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

In the Matter of	)	
	)	
Telesat Brasil Capacidade de Satelites Ltda.	)	File No. _____
	)	
Petition for Declaratory Ruling to Add Estrela do Sul 2, a Replacement Ku-band Satellite, to the Permitted Space Station List	)	

PETITION FOR DECLARATORY RULING

I. INTRODUCTION

Telesat Brasil Capacidade de Satelites Ltda. ("Telesat Brasil"), an indirect subsidiary of Telesat Canada, respectfully petitions the Federal Communications Commission, pursuant to Section 25.137 of the Commission's rules and the *DISCO II Reconsideration Order*,[1] for a declaratory ruling adding Telesat Brasil's Estrela do Sul 2 satellite, which has been licensed by Brazil, to the Permitted Space Station List ("Permitted List").

Construction of Estrela do Sul 2, a Ku-band satellite, has been completed and the satellite is undergoing final testing. Launch of Estrela do Sul 2 and placement into service is anticipated to occur in the second or third quarter of 2011. Telesat Brasil

[1] *In re Amendment of the Commission's Regulatory Practices to Allow Non-U.S. Licensed Space Stations to Provide Domestic and International Satellite Service in the United States*, First Order on Reconsideration, 15 FCC Rcd. 7207 (1999) ("*DISCO II Reconsideration Order*").

intends to operate the satellite as a replacement for Estrela do Sul 1 at 63° W.L., which already is on the Permitted List.[2]

Grant of Telesat Brasil's request to add Estrela do Sul 2 to the Permitted List will provide authority for all earth stations in the United States that the Commission has licensed on an "ALSAT" basis to communicate with Estrela do Sul 2 without further Commission action, so long as all communications fall within the same technical parameters and conditions established in the earth stations' original licenses.[3] The request is limited to services covered by the WTO Basic Telecommunications Agreement; Telesat Brasil does not seek authority to provide direct-to-home, Direct Broadcast Satellite, or Digital Audio Radio Service services in the United States. The request also is limited to conventional Ku-band band frequencies.[4]

Grant of Telesat Brasil's petition for declaratory ruling is in the public interest. A grant will preserve the benefits of competition associated with using a Ku-band satellite at 63° W.L. to serve the United States and will ensure continuity of service as customers migrate from Estrela do Sul 1 to its replacement. Telesat Brasil demonstrates below that Estrela do Sul 2 satisfies all of the requirements to be added to the Permitted List and

---

[2] The Commission added Estrela do Sul 1 to the Permitted Space Station List on Dec. 23, 2003. *See In the Matter of Loral Skynet do Brasil, Petition for Declaratory Ruling to Add Estrela do Sul 1, a Ku-band Satellite, to the Permitted Space Station List*, Order, DA 03-4095 (rel. Dec. 23, 2003; FCC File Nos. SAT-PDR-20021010-00196 and SAT-WAV-20031202-00352).

[3] *See Loral Skynet do Brasil, Petition for Declaratory Ruling to Add Estrela do Sul 1, a Ku-band Satellite, to the Permitted Space Station List,* DA 03-4095 (Int'l Bur., Dec. 23, 2003) ("Estrela do Sul 1 Order") at ¶ 2

[4] However, a sister company of Telesat Brasil will be filing one or more earth station applications seeking authority to communicate with Estrela do Sul 2 using extended Ku-band frequencies on the satellite in the 13.8-14 GHz band. The Commission already has authorized communication with Estrela do Sul 1using these same extended Ku-band frequencies. *See* FCC File No. SES−MFS−20070502−00542.

that the satellite qualifies for streamlined processing under the Commission's replacement satellite policy.

II. ESTRELA DO SUL 2 SATISFIES THE REQUIREMENTS FOR ENTRY ON THE PERMITTED SPACE STATION LIST.

In the *DISCO II Reconsideration Order*, the Commission held that a non-U.S. licensed satellite may be included on the Permitted List if the Commission finds that operation of the satellite complies with Sections 25.114 and 25.137 of the Commission's rules and raises no other public interest concerns.[5] Section 25.114 establishes the technical and legal qualification requirements for space station applicants. Section 25.137 sets forth entry requirements for satellites licensed outside the United States. And under the "other public interest concerns" part of the *DISCO II* standard, the Commission considers spectrum availability and evaluates whether there are any national security, law enforcement, foreign policy, or trade concerns. The proposed operation of Estrela do Sul 2 to serve the United States satisfies all of these tests.

A. Technical Qualifications

Estrela do Sul 2 will include 46 active Ku-band transponders providing VSAT services, point to point communication links, and video transmissions for cable head-ends in South and North America and the North Atlantic Ocean Region ("NAOR"). The attached technical exhibit and the Schedule S that is filed with this petition establish that the proposed operation of Estrela do Sul 2 is consistent with the Commission's

[5] *See DISCO II Reconsideration Order*, 15 FCC Rcd at 7214 ("U.S. earth stations with ALSAT licenses should be permitted to communicate with any non-U.S. satellite just as easily as they communicate with any U.S.-licensed satellite, provided that those communications do not cause harmful interference to or require protection from adjacent satellite operations, and otherwise comply with DISCO II.").

technical requirements, including its requirements for two-degree satellite spacing compatibility.

B. Legal Qualifications

The information provided in the FCC Form 312 that accompanies this petition establishes Telesat Brasil's legal qualifications.

C. Section 25.137 Entry Requirements

The *DISCO II Order,* as implemented in Section 25.137(a) of the Commission's rules, establishes a presumption that granting applications to provide service in the United States via satellites licensed by countries that are members of the World Trade Organization ("WTO") will enhance competition and therefore is in the public interest.[6] Estrela do Sul 2 is licensed by Brazil, which is a WTO member country. Accordingly, this petition satisfies the requirements of Section 25.137 and there is a presumption that granting U.S. market entry to Estrela do Sul 2 is in the public interest.

D. Other Public interest Factors

The Commission considers under the "other public interest factors" element of *DISCO II* whether grant of an application would have an impact on spectrum availability and whether a grant would implicate national security, law enforcement, foreign policy, or trade concerns.[7] These aspects of *DISCO II* also are satisfied.

---

[6] *See In re Amendment of the Commission's Regulatory Policies to Allow Non-U.S. Licensed Space Stations to Provide Domestic and International Satellite Service in the United States*, Report and Order, 12 FCC Rcd. 24094, 24112 (1997) ("*DISCO II Order*"). *See also* Estrela do Sul 1 Order, ¶ 5. The presumption applies only to satellite services that are covered under the WTO's Basic Telecommunications Agreement. As discussed in Section I, above, Telesat Brasil's petition is limited to such services.

[7] *See DISCO II Order,* ¶¶ 146-182.

Estrela do Sul 2 will operate at 63° W.L. in accordance with the B-SAT I network. B-SAT I is also the network under which Estrela do Sul 1 operates. B-SAT I has been coordinated by Brazil and has been notified with the ITU-R by Brazil. Accordingly, the conventional Ku-band spectrum to be used by Estrela do Sul 2 at 63° W.L. is unavailable to U.S. applicants, and adding the satellite to the Permitted List will have no impact on spectrum availability.

The Commission previously determined that operation of Estrela do Sul 1 at 63° W.L. to serve the United States raises no national security, law enforcement, foreign policy, or trade concerns.[8] This finding applies with equal force to Estrela do Sul 2.

III. ESTRELA DO SUL 2 QUALIFIES FOR STREAMLINED PROCESSING AS A REPLACEMENT SATELLITE.

A. Streamlined Procedures

The Commission has adopted streamlined licensing procedures for replacement satellites. Under these procedures, uncontested replacement satellite applications for U.S.-licensed space stations may be acted on using a "grant stamp."[9] These streamlined procedures also apply in the case of applications to replace non-U.S. licensed satellites that are on the Permitted List.[10]

Replacement satellite applications are exempt from the requirement for posting a bond. The Commission has found that a bond is unnecessary "[o]nce a licensee has begun to provide service," because at that point the Commission can be "confident that

[8] Estrela do Sul 1 Order, ¶ 15.
[9] *See In the Matter of the Commission's Space Station Licensing Rules and Policies; Mitigation of Orbital Debris*, First Report and Order and Further Notice of Proposed Rulemaking, 18 FCC Rcd 10760, 10856 (2003) ("Licensing Reform Order"), ¶ 253.
[10] Licensing Reform Order, ¶¶ 321-323.

its replacement satellite application will be intended to continue service, and would not be filed for speculative purposes."[11]

To qualify for treatment under the Commission's replacement satellite policy, *i.e.*, to be eligible for streamlined processing and exempt from bond requirements, a satellite must be "technically consistent" with the satellite it is replacing, but need not be "technically identical" to its predecessor.[12] The Commission recognizes that "next-generation satellites will incorporate … technical advancements made since the previous generation was launched."[13] For this reason, the Commission will "consider applications for replacement satellites with higher power capabilities relative to the applicant's existing satellites."[14]

At one time, the Commission applied streamlined processing to applications for follow-on satellites having greater "coverage areas" than the original satellites.[15] More recently, however, the Commission determined that classifying applications proposing service to new coverage areas as replacement satellite applications would undercut its "first come, first served" processing procedures by enabling applicants to gain authority to serve new areas without having to compete in the first come, first served processing queue.[16] Accordingly, if an application for a follow-on satellite includes new coverage areas, it is not eligible for streamlined processing. For similar reasons, the Commission

[11] Licensing Reform Order, ¶ 167.
[12] Licensing Reform Order, ¶ 257.
[13] Licensing Reform Order, ¶ 257.
[14] Licensing Reform Order, ¶ 257.
[15] Licensing Reform Order, ¶ 258.
[16] *See* Licensing Reform Order, ¶ 258.

does not apply streamlined processing to applications for follow-on satellites in which it is proposed to use frequencies that were not used on the satellites to be replaced.[17]

B. Applicability to Estrela do Sul 2

Under the principles described above, Estrela do Sul 2 qualifies as a replacement satellite for Permitted List purposes. It is licensed by the same administration (Brazil) that licensed Estrela do Sul 1, and will operate at the same orbital location (63° W.L.) as Estrela do Sul 1. It will serve the United States using the same conventional Ku-band frequencies that the Commission authorized Estrela do Sul 1 to use when it added that satellite to the Permitted List. Its operating parameters are technically consistent with the operating parameters of Estrela do Sul 1. And it has the same coverage area in the United States – CONUS – as Estrela do Sul 1.[18]

Coverage area in the United States is the only coverage area that matters for this purpose, because U.S. coverage is the only coverage that is authorized by including Estrela do Sul 1 and Estrela do Sul 2 on the Permitted List. Coverage areas outside the United States are under the authority of Brazil or other countries, not the United States, and it is Brazil's responsibility, not the responsibility of the United States, to address coordination and related interference issues arising from such non-U.S. coverage.

---

[17] *See* Licensing Reform Order, ¶ 258.

[18] In some locations within this CONUS coverage area, Telesat Brasil will provide service via Estrela do Sul 2 at a higher power level than it currently provides service on via Estrela do Sul 1. These higher power levels are no impediment to streamlined processing. As stated above, the Commission, in recognition of the fact that that "next-generation satellites will incorporate … technical advancements made since the previous generation was launched," will "consider applications for replacement satellites with higher power capabilities relative to the applicant's existing satellites." Licensing Reform Order, ¶ 257.

Even if coverage areas outside the United States were relevant, Telesat Brasil's request to add Estrela do Sul 2 to the Permitted List would be eligible for streamlined replacement satellite treatment. Although there are minor differences in the beam patterns of the two satellites outside the United States,[19] Estrela do Sul 2 will serve the same basic "coverage areas," using the same non-U.S. beams –North Atlantic Ocean Region, Andean, Brazil, South Cone (a/k/a Mercosul) – as Estrela do Sul 1.

Moreover, Telesat Brasil's provision of service via Estrela do Sul 2 to areas associated with the minor differences in beam patterns, even if that service were relevant despite the fact that these areas are outside the United States, does not implicate the processing queue concerns that underlie the Commission's "no new coverage areas for replacement satellites" policy. Any application filed with the Commission seeking to serve the "minor difference" areas on the frequencies to be used by Estrela do Sul 2 would have to be dismissed, because such service would have to be coordinated with the B-SAT I network. There is no reason to believe successful coordination would be possible, given the interference that would be caused to Telesat Brasil's already-licensed Estrela do Sul 1.[20] Any such application, therefore, would not be entitled to a place in the processing queue.

---

[19] The North Atlantic Ocean Region beam for Estrela do Sul 2 extends further south over the Atlantic Ocean than the corresponding beam on Estrela do Sul 1. In addition, Estrela do Sul 2 includes coverage of the following areas not covered by Estrela do Sul 1: offshore islands in the Brazil beam, the Galapagos Islands, portions of the Caribbean, islands off the coast of Chile, and portions of Antarctica.

[20] *Cf. Mobile Satellite Ventures Subsidiary LLC,* DA 05-50 (IB, Jan. 10, 2005) at ¶ 8 (processing MSV's application for an NGSO-like satellite serving South America without initiating a processing round because "[a]s a practical matter, any NGSO like satellite [licensed to a third party and] serving South America in the bands licensed to AMSC-1 is likely to cause harmful interference to AMSC-1's North American operations.").

For all of these reasons, streamlined processing is appropriate.

CONCLUSION

In view of the foregoing, grant of Telesat Brasil's application is in the public interest, and it is respectfully requested that the Commission grant the application expeditiously.

Respectfully submitted,

Telesat Brasil Capacidade de Satelites Ltda.

/s/ Andre Panesi
Andre Panesi
Director and Manager of Satellite Operations
Telesat Brasil Capacidade de Satelites Ltda.
Av. Rio Branco, 1 grupo 1608, Centro
Rio de Janeiro – RJ
CEP 20090-003, Brazil
011-55-21-2253-5195

OF COUNSEL:
Joseph A. Godles
GOLDBERG, GODLES, WIENER
& WRIGHT
1229 Nineteenth Street, N.W.
Washington, DC 20036
(202) 429-4900
Counsel for Telesat Brasil

January 12, 2011

Technical Exhibit for "Estrela do Sul 2" Satellite at 63 West Longitude Orbital Location

This document is an attachment to the application of Telesat with regard to "Estrela do Sul 2" satellite at 63° west longitude (WL) geostationary orbital location. The technical information for the proposed system as required by paragraph (d) of Section 25.114[1] of the FCC rules and regulation is provided in this document. The information specified in paragraph (c) of that section has been provided in the Schedule S and is not repeated in this document.

§25.114(d)(1): General description of the overall system

"Estrela do Sul 2" satellite will operate at 63 WL as a replacement to "Estrela do Sul 1" satellite which is currently operating at that orbital location.[2] The operating frequency band and coverage area of "Estrela do Sul 2" satellite remain similar to those of "Estrela do Sul 1" satellite.

The "Estrela do Sul 2" satellite will provide a range of fixed satellite services (FSS) to various countries within the ITU Region 1 and Region 2 in the Standard Ku band and Extended Ku band frequencies. [3] The "Estrela do Sul 2" satellite network will consist of a geostationary satellite at 63 WL and associated earth station (ES) facilities. The satellite will have 46 active transponders and the transponders will be of bandwidths of 36, 72, or 76 MHz. The uplink frequency band will be 13.75-14.5 GHz and the downlink frequency band will be 11.45-12.2 GHz. The downlink in the band 11.45-11.7 GHz will be used only for international systems, i.e., other than United States (US) domestic services. Telesat may seek authorization to use this band (11.45-11.7 GHz) for communication between earth station on vessels (ESVs) and U.S. earth stations in which case interference from terrestrial systems operating in accordance with the FCC rules will be accepted (as allowed by footnote NG182 of the FCC table of frequency allocations).[4]

The polarization used in all emissions is linear, either vertical or horizontal. Frequency reuse will be exploited through the use of orthogonal polarization and spatial isolation of the beams. All transponders will contain step attenuators (adjustable in 1 dB steps with an overall range of 20 dB attenuation) which can be adjusted remotely by ground commands.

[1] 47 C.F.R. §25.114
[2] FCC file numbers SAT-PDR-20021010-00196 and SAT-PPL-20071127-00163.
[3] In this document, the term "Standard Ku band" is used to refer to the uplink and downlink frequency bands 14.0-14.5 GHz and 11.7-12.2 GHz, respectively. The term "Extended Ku band" is used to refer to the uplink and downlink frequency bands 13.75-14.0 GHz and 11.45-11.7 GHz, respectively.
[4] FCC Online table of Frequency allocations, 47 C.F.R. §2.106, Revised on July 1, 2010

The satellite TT&C operations will be performed from the following address:

Av. Rio Branco, 1 grupo 1608, Centro
Rio de Janeiro – RJ
CEP 20090-003, Brazil
Phone: +55-21-2253-5195

Satellite transmission on each active channel (TWTA chain) can be individually turned on and off by ground Tele-command signals, enabling cessation of emissions from the satellite, as required by §25.207[5] of the Commission's rules.

§25.114(d)(3): Space station antenna gain contours

The space station antenna gain contours for all the beams have been provided in .gxt format. The gain values of the contours in the gxt files are relative to the peak gain. The peak gain values, polarization information, and service area for each of the beams is shown in Table 1. There are five service areas: Andean, Brazil, US, NAOR[6], and South Cone. The service areas are demonstrated in Figures 1 to 5.

Table 1: List of the satellite beams and their peak values

Beam	Uplink/ Downlink	Co-pol Antenna Peak Gain [dBi]	Cross-pol Antenna Peak Gain [dBi]	Polarization	Service Area
ATXV	Downlink	30.4	0.2	V	Andean
BTXH	Downlink	31.4	0.8	H	Brazil
BTXV	Downlink	31.4	0.8	V	Brazil
UTXH	Downlink	30.4	-0.5	H	US
UTXV	Downlink	30.4	-0.5	V	US
NTXH	Downlink	30.4	-5.2	H	NAOR
NTXV	Downlink	30.4	-5.2	V	NAOR
STXV	Downlink	31.4	-0.3	V	South Cone
ARXH	Uplink	31.9	0.2	H	Andean
BRXH	Uplink	32.9	0.8	H	Brazil
BRXV	Uplink	32.9	0.8	V	Brazil
URXH	Uplink	31.9	-0.5	H	US
URXV	Uplink	31.9	-0.5	V	US
NRXH	Uplink	31.9	-5.2	H	NAOR
NRXV	Uplink	31.9	-5.2	V	NAOR
SRXH	Uplink	32.9	-0.3	H	South Cone

[5] 47 C.F.R. §25.207
[6] NAOR stands for North Atlantic Ocean Region

Figure 1: "Andean" service area

Notice ID : 1
Administration : B
Satellite Network : ESTRELA DO SUL 2
Beam : ANDEAN
Emission / Reception : E
Polarization : C
Service Area Number : 1
Service Area Name : ANDEAN
Reason : C
Satellite Position : -63.000

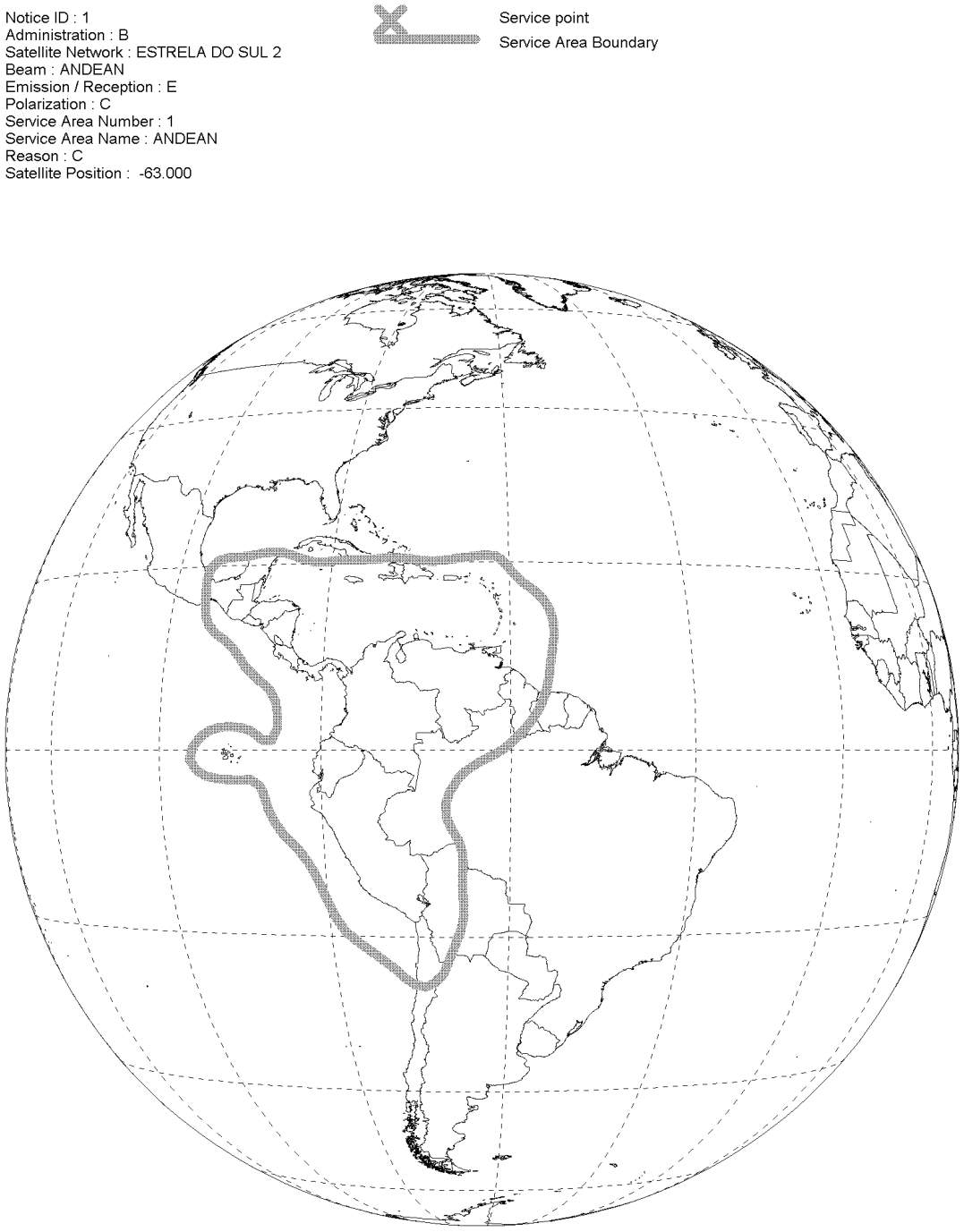


Figure 2: "Brazil" service area

Notice ID : 1
Administration : B
Satellite Network : ESTRELA DO SUL 2
Beam : BRAZIL
Emission / Reception : E
Polarization : C
Service Area Number : 2
Service Area Name : BRAZIL
Reason : C
Satellite Position : -63.000

Service point
Service Area Boundary

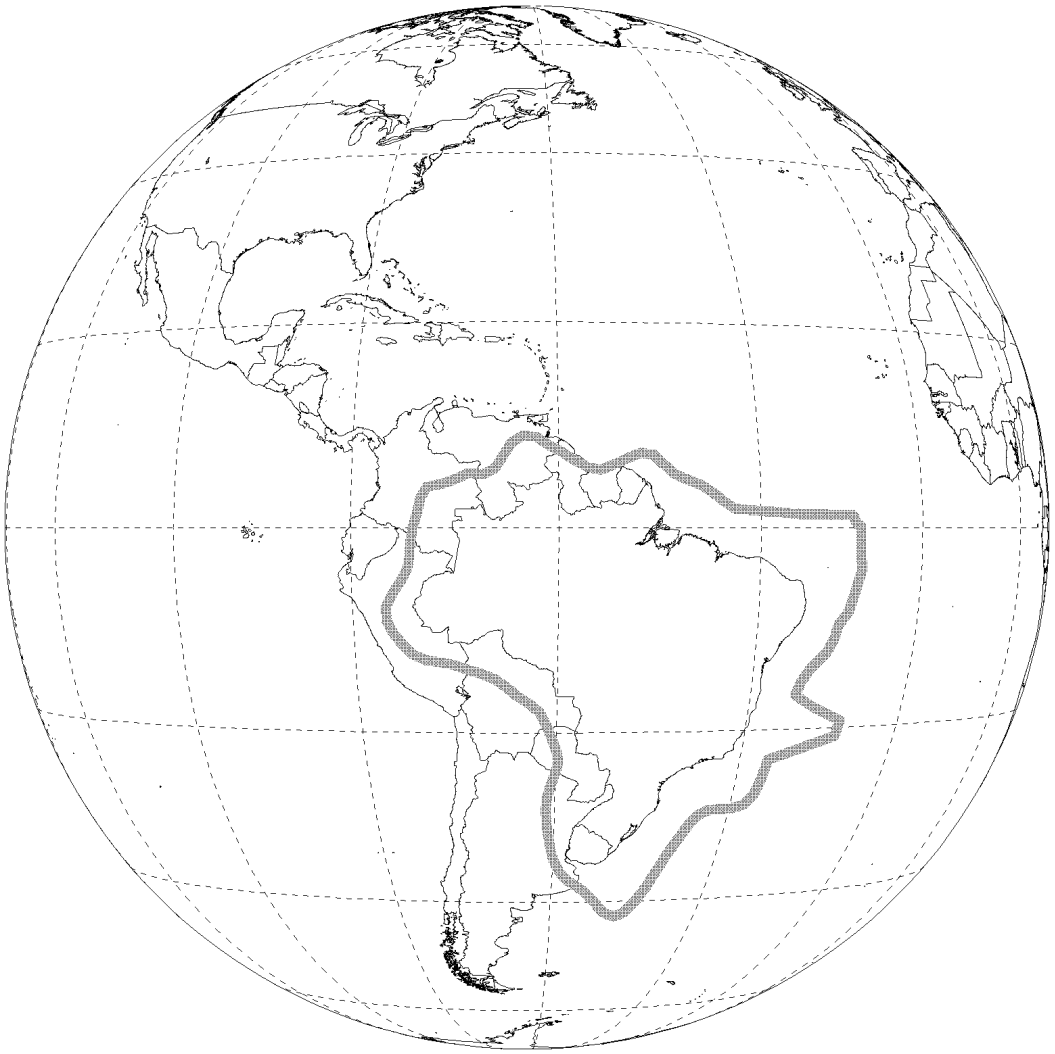


Figure 3: "US" service area

Notice ID : 1
Administration : B
Satellite Network : ESTRELA DO SUL 2
Beam : US
Emission / Reception : E
Polarization : C
Service Area Number : 3
Service Area Name : US
Reason : C
Satellite Position : -63.000

Service point
Service Area Boundary

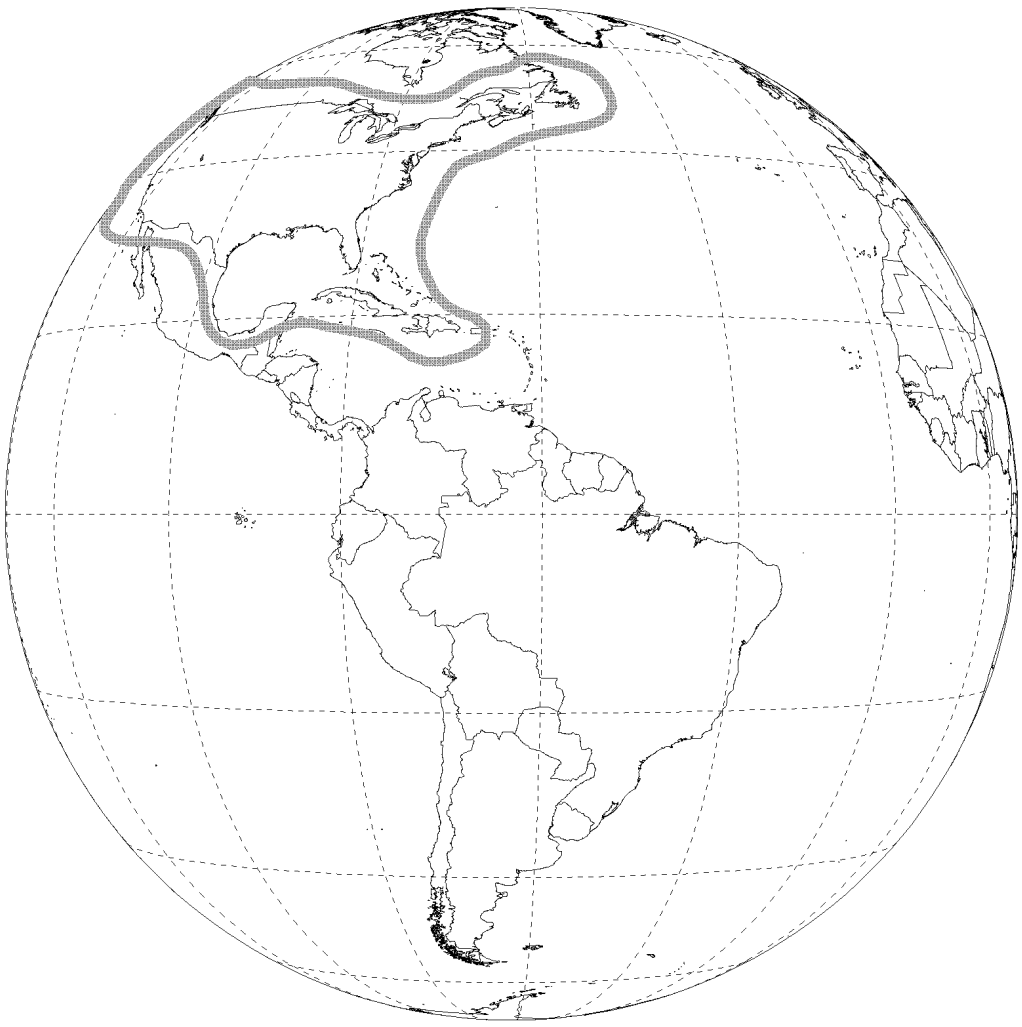


Figure 4: "NAOR" service area

Notice ID : 1
Administration : B
Satellite Network : ESTRELA DO SUL 2
Beam : NAOR
Emission / Reception : E
Polarization : C
Service Area Number : 4
Service Area Name : NAOR
Reason : C
Satellite Position : -63.000

Service point
Service Area Boundary

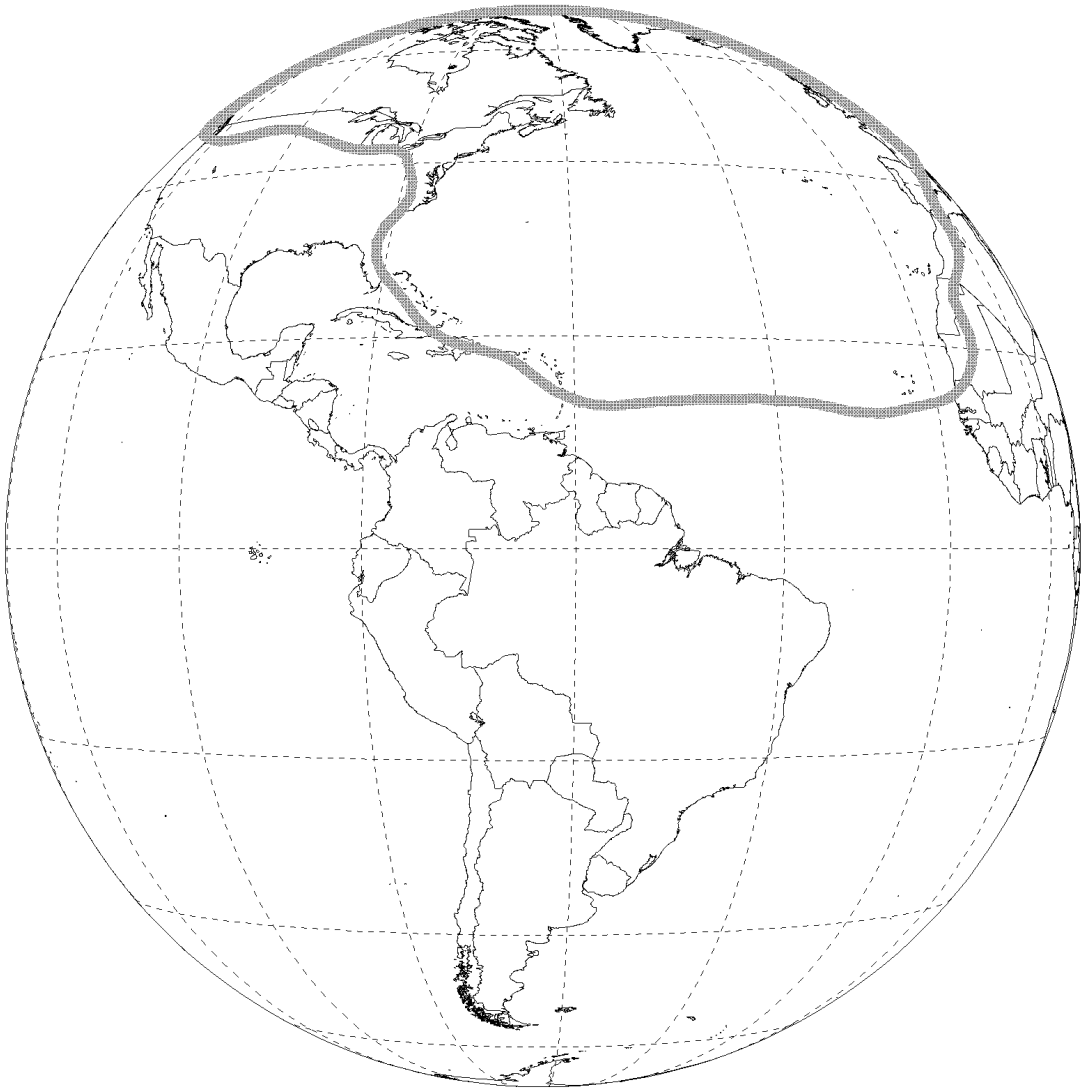
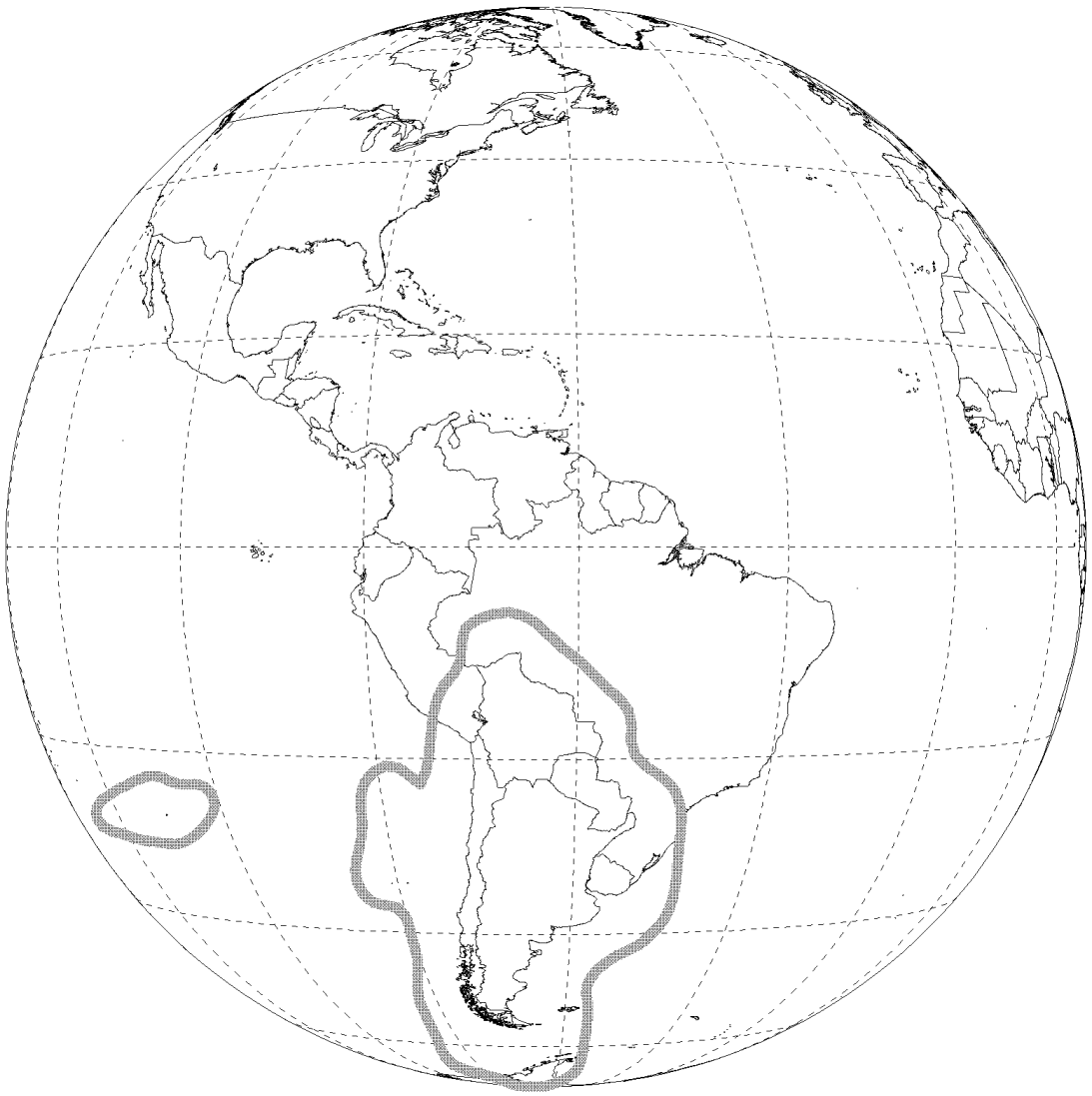


Figure 5: "South Cone" service area

Notice ID : 1
Administration : B
Satellite Network : ESTRELA DO SUL 2
Beam : SOUTH CO
Emission / Reception : E
Polarization : C
Service Area Number : 5
Service Area Name : SOUTH CONE
Reason : C
Satellite Position : -63.000

Service point
Service Area Boundary



§25.114(d)(4): Description of the types of services to be provided, areas served, transmission characteristics, performance objectives, link noise budget, typical earth station parameters, and modulation parameters

"Estrela do Sul 2" satellite network will provide a range of FSS services to various countries within the ITU Region 1 and Region 2. As mentioned in the previous section, the areas served by this satellite are shown in Figures 1 to 5. Services to Alaska and Hawaii cannot be provided because these areas are not visible from the satellite geostationary orbital location of 63WL. The services provided by "Estrela do Sul 2" will include VSAT services, point to point communication links, and video transmissions for cable head-ends.

Typical digital modulation and emission schemes that will be used along with their characteristics, including the performance objectives, are listed in Table 2. The satellite is capable of supporting analog FM transmissions as well.

Table 2: Modulation/emission schemes and the corresponding performance objectives

Digital Modulation ID	Modulation	Emission Designator	Assigned BW [kHz]	Information (bit) rate [kbps]	FEC Rate	Total C/N Objective [dB]
1	QPSK	36M0G7W	36000	38081	0.667	3.90
2	QPSK	2M00G7W	2000	2116	0.667	3.90
3	QPSK	500KG7W	500	529	0.667	3.90
4	QPSK	18M0G7W	18000	21420	0.750	4.83
5	QPSK	1M00G7W	1000	1190	0.750	4.83
6	QPSK	200KG7W	200	283	0.889	7.00
7	8PSK	9M00G7W	9000	14261	0.667	7.92
8	QPSK	450KG7D	450	176	0.250	-1.55
9	QPSK	225KG7D	225	88	0.250	-1.55
10	8PSK	18M0G7W	18000	28521	0.667	7.92

For the Hub earth stations, typical 9.1 meter or 6 meter antennas will be used and for the terminal earth stations typical 1.2 m, 1.5 m, 1.8 m, 2.0 m, 2.4 m, or 4.5 m antennas will be used. The earth station antennas for some of the applications will have auto-track capability and maintain accurate antenna pointing toward the satellite. Some of the earth stations may use uplink power control (UPC) to compensate for the effects of rain fade. The basic characteristics of the typical earth station antennas are shown in Table 3 (the parameters in this table correspond to an operating frequency of 14 GHz). The earth station antennas will meet the antenna performance requirements specified in §25.209[7] of the Commission's rules, and the uplink transmit power will comply with the requirements of §25.204.[8]

[7] 47 C.F.R. §25.209
[8] 47 C.F.R. §25.204

Table 3: Typical earth station antenna parameters at 14 GHz

ES antenna diameter [m]	ES antenna gain [dBi]	HPBW[9] [deg]
9.1	60.6	0.16
6	57.0	0.25
4.5	54.5	0.33
2.4	49.1	0.63
2	47.5	0.75
1.8	46.6	0.83
1.5	45.0	1.00
1.2	43.0	1.25

Typical link budgets and overall performance analysis, including the analysis of the effects of each contributing noise and interference source, are provided in Tables 4 to 9. Below is a brief description of those tables (note that modulation ID that appears on the first row of Tables 4 to 9 refers to the modulation schemes specified in Table 2):

- Table 4 and Table 5 show the link budgets for the standard Ku band (14-14.5 GHz uplink and 11.7-12.2 GHz downlink) where Table 4 corresponds to Andean, US, and NAOR service areas and Table 5 corresponds to Brazil and South Cone service areas
- Table 6 and Table 7 show the link budgets for the Extended Ku band (13.75-14 GHz uplink and 11.45-11.7 GHz downlink) where Table 6 corresponds to Andean, US, and NAOR service areas and Table 7 corresponds to Brazil and South Cone service areas
- Table 8 shows a typical Command link budget and Table 9 demonstrates a typical Telemetry link budget.

[9] HPBW stands for half power beam width

Table 4: Typical link budgets for Andean, US, and NAOR service areas in the standard Ku band

Digital Modulation ID	1	2	3	4	5	6	7
Emission BW [kHz]	36000	2000	500	18000	1000	200	9000
Modulation type	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	8PSK
Information (bit) rate [kbps]	38081	2116	529	21420	1190	283	14261
FEC Rate	0.667	0.667	0.667	0.750	0.750	0.889	0.667
Uplink Frequency [GHz]	14	14	14	14	14	14	14
Uplink ES antenna diameter [m]	6	1.2	1.2	6	9.1	2.4	9.1
Uplink ES antenna gain [dBi]	57.0	43.0	43.0	57.0	60.6	49.1	60.6
Uplink Antenna feed flange power [dBW]	14.6	5.0	-1.0	11.6	-1.0	-7.0	8.5
Uplink ES to Satellite Distance [km]	38000	38000	38000	38000	38000	38000	38000
Uplink Free-Space Loss [dB]	207.0	207.0	207.0	207.0	207.0	207.0	207.0
Satellite RX antenna gain [dBi]	31.9	31.9	31.9	31.9	31.9	31.9	31.9
Satellite Rx system noise temperature [K]	400	400	400	400	400	400	400
Uplink Rain Atten. [dB]	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Uplink Cloud Atten. [dB]	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Uplink Noise temp. increase due to rain and cloud [K]	174.5	174.5	174.5	174.5	174.5	174.5	174.5
Uplink Thermal C/N [dB]	18.0	7.0	7.0	18.0	21.6	11.0	21.6
Uplink C/I (ASI) [dB]	14.2	14.2	14.2	15.2	15.2	17.3	18.3
Uplink C/I (Xpol) [dB]	30	30	30	30	30	30	30
Uplink C/I (IM) [dB]	27	27	27	27	27	27	27
Uplink C/(N+I) [dB]	12.5	6.2	6.2	13.1	13.9	10.0	16.0
Downlink Frequency (GHz)	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Downlink EIRP [dBW]	48.5	32.6	26.6	45.5	33.0	25.1	42.5
Downlink ES to Satellite Distance [km]	38000	38000	38000	38000	38000	38000	38000
Downlink Free-Space Loss [dB]	205.4	205.4	205.4	205.4	205.4	205.4	205.4
RX ES antenna diameter [m]	1.2	6	6	1.2	1.2	9.1	1.2
RX ES antenna gain [dBi]	41.5	55.5	55.5	41.5	41.5	59.1	41.5
RX ES system noise temperature [K]	200	200	200	200	200	200	200
Downlink Rain Atten. [dB]	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Downlink Cloud Atten. [dB]	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Downlink Noise temp. increase due to rain and cloud [deg K]	137.8	137.8	137.8	137.8	137.8	137.8	137.8
Downlink Thermal C/N [dB]	9.5	20.1	20.1	9.5	9.5	26.3	9.5
Downlink C/I (ASI) [dB]	14.2	14.2	14.2	15.2	15.2	17.3	18.3
Downlink C/I (Xpol) [dB]	30	30	30	30	30	30	30
Downlink C/I (IM) [dB]	27	27	27	27	27	27	27
Downlink C/(N+I) [dB]	8.2	13.0	13.0	8.4	8.4	16.2	8.9
Total C/(N+I) [dB]	6.79	5.35	5.35	7.10	7.31	9.04	8.10
Required C/(N+I) [dB]	3.90	3.90	3.90	4.83	4.83	7.00	7.92
Margin [dB]	2.89	1.45	1.45	2.27	2.48	2.04	0.18

Table 5: Typical link budgets for Brazil and South Cone service areas in the standard Ku band

Digital Modulation ID	1	2	3	4	5	6	7
Emission BW [kHz]	36000	2000	500	18000	1000	200	9000
Modulation type	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	8PSK
Information (bit) rate [kbps]	38081	2116	529	21420	1190	283	14261
FEC Rate	0.667	0.667	0.667	0.750	0.750	0.889	0.667
Uplink Frequency [GHz]	14	14	14	14	14	14	14
Uplink ES antenna diameter [m]	6	1.2	1.2	6	9.1	2.4	9.1
Uplink ES antenna gain [dBi]	57.0	43.0	43.0	57.0	60.6	49.1	60.6
Uplink Antenna feed flange power [dBW]	10.6	5.0	-1.0	17.6	-5.0	-8.0	4.5
Uplink ES to Satellite Distance [km]	38000	38000	38000	38000	38000	38000	38000
Uplink Free-Space Loss [dB]	207.0	207.0	207.0	207.0	207.0	207.0	207.0
Satellite RX antenna gain [dBi]	32.9	32.9	32.9	32.9	32.9	32.9	32.9
Satellite Rx system noise temperature [K]	400	400	400	400	400	400	400
Uplink Rain Atten. [dB]	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Uplink Cloud Atten. [dB]	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Uplink Noise temp. increase due to rain and cloud [K]	208.3	208.3	208.3	208.3	208.3	208.3	208.3
Uplink Thermal C/N [dB]	13.2	6.2	6.2	23.2	16.8	9.3	16.8
Uplink C/I (ASI) [dB]	14.2	14.2	14.2	15.2	15.2	17.3	18.3
Uplink C/I (Xpol) [dB]	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Uplink C/I (IM) [dB]	27.0	27.0	27.0	27.0	27.0	27.0	27.0
Uplink C/(N+I) [dB]	10.5	5.6	5.6	14.2	12.7	8.5	14.1
Downlink Frequency (GHz)	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Downlink EIRP [dBW]	47.0	29.1	23.1	44.0	31.5	22.1	41.0
Downlink ES to Satellite Distance [km]	38000	38000	38000	38000	38000	38000	38000
Downlink Free-Space Loss [dB]	205.4	205.4	205.4	205.4	205.4	205.4	205.4
RX ES antenna diameter [m]	1.2	6.0	6.0	1.2	1.2	9.1	1.8
RX ES antenna gain [dBi]	41.5	55.5	55.5	41.5	41.5	59.1	45.0
RX ES system noise temperature [K]	200	200	200	200	200	200	200
Downlink Rain Atten. [dB]	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Downlink Cloud Atten. [dB]	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Downlink Noise temp. increase due to rain and cloud [deg K]	174.5	174.5	174.5	174.5	174.5	174.5	174.5
Downlink Thermal C/N [dB]	6.4	15.0	15.0	6.4	6.4	21.6	9.9
Downlink C/I (ASI) [dB]	14.2	14.2	14.2	15.2	15.2	17.3	18.3
Downlink C/I (Xpol) [dB]	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Downlink C/I (IM) [dB]	27.0	27.0	27.0	27.0	27.0	27.0	27.0
Downlink C/(N+I) [dB]	5.7	11.4	11.4	5.8	5.8	15.5	9.2
Total C/(N+I) [dB]	4.43	4.54	4.54	5.19	4.96	7.73	7.98
Required C/(N+I) [dB]	3.90	3.90	3.90	4.83	4.83	7.00	7.92
Margin [dB]	0.53	0.64	0.64	0.36	0.13	0.73	0.06

Table 6: Extended Ku band typical link budgets for Andean, US, and NAOR service areas

Digital Modulation ID	1	4	7	10
Emission BW [kHz]	36000	18000	9000	18000
Modulation type	QPSK	QPSK	8PSK	8PSK
Information (bit) rate [kbps]	38081	21420	14261	28521
FEC Rate	0.667	0.750	0.667	0.667
Uplink Frequency [GHz]	14	14	14	14
Uplink ES antenna diameter [m]	6	6	9.1	4.5
Uplink ES antenna gain [dBi]	57.0	57.0	60.6	54.5
Uplink Antenna feed flange power [dBW]	14.6	11.6	8.5	13.6
Uplink ES to Satellite Distance [km]	38000	38000	38000	38000
Uplink Free-Space Loss [dB]	207.0	207.0	207.0	207.0
Satellite RX antenna gain [dBi]	31.9	31.9	31.9	31.9
Satellite Rx system noise temperature [K]	400	400	400	400
Uplink Rain Atten. [dB]	3.3	3.3	3.3	3.3
Uplink Cloud Atten. [dB]	0.7	0.7	0.7	0.7
Uplink Noise temp. increase due to rain and cloud [K]	174.5	174.5	174.5	174.5
Uplink Thermal C/N [dB]	18.0	18.0	21.6	17.5
Uplink C/I (ASI) [dB]	14.2	15.2	18.3	18.3
Uplink C/I (Xpol) [dB]	30.0	30.0	30.0	30.0
Uplink C/I (IM) [dB]	27.0	27.0	27.0	27.0
Uplink C/(N+I) [dB]	12.5	13.1	16.0	14.5
Downlink Frequency (GHz)	11.7	11.7	11.7	11.7
Downlink EIRP [dBW]	46.0	43.0	42.0	46.0
Downlink ES to Satellite Distance [km]	38000	38000	38000	38000
Downlink Free-Space Loss [dB]	205.4	205.4	205.4	205.4
RX ES antenna diameter [m]	1.2	1.2	1.5	1.2
RX ES antenna gain [dBi]	41.5	41.5	43.4	41.5
RX ES system noise temperature [K]	200	200	200	200
Downlink Rain Atten. [dB]	2.3	2.3	2.3	2.3
Downlink Cloud Atten. [dB]	0.5	0.5	0.5	0.5
Downlink Noise temp. increase due to rain and cloud [deg K]	137.8	137.8	137.8	137.8
Downlink Thermal C/N [dB]	7.0	7.0	10.9	10.0
Downlink C/I (ASI) [dB]	14.2	15.2	18.3	18.3
Downlink C/I (Xpol) [dB]	30.0	30.0	30.0	30.0
Downlink C/I (IM) [dB]	27.0	27.0	27.0	27.0
Downlink C/(N+I) [dB]	6.2	6.3	10.1	9.3
Total C/(N+I) [dB]	5.28	5.50	9.09	8.14
Required C/(N+I) [dB]	3.90	4.83	7.92	7.92
Margin [dB]	1.38	0.67	1.17	0.22

Table 7: Extended Ku band typical link budgets for Brazil and South Cone service areas

Digital Modulation ID	1	4	7	10
Emission BW [kHz]	36000	18000	9000	18000
Modulation type	QPSK	QPSK	8PSK	8PSK
Information (bit) rate [kbps]	38081	21420	14261	28521
FEC Rate	0.667	0.750	0.667	0.667
Uplink Frequency [GHz]	14	14	14	14
Uplink ES antenna diameter [m]	6	6	9.1	4.5
Uplink ES antenna gain [dBi]	57.0	57.0	60.6	54.5
Uplink Antenna feed flange power [dBW]	11.6	11.6	7.5	13.6
Uplink ES to Satellite Distance [km]	38000	38000	38000	38000
Uplink Free-Space Loss [dB]	207.0	207.0	207.0	207.0
Satellite RX antenna gain [dBi]	32.9	32.9	32.9	32.9
Satellite Rx system noise temperature [K]	400	400	400	400
Uplink Rain Atten. [dB]	5.0	5.0	5.0	5.0
Uplink Cloud Atten. [dB]	0.5	0.5	0.5	0.5
Uplink Noise temp. increase due to rain and cloud [K]	208.3	208.3	208.3	208.3
Uplink Thermal C/N [dB]	14.2	17.2	19.8	16.7
Uplink C/I (ASI) [dB]	14.2	15.2	18.3	18.3
Uplink C/I (Xpol) [dB]	30.0	30.0	30.0	30.0
Uplink C/I (IM) [dB]	27.0	27.0	27.0	27.0
Uplink C/(N+I) [dB]	11.0	12.8	15.5	14.1
Downlink Frequency (GHz)	11.7	11.7	11.7	11.7
Downlink EIRP [dBW]	47.0	44.0	41.0	47.0
Downlink ES to Satellite Distance [km]	38000	38000	38000	38000
Downlink Free-Space Loss [dB]	205.4	205.4	205.4	205.4
RX ES antenna diameter [m]	1.2	1.2	1.8	1.5
RX ES antenna gain [dBi]	41.5	41.5	45.0	43.4
RX ES system noise temperature [K]	200	200	200	200
Downlink Rain Atten. [dB]	3.6	3.6	3.6	3.6
Downlink Cloud Atten. [dB]	0.4	0.4	0.4	0.4
Downlink Noise temp. increase due to rain and cloud [deg K]	174.5	174.5	174.5	174.5
Downlink Thermal C/N [dB]	6.4	6.4	9.9	11.3
Downlink C/I (ASI) [dB]	14.2	15.2	18.3	18.3
Downlink C/I (Xpol) [dB]	30.0	30.0	30.0	30.0
Downlink C/I (IM) [dB]	27.0	27.0	27.0	27.0
Downlink C/(N+I) [dB]	5.7	5.8	9.2	10.4
Total C/(N+I) [dB]	4.55	4.99	8.27	8.82
Required C/(N+I) [dB]	3.90	4.83	7.92	7.92
Margin [dB]	0.65	0.16	0.35	0.90

Table 8: Typical link budget for Command signals

Digital Modulation ID	8
Emission BW [kHz]	450
Modulation type	QPSK
Information (bit) rate [kbps]	176
FEC Rate	0.25
Uplink Frequency [GHz]	14
Uplink ES antenna diameter [m]	9.1
Uplink ES antenna gain [dBi]	60.6
Uplink Antenna feed flange power [dBW]	-3.5
Uplink ES to Satellite Distance [km]	38000
Uplink Free-Space Loss [dB]	207.0
Satellite RX antenna gain [dBi]	32.9
Satellite Rx system noise temperature [K]	400
Uplink Rain Atten. [dB]	5
Uplink Cloud Atten. [dB]	0.5
Uplink Noise temp. increase due to rain and cloud [K]	208.3
Uplink Thermal C/N [dB]	21.8
Uplink C/I (ASI) [dB]	8.8
Uplink C/I (Xpol) [dB]	30
Uplink C/I (IM) [dB]	27
Uplink C/(N+I) [dB]	8.48
Required C/(N+I) [dB]	-1.55
Margin [dB]	10.03

Table 9: Typical link budget for Telemetry signals

Digital Modulation ID	9
Emission BW [kHz]	225
Modulation type	QPSK
Information (bit) rate [kbps]	88
FEC Rate	0.25
Downlink Frequency (GHz)	11.7
Downlink EIRP [dBW]	22.0
Downlink ES to Satellite Distance [km]	38000
Downlink Free-Space Loss [dB]	205.4
RX ES antenna diameter [m]	9.1
RX ES antenna gain [dBi]	59.1
RX ES system noise temperature [K]	200
Downlink Rain Atten. [dB]	3.6
Downlink Cloud Atten. [dB]	0.4
Downlink Noise temp. increase due to rain and cloud [deg K]	174.5
Downlink Thermal C/N [dB]	21.0
Downlink C/I (ASI) [dB]	8.8
Downlink C/I (Xpol) [dB]	30.0
Downlink C/I (IM) [dB]	27.0
Downlink C/(N+I) [dB]	8.44
Required C/(N+I) [dB]	-1.55
Margin [dB]	9.99

§25.114(d)(5): Power flux density compliance with §25.208

In this section it is demonstrated that the proposed system complies with the power flux density (PFD) limits of §25.208(b).[10]

Table 10 shows the peak values of the downlink equivalent isotropic radiated power (EIRP) for each of the service areas, as well as the peak PFD values over a bandwidth (BW) of 4 kHz (the column on the right shows the peak PFD values). Using the parameters of Table 10 and the gain contours of the downlink beams (provided in gxt format), the maximum PFD levels were calculated for several angles of arrival, including 0°, 5°, 10°, 15°, 20°, 25°, and 90°. These values are shown in Table 11, where θ denotes the angle of arrival. Also shown in this table are the PFD limits of §25.208(b). From Table 11 it can be seen that the requirements of §25.208(b) are satisfied by all the beams.

Table 10: Downlink peak EIRP and PFD values for each of the service areas

Sevice area	Corresponding downlink beam(s)	Peak EIRP over 36 MHz BW [dBW]	Peak EIRP over 4 kHz BW [dBW]	Location of the peak antenna gain (long/lat)	Distance between the satellite and the peak gain point on the earth [km]	PFD at the peak gain point on the earth [dB(W/m^2/4kHz]
Andean	ATXV	52	12.5	68.32W / 0.0N	35818.4	-149.62
Brazil	BTXH, BTXV	53	13.5	50.73W / 26.69S	36722.7	-148.83
US	UTXH, UTXV	52	12.5	84.55W / 27.15N	37053.9	-149.91
NAOR	NTXH, NTXV	52	12.5	21.41W / 19.01N	37921.0	-150.11
South Cone	STXV	53	13.5	53.72W / 27.93S	36730.2	-148.83

Table 11: Maximum PFD values over 4 kHz bandwidth for different angles of arrival (θ)

Service Area	Corresponding downlink beam(s)	Maximum PFD [dB(W/m^2/4kHz]						
		θ=0°	θ=5°	θ=10°	θ=15°	θ=20°	θ=25°	θ=90°
Andean	ATXV	-164	-164	-164	-164	-164	-164	-149.62
Brazil	BTXH, BTXV	-168	-168	-168	-168	-168	-168	-148.83
US	UTXH, UTXV	-151.35	-151.34	-149.91	-149.91	-149.91	-149.91	-149.91
NAOR	NTXH, NTXV	-151.31	-151.31	-150.11	-150.11	-150.11	-150.11	-150.11
South Cone	STXV	-156.83	-154.83	-152.83	-152.83	-150.83	-148.83	-148.83
PFD limits of §25.208(b) [dB(W/m^2/4kHz]		**-150**	**-150**	**-147.5**	**-145**	**-142.5**	**-140**	**-140**

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

The "Estrela do Sul 2" satellite will operate at 63 WL as a replacement to "Estrela do Sul 1" satellite which is currently operating at that orbital location. Estrela do Sul 1 satellite currently provides services to the United States and several other countries. "Estrela do Sul 2" satellite will enable the continuity of these services, and therefore will provide the additional Ku band capacity that is in demand and will provide more options to the consumers in the United States who will benefit from more competitive rates and services. These will be in the public interest.

[10] 47 C.F.R. §25.208(b)

§25.114(d)(7): Information specified in §25.140(b) (Interference analysis and the compatibility of the proposed system two degrees from any authorized space station)

In this section the information specified in §25.140(b)[11] are presented (as required by §25.114(d)(7)).

§25.140(b)(1) asks for presenting the information specified in §25.114 which is accomplished by the Schedule S and other sections of this Technical Exhibit. §25.140(b)(2) asks for demonstration of the compatibility of the proposed space system two degrees from any authorized space stations. This demonstration is provided in this section.

The geostationary space stations in the Standard Ku or Extended Ku bands within two degrees from the location of "Estrela do Sul 2" (63 WL) are the Amazonas satellites at 61 WL (Amazonas-1 and Amazonas-2)[12] and Star One C1 at 65 WL.[13] It is noted that Telesat has been operating "Estrela do Sul 1" under the existing coordination agreements between the satellite operators and there has been no interference problem between these adjacent satellite networks. The replacement satellite network "Estrela do Sul 2" has similar operating frequency bands and coverage areas to those of "Estrela do Sul 1" and it uses transmission power levels that comply with the coordination agreements obtained for "Estrela do Sul 1" satellite with regard to Amazonas satellites at 61 WL and Star One C1 satellite at 65 WL. In the following, the adjacent satellite interference from "Estrela do Sul 2" into Star One C1 satellite and the Amazonas satellites is analyzed.

In order to demonstrate the two-degree satellite spacing compatibility, for "Estrela do Sul 2", the typical link parameters of the link budget presented in Table 4 have been used. The parameters used in the interference analysis have been extracted from that table and summarized in Table 12.

Table 12: "Estrela do Sul 2" satellite network link parameters (extracted from Table 4)

Digital Modulation ID	1	2	3	4	5	6	7
Information Rate [kbps]	38081	2116	529	21420	1190	283	14261
Emission BW [kHz]	36000	2000	500	18000	1000	200	9000
Uplink power at the antenna input [dBW]	14.6	5.0	-1.0	11.6	-1.0	-7.0	8.5
Uplink power density at the antenna input [dB(W/Hz)]	-61	-58	-58	-61	-61	-60	-61
Downlink EIRP [dBW]	48.5	32.6	26.6	45.5	33.0	25.1	42.5
Downlink EIRP density [dB(W/Hz)]	-27.1	-30.4	-30.4	-27.1	-27.1	-27.9	-27.1

[11] 47 C.F.R. §25.140(b)
[12] FCC file numbers SAT-PPL-20040402-00073 and SAT-PPL-20090806-00081
[13] FCC file number SAT-PPL-20050706-00143

Table 13 shows the digital carrier Ku-band link parameters for Star One C1 satellite network. These parameters have been extracted from the corresponding FCC application.[14]

Table 13: Ku-band link parameters for Star One C1 satellite located at 65 WL

Information Rate [kbps]	48400	34368	8448	2048	512	4.8
Emission Designator	36M0G7W	17M9G7W	5M50G7W	1M64G7W	614KG7W	5K80G7W
Emission Bandwidth [kHz]	36000	17900	5500	1640	614	5.8
Uplink ES antenna diameter [m]	7.5	7.5	6	2.4	1.8	1.2
Uplink ES antenna gain [dBi]	59.0	59.0	57.0	49.1	46.6	43.1
Uplink power at the antenna input [dBW]	15.5	9	6.5	12.4	8.9	-7.6
Uplink power density at the antenna input [dB(W/Hz)]	-60.1	-63.5	-60.9	-49.7	-49.0	-45.2
Downlink EIRP [dBW]	46	37	33	28.5	22.5	2.5
Downlink EIRP density [dB(W/Hz)]	-29.6	-35.5	-34.4	-33.6	-35.4	-35.1
RX ES antenna diameter [m]	1.8	7.5	6	6	4.5	3.6
RX ES antenna gain [dBi]	45.0	57.4	55.5	55.5	53.0	51.0
Single Entry C/I Objective [dB]	20	24.6	21.6	20.7	17.9	17.9

Table 14 shows the Ku-bank link parameters for Amazonas-1 satellite network as provided to the Commission[15] and Table 15 shows the link parameters for Amazonas-2 satellite extracted from the corresponding FCC filing.[16]

Table 14: Ku-band link parameters for Amazonas-1 satellite at 61 WL

Information Rate [kbps]	2048	38010	11300	11
Emission Designator	1M50G7W	36M0G7W	7M89G7W	14K0G7W
Emission Bandwidth [kHz]	1500	36000	7890	14
Uplink ES antenna diameter [m]	3.8	3.8	3.8	2.5
Uplink ES antenna gain [dBi]	53	53	53	49.2
Uplink power at the antenna input [dBW]	9.5	23	15.1	-9.4
Uplink power density at the antenna input [dB(W/Hz)]	-52.3	-52.6	-53.9	-50.9
Downlink EIRP [dBW]	34.7	44.6	37.6	9.4
Downlink EIRP density [dB(W/Hz)]	-27.1	-31.0	-31.4	-32.1
RX ES antenna diameter [m]	2.5	1.8	2.5	1.8
RX ES antenna gain [dBi]	48.4	45.5	48.4	45.5
Single Entry C/I Objective [dB]	17.7	18.3	20.2	19

[14] FCC file number SAT-PPL-20050706-00143
[15] FCC file numbers SAT-PPL-20040402-00073
[16] FCC file number SAT-PPL-20090806-00081

Table 15: Link parameters for Amazonas-2 satellite located at 61 WL

Information Rate [kbps]	2048	38010	11300	11
Emission Designator	1M80G7W	33M0G7W	7M89G7W	14K0G7W
Emission Bandwidth [kHz]	1800	33000	7890	14
Uplink ES antenna diameter [m]	3.7	3.7	2.4	1.2
Uplink ES antenna gain [dBi]	53.1	53.1	49.4	43.4
Uplink power at the antenna input [dBW]	9.2	19.8	16.1	-9.9
Uplink power density at the antenna input [dB(W/Hz)]	-53.4	-55.4	-52.9	-51.4
Downlink EIRP [dBW]	32	43.7	38.6	5.15
Downlink EIRP density [dB(W/Hz)]	-30.6	-31.5	-30.4	-36.3
RX ES antenna diameter [m]	2.6	1.6	1.7	3.6
RX ES antenna gain [dBi]	48.6	44.6	45.1	51.6
Single Entry C/I Objective [dB]	17.7	18.3	20.2	19

Using the parameters of Tables 12 to 15, the impact of interference from "Estrela do Sul 2" satellite network to each of the three adjacent satellites (Star One C1, Amazonas-1, and Amazonas-2) was analyzed. In this analysis, the overall link carrier to interference ratio (C/I) due to adjacent satellite interference (ASI) was calculated and compared with the corresponding single entry C/I objective to obtain the available C/I margin. For all the earth station antennas, 29-25log(θ) has been used as the side-lobe pattern. Longitudinal station keeping tolerance of 0.05° for the satellites has been considered and antenna pointing error of 0.1 dB for the earth stations has been taken into consideration in the calculation of the interference levels. The details of the methodology used for this analysis have been provided in Annex 1 of this document. The summary results are shown in Tables 16 to 18.

Table 16 shows the overall link C/I margins for each of the "Estrela do Sul 2" carriers interfering into each of Star One C1 carriers. From this table it can be seen that when "Estrela do Sul 2" is operating with the typical link parameters of Table 4 and Star One C1 is operating with the typical link parameters of Table 13, the available C/I margin is greater than or equal to 1.0 dB.

Table 17 displays the overall link C/I margins for each of the "Estrela do Sul 2" satellite carriers interfering into each of the Amazonas-1 satellite carries. From this table it can be seen that when "Estrela do Sul 2" is operating with the typical link parameters of Table 4 and Amazonas-1 is operating with the typical link parameters of Table 14, the available C/I margin is greater than or equal to 0.0 dB.

Table 18 presents the overall link C/I margins for each of the "Estrela do Sul 2" satellite carriers interfering into each of the Amazonas-2 satellite carries. From this table it can be seen that when "Estrela do Sul 2" is operating with the typical link parameters of Table 4 and Amazonas-2 is operating with the typical link parameters of Table 15, the available C/I margin is greater than or equal to 0.0 dB.

Table 16: Overall link C/I margins (dB) for the Star One C1 satellite network

C/I Margin [dB]	Interfering Carrier ("Estrela do Sul 2")							
	Information Rate [kbps]	38081	2116	529	21420	1190	283	14261
Wanted Carrier (Star One C1)	48400	1.0	4.1	4.1	1.0	1.0	1.8	1.0
	34368	2.2	3.8	3.8	2.2	2.2	2.7	2.2
	8448	4.6	6.6	6.6	4.6	4.6	5.2	4.6
	2048	6.4	8.9	8.9	6.4	6.4	7.1	6.4
	512	5.1	8.0	8.0	5.1	5.1	5.9	5.1
	4.8	3.5	6.5	6.5	3.5	3.5	4.3	3.5

Table 17: Overall link C/I margins (dB) for the Amazonas-1 satellite network

C/I (ASI) Margin [dB]	Interfering Carrier ("Estrela do Sul 2")							
	Information Rate [kbps]	38081	2116	529	21420	1190	283	14261
Wanted Carrier (Amazonas-1)	2048	9.0	11.8	11.8	9.0	9.0	9.8	9.0
	38010	1.8	5.0	5.0	1.8	1.8	2.7	1.8
	11300	2.3	5.3	5.3	2.3	2.3	3.1	2.3
	11	0.0	3.2	3.2	0.0	0.0	0.8	0.0

Table 18: Overall link C/I margins (dB) for the Amazonas-2 satellite network

C/I Margin [dB]	Interfering Carrier ("Estrela do Sul 2")							
	Information Rate [kbps]	38081	2116	529	21420	1190	283	14261
Wanted Carrier (Amazonas-2)	2048	5.9	8.9	8.9	5.9	5.9	6.6	5.9
	38010	0.4	3.5	3.5	0.4	0.4	1.2	0.4
	11300	0.0	3.1	3.1	0.0	0.0	0.8	0.0
	11	1.6	3.9	3.9	1.6	1.6	2.2	1.6

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

§25.114(d)(14)(i), Debris Release Assessment. Telesat has assessed the launch, orbit raising, deployment and normal operations portions of the mission and has determined that no debris will be released by the spacecraft. The only portion of the mission in which portions of the spacecraft are separated from the main spacecraft body is during deployment. However, all separation and deployment mechanisms are designed to contain all debris generated when activated (so no debris ends up leaving the spacecraft). The assessment found no other sources for debris throughout the mission.

To protect from small body collisions, the spacecraft hardware design of "Estrela do Sul 2" will allow for individual faults without losing the entire spacecraft. All critical components (e.g. computers and control devices) will be built within the structure and shielded from external influences. Items that can not be built within the spacecraft nor shielded (e.g. antennas) will be able to withstand impact. The spacecraft can be controlled through both the normal payload antennas and wide angle antennas. The likelihood of both being damaged during a small body collision is minimal. The wide angle antennas on this spacecraft will be basically open waveguide that point towards the earth (there is one set on each side of the spacecraft and either set could be used to successfully de-orbit the spacecraft). These wide angle antennas would continue to operate even if struck and bent.

§25.114(d)(14)(ii), Accidental Explosion Assessment. Telesat has reviewed failure modes for all equipment to assess the possibility of an accidental explosion onboard the spacecraft. In order to ensure that the spacecraft does not explode on orbit, Telesat will take specific precautions. All batteries and fuel tanks are monitored for pressure or temperature variations. Alarms in the Satellite Control Center ("SCC") inform controllers of any variations. Additionally, long-term trending analysis will be performed to monitor for any unexpected trends.

Once the satellite is on station, the batteries will be operated utilizing the manufacturer's automatic recharging scheme. Doing so will ensure that charging terminates normally without building up additional heat and pressure. As this process occurs wholly within the spacecraft, it also affords protection from command link failures (on the ground).

In order to protect the propulsion system, fuel tanks will all be operated in a blow down mode. At the completion of orbit-raising, the pressurant will be isolated from the fuel system. This will cause the pressure in the tanks to decrease over the life of the spacecraft. This will also protect from a pressure valve failure causing the fuel tanks to become over pressurized. In order to ensure that the spacecraft has no explosive risk after it has been successfully de-orbited, all stored energy onboard the spacecraft will be removed. Upon successful de-orbit of the spacecraft, all propulsion lines and latch valves will be vented and left open. All battery chargers will be turned off and batteries will be left in a permanent discharge state. These steps will ensure that no buildup of energy can occur resulting in an explosion in the years after the spacecraft is de-orbited.

§25.114(d)(14)(iii), Assessment Regarding Collision with Larger Debris and Other Space Stations. Telesat has also assessed the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations. In order to minimize the possibility of a large body impact collision, Telesat will continue to monitor scheduled launches to determine whether other satellites will be located in close proximity to "Estrela do Sul 2". As construction of "Estrela do Sul 2" progresses and a launch window is declared, Telesat will contact the operators of any potentially close satellite to coordinate station keeping strategies, as it has done in the past with other spacecraft operators.

Alternatively, Telesat may seek authorization to make a minor adjustment to the "Estrela do Sul 2" orbital position to avoid overlapping "boxes" with adjacent satellites.

To limit future potential for collision, once the satellite is on-station, Telesat will continue to monitor new satellite launches to ensure that future satellites do not present a danger to "Estrela do Sul 2". If a new satellite is located within 0.5º of "Estrela do Sul 2", Telesat will coordinate station keeping activities with the satellite operator to avoid any risk of collision.

§25.114(d)(14)(iv), Post-Mission Disposal Plans. "Estrela do Sul 2" satellite will be removed from its geostationary orbit at 63° WL at a perigee altitude no less than about 300 km above the standard geostationary orbit of 35,786 km. This altitude will be determined by using the FCC-recommended equation in section 25.283(a)[17] regarding end-of-life satellite disposal. An example is described below:

Minimum Deorbit Altitude= 36,021 km + (1000•CR•A/m) (Eq.1)
CR = solar pressure radiation coefficient of the spacecraft = 1.6
A/m = area to mass ratio, in square meters per kilogram, of the spacecraft = 0.036
Result: (Eq.1) Minimum Deorbit Altitude = 36,021 km + (1000·1.6•.036) = 36,078.6 km which is 292.6 km above the geostationary orbit of 35,786 km.

The propellant needed to achieve the minimum de-orbit altitude is based on the delta-V required and will be specified by the spacecraft manufacturer.

Based on IADC calculation, an estimated end-of-life mass of 2203.4 kg, and the delta-V required, approximately 9.5 kg of propellant will be reserved to ensure minimum de-orbit altitude is obtained. Any remaining propellant will be consumed by further raising the orbit until combustion is no longer possible. The remaining species of propellant, either Oxidizer (N204) or Fuel (MMH), will be vented, placing the propulsion system on the spacecraft in "safe" mode.

Propellant tracking is accomplished using a bookkeeping method. Using this method, the ground control station tracks the number of jet seconds utilized for station keeping, momentum control and other attitude control events. The amount of fuel used is

[17] 47 C.F.R. §25.283(a)

determined from the number of jet seconds. This process has been calibrated using data collected from thruster tests conducted on the ground and has been found to be accurate to within a few months of life on the spacecraft.

One year from the end of life of the spacecraft, a PGS test is to be performed. This test uses heaters and heat transfer curves to determine the actual fuel still aboard the spacecraft. As the amount of fuel in the tanks decreases, the accuracy of the test results increases. Operationally, the test is scheduled to be performed one year before end of life as it provides more than adequate margin to compensate for any bookkeeping uncertainty as well as maximum accuracy for determining the amount of fuel remaining.

The PGS test is also conducted periodically while the satellite is on-orbit to confirm the amount of fuel used and verify the results of the bookkeeping method. Only at the final year mark is it used as the mechanism to determine the amount of remaining fuel.

Annex 1

Details of the methodology for the calculation of C/I due to adjacent satellite interference

In this annex, the details of the methodology for the calculation of C/I due to adjacent satellite interference are presented and it is shown how the C/I margins of Tables 16 to 18 have been computed.

Table 19 shows the details of the calculation of C/I and the corresponding margin when "Estrela do Sul 2" interferes into Star One C1 satellite network. In this table, each of the six columns on the right corresponds to one of the Star One C1 carriers, as provided in Table 13. For "Estrela do Sul 2", the uplink power density and downlink EIRP density values are those corresponding to the information rate of 38081 kbps in Table 4 (Digital Modulation ID = 1). Table 19 shows how the C/I margins of the first column of Table 16 have been calculated. The C/I margins in the other columns of Table 16 have been calculated in a similar way.

Table 20 shows the details of the calculation of C/I values and the corresponding margins when "Estrela do Sul 2" interferes into the Amazonas-1 satellite network. In this table, each of the four columns on the right corresponds to one of the Amazonas-1 carriers, as provided in Table 14. For "Estrela do Sul 2", the uplink power density and downlink EIRP density values are those corresponding the information rate of 38081 kbps in Table 4 (Digital Modulation ID = 1). The C/I margins calculated in Table 20 are those presented in the first column of Table 17. The C/I margins in the other columns of Table 17 have been calculated in a similar way.

Table 21 shows the details of the calculation of C/I values and the corresponding margins when "Estrela do Sul 2" interferes into the Amazonas-2 satellite network. In this table, each of the four columns on the right corresponds to one of the Amazonas-2 carriers, as provided in Table 15. For "Estrela do Sul 2", the uplink power density and downlink EIRP density values are those corresponding to the information rate of 38081 kbps in Table 4 (Digital Modulation ID = 1). The C/I margins calculated in Table 21 are those presented in the first column of Table 18. The C/I margins in the other columns of Table 18 have been calculated in a similar way.

Table 19: Calculation of the C/I due to interference from "Estrela do Sul 2" to Star One C1 satellite network

Star One C1 Carrier Information Rate	kbps	48400	34368	8448	2048	512	4.8
"Estrela do Sul 2" Satellite Location	Deg WL	63	63	63	63	63	63
Star One C1Satellite Location	Deg WL	65	65	65	65	65	65
Station Keeping Tolerance	Deg	0.05	0.05	0.05	0.05	0.05	0.05
Minimum Geocentric Effective Separation	Deg	1.9	1.9	1.9	1.9	1.9	1.9
Topocentric Separation	Deg	2.11	2.11	2.11	2.11	2.11	2.11
Pointing Accuracy	Deg	0.1	0.1	0.1	0.1	0.1	0.1
Topocentric Separation Including the Pointing Error	Deg	2.01	2.01	2.01	2.01	2.01	2.01
"Estrela do Sul 2" downlink EIRP density	[dB(W/Hz)]	-27.1	-27.1	-27.1	-27.1	-27.1	-27.1
"Estrela do Sul 2" uplink power density at the antenna input	[dB(W/Hz)]	-61.0	-61.0	-61.0	-61.0	-61.0	-61.0
Star One C1 downlink EIRP density	[dB(W/Hz)]	-29.6	-35.5	-34.4	-33.6	-35.4	-35.1
Star One C1 uplink power density at the antenna input	[dB(W/Hz)]	-60.1	-63.5	-60.9	-49.7	-49.0	-45.2
Uplink ASI C/I Calculation							
Frequency	GHz	14	14	14	14	14	14
Earth Station Antenna							
Diameter	m	7.5	7.5	6	2.4	1.8	1.2
Gain max	dBi	59.0	59.0	57.0	49.1	46.6	43.0
Off-axis gain	dBi	21.4	21.4	21.4	21.4	21.4	21.4
C/I (Uplink ASI)	dB	38.5	35.0	35.7	38.9	37.2	37.4
Downlink ASI C/I Calculation							
Frequency	GHz	11.7	11.7	11.7	11.7	11.7	11.7
Receive Earth Station Antenna							
Diameter	m	1.8	7.5	6	6	4.5	3.6
Gain Max	dBi	45.0	57.4	55.5	55.5	53.0	51.0
Off-axis gain	dBi	21.4	21.4	21.4	21.4	21.4	21.4
C/I (Downlink ASI)	dB	21.1	27.5	26.7	27.4	23.2	21.5
Overall Link ASI C/I Calculation							
Overall link C/I due to ASI	dB	21.0	26.8	26.2	27.1	23.0	21.4
Single Entry C/I Objective	dB	20.0	24.6	21.6	20.7	17.9	17.9
C/I (ASI) Margin	dB	1.0	2.2	4.6	6.4	5.1	3.5

Table 20: Calculation of the C/I due to interference from "Estrela do Sul 2" to Amazonas-1 satellite network

Amazonas-1 Carrier Information Rate	kbps	2048	38010	11300	11
"Estrela do Sul 2" Satellite Location	Deg WL	63	63	63	63
Amazonas-1 Satellite Location	Deg WL	61	61	61	61
Station Keeping Tolerance	Deg	0.05	0.05	0.05	0.05
Minimum Geocentric Effective Separation	Deg	1.9	1.9	1.9	1.9
Topocentric Separation	Deg	2.11	2.11	2.11	2.11
Pointing Accuracy	Deg	0.1	0.1	0.1	0.1
Topocentric Separation Including the Pointing Error	Deg	2.01	2.01	2.01	2.01
"Estrela do Sul 2" downlink EIRP density	dB(W/Hz)	-27.1	-27.1	-27.1	-27.1
"Estrela do Sul 2" uplink power density at the antenna input	dB(W/Hz)	-61.0	-61.0	-61.0	-61.0
Amazonas-1 downlink EIRP density	dB(W/Hz)	-27.1	-31.0	-31.4	-32.1
Amazonas-1 uplink power density at the antenna input	dB(W/Hz)	-52.3	-52.6	-53.9	-50.9
Uplink ASI C/I Calculation					
Frequency	GHz	14	14	14	14
Earth Station Antenna					
Diameter	m	3.8	3.8	3.8	2.5
Gain max	dBi	53.0	53.0	53.0	49.2
Off-axis gain	dBi	21.4	21.4	21.4	21.4
C/I (Uplink ASI)	dB	40.4	40.1	38.8	37.9
Downlink ASI C/I Calculation					
Frequency	GHz	11.7	11.7	11.7	11.7
Receive Earth Station Antenna					
Diameter	m	2.5	1.8	2.5	1.8
Gain Max	dBi	48.4	45.5	48.4	45.5
Off-axis gain	dBi	21.4	21.4	21.4	21.4
C/I (Downlink ASI)	dB	26.9	20.2	22.6	19.1
Overall Link ASI C/I Calculation					
Overall link C/I due to ASI	dB	26.7	20.1	22.5	19.0
Single Entry C/I Objective	dB	17.7	18.3	20.2	19.0
C/I (ASI) Margin	dB	9.0	1.8	2.3	0.0

Table 21: Calculation of the C/I due to interference from "Estrela do Sul 2" to Amazonas-2 satellite network

Amazonas-2 Carrier Information Rate	kbps	2048	38010	11300	11
"Estrela do Sul 2" Satellite Location	Deg WL	63	63	63	63
Amazonas-2 Satellite Location	Deg WL	61	61	61	61
Station Keeping Tolerance	Deg	0.05	0.05	0.05	0.05
Minimum Geocentric Effective Separation	Deg	1.9	1.9	1.9	1.9
Topocentric Separation	Deg	2.11	2.11	2.11	2.11
Pointing Accuracy	Deg	0.1	0.1	0.1	0.1
Topocentric Separation Including the Pointing Error	Deg	2.01	2.01	2.01	2.01
"Estrela do Sul 2" downlink EIRP density	[dB(W/Hz)]	-27.1	-27.1	-27.1	-27.1
"Estrela do Sul 2" uplink power density at the antenna input	[dB(W/Hz)]	-61.0	-61.0	-61.0	-61.0
Amazonas-2 downlink EIRP density	[dB(W/Hz)]	-30.6	-31.5	-30.4	-36.3
Amazonas-2 uplink power density at the antenna input	[dB(W/Hz)]	-53.4	-55.4	-52.9	-51.4
Uplink ASI C/I Calculation					
Frequency	GHz	14	14	14	14
Earth Station Antenna					
Diameter	m	3.7	3.7	2.4	1.2
Gain max	dBi	53.1	53.1	49.4	43.4
Off-axis gain	dBi	21.4	21.4	21.4	21.4
C/I (Uplink ASI)	dB	39.4	37.3	36.1	31.6
Downlink ASI C/I Calculation					
Frequency	GHz	11.7	11.7	11.7	11.7
Receive Earth Station Antenna					
Diameter	m	2.6	1.6	1.7	3.6
Gain Max	dBi	48.6	44.6	45.1	51.6
Off-axis gain	dBi	21.4	21.4	21.4	21.4
C/I (Downlink ASI)	dB	23.7	18.7	20.4	20.9
Overall Link ASI C/I Calculation					
Overall link C/I due to ASI	dB	23.6	18.7	20.2	20.6
Single Entry C/I Objective	dB	17.7	18.3	20.2	19.0
C/I (ASI) Margin	dB	5.9	0.4	0.0	1.6

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this application and that it is complete and accurate to the best of my knowledge and belief.

Bahram Borna
Satellite Spectrum Coordination Engineer
Telesat
1601 Telesat Court, Ottawa,
ON, Canada K1B5P4
Phone: 613-748-8700 Ext. 2298

January 12, 2011