LORAL
Space & Communications Ltd
1755 Jefferson Davis Hwy
Suite 1007
Arlington, VA 22202-3501
(703) 414-1060
Fax: (703) 414-1079

SAT-PDR-20021010-00196
Loral Skynet do Brasil
Estrela do Sol 1

John P. Stern
Deputy General Counsel

October 10, 2002

Marlene H. Dortch, Secretary
Federal Communications Commission
Office of the Secretary
445 12th Street, SW
Washington, D.C. 20554

Re: Petition for Declaratory Ruling to Add Loral Skynet do Brasil's Estrela do Sul1 Ku band Satellite to the Permitted Space Station List

Dear Ms. Dortch:

Enclosed for filing on behalf of Loral Skynet do Brasil (Loral) is an original and four (4) copies of a Petition for Declaratory Ruling and associated FCC form 312 and technical and financial attachments to add Loral's Estrela do Sul 1 Ku band satellite, authorized by Brazil to operate at 63° W.L., to the Permitted Space Station List pursuant to Sections 1.2 and 25.137 of the Commission's rules. Any inquiries related to this request should be directed to the undersigned.

Sincerely,

John P. Stern
Deputy General Counsel
Loral Space & Communications Ltd.

cc: Tom Tycz
Fern Jarmulnek
Jennifer Gilsenan

FCC 312
Main Form

FEDERAL COMMUNICATIONS COMMISSION

APPLICATION FOR SATELLITE SPACE AND EARTH STATION AUTHORIZATIONS

Approved by OMB 3060-0678

Est. Avg Burden Hours Per Response 11 Hrs.

FCC Use Only
File Number:
Call Sign:
Fee Number:

APPLICANT INFORMATION

1. Legal Name of Applicant **Loral Skynet do Brasil**	2. Voice Telephone Number **703-414-1060**
3. Other Name Used for Doing Business (if any)	4. Fax Telephone Number **703-414-1079**
5. Mailing Street Address or P.O. Box **C/O Loral Space & Communications Ltd.** **, 1755 Jefferson Davis Hwy.** ATTENTION: **John P. Stern**	6. City **Arlington** 7. State / Country **Virginia** 8. Zip Code **22202-3501**
9. Name of Contact Representative (If other than applicant)	10. Voice Telephone Number
11. Firm or Company Name	12. Fax Telephone Number
13. Mailing Street Address or P.O. Box ATTENTION:	14. City 15. State / Country (if not U.S.A) 16. Zip Code

CLASSIFICATION OF FILING

17. Place an "X" in the box next to the classification that applies to this filing for both questions a. and b. Mark only one box for 17a and only one box for 17b.

- ☐ a1. Earth Station
- ☒ a2. Space Station

- ☐ b1. Application for License of New Station
- ☐ b2. Application for Registration of New Domestic Receive-Only Station
- ☐ b3. Amendment to a Pending Application
- ☐ b4. Modification of License or Registration
- ☐ b5. Assignment of License or Registration
- ☐ b6. Transfer of Control of License or Registration
- ☐ b7. Notification of Minor Modification
- ☐ b8. Application for License of New Receive-Only Station Using Non-U.S. Licensed Satellite
- ☐ b9. Letter of Intent to Use Non-U.S. Licensed Satellite to Provide Service in the United States
- ☒ b10. Other (Please Specify): **PETITION FOR DECLARATORY RULING FOR INCLUSION OF ESTRELA do SUL 1 ON THE PERMITTED SPACE STATION LIST**

18. If this filing is in reference to an existing station, enter: Call sign of station **N/A**	19. If this filing is an amendment to a pending application enter: (a) Date pending application was filed: **N/A** (b) File number of pending application:

TYPE OF SERVICE

20. NATURE OF SERVICE: This filing is for an authorization to provide or use the following type(s) of service(s): Place an "X" in the box(es) next to all that apply.

☒ a. Fixed Satellite ☐ c. Radiodetermination Satellite ☐ e. Direct to Home Fixed Satellite
☐ b. Mobile Satellite ☐ d. Earth Exploration Satellite ☐ f. Digital Audio Radio Service ☐ g. Other (please specify) _____

21. STATUS: Place an "X" in the box next to the applicable status. Mark only one box.

☐ a. Common Carrier ☒ b. Non-Common Carrier

22. If earth station applicant, place an "X" in the box(es) next to all that apply.

☐ a. Using U.S. licensed satellites ☐ b. Using Non-U.S. licensed satellites **N/A**

23. If applicant is providing INTERNATIONAL COMMON CARRIER service, see instructions regarding Sec. 214 filings. Mark only one box. Are these facilities:

☐ a. Connected to the Public Switched Network ☐ b. Not connected to the Public Switched Network **N/A**

24. FREQUENCY BAND(S): Place an "X" in the box(es) next to all applicable frequency band(s).

☐ a. C-Band (4/6 GHz)
☒ b. Ku-Band (12/14 GHz) ☐ c. Other (Please specify) _____

TYPE OF STATION

25. CLASS OF STATION: Place an "X" in the box next to the class of station that applies. Mark only one box.

☐ a. Fixed Earth Station ☐ b. Temporary-Fixed Earth Station ☐ c. 12/14 GHz VSAT Network ☐ d. Mobile Earth Station ☒ e. Space Station ☐ f. Other (Specify) _____

If space station applicant, go to Question 27.

26. TYPE OF EARTH STATION FACILITY Mark only one box.

☐ a. Transmit/Receive ☐ b. Transmit-Only ☐ c. Receive-Only **N/A**

PURPOSE OF MODIFICATION OR AMENDMENT

27. The purpose of this proposed modification or amendment is to: Place an "X" in the box(es) next to all that apply.

	a -- authorization to add new emission designator and related service
	b -- authorization to change emission designator and related service
	c -- authorization to increase EIRP and EIRP density
	d -- authorization to replace antenna
	e -- authorization to add antenna
	f -- authorization to relocate fixed station
	g -- authorization to change assigned frequency(ies)
X	h -- authorization to add Points of Communication (satellites & countries)
	i -- authorization to change Points of Communication (satellites & countries)
	j -- authorization for facilities for which environmental assessment and radiation hazard reporting is required
X	k - Other (Please Specify) **PETITION FOR DECLARATORY RULING FOR INCLUSION OF ESTRELA do SUL 1 ON THE PERMITTED SPACE STATION LIST**

ENVIRONMENTAL POLICY

28 Would a Commission grant of any proposal in this application or amendment have a significant environmental impact as defined by 47 CFR 1.307? ☐ YES ☒ NO
If YES, submit the statement as required by Sections 1.1308 and 1.1311 of the Commission's rules, 47 C F R §§ 1.1308 and 1.1311, as an exhibit to this application.
A Radiation Hazard Study must accompany all applications as an exhibit for new transmitting facilities, major modifications, or major amendments. Refer to OET Bulletin 65.

ALIEN OWNERSHIP

29. Is the applicant a foreign government or the representative of any foreign government?	☐ YES	☒ NO
30. Is the applicant an alien or the representative of an alien?	☐ YES	☒ NO
31. Is the applicant a corporation organized under the laws of any foreign government?	☐ YES	☒ NO
32. Is the applicant a corporation of which more than one-fifth of the capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?	☐ YES	☒ NO
33. Is the applicant a corporation directly or indirectly controlled by any other corporation of which more than one-fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?	☒ YES	☐ NO
34. If any answer to questions 29, 30, 31, 32 and/or 33 is Yes, attach as an exhibit, the identification of the aliens or foreign entities, their nationality, their relationship to the applicant, and the percentage of stock they own or vote.	**See Exhibit 1**	

BASIC QUALIFICATIONS

35. Does the applicant request any waivers or exemptions from any of the Commission's Rules? If Yes, attach as an exhibit, copies of the requests for waivers or exceptions with supporting documents.	☐ YES	☒ NO
36. Has the applicant or any party to this application had any FCC station authorization or license revoked or had any application for an initial, modification or renewal of FCC station authorization, license, or construction permit denied by the Commission? If Yes, attach as an exhibit, an explanation of the circumstances.	☐ YES	☒ NO
37. Has the applicant, or any party to this application, or any party directly or indirectly controlling the applicant ever been convicted of a felony by any state or federal court? If Yes, attach as an exhibit, an explanation of the circumstances.	☐ YES	☒ NO
38. Has any court finally adjudged the applicant, or any person directly or indirectly controlling the applicant, guilty of unlawfully monopolizing or attempting unlawfully to monopolize radio communication, directly or indirectly, through control of manufacture or sale of radio apparatus, exclusive traffic arrangement or any other means or unfair methods of competition? If Yes, attach as an exhibit, an explanation of the circumstances.	☐ YES	☒ NO
39. Is the applicant, or any person directly or indirectly controlling the applicant, currently a party in any pending matter referred to in the preceeding two items? If Yes, attach as an exhibit, an explanation of the circumstances.	☐ YES	☒ NO
40. If the applicant is a corporation and is applying for a space station license, attach as an exhibit the names, addresses, and citizenship of those stockholders owning of record and/or voting 10 percent or more of the Filer's voting stock and the percentages so held. In the case of fiduciary control, indicate the beneficiary(ies) or class of beneficiaries. Also list the names and addresses of the officers and directors of the Filer.		
41. By checking Yes, the undersigned certifies, that neither the applicant nor any other party to the application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance. See 47 CFR 1.2002(b) for the meaning of "party to the application" for these purposes.	☒ YES	☐ NO
42a. Does the applicant intend to use a non-U.S. licensed satellite to provide service in the United States? If yes, answer 42b and attach an exhibit providing the information specified in 47 C.F.R. § 25.137, as appropriate. If no, proceed to question 43	☒ YES	☐ NO
	See the attached Petition for Declaratory Ruling	
42b. What administration has licensed or is in the process of licensing the space station? If no license will be issued, what administration has coordinated or is in the process of coordinating the space station?	**Brazil**	

43. Description. (Summarize the nature of the application and the service to be provided).

Loral Space & Communications Ltd. requests that the Estrela do Sul 1 satellite be included on the Permitted Space list pursuant to section 25.137 of the Commissions rules, as further explained in the attached Petition for Declaratory Ruling

Exhibit No.	Identify all exhibits that are attached to this application.
1	**Foreign Ownership Information**
	Petition For Declaratory Ruling
Appendix A	**Technical description**
Appendix B	**Financial Information**

CERTIFICATION

The Applicant 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, and requests an authorization in accordance with this application. The applicant certifies that grant of this application would not cause the applicant to be in violation of the spectrum aggregation limit in 47 CFR Part 20. All statements made in exhibits are a material part hereof and are incorporated herein as if set out in full in this application. The undersigned, individually and for the applicant, hereby certifies that all statements made in this application and in all attached exhibits are true, complete and correct to the best of his or her knowledge and belief, and are made in good faith.

44. Applicant is a (an): (Place an "X" in the box next to applicable response.)

☐ b. Unincorporated Association ☐ c. Partnership ☒ d. Corporation ☐ e. Governmental Entity ☐ f. Other (Please specify) _____

45. Typed Name of Person Signing
Stanley Edinger

46. Title of Person Signing
Manager Government Relations

47. Signature

48. Date
October 10, 2002

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND/OR IMPRISONMENT (U.S. Code, Title 18, Section 1001), AND/OR REVOCATION OF ANY STATION AUTHORIZATION (U.S. Code, Title 47, Section 312(a)(1)), AND/OR FORFEITURE (U.S. Code, Title 47, Section 503).

FCC 312
Schedule B

FEDERAL COMMUNICATIONS COMMISSION
SATELLITE EARTH STATION AUTHORIZATIONS
(Technical and Operational Description)

(Place an "X" in one of the blocks below)

☐ License of New Station ☐ Registration of New Domestic Receive-Only Station ☐ Amendment to a Pending Application ☐ Modification of License/Registration ☐ Notification of Minor Modification

B1. Location of Earth Station Site. If temporary fixed, mobile, or VSAT remote facility, specify area of operation and point of contact. If VSAT hub station, give its location. For VSAT networks attach individual Schedule B, Page 1 sheets for each hub station and each remote station. Individually provide the Location, Points of communications, and Destination Points for each hub and remote station.

B1a. Station Call Sign	B1b. Site identifier (HUB. REMOTE, etc.).	B1c. Telephone Number	B1j. Geographic Coordinates N/S, Deg. - Min. - Sec. - E/W Lat ____ ____ ____ ____ Lon.	B1k. Lat./Lon. Coordinates are: ☐ NAD-27 ☐ NAD-83
B1d. Street Address of Station or Area of Operation .	B1e. Name of Contact Person			
B1c City	B1g. County	B1h. State	B1i. Zip Code	B1l. Site Elevation (AMSL) meters

B2. Points of Communications: List the names and orbit locations of all satellites with which this earth station will communicate. The entry "ALSAT" is sufficient to identify the names and locations of all satellite facilities licensed by the U.S. All non-U.S. licensed satellites must be listed individually.

Satellite Name and Orbit Location	Satellite Name and Orbit Location	Satellite Name and Orbit Location
Estrela do Sul 1 @63°W.L.		

B3. Destination points for communications using non-US. licensed satellites. For each non-U.S. licensed satellite facility identified in section B2 above, specify the destination point(s) (countries) where the services will be provided by this earth station via each non-U.S. licensed satellite system. Use additional sheets as needed.

Satellite Name	List of Destination Points
Estrela do Sul 1	**South America, North America, and the North Atlantic Ocean Region**

FEDERAL COMMUNICATIONS COMMISSION

SATELLITE EARTH STATION AUTHORIZATIONS

FCC Form 312 - Schedule B: (Technical and Operational Description)

B4. **Earth Station Antenna Facilities: Use additional pages as needed.**

(a) Site ID*	(b) Antenna ID**	(c) Quantity	(d) Manufacturer	(e) Model	(f) Antenna Size (meters)	(g) Antenna Gain Transmit and/or Receive (___dBi at _____GHz)
			Loral Skynet do Brazil is not providing individual earth station information because it seeks to operate Estrela do Sul 1 at 63° W.L. only with "ALSAT" earth stations, which are already licensed to operate with satellites meeting the Commission's technical requirements.			

B5. **Antenna Heights and Maximum Power Limits: (The corresponding Antenna ID in tables B4 and 5 applies to the same antenna)**

(a) Antenna ID**	(b) Antenna Structure Registration No.	Maximum Antenna Height (c) Above Ground Level (meters)	Maximum Antenna Height (d) Above Men Sea Level (meters)	(e) Building Height Above Ground Level (meters)***	(f) Maximum Antenna Height Above Rooftop (meters)***	(g) Total Input Power, at Antenna flange (Watts)	(h) Total EIRP for all carriers (dBW)

Notes: * If this is an application for a VSAT network, identify the site (Item B lb. Schedule B, Page 1) where each antenna is located. Also include this Site-ID on Schedule B. Page 5.

** Identify each antenna in VSAT network or multi-antenna station with a unique identifier. such as HUB, REMOTEI, Al, A2, 10M, 12M, 7M. etc. Use this same antenna ID throughout tables B4, B5, B6, and B7 when referring to the same antenna.

.***Attach sketch of site or exemption. See 47 CFR Part 17.

FEDERAL COMMUNICATIONS COMMISSION
SATELLITE EARTH STATION AUTHORIZATIONS
FCC Form 312 - Schedule B: (Technical and Operational Description)

B6. Frequency Coordination Limits: Use additional pages as needed.

(a) Antenna ID*	(b) Frequency Limits (MHz)	(c) Range of Satellite Arc Eastern Limit**	(d) Range of Satellite Arc Western Limit**	(e) Antenna Elevation Angle Eastern Limit	(f) Antenna Elevation Angle Western Limit	(g) Earth Station Azimuth Angle Eastern Limit	(h) Earth station Azimuth Angle Western Limit	(i) Maximum EIRP Density toward the Horizon (dBW/4kHz)
	Loral Skynet do Brazil is not providing individual earth station information because it seeks to operate Estrela do Sul 1 at 63° W.L. only with "ALSAT" earth stations, which are already licensed to operate with satellites meeting the Commission's technical requirements.							

Notes: * Provide the ANTENNA-ID from table B4 to identify the antenna to which each frequency band and orbital arc range is associated.
** If operating with geostationary satellites. give the orbital arc limits and the associated elevation and azimuth angles. If operating with non-geostationary satellites, give the notation "NON-GEO" for the satellite arc and give the minimum operational elevation angle and the maximum azimuth angle range.

FEDERAL COMMUNICATIONS COMMISON
SATELLITE EARTH STATION AUTHORIZATIONS
FCC Form 312 - Schedule B: (Technical and Operational Description)

B7. Particulars of Operation (Full particulars are required for each r.f. carrier): Use additional pages as needed.

(a) Antenna ID*	(b) Frequency Bands (MHz)	(c) T/R mode **	(d)Antenna Polarization (H,V, L,R)	(e) Emission Designator	(f) Maximum EIRP per Carrier (dBW)	(g)Maximum EIRP Density per Carrier (dBW/4kHz)	(h) Description of Modulation and Services
	Loral Skynet do Brazil is not providing individual earth station information because it seeks to operate Estrela do Sul 1 at 63° W.L. only with "ALSAT" earth stations, which are already licensed to operate with satellites meeting the Commission's technical requirements.						

Notes: * Provide the ANTENNA-ID from table B4 to identify the antenna to which each frequency band and emission is associated. For VSAT networks, include frequencies and emissions for all HUB and REMOTE units.
** Indicate whether the earth station transmits or receives in each frequency band.

FEDERAL COMMUNICATIONS COMMISSION
SATELLITE EARTH STATION AUTHORIZATIONS
FCC Form 312 - Schedule B: (Technical and Operational Description)

If VSAT Network, provide the SITE-ID) (Item B Ib) of the station that B8-B13 are in response to (HUB, REMOTE I, etc.):

B8. If the proposed antenna(s) operate in the Fixed Satellite Service (FSS) with geostationary satellites, do(es) the proposed antenna(s) comply with the antenna pin patterns specified in Section 25.209(a) and (b) as demonstrated by the manufacturer's qualification measurements? If NO, provide as Exhibit H, a technical analysis showing compliance with two-degree spacing policy. ☒ YES ☐ NO

B9. If the proposed antenna(s) do not operate in the Fixed Satellite Service (FSS), or if they operate in the Fixed Satellite Service (FSS) with non-geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a2) and (b) as demonstrated by the manufacturer's qualification measurements? **N/A** ☐ YES ☐ NO

B 10. Is the facility operated by remote control? If YES, provide the location and telephone number of the control point. ☐ YES ☐ NO

N/A

Remote Control Point Location:

B10a Street Address			
B10b. Citv	B10c. County	B10d. State /Country	B10e Zip Code
B10f. Telephone Number	B10g. Call Sign of Control Station		

B I 1. Is frequency coordination required? If YES, attach a frequency coordination report as Exhibit I. **See petition for Declaratory Ruling** ☐ YES ☐ NO

B 12. Is coordination with another country required? If YES, attach the name of die country(ies) and plot of coordination contours as Exhibit J. **See Petition for Declaratory Ruling** ☐ YES ☐ NO

B13. FAA Notification - (See 47 CFR Part 17 and 47 CFR Part 25.113(c)
Where FAA notification is required, have you attached a copy of a completed FCC Form 854 And for the FAA's study regarding the potential hazard of the structure to aviation? **N/A** ☐ YES ☐ NO

FAILURE TO COMPLY WITH 47 CFR PARTS 17 AND 25 WILL RESULT IN THE RETURN OF THIS APPLICATION.

FOREIGN OWNERSHIP INFORMATION

Loral SpaceCom Corporation (d/b/a Loral Skynet), a Delaware corporation, is a wholly owned subsidiary of Loral Space & Communications Corporation, also a Delaware corporation. Loral Space & Communications Corporation is owned and controlled by Loral Space & Communications Ltd. ("Loral"), a Bermuda company publicly traded on the New York Stock Exchange (NYSE: LOR). Loral's home market is the United States. *See In re* Application of AT&T Corp. and Loral SpaceCom Corporation, *Order and Authorization*, 12 FCC Rcd. 925 at ¶ 9 (1997).

PETTITION FOR DECLARATORY RULING

BEFORE THE
Federal Communications Commission
WASHINGTON, D.C.

In the Matter of	)	
	)	
Loral SpaceCom Corporation	)	
	)	File No.
Petition for Declaratory Ruling to Add	)	
Estrela do Sul 1 a Ku-Band Satellite	)	
to the Permitted Space Station List	)	

PETITION FOR DECLARATORY RULING

I. INTRODUCTION

Loral Space and Communications Ltd., on behalf of its subsidiary, Loral Skynet do Brasil (LSdB),[1] respectfully petitions the Federal Communications Commission, pursuant to Section 25.137[2] of the Commission's rules and the *DISCO II Reconsideration Order,*[3] to add LSdB's Estrela do Sul 1, a Ku-band satellite authorized by Brazil, to the Permitted Space Station List. The satellite is scheduled for launch in the first quarter of 2003. It will operate at 63° W.L. Grant of LSdB'S request will permit all U.S. ALSAT earth stations to provide services covered by the WTO Basic Telecommunications Agreement on all routes to, from, and within the United States using Ku-band frequencies via Estrela do Sul 1.

II. THE ESTRELA DO SUL 1 PAYLOAD SATISFIES COMMISSION REQUIREMENTS FOR ENTRY ON THE PERMITTED SPACE STATION LIST.

In the *DISCO II Reconsideration Order,* the Commission stated that non-U.S. satellites may be included on the Permitted Space Station List if they demonstrate compliance with

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[1] Loral Skynet do Brasil is a subsidiary of Loral Space and Commnications Ltd.

[2] 47 C.F.R. § 25.137 (2001).

[3] *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, *First Order on Reconsideration,* 15 FCC Rcd. 7207 (1999) [hereinafter *DISCO II Reconsideration Order*].

Sections 25.114 and 25.137 of the Commission's rules and raise no other public interest concerns.[4] As this petition and its appendix show, the Estrela do Sul 1 payload satisfies the legal, financial and technical requirements of the Commission's rules for inclusion on the list, and its addition would further the public interest in providing competitive services by permitting all U.S. ALSAT-designated Ku-band earth stations to provide such services via Estrela do Sul 1.

A. Loral Skynet do Brasil Satisfies the Commission's Legal and Technical Requirements as Outlined in Section 25.114.

The Estrela do Sul 1 payload will include 41 Ku-band transponders providing digital services and analog video services to South and North America and the North Atlantic Ocean Region (NAOR). The satellite will be operated under Brazil's BSAT-I satellite network filing. Attached to this application at Appendix A is the necessary information to show that Estrela do Sul 1 complies with the relevant technical requirements of Section 25.114 of the Commission's rules. Loral Skynet do Brasil has already coordinated its satellite with U.S.-licensed satellites within the ±9° "coordination arc."[5] The international coordination process for Estrela do Sul 1 is nearly complete.

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[4] *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.").

[5] The coordination arc coordination threshold was established by WRC 2000 Final Acts, Appendix S5, *Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article S9*, Table S5-1 Technical Conditions for Coordination.

Loral Skynet do Brasil Is Financially Qualified to Operate Estrela do Sul 1.

Although Estrela do Sul 1 is under construction and thus not yet in orbit, Loral Skynet do Brasil is financially qualified to construct, launch and operate the satellite that is the subject of this application, and respectfully requests a waiver of the requirement to make a detailed financial qualification showing.[6] In its *DISCO II Order,* the Commission exempted in-orbit systems from this requirement, concluding that, "where the foreign satellite is already in orbit, there is no concern about whether the prospective entrant is financially capable of building and launching the system." The same policy considerations underlying this exemption apply to Estrela do Sul 1.

There is no risk that Estrela do Sul 1 will not be constructed and launched as it is scheduled for launch in the first quarter, 2003. Loral Skynet do Brasil contracted with Space Systems/Loral for the construction and launch of the satellite, and has already invested significant funds in the development of this spacecraft. There is no practical danger of spectrum warehousing in this situation. Loral is authorized by Brazil to use the ITU Ku-band filing, BSAT I, at the 63° W.L. orbital location.

Finally, Loral is an established U.S. satellite provider and, through the Loral Global Alliance, operates dozens of satellites serving U.S. and foreign markets. There is no need to make a detailed financial showing here to establish that Loral Skynet do Brasil is "financially capable of building and launching its system."[7] Nevertheless, Loral's balance sheet is attached at Appendix B to demonstrate its adequate financial resources.

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[6] *See* 47 C.F.R. §§ 25.114(c)(13) & (17), 25.137(b) and 25.140.

[7] *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, IB Dkt. No. 96-111, *Report and Order,* 12 FCC Rcd. 24094, 24176 (1997) [hereinafter *DISCO II Order*].

B. Loral Skynet do Brasil Satisfies the Effective Competition Requirements of Section 25.137(a)(2).

The *DISCO II Order* established a presumption in favor of granting applications to provide services into the U.S. that are covered under the World Trade Organization ("WTO") Basic Telecommunications Agreement by satellite operators that are already licensed by WTO members.[8] Estrela do Sul 1 is licensed by Brazil, a WTO member country. As such, it satisfies the effective competitive opportunities requirement laid out in Section 25.137(a)(2) of the Commission's rules.[9]

Grant of this petition and inclusion of Estrela do Sul 1 on the Permitted Space Station List is in the public interest. By granting the Petition, the Commission will increase competition and provide additional Ku-band capacity and more options for U.S. consumers, who would benefit via lower rates and better service. These are the very public interest goals the Commission sought to promote when it established its presumption in favor of entry for WTO satellites,[10] and thus the public interest weighs heavily in favor of grant of this petition.

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[8] *See id.* at 24112.

[9] 47 C.F.R. § 25.137(a)(2).

[10] *See DISCO II Order,* 12 FCC Rcd. at 24113 ("By enhancing competition, this approach will provide U.S. consumers with additional choices among providers, reduce prices, and increase the quality and variety of services.").

IV. CONCLUSION

For the reasons discussed above, grant of this petition for declaratory ruling is in the public interest. Loral Skynet do Brasil requests that the Commission expeditiously grant this request.

Respectfully submitted,

for LORAL SPACE & COMMUNICATIONS LTD.

John P. Stern
Deputy General Counsel
Loral Space & Communications Ltd.
1755 Jefferson Davis Highway Ste. 1007
Arlington, VA 22202-3501

October 10, 2002

ENGINEERING CERTIFICATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this Petition for Declaratory Ruling of Loral Space & Communications Ltd. to add the Estrela do Sul 1 satellite to the Permitted space Station List; that I am familiar with Parts 21 and 25 of the Commission's rules; that I have either prepared or reviewed the engineering information contained in Appendix A; and that it is complete and accurate to the best of my knowledge.

Dated the 10th day of October 2002

By: Peter E. Goettle

Peter E. Goettle
Principle Engineer, Satellite and
Spectrum Development
Loral Skynet®[1]

[1] Skynet is a registered trademark of Loral SpaceCom Corporation.

APPENDIX A

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. GENERAL SYSTEM AND SERVICE DESCRIPTION

1.1. GENERAL SYSTEM DESCRIPTION

The Estrela do Sul satellite will be deployed at 63° WL and will be a Space Systems/Loral FS1300 class, three-axis stabilized spacecraft that will operate in standard and extended Ku-band. Estrela do Sul will be the most powerful Ku-band FSS satellite serving Brasil. The satellite will have 5 separate Ku-band transmit and receive beams, which cover Brasil, Mercosul, the Andean countries and the Guyanas and Panama, most of North and Central America, and the North Atlantic Ocean Region (NAOR). The coverage areas are depicted in Figure 1-1 and summarized in Table 1-1.

Table 1-1. **Coverage Areas for the Estrela do Sul Beams**

Beam Name	Coverage Area	Maximum number of transponders
Brasil Beam	Brasil	Up to 21
Mercosul Beam	Southeast Brasil, Argentina, Uraguay, & Chile	Up to 9
Andean Beam	Bolivia, Columbia, Ecuador, Peru, Venezuela, Guyanas, & Panama	Up to 3
NAFTA Beam	US (including Puerto Rico), Mexico, Southern Canada, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rico, & Cuba	Up to 13
NAOR	North Atlantic Ocean	Up to 9

The spacecraft will provide 41 transponders; 26 transponders have bandwidth of 36 MHz, 4 transponders have bandwidth of 28 MHz, 10 have bandwidth of 76 MHz, and 1 has bandwidth of 60 MHz. Frequency reuse will be obtained through the use of orthogonal polarization and spatial isolation of the antenna beams. The Ku-band transponders will have a mix of 130-W and 100-W TWTAs, and the spacecraft is designed to ensure that at least 50% of the prime power is devoted to the portion of the payload, which will serve Brasil. All transponders will contain gain-step attenuators (adjustable in 1 dB steps) that can be adjusted remotely by ground commands. The satellite will also include inter-beam switching on a channel by channel basis, which, for example, would permit connectivity between Brasil and the US.

The satellite transponder arrangement is provided in Table 1-2. Table 1-3 provides details on the TWTA power for each beam and shows that more than 50% of the spacecraft prime power is directed into Brasil beam transponders which operate in standard Ku-band.

The satellite design provides a high degree of flexibility in switching TWTAs among the NAFTA, Mercosul, Andean, and NAOR beams. And to ensure that the spacecraft meets the important prime power requirement set by Anatel, sixteen standard 36-MHz and two standard 28-MHz Ku-band transponders, powered by 130-W TWTAs, are dedicated to the Brasil beams. There is the potential to obtain three additional transponders for the Brasil beam by switching TWTAs from the NAOR beam, but this switching is not necessary for the satellite to meet Anatel's prime power requirement. Furthermore, the flexible design of Estrela do Sul will enable Loral Skynet do Brasil to make additional

transponder capacity, contained in the Mercosur beam, available for use by Brazilian customers. Up to 75% of the prime potency of the satellite can be available for use by Brazilian customers.

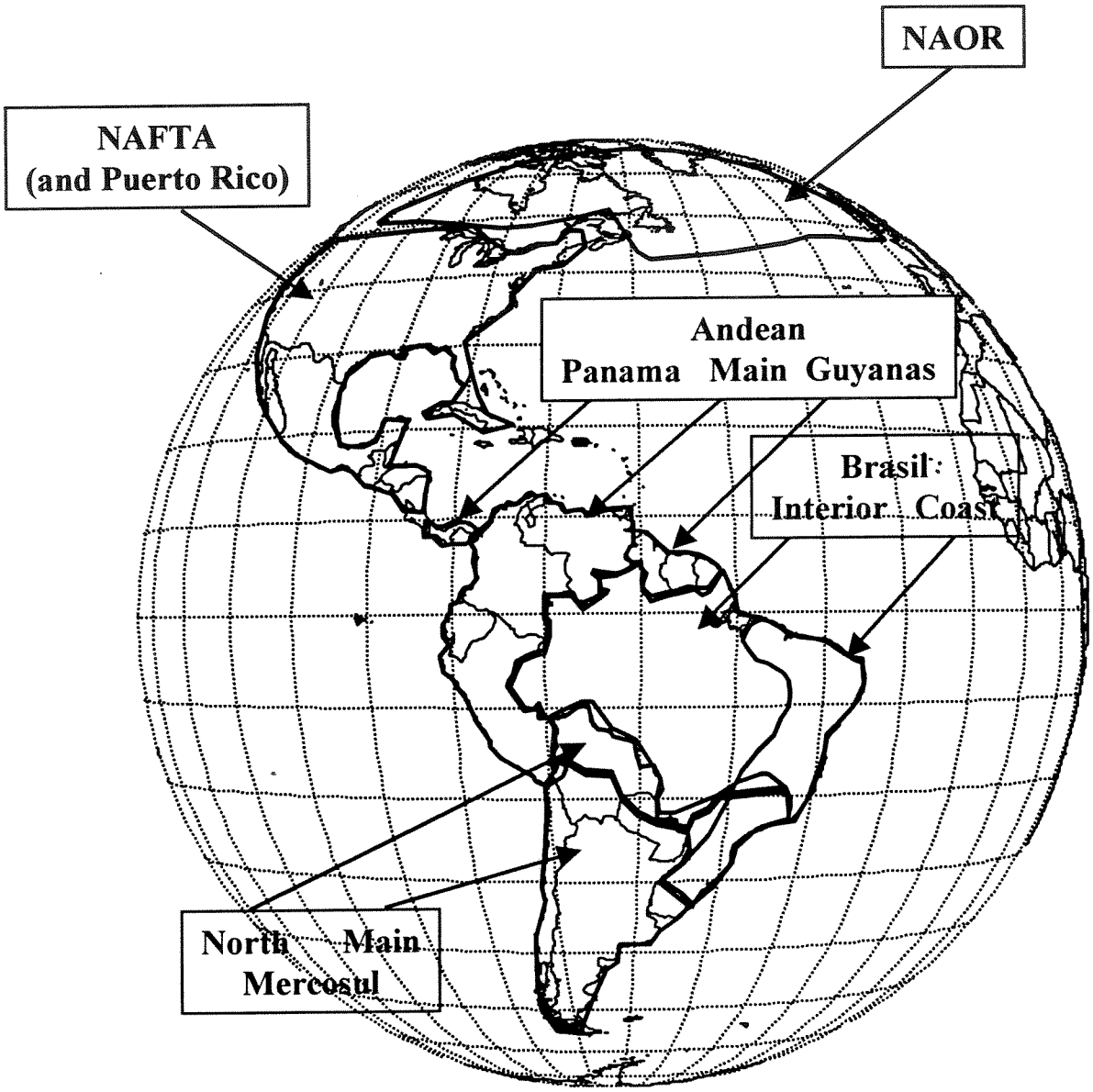


Figure 1-1. Coverage Areas for Estrela do Sul Satellite

Table 1-2. **Transponder Arrangement for Ku-band Beams**

Beam Name	BW and # of Dedicated Transponders	BW and # of Switchable Transponders
Brasil	16 @ 36 MHz 2 @ 28 MHz	0-3 @ 36 MHz
Mercosul	2 @ 76 MHz 1 @ 60 MHz	0-3 @ 76 MHz
		0-3 @ 36 MHz
NAFTA	1 @ 36 MHz 2 @ 28 MHz	0-3 @ 36 MHz
	5 @ 76 MHz	0-2 @ 76 MHz
Andean	-	0-3 @ 76 MHz
NAOR	-	0-3 @ 36 MHz 0-3 @ 36 MHz 0-3 @ 36 MHz
Totals	29 Dedicated	12 Switchable

For the Ku-band NAFTA beam, there will be a minimum of two 28-MHz and one 36-MHz transponders and four 76-MHz and one 60-MHz transponders. With TWTA switching, the quantity of 36-MHz and 76-MHz can be increased to four and six, respectively. For the Mercosul beam, there will be a minimum of two 76-MHz and one 60-MHz transponder and a maximum of five 76-MHz transponders and up to three 36-MHz transponders. For the Andean beam, there will be up to three 76-MHz transponders, and for the NAOR beam there will be up to nine 36-MHz transponders. The majority of switchable TWTAs come from the TWTA bank, which serves the NAOR beam.

The satellite will be designed for a 15-year orbital maneuver life and will use linearized Traveling Wave Tube Amplifiers (TWTAs) exclusively.

Loral Skynet do Brasil will lease or develop the necessary Telemetry, Tracking, and Control (TT&C) facilities to operate the satellite from a site within Brasil.

Beam	TWTA Saturation RF Power	TWTA OBO	TWTA Operating RF Power	# of TWTAs	Sub-Total of TWTA RF Pwr for Each Beam
Brasil	130 W	0 dB	130 W	18	2340 W
Mercosul/ Andean	100 W	3 dB	50 W[1]	6	300 W
NAFTA	100 W	0 dB	100 W	3	300 W
	100 W	3 dB	50 W[1]	5	250 W
NAOR	100 W	0 dB	100 W	9	900 W
Total Spacecraft TWTA Power					4090 W
Spacecraft Potency for Brasil = 2340/4090 = 57.2%					

Note 1: The TWTAs which provide RF power of 50 W will carry multi-carrier traffic and will be operated at 3 dB OBO. The potency for Brasil with these TWTAs operated at saturation is 50.4%.

Table 1-3. **Calculation of Spacecraft Potency for Brasil**

1.2. GENERAL SERVICES DESCRIPTION

The service objectives are to provide:

- Digital Services supporting a variety of information rates ranging between 64 kbps to 45 Mbps. The transponders can be used to relay a single wideband carrier or hundreds of narrowband carriers. The anticipated use of the transponders on the satellite will be to support communications applications which use primarily Phase Shift Keying (e.g. 8PSK, QPSK) modulation. The transponders are also compatible with more advanced modulation techniques such as 16QAM. The satellite users will employ Forward Error Correction Coding (FEC) where appropriate.
- Analog Video Services using Frequency Modulation (FM) in the full-transponder mode as well as in the half transponder mode.

Whether digital or analog, Skynet do Brasil will be able to offer customers point-to-point and point-to-multipoint services.

Detailed characteristics for some typical services are given in Section 4.

2. PAYLOAD DESCRIPTION

Table 2-1 summarizes the key characteristics of the Estrela do Sul satellite.

The satellite design conforms to the International Radio Regulations technical standards. To maximizec the use of Brazil's scarce orbital resources, Estrela do Sul is designed to operate at 2° orbital separation from other co-coverage satellites. The following subsections provide more detailed information on the satellite design.

Table 2-1. **Summary of Spacecraft Characteristics**

General	
Mission Life	15 Years
Stabilization	Three-Axis
Stationkeeping	± 0.05° N-S, E-W
Eclipse Capability	100%
Antenna Pointing Accuracy	Within 0.15°, half cone
Launch Vehicle	Compatible with Sea Launch, Ariane 4 and 5, Proton, Delta-IV, and Atlas V
Communications	
Frequency Band	Standard Ku, Extended Ku
Antenna Coverage	Brasil, the remaining parts of South America, Central America, most of North America, and the North Atlantic Ocean
Polarization	Orthogonal Linear
Number of Transponders	41 Ku-Band
Usable Bandwidth	1824 MHz at Ku-Band
Transmitter RF Power	Ku-Band: 130, 100 Watts
Connectivity	Brasil-Brasil, Brasil-NAFTA, NAFTA-Brasil Mercosul-Mercosul, Mercosul-Andean, Mercosul-NAFTA, NAFTA-Mercosul, Andean-Andean, Andean-Mercosul, Andean-NAFTA, NAFTA-Andean, NAFTA-NAFTA, NAFTA-NAOR, NAOR-NAFTA
Redundancy: Receivers Channel Amplifiers and TWTAs	 13 for 9 130-W TWTAs: 24 for 18 100-W TWTAs: 32 for 23
Tracking, Telemetry, and Command (TT&C)	
Frequency	Ku-Band
Earth Station Location	Brasil

2.1. COMMUNICATIONS SUBSYSTEM

2.1.1. Capacity

The payload provides 26 transponders with bandwidth of 36 MHz, 4 transponders with bandwidth of 28 MHz, 10 transponders with bandwidth of 76 MHz, of which 72 MHz is usable, and 1 transponder with bandwidth of 60 MHz, of which 56 MHz is usable. In total, the payload provides 41 transponders with 1824 MHz of usable bandwidth. The spacecraft power subsystem will be sized to provide simultaneous operation for all of the 28 and 36-MHz transponders at saturation and all of the 60 and 76-MHz transponders at 3 dB OBO for a minimum of 15 years with 100% eclipse operation.

2.1.2. Transponder Frequency and Polarization Plan

Loral Skynet do Brasil has designed the frequency plan for the Estrela do Sul satellite to provide significant value to Brasilian and other customers in the western hemisphere. Specifically, the frequency plan provides:

1. The largest amount of dedicated FSS Ku-band capacity for Brasil of any existing satellite.
2. Large capacity of inter-connectivity between South America and North America.
3. The ability to flexibly assign additional capacity to the Brasilian customers, depending on market needs.

The Estrela do Sul satellite design enables Loral Skynet do Brasil to be a prominent domestic FSS supplier and instantly catapults Loral Skynet do Brasil into the international FSS arena.

Orthogonal linear polarization, frequency selection, and spatial isolation are used to obtain substantial frequency re-use with minimal interference among the beams. Figures 2-1 and 2-2 summarize the downlink and uplink frequency plans, respectively, for all of the beams on the Estrela do Sul satellite, while Tables 2-2 through 2-11 provide more details, such as start, stop, and center frequencies for the transponders.

The transponders in the Brasil beam operate in both horizontal and vertical polarization. Sixteen 36-MHz bandwidth and two 28-MHz bandwidth transponders are dedicated to the Brasil beam and are operated with uplink frequencies between 14.00-14.50 GHz and downlink frequencies between 11.70-12.20 GHz. Twelve of these eighteen transponders use uplink vertical polarization and downlink horizontal polarization, and the remaining six transponders use uplink horizontal polarization and downlink vertical polarization. Three additional 36-MHz transponders can be switched into the Brasil beam to support customer applications if the market requires additional capacity. These transponders, which are operated in the extended Ku-band, use uplink vertical polarization and downlink horizontal polarization. Cross-polarization isolation within the coverage area will be a minimum of 30 dB.

The major population centers of Brasil can access the Estrela do Sul satellite through not only the Brasil beam but also the Mercosul beam. The transponders in the Mercosul beam, like those in the Brasil beam, operate in both horizontal and vertical polarization. Two 76 MHz transponders and one 60 MHz transponders are dedicated to the Mercosul beam, and one of these transponders is operated in the standard Ku-band while the remaining two are operated in the extended Ku-band. As a result of the TWTA switch network, the satellite can provide up to three additional 76-MHz and three additional 36-MHz transponders for the Mercosul beam.

The Andean beam is designed to provide coverage for the parts of South America not covered by the Brasil and Mercosul beams. The three 76-MHz transponders in the Andean beam are switchable from other beams on the satellite and operate with uplink horizontal polarization and downlink vertical polarization.

Because of the proximity of the Andean, Mercosul, and Brasil coverage regions, polarization isolation, frequency selection, and transponder switching are used to obtain minimal interference among these South American beams.

The spatial isolation between the Brasil and the NAFTA coverage areas is exploited to obtain frequency and polarization re-use for parts of the standard and extended Ku-band. The Estrela do Sul satellite provides one dedicated 36 MHz, two dedicated 28 MHz, four dedicated 76 MHz, and one dedicated 60 MHz bandwidth transponders for the NAFTA beam. The satellite can be configured to obtain up to three additional 36-MHz and two additional 76-MHz transponders in the NAFTA beam. For the uplinks, the NAFTA receive beam provides twenty 36 MHz and four 28 MHz channels in the standard Ku-band (12 V-pol and 12 H-pol) and twelve 36-MHz channels in the extended Ku-band (6 V-pol and 6 H-pol).

All of the transponders for the NAOR beam are switchable into other beams. The downlink NAOR beam provides up to nine 36-MHz transponders whose uplinks are expected to originate in the US. The downlink NAOR beam uses both horizontal and vertical polarization and operates exclusively in the 11.45-11.70 GHz band. The uplink NAOR beam contains up to twelve 36-MHz transponders, which use horizontal and vertical polarization and operate exclusively in the 14.00-14.50 GHz band.

It is important to note that the bandwidth for channel 6' is 34 MHz, the bandwidth for channels 5' through 10 is 36 MHz, and the bandwidth for channels 11 and 12 is 28 MHz. There are no 76 MHz or 60 MHz uplink channels. Inside the spacecraft repeater, there are some cases where two uplink channels are combined to form a downlink channel with bandwith of 76 MHz (there is one case where the resulting downlink channel bandwidth is 74 MHz and one case where the downlink channel bandwidth is 60 MHz). The design details for connectivity between 36-MHz uplink channels and 76-MHz downlink channels are provided in a following section.

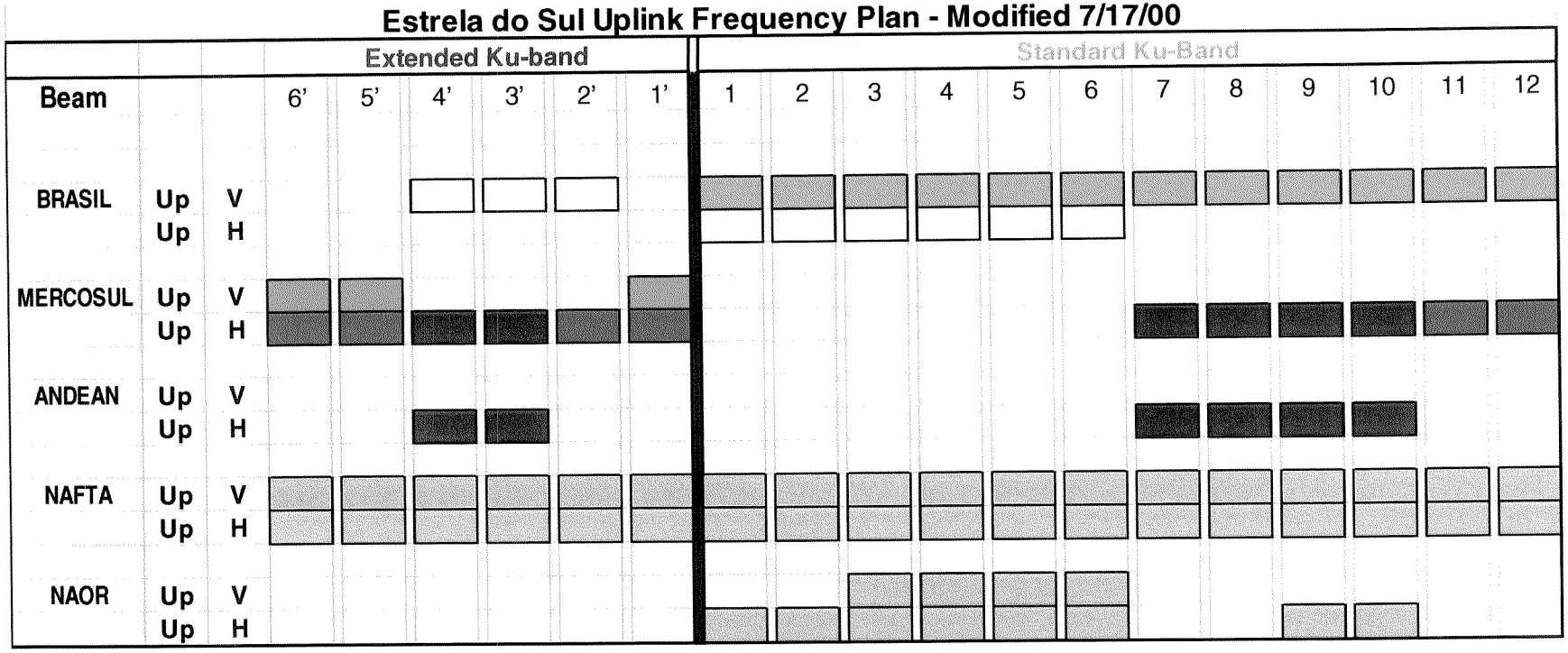


Figure 2-1. Uplink Frequency Plan

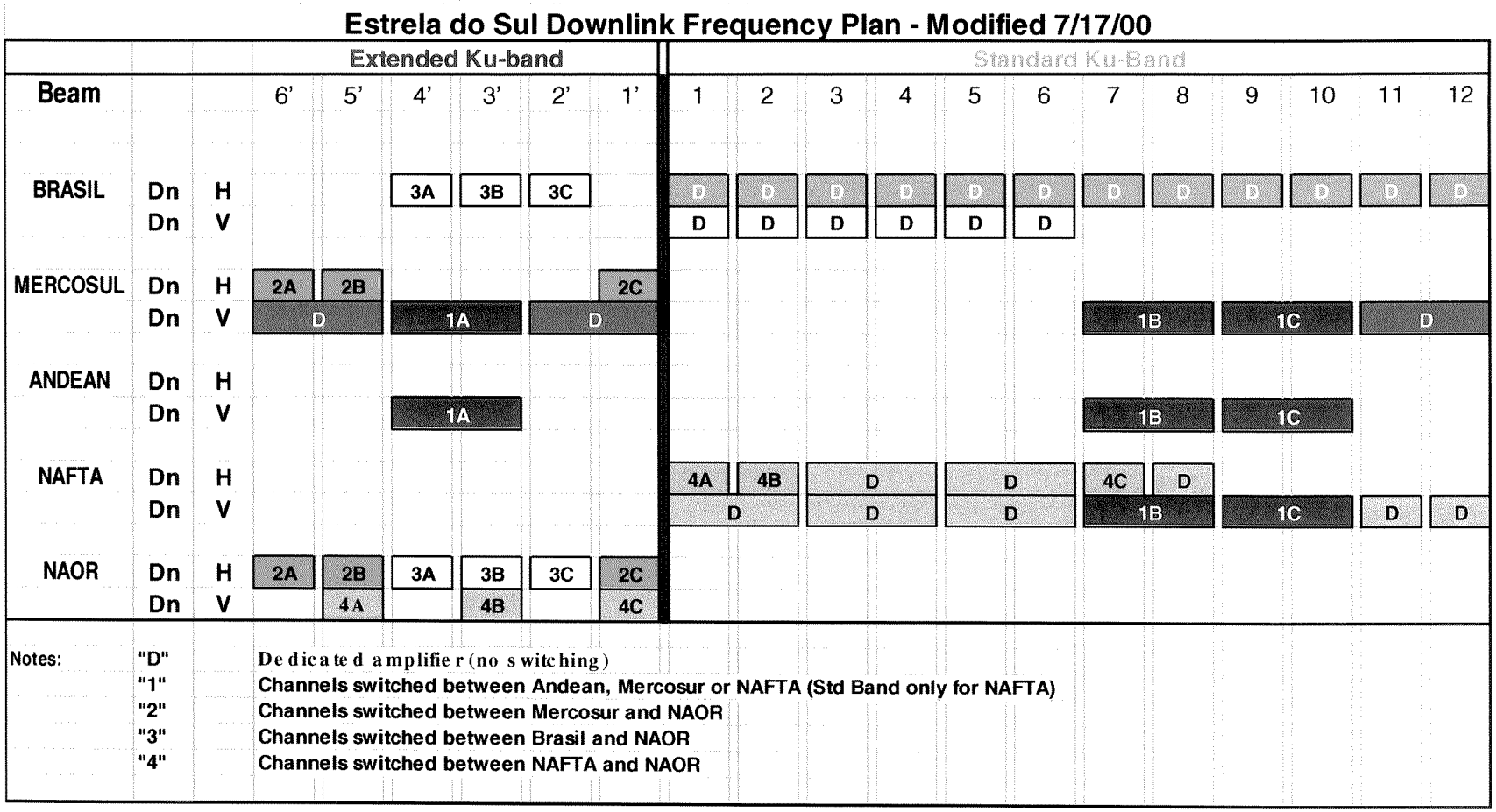


Figure 2-2. Downlink Frequency Plan

Table 2-2. Uplink Channel Plan for the Brasil Beam

	Brasil Beam Uplink Channels											
	Horizontal Polarization						Vertical Polarization					
	Chan	Uplink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz	Chan	Uplink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz
Ext. Band	Edge				13750		Edge				13750	2
							4'	13852	36	13834	13870	4
							3'	13892	36	13874	13910	8
							2'	13936	36	13918	13954	4
	Edge			14000			Edge			14000		
Std. Band	Edge				14000	2	Edge				14000	2
	1	14020	36	14002	14038	4	1	14020	36	14002	14038	4
	2	14060	36	14042	14078	8	2	14060	36	14042	14078	8
	3	14104	36	14086	14122	4	3	14104	36	14086	14122	4
	4	14144	36	14126	14162	8	4	14144	36	14126	14162	8
	5	14188	36	14170	14206	4	5	14188	36	14170	14206	4
	6	14228	36	14210	14246	8	6	14228	36	14210	14246	8
							7	14272	36	14254	14290	4
							8	14312	36	14294	14330	8
							9	14356	36	14338	14374	4
							10	14396	36	14378	14414	8
							11	14436	28	14422	14450	4
							12	14468	28	14454	14482	14.5
							CMD_1	14497	1	14496.5	14497.5	2.5
	CMD_2	14499	1	14498.5	14499.5	0.5						
	Edge			14500			Edge			14500		

Table 2-3. Downlink Channel Plan for the Brasil Beam

	Brasil Beam Downlink Channels											
	Vertical Polarization						Horizontal Polarization					
	Chan	Downlink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz	Chan	Downlink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz
Ext. Band	Edge				11450		Edge				11450	
							4'	11552	36	11534	11570	4
							3'	11592	36	11574	11610	8
							2'	11636	36	11618	11654	4
	Edge			11700			Edge			11700		
Std. Band	Edge				11700	2	Edge				11700	2
	1	11720	36	11702	11738	4	1	11720	36	11702	11738	4
	2	11760	36	11742	11778	8	2	11760	36	11742	11778	8
	3	11804	36	11786	11822	4	3	11804	36	11786	11822	4
	4	11844	36	11826	11862	8	4	11844	36	11826	11862	8
	5	11888	36	11870	11906	4	5	11888	36	11870	11906	4
	6	11928	36	11910	11946	8	6	11928	36	11910	11946	8
							7	11972	36	11954	11990	4
							8	12012	36	11994	12030	8
							9	12056	36	12038	12074	4
							10	12096	36	12078	12114	8
							11	12136	28	12122	12150	4
							12	12168	28	12154	12182	16.9
	TLM_1	12197.5	0.2	12197.4	12197.6	2.4						
							TLM_2	12199	0.2	12198.9	12199.1	0.9
	Edge			12200			Edge			12200		

Table 2-4. Uplink Channel Plan for the Mercosul Beam

	Mercosur Uplink Channels											
	Horizontal Polarization						Vertical Polarization					
	Chan	Uplink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz	Chan	Uplink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz
Ext. Band	Edge				13750	2	Edge				13750	2
	6'	13769	34	13752	13786	4	6'	13769	34	13752	13786	4
	5'	13808	36	13790	13826	8	5'	13808	36	13790	13826	8
	4'	13852	36	13834	13870	4						
	3'	13892	36	13874	13910	8						
	2'	13936	36	13918	13954	4						
	1'	13976	36	13958	13994	6	1'	13976	36	13958	13994	6
	Edge			14000			Edge			14000		
Std. Band	Edge				14000	2	Edge				14000	
	7	14272	36	14254	14290	4						
	8	14312	36	14294	14330	8						
	9	14356	36	14338	14374	4						
	10	14396	36	14378	14414	8						
	11	14436	28	14422	14450	4						
	12	14468	28	14454	14482	16.5						
							CMD_1*	14497	1	14496.5	14497.5	2.5
	CMD_2*	14499	1	14498.5	14499.5	0.5						
	Edge			14500			Edge			14500		

* Note: Command frequencies are shown for illustrative purposes. Commanding will not be performed in the Mercosul beam; commanding is performed from the Brasil and NAFTA coverage areas only.

Table 2-5. Downlink Channel Plan for the Mercosul Beam

	Mercosur Downlink Channels											
	Vertical Polarization						Horizontal Polarization					
	Chan	Downlink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz	Chan	Downlink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz
Ext. Band	Edge				11450	2	Edge				11450	2
	6'-5'	11489	74	11452	11526	8	6'	11469	34	11452	11486	4
							5'	11508	36	11490	11526	8
	4'-3'	11572	76	11534	11610	8						
	2'-1'	11656	76	11618	11694	4.8	1'	11676	36	11658	11694	6
	Edge			11700			Edge			11700		
Std. Band	Edge				11700	2	Edge				11700	
	7-8	11992	76	11954	12030	8						
	9-10	12076	76	12038	12114	8						
	11-12	12152	60	12122	12182	15.4						
	TLM_1*	12197.5	0.2	12197.4	12197.6	2.4						
							TLM_2*	12199	0.2	12198.9	12199.1	0.9
	Edge			12200			Edge			12200		

* Note: Spacecraft telemetry beacons shall be used by earth stations for antenna pointing, tracking, and uplink power control.

Table 2-6. Uplink Channel Plan for the Andean Beam

	Andean Uplink Channels											
	Horizontal Polarization						Vertical Polarization					
	Chan	Uplink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz	Chan	Uplink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz
Ext. Band	Edge				13750	2	Edge				13750	
	4'	13852	36	13834	13870	4						
	3'	13892	36	13874	13910	8						
	Edge			14000			Edge			14000		
Std. Band	Edge				14000	2	Edge				14000	
							CMD	N/A				
	7	14272	36	14254	14290	4						
	8	14312	36	14294	14330	8						
	9	14356	36	14338	14374	4						
	10	14396	36	14378	14414	8						
							CMD_1*	14497	1	14496.5	14497.5	2.5
	CMD_2*	14499	1	14498.5	14499.5	0.5						
	Edge			14500			Edge			14500		

* Note: Command frequencies are shown for illustrative purposes. Commanding will not be performed in the Andean beam; commanding is performed from the Brasil and NAFTA coverage areas only.

Table 2-7. Downlink Channel Plan for the Andean Beam

	Downlink Channels											
	Vertical Polarization						Horizontal Polarization					
	Chan	Downlink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz	Chan	Downlink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz
Ext. Band	Edge				11450	2	Edge				11450	
	4'-3'	11572	76	11534	11610	8						
	Edge			11700			Edge			11700		
Std. Band	Edge				11700	2	Edge				11700	
	7-8	11992	76	11954	12030	8						
	9-10	12076	76	12038	12114	8						
	TLM_1*	12197.5	0.2	12197.4	12197.6	2.4						
							TLM_2*	12199	0.2	12198.9	12199.1	0.9
	Edge			12200			Edge			12200		

* Note: Spacecraft telemetry beacons shall be used by earth stations for antenna pointing, tracking, and uplink power control.

Table 2-8. Uplink Channel Plan for the NAFTA Beam

	NAFTA Uplink Channels											
	Horizontal Polarization						Vertical Polarization					
	Chan	Uplink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz	Chan	Uplink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz
Ext. Band	Edge				13750	2	Edge				13750	2
	6'	13769	34	13752	13786	4	6'	13769	34	13752	13786	4
	5'	13808	36	13790	13826	8	5'	13808	36	13790	13826	8
	4'	13852	36	13834	13870	4	4'	13852	36	13834	13870	4
	3'	13892	36	13874	13910	8	3'	13892	36	13874	13910	8
	2'	13936	36	13918	13954	4	2'	13936	36	13918	13954	4
	1'	13976	36	13958	13994	6	1'	13976	36	13958	13994	6
	Edge			14000			Edge			14000		
Std. Band	Edge				14000	2	Edge				14000	2
							CMD	N/A				
	1	14020	36	14002	14038	4	1	14020	36	14002	14038	4
	2	14060	36	14042	14078	8	2	14060	36	14042	14078	8
	3	14104	36	14086	14122	4	3	14104	36	14086	14122	4
	4	14144	36	14126	14162	8	4	14144	36	14126	14162	8
	5	14188	36	14170	14206	4	5	14188	36	14170	14206	4
	6	14228	36	14210	14246	8	6	14228	36	14210	14246	8
	7	14272	36	14254	14290	4	7	14272	36	14254	14290	4
	8	14312	36	14294	14330	8	8	14312	36	14294	14330	8
	9	14356	36	14338	14374	4	9	14356	36	14338	14374	4
	10	14396	36	14378	14414	8	10	14396	36	14378	14414	8
	11	14436	28	14422	14450	4	11	14436	28	14422	14450	4
	12	14468	28	14454	14482	16.5	12	14468	28	14454	14482	14.5
							CMD_1	14497	1	14496.5	14497.5	2.5
	CMD_2	14499	1	14498.5	14499.5	0.5						
	Edge			14500			Edge			14500		

Table 2-9. Downlink Channel Plan for the NAFTA Beam

	NAFTA Downlink Channels											
	Vertical Polarization						Horizontal Polarization					
	Chan	Downlink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz	Chan	Downlink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz
Ext. Band	Edge				11450		Edge				11450	
	Edge			11700			Edge			11700		
Std. Band	Edge				11700	2	Edge				11700	
	1-2	11740	76	11702	11778	8	1	11720	36	11702	11738	4
							2	11760	36	11742	11778	8
	3-4	11824	76	11786	11862	8	3-4	11824	76	11786	11862	8
	5-6	11908	76	11870	11946	8	5-6	11908	76	11870	11946	8
	7-8	11992	76	11954	12030	8	7	11972	36	11954	11990	4
							8	12012	36	11994	12030	8
	9-10	12076	76	12038	12114	8						
	11	12136	28	12122	12150	4						
	12	12168	28	12154	12182	15.4						
	TLM_1	12197.5	0.2	12197.4	12197.6	2.4						
							TLM_2	12199	0.2	12198.9	12199.1	0.9
	Edge			12200			Edge			12200		

Table 2-10. Uplink Channel Plan for the NAOR Beam

	NAOR Beam Uplink Channels											
	Horizontal Polarization						Vertical Polarization					
	Chan	Uplink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz	Chan	Uplink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz
Ext. Band	Edge				13750		Edge				13750	
	Edge			14000			Edge			14000		
Std. Band	Edge				14000	2	Edge				14000	
	1	14020	36	14002	14038	4						
	2	14060	36	14042	14078	8						
	3	14104	36	14086	14122	4	3	14104	36	14086	14122	4
	4	14144	36	14126	14162	8	4	14144	36	14126	14162	8
	5	14188	36	14170	14206	4	5	14188	36	14170	14206	4
	6	14228	36	14210	14246	8	6	14228	36	14210	14246	8
	9	14356	36	14338	14374	4						
	10	14396	36	14378	14414	8						
							CMD_1*	14497	1	14496.5	14497.5	2.5
	CMD_2*	14499	1	14498.5	14499.5	0.5						
	Edge			14500			Edge			14500		

* Note: Command frequencies are shown for illustrative purposes. Commanding will not be performed in the NAOR beam; commanding is performed from the Brasil and NAFTA coverage areas only.

Table 2-11. Downlink Channel Plan for the NAOR Beam

	NAOR Beam Downlink Channels											
	Vertical Polarization						Horizontal Polarization					
	Chan	Downlink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz	Chan	Downlink Center Freq, MHz	BW, MHz	Chann Low Edge, MHz	Chann High Edge, MHz	Guard Band, MHz
Ext. Band	Edge				11450	2	Edge				11450	2
							6'	11469	34	11452	11486	4
	5'	11508	36	11490	11526	8	5'	11508	36	11490	11526	8
	BCN	11533	0.01									
							4'	11552	36	11534	11570	4
	3'	11592	36	11574	11610	8	3'	11592	36	11574	11610	8
							2'	11636	36	11618	11654	4
	1'	11676	36	11658	11694	6	1'	11676	36	11658	11694	6
	Edge			11700			Edge			11700		
Std. Band	Edge				11700		Edge				11700	
	TLM_1*	12197.5	0.2	12197.4	12197.6	2.4						
							TLM_2*	12199	0.2	12198.9	12199.1	0.9
	Edge			12200			Edge			12200		

* Note: Telemetry frequencies are shown for illustrative purposes only.

2.1.3. Types of Emissions

The transponders of the Estrela do Sul spacecraft payload are expected to handle a wide variety of digital traffic from narrowband data to wideband video. Some FM TV traffic is also expected to be loaded in the transponders. Table 2-12 below provides some of the important characteristics of these signals.

Table 2-12. **Emission Designators for Communications Traffic for the Estrela do Sul Spacecraft**

Signal	Emission Designators	Allocated Bandwidth
Wideband Digital	27M0G7W, 32M0G7W	32MHz, 36 MHz
Medium-band Digital	5M00G7W, 3M00G7W, 1M98G7W	6 MHz, 3.6 MHz, 2.4 MHz
Narrowband Digital Data	128KG7W, 44K1G1D	155 kHz, 55 kHz
FM-TV	32M0F9W, 27M0F9W	36 MHz, 32 MHz
Command	1M00F9D	1 MHz
Telemetry / Ranging	144KG9D, 200KG9D, 200KG8X	175 kHz, 240 kHz
Tracking	25K0NON, 144KG9D, 200KG9D	40 kHz, 175 kHz, 240 kHz

2.1.4. Subsytem Configuration

Figure 2-3 contains a high-level block diagram for the Ku-band communications subsystem, and Figure 2-4 depicts the spacecraft antenna configuration as viewed from the earth.

The spacecraft has four deployable antennas, two off the west side and two off the east side, which are capable of simultaneous transmission and reception. Two of these antennas use a Gregorian design with an elliptical shaped-reflector to provide coverage of the Brasil and NAFTA regions. Two of these antennas use a single offset feed and a circular shaped-reflector to provide coverage of Mercosul and the Andean regions. The feeds for all of the antennas are dual-polarization (H-Pol and V-Pol), derived from ortho-mode junctions, and operate over both the transmit and receive bands. The dimensions for the elliptical Brasil and NAFTA beam antenna reflectors are 2.2 x 2.8 m; the diameter for the circular Mercosul and Andean beam antenna reflectors is 1.8 m.

There are up to nine active low-noise receivers, arranged in a single redundancy ring of 13-for-9, which amplify and down-convert each set of signals to the 11.45-12.20 GHz range. The net translation frequency is 2.300 GHz.

After down conversion the signals are applied through a channel-dropping network to filters (input multiplexers or IMUXes) that demultiplex them into individual channels.

For most of the channels there are 2x1, 2x2, 3x2, and 4x1 switch matrices which permit a wide range of possible inter-connectivity between the uplink beams and the downlink beams on a channel-by-channel basis. For six of the Brasil beam channels, the uplink channels are connected directly to the downlink channels with no switching. A summary of how the individual transponders can be configured is provided in Table 2-13, and the details of the potential connectivity arrangements for each beam are provided in Tables 2-14 through 2-23.

With its comprehensive switching capability for individual channels, the Estrela do Sul spacecraft will provide Brasilian customers with the capability of connecting to nearly the entire western hemisphere with just a single spacecraft "hop."

For the case of a 76 MHz downlink channel, for instance Mercosul channel 2'-1', the switch matrix output for 36-MHz Mercosul channel 1' and the switch matrix output for 36-MHz Mercosul channel 2' are combined with a 3-dB hybrid to obtain channel 2'-1'. The guard-band between the channels and 1' and 2' is 4 MHz, so the bandwidth for wideband downlink channel 2'-1' is 76 MHz.

The outputs of the switch matrices, the outputs of the channel combining hybrids, and the outputs of the IMUX filters, which are not connected to switch matrices, are then routed to the Linearized Channel Amplifiers (LCAMPs) and TWTAs. The LCAMPs use pre-distortion linearizers to provide corrections for the TWTA non-linearities and contain commandable attenuators that control channel gain and saturation flux density.

Many of the TWTAs are dedicated to a particular downlink beam and some of the TWTAs are switchable among two or three downlink beams. The 130-W TWTAs for the Brasil downlink beam are dedicated solely to the Brasil beam and are arranged in two redundancy rings – one ring of 16-for-12 and one ring of 8-for-6.

For the 100-W TWTAs, eight are dedicated to the NAFTA beam, three are dedicated to the Mercosul beam, and the remaining TWTAs are switchable among the Andean, Mercosul, NAFTA, NAOR and Brasil beams. All of the TWTAs, which energize the NAOR beam, can be switched into the remaining beams on the spacecraft. The switching arrangements for the TWTAs are provided in Tables 2-24 through 2-28. The 100-W TWTAs are arranged in two redundancy rings – one ring of 16-for-12 and one ring of 16-for-11

The TWTA outputs are connected through R-switches to complete the redundancy rings and are subsequently routed to output multiplexers (OMUXes) for each of the downlink beams. The OMUXes combine the appropriate channels for each spacecraft transmit antenna. After filtering in the OMUXes, the signals are routed through test couplers to the transmit antennas.

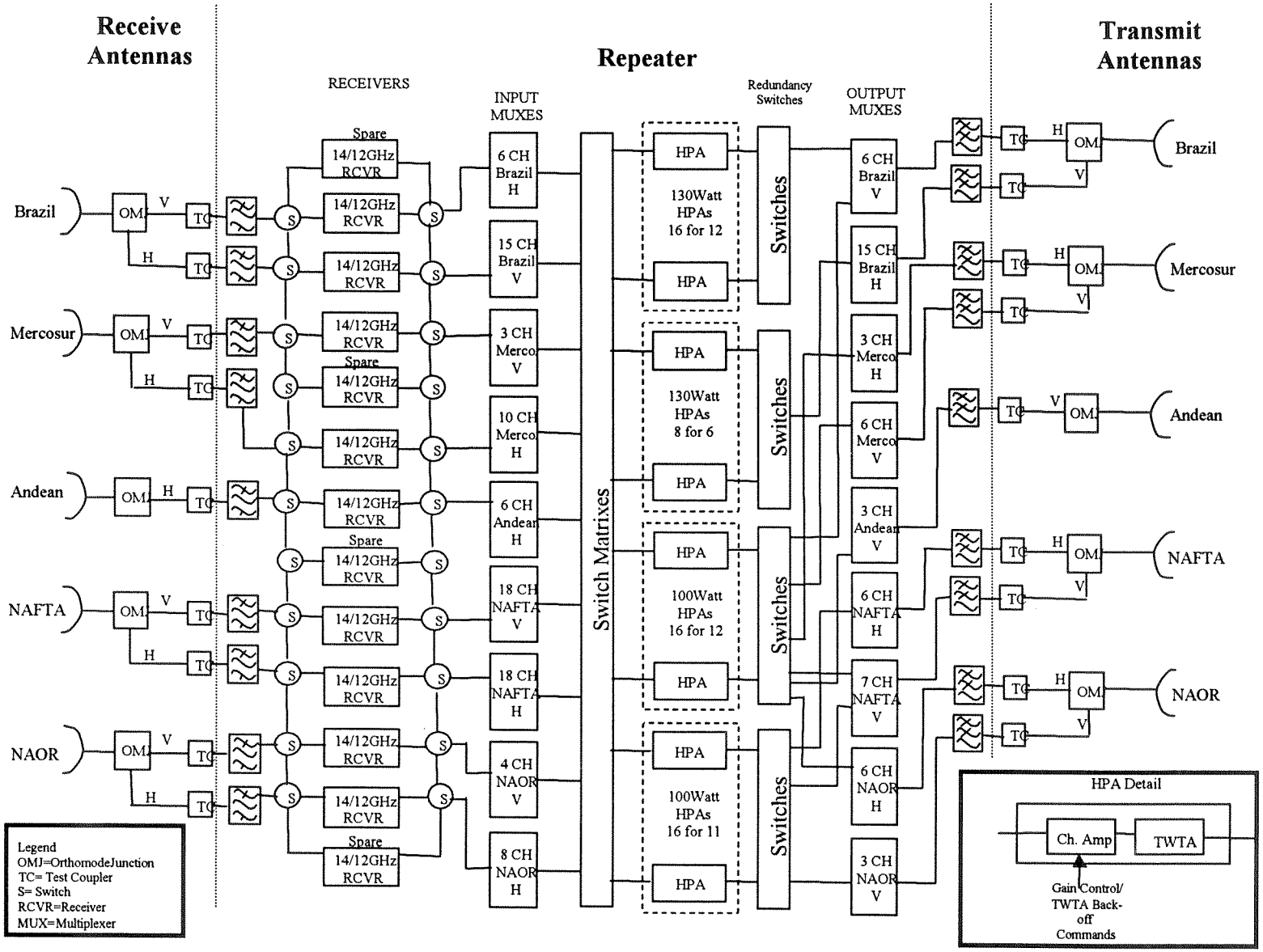


Figure 2-3. Block Diagram for Payload System

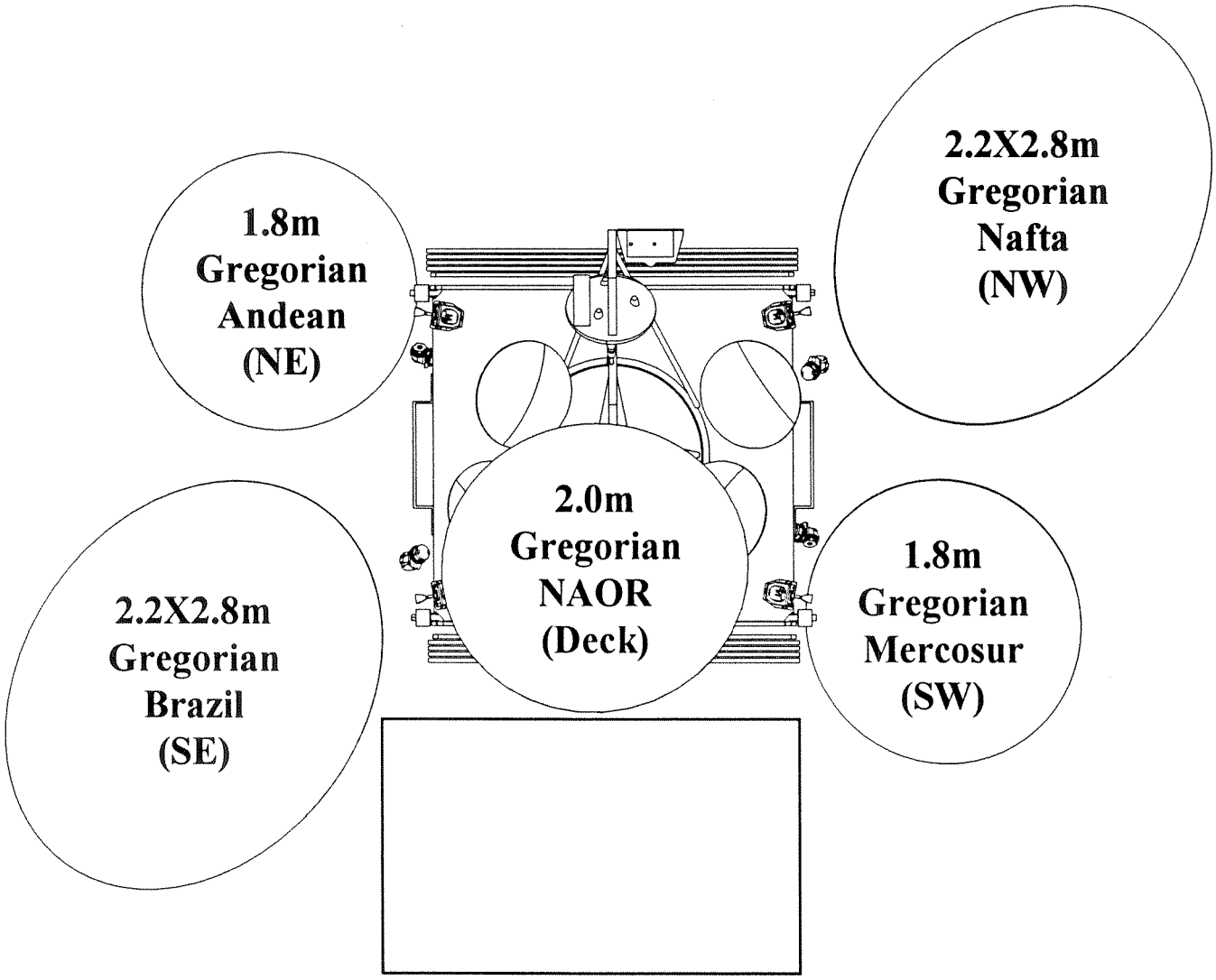


Figure 2-4. Depiction of Communications Antenna Layout

Table 2-13. **Configuration Summary for the Individual Transponders**

Xpndr #	BW	Power	Chan & D/L Pol	Uplink Beams					Downlink Beams				
				BR	MS	AN	NF	AO	BR	MS	AN	NF	AO
1	36 MHz	130 W	1H	S	-	-	S	-	F	-	-	-	-
2	36 MHz	130 W	2H	S	-	-	S	-	F	-	-	-	-
3	36 MHz	130 W	3H	F	-	-	-	-	F	-	-	-	-
4	36 MHz	130 W	4H	F	-	-	-	-	F	-	-	-	-
5	36 MHz	130 W	5H	S	-	-	S	S	F	-	-	-	-
6	36 MHz	130 W	6H	S	-	-	S	S	F	-	-	-	-
7	36 MHz	130 W	7H	S	-	-	S	-	F	-	-	-	-
8	36 MHz	130 W	8H	S	-	-	S	-	F	-	-	-	-
9	36 MHz	130 W	9H	S	-	-	S	-	F	-	-	-	-
10	36 MHz	130 W	10H	S	-	-	S	-	F	-	-	-	-
11	28 MHz	130 W	11H	S	-	-	S	-	F	-	-	-	-
12	28 MHz	130 W	12H	S	-	-	S	-	F	-	-	-	-
13	36 MHz	130 W	1V	F	-	-	-	-	F	-	-	-	-
14	36 MHz	130 W	2V	F	-	-	-	-	F	-	-	-	-
15	36 MHz	130 W	3V	F	-	-	-	-	F	-	-	-	-
16	36 MHz	130 W	4V	F	-	-	-	-	F	-	-	-	-
17	36 MHz	130 W	5V	S	-	-	S	S	F	-	-	-	-
18	36 MHz	130 W	6V	S	-	-	S	S	F	-	-	-	-
19	36 MHz	100 W	2'H	S	-	-	S	-	S	-	-	-	S
20	36 MHz	100 W	3'H	S	-	-	S	-	S	-	-	-	S
21	36 MHz	100 W	4'H	S	-	-	S	-	S	-	-	-	S
22	36 MHz	100 W	1'H	-	S	-	S	-	-	S	-	-	S
23	36 MHz	100 W	5'H	-	S	-	S	-	-	S	-	-	S
24	36 MHz	100 W	6'H	-	S	-	S	-	-	S	-	-	S
25A	36 MHz	100 W	5'V	-	S	-	S	-	-	-	-	-	S
25B	36 MHz	100 W	1H	S	-	-	S	-	-	-	-	S	-
26A	36 MHz	100 W	3'V	-	S	S	S	-	-	-	-	-	S
26B	36 MHz	100 W	2H	S	-	-	S	-	-	-	-	S	-
27A	36 MHz	100 W	1'V	-	S	-	S	-	-	-	-	-	S
27B	36 MHz	100 W	7H	S	-	-	S	-	-	-	-	S	-
28	36 MHz	100 W	8H	S	-	-	S	-	-	-	-	F	-
29	28 MHz	100 W	11V	-	S	-	S	-	-	-	-	F	-
30	28 MHz	100 W	12V	-	S	-	S	-	-	-	-	F	-
31	76 MHz	100 W	3-4H	-	-	-	S	S	-	-	-	F	-
32	76 MHz	100 W	5-6H	S	-	-	S	S	-	-	-	F	-
33	76 MHz	100 W	1-2V	-	-	-	S	S	-	-	-	F	-
34	76 MHz	100 W	3-4V	-	-	-	S	S	-	-	-	F	-
35	76 MHz	100 W	5-6V	S	-	-	S	S	-	-	-	F	-
36	76 MHz	100 W	7-8V	-	S	S	S	-	-	S	S	S	-
37	76 MHz	100 W	9-10V	-	S	S	S	S	-	S	S	S	-
38	60 MHz	100 W	11-12V	-	S	-	S	-	-	F	-	-	-
39	76 MHz	100 W	1'-2'V	-	S	-	S	-	-	F	-	-	-
40	76 MHz	100 W	3'-4'V	-	S	S	S	-	-	S	S	-	-
41	76 MHz	100 W	5'-6'V	-	S	-	S	-	-	F	-	-	-

Table 2-14. **Downlink Connectivity Options for Brasil Uplink Channels**

Uplink Brasil V-Pol Beam				Uplink Brasil H-Pol Beam			
Ch	Downlinks	Ch	Downlinks	Ch	Downlinks	Ch	Downlinks
6'	N/A	4	BR H	6'	N/A	4	BR V
5'	N/A	5	BR H, NF H	5'	N/A	5	BR V, NF V
4'	BR H	6	BR H, NF H	4'	N/A	6	BR V, NF H
3'	BR H	7	BR H, NF H	3'	N/A	7	N/A
2'	BR H	8	BR H, NF H	2'	N/A	8	N/A
1'	N/A	9	BR H	1'	N/A	9	N/A
1	BR H, NF H	10	BR H	1	BR V	10	N/A
2	BR H, NF H	11	BR H	2	BR V	11	N/A
3	BR H	12	BR H	3	BR V	12	N/A

Table 2-15. **Uplink Connectivity Options for Brasil Downlink Channels**

Downlink Brasil H-Pol Beam				Downlink Brasil V-Pol Beam			
Ch	Uplinks	Ch	Uplinks	Ch	Uplinks	Ch	Uplinks
6'	N/A	4	BR V	6'	N/A	4	BR H
5'	N/A	5	BR V, NF V, AO V	5'	N/A	5	BR H, NF H, AO H
4'	BR V, NF V	6	BR V, NF V, AO V	4'	N/A	6	BR H, NF H, AO H
3'	BR V, NF V	7	BR V, NF V	3'	N/A	7	N/A
2'	BR V, NF V	8	BR V, NF V	2'	N/A	8	N/A
1'	N/A	9	BR V	1'	N/A	9	N/A
1	BR V, NF V	10	BR V	1	BR H	10	N/A
2	BR V, NF V	11	BR V	2	BR H	11	N/A
3	BR V	12	BR V	3	BR H	12	N/A

Table 2-16. **Downlink Connectivity Options for Mercosul Uplink Channels**

Uplink Mercosur V-Pol Beam				Uplink Mercosur H-Pol Beam			
Ch	Downlinks	Ch	Downlinks	Ch	Downlinks	Ch	Downlinks
6'	MS H	4	N/A	6'	MS V	4	N/A
5'	MS H	5	N/A	5'	MS V, AO V	5	N/A
4'	N/A	6	N/A	4'	MS V, AN V	6	N/A
3'	N/A	7	N/A	3'	MS V, AN V, AO V	7	MS V, AN V, NF V
2'	N/A	8	N/A	2'	MS V	8	MS V, AN V, NF V
1'	MS H	9	N/A	1'	MS V, AO V	9	MS V, AN V, NF V
1	N/A	10	N/A	1	N/A	10	MS V, AN V, NF V
2	N/A	11	N/A	2	N/A	11	MS V
3	N/A	12	N/A	3	N/A	12	MS V

Table 2-17. **Uplink Connectivity Options for Mercosul Downlink Channels**

Downlink Mercosur H-Pol Beam				Downlink Mercosur V-Pol Beam			
Ch	Uplinks	Ch	Uplinks	Ch	Uplinks	Ch	Uplinks
6'	MS V, NF V	4	N/A	6'	MS H, NF H	4	N/A
5'	MS V, NF V	5	N/A	5'	MS H, NF H	5	N/A
4'	N/A	6	N/A	4'	MS H, AN H, NF H	6	N/A
3'	N/A	7	N/A	3'	MS H, AN H, NF H	7	MS H, AN H, NF H
2'	N/A	8	N/A	2'	MS H, NF H	8	MS H, AN H, NF H
1'	MS V, NF V	9	N/A	1'	MS H, NF H	9	MS H, AN H, NF H, AO H
1	N/A	10	N/A	1	N/A	10	MS H, AN H, NF H, AO H
2	N/A	11	N/A	2	N/A	11	MS H, NF H
3	N/A	12	N/A	3	N/A	12	MS H, NF H

Table 2-18. **Downlink Connectivity Options for Andean Uplink Channels**

Uplink Andean V-Pol Beam				Uplink Andean H-Pol Beam			
Ch	Downlinks	Ch	Downlinks	Ch	Downlinks	Ch	Downlinks
6'	N/A	4	N/A	6'	N/A	4	N/A
5'	N/A	5	N/A	5'	N/A	5	N/A
4'	N/A	6	N/A	4'	MS V, AN V	6	N/A
3'	N/A	7	N/A	3'	MS V, AN V	7	MS V, AN V, NF V
2'	N/A	8	N/A	2'	N/A	8	MS V, AN V, NF V
1'	N/A	9	N/A	1'	N/A	9	MS V, AN V, NF V
1	N/A	10	N/A	1	N/A	10	MS V, AN V, NF V
2	N/A	11	N/A	2	N/A	11	N/A
3	N/A	12	N/A	3	N/A	12	N/A

Table 2-19. **Uplink Connectivity Options for Andean Downlink Channels**

Downlink Andean H-Pol Beam				Downlink Andean V-Pol Beam			
Ch	Uplinks	Ch	Uplinks	Ch	Uplinks	Ch	Uplinks
6'	N/A	4	N/A	6'	N/A	4	N/A
5'	N/A	5	N/A	5'	N/A	5	N/A
4'	N/A	6	N/A	4'	MS H, AN H, NF H	6	N/A
3'	N/A	7	N/A	3'	MS H, AN H, NF H	7	MS H, AN H, NF H
2'	N/A	8	N/A	2'	N/A	8	MS H, AN H, NF H
1'	N/A	9	N/A	1'	N/A	9	MS H, AN H, NF H, AO H
1	N/A	10	N/A	1	N/A	10	MS H, AN H, NF H, AO H
2	N/A	11	N/A	2	N/A	11	MS H, NF H
3	N/A	12	N/A	3	N/A	12	MS H, NF H

Table 2-20. **Downlink Connectivity Options NAFTA Uplink Channels**

Uplink NAFTA V-Pol Beam				Uplink NAFTA H-Pol Beam			
Ch	Downlinks	Ch	Downlinks	Ch	Downlinks	Ch	Downlinks
6'	MS H, AO H	4	NF H	6'	MS V	4	NF V
5'	MS H, AO H	5	BR H, NF H	5'	MS V, AO V	5	BR V, NF V
4'	BR H, AO H	6	BR H, NF H	4'	MS V, AN V	6	BR V, NF V
3'	BR H, AO H	7	BR H, NF H	3'	MS V, AN V, AO V	7	MS V, AN V, NF V
2'	BR H, AO H	8	BR H, NF H	2'	MS V	8	MS V, AN V, NF V
1'	MS H, AO H	9	BR H	1'	MS V, AO V	9	MS V, AN V, NF V
1	BR H, NF H	10	BR H	1	BR V, NF V	10	MS V, AN V, NF V
2	BR H, NF H	11	BR H	2	BR V, NF V	11	BR V, NF V
3	NF H	12	BR H	3	NF V	12	BR V, NF V

Table 2-21. **Uplink Connectivity Options for NAFTA Downlink Channels**

Downlink NAFTA H-Pol Beam				Downlink NAFTA V-Pol Beam			
Ch	Uplinks	Ch	Uplinks	Ch	Uplinks	Ch	Uplinks
6'	N/A	4	NF V, AO V	6'	N/A	4	NF V, AO V
5'	N/A	5	BR V, NF V, AO V	5'	N/A	5	BR H, NF H, AO H
4'	N/A	6	BR V, NF V, AO V	4'	N/A	6	BR H, NF H, AO H
3'	N/A	7	N/A	3'	N/A	7	MS H, AN H, NF H
2'	N/A	8	N/A	2'	N/A	8	MS H, AN H, NF H
1'	N/A	9	N/A	1'	N/A	9	MS H, AN H, NF H, AO H
1	BR V, NF V	10	N/A	1	NF H, AO H	10	MS H, AN H, NF H, AO H
2	BR V, NF V	11	N/A	2	NF H, AO H	11	MS H, NF H
3	NF V, AO V	12	N/A	3	NF H, AO H	12	MS H, NF H

Table 2-22. **Downlink Connectivity Options for NAOR Uplink Channels**

Uplink NAOR V-Pol Beam				Uplink NAOR H-Pol Beam			
Ch	Downlinks	Ch	Downlinks	Ch	Downlinks	Ch	Downlinks
6'	N/A	4	NF H	6'	N/A	4	NF V
5'	N/A	5	BR H, NF H	5'	N/A	5	BR V, NF V
4'	N/A	6	BR H, NF H	4'	N/A	6	BR V, NF V
3'	N/A	7	N/A	3'	N/A	7	N/A
2'	N/A	8	N/A	2'	N/A	8	N/A
1'	N/A	9	N/A	1'	N/A	9	NF V
1	N/A	10	N/A	1	NF V	10	NF V
2	N/A	11	N/A	2	NF V	11	N/A
3	NF H	12	N/A	3	NF V	12	N/A

Table 2-23. **Uplink Connectivity Options for NAOR Downlink Channels**

Downlink NAOR H-Pol Beam				Downlink NAOR V-Pol Beam			
Ch	Uplinks	Ch	Uplinks	Ch	Uplinks	Ch	Uplinks
6'	MS V, NF V	4	N/A	6'	N/A	4	N/A
5'	MS V, NF V	5	N/A	5'	MS H, NF H	5	N/A
4'	BR V, NF V	6	N/A	4'	N/A	6	N/A
3'	BR V, NF V	7	N/A	3'	MS H, AN H, NF H	7	N/A
2'	BR V, NF V	8	N/A	2'	N/A	8	N/A
1'	MS V, NF V	9	N/A	1'	MS H, NF H	9	N/A
1	N/A	10	N/A	1	N/A	10	N/A
2	N/A	11	N/A	2	N/A	11	N/A
3	N/A	12	N/A	3	N/A	12	N/A

Table 2-24. **TWTA Switching Between the NAOR and NAFTA Beams**

	NAFTA H Channel 1	NAFTA H Channel 2	NAFTA H Channel 7
NAOR V Channel 5'	X		
NAOR V Channel 3'		X	
NAOR V Channel 1'			X

Table 2-25. **TWTA Switching Between the NAOR and Mercosul Beams**

	Mercosur H Channel 6'	Mercosur H Channel 5'	Mercosur H Channel 1'
NAOR H Channel 6'	X		
NAOR H Channel 5'		X	
NAOR H Channel 1'			X

Table 2-26. **TWTA Switching Between the NAOR and Brasil Beams**

	Brasil H Channel 4'	Brasil H Channel 3'	Brasil H Channel 2'
NAOR H Channel 4'	X		
NAOR H Channel 3'		X	
NAOR H Channel 2'			X

Table 2-27. **TWTA Switching Between the Mercosul and Andean Beams**

	Andean V Channel 4'-3'	Andean V Channel 7-8	Andean V Channel 9-10
Mercosur V Channel 4'-3'	X		
Mercosur V Channel 7-8		X	
Mercosur V Channel 9-10			X

Table 2-28. **TWTA Switchability Between the Mercosul and NAFTA Beams**

	NAFTA V Channel 7-8	NAFTA V Channel 9-10
Mercosur V Channel 7-8	X	
Mercosur V Channel 9-10		X

2.1.5. EIRP and G/T Parameters

Tables 2-29 and 2-30 provide summaries of the predicted EIRP and G/T performance respectively.

Table 2-29. **EIRP Summary for the Ku-band Beams**

Beam	**Brasil**[1]		**Mercosul**[2]	**Andean**[3]	**NAFTA**	**NAOR**
Coverage Area	**Brasil Coast**	**Brasil Interior**	**Mercosul Main**	**Andean Main**	**NAFTA**	**NAOR**
Amplifier Output Power (Watts)	130	130	100	100	100	100
Amplifier Output Power (dBW)	21.1	21.1	20.0	20.0	20.0	20.0
Net Output Losses (dB)	2.5	2.5	2.5	2.5	2.5	2.5
Antenna Input Power (dBW)	18.6	18.6	17.5	17.5	17.5	17.5
Antenna Gain at EOC (dBi)	31.9	23.4	30.0	30.0	29.0	30.5
EOC EIRP (dBW)	50.5	42.0	47.5	47.5	46.5	48.0

Notes: 1. Values shown for the Brasil beam are for the standard Ku-band transponders. For the three extended Ku-band transponders, the single carrier saturation EIRP levels are expected to be 1.1 dB lower, because 100-W TWTAs are used for these transponders.
2. EOC values for Mercosul North coverage area will be 3 dB lower.
3. EOC EIRP values for Andean Panama and Andean Guyanas coverage areas will be 3 and 5 dB lower, respectively.

Table 2-30. G/T Summary for the Ku-band Beams

Beam	Brasil		Mercosul[2]	Andean[3]	NAFTA	NAOR
Coverage Area	Brasil Coast	Brasil Interior	Mercosul Main	Andean Main	NAFTA	NAOR
Antenna Gain at EOC (dBi)	31.0	22.0	29.0	28.5	28.5	28.5
Transponder Noise Temperature (K) [1]	700	700	700	700	700	700
Transponder Noise temperature (dBK)	28.5	28.5	28.5	28.5	28.5	28.5
EOC G/T (dB/K)	2.5	-6.5	0.5	0.0	0.0	0.0

Notes:
1. Worst-case temperature referenced at output of spacecraft receive antenna with earth Temp = 290 K.
2. EOC values for Mercosul North coverage area will be 3 dB lower.
3. EOC G/T values for Andean Panama and Andean Guyanas coverage areas will be 3 and 5 dB lower, respectively.

2.1.6. Saturation Flux Density and Transponder Gain

The transponders have individual gain control that is set by command. Table 2-31 shows the channel gain settings and the corresponding saturation flux densities for the Ku-band beams.

Table 2-31. Transponder Saturation Flux Density and Gain

Brasil Beam (Coast)								
Gain Step Attenuator setting (dB)	0	3	6	9	12	15	18	21
Transponder Saturation Gain[1,2,3] (dB)	133.0	130.0	127.0	124.0	121.0	118.0	115.0	112.0
Saturation Flux Density[3] (dBW/m^2)	-98.0	-95.0	-92.0	-89.0	-86.0	-83.0	-80.0	-77.0
Mercosul Beam (Main)								
Gain Step Attenuator setting (dB)	0	3	6	9	12	15	18	21
Transponder Saturation Gain[1,2,3] (dB)	130.5	127.5	124.5	121.5	118.5	115.5	112.5	109.5
Saturation Flux Density[3] (dBW/m^2)	-98.0	-95.0	-92.0	-89.0	-86.0	-83.0	-80.0	-77.0
Andean Beam (Main)								
Gain Step Attenuator setting (dB)	0	3	6	9	12	15	18	21
Transponder Saturation Gain[1,2,3] (dB)	131.0	128.0	125.0	122.0	119.0	116.0	113.0	110.0
Saturation Flux Density[3] (dBW/m^2)	-98.0	-95.0	-92.0	-89.0	-86.0	-83.0	-80.0	-77.0
NAFTA Beam								
Gain Step Attenuator setting (dB)	0	3	6	9	12	15	18	21
Transponder Saturation Gain[1,2,3] (dB)	131.0	128.0	125.0	122.0	119.0	116.0	113.0	110.0
Saturation Flux Density[3] (dBW/m^2)	-98.0	-95.0	-92.0	-89.0	-86.0	-83.0	-80.0	-77.0
NAOR Beam								
Gain Step Attenuator setting (dB)	0	3	6	9	12	15	18	21
Transponder Saturation Gain[1,2,3] (dB)	131.5	128.5	125.5	122.5	119.5	116.5	113.5	110.5
Saturation Flux Density[3] (dBW/m^2)	-98.0	-95.0	-92.0	-89.0	-86.0	-83.0	-80.0	-77.0

(1) Gain is from output of receiving antenna to input of transmit antenna.
(2) Attenuator setting selectable by ground command
(3) Gains and Saturation Flux Densities rounded to the nearest 0.5 dB
(4) Gain is adjustable in 1-dB steps.

2.1.7. Transponder Receive Channel Filter Response Characteristics

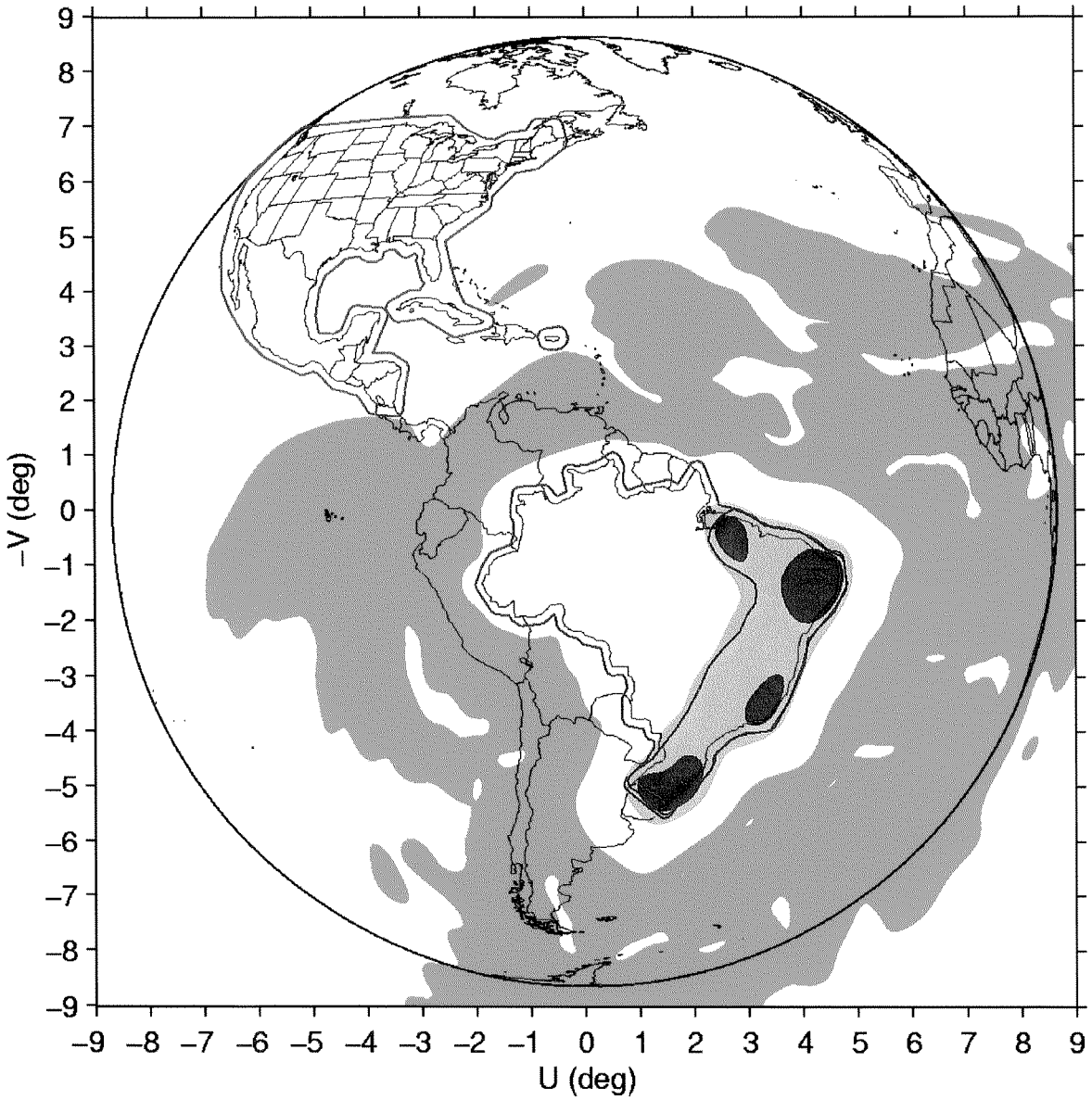
The receive out of band response is defined as the response from the input antenna to the input of the final amplifier. The receive response will be a minimum of 20 dB below center frequency response for signals greater than ±23 MHz from center frequency and greater than 22 dB below center frequency for signals greater than ±30 MHz from center frequency.

2.1.8. Transponder Transmit Channel Filter Response Characteristics

The transmit response is defined as the response from the input of the final amplifier to the output of the transmit antenna. For 36 MHz downlink channels, the transmit response will be greater than 10 dB below center frequency response for signals greater than ±23 MHz from center frequency and greater than 22 dB below center frequency for signals greater than ±30 MHz from center frequency. For 76 MHz downlink channels, the transmit response will be greater than 10 dB below center frequency response for signals greater than ±47 MHz from center frequency and greater than 22 dB below center frequency for signals greater than ±54 MHz from center frequency.

3. ANTENNA COVERAGE PATTERNS

Figures 3-1 through 3-10 show the receive and transmit antenna coverage patterns for the Ku-band beams of the Estrela do Sul spacecraft. The EIRP and G/T contours are presented at the –2 dB, -4 dB, -6 dB, -10 dB, and –20 dB levels.



2.2x2.8m Gregorian
South East Deployed
130 Watt TWTA

Black Line : Map
Red Line : Coverage Polygon with 0.15^0 Ptg. Error

Peak EIRP : 53.2 dBW
EIRP Contours

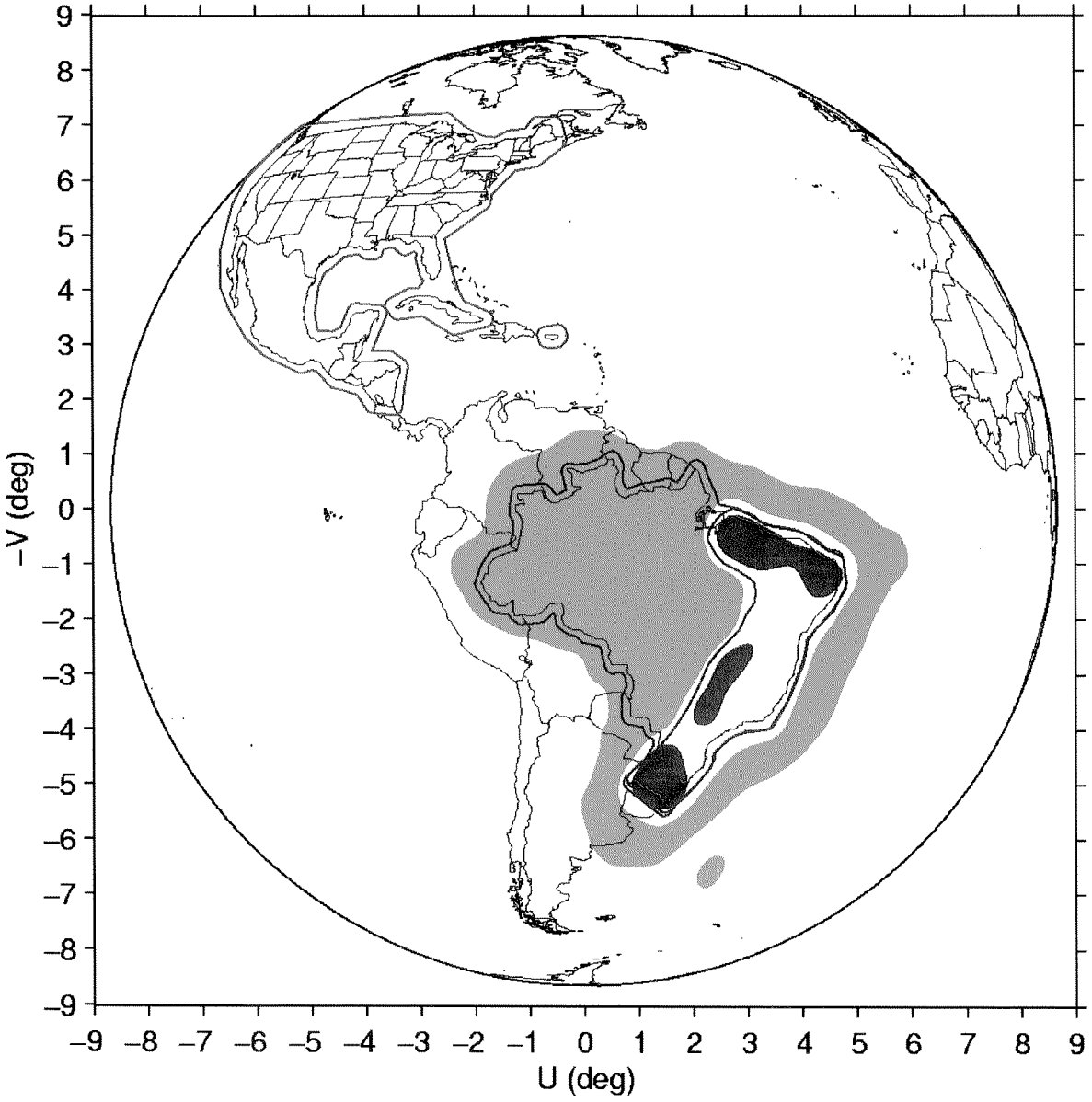
- **: 52.0 dBW**
- **: 51.0 dBW**
- **: 42.0 dBW**
- **: 19.0 dBW**

EOC over Brasil
Coast : 51.0 dBW
Interior : 42.0 dBW

Max. Level Over Nafta : 18.0 dBW

Interferer : Nafta
Interfered : Brazil
Isolation : 25.1 dB

Figure 3-1. EIRP Contours for the Brasil Beam



2.2x2.8m Gregorian
South East Deployed

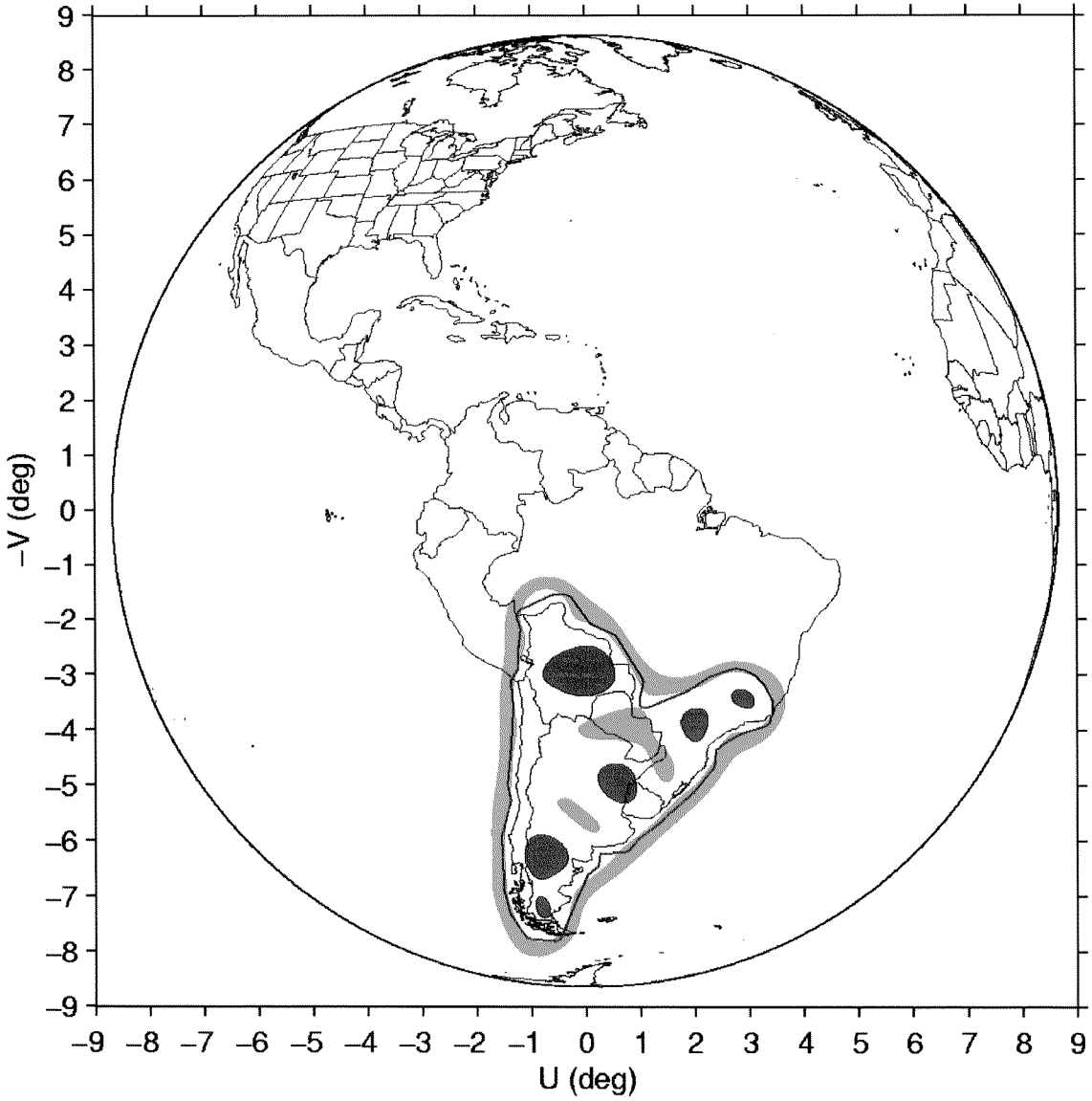
Black Line : Map
Red Line : Coverage Polygon with 0.15^0 Ptg. Error

Peak G/T : 5.7 dB/K
G/T Contours

: 4.5 dB/K
: 2.5 dB/K
: -6.5 dB/K

EOC over Brasil
Coast : 3.2 dB/K
Interior : -5.8 dB/K

Figure 3-2. G/T Contours for the Brasil Beam



1.8m Gregorian
South West Deployed
100 Watt TWTA

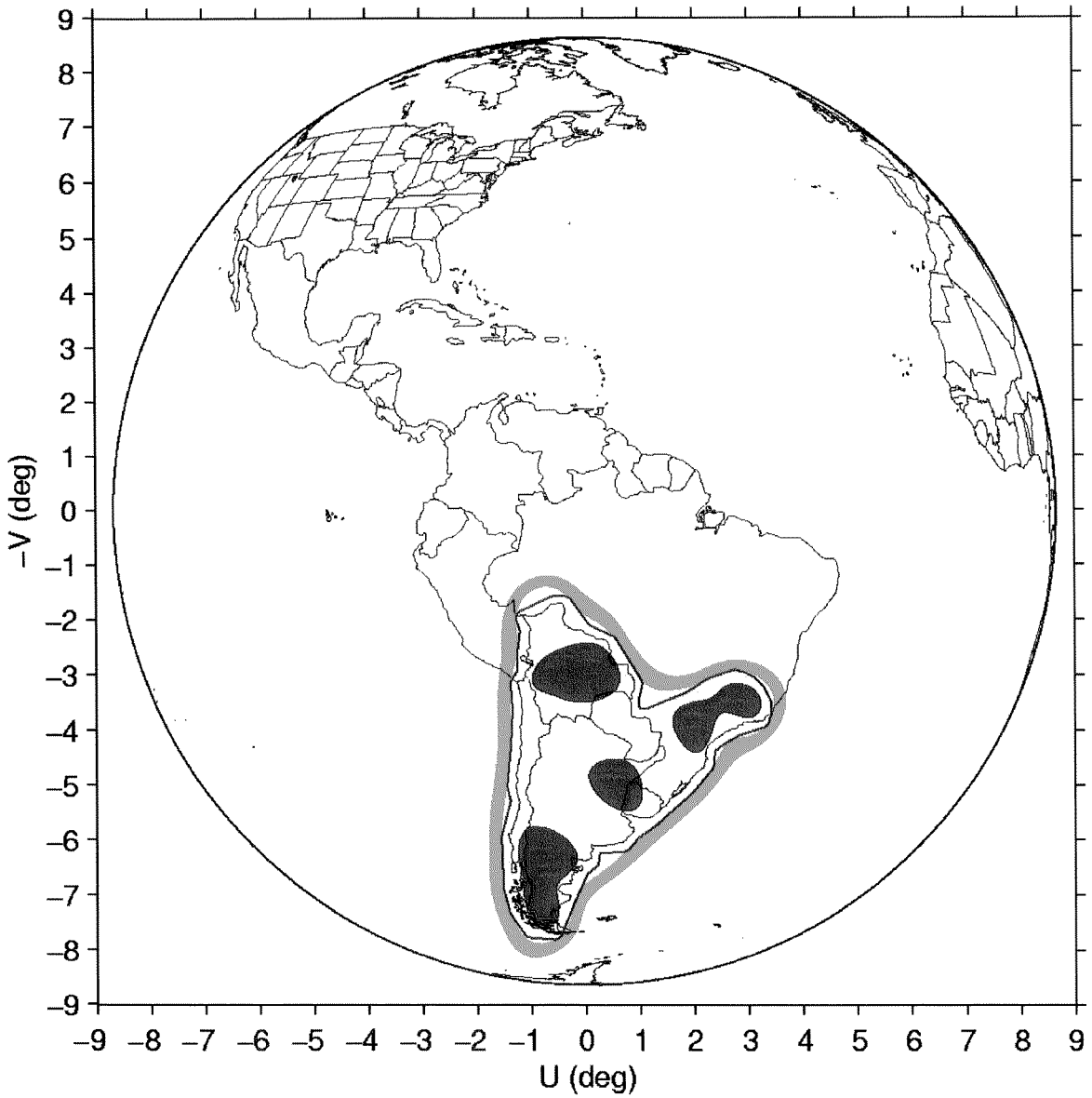
Black Line : Map
Red Line : Coverage Polygon with 0.15^0 Ptg. Error

Peak EIRP : 49.7 dBW
EIRP Contours

- **: 49.0 dBW**
- **: 48.0 dBW**
- **: 47.0 dBW**

EOC over Mercosur : 47.7 dBW

Figure 3-3. EIRP Contours for the Mercosur Beam



1.8m Gregorian
South West Deployed

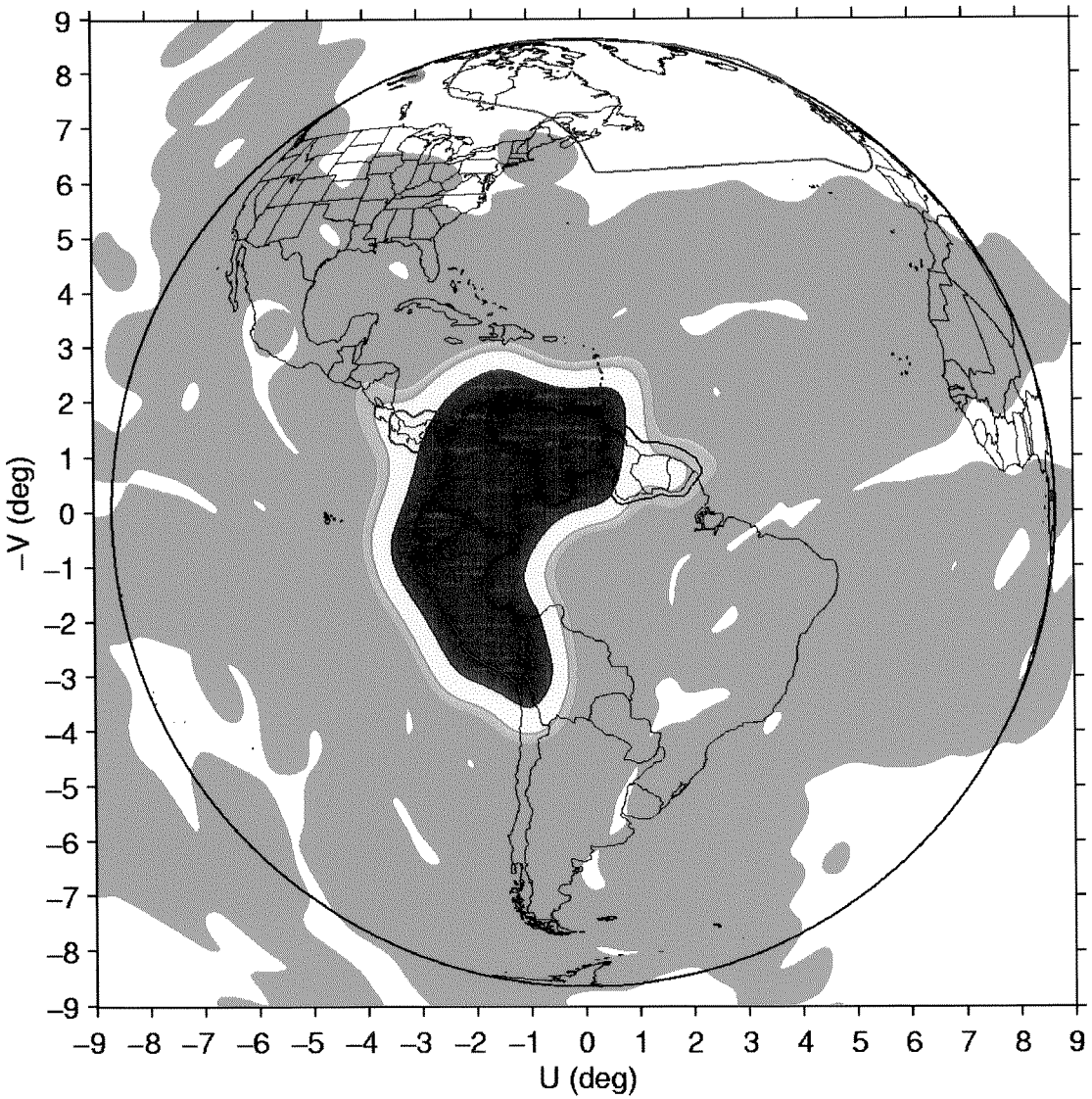
Black Line : Map
Red Line : Coverage Polygon with 0.15^0 Ptg. Error

Peak G/T : 3.4 dB/K
G/T Contours

: 2.5 dB/K
: 1.5 dB/K
: 0.5 dB/K

EOC over Mercosur : 1.6 dB/K

Figure 3-4. G/T Contours for the Mercosur Beam



1.8m Gregorian
North East Deployed
100 Watt TWTA

Black Line : Map
Red Line : Coverage Polygon with 0.15^0 Ptg. Error

Peak EIRP : 49.9 dBW
EIRP Contours

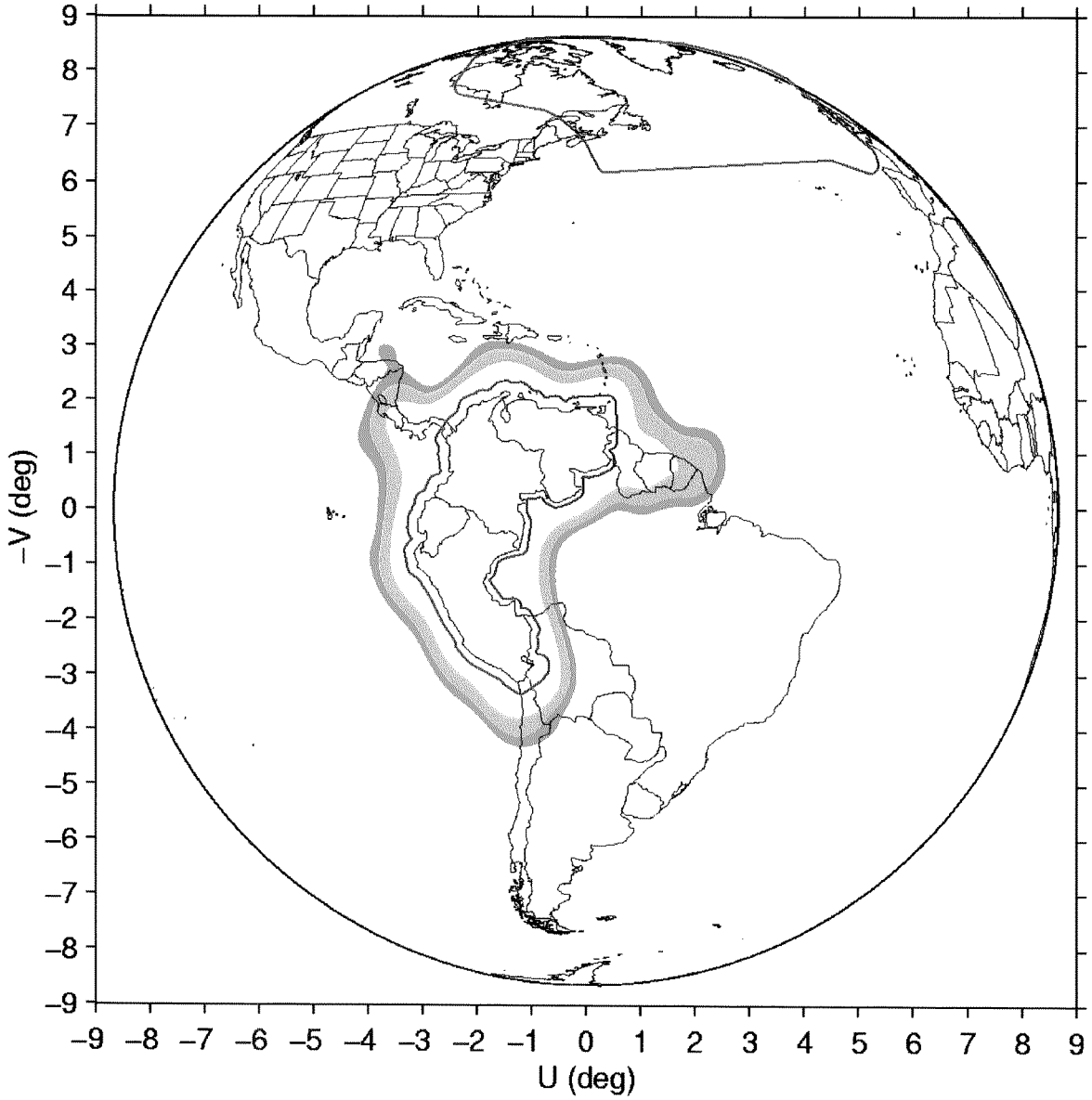
- **: 47.0 dBW**
- **: 44.0 dBW**
- **: 42.0 dBW**
- **: 17.0 dBW**

EOC over Andean
Inner : 47.8 dBW
Panama : 44.8 dBW
Guyana's : 42.8 dBW

Max. Level Over NAOR : 17.0 dBW

Interferer : NAOR
Interfered : Andean
Isolation : 27.8 dB

Figure 3-5. EIRP Contours for the Andean Beam



1.8m Gregorian
North East Deployed

Black Line : Map
Red Line : Coverage Polygon with 0.15^0 Ptg. Error

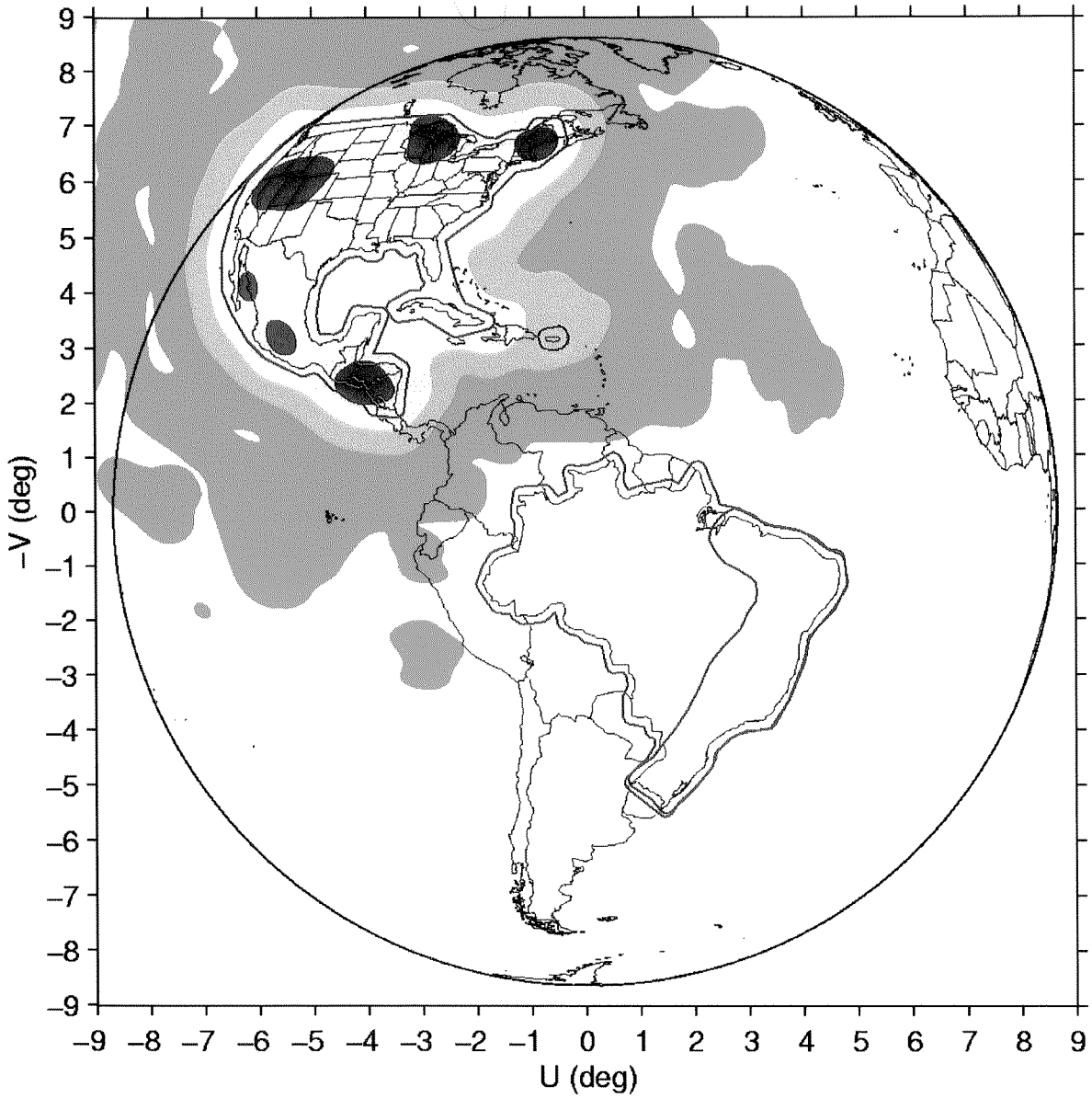
Peak G/T : 5.0 dB/K
G/T Contours

- **: 0.0 dB/K**
- **: -3.0 dB/K**
- **: -5.0 dB/K**

EOC over Andean

Inner	**: 2.3 dB/K**
Panama	**: -0.7 dB/K**
Guyana's	**: -2.9 dB/K**

Figure 3-6. G/T Contours for the Andean Beam



2.2x2.8m Gregorian
North West Deployed
100 Watt TWTA

Black Line : Map
Red Line : Coverage Polygon with 0.15^0 Ptg. Error

Peak EIRP : 48.9 dBW
EIRP Contours

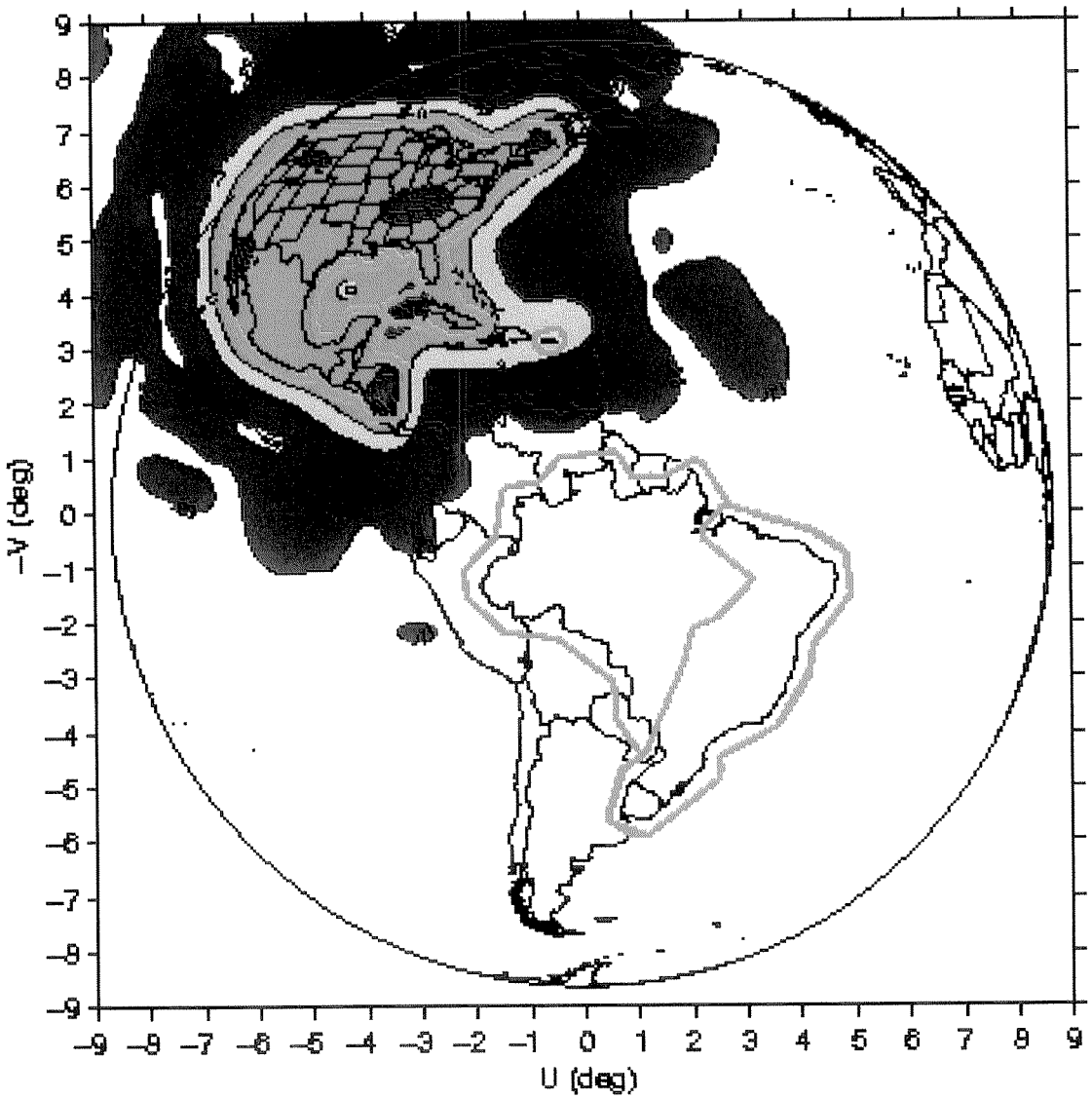
- **: 48.0 dBW**
- **: 46.0 dBW**
- **: 42.0 dBW**
- **: 21.0 dBW**

EOC over Nafta
Inner : 46.9 dBW
Puerto Rico : 43.4 dBW

Max. Level Over Brasil : 17.0 dBW

Interferer : Brazil
Interfered : Nafta
Isolation : 25.0 dB

Figure 3-7. EIRP Contours for the NAFTA Beam



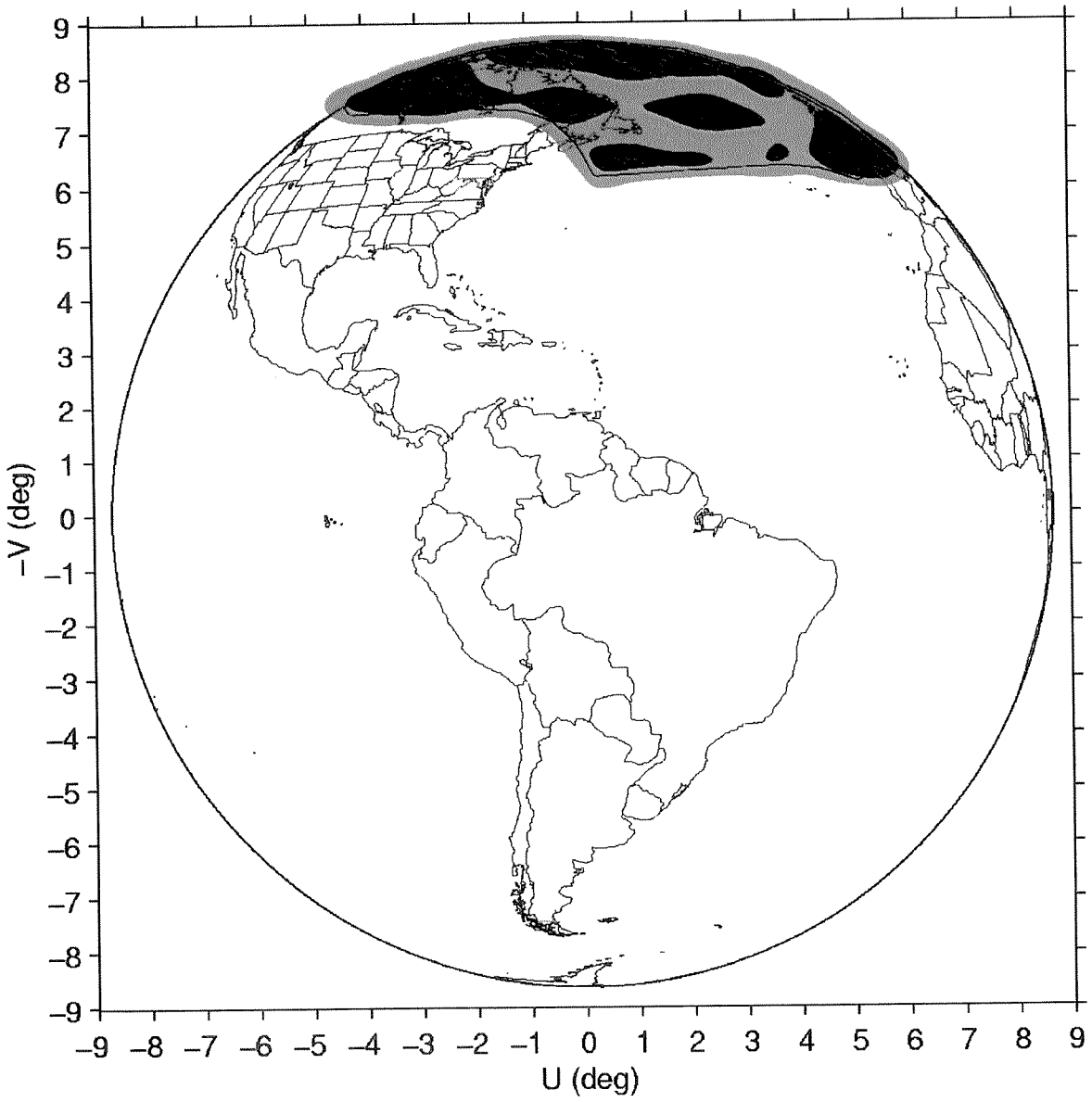
2.2x2.8m Gregorian
North West Deployed

Black Line : Map
Red Line : Coverage Polygon
with 0.15^0 Ptg. Error

Peak G/T : 3.0 dB/K
G/T Contours
: 2.0 dB/K
: 0.0 dB/K
: -3.0 dB/K

EOC over Nafta
Inner : 0.6 dB/K
Puerto Rico : -2.9 dB/K

Figure 3-8. G/T Contours for the NAFTA Beam (H and V)



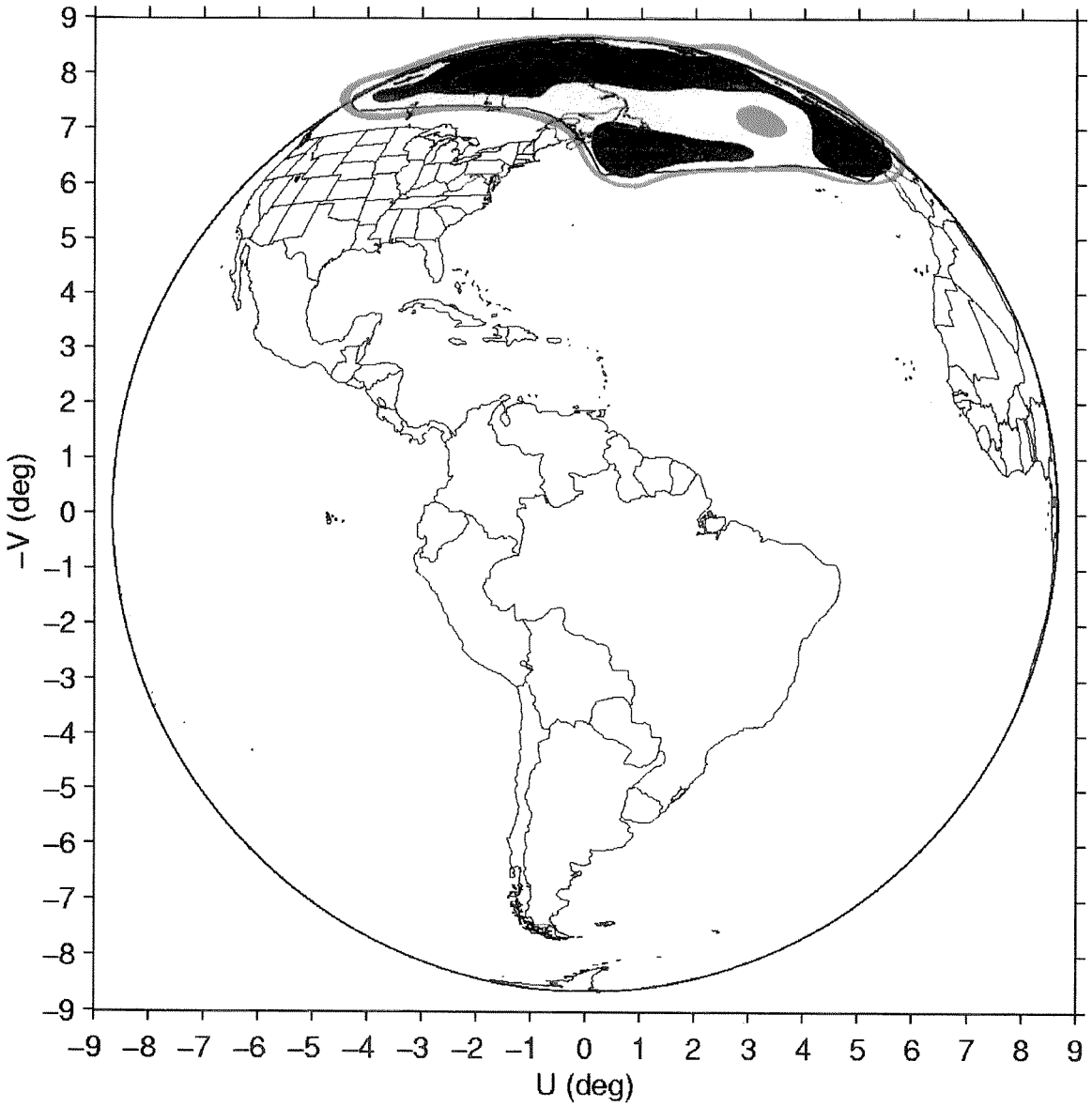
2.0m Gregorian
Deck Mounted
100 Watt TWTA

Black Line : Map
Red Line : Coverage Polygon with 0.15^0 Ptg. Error

Peak EIRP : 49.0 dBW
EIRP Contours
: 48.0 dBW
: 47.0 dBW

EOC over NAOR : 47.3 dBW

Figure 3-9. EIRP Contours for the NAOR Beam (H and V)



2.0m Gregorian
Deck Mounted

Black Line : Map
Red Line : Coverage Polygon with 0.15^0 Ptg. Error

Peak G/T : 4.8 dB/K
G/T Contours

: 3.0 dB/K
: 2.0 dB/K
: 1.0 dB/K

EOC over NAOR : 1.3 dB/K

Figure 3-10. G/T Contours for the NAOR Beam (H and V)

4. DETAILED SERVICE DESCRIPTION

High-level characteristics for some typical services are provided below in Table 4-1. The Estrela do Sul spacecraft is designed to satisfy present and future customer requirements. More details regarding the types of services supported by the satellite are provided in the following section.

It is important to note that the spacecraft EIRP and G/T levels provided in the following sections are at or near the edge of coverage. Thus, the service availability estimates and the link budgets are worst-case. And under these worst-case conditions, the users of the Estrela do Sul will be provided with acceptable service.

Table 4-1. **Overview of Service Characteristics**

	Wideband Digital	**Medium-Band Digital**	**Narrow-Band Digital**	**FM TV**
Signal Characteristics				
Modulation	QPSK	QPSK	QPSK	FM
Signals per Transponder	1-2	15-25	180-300	1-2
Information rate (Mbps)	41.0	1.54	0.128	N/A
Coding rate	0.691	0.461	0.461	N/A
Application	CDV	CDV, Data	Data	CDV
Transponder Characteristics				
Bandwidth (MHz)	36-76	36-76	36-76	36-76
Single Carrier Saturated EIRP (dBW)	46-51	46-51	46-51	46-51
G/T (dB/K)	-6.5 to 2.5	-6.5 to 2.5	-6.5 to 2.5	-6.5 to 2.5
Input Back Off (dB)/ Output Back Off (dB)	0.0/0.4 or 5.5/3.0	0.0/0.4 or 5.5/3.0	0.0/0.4 or 5.5/3.0	0.0/0.0 or 5.5/3.0
Transmit Earth Station				
Antenna Diameter (Meter)	3.7-7.0	1.2-3.0	1.2-2.4	7.0-9.0
Sidelobe Characteristics	29–25Logθ	29–25Logθ	29–25Logθ	29–25Logθ
Uplink Power Control (dB)	0-6	0-3	0	3-9
Receive Earth Station				
Antenna Diameter (Meter)	2.4-6.0	1.2-3.0	1.2-2.4	4.5-7.0
LNA Noise Temperature (K)	90	90	90	90
Performance Objectives				
End-to-End Availability (%)	99.9	99.7-99.9	99.5-99.9	99.9
Required E_b/N_o (dB)	5.5	5.0	5.0	N/A
Required S/N (dB)	N/A	N/A	N/A	49-52
Bit Error Rate	$1x\ 10^{-10}$	$1x\ 10^{-10}$	$1x\ 10^{-7}$	N/A

4.1. LINK BUDGETS

Tables 4-2 through 4-17 show the link budgets for the different services over different beams. The link budgets include all the relevant impairments and have been performed at or near the edge-of-coverage of the indicated regions (for instance, at the edge of the defined Brasil Coast region). The link budgets show that with reasonably sized earth stations, the spacecraft can support a variety of services, such as digital video distribution or VSAT, with a significant amount of clear-sky margin. In addition, the spacecraft EIRP and G/T are ample enough to minimize the effects of rain-induced attenuation, which is especially prevalent in South America. As a result, Skynet do Brasil anticipates the Estrela do Sul spacecraft to be especially useful to Brasilian and other western hemispheric customers.

Table 4-2. **Brasil Beam (Coast) Link Budget Summaries (Clear Weather)**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV **	
Carrier Frequency (GHz)	14.25	14.25	14.25	14.25	
Carriers/Transponder	1	15	180	1	
Uncoded Bit Rate (Mbps)	41.0	1.54	0.128	N/A	
Coding Rate	0.691	0.461	0.461	N/A	
Modulation	QPSK	QPSK	QPSK	FM	U
Noise Bandwidth (dB-Hz)	75.5	63.0	52.2	75.5	P
Transmit Antenna Diameter (m)	6.0	1.8	1.2	9.0	L
Transmit Antenna Gain (dBi)	57.2	46.7	43.2	60.7	I
Carrier EIRP (dBW)	74.4	57.1	43.3	77.4	N
SFD @ 0 dB Pad (dBW/m^2)	-98.0	-98.0	-98.0	-98.0	K
Attenuation Pad (dB)	9.0	9.0	6.0	12.0	
Total Path Loss (dB) *	207.9	207.9	207.9	207.9	
Transponder Input Backoff (dB)	0.0	5.5	5.5	0.0	
Satellite G/T (dB/K)	2.5	2.5	2.5	2.5	
C/N$_{th}$ Uplink (dB)	22.1	17.3	14.3	25.1	
Carrier Frequency (GHz)	11.95	11.95	11.95	11.95	
Saturated Single Carrier EIRP (dBW)	51.0	51.0	51.0	51.0	D
EIRP / Carrier (dBW) ***	50.6	36.2	25.4	49.0	O
Receive Antenna Diameter (m)	2.4	1.8	1.8	4.5	W
Receive Antenna Gain (dB)	47.7	45.2	45.2	53.2	N
Total Path Loss (dB) *	206.0	206.0	206.0	206.0	L
LNA Noise Temperature (K)	90	90	90	90	I
System Noise Temperature (K)	170	170	170	170	N
Earth Station G/T (dB/K)	25.1	22.6	22.6	30.6	K
C/N$_{th}$ Downlink (dB)	22.8	18.4	18.4	26.7	
C/Nth Uplink (dB)	22.1	17.3	14.3	25.1	
C/Nth Downlink (dB)	22.8	18.4	18.4	26.7	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	15.0	11.1	10.1	15.9	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	8.9	7.1	6.1	1.9	

* Total Path Loss for Uplink and Downlink includes antenna mispointing, polarization misalignment, and atmospheric losses.

** For FM TV, the transponders must be operated at 2 to 3 dB OBO to ensure compliance with ITU PFD limits.

*** In the case of multi-carrier traffic, the total OBO for the transponders is 3 dB.

Table 4-3. **Brasil Beam (Coast) Link Budget Summaries (Fade Conditions)**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
UPLINK RAIN					
Target Uplink Availability (%)	99.9	99.8	99.5	99.9	
Uplink Rain Fade (dB) [Sao Paulo]	5.9	4.1	2.7	5.9	
Uncompensated Uplink Rain Fade (dB)	0.0	1.1	2.7	0.0	
C/Nth Uplink (dB)	22.1	16.2	11.6	25.1	
C/Nth Downlink (dB)	22.8	17.3	15.7	26.7	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	14.9	13.3	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	21.9	20.3	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	21.9	20.3	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	25.9	24.3	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	25.9	24.3	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	23.9	22.3	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	23.9	22.3	25.0	T
Overall C/N (dB)	15.0	10.0	7.4	15.9	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	8.9	6.0	3.4	1.9	
DOWNLINK RAIN					
Target Downlink Availability (%)	99.9	99.9	99.9	99.9	
Downlink Rain Fade (dB) [Rio de Janeiro]	4.2	4.2	4.2	4.2	
C/Nth Uplink (dB)	22.1	17.3	14.3	25.1	
C/Nth Downlink (dB)	16.1	11.8	11.8	20.0	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	12.9	8.8	8.3	14.8	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	6.8	4.8	4.3	0.8	

Table 4-4. **Brasil Beam (Interior) Link Budget Summaries for Downlink-Limited Links (Clear Weather)**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV **	
Carrier Frequency (GHz)	14.25	14.25	14.25	14.25	
Carriers/Transponder	1	15	180	1	
Uncoded Bit Rate (Mbps)	41.0	1.54	0.128	N/A	
Coding Rate	0.691	0.461	0.461	N/A	
Modulation	QPSK	QPSK	QPSK	FM	U
Noise Bandwidth (dB-Hz)	75.5	63.0	52.2	75.5	P
Transmit Antenna Diameter (m)	6.0	2.4	2.4	9.0	L
Transmit Antenna Gain (dBi)	57.2	49.2	49.2	60.7	I
Carrier EIRP (dBW)	74.4	57.1	46.3	80.4	N
SFD @ 0 dB Pad (dBW/m^2)	-98.0	-98.0	-98.0	-98.0	K
Attenuation Pad (dB)	9.0	9.0	9.0	15.0	
Total Path Loss (dB) *	207.9	207.9	207.9	207.9	
Transponder Input Backoff (dB)	0.0	5.5	5.5	0.0	
Satellite G/T (dB/K)	2.5	2.5	2.5	2.5	
C/N_{th} Uplink (dB)	22.1	17.3	17.3	28.1	
Carrier Frequency (GHz)	11.95	11.95	11.95	11.95	
Saturated Single Carrier EIRP (dBW)	42.0	42.0	42.0	42.0	D
EIRP / Carrier (dBW) ***	41.6	27.2	16.4	40.0	O
Receive Antenna Diameter (m)	4.5	2.4	1.8	7.0	W
Receive Antenna Gain (dB)	53.2	47.7	45.2	57	N
Total Path Loss (dB) *	206.0	206.0	206.0	206.0	L
LNA Noise Temperature (K)	90	90	90	90	I
System Noise Temperature (K)	170	170	170	170	N
Earth Station G/T (dB/K)	30.6	25.1	22.6	34.4	K
C/N_{th} Downlink (dB)	19.3	11.9	9.4	21.5	
C/Nth Uplink (dB)	22.1	17.3	17.3	28.1	
C/Nth Downlink (dB)	19.3	11.9	9.4	21.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	14.2	8.9	7.5	15.4	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	8.1	4.9	3.5	1.4	

* Total Path Loss for Uplink and Downlink includes antenna mispointing, polarization misalignment, and atmospheric losses.

** For FM TV, the transponders must be operated at 2 to 3 dB OBO to ensure compliance with ITU PFD limits.

*** In the case of multi-carrier traffic, the total OBO for the transponders is 3 dB.

Table 4-5. **Brasil Beam (Interior) Link Budget Summaries for Downlink-Limited Links (Fade Conditions)**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
UPLINK RAIN					
Target Uplink Availability (%)	99.9	99.8	99.8	99.9	
Uplink Rain Fade (dB) [Sao Paulo]	5.9	4.1	4.1	5.9	
Uncompensated Uplink Rain Fade (dB)	0.0	1.1	1.1	0.0	
C/Nth Uplink (dB)	22.1	16.2	16.2	28.1	
C/Nth Downlink (dB)	19.3	10.8	8.3	21.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	14.9	14.9	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	21.9	21.9	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	21.9	21.9	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	25.9	25.9	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	25.9	25.9	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	23.9	23.9	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	23.9	23.9	25.0	T
Overall C/N (dB)	14.2	7.8	6.4	15.4	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	8.1	3.8	2.4	1.4	
DOWNLINK RAIN					
Target Downlink Availability (%)	99.9	99.7	99.5	99.9	
Downlink Rain Fade (dB) [Manaus]	6.2	3.5	2.4	6.2	
C/Nth Uplink (dB)	22.1	17.3	17.3	28.1	
C/Nth Downlink (dB)	10.2	6.2	5.3	12.4	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	9.1	5.2	4.4	11.0	E
Required C/N (dB)	6.1	4.0	4.0	11.0 *	
Link Margin (dB)	3.0	1.2	0.4	0.0	

* Under extreme downlink fade conditions, a 3 dB degradation in C/N is permitted.

Table 4-6. **Brasil Beam (Interior) Link Budget Summaries for Up-Limited Links (Clear Weather)**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV **	
Carrier Frequency (GHz)	14.25	14.25	14.25	14.25	
Carriers/Transponder	1	15	180	1	
Uncoded Bit Rate (Mbps)	41.0	1.54	0.128	N/A	
Coding Rate	0.691	0.461	0.461	N/A	
Modulation	QPSK	QPSK	QPSK	FM	U
Noise Bandwidth (dB-Hz)	75.5	63.0	52.2	75.5	P
Transmit Antenna Diameter (m)	6.0	2.4	1.8	9.0	L
Transmit Antenna Gain (dBi)	57.2	49.2	46.7	60.7	I
Carrier EIRP (dBW)	74.4	57.1	46.3	81.4	N
SFD @ 0 dB Pad (dBW/m^2)	-98.0	-98.0	-98.0	-98.0	K
Attenuation Pad (dB)	9.0	9.0	9.0	16.0	
Total Path Loss (dB) *	207.9	207.9	207.9	207.9	
Transponder Input Backoff (dB)	0.0	5.5	5.5	0.0	
Satellite G/T (dB/K)	-6.5	-6.5	-6.5	-6.5	
C/N_{th} Uplink (dB)	13.1	8.3	8.3	20.1	
Carrier Frequency (GHz)	11.95	11.95	11.95	11.95	
Saturated Single Carrier EIRP (dBW)	51.0	51.0	51.0	51.0	D
EIRP / Carrier (dBW) ***	50.6	36.2	25.4	49.0	O
Receive Antenna Diameter (m)	4.5	4.5	2.4	4.5	W
Receive Antenna Gain (dB)	53.2	53.2	47.7	53.2	N
Total Path Loss (dB) *	206.0	206.0	206.0	206.0	L
LNA Noise Temperature (K)	90	90	90	90	I
System Noise Temperature (K)	170	170	170	170	N
Earth Station G/T (dB/K)	30.6	30.6	25.1	30.6	K
C/N_{th} Downlink (dB)	28.3	26.4	20.9	26.7	
C/Nth Uplink (dB)	13.1	8.3	8.3	20.1	
C/Nth Downlink (dB)	28.3	26.4	20.9	26.7	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	11.5	7.1	7	14.9	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	5.4	3.1	3.0	0.9	

* Total Path Loss for Uplink and Downlink includes antenna mispointing, polarization misalignment, and atmospheric losses.

** For FM TV, the transponders must be operated at 2 to 3 dB OBO to ensure compliance with ITU PFD limits.

*** In the case of multi-carrier traffic, the total OBO for the transponders is 3 dB.

Table 4-7. **Brasil Beam (Interior) Link Budget Summaries for Uplink-Limited Links (Fade Conditions)**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
UPLINK RAIN					
Target Uplink Availability (%)	99.9	99.7	99.5	99.9	
Uplink Rain Fade (dB) [Manaus]	8.7	4.9	2.4	8.7	
Uncompensated Uplink Rain Fade (dB)	2.7	1.1	2.4	0.0	
C/Nth Uplink (dB)	10.4	7.2	5.9	20.1	
C/Nth Downlink (dB)	25.6	25.3	18.5	26.7	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	14.9	13.6	N/A	O
C/I Adj. Sat. Uplink (dB)	20.3	21.9	20.6	23.0	M
C/I Adj. Sat. Downlink (dB)	20.3	21.9	20.6	23.0	P
C/I Cross Polarization Uplink (dB)	24.3	25.9	24.6	27.0	O
C/I Cross Polarization Downlink (dB)	24.3	25.9	24.6	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	22.3	23.9	22.6	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	22.3	23.9	22.6	25.0	T
Overall C/N (dB)	8.8	6.0	4.6	14.9	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	2.7	2.0	0.6	0.9	
DOWNLINK RAIN					
Target Downlink Availability (%)	99.9	99.9	99.8	99.9	
Downlink Rain Fade (dB) [Sao Paulo]	4.2	4.2	2.9	4.2	
C/Nth Uplink (dB)	13.1	8.3	8.3	20.1	
C/Nth Downlink (dB)	21.6	19.8	16.0	20.0	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	11.2	6.9	6.6	14.0	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	5.1	2.9	2.6	0.0	

Table 4-8. **Mercosul Beam Link Budget Summaries (Clear Weather) for 36-MHz Channels**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV **	
Carrier Frequency (GHz)	14.25	14.25	14.25	14.25	
Carriers/Transponder	1	15	180	1	
Uncoded Bit Rate (Mbps)	41.0	1.54	0.128	N/A	
Coding Rate	0.691	0.461	0.461	N/A	
Modulation	QPSK	QPSK	QPSK	FM	U
Noise Bandwidth (dB-Hz)	75.5	63.0	52.2	75.5	P
Transmit Antenna Diameter (m)	6.0	1.8	1.2	9.0	L
Transmit Antenna Gain (dBi)	57.2	46.7	43.2	60.7	I
Carrier EIRP (dBW)	77.4	57.1	44.3	81.4	N
SFD @ 0 dB Pad (dBW/m^2)	-98.0	-98.0	-98.0	-98.0	K
Attenuation Pad (dB)	12.0	9.0	7.0	16.0	
Total Path Loss (dB) *	207.9	207.9	207.9	207.9	
Transponder Input Backoff (dB)	0.0	5.5	5.5	0.0	
Satellite G/T (dB/K)	1.0	1.0	1.0	1.0	
C/N_{th} Uplink (dB)	23.6	15.8	13.8	27.6	
Carrier Frequency (GHz)	11.95	11.95	11.95	11.95	
Saturated Single Carrier EIRP (dBW)	47.0	47.0	47.0	47.0	D
EIRP / Carrier (dBW) ***	46.6	32.2	21.4	45.0	O
Receive Antenna Diameter (m)	3.0	1.8	1.8	7.0	W
Receive Antenna Gain (dB)	49.6	45.2	45.2	57.0	N
Total Path Loss (dB) *	206.0	206.0	206.0	206.0	L
LNA Noise Temperature (K)	90	90	90	90	I
System Noise Temperature (K)	170	170	170	170	N
Earth Station G/T (dB/K)	27	22.6	22.6	34.4	K
C/N_{th} Downlink (dB)	20.7	14.4	14.4	26.5	
C/Nth Uplink (dB)	23.6	15.8	13.8	27.6	
C/Nth Downlink (dB)	20.7	14.4	14.4	26.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	14.8	9.7	9.1	16.1	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	8.7	5.7	5.1	2.1	

* Total Path Loss for Uplink and Downlink includes antenna mispointing, polarization misalignment, and atmospheric losses.

** For FM TV, the transponders must be operated at 2 to 3 dB OBO to ensure compliance with ITU PFD limits.

*** In the case of multi-carrier traffic, the total OBO for the transponders is 3 dB.

Table 4-9. **Mercosul Beam Link Budget Summaries (Fade Conditions) for 36-MHz Channels**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
UPLINK RAIN					
Target Uplink Availability (%)	99.9	99.8	99.5	99.9	
Uplink Rain Fade (dB) [Sao Paulo]	5.9	4.1	2.7	5.9	
Uncompensated Uplink Rain Fade (dB)	0.0	1.1	2.7	0.0	
C/Nth Uplink (dB)	23.6	14.7	11.1	27.6	
C/Nth Downlink (dB)	20.7	13.3	11.7	26.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	14.9	13.3	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	21.9	20.3	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	21.9	20.3	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	25.9	24.3	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	25.9	24.3	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	23.9	22.3	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	23.9	22.3	25.0	T
Overall C/N (dB)	14.8	8.6	6.4	16.1	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	8.7	4.6	2.4	2.1	
DOWNLINK RAIN					
Target Downlink Availability (%)	99.9	99.9	99.9	99.9	
Downlink Rain Fade (dB) [Rio de Janeiro]	4.2	4.2	4.2	4.2	
C/Nth Uplink (dB)	23.6	15.8	13.8	27.6	
C/Nth Downlink (dB)	14.0	7.8	7.8	19.8	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	11.9	6.2	6	14.9	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	5.8	2.2	2.0	0.9	

Table 4-10. **Mercosul Beam Link Budget Summaries (Clear Weather) for 76-MHz Channels**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
Carrier Frequency (GHz)	14.25	14.25	14.25	14.25	
Carriers/Transponder	2	25	300	2	
Uncoded Bit Rate (Mbps)	41.0	1.54	0.128	N/A	
Coding Rate	0.691	0.461	0.461	N/A	
Modulation	QPSK	QPSK	QPSK	FM	U
Noise Bandwidth (dB-Hz)	75.5	63.0	52.2	75.5	P
Transmit Antenna Diameter (m)	6.0	1.8	1.2	9.0	L
Transmit Antenna Gain (dBi)	57.2	46.7	43.2	60.7	I
Carrier EIRP (dBW)	68.9	54.9	42.1	72.9	N
SFD @ 0 dB Pad (dBW/m^2)	-98.0	-98.0	-98.0	-98.0	K
Attenuation Pad (dB)	12.0	9.0	7.0	16.0	
Total Path Loss (dB) *	207.9	207.9	207.9	207.9	
Transponder Input Backoff (dB)	5.5	5.5	5.5	5.5	
Satellite G/T (dB/K)	1.0	1.0	1.0	1.0	
C/N_{th} Uplink (dB)	15.1	13.6	11.6	19.1	
Carrier Frequency (GHz)	11.95	11.95	11.95	11.95	
Saturated Single Carrier EIRP (dBW)	47.0	47.0	47.0	47.0	D
EIRP / Carrier (dBW) ***	41.0	30.0	19.2	41.0	O
Receive Antenna Diameter (m)	3.0	1.8	1.8	7.0	W
Receive Antenna Gain (dB)	49.6	45.2	45.2	57.0	N
Total Path Loss (dB) *	206.0	206.0	206.0	206.0	L
LNA Noise Temperature (K)	90	90	90	90	I
System Noise Temperature (K)	170	170	170	170	N
Earth Station G/T (dB/K)	27	22.6	22.6	34.4	K
C/N_{th} Downlink (dB)	15.1	12.2	12.2	22.5	
C/Nth Uplink (dB)	15.1	13.6	11.6	19.1	
C/Nth Downlink (dB)	15.1	12.2	12.2	22.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	10.9	8.3	7.6	14.2	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	4.8	4.3	3.6	0.2	

* Total Path Loss for Uplink and Downlink includes antenna mispointing, polarization misalignment, and atmospheric losses.

** For FM TV, the transponders must be operated at 2 to 3 dB OBO to ensure compliance with ITU PFD limits.

*** In the case of multi-carrier traffic, the total OBO for the transponders is 3 dB.

Table 4-11. **Mercosul Beam Link Budget Summaries (Fade Conditions) for 76-MHz Channels**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
UPLINK RAIN					
Target Uplink Availability (%)	99.9	99.8	99.5	99.9	
Uplink Rain Fade (dB) [Sao Paulo]	5.9	4.1	2.7	5.9	
Uncompensated Uplink Rain Fade (dB)	0.0	1.1	2.7	0.0	
C/Nth Uplink (dB)	15.1	12.5	8.9	19.1	
C/Nth Downlink (dB)	15.1	11.1	9.5	22.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	14.9	13.3	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	21.9	20.3	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	21.9	20.3	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	25.9	24.3	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	25.9	24.3	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	23.9	22.3	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	23.9	22.3	25.0	T
Overall C/N (dB)	10.9	7.2	4.9	14.2	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	4.8	3.2	0.9	0.2	
DOWNLINK RAIN					
Target Downlink Availability (%)	99.9	99.9	99.9	99.9	
Downlink Rain Fade (dB) [Rio de Janeiro]	4.2	4.2	4.2	4.2	
C/Nth Uplink (dB)	15.1	13.6	11.6	19.1	
C/Nth Downlink (dB)	8.4	5.6	5.6	15.8	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	7.1	4.4	4.1	12.3	E
Required C/N (dB)	6.1	4.0	4.0	11.0 *	
Link Margin (dB)	1.0	0.4	0.1	1.3	

* Under extreme downlink fade conditions, a 3 dB degradation in C/N is permitted.

Table 4-12. **Andean Beam Link Budget Summaries (Clear Weather) for 76-MHz Channels**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
Carrier Frequency (GHz)	14.25	14.25	14.25	14.25	
Carriers/Transponder	2	25	300	2	
Uncoded Bit Rate (Mbps)	41.0	1.54	0.128	N/A	
Coding Rate	0.691	0.461	0.461	N/A	
Modulation	QPSK	QPSK	QPSK	FM	U
Noise Bandwidth (dB-Hz)	75.5	63.0	52.2	75.5	P
Transmit Antenna Diameter (m)	6.0	1.8	1.2	9.0	L
Transmit Antenna Gain (dBi)	57.2	46.7	43.2	60.7	I
Carrier EIRP (dBW)	68.9	54.9	42.1	72.9	N
SFD @ 0 dB Pad (dBW/m^2)	-98.0	-98.0	-98.0	-98.0	K
Attenuation Pad (dB)	12.0	9.0	7.0	16.0	
Total Path Loss (dB) *	207.9	207.9	207.9	207.9	
Transponder Input Backoff (dB)	5.5	5.5	5.5	5.5	
Satellite G/T (dB/K)	1.0	1.0	1.0	1.0	
C/N_{th} Uplink (dB)	15.1	13.6	11.6	19.1	
Carrier Frequency (GHz)	11.95	11.95	11.95	11.95	
Saturated Single Carrier EIRP (dBW)	47.0	47.0	47.0	47.0	D
EIRP / Carrier (dBW) ***	41.0	30.0	19.2	41.0	O
Receive Antenna Diameter (m)	3.0	1.8	1.8	7.0	W
Receive Antenna Gain (dB)	49.6	45.2	45.2	57.0	N
Total Path Loss (dB) *	206.0	206.0	206.0	206.0	L
LNA Noise Temperature (K)	90	90	90	90	I
System Noise Temperature (K)	170	170	170	170	N
Earth Station G/T (dB/K)	27.0	22.6	22.6	34.4	K
C/N_{th} Downlink (dB)	15.1	12.2	12.2	22.5	
C/Nth Uplink (dB)	15.1	13.6	11.6	19.1	
C/Nth Downlink (dB)	15.1	12.2	12.2	22.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	10.9	8.3	7.6	14.2	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	4.8	4.3	3.6	0.2	

* Total Path Loss for Uplink and Downlink includes antenna mispointing, polarization misalignment, and atmospheric losses.

** For FM TV, the transponders must be operated at 2 to 3 dB OBO to ensure compliance with ITU PFD limits.

*** In the case of multi-carrier traffic, the total OBO for the transponders is 3 dB.

Table 4-13. **Andean Beam Link Budget Summaries (Fade Conditions) for 76-MHz Channels**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
UPLINK RAIN					
Target Uplink Availability (%)	99.9	99.8	99.5	99.9	
Uplink Rain Fade (dB) [Caracas]	7.6	5.4	2.9	5.9	
Uncompensated Uplink Rain Fade (dB)	0.0	1.1	2.9	0.0	
C/Nth Uplink (dB)	15.1	12.5	8.7	19.1	
C/Nth Downlink (dB)	15.1	11.1	9.3	22.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	14.9	13.1	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	21.9	20.1	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	21.9	20.1	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	25.9	24.1	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	25.9	24.1	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	23.9	22.1	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	23.9	22.1	25.0	T
Overall C/N (dB)	10.9	7.2	4.7	14.2	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	4.8	3.2	0.7	0.2	
DOWNLINK RAIN					
Target Downlink Availability (%)	99.9	99.8	99.8	99.9	
Downlink Rain Fade (dB) [Lima]	5.1	3.6	3.6	5.1	
C/Nth Uplink (dB)	15.1	13.6	11.6	19.1	
C/Nth Downlink (dB)	7.3	6.4	6.4	14.7	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	6.2	4.9	4.6	11.8	E
Required C/N (dB)	6.1	4.0	4.0	11.0 *	
Link Margin (dB)	0.1	0.9	0.6	0.8	

* Under extreme downlink fade conditions, a 3 dB degradation in C/N is permitted.

Table 4-14. NAFTA Beam Link Budget Summaries (Clear Weather) for 36-MHz Channels

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
Carrier Frequency (GHz)	14.25	14.25	14.25	14.25	
Carriers/Transponder	1	15	180	1	
Uncoded Bit Rate (Mbps)	41.0	1.54	0.128	N/A	
Coding Rate	0.691	0.461	0.461	N/A	
Modulation	QPSK	QPSK	QPSK	FM	U
Noise Bandwidth (dB-Hz)	75.5	63.0	52.2	75.5	P
Transmit Antenna Diameter (m)	6.0	1.8	1.2	9.0	L
Transmit Antenna Gain (dBi)	57.2	46.7	43.2	60.7	I
Carrier EIRP (dBW)	74.9	58.1	45.3	77.9	N
SFD @ 0 dB Pad (dBW/m^2)	-98.0	-98.0	-98.0	-98.0	K
Attenuation Pad (dB)	15.0	10.0	8.0	18.0	
Total Path Loss (dB) *	207.9	207.9	207.9	207.9	
Transponder Input Backoff (dB)	5.5	5.5	5.5	5.5	
Satellite G/T (dB/K)	0.0	0.0	0.0	0.0	
C/N$_{th}$ Uplink (dB)	20.1	15.8	13.8	23.1	
Carrier Frequency (GHz)	11.95	11.95	11.95	11.95	
Saturated Single Carrier EIRP (dBW)	46.0	46.0	46.0	46.0	D
EIRP / Carrier (dBW) ***	45.6	31.2	20.4	46.0	O
Receive Antenna Diameter (m)	3.7	2.4	2.4	7.0	W
Receive Antenna Gain (dB)	51.4	47.7	47.7	57.0	N
Total Path Loss (dB) *	206.0	206.0	206.0	206.0	L
LNA Noise Temperature (K)	90	90	90	90	I
System Noise Temperature (K)	170	170	170	170	N
Earth Station G/T (dB/K)	28.8	25.1	25.1	34.4	K
C/N$_{th}$ Downlink (dB)	21.5	15.9	15.9	27.5	
C/Nth Uplink (dB)	20.1	15.8	13.8	23.1	
C/Nth Downlink (dB)	21.5	15.9	15.9	27.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	14.3	10.1	9.5	15.7	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	8.2	6.1	5.5	1.7	

* Total Path Loss for Uplink and Downlink includes antenna mispointing, polarization misalignment, and atmospheric losses.

** For FM TV, the transponders must be operated at 2 to 3 dB OBO to ensure compliance with ITU PFD limits.

*** In the case of multi-carrier traffic, the total OBO for the transponders is 3 dB.

Table 4-15. **NAFTA Beam Link Budget Summaries (Fade Conditions) for 36-MHz Channels**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
UPLINK RAIN					
Target Uplink Availability (%)	99.9	99.8	99.8	99.9	
Uplink Rain Fade (dB) [New York]	3.4	2.1	2.1	3.4	
Uncompensated Uplink Rain Fade (dB)	0.0	2.1	2.1	0.0	
C/Nth Uplink (dB)	20.1	13.7	11.7	23.1	
C/Nth Downlink (dB)	21.5	13.8	13.8	27.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	13.9	13.9	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	20.9	20.9	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	20.9	20.9	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	24.9	24.9	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	24.9	24.9	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	22.9	22.9	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	22.9	22.9	25.0	T
Overall C/N (dB)	14.3	8.0	7.4	15.7	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	8.2	4.0	3.4	1.7	
DOWNLINK RAIN					
Target Downlink Availability (%)	99.9	99.9	99.9	99.9	
Downlink Rain Fade (dB) [Miami]	5.4	5.4	5.4	5.4	
C/Nth Uplink (dB)	20.1	15.8	13.8	23.1	
C/Nth Downlink (dB)	13.3	7.8	7.8	19.3	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	11.2	6.2	6	14.3	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	5.1	2.2	2.0	0.3	

Table 4-16. **NAFTA Beam Link Budget Summaries (Clear Weather) for 76-MHz Channels**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
Carrier Frequency (GHz)	14.25	14.25	14.25	14.25	
Carriers/Transponder	2	25	300	2	
Uncoded Bit Rate (Mbps)	41.0	1.54	0.128	N/A	
Coding Rate	0.691	0.461	0.461	N/A	
Modulation	QPSK	QPSK	QPSK	FM	U
Noise Bandwidth (dB-Hz)	75.5	63.0	52.2	75.5	P
Transmit Antenna Diameter (m)	6.0	1.8	1.2	9.0	L
Transmit Antenna Gain (dBi)	57.2	46.7	43.2	60.7	I
Carrier EIRP (dBW)	71.9	55.9	43.1	74.9	N
SFD @ 0 dB Pad (dBW/m^2)	-98.0	-98.0	-98.0	-98.0	K
Attenuation Pad (dB)	15.0	10.0	8.0	18.0	
Total Path Loss (dB) *	207.9	207.9	207.9	207.9	
Transponder Input Backoff (dB)	5.5	5.5	5.5	5.5	
Satellite G/T (dB/K)	0.0	0.0	0.0	0.0	
C/N$_{th}$ Uplink (dB)	17.1	13.6	11.6	20.1	
Carrier Frequency (GHz)	11.95	11.95	11.95	11.95	
Saturated Single Carrier EIRP (dBW)	46.0	46.0	46.0	46.0	D
EIRP / Carrier (dBW) ***	40.0	29.0	18.2	40.0	O
Receive Antenna Diameter (m)	3.7	2.4	2.4	7.0	W
Receive Antenna Gain (dB)	51.4	47.7	47.7	57.0	N
Total Path Loss (dB) *	206.0	206.0	206.0	206.0	L
LNA Noise Temperature (K)	90	90	90	90	I
System Noise Temperature (K)	170	170	170	170	N
Earth Station G/T (dB/K)	28.8	25.1	25.1	34.4	K
C/N$_{th}$ Downlink (dB)	15.9	13.7	13.7	21.5	
C/Nth Uplink (dB)	17.1	13.6	11.6	20.1	
C/Nth Downlink (dB)	15.9	13.7	13.7	21.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	11.8	8.8	8	14.3	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	5.7	4.8	4.0	0.3	

* Total Path Loss for Uplink and Downlink includes antenna mispointing, polarization misalignment, and atmospheric losses.

** For FM TV, the transponders must be operated at 2 to 3 dB OBO to ensure compliance with ITU PFD limits.

*** In the case of multi-carrier traffic, the total OBO for the transponders is 3 dB.

Table 4-17. **NAFTA Beam Link Budget Summaries (Fade Conditions) for 76-MHz Channels**

Parameter	Wideband Digital	Medium-Band Digital	Narrow-Band Digital	FM TV	
UPLINK RAIN					
Target Uplink Availability (%)	99.9	99.8	99.8	99.9	
Uplink Rain Fade (dB) [New York]	3.4	2.1	2.1	3.4	
Uncompensated Uplink Rain Fade (dB)	0.0	2.1	2.1	0.0	
C/Nth Uplink (dB)	17.1	11.5	9.5	20.1	
C/Nth Downlink (dB)	15.9	11.6	11.6	21.5	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	13.9	13.9	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	20.9	20.9	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	20.9	20.9	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	24.9	24.9	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	24.9	24.9	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	22.9	22.9	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	22.9	22.9	25.0	T
Overall C/N (dB)	11.8	6.7	5.9	14.3	E
Required C/N (dB)	6.1	4.0	4.0	14.0	
Link Margin (dB)	5.7	2.7	1.9	0.3	
DOWNLINK RAIN					
Target Downlink Availability (%)	99.9	99.9	99.9	99.9	
Downlink Rain Fade (dB) [Miami]	5.4	5.4	5.4	5.4	
C/Nth Uplink (dB)	17.1	13.6	11.6	20.1	
C/Nth Downlink (dB)	7.7	5.6	5.6	13.3	
C/I Intermod Earth Station HPA (dB)	N/A	N/A	N/A	N/A	C
C/I Intermod Satellite HPA (dB)	N/A	16.0	16.0	N/A	O
C/I Adj. Sat. Uplink (dB)	23.0	23.0	23.0	23.0	M
C/I Adj. Sat. Downlink (dB)	23.0	23.0	23.0	23.0	P
C/I Cross Polarization Uplink (dB)	27.0	27.0	27.0	27.0	O
C/I Cross Polarization Downlink (dB)	27.0	27.0	27.0	27.0	S
C/I Co-Polarization Isolation Uplink (dB)	25.0	25.0	25.0	25.0	I
C/I Co-Polarization Isolation Downlink (dB)	25.0	25.0	25.0	25.0	T
Overall C/N (dB)	6.8	4.4	4.1	11.2	E
Required C/N (dB)	6.1	4.0	4.0	11.0 *	
Link Margin (dB)	0.7	0.4	0.1	0.2	

* Under extreme downlink fade conditions, a 3 dB degradation in C/N is permitted.

5. STATION KEEPING AND ANTENNA POINTING ACCURACY

The mission objectives of maintaining antenna axis attitude (also called antenna pointing) during the spacecraft orbital life are met with combinations of attitude sensors, actuators and control algorithms flight proven on many SS/L programs. These combinations form a multitude of control modes designed to carry out specific tasks and are divided into three main mission categories, namely:

1. The transfer orbit mission in which the various modes function to place the spacecraft in the proper orbital position and in the proper satellite attitude for sun and earth acquisition.
2. The synchronous orbit mission in which the various modes function to maintain the satellite in proper orbital position. Regularly scheduled spacecraft maneuvers will be performed to keep the Estrela do Sul satellite inside the "station-keeping box," which will be ±0.05 degrees from the nominal orbital slot. Maneuvers will also be performed to prevent the orbit inclination from exceeding 0.1 degrees.
3. The syncronous orbit mission to maintain precise RF beam pointing throughout the life of the spacecraft. The expected pointing error for all of the antennas is less than 0.15 degrees.

The attitude control system (ACS) for the synchronous orbit mission features flight-proven control algorithms successful in many previous SS/L programs and bi-propellant thrusters used for North-South Stationkeeping (NSSK) and East-West maneuvers. For high reliability, all key components are fully redundant and cross-strapped.

During each mission mode phase, the ACS uses unique combinations of Sun, Earth, and inertial (gyro) sensors to provide attitude information to the Attitude Control Processor. Using flight-proven algorithms, the control processor acts upon the sensor inputs and generates commands to one or more of the various spacecraft torque actuators to maintain the spacecraft's desired attitude.

The control system hardware for Estrela do Sul has been used in many SS/L satellites, including the Intelsat-IX, Intelsat-VII, INSAT, Arabsat, Superbird, and N-Star satellites.

6. POWER FLUX DENSITIES

Through a combination of spacecraft design and, where necessary, operational constraints (backed-off operation of the transponders and sufficient dispersal of the energy), Skynet do Brasil will ensure that earth station and space station emission levels comply with the restrictions and recommendations set forth by ANATEL and the ITU.

The ITU'S Radio Regulations, in Article 21, specify power flux density (PFD) limits for geostationary space stations operating in the Fixed Satellite Service in the 11.450-11.700 GHz band. At the World Radio Conference (Istanbul, 2000), the ITU adopted Resolution 77 that established PFD thresholds for geostationary space stations operating in the Fixed Satellite Service in the 11.700-12.200 GHz band. Skynet do Brasil will operate all of the spacecraft beams in a manner to ensure compliance with these PFD limits and thresholds.

The cases of FM TV traffic, which would present the worst-case PFD levels for all of the beams, and wideband digital traffic are considered and presented for standard and extended Ku-band in Tables 6-1

and 6-2, respectively. Skynet do Brasil anticipates that the spacecraft will carry primarily digital traffic and the tables show that the maximum expected PFD levels for such traffic are below the existing and provisional limits under consideration by the ITU. The tables also indicate for FM TV signals, transponder output backoff can be employed to ensure compliance with the ITU regulations.

It is important to note:

1. NAOR beam downlinks occupy only the 11.450-11.700 GHz range
2. No FM TV traffic will be transmitted in the NAOR beam
3. NAFTA beam downlinks occupy only the 11.700-12.200 GHz range

Table 6-1. Maximum Downlink Power Flux Densities (PFD) for Standard Ku-band

FM TV					
	Brasil Beam	**Mercosul Beam**	**Andean Beam**	**NAFTA Beam**	**NAOR Beam**
Carriers per Transponder	1	1	1	1	N/A
Maximum EIRP (dBW)	53	49	50	47	
OBO (dB)	2	2	2	3	
EIRP / Carrier[1] (dBW)	51	47	48	44	
Spreading factor(dB)	-162.7	-162.7	-162.7	-162.7	
Energy Dispersal (dB/Hz)	-63.0	-63.0	-63.0	-63.0	
Conversion to 4 kHz (dB)	+36	+36	+36	+36	
Max PFD (dBW/m^2/4 kHz)	-138.7	-142.7	-141.7	-145.7	
Minimum Elev Angle (°)	>25	≈20	>25	≈10	
Corresponding PFD Limit (dBW/m^2/4 kHz)	-138.0	-140.5	-138.0	-145.5	
Margin (dB)	0.7	2.2	3.7	0.2	
Wideband Digital					
	Brasil Beam	**Mercosul Beam**	**Andean Beam**	**NAFTA Beam**	**NAOR Beam**
Carriers per Transponder	1	1	1	1	N/A
Maximum EIRP[1,2] (dBW)	53	49	50	47	
OBO (dB)	0	0	0	0	
EIRP / Carrier[3] (dBW)	53	49	50	47	
Spreading factor(dB)	-162.7	-162.7	-162.7	-162.7	
Energy Dispersal (dB)	-74.3	-74.3	-74.3	-74.3	
Conversion to 4 kHz (dB)	+36	+36	+36	+36	
Max PFD (dBW/m^2/4 kHz)	-148.0	-152.0	-151.0	-154.0	
Minimum Elev Angle (°)	>25	≈20	>25	≈10	
Corresponding PFD Limit (dBW/m^2/4 kHz)	-138.0	-140.5	-138.0	-145.5	
Margin (dB)	10.0	11.5	13.0	8.5	

[1] For FM TV traffic, the TWTAs for all of the beams will be operated at 2 to 3 dB OBO.

Table 6-2. Maximum Downlink Power Flux Densities (PFD) for Extended Ku-band

FM TV					
	Brasil Beam	**Mercosul Beam**	**Andean Beam**	**NAFTA Beam**	**NAOR Beam**
Carriers per Transponder	1	1	1	N/A	N/A
Maximum EIRP (dBW)	51.9	49	50		
OBO (dB)	3	3	3		
EIRP / Carrier[1] (dBW)	48.9	46	47		
Spreading factor(dB)	-162.7	-162.7	-162.7		
Energy Dispersal (dB/Hz)	-63.0	-63.0	-63.0		
Conversion to 4 kHz (dB)	+36	+36	+36		
Max PFD (dBW/m^2/4 kHz)	-140.8	-143.7	-142.7		
Minimum Elev Angle (°)	>25	≈20	>25		
Corresponding PFD Limit (dBW/m^2/4 kHz)	-140.0	-142.5	-140.0		
Margin (dB)	0.8	1.2	2.7		
Wideband Digital					
	Brasil Beam	**Mercosul Beam**	**Andean Beam**	**NAFTA Beam**	**NAOR Beam**
Carriers per Transponder	1	1	1	N/A	1
Maximum EIRP[1,2] (dBW)	53	49	50		49
OBO (dB)	0	0	0		0
EIRP / Carrier[3] (dBW)	53	49	50		49
Spreading factor(dB)	-162.7	-162.7	-162.7		-162.7
Energy Dispersal (dB)	-74.3	-74.3	-74.3		-73.0
Conversion to 4 kHz (dB)	+36	+36	+36		+36
Max PFD (dBW/m^2/4 kHz)	-148.0	-152.0	-151.0		-150.7
Minimum Elev Angle (°)	>25	≈20	>25		5
Corresponding PFD Limit (dBW/m^2/4 kHz)	-140.0	-142.5	-140.0		-150.0
Margin (dB)	8.0	9.5	11.0		0.7

[1] For FM TV traffic, the TWTAs for all of the beams will be operated at 2 to 3 dB OBO.

7. TELEMETRY, TRACKING, AND CONTROL (TT&C) SUBSYSTEM

The Telemetry, Tracking, and Control (TT&C) subsystem provides positive margins for command and telemetry in all mission modes. All components have extensive heritage in SS/L flight programs. The Omni antennas are lightweight, open-ended waveguide types that are fix-mounted and require no deployment. A global coverage horn-antenna is used for on-station transmission of the spacecraft telemetry. The subsystem takes advantage of the redundant TWTAs in the communications payload by using the spares and switching network.

The principal functions of the TT&C subsystem are:

a. Reception, amplification, and demodulation of microwave command signals to a bit stream for subsequent command interpretation and processing

b. Modulation and transmission of all telemetry data, providing spacecraft status

The TT&C subsystem consists of the following hardware elements:

a. Two dual-frequency command receivers, operating on both the 14.497- and 14.499-GHz uplink carriers. The command receivers are cross-strapped to the redundant command decoders

b. Two telemetry transmitters, each operating at 12.1975 and 12.199 GHz. The transmitters are cross-strapped with the redundant telemetry encoders

c. One global horn antenna for telemetry transmission

d. Two command antennas, consisting of wide beam linear antenna elements on the earth (+Z) axis, and medium beam linear antenna elements on the anti-earth (–Z) axis

e. Two telemetry antennas, with each antenna consisting of wide beam linear antenna elements on the earth (+Z) axis, and medium beam linear antenna elements on the anti-earth (-Z) axis

f. Minor microwave components including filters, diplexers, switches, power splitters, isolators, and cables

All digital functions following bit detection, such as command processing and telemetry formatting, are implemented in the Data Handling Subsystem.

The TT&C subsystem is configured to meet the unique requirements of pre-launch, transfer orbit, and on-station synchronous orbit operations. The transfer-orbit antennas provide continuous command and telemetry access. When on-station, the primary path for commanding is the omni antenna system and for telemetry is the global horn antenna, with the omni-antennas available for back-up.

An on-station contingency mode (autonomous or commandable) is available to provide continuous antenna coverage. The Data Handling Subsystem automatically detects contingency situations and turns on the telemetry TWTAs and switches the telemetry path to the Omni antennas. Command capability is always available via the Omni antennas.

A functional block diagram of the TT&C subsystem is shown in Figure 11-1. Although omitted from the figure for clarity, each command receiver has two ranging outputs for cross strapping to both telemetry transmitters.

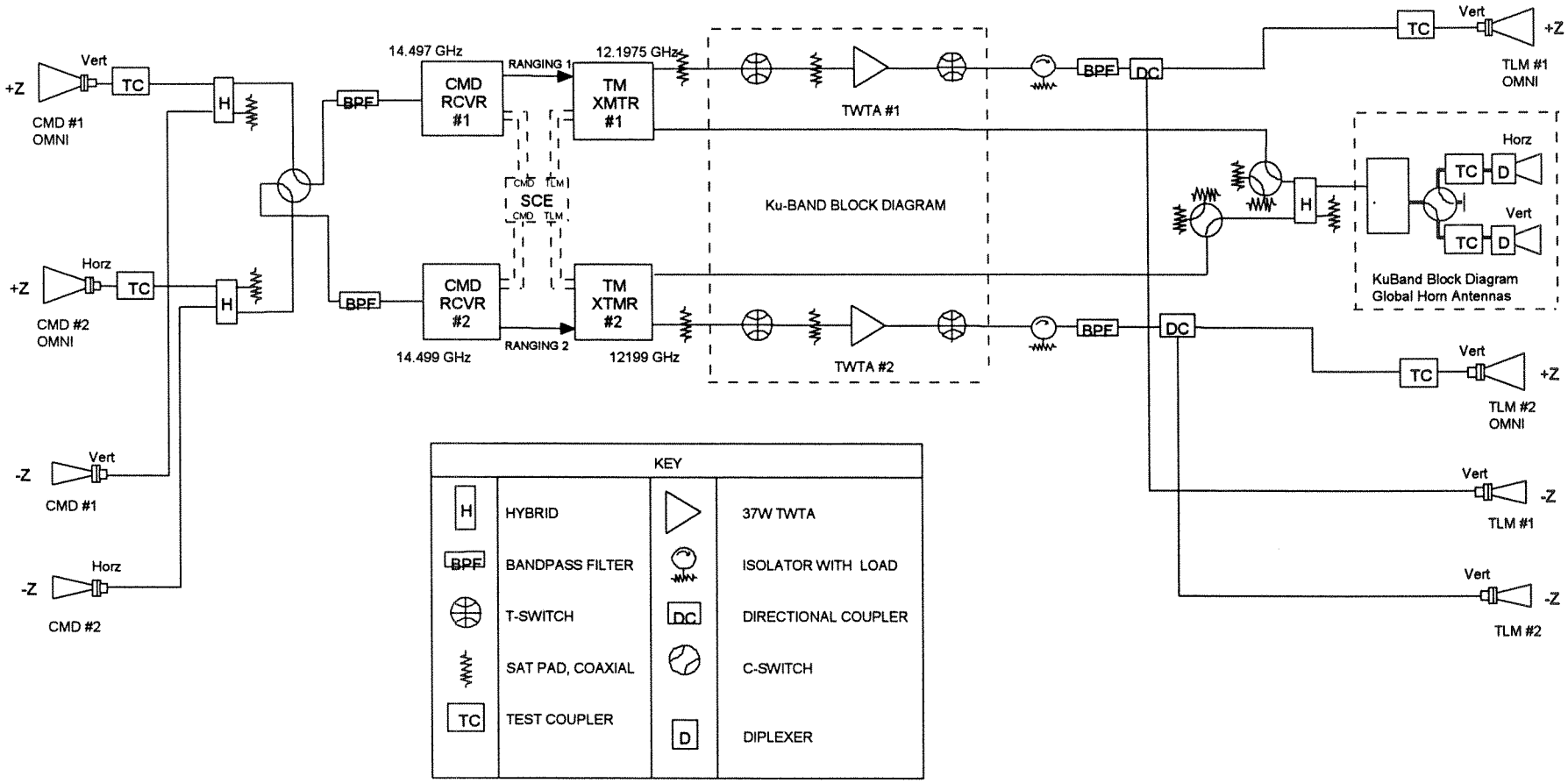


Figure 7-1. TT&C Subsystem Functional Block Diagram

8. PHYSICAL CHARACTERISTICS OF THE SPACECRAFT

The structure subsystem is derived from SS/L's heritage FS1300 spacecraft that started with Intelsat-VIIA and has continued with design modifications and enhancements for growing payload requirements. This structure is closest in similarity to the structure being qualified for Intelsat-IX, which is an extended version of SS/L's heritage FS1300. This is a low risk approach because:

a. Heritage structural designs and proven concepts are for almost all of the primary structure.

b. New structure, if required, will be based on heritage concepts and will be qualified for the spacecraft

c. Heritage materials, including composites, are used.

d. Existing manufacturing procedures and processes are used

e. Existing ground handling equipment is used

Three-dimensional analyses are performed with state-of-the-art software to provide the spacecraft component layout details. The use of this powerful tool permits the identification and resolution of design and layout issues well before satellite assembly begins. In addition, the resultant 3-D models are used for numerical control machining of parts and as a virtual mock-up for other subsystems to use in their designs.

Sophisticated software packages are also used to model the structure, and extensive testing is performed to derive a mass-efficient structure which meets all strength and stiffness requirements

Tables 8-1 and 8-2 contain the mass and power budgets for the proposed spacecraft. A drawing for the satellite is provided in Figure 8-1.

The Satellite will be loaded with sufficient fuel to obtain a 15-year lifetime. The various subsystems of the bus and payload systems include sufficient redundancy to provide a probability of mission success for each individual beam of at least 0.75 at 15 years. Mission success is defined as no failed transponders in a given beam.

Table 8-1. **Estrela do Sul Mass Budget**

Component	Mass (kg)
Payload	400
Bus	1400
Subtotal	1800
Margin (5%)	90
Total Dry Mass	1890

Table 8-2. **Estrela do Sul Power Budget**

Subsystem	Autumnal Equinox (W)	Summer Solstice (W)	Eclipse (W)
Payload	7600	7600	7600
Bus	2360	1280	1750
Total	9960	8880	9350
Solar Array EOL Capability	10450	9650	N/A
Batt Cap (80% DOD, cell Failed)	N/A	N/A	9660
Failed String and Shadowing	280	500	N/A
Power Margin w/ Failed Circuit / 80% Batt DOD	210	270	310

Estrela do Sul Satellite On-Orbit Configuration

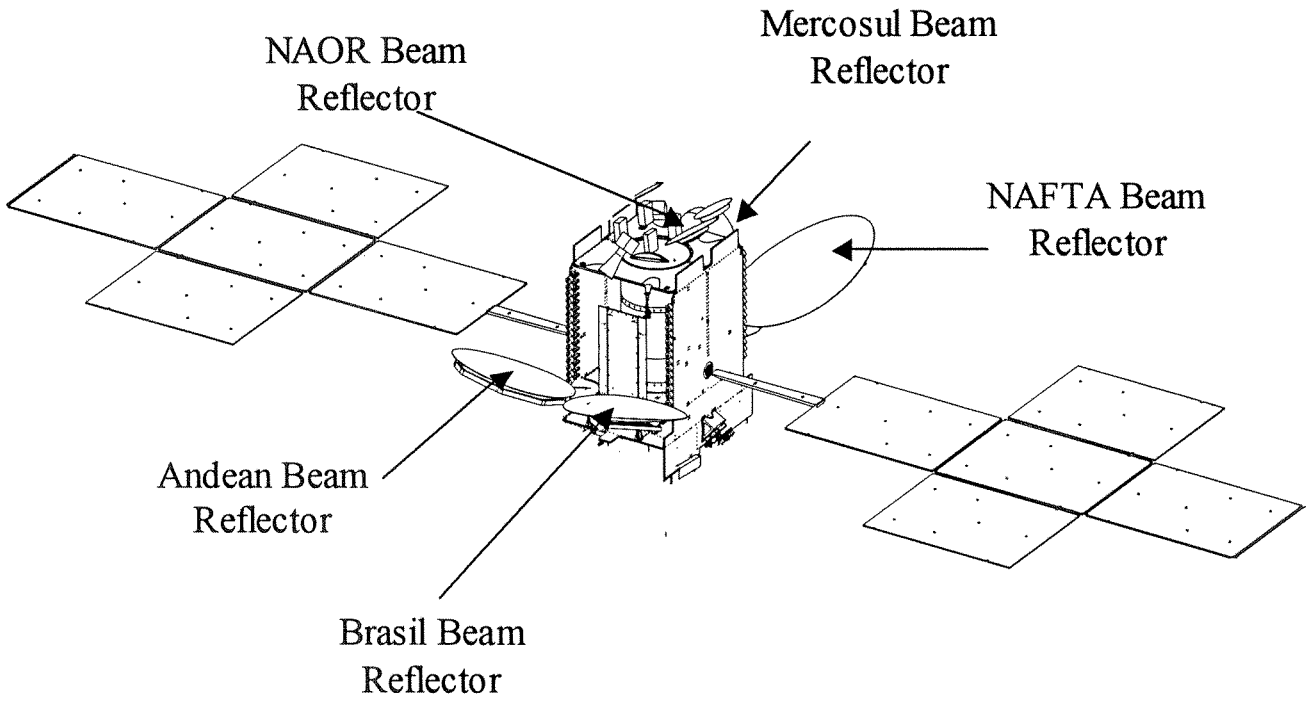


Figure 8-1. Drawing of Proposed Spacecraft

APPENDIX B

PART 1.

FINANCIAL INFORMATION
LORAL SPACE & COMMUNICATIONS LTD.
CONDENSED CONSOLIDATED BALANCE SHEETS
(In thousands, except share data)

	June 30, 2002 (Unaudited)	December 31, 2001 (Note)
ASSETS		
Current assets:		
Cash and cash equivalents	$ 107,680	$ 159,949
Accounts receivable, net	40,363	39,299
Contracts-in-process	187,051	178,599
Inventories	106,660	98,179
Other current assets	75,429	93,667
Total current assets	517,183	569,693
Property, plant and equipment, net	1,983,602	1,977,356
Cost in excess of net assets acquired, net	—	891,719
Long-term receivables	192,574	190,306
Investments in and advances to affiliates	182,881	189,119
Deposits	105,290	155,490
Deferred tax assets	301,363	297,528
Other assets	104,880	119,494
	$ 3,387,773	$ 4,390,705
LIABILITIES AND SHAREHOLDERS' EQUITY		
Current liabilities:		
Current portion of long-term debt	$ 165,931	$ 136,616
Accounts payable	113,718	144,841
Accrued employment costs	38,218	39,232
Customer advances	138,050	148,990
Accrued interest and preferred dividends	43,073	31,170
Income taxes payable	35,056	34,516
Other current liabilities	51,499	46,960
Total current liabilities	585,545	582,325
Pension and other postretirement liabilities	60,015	55,590
Long-term liabilities	137,090	156,716
Long-term debt	2,164,181	2,226,525
Minority interest	15,917	18,681
Convertible redeemable preferred stock:		
6% Series C ($133,797 redemption value), $.01 par value	131,996	—
6% Series D ($57,061 redemption value), $.01 par value	55,378	—
Commitments and contingencies (Notes 7, 8 and 9)		
Shareholders' equity:		
6% Series C convertible redeemable preferred stock ($270,412 and $491,994 redemption value), $.01 par value	266,772	485,371
6% Series D convertible redeemable preferred stock ($112,523 and $305,539 redemption value), $.01 par value	109,205	296,529
Common stock, $.01 par value	3,711	3,368
Paid-in capital	3,035,219	2,771,964
Treasury stock	(3,360)	(3,360)
Unearned compensation	(4)	(81)
Retained deficit	(3,195,504)	(2,223,710)
Accumulated other comprehensive income	21,612	20,787
Total shareholders' equity	237,651	1,350,868
	$ 3,387,773	$ 4,390,705

Note: The December 31, 2001 balance sheet has been derived from the audited consolidated financial statements at that date.

See notes to condensed consolidated financial statements.

LORAL SPACE & COMMUNICATIONS LTD.

CONDENSED CONSOLIDATED STATEMENTS OF OPERATIONS
(In thousands, except per share amounts)
(Unaudited)

	Three Months Ended June 30,		Six Months Ended June 30,	
	2002	2001	2002	2001
Revenues from satellite sales	$ 214,579	$ 160,164	$ 413,050	$ 307,986
Revenues from satellite services	101,781	114,698	211,486	228,011
Total revenues	316,360	274,862	624,536	535,997
Cost of satellite sales	193,857	139,125	380,285	265,729
Cost of satellite services	62,422	73,189	128,718	149,144
Selling, general and administrative expenses	42,373	55,740	83,120	110,390
Operating income	17,708	6,808	32,413	10,734
Interest and investment income	4,452	6,660	9,861	14,328
Interest expense	(18,385)	(46,751)	(36,955)	(96,444)
Income (loss) before income taxes, equity in net loss of affiliates, minority interest and cumulative effect of change in accounting principle	3,775	(33,283)	5,319	(71,382)
Income tax (expense) benefit	(7,724)	25	(13,252)	1,950
Loss before equity in net loss of affiliates, minority interest and cumulative effect of change in accounting principle	(3,949)	(33,258)	(7,933)	(69,432)
Equity in net losses of affiliates, net of taxes	(12,644)	(20,707)	(28,594)	(43,061)
Minority interest, net of taxes	(68)	(732)	6	529
Loss before cumulative effect of change in accounting principle	(16,661)	(54,697)	(36,521)	(111,964)
Cumulative effect of change in accounting principle, net of taxes (Notes 3 and 6)	—	—	(876,500)	(1,741)
Net loss	(16,661)	(54,697)	(913,021)	(113,705)
Preferred dividends	(46,810)	(40,694)	(58,773)	(56,817)
Net loss applicable to common shareholders	$ (63,471)	$ (95,391)	$ (971,794)	$ (170,522)
Basic and diluted loss per share:				
Before cumulative effect of change in accounting principle	$ (0.18)	$ (0.29)	$ (0.27)	$ (0.54)
Cumulative effect of change in accounting principle	—	—	(2.53)	(0.01)
Loss per share	$ (0.18)	$ (0.29)	$ (2.80)	$ (0.55)
Weighted average shares outstanding: Basic and diluted	358,166	326,859	347,609	312,758

See notes to condensed consolidated financial statements.