temperature	K	504	794
No	dBW/Hz	-201.6	-199.6
Io	dBW/Hz	-232.5	-246.5
Io/No	dB	-30.9	-46.9
dT/T	%	0.08	0.002
Downlink:			
Frequency band	GHz	19	19
Interfering satellite downlink EIRP density	dBW/Hz	-19.05	-18
Slant range (Interfering path)	km	40586	21046
Space loss (Interfering path)	dB	210.2	204.5
Atmospheric & scintillation losses	dB	1	1
Angular separation	degrees	27.4	27.4
Victim Rx earth station system noise temperature	K	315	300
No	dBW/Hz	-203.6	-203.8
Io	dBW/Hz	-237.2	-230.5
Io/No	dB	-33.6	-26.7
dT/T	%	0.04	0.22

A.13 Orbital Debris Mitigation Plan (§25.114(d)(14))

The spacecraft manufacturer for the INMARSAT-KA 63W satellite has not yet been selected and therefore Inmarsat's Orbital Debris Mitigation Plan is necessarily forward looking. Inmarsat plans to reflect the material objectives of §25.114(d)(14) of the Commission's Rules in the design of the satellite through the satellite's Technical Specifications, Statement of Work and Test Plans. The Statement of Work will include provisions to address orbital debris mitigation under the scenarios described in §25.114(d)(14) as part of the preliminary design review ("PDR") and the critical design review ("CDR") and to incorporate the requirements of §25.114(d)(14), as appropriate, into its Test Plan, including a formal Failure Mode Verification

Analysis ("FMVA") for orbital debris mitigation involving particularly the TT&C, propulsion and energy systems. During this process Inmarsat will provide the Commission with updated information, as appropriate.

A.13.1 Spacecraft Hardware Design

Although the INMARSAT-KA 63W satellite has not been completely designed, Inmarsat will ensure that the satellite does not release any debris during its operation. Furthermore, all separation and deployment mechanisms, and any other potential source of debris will be retained by the spacecraft or launch vehicle.

In conjunction with the satellite manufacturer, Inmarsat will assess and limit the probability of the satellite becoming a source of debris by collisions with small debris or meteoroids of less than one centimeter in diameter that could cause loss of control and prevent post-mission disposal. Inmarsat will take steps to limit the effects of such collisions through shielding, the placement of components, and the use of redundant systems.

The INMARSAT-KA 63W satellite includes separate TT&C and propulsion subsystems that are necessary for end-of-life disposal. The spacecraft TT&C system, vital for orbit raising, will be extremely rugged with regard to meteoroids smaller than 1 cm, by virtue of its redundancy, shielding, separation of components and physical characteristics. The TT&C subsystem will have no single points of failure. Near-omni-directional antenna feeds are mounted on opposite sides of the spacecraft to create a composite omni antenna configuration. These antenna feeds are extremely rugged and capable of providing adequate coverage even if struck, bent or otherwise damaged by a small or medium sized particle. Either one of the two omni-directional antenna feeds, for both command and telemetry, will be sufficient to enable orbit raising. The command receivers and decoders and telemetry encoders and transmitters will be located within a shielded area and will be totally redundant and physically separated. A single rugged thruster and shielded propellant tank provide the energy for orbit-raising.

A.13.2 Accidental Explosion Assessment (§25.144(d)(14)(ii))

In conjunction with satellite manufacturer, Inmarsat will assess and limit the probability of accidental explosions during and after completion of mission operations through a failure mode verification analysis. The satellite manufacturer will take steps to ensure that debris generation will not result from the conversion of energy sources on board the satellite into energy that fragments the satellite. All pressures, including those of the batteries, will be monitored by telemetry. At end-of-life and once the satellite has been placed into its final disposal orbit, Inmarsat will remove all stored energy from the spacecraft by depleting any residual fuel, leaving all fuel line valves open, venting the pressure vessels and the batteries will be left in a permanent state of discharge.

A.13.3 Safe Flight Profiles (§25.144(d)(14)(iii))

In considering current and planned satellites that may have a station-keeping volume that overlaps the INMARSAT-KA 63W satellite, Inmarsat has reviewed the lists of FCC licensed satellite networks, as well as those that are currently under consideration by the FCC. In addition, networks for which a request for coordination has been published by the ITU within ±0.15° of 62.85° W.L. have also been reviewed.

Telesat operates the TELSTAR 14R (ESTRELA DO SUL 2) satellite at 63°W with ±0.05° east-west station-keeping. Inmarsat proposes to locate the INMARSAT-KA 63W satellite at 62.85° W.L. in order to eliminate the possibility of any station-keeping volume overlap with this satellite. There are no other operational satellites within ±0.15° of 62.85° W.L., nor are there any pending applications before the Commission to operate a satellite within this sub-arc. With respect to published ITU filings, there are no other networks filed within ±0.15° of 62.85° W.L.

Based on the preceding, Inmarsat therefore concludes that physical coordination of the INMARSAT-KA 63W satellite with another party is not required at the present time.

A.13.4 Post-Mission Disposal

At the end of the operational life of the INMARSAT-KA 63W satellite, Inmarsat will manoeuvre the satellite to a disposal orbit with a minimum perigee of 300 km above the normal GSO operational orbit. The post-mission disposal orbit altitude is based on the following calculation, according to §25.283:

Total Solar Pressure Area "A" = 93.1 m^2

"M" = Dry Mass of Satellite = 3497 kg

"CR" = Solar Pressure Radiation Coefficient = 1.29

Therefore the Minimum Disposal Orbit Perigee Altitude is calculated as:

= 36,021 km + 1000 x CR x A/m

= 36,021 km + 1000 x 1.29 x 93.1/3497

= 36,055.3 km

= 270 km above GSO (35,786 km)

To provide adequate margin, the disposal orbit will be increased to 300 km. This will require approximately 15 kg of propellant, taking account of all fuel measurement uncertainties, which will be allocated and reserved in order to perform the final orbit raising manoeuvre.

A.14 Additional Information Concerning Certain Data in the Associated Schedule S

The Schedule S software does not accept the embedding of a large number of GXT files into the Schedule S form. Therefore all GXT files are being provided to the Commission as a separate data package.

ENGINEERING CERTIFICATION

I hereby certify that the following statements are true and correct to the best of my information and belief:

(i) I am the technically qualified person responsible for the engineering information contained in the foregoing Application,

(ii) I am familiar with Part 25 of the Commission's Rules, and

(iii) I have either prepared or reviewed the engineering information contained in the foregoing Application and found it to be complete and accurate.

/s/ Jonas Eneberg
Jonas Eneberg
Director, International Spectrum Management

Dated: March 19, 2013