(RESERVED)

(Read instructions carefully BEFORE proceeding.)

FEDERAL COMMUNICATIONS COMMISSION

FCC REMITTANCE ADVICE

Approved by OMB 3060-0589 Expires 2/28/97

SPECIAL USE: FCC/MELLON JUN 10 1996

FCC USE ONLY

PAYOR INFORMATION

(1) FCC ACCOUNT NUMBER: 0 1 3 3 8 6 7 4 2 4

Did you have a number prior to this? Enter it.

(2) TOTAL AMOUNT PAID (dollars and cents): $ 11,480.00

(3) PAYOR NAME (If paying by credit card, enter name exactly as it appears on your card): Loral Space and Communications, Ltd.

Received JUN 18 1996 Satellite Policy Branch International Bureau

(4) STREET ADDRESS LINE NO. 1: 600 Third Avenue

(5) STREET ADDRESS LINE NO. 2:

(6) CITY: New York

(7) STATE: NY

(8) ZIP CODE: 10016

(9) DAYTIME TELEPHONE NUMBER (Include area code): (212) 338-5381

(10) COUNTRY CODE (if not U.S.A.):

ITEM #1 INFORMATION

(11A) NAME OF APPLICANT, LICENSEE, REGULATEE, OR DEBTOR:

FCC USE ONLY

(12A) FCC CALL SIGN/OTHER ID	(13A) ZIP CODE	(14A) PAYMENT TYPE CODE	(15A) QUANTITY	(16A) FEE DUE FOR PAYMENT TYPE CODE IN BLOCK 14
72-SAT-P/LA-95		B F Y	1	$5,740.00

(17A) FCC CODE 1:

(18A) FCC CODE 2: 123-SAT-MP-96

(19A) ADDRESS LINE NO. 1:

(20A) ADDRESS LINE NO. 2):

(21A) CITY/STATE OR COUNTRY CODE:

ITEM #2 INFORMATION

(11B) NAME OF APPLICANT, LICENSEE, REGULATEE, OR DEBTOR:

FCC USE ONLY

(12B) FCC CALL SIGN/OTHER ID	(13B) ZIP CODE	(14B) PAYMENT TYPE CODE	(15B) QUANTITY	(16B) FEE DUE FOR PAYMENT TYPE CODE IN BLOCK 14
73-SAT-P/LA-95		B F Y	1	$5,740.00

(17B) FCC CODE 1:

(18B) FCC CODE 2: 124-SAT-MP-96

(19B) ADDRESS LINE NO. 1:

(20B) ADDRESS LINE NO. 2:

(21B) CITY/STATE OR COUNTRY CODE:

CREDIT CARD PAYMENT INFORMATION

(22) MASTERCARD/VISA ACCOUNT NUMBER:

☐ Mastercard

EXPIRATION DATE: Month Year

☐ Visa

(23) **I hereby authorize the FCC to charge my VISA or Mastercard for the service(s)/authorization(s) herein describe.**

AUTHORIZED SIGNATURE DATE

See public burden estimate on reverse.

WILLKIE FARR & GALLAGHER

Washington, DC
New York
London
Paris

June 10, 1996

Federal Communications Commission
Satellite and Radiocommunication Div'n
P.O. Box 358210
Pittsburgh, PA 15251-5210

Re: File Nos. 72-SAT-P/LA-95
73-SAT-P/LA-95
137-SAT-P-95

Ladies and Gentlemen:

The Federal Communications Commission ("Commission") recently granted Loral Space & Communications Ltd. ("Loral Space"), a new licensee in the fixed satellite service, authority to construct, launch and operate two hybrid C/Ku-band FSS satellites in geosynchronous orbit at 77 and 129 degrees west longitude.[1]

At the time that Loral Space applied for authority to build its satellite system, the Commission treated domestic satellite systems and separate international systems under distinct regulatory policies.[2] Since then, however, the Commission has revised these policies.[3] In its DISCO I Order, the Commission consolidated the regulatory treatment of domestic satellites and separate systems under a unified "separate system" scheme. The scheme was designed to "benefit users of satellite services by enhancing competition, increasing available capacity, and encouraging greater innovation in services at lower prices to consumers."[4]

Under the new rules, the Commission authorized domsat operators to provide international service by "automatically [modifying] all FSS space station licenses to allow the facilities to provide domestic and international services."[5]

---

1 See In the Matter of Assignment of Orbital Location to Space Stations in the Domestic Fixed-Satellite Service, DA 96-713 (rel. May 7, 1996)

2 See Establishment of Satellite Systems Providing International Communications, 101 F.C.C. 2d 1046 (1985), recon., 61 R.R.2d 649 (1989), further recon., 1 F.C.C. Rcd 439 (1985) (establishing the Separate Systems Policy).

3 Amendment to the Commission's Regulatory Policies Governing Domestic Fixed Satellites and Separate International Systems, 11 F.C.C. Rcd 2429 (1996) ("DISCO I Order").

4 Id. at ¶ 34.

5 Id.

Three Lafayette Centre
1155 21st Street, NW
Washington, DC 20036-3384
202 328 8000

Telex: RCA 229800
WU 89-2762
Fax: 202 887 8979

Loral Space would like to take advantage of the consolidated regulatory policies adopted in DISCO I by providing service to domestic and international locations from its two orbital locations. As a new entrant in the FSS satellite services market, Loral Space believes that its entry will facilitate the Commission's goals of enhancing competition, increasing capacity and encouraging innovation in services provided to consumers. Loral stands ready to conduct all additional coordination and consultations that transmitting to previously unserved areas may require, including additional frequency coordination (both domestically and internationally), and new Article XIV (d) consultations with Intelsat.[6]

Certain technical modifications to Loral Space's satellite system (as represented in its original application that was filed with the Commission on February 15, 1995), are necessary in order to facilitate the provision of international service from the satellites. Enclosed are copies of the technical modifications to the application. In brief, the modifications include changes to the mass and power budgets, service area coverage and antenna configuration. Because Loral Space is able to incorporate these changes at the early stages of the design and developed phase, the total cost of the satellite system will not change.

Loral Space submits an original and nine copies of a modification application to provide international service from its orbital locations at 79 degrees and 129 degrees west longitude along with one "Stamp Received" copy. Also enclosed is an FCC Form 159 and a check for $11,480 per Section 1.1107 of the Commission's Rules.

If you have any questions concerning this modification application, please contact me at the above address.

Very truly yours,

Michele R Pistone

Philip L. Verveer, Esq.
Michele R. Pistone, Esq.
Willkie Farr & Gallagher

---

6 Id.

LORAL SPACE

June 10, 1996

ORIGINAL

Before the

Federal Communications Commission

Washington, D.C.

Technical Modification to Application of

Loral Space & Communications Ltd.

To Expand the Operation of

Communications Satellites

in the Domestic Fixed-Satellite Service

to Include International Service

SUMMARY

LORAL SPACE & COMMUNICATIONS LTD ("Loral Space" or the "Applicant") seeks to modify certain technical aspects of its authorization to construct, launch and operate two hybrid C-band/Ku-bands satellites (at 77° W.L. and 129° W.L.). The technical modifications will facilitate the provision of service to North and South America from the satellites. At the time that Loral Space applied for authority to build its satellite system, the Commission treated domestic satellite systems and separate international systems under distinct regulatory policies. Since then, however, the Commission has revised these policies. In its DISCO I Order, the Commission consolidated the regulatory treatment of domestic satellites and separate systems under a unified "separate system" scheme.

Under the new rules, the Commission authorized domsat operators to provide international service by "automatically [modifying] all FSS space station licenses to allow the facilities to provide domestic and international services." Through this modification, Loral Space conforms with the consolidated regulatory policies adopted in DISCO I by providing service to domestic and international locations from its two orbital locations.

CONTENTS

ILLUSTRATIONS

TABLES

SECTION 1 - MODIFIED PROPOSAL

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

In the Matter of the Application of	)	
	)	
	)	
LORAL SPACE & COMMUNICATIONS LTD	)	File Nos. 72-SAT-P/LA-95
	)	73-SAT-P/LA-95
For Authority to Modify System Proposal	)	137-SAT-P-95
to Provide International Communications	)	
Satellites in the Domestic Fixed-Satellite	)	
Service	)	

MODIFIED APPLICATION

LORAL SPACE & COMMUNICATIONS LTD (the "Applicant" or "Loral Space"), hereby requests authority to provide international service from its two C-band/Ku-band satellites in the domestic fixed-satellite service ("FSS").[1]

Loral Space submits this modification application in response to the recent Commission decision to consolidate its regulatory policies concerning domestic satellites and separate international satellite systems.[2] At the time that Loral Space applied for authority to build its satellite system, the Commission treated domestic satellite systems and separate international systems under distinct regulatory

1 The FCC authorized Loral to construct, launch and operate these satellites in May 1996. See Assignment of Orbital Locations to Space Stations in the Domestic Fixed-Satellite Service; DA 96-713, (rel. May 7, 1996).

2 See In the Matter of Amendment to the Commission's Regulatory Policies Governing Domestic Fixed Satellites and Separate International Satellite Systems, 11 FCC Rcd 2429 (1996) ("DISCO I Order").

policies.[3] Since then, however, the Commission has revised these policies.[4] In its DISCO I Order, the Commission consolidated the regulatory treatment of domestic satellites and separate systems under a unified "separate system" scheme. The scheme was designed to "benefit users of satellite services by enhancing competition, increasing available capacity, and encouraging greater innovation in services at lower prices to consumers."[5]

Under the new rules, the Commission authorized domsat operators to provide international service by "automatically [modifying] all FSS space station licenses to allow the facilities to provide domestic and international services."[6]

The Commission recently assigned orbital locations to Loral Space for two C-band/Ku-band fixed-satellites to provide U.S. domestic coverage.[7] Loral Space would now like to take advantage of the consolidated regulatory policies adopted in DISCO I by providing service to domestic and international locations from its two new orbital locations. As a new entrant in the FSS satellite services market, Loral Space believes that its entry will facilitate the Commission's goals of enhancing competition, increasing capacity and encouraging innovation in services provided to consumers. In addition, by expanding the satellite system's coverage area, Loral Space will more efficiently use the orbital locations that have been licensed to it.

---

3 See Establishment of Satellite Systems Providing International Communications, 101 F.C.C. 2d 1046 (1985), recon., 61 R.R.2d 649 (1989), further recon., 1 F.C.C. Rcd 439 (1985) (establishing the Separate Systems Policy).

4 Amendment to the Commission's Regulatory Policies Governing Domestic Fixed Satellites and Separate International Systems, 11 F.C.C. Rcd 2429 (1996) ("DISCO I Order").

5 Id. at ¶ 34.

6 Id.

7 Assignment of Orbital Locations to Space Station in the Domestic Fixed Satellite, DA 96-713 (rel. May 7, 1996).

The satellite system proposed in this modified system application will provide C-/Ku-band communications capability for 12 years of life over the contiguous United States (CONUS), Alaska, Hawaii, Puerto Rico and the Virgin Islands, Mexico, Canada, and Central and South America. The Loral Space system will be composed of two satellites and two earth stations that will provide feeder links to the satellites and perform the functions of tracking, telemetry, and control (TT&C) of the spacecraft.

This submission sets out the technical modifications to Loral Space's applications that were filed on February 15, 1995 (The "Initial Application"). In brief, the modifications include changes to the mass and power budgets, service area coverage and antenna configuration. Because Loral Space is able to incorporate these changes at the early stages of the design and developed phase, the total cost of the satellite system will not change. Loral Space has either included in this modification application all information necessary to evaluate the request, or provided reference to other documents previously submitted to the Commission. Loral Space will supplement the instant application with such additional information as the FCC deems appropriate to grant the modification request.

SECTION 2 – PUBLIC INTEREST CONSIDERATIONS

It is in the public interest to encourage Loral Space to provide international service from its proposed satellites at 77 and 129 degrees W.L. Indeed, the Commission determined, in the DISCO I Order, that its decision to permit licensees to provide fixed-satellite service to domestic and international points would serve the public interest by enhancing competition, increasing available capacity, and encouraging the provision of innovative service at lower prices.[1] In that order, the Commission automatically modified all FSS space station licenses to permit the facilities to provide both domestic and international service.[2] This submission, accordingly, notifies the Commission that Loral Space intends to expand its coverage area to include service to international points, and modifies those sections of its Initial Applications to make them consistent with its revised service plan.

1 See DISCO I Order, at ¶ 33.
2 Id.

SECTION 3 - GENERAL SYSTEM DESCRIPTION

As stated in the Initial Application, the Loral Space System will be composed of two satellites for use at 77° W.L. and 129° W.L. The satellites, identical FS-1300 class, three-axis stabilized spacecraft, will operate in the C-band and Ku-band. Each satellite will have 24 C-band transponders and 48 Ku-band transponders which will serve North and South America. Full frequency reuse will be provided at C-band by using orthogonal linear polarization. At Ku-band, in addition to orthogonal linear polarization, geographical separation of beams will provide three times frequency reuse. The C-band transponders have been modified to operate at 60 watts. The Ku-band transponders will operate at 120 watts combinable to 240 watts. Sixteen of the Ku-band transponders will be switchable between two beam coverage areas. Sixteen will be dedicated to the north beam and 16 to the south beam. All transponders will contain commandable gain step attenuators.

The satellites will provide Ku-band coverage to the 48 contiguous states (CONUS), Alaska, Canada, Puerto Rico and the Virgin Islands, Mexico and the Central American countries except Panama, and to all countries in South America except for interior northern areas of Brazil and the Guyanas.

The satellites will also provide C-band coverage to all North, Central and South American countries.

The satellites will be designed for a 12-year service life. Receiver redundancy of 4-for-2 will be provided in C-band and 6-for-4 in Ku-band. Instead of using SSPA's for C-band, as stated in the Initial Application, the system will use all traveling wave tube amplifiers (TWTAs).

Uplink and TT&C facilities will be developed by the Applicant. The uplink facilities will primarily be for signal replaying and turnaround. There will be minimal production capabilities. Some Loral Space customers may have their own uplink facilities, which could be used to access leased transponders.

The number and distribution of earth stations will be commensurate with customer requirements of Loral Space's satellite system and will be the responsibility of the customer.

3.1 SERVICE TECHNICAL CHARACTERISTICS

As the Initial Application states, the service objective is to provide C-band and Ku-band transponder service optimized for delivering analog and compressed digital signals to cable headends and to provide digital business service communication links. The satellites will primarily provide point-to-point digital data transmission. The predominant transmission for Ku-band is anticipated to be single-carrier QPSK compressed digital TV, although the satellites can accommodate other types of traffic, e.g., QAM and SCPC.

3.1.1 Transmission Characteristics

As indicated in the Initial Application, the Loral Space satellites will provide analog FM-TV signals and compressed digital TV. The compressed digital TV will use QPSK or QAM with forward error correction (FEC). A typical modulation will be 21M symbols/second rate QPSK with a net data rate of 24 Mb/s. The high degree of FEC results in an abrupt threshold in picture quality corresponding to an E_b/N_o of about 5.5 dB. Above that level the picture is essentially noiseless; below it the picture quickly becomes unusable. The transmission objective is to minimize link outage due to rain fade. The antenna coverages will be weighted to provide increased gain to those areas of the U.S. which require higher EIRP to offset rain fade.

3.2 ANTENNA COVERAGE PATTERNS

The satellites will provide simultaneous Ku-band coverage to:

a. CONUS, Alaska, Hawaii, Canada, Mexico, Puerto Rico and the Virgin Islands, and Central American countries except Panama.

b. All countries of South America except for the northern and interior regions of Brazil and the Guyanas.

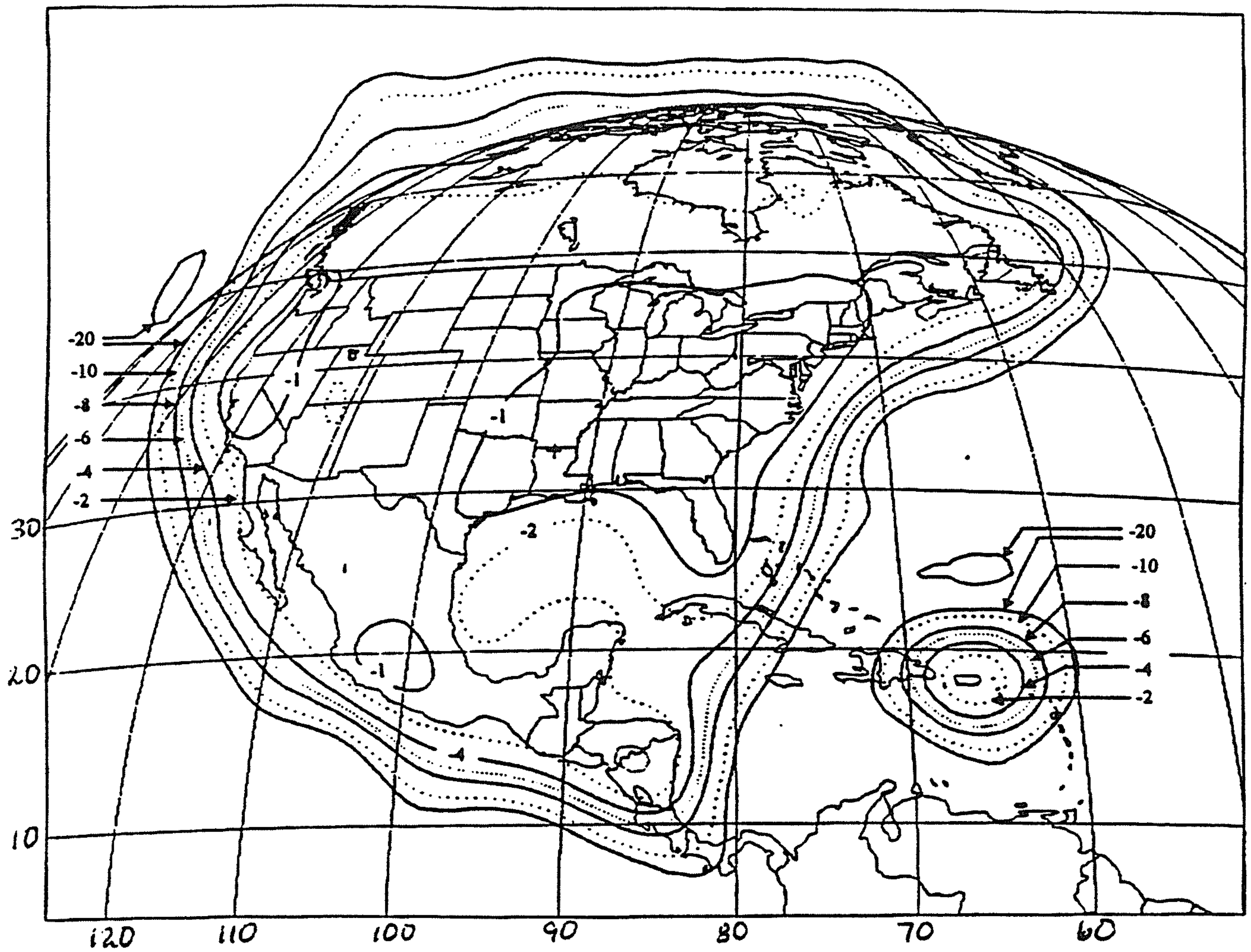
C-band antenna coverage of all the Americas is provided by a dual-gridded transmit/receive antenna that uses a shaped reflector. Ku-band antenna coverage is provided via four shaped-reflector antennas. The Ku-band antennas utilize Gregorian optics for high-polarization purity. The antennas will provide nearly identical patterns for each polarization. Modified Figures 3-1 through 3-6 give the predicted transmit and receive coverage contours for the orbital locations of 77° W and 129° W.

3.3 LINK BUDGETS

Typical C- and Ku-band uplink budget data for the feeder links are given in Tables 3-1a and 3-1b. For the Ku-band compressed digital transmission, it is anticipated that a combination of rain fade control and spatial diversity will be used to essentially eliminate any link outage due to rain fade on the uplink.

Downlink budgets for C-band are presented in Table 3-2a for a 6-meter earth station.

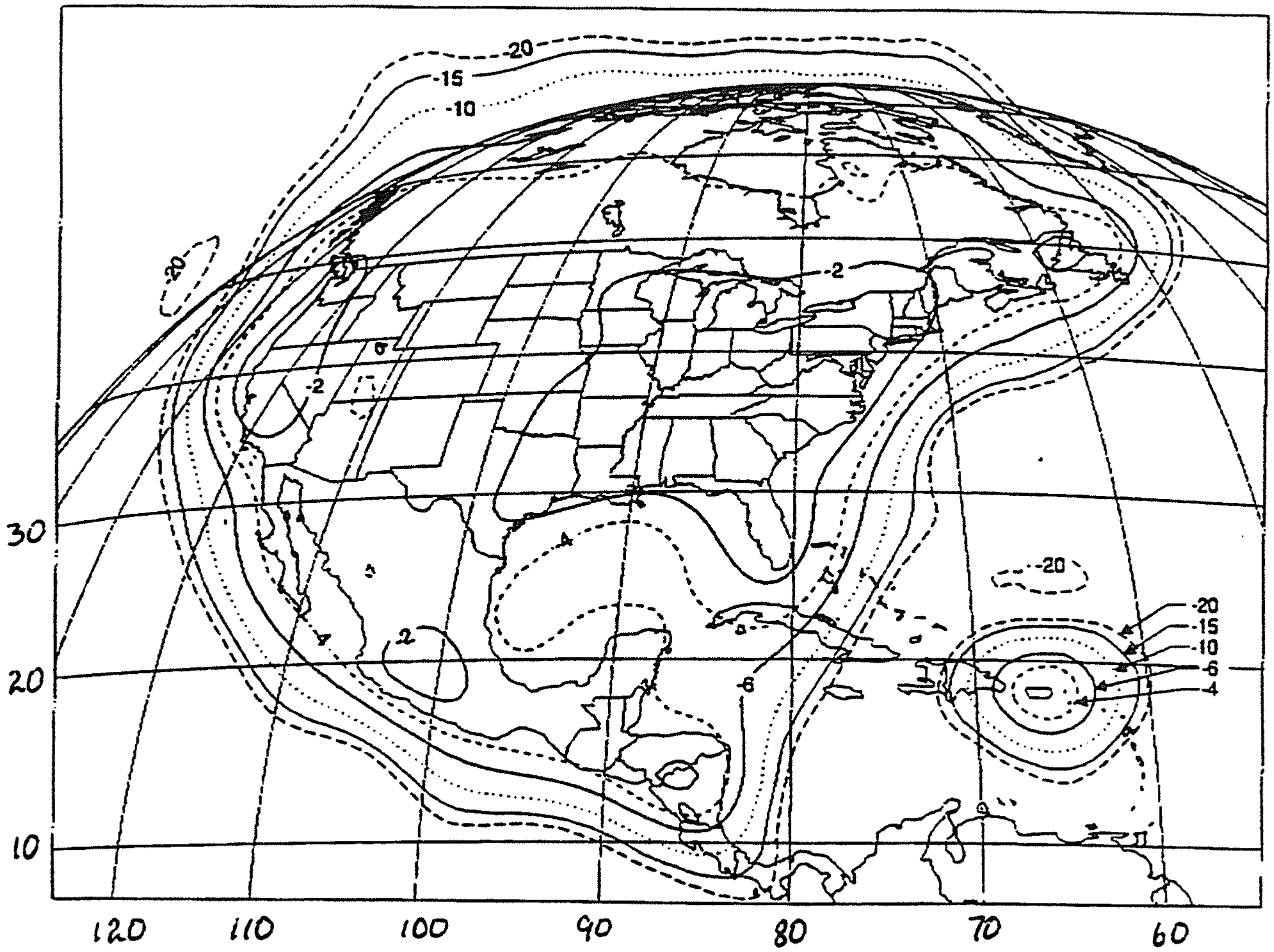
Downlink budgets for Ku-band are given in Table 3-2b for a 4.5-meter earth station typical of broadcast stations or cable headends. The clear sky link margin is tabulated, followed by the predicted link availability. The availability prediction is based on the CCIR/ITU (1994) Rain Model and includes the effects of increased noise during rain as well as rain attenuation. The earth terminal latitude, altitude, elevation to the spacecraft, and the rain zone are used in the calculation. Broadcast stations and cable headends in high rain rate regions such as Miami and Houston can use spatial diversity for improved availability.



Notes:

1. Contours shown are -1, -2, -4, -6, -8, -10, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +31.4 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. X Denotes subsatellite point.
5. + Denotes peak gain.

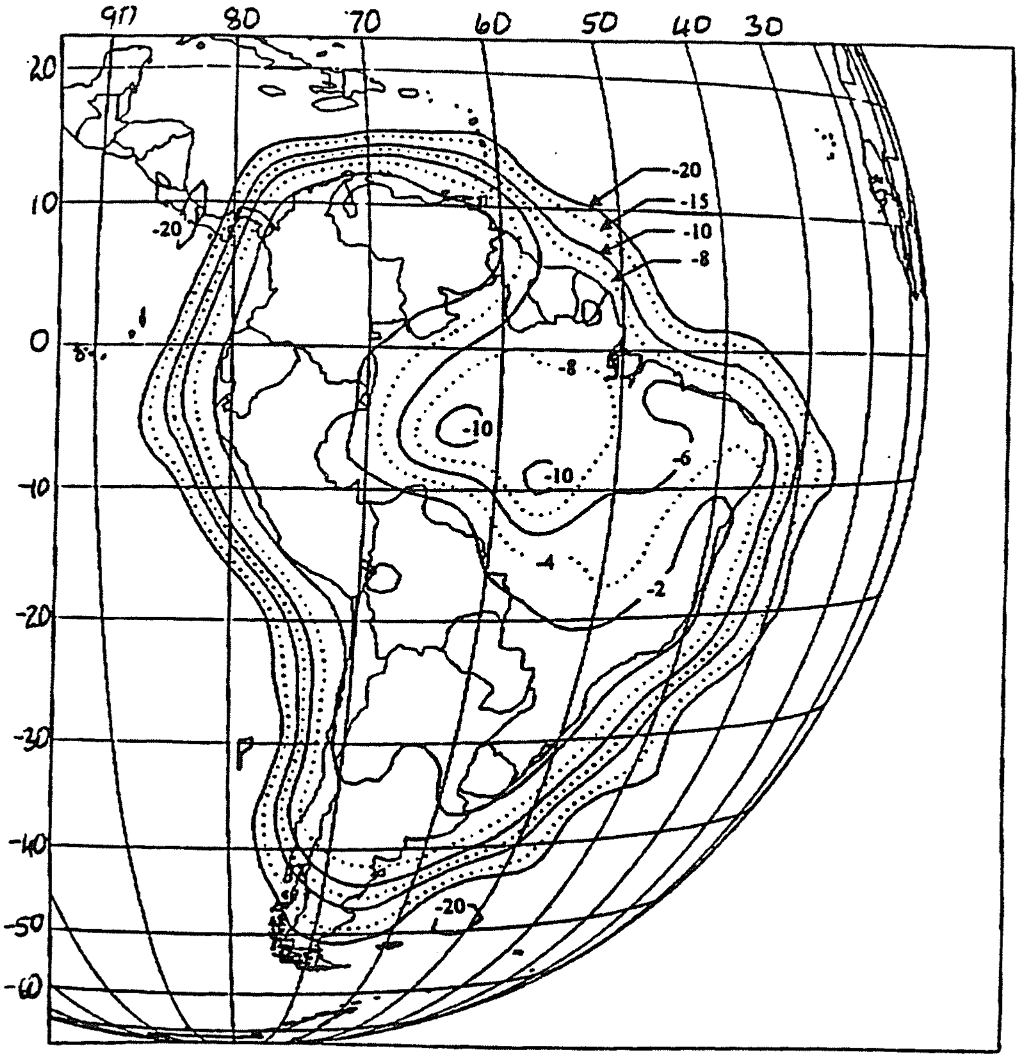
Figure 3-1a. North American Ku-Band Transmit Coverage from 77° W.L.



Notes:

1. Contours shown are -2, -4, -6, -10, -15, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +31.4 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. X Denotes subsatellite point.
5. + Denotes peak gain.

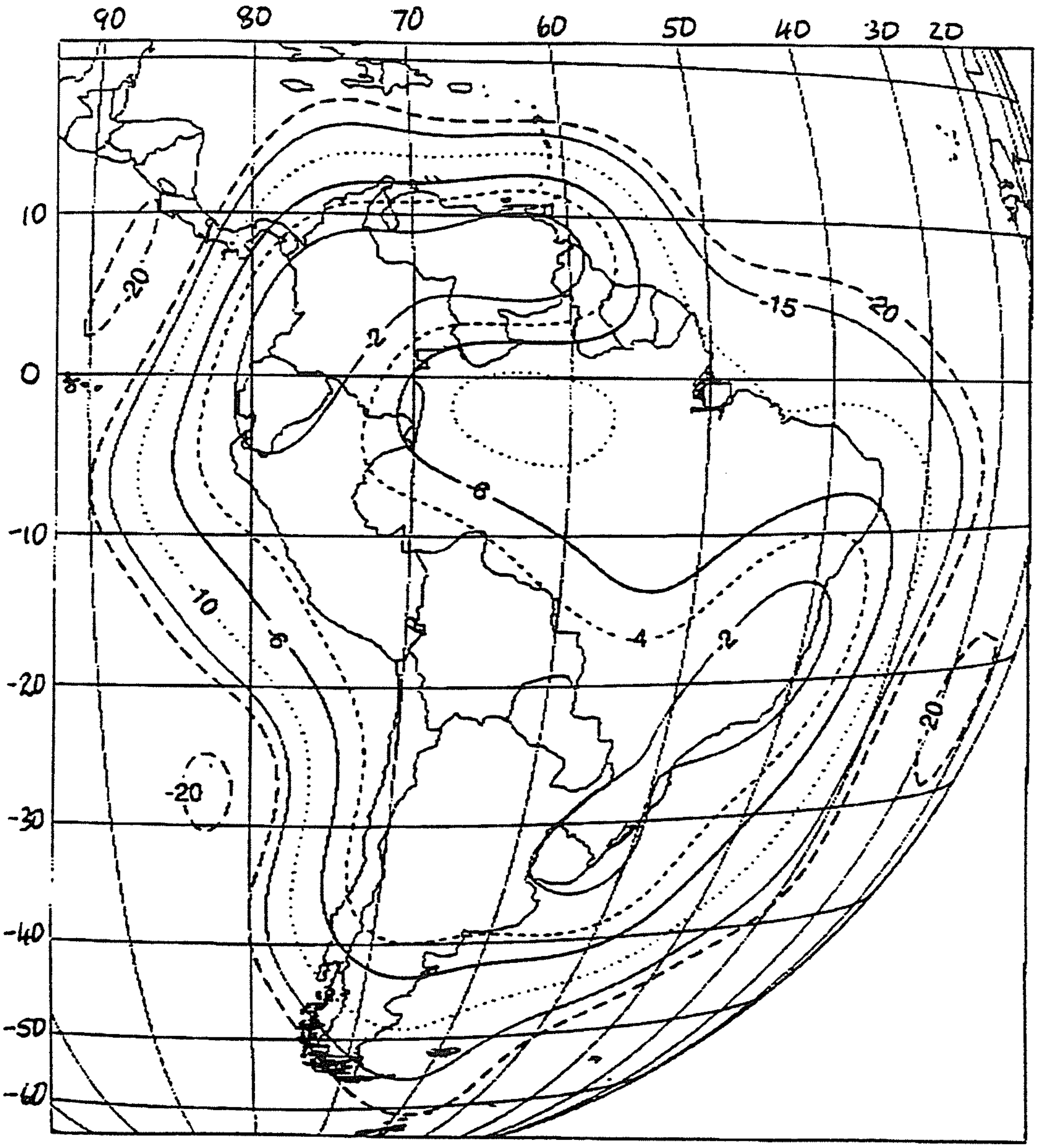
Figure 3-1b. North American Ku-Band Receive Coverage from 77° W.L.



Notes:

1. Contours shown are -2, -4, -6, -8, -10, -15, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +30.4 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. X Denotes subsatellite point.
5. + Denotes peak gain.

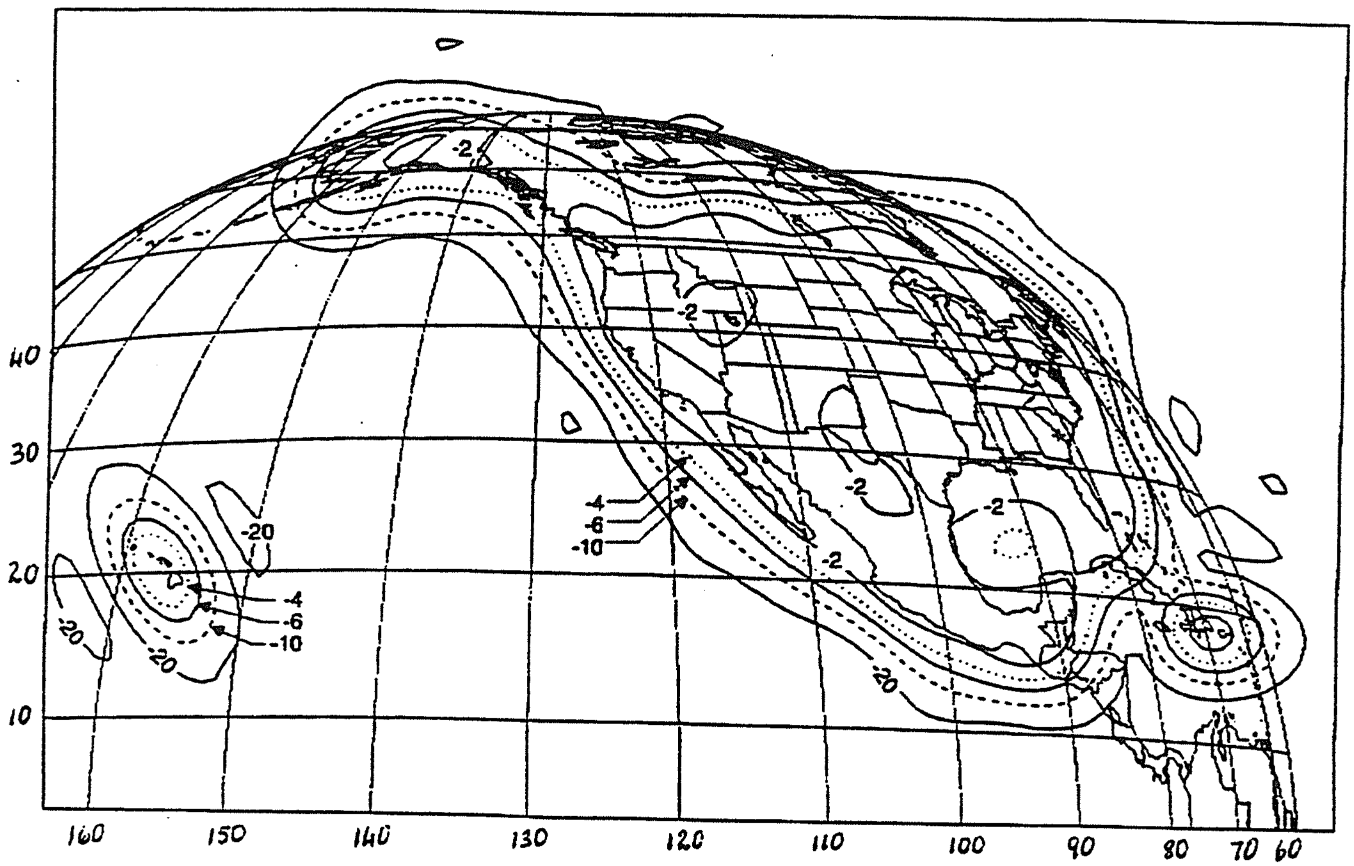
Figure 3-2a. South American Ku-Band Transmit Coverage from 77° W.L.



Notes:

1. Contours shown are -2, -4, -6, -10, -15, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +30.4 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. X Denotes subsatellite point.
5. + Denotes peak gain.

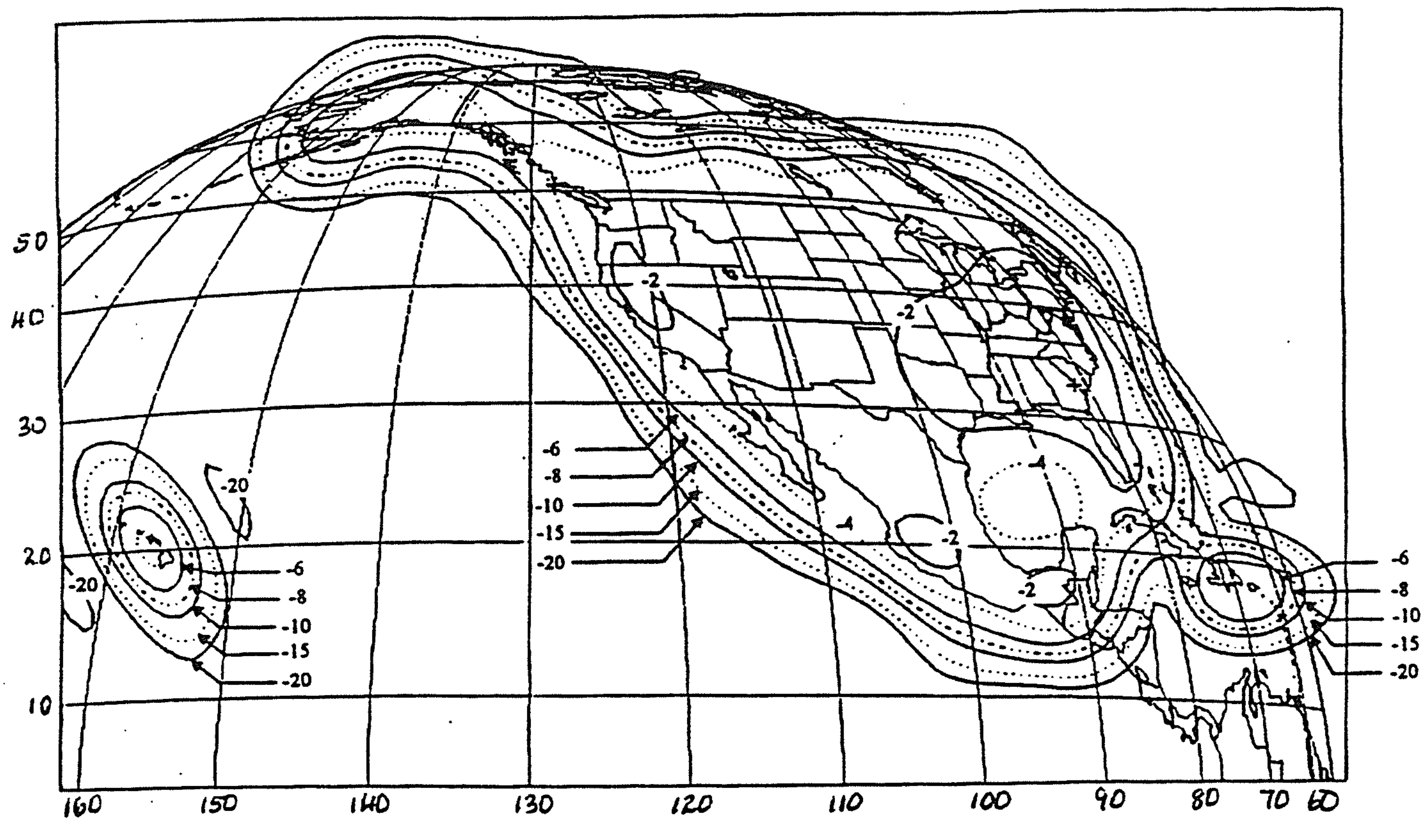
Figure 3-2b. South American Ku-Band Receive Coverage from 77° W.L.



Notes:

1. Contours shown are -2, -4, -6, -10, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +32.1 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. + Denotes peak gain.

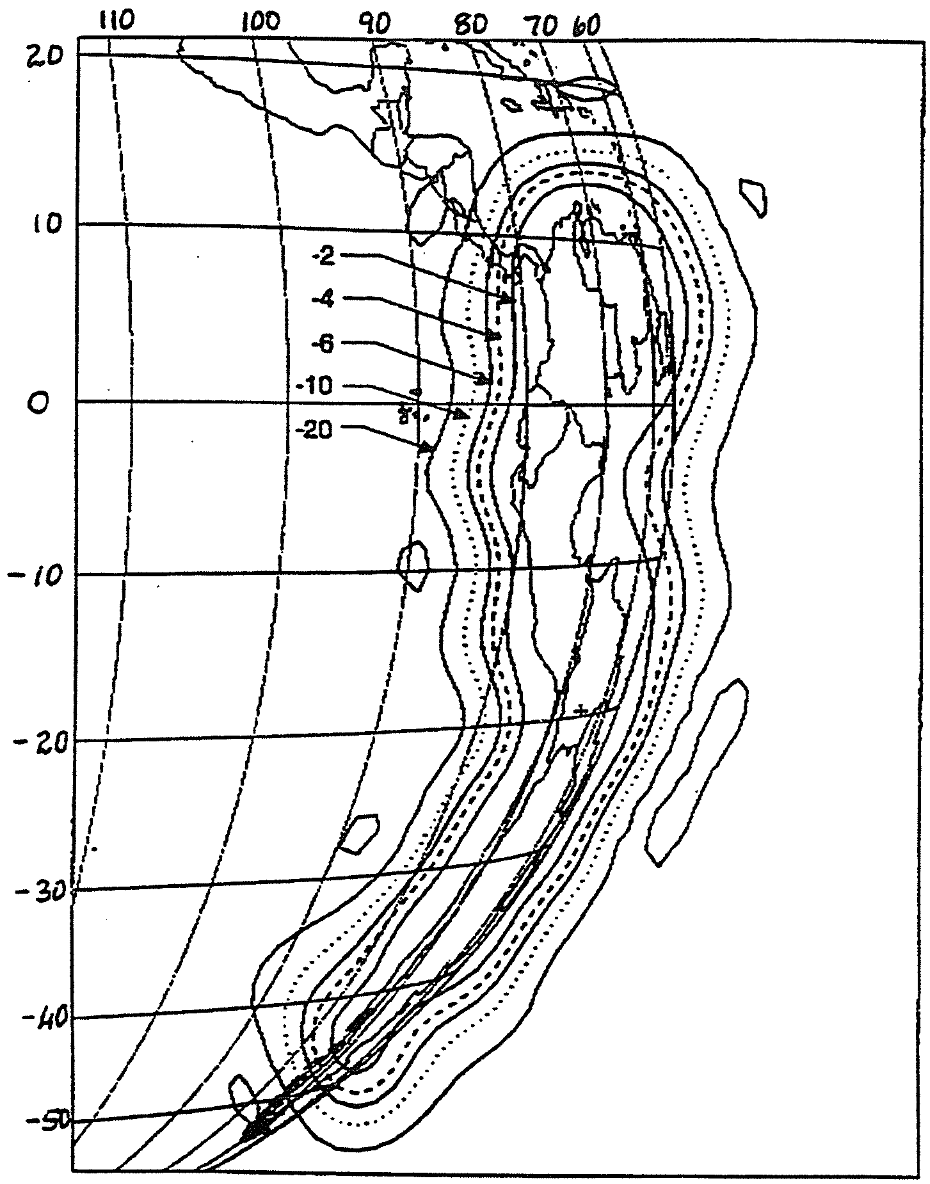
Figure 3-3a. North American Ku-Band Transmit Coverage from 129° W.L.



Notes:

1. Contours shown are -2, -4, -6, -8, -10, -15, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +32.1 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. + Denotes peak gain.

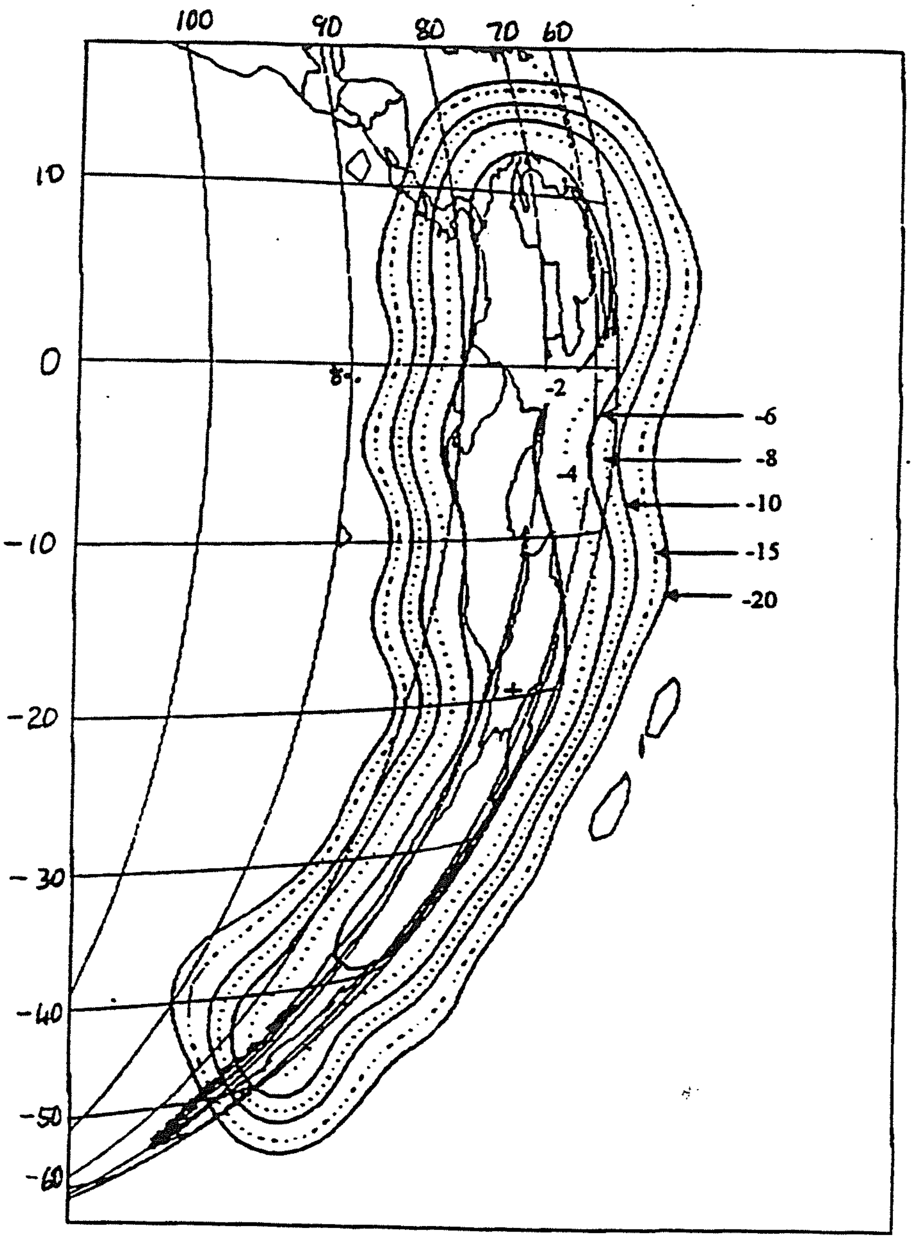
Figure 3-3b. North American Ku-Band Receive Coverage from 129° W.L.



Notes:

1. Contours shown are -2, -4, -6, -10, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +34.5 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. + Denotes peak gain.

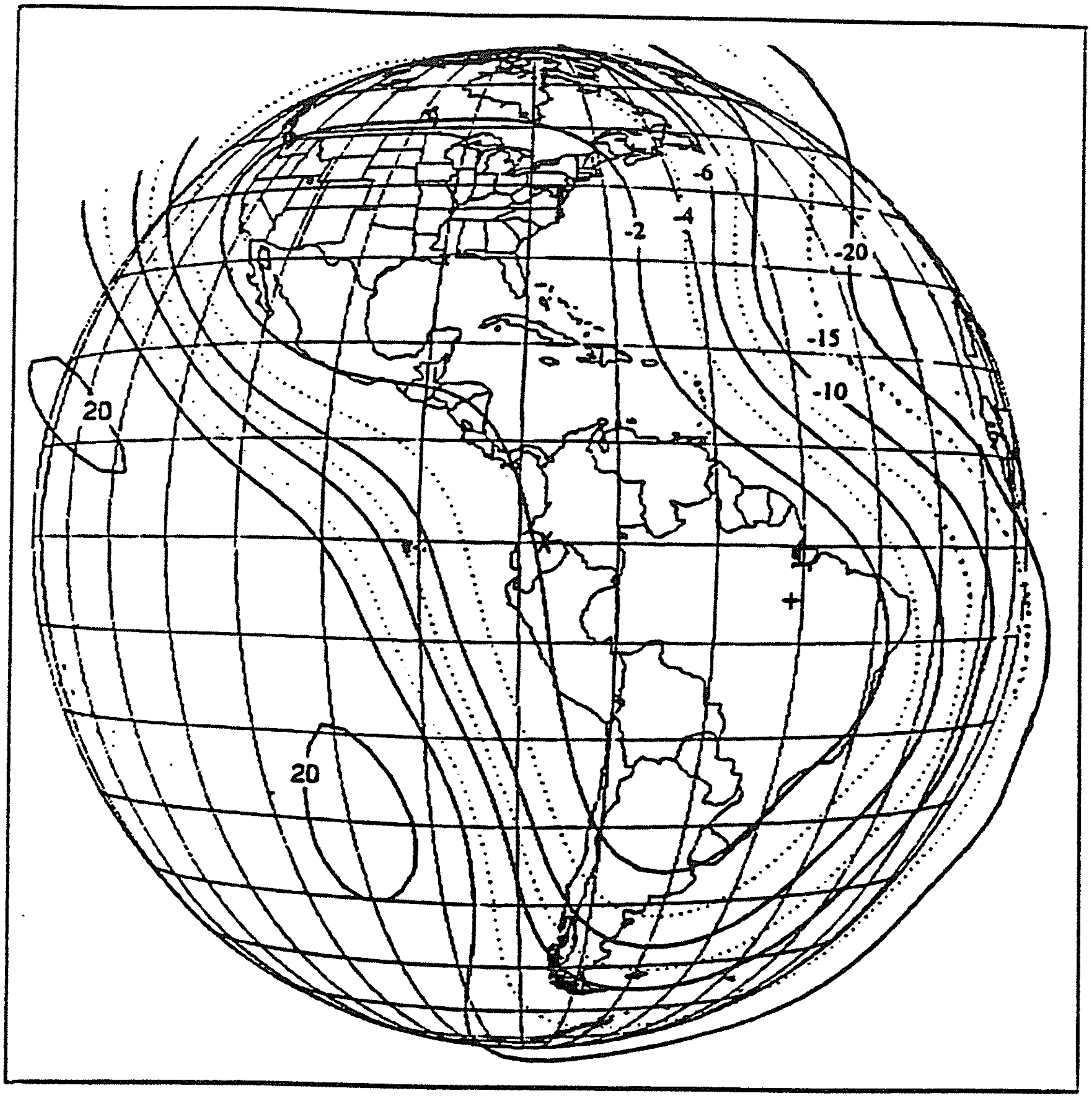
Figure 3-4a. South American Ku-Band Transmit Coverage from 129° W.L.



Notes:

1. Contours shown are -2, -4, -6, -8, -10, -15, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +34.5 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. + Denotes peak gain.

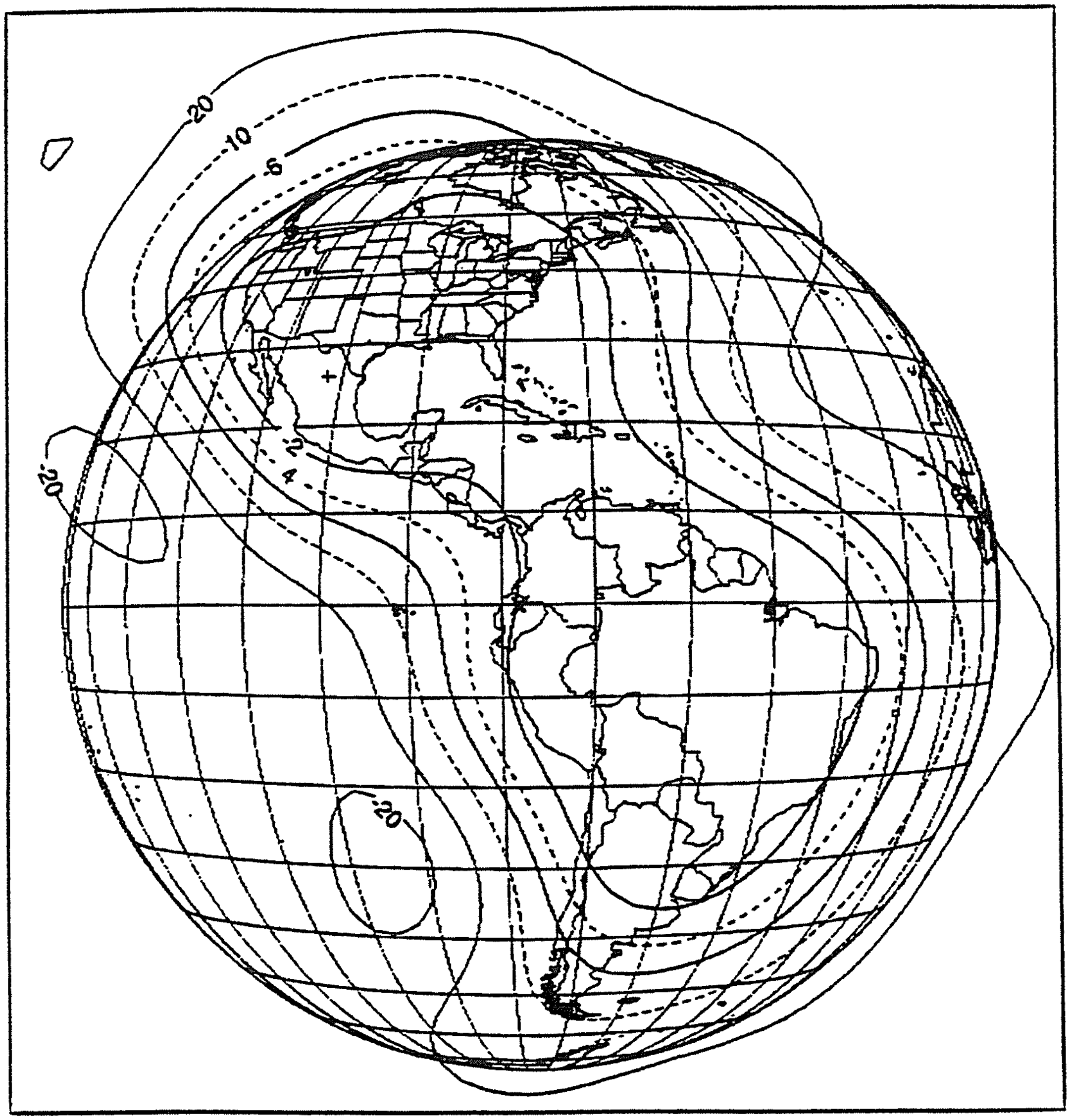
Figure 3-4b. South American Ku-Band Receive Coverage from 129° W.L.



Notes:

1. Contours shown are -2, -4, -6, -10, -15, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +24.9 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. X Denotes subsatellite point.
5. + Denotes peak gain.

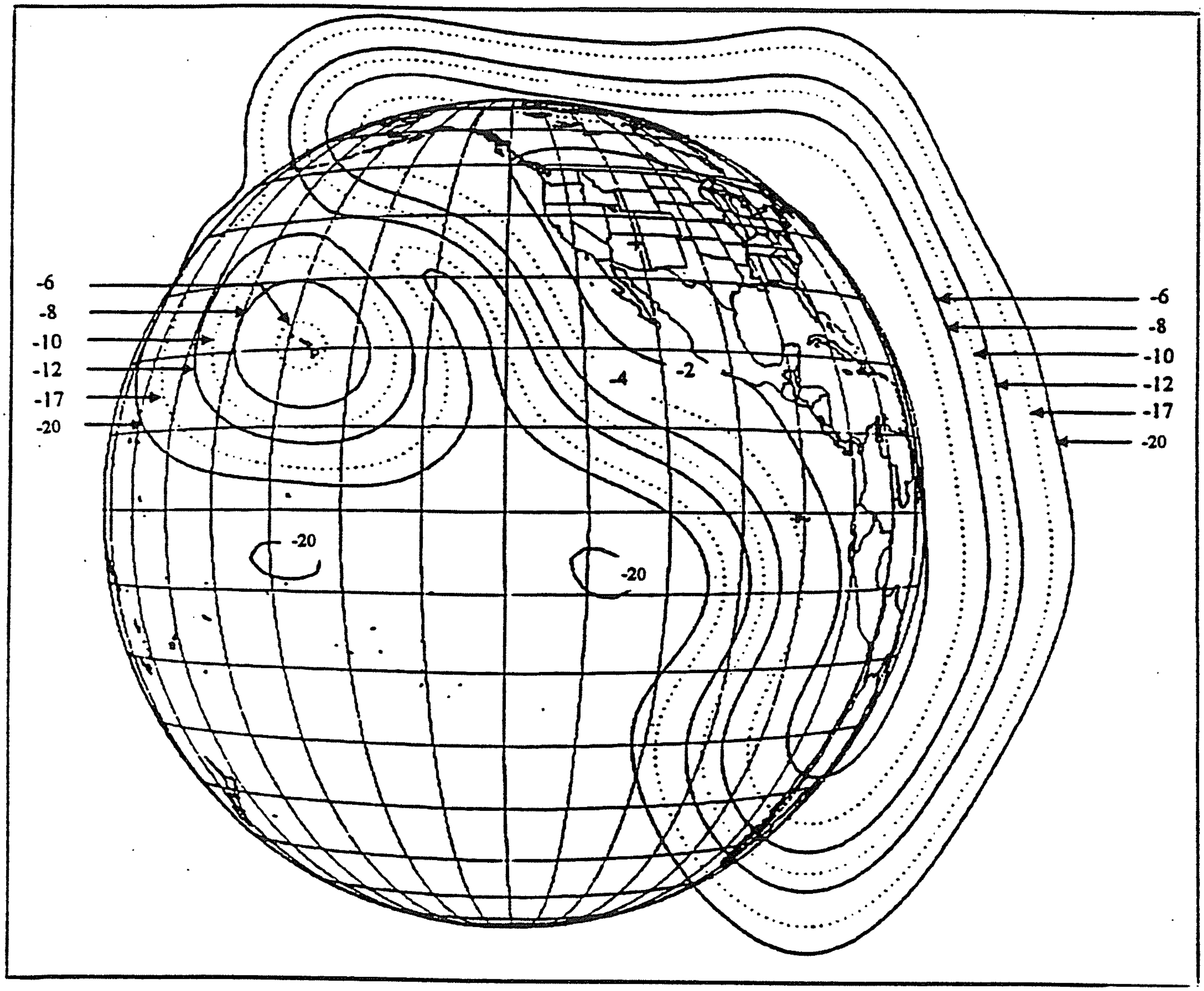
Figure 3-5a. C-Band Transmit Coverage from 77° W.L.



Notes:

1. Contours shown are -2, -4, -6, -10, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +24.9 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. X Denotes subsatellite point.
5. + Denotes peak gain.

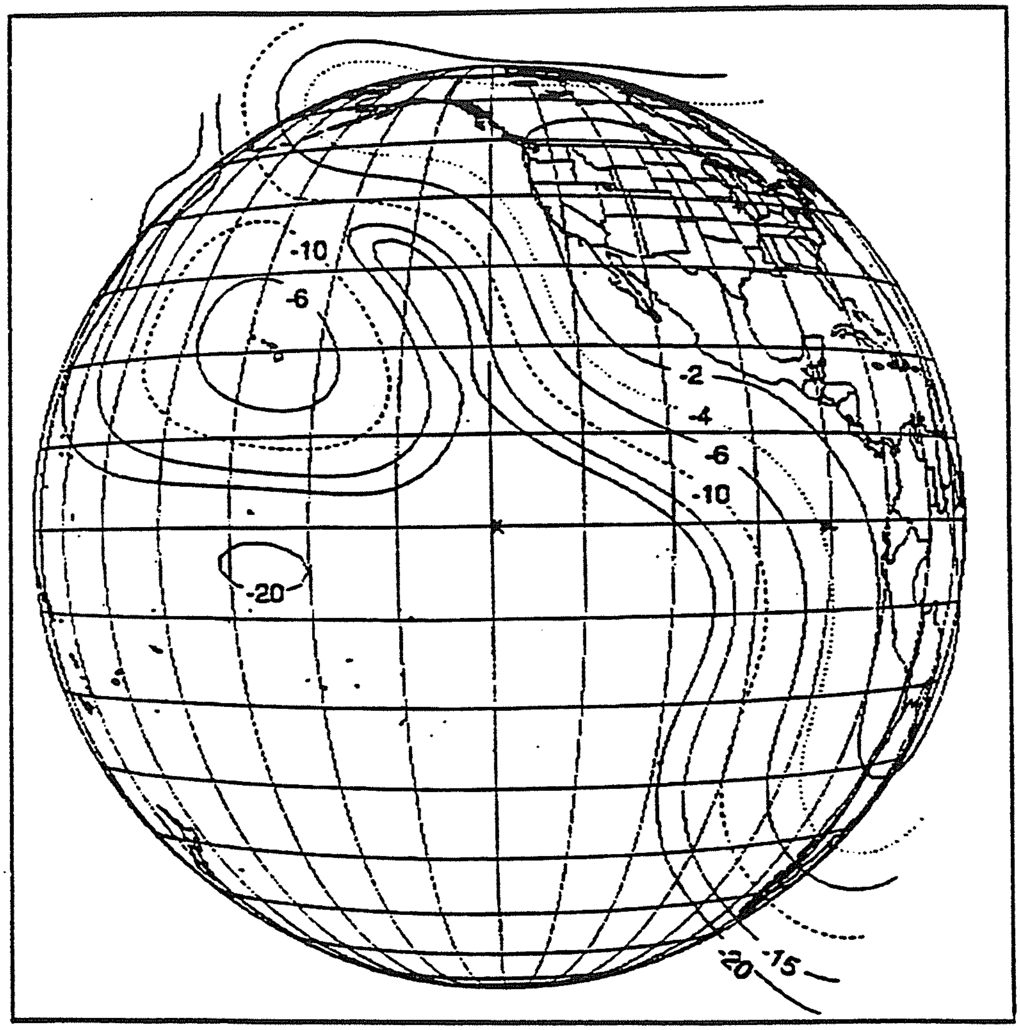
Figure 3-5b. C-Band Receive Coverage from 77° W.L.



Notes:

1. Contours shown are -2, -4, -6, -8, -10, -12, -17, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +25.7 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. X Denotes subsatellite point.
5. + Denotes peak gain.

Figure 3-6a. C-Band Transmit Coverage from 129° W.L.



Notes:

1. Contours shown are -2, -4, -6, -10, and -20 dB relative to maximum gain.
2. Maximum isotropic gain is +25.7 dBi.
3. Does not include antenna pointing error of ±0.1° worst case.
4. X Denotes subsatellite point.
5. + Denotes peak gain.

Figure 3-6b. C-Band Receive Coverage from 129° W.L.

Table 3-1a. C-Band Uplink Budget Summary

Parameter	77° W.L.	129° W.L.
Carrier Frequency (GHz)	6.175	6.175
EIRP (dBW)	72	72
Path Loss (dB)	-200.1	-200.1
Atmospheric Loss (dB)	-0.2	-0.2
Combined Space Loss (dB)	-200.3	-200.3
Rain Attenuation (dB)	0.0	0.0
Incident Isotropic Power (dB)	-128.4	-128.4
Receive Antenna Gain (dB)	22.9	24.0
System Temperature (dB-K)	27.8	27.8
Receiver G/T (dB/K)	-4.9	-3.8
C/No (dB-Hz)	95.3	96.4
Transponder Bandwidth (dB-Hz)	75.6	75.6
Transponder S/N (dB)	19.7	20.8

Table 3-1b. Ku-Band Uplink Budget Summary

	77° W.L.		129° W.L.	
Parameter	North America	South America	North America	South America
Carrier Frequency	14.250 GHz	14.250 GHz	14.250 GHz	14.250 GHz
On-axis EIRP	73.4 dBW	73.4 dBW	73.4 dBW	73.4 dBW
Pointing Loss	-0.1 dB	-0.1 dB	-0.1 dB	-0.1 dB
EIRP (Including Pointing Loss)	73.3 dBW	73.3 dBW	73.3 dBW	73.3 dBW
Range Factor (39,598 km)	-162.9 dB-m^2	-162.9 dB-m^2	-162.9 dB-m^2	-162.9 dB-m^2
Atmospheric Loss	-0.3 dB	-0.3 dB	-0.3 dB	-0.3 dB
Incident Flux Density	-90.0 dBW/m^2	-90.0 dBW/m^2	-90.0 dBW/m^2	-90.0 dBW/m^2
Aperture Factor	-44.5 dB-m^2	-44.5 dB-m^2	-44.5 dB-m^2	-44.5 dB-m^2
Incident Isotropic Power	-134.5 dBWi	-134.5 dBWi	-134.5dBWi	-134.5 dBWi
Antenna Gain	26.4 dB	27.4 dB	28.1 dB	31.5 dB
Line Loss	-1.0 dB	-1.0 dB	-1.0 dB	-1.0 dB
Net gain at receiver	25.4 dB	26.4 dB	27.1 dB	30.5 dB
Net Receiver Input Power	-109.1 dBW	-108.1 dBW	-107.4 dBW	-104.0 dBW
System Temp (515.7 K) (Ta=290 K, Rcvr NF=2.5 dB)	27.1 dB-K	27.1 dB-K	27.1 dB-K	27.1 dB-K
Receive G/T	-1.7 dB/K	-0.7 dB/K	0.0 dB/K	3.4 dB/K
C/No	92.4 dB-Hz	93.4 dB-Hz	94.1 dB-Hz	97.5 dB-Hz
Transponder Bandwidth (27 MHz)	74.3 dB-Hz	74.3 dB-Hz	74.3 dB-Hz	74.3 dB-Hz
Transponder S/N Ratio	18.1 dB	19.1 dB	19.8 dB	23.2 dB
Max EIRP capability	80.9 dBW	80.9 dBW	8170.9 dBW	80.9 dBW
Uplink Rain Fade Margin	7.5 dB	8.5 dB	9.2 dB	12.6 dB

Table 3-2a. C-Band Downlink Summary

Parameter	77° W.L.	129° W.L.
Carrier Frequency (GHz)	3.95	3.95
Transmit Power (dBW)	17.8	17.8
Antenna Gain (EOC) (dBi)	22.9	24.0
Transmission Loss (dB)	1.7	1.7
EIRP (dBW)	39.0	40.1
Path Loss (dB)	-196.2	-196.2
Atmospheric Loss (dB)	-0.2	-0.2
Combined Space Loss (dB)	-196.4	-196.4
Rain Attenuation (dB)	0.0	0.0
Incident Isotropic Power (dB)	-157.4	-156.3
Receive Antenna Gain (dB)	46.0	46.0
System Temperature (dB-K)	27.8	27.8
Receive G/T (dB/K)	18.2	18.2
C/No (dB-Hz)	89.4	90.5
Transponder Bandwidth (dB-Hz)	75.6	75.6
Transponder S/N (dB)	13.8	14.9

Table 3-2b. Ku-Band Downlink Budget Summary

77° W.L.	North America (Miami)	Puerto Rico/U.S. Virgin Islands	South America (Rio)
EIRP at edge of coverage, dBW	48.2	48.2	49.2
Path loss, dB	-205.7	-205.7	-205.7
Net incident isotropic power, dBWi	-157.5	-157.5	-156.5
4.5-m dish performance			
G/T, dB/K	30.5	30.5	30.5
C/No, dB-Hz	101.6	101.6	102.6
Net data rate (24 Mb/s), dB-Hz	73.8	73.8	73.8
Eb/No, dB	27.8	27.8	28.8
Eb/Io, dB	30.0	30.0	30.0
Eb/(No+Io), dB	25.8	25.8	26.3
Required Eb/(No+Io), dB	5.5	5.5	5.5
Clear sky margin, dB	20.3	20.3	20.8
Availability, %	>99.99	>99.99	>99.99
Minutes/month outage	<4	<4	<4

129° W.L.	North America (Miami)	Puerto Rico/U.S. Virgin Islands	South America (Rio)
EIRP at edge of coverage, dBW	49.9	49.9	50.3
Path loss, dB	-205.7	-205.7	-205.7
Net incident isotropic power, dBWi	-155.8	-155.8	-155.4
4.5-m dish performance			
G/T, dB/K	30.5	30.5	30.5
C/No, dB-Hz	103.3	103.3	103.7
Net data rate (24 Mb/s), dB-Hz	73.8	73.8	73.8
Eb/No, dB	29.5	29.5	29.9
Eb/Io, dB	30.0	30.0	30.0
Eb/(No+Io), dB	26.7	26.7	26.9
Required Eb/(No+Io), dB	5.5	5.5	5.5
Clear sky margin, dB	21.2	21.2	21.4
Availability, %	>99.99	>99.99	>99.99
Minutes/month outage	<4	<4	<4

SECTION 4 – DESCRIPTION OF SERVICES PROVIDED

Loral Space proposes to construct, launch and operate general purpose communications satellites for service to North and South America. Depending upon the needs of the transponder customers, the transponders can be used for television, radio, voice or data communications. The types of services that the satellites will be capable of providing include: distance learning, cable television programming, sports programming, niche programming, interactive services, teleconferencing, business video, training, very small aperture terminals, direct-to-home and pay-per-view.

The Loral Space satellites will provide analog applications and compressed digital signals from Ku-band and from C-band transponders. The C-band transponders will meet the increasing demand for capacity from C-band customers on satellites that are close to their end of life. In addition demand for Ku-band capacity is very strong.

SECTION 5 – ORBITAL ARC CONSIDERATIONS

Loral Space has recently been assigned orbital locations at 77° W.L. and 129° W.L. These locations provide for optimized coverage, elevation angles and service availability. In addition, these locations ensure that the Loral Space system will provide the maximum operational, economic and public interests benefits to users within the proposed service area.

Loral Space intends to provide video, data and audio capacity to satellite users in CONUS, Alaska, Hawaii, Puerto Rico and the Virgin Islands, Mexico, Canada, and Central and South America. This coverage, particularly for Ku-band, is critical to certain customers, especially those providing distance learning services. To provide the full capacity of coverage to the proposed international service areas, Loral Space respectfully requests authorization for extended coverage from 77° and 129° W.L. The 77° orbital position can satisfy customer requirements by providing efficient coverage of the east coast of the United States, Puerto Rico and the Virgin Islands, particularly given the high rain rate in the southern states. In addition, the 77° W.L. orbital location allows excellent service availability to Central and South America. From the 129° orbital position, Loral Space will be able to provide coverage to the continental United States, as well as Alaska[1] and Hawaii and efficient service in the high rain rate areas of Washington and Oregon. The 129° W.L. position allows service coverage to Canada, Mexico, and western portions of South America. Together, the Loral Space satellites will be able to meet customer requirements for

---

[1] The Commission seeks to increase service to Alaska. See Integration of Rates and Services for the Provision of Communications by Authorized Common Carriers Between the Contiguous United States and Alaska, Hawaii, Puerto Rico, and the Virgin Islands, 75 R.R. 2d 279 (1994).

50-state and Puerto Rico/Virgin Island coverage as well as furthering the Commission's intention to enhance competition and encourage innovation in the provision of satellite services.[1]

[1] See generally, DISCO I Order, at ¶ 33.

SECTION 6 - SATELLITE SYSTEM DESCRIPTION

Loral Space will use spacecraft based upon a three-axis, FS-1300 class satellite built by Space Systems/Loral ("SS/L"). The design is for a hybrid C-band and Ku-band repeater that provides full frequency reuse in the C-band and three times reuse at the Ku-band. Each satellite contains 24 C-band and 48 Ku-band transponders operating at 36 MHz and 27 MHz bandwidth channels, respectively. The C-band transponders are powered through 60-watt traveling wave tube power amplifiers (TWTAs). The Ku-band power is provided through 120-watt TWTAs. Groups of 16 Ku-band transponders are dedicated as follows: 16 dedicated to the northern beam, 16 dedicated to the southern beam, and 16 switchable between north and south.

The satellite design conforms to the International Radio Regulations technical standards, Part 25 of the Commission's Rules and Regulations, and CC Docket No. 81-704's Report and Order. The design is also fully compatible with the Commission Docket's 2-degree orbital separation plan. Table 6-1 summarizes the major spacecraft characteristics, as modified. Additional information is contained in the Appendix 3 - Section Z (AP3/II) Form of Notice documents submitted by the Commission to the ITU on June 1, 1996. The following subsections describe the satellite design in more detail.

Table 6-1. Modified Spacecraft Characteristics Summary

Parameter	Value
General	
Mission Life	12 years
Stabilization	Three-axis
Stationkeeping	±0.05° N-S, E-W
Eclipse capability	100%
Antenna pointing accuracy	Within 0.13°, half cone
Launch vehicle	Compatible with Atlas 2 and Ariane 4 series
Communications	
Frequency band	C and Ku
Antenna coverage	From 77° W: The 48 contiguous states (CONUS), Canada, Puerto Rico and the Virgin Islands, Mexico and all countries of Central America except Panama. The countries of South America except for the interior and northern areas of Brazil and the Guyanas. From 129° W: The 48 contiguous states (CONUS), Alaska, Hawaii, Canada, Mexico, Puerto Rico and the Virgin Islands. The western coastal countries of South America plus Venezuela and Bolivia.
Polarization	Orthogonal linear
Number of transponders	24 C-band 48 Ku-band, a maximum of 32 in any (north or south) beam, 16 switchable between north and south beams.
Usable bandwidth	864 MHz at C-band 1728 MHz in Ku-band
Transmitter RF power	60 watts C-band, 120/240 watts Ku-band
Redundancy	
Receivers	4-for-2 at C-band, Ku-band 6-for-4
Channel amplifiers and TWTAs	Four rings of 8-for-6 for C-band Four rings of 16-for-12 for Ku-band
Tracking, Telemetry, and Command (TT&C)	
Frequency	Ku-band
Ground station locations	Two: one in the western United States, one in the eastern United States

6.1 COMMUNICATIONS SUBSYSTEM

6.1.1 C-Band Communications

The primary functions of the C-band payload are as follows:

a. Receive information contained within a given signal channel, amplify, translate frequency, and retransmit the signal without introducing distortion or noise to provide a "transparent" spacecraft repeater.

b. Provide 24 channels, each 36-MHz wide. This is accomplished by frequency reuse and is implemented by providing polarization isolation in the antenna beams.

c. Be able, upon ground command, to adjust repeater gain, switch between redundant units, and configure the payload so that it may operate in a mode that is compatible with the operational requirements.

6.1.1.1 Capacity

Twenty-four C-band transponders provide full frequency reuse with a 864-MHz usable bandwidth (1000 MHz, including guard bands). Each satellite has 24 36-MHz transponders that provide 60 watts at saturation, instead of 20 watts as indicated in the Initial Application. The transponders will contain commandable gain step attenuators and automatic gain control to mitigate the effects of uplink rain fade. The power subsystem is sized to provide simultaneous operation of all transponders at saturation for a minimum of 12 years with 100% eclipse operation.

6.1.1.2 Transponder Frequency and Polarization Plan

As the Initial Application states, linear polarization will be used. A transponder's uplink and downlink polarizations will be orthogonal. Cross-polarization isolation within the proposed coverage areas will be a minimum of 30 dB.

The C-band transponders will transmit (downlink) in the 3700-4200 MHz and receive (uplink) in the 5925-6425 MHz band. Twenty-four transponders, each having a 36-MHz bandwidth, are provided. The proposed frequency and polarization plan is illustrated in Figure 6-1 and Table 6-2.

Spurious emissions outside the usable bandwidth of each transponder will be attenuated by filtering as follows:

Percent of authorized bandwidth	Attenuation in any 4-kHz band
1. For any frequency removed from the assigned frequency by 50 to 100%	>25 dB
2. For any frequency removed from the assigned frequency by 100 to 250%	>35 dB
3. For any frequency removed from the assigned frequency by more than 250%	>60 dB

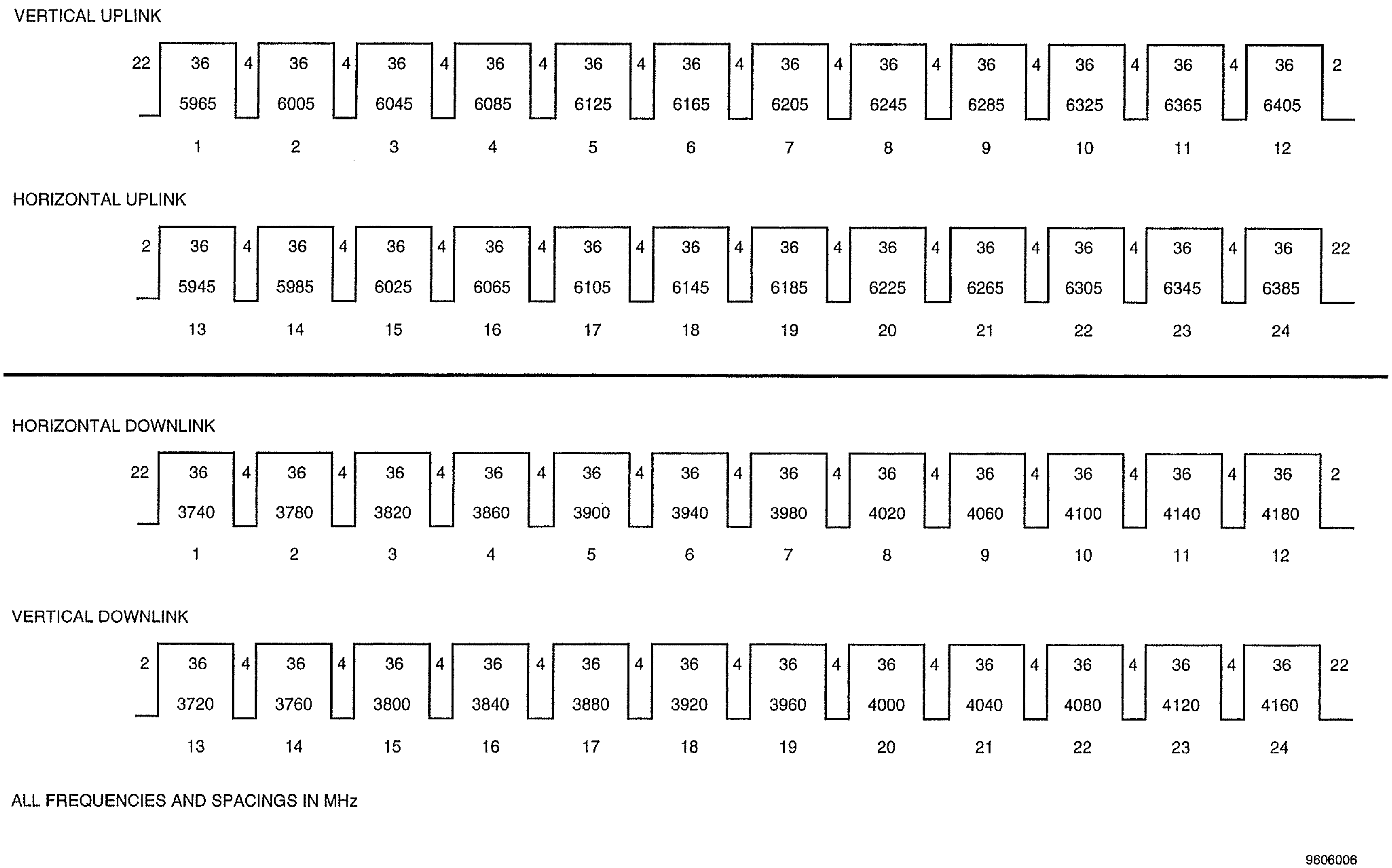


Figure 6-1. C-Band Frequency Plan

Table 6-2. C-Band Frequency and Polarization Plan

Channel	Bandwidth (MHz)	Polarization (Up/Down)	Uplink Center Frequency (MHz)	Downlink Center Frequency (MHz)
1	36	V/H	5965	3740
2	36	V/H	6005	3780
3	36	V/H	6045	3820
4	36	V/H	6085	3860
5	36	V/H	6125	3900
6	36	V/H	6165	3940
7	36	V/H	6205	3980
8	36	V/H	6245	4020
9	36	V/H	6285	4060
10	36	V/H	6325	4100
11	36	V/H	6365	4140
12	36	V/H	6405	4180
13	36	H/V	5945	3720
14	36	H/V	5985	3760
15	36	H/V	6025	3800
16	36	H/V	6065	3840
17	36	H/V	6105	3880
18	36	H/V	6145	3920
19	36	H/V	6185	3960
20	36	H/V	6225	4000
21	36	H/V	6265	4040
22	36	H/V	6305	4080
23	36	H/V	6345	4120
24	36	H/V	6385	4160

H: Horizontal Polarization
V: Vertical Polarization

6.1.1.3 Subsystem Configuration

The block diagram of the C-band communications subsystem is shown in Figure 6-2. The design features a dual-gridded shaped reflector transmit/receive antenna on the earth face of the satellite, with the front subreflector providing vertical polarization and the rear subreflector providing horizontal polarization.

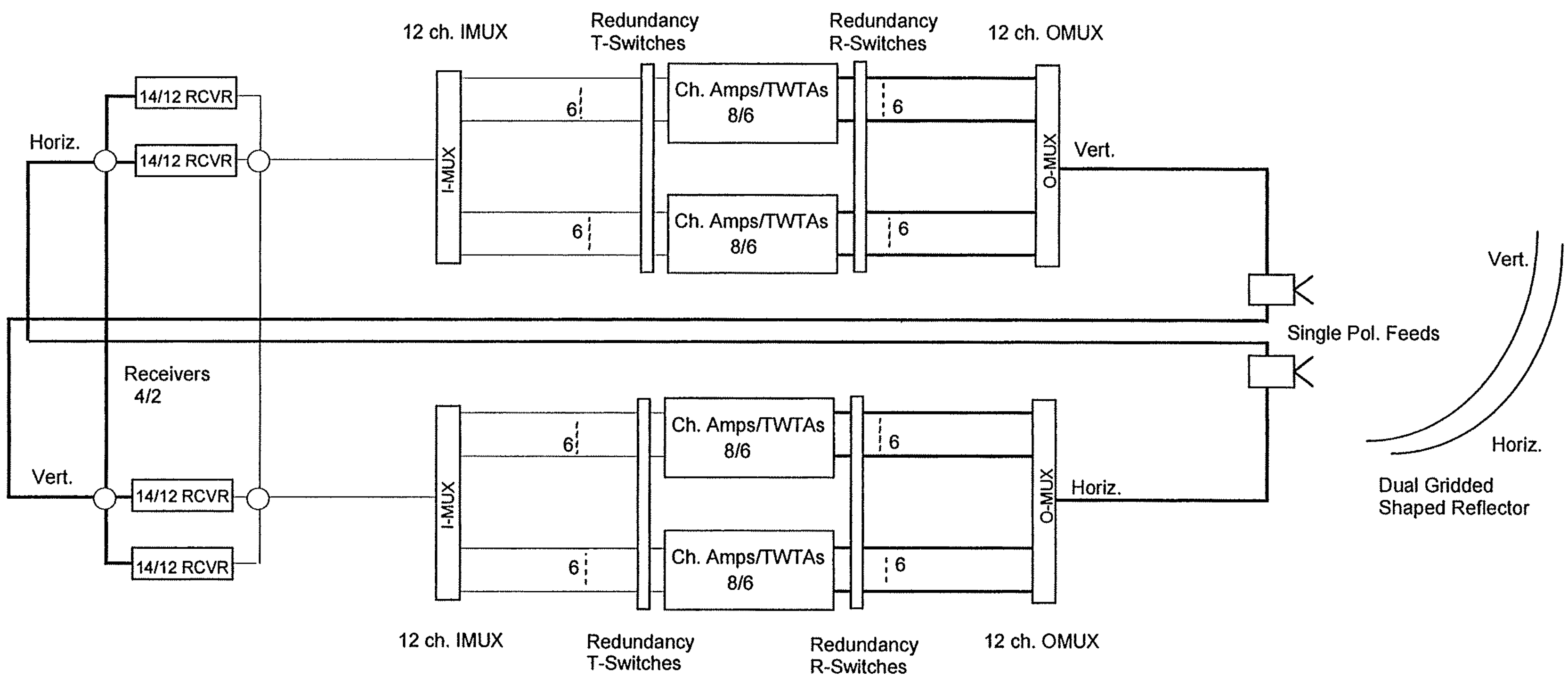


Figure 6-2. C-Band Communications Subsystem Block Diagram

Signals are received at 6 GHz and are transmitted at 4 GHz, by the 1.8-meter dual-shaped reflector directional antenna. The antenna uses two shaped reflectors, each with an associated dual-band (transmit and receive) feed horn. Each horn-reflector pair provides one of the linear polarizations. High polarization isolation is provided by the embedded grid on the front reflector. The signals received by the earth-deck-mounted antenna on each of the two linear polarizations are routed to the repeater subsystem. Each set of signals is amplified by a low-noise receiver. The receivers amplify and mix the signals with a local oscillator signal at 2225 MHz, translating them to the 4-GHz common intermediate frequency.

After downconversion, the signals are applied through a circulator channel-dropping network to filters that demultiplex them into individual channels. The signals are then routed to the channel amplifiers followed by high-power amplifiers for power amplification. For C-band, the power amplifier is a TWTA, which is preceded by a solid-state channel amplifier which contains the commandable attenuators that control channel gain and, hence, saturation flux density. The channel amplifier provides linear gain with 21 dB of commandable gain control in 3-dB steps. The C-band output multiplexers, combine the appropriate channels for each antenna port. The output multiplexers are a contiguous channel configuration, each containing the 12 channels for one polarization. The design uses manifold coupling to achieve low loss; the filters are graphite fiber reinforced epoxy (GFRP). After filtering in the output multiplexer, the signal is routed through a test coupler to the transmit antenna

6.1.1.4 Transmission Modes and Emission Designators

As stated in the Initial Application, the communication subsystem is capable of providing a wide variety of transmission modes, including QAM, M-ary QPSK, SCPC, and TDMA. These modes can be accommodated in any combination with complete flexibility in transponder assignment without significant interference to other transponders.

Table 6-3 presents the emission designators and the predicted maximum power flux density levels for representative transmission modes. (It has not been modified.) The emission designators for telemetry and command are 66K0G2D and 800KG2D.

Table 6-3. C-Band Maximum Power Flux Density (PFD) Levels

Parameter	FM	SCPC	TDMA
Emission Designator	FXF	F3W	M7W
Number of Carriers	1.0	640.0	1.0
EIRP (dBW)(1)	41.5	41.5	41.5
Power/Carrier (dB)	41.5	9.5	41.5
Spreading Factor (dB)	162.5	162.5	162.5
Energy Dispersal (dB)(2)	27.0	3.5	35.7
PFD (dBW/m^2/4 kHz)	-148.0	-156.5	-156.7

Notes

(1) Maximum EIRPs of 41.5 dBW for C-band have been used in all cases except SCPC, where 4 dB output backoff is assumed. These values are the predicted peak EIRPs over the proposed coverage area.

(2) Assumes energy spread over 30 MHz with a 3 dB peak near the carrier for TDMA, a video energy dispersal of 2 MHz for FM video, and an energy spread of 18 kHz with a 3 dB peak near the carrier for SCPC.

6.1.1.5 Technical Parameters

The transponders will have nominal RF output powers of 60 watts. All specifications will be met over the entire usable bandwidth.

EIRP and G/T Performance

Tables 6-4 and 6-5 summarize the predicted EIRP and G/T performance.

Table 6-4. C-Band EIRP Summary

	77° W.L.	129° W.L
Amplifier output power (watts)	60.0	60
Amplifier output power (dBW)	17.8	17.8
Net output losses (dB)	-1.7	-1.7
Antenna input power (dBW)	16.1	16.1
Antenna gain at EOC (dBi)	22.9	24.0
EIRP (dBW)	39.0	40.1

Table 6-5. C-Band G/T Summary

	77° W.L.	129° W.L
Antenna Gain, at EOC (dBi)	22.9	24.0
Transponder noise figure, dB(1)	3.2	3.2
Transponder noise temperature (dB-K)(2)	27.8	27.8
G/T (dB/K)	-4.9	-3.8

Notes:
(1) Includes input losses
(2) Referred to antenna output; antenna temperature = 290 K

Saturation Flux Density and Transponder Gain

The transponders will have individual commandable gain control. The transponder gain can be varied by 21 dB in 3 dB-steps. Table 6-6 illustrates the transponder saturation flux densities and overall gain versus the different channel gain attenuator settings for the minimum edge-of-cover (EOC) gain over the modified coverage area.

Table 6-6. C-Band Transponder Saturation Flux Density and Gain

77° W.L								
Gain step attenuator setting, dB	0	3	6	9	12	15	18	21
Transponder sat. gain, dB (1,2)	123	120	117	114	111	108	105	102
Saturation flux density, dBW/m^2	-91	-88	-85	-82	-79	-76	-73	-70
129° W.L.								
Gain step attenuator setting, dB	0	3	6	9	12	15	18	21
Transponder sat. gain, dB (1,2)	122	119	116	113	110	107	104	101
Saturation flux density, dBW/m^2	-91	-88	-85	-82	-79	-76	-73	-70

Notes:
(1) Gain is from output of receiving antenna to input of transmit antenna.
(2) Attenuator setting selectable by ground command.
(3) Gains and SFDs rounded to nearest dB.

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 3 dB below center frequency response for signals greater than ±18 MHz from center frequency and greater than 40 dB below center frequency response for signals greater than ±22 MHz from center frequency.

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. The transmit response will be greater than 1 dB below center frequency response for signals greater than ±17 MHz from center frequency and greater than 20 dB below center frequency response for signals greater than ±22 MHz from center frequency.

6.1.2 Ku-Band Communications

6.1.2.1 Capacity

Forty-eight active Ku-band transponders will be partially switchable to serve up to 32 channels in each beam, providing three times frequency reuse with 1728 MHz total usable bandwidth (a maximum of 1296 MHz in use at any given time). The satellites will each have 48 27-MHz Ku-band transponders that provide 120 watts at saturation. A power combined mode permits up to 240 watts on any selected channel. The transponders will contain commandable gain step attenuators and limiters to mitigate the effects of uplink rain fade. The power subsystem is sized to provide simultaneous operation of all transponders at saturation for a minimum of 12 years with 100% eclipse operation.

6.1.2.2 Transponder Frequency and Polarization Plan

Linear polarization will be used. A transponder's uplink and downlink polarizations will be orthogonal. Cross-polarization isolation within the proposed coverage areas will be a minimum of 30 dB.

The Ku-band transponders will transmit (downlink) in the 11700-12200 MHz and receive (uplink) in the 14000-14500 MHz band. Forty-eight transponders, each having a 27-MHz bandwidth, are provided. Sixteen of the 48 transponders are switchable to provide service in either the northern or southern beam coverage areas. The remaining transponders are fixed assigned, 16 to the northern beam and 16 to the southern beam, respectively. The switchable transponders can provide north-south connectivity as required. The proposed frequency and polarization plan is illustrated in Figure 6-3 and Table 6-7.

Spurious emissions outside the usable bandwidth of each transponder will be attenuated by filtering as follows:

Percent of authorized bandwidth	Attenuation in any 4 kHz band
1. for any frequency removed from the assigned frequency by 50 to 100%	>25 dB
2. for any frequency removed from the assigned frequency by 100 to 250%	>35 dB
3. for any frequency removed from the assigned frequency by more than 250%	>60 dB

6.1.2.3 Subsystem Configuration

The block diagram of the Ku-band communications subsystem is shown in Figure 6-4. Four antennas will be used. As the Initial Application states, the antennas will be shaped-reflector, Gregorian optics designs with a single corrugated-horn feed, fed via an orthomode junction with the two orthogonal polarizations. This approach provides nearly identical performance for both senses of polarization and provides excellent cross-polarization isolation performance. The antenna reflectors will be nominally 2.1 meters in diameter.

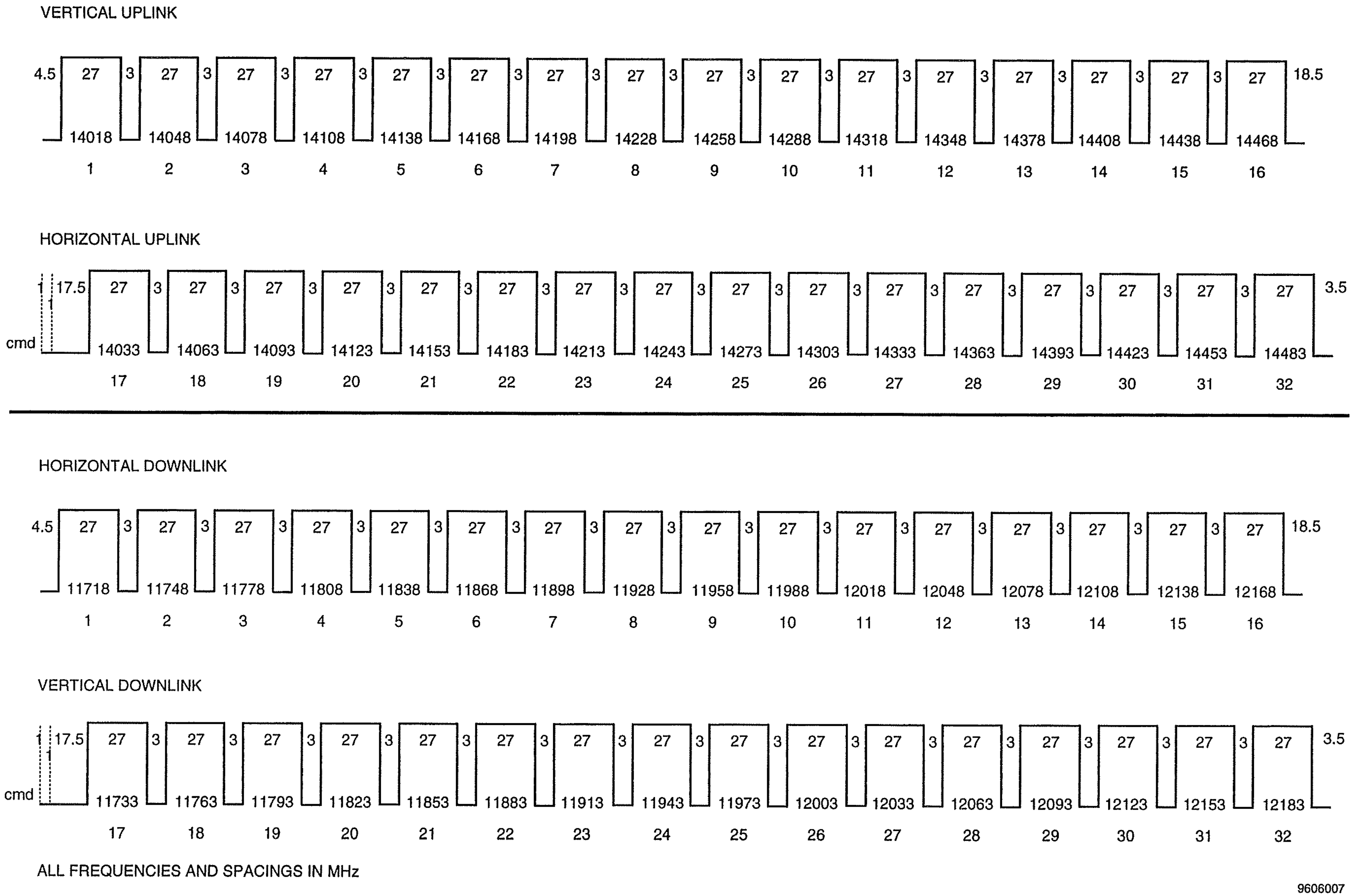


Figure 6-3. Ku-Band Frequency Plan

Table 6-7. Ku-Band Frequency and Polarization Plan

Channel	Bandwidth (MHz)	Polarization (Up/Down)	Uplink Center Frequency (MHz)	Downlink Center Frequency (MHz)
1	27	V/H	14018	11718
2	27	V/H	14048	11748
3	27	V/H	14078	11778
4	27	V/H	14108	11808
5	27	V/H	14138	11838
6	27	V/H	14168	11868
7	27	V/H	14198	11898
8	27	V/H	14228	11928
9	27	V/H	14258	11958
10	27	V/H	14288	11988
11	27	V/H	14318	12018
12	27	V/H	14348	12048
13	27	V/H	14378	12078
14	27	V/H	14408	12108
15	27	V/H	14438	12138
16	27	V/H	14468	12168
17	27	H/V	14033	11733
18	27	H/V	14063	11763
19	27	H/V	14093	11793
20	27	H/V	14123	11823
21	27	H/V	14153	11853
22	27	H/V	14183	11883
23	27	H/V	14213	11913
24	27	H/V	14243	11943
25	27	H/V	14273	11973
26	27	H/V	14303	12003
27	27	H/V	14333	12033
28	27	H/V	14363	12063
29	27	H/V	14393	12093
30	27	H/V	14423	12123
31	27	H/V	14453	12153
32	27	H/V	14483	12183

H: Horizontal Polarization
V: Vertical Polarization

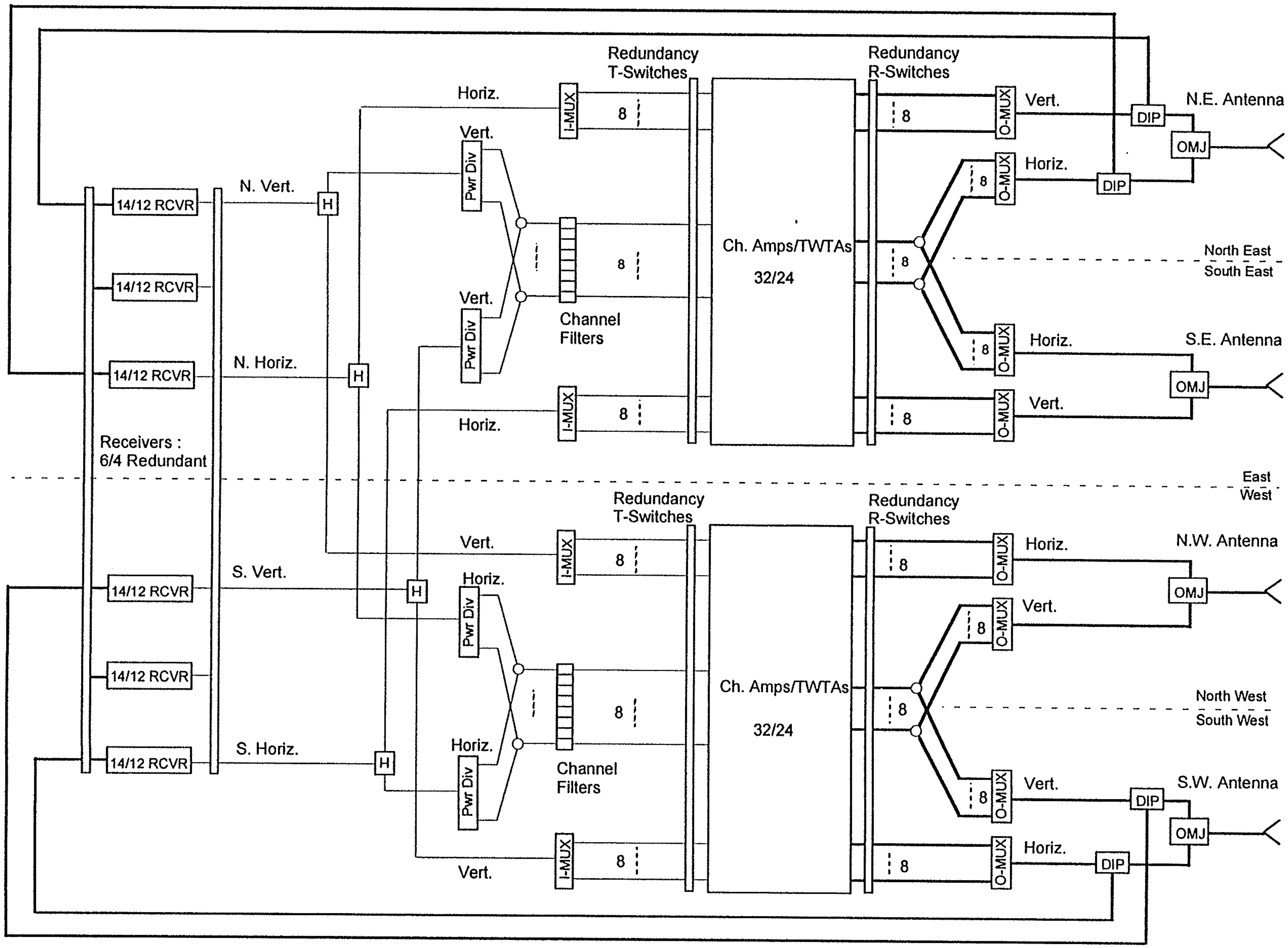


Figure 6-4. Ku-Band Communications Subsystem Block Diagram

Signals on each uplink polarization are independently received via orthogonal antenna ports and processed through separate paths. The input section comprises a diplexer, test coupler, switches, and receivers. The receivers amplify the input signals and downconvert them to the transmit frequency. The signals are then separated by transponders via the input channel filters. The transponders, following channelization, are routed to 16-for-12 channel amplifier/TWTA redundancy rings. The channel amplifiers provide additional gain. They contain commandable gain step attenuators and automatic gain control (AGC) to protect the TWTA from overdrive. Each channel amplifier drives an associated TWTA. Following amplification, the transponder output signals are combined and filtered in an output multiplexer, then routed through a test coupler to the transmit antenna. The estimated net loss from the TWTAs to the antenna terminal is 2 dB.

The telemetry transmitter will be used to provide a beacon for earth station use in polarization tracking and rain fade compensation.

6.1.2.4 Transmission Modes and Emission Designators

The communication subsystem is capable of providing a wide variety of transmission modes, including QAM, M-ary QPSK, SCPC, and TDMA. These modes can be accommodated in any combination with complete flexibility in transponder assignment without significant interference to other transponders.

Table 6-8 presents the emission designators and the predicted maximum power flux density levels for representative transmission modes. The emission designators for telemetry and command are 66K0G2D and 800KD2D.

Table 6-8. Ku-Band Maximum Power Flux Density (PFD) Levels

Parameter	TDMA	SCPC
Emission Designator	M7W	F3W
Number of Carriers	1	640
EIRP (dBW)(1)	53.0	49.0
Power/Carrier (dB)	53.0	20.9
Spreading Factor (dB)	162.5	162.5
Energy Dispersal (dB)(2)	34.8	3.5
PFD ($dBW/m^2/4$ kHz)	-144.3	-145.0

Notes

(1) Maximum EIRPs of 53 dBW for Ku-band have been used in all cases except SCPC, where 4 dB output backoff is assumed. These values are the predicted peak EIRPs over the proposed coverage area.

(2) Assumes energy spread over 24 MHz with a 3 dB peak near the carrier for TDMA and an energy spread of 18 kHz with a 3 dB peak near the carrier for SCPC.

6.1.2.5 Technical Parameters

The transponders will have nominal RF output powers of 120/240 watts. All specifications will be met over the entire usable bandwidth.

EIRP and G/T Performance

Tables 6-9 and 6-10 summarize the predicted EIRP and G/T performance, as modified. Where regulatory limits on EIRP on downlink power flux density can be exceeded, operational constraints will be applied to transmitter powers to ensure compliance.

Table 6-9. Modified Ku-Band EIRP Summary

77° W.L.	North American Beam (EOC)	Puerto Rico/ Virgin Islands	South American Beam (EOC)
Amplifier output (watts)	240	240	240
Amplifier output (dBW)	23.8	23.8	23.8
Net output losses (dB)	-2.0	-2.0	-2.0
Antenna input power (dBW)	21.8	21.8	21.8
Antenna gain at EOC (dBi)	26.4	26.4	27.4
EIRP (dBW)	48.2	48.2	49.2

129° W.L.	North American Beam (EOC)	Puerto Rico/ Virgin Islands	South American Beam (EOC)
Amplifier output (watts)	240	240	120
Amplifier output (dBW)	23.8	23.8	20.8
Net output losses (dB)	-2.0	-2.0	-2.0
Antenna input power (dBW)	21.8	21.8	18.8
Antenna gain at EOC (dBi)	28.1	28.1	31.5
EIRP (dBW)	49.9	49.9	50.3

Table 6-10. Modified Ku-Band G/T Summary

77° W.L.	North American Beam (EOC)	Puerto Rico/ Virgin Islands	South American Beam (EOC)
Antenna Gain, EOC (dBi)	26.4	26.4	27.4
Transponder noise figure, dB (1)	3.4	3.4	3.4
Transponder noise temperature (dB-K) (2)	28.0	28.0	28.0
G/T (dB/K)	-1.6	-1.6	-0.6

129° W.L.	North American Beam (EOC)	Puerto Rico/ Virgin Islands	South American Beam (EOC)
Antenna Gain, EOC (dBi)	28.1	28.1	31.5
Transponder noise figure, dB (1)	3.4	3.4	3.4
Transponder noise temperature (dB-K) (2)	28.0	28.0	28.0
G/T (dB/K)	0.1	0.1	3.5

(1) Includes input losses
(2) Referred to antenna output: Antenna temperature = 290 K

Saturation Flux Density and Transponder Gain

The transponders will have individual commandable gain control. The transponder gain can be varied by 21 dB in 3 dB steps. Table 6-11 illustrates the modified transponder saturation flux densities and overall gain versus the different channel gain attenuator settings for the minimum EOC gain from the North American and South American beams.

Table 6-11. Ku-Band Transponder Saturation Flux Density and Gain

North America Beam 77° W.L.								
Gain step attenuator setting, dB	0	3	6	9	12	15	18	21
Transponder sat. gain, dB (1,2)	132	129	126	123	120	117	114	111
Saturation flux density, dBW/m^2	-90	-87	-84	-81	-78	-75	-72	-69
South America Beam 77° W.L.								
Gain step attenuator setting, dB	0	3	6	9	12	15	18	21
Transponder sat. gain, dB (1,2)	131	128	125	122	119	116	113	110
Saturation flux density, dBW/m^2	-91	-88	-85	-82	-79	-76	-73	-70

North America Beam 129° W.L.								
Gain step attenuator setting, dB	0	3	6	9	12	15	18	21
Transponder sat. gain, dB (1,2)	130	127	124	121	118	115	112	109
Saturation flux density, dBW/m^2	-90	-87	-84	-81	-78	-75	-72	-69
South America Beam 129° W.L.								
Gain step attenuator setting, dB	0	3	6	9	12	15	18	21
Transponder sat. gain, dB (1,2)	127	124	121	118	115	112	109	106
Saturation flux density, dBW/m^2	-91	-88	-85	-82	-79	-76	-73	-70

Notes:

(1) Gain is from output of receiving antenna to input of transmit antenna.

(2) Attenuator setting selectable by ground command.

(3) Gains and SFDs rounded to nearest dB.

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 modified receive response will be a minimum of 3 dB below center frequency response for signals greater than ±13.5 MHz from center frequency and greater than 30 dB below center frequency response for signals greater than ±16.5 MHz from center frequency.

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. The modified transmit response will be greater than 1 dB below center frequency response for signals greater than ±13.5 MHz from center frequency and greater than 20 dB below center frequency response for signals greater than ±16.5 MHz from center frequency.

6.2 TRACKING, TELEMETRY, AND COMMAND (TT&C) SUBSYSTEM

The TT&C subsystem will operate at Ku-band. Two geographically dispersed TT&C ground stations at sites to be selected will control the satellites.

The command uplink will be frequency modulated by a command subcarrier or ranging tones. The nominal carrier deviation will be ±400 kHz peak. The redundant command receivers on the satellite are connected to near-omnidirectional antennas. The demodulated command subcarrier is routed to the redundant command processors. The ranging tones are connected to the telemetry transmitter for retransmission to the TT&C ground station.

The addressed command processor decodes and processes the command. Commands can be executed autonomously or stored, verified by ground command and executed by a subsequent command. Commands can also be time-tagged for autonomous execution at a future time.

The command link can be operated in either a clear or secure mode. Command decrypters are provided in each command processor. When in the secure mode, a fail-safe timer will revert the system to clear mode operation if a valid encrypted command has not been received within a predetermined period of time.

The telemetry data biphase modulates a subcarrier. This subcarrier and/or ranging tones phase modulate the telemetry transmitter. During orbit raising operations the telemetry is transmitted by broadbeam antennas with a nominal 10 watts RF power. In normal on-station operations, a low-level (nominally -5 dBW) telemetry signal is routed to a communications multiplexer and transmitted via a communications transmit antenna.

6.3 ATTITUDE CONTROL AND STATIONKEEPING SUBSYSTEM

The attitude control and stationkeeping (ACS) subsystem will provide satellite attitude control beginning with spacecraft separation from the launch vehicle and continuing through transfer to geosynchronous orbit. The ACS will also provide station acquisition and on-station attitude control. The ACS design will incorporate sun and earth sensors, momentum wheels, and thrusters to perform its required functions.

6.3.1 Accuracy for Orbital Inclination, Antenna Axis Attitude, and Longitudinal Drift

The spacecraft will be maintained within ±0.05°, in both the north/south and east/west directions, of its assigned orbital location. The stationkeeping will be performed by ground-commandable reaction control thrusters located on the body of the spacecraft.

The spacecraft communications antenna will be maintained within ±0.13° in both east/west (pitch) and north/south (roll) directions of its nominal boresight position during both normal spacecraft operations and stationkeeping maneuver operations.

6.4 ELECTRICAL POWER SUBSYSTEM

The electrical power subsystem (EPS) will consist of solar arrays for converting solar energy into the electrical energy required for normal operations, nickel-hydrogen batteries for supplying 100% of the required electrical energy during eclipse periods, power supply electronics for charging the batteries and limiting the maximum bus voltage, and solar array drives for rotating the solar arrays. The power output of the EPS will be sufficient to provide the electrical power required to operate 100% of the spacecraft payload and all other subsystems for the full spacecraft design life.

6.5 PROPULSION

The satellite propulsion subsystem will include all propellants/pressurants, components and assemblies associated with storing, conditioning, routing, controlling, and expelling propellant, required to change the spacecraft's attitude and its angular or linear velocity to meet the mission requirements, from the moment of separation from the launch vehicle, through and including the final orbit raising maneuver.

The propulsion subsystem provides perigee augmentation and apogee injection velocities as well as providing on-orbit reaction control using the integrated bipropellant propulsion system. This integrated bipropellant propulsion concept combines high thruster efficiency with performance flexibility.

6.6 SPACECRAFT DESCRIPTION

The proposed satellite configuration consists of a light-weight graphite-reinforced epoxy central cylinder and the surrounding equipment mounting panels that form a cube of approximately three meters on a side. Solar panels extend from the north and south faces and antenna reflectors are mounted on the east and west faces. The structure will also provide a stable platform for preserving the alignment of the critical elements of the spacecraft system, such as earth sensors.

The major heat dissipating units, such as RF power amplifiers, batteries, etc., are located on the north and south equipment panels to radiate their heat efficiently. To provide maximum thermal efficiency, the outside of the north and south panels will be covered with optical solar reflectors (OSRs), and the panels contain heat pipes for spreading the heat over the maximum area.

The system design fits comfortably within the constraints imposed by several launch vehicles. The satellite is compatible with the launch requirements of both the Atlas 2 and Ariane 4 launch vehicles.

Figure 6-5 presents a conceptual view of the spacecraft with the dry mass of the satellite is 2930 kg and provides 2900 kg of propellant capacity, as shown in Table 6-12. The power budget is approximately 13,000 watts, as shown in Table 6-13.

6.7 RELIABILITY AND OPERATIONAL LIFE

The design life of 15 years was chosen as a design criteria to meet a mission life of 12 years. Because the satellite design is a well-proven design, it is expected that the actual satellite longevity will far exceed the design life.

The calculated probability of survival of all the satellite bus subsystems will be greater than 0.75. The satellite subsystems shall be designed to include fail-safe features wherever possible. A failure within a unit or subsystem will not disable or degrade the performance of the remainder of the satellite. The calculated probability of survival for the on-board communication subsystem will be greater than 0.80.

6.8 LAUNCH VEHICLE

The spacecraft design is compatible with multiple launch vehicles. The satellites can be deployed during the standard launch window for all launch vehicles. The deployment window compatibility is made possible by the digital integrating rate assembly control system incorporated into the spacecraft design. The restartable bipropellant main satellite thruster combines high Isp with operational flexibility.

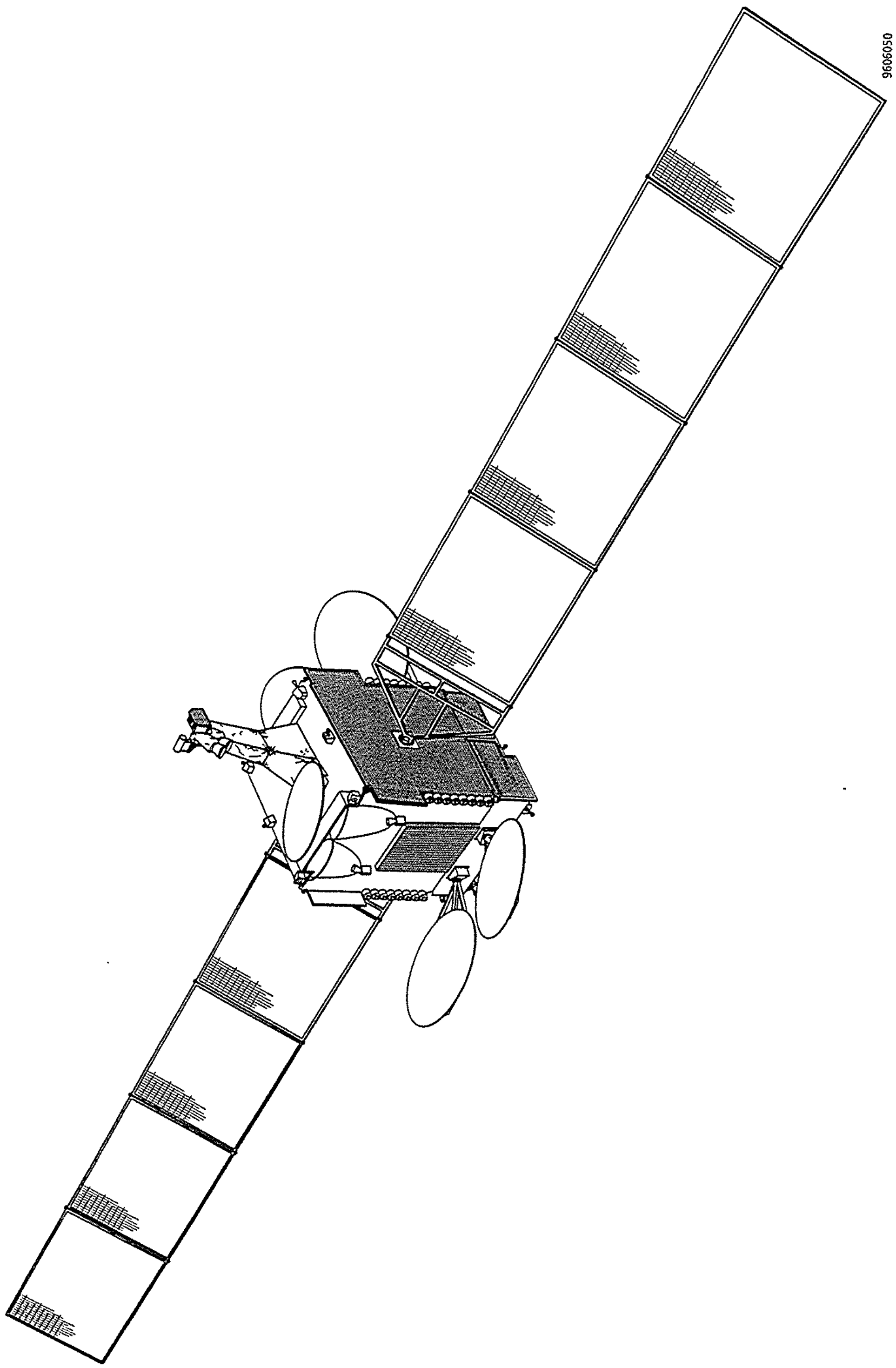


Figure 6-5. Spacecraft Configuration

Table 6-12. Mass Budget

Component	Mass (kg)
Payload	610
Bus	2,200
Subtotal	2,810
Margin	120
Total	2,930
Propellant/Pressurant	2,900
Separation mass	5,830

Table 6-13. End of Life (12 Years) Synchronous Power

Payload	12,244
Bus	908
Total Spacecraft	13,152
Power Supplied	14,400

The three-axis operation during transfer orbit is identical to on-station operation which ensures operational deployment flexibility. Loral Space will enter into a final contract for launch after receiving construction approval.

SECTION 7 - LEGAL AND FINANCIAL

7.1 LEGAL

Loral Space's legal qualifications are demonstrated in FCC Form 430, "Licensee Qualification Report," which is on file with the Commission.

7.2 FINANCIAL

Loral Space is expected to purchase its satellites from Space Systems/Loral. Because this modification will be implemented in the early phases of the design and development of the spacecraft, there will be no impact to scheduled milestone dates. In addition, the total cost of the satellite system, as set forth in the Initial Application, will remain unchanged.

SECTION 8 - WAIVER PURSUANT TO SECTION 304 OF THE ACT

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

SECTION 9 - ANTI-DRUG ABUSE ACT OF 1988

The Applicant hereby certifies under penalty of perjury that neither the Applicant nor any party to this Modification is subject to a denial of federal benefits by Federal and/or state courts under authority granted in 21 U.S.C. § 853(a).

SECTION 10 - CERTIFICATION

Loral Space & Communications Ltd. acknowledges that all of the statements in this application and in the exhibits and associated attachments are considered material representations, and that all the exhibits and attachments are a material part hereof. and are incorporated herein as if set out in full in this application.

The undersigned certifies individually and for Loral Space & Communications Ltd. that the statements made in this application are true, complete, and correct to the best of his knowledge and belief, and are made in good faith.

Wherefore, Loral Space & Communications Ltd. requests that the Commission authorize the construction, launch and operation of the Loral satellite in accordance with this application.

Respectfully submitted,

Loral Space & Communications Ltd.

By:

Michael B. Targoff
President and Chief Operating Officer

LORAL

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION CONTAINED IN THIS APPLICATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this Application and the exhibits attached hereto; that I am familiar with Part 25 of the Commission's Rules and Appendix B to the 1983 Orbital Processing Order; that I have either prepared or reviewed the engineering information contained in this application and the exhibits attached hereto; and that it is complete and true to the best of my knowledge.

By: ______________________

Michael J. Malone
Space Systems/Loral Engineering
3825 Fabian Way
Palo Alto, CA 94303
(415) 852-6832

Signed and sworn before me this 7th day of June 1996.

Notary Public:

MARIE A. CANNON
COMM. #1046416
NOTARY PUBLIC - CALIFORNIA
SANTA CLARA COUNTY
My Comm. Exp. Dec. 12, 1998

LORAL

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING FINANCIAL INFORMATION CONTAINED IN THIS APPLICATION

I hereby certify that I am the technically qualified person responsible for preparation of the financial information contained in this Application; that I am familiar with the financial requirements of Appendix B to the 1983 Orbital Processing Order; that I have either prepared or reviewed the financial information contained in this application and that it is complete and true to the best of my knowledge.

By: ______________________

Michael B. Targoff
President and Chief Operating Officer
Loral Space & Communications Ltd.
600 Third Avenue
New York, NY 10016
(212) 697-1105

Signed and sworn before me this 4th day of June 1996

Notary Public: ______________________

RENEE M. YARZIG
Notary Public, State of New York