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ORIGINAL

PAGE NO. 1 OF 1

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SECTION A - PAYER INFORMATION

(2) PAYER NAME (if paying by credit card, enter name exactly as it appears on your card): PanAmSat Corporation

(3) TOTAL AMOUNT PAID (dollars and cents): $ 89,460.00

(4) STREET ADDRESS LINE NO. 1: One Pickwick Plaza

(5) STREET ADDRESS LINE NO. 2:

(6) CITY: Greenwich

(7) STATE: CT

(8) ZIP CODE: 06830

(9) DAYTIME TELEPHONE NUMBER (include area code): (203) 622-6664

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

IF PAYER NAME AND THE APPLICANT NAME ARE DIFFERENT, COMPLETE SECTION B
IF MORE THAN ONE APPLICANT, USE CONTINUATION SHEETS (FORM 159-C)

SECTION B - APPLICANT INFORMATION

(11) APPLICANT NAME (if paying by credit card, enter name exactly as it appears on your card):

(12) STREET ADDRESS LINE NO. 1:

(13) STREET ADDRESS LINE NO. 2:

SAT-LOA-19990126-00018

(14) CITY:

(15) STATE:

(16) ZIP CODE:

(17) DAYTIME TELEPHONE NUMBER (include area code):

(18) COUNTRY CODE (if not in U.S.A.):

COMPLETE SECTION C FOR EACH SERVICE, IF MORE BOXES ARE NEEDED, USE CONTINUATION SHEETS (FORM 159-C)

SECTION C - PAYMENT INFORMATION

(19) FCC CALL SIGN/OTHER ID	(20) PAYMENT TYPE CODE (PTC)	(21) QUANTITY	(22) FEE DUE FOR (PTC)	FCC USE ONLY
(19A) PAS-1R	(20A) B N Y	(21A) 1	(22A) $ 89,460.00	
(19B)	(20B)	(21B)	(22B) $	
(19C)	(20C)	(21C)	(22C) $	
(19D)	(20D)	(21D)	(22D) $	

FCC CODE 1	FCC CODE 2
(23A)	(24A)
(23B)	(24B)
(23C)	(24C)
(23D)	(24D)

SECTION D - TAXPAYER INFORMATION (REQUIRED)

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

ORIGINAL

In the Matter of the Application of	)	
	)	000018
PANAMSAT LICENSEE CORP.	)	File No.
	)	SAT-LOA-19990126-00018
For Authority To Launch and Operate A Hybrid Replacement Fixed-Satellite Service Space Station	)	

APPLICATION

Kalpak Gude
Vice President &
Associate General Counsel
PANAMSAT CORPORATION
1133 Connecticut Avenue, N.W.
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Washington, D.C. 20036
(202) 223-3511

Of Counsel:

Henry Goldberg, Esq.
Joseph A. Godles, Esq.
Goldberg, Godles, Wiener & Wright
1229 19th Street, N.W.
Washington, D.C. 20036
(202) 429-4900

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

In the Matter of the Application of	)	
	)	
PANAMSAT LICENSEE CORP.	)	File No.
	)	
For Authority To Launch and Operate A Hybrid Replacement Fixed-Satellite Service Space Station	)))	

APPLICATION

PanAmSat Licensee Corp. ("PanAmSat"), pursuant to Sections 308 and 309 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 308, 309, hereby requests authority to launch and operate PAS-1R — a hybrid C/Ku-band fixed-satellite service ("FSS") satellite — to replace PanAmSat's PAS-1 satellite, which is nearing the end of its useful life.

PanAmSat proposes to locate PAS-1R at 45° W.L., which is the orbital location currently occupied by PAS-1. PanAmSat has requested continuing authority to operate PAS-1 from the 45° W.L. orbital location beyond its original license term.[1] PanAmSat intends to operate PAS-1 and PAS-1R on a collocated basis at 45° W.L. for as long as it is permitted to do so and PAS-1 is able to hold station at that location.

Significantly, because PAS-1R will be providing service from the orbital location currently occupied by PAS-1, PanAmSat is not herein seeking the assignment of an additional orbital location, nor will grant of PanAmSat's Application increase congestion in the satellite arc. For those reasons the Commission's "freeze" on satellite applications seeking assignments between 60° W.L. and 30° W.L. is inapplicable to this Application.[2]

Since becoming operational, the PAS-1 satellite has played a vital role in PanAmSat's global satellite fleet. Today, PAS-1 provides voice, video, and data services

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[1] See In the Matter of Application of PanAmSat Licensee Corp., Application or License Modification or, in the Alternative, Request for Special Temporary Authority, File No. 106-SAT-ML-98 (filed Apr. 7, 1998).

[2] See In the Matter of PanAmSat Licensee Corp., 11 FCC Rcd 22098 (1996). In the event that the Commission concludes that the "freeze" is applicable, PanAmSat requests waiver of the freeze because grant of PanAmSat's Application "would not in any way restrict [the FCC's] ability in the future to assign orbital positions or frequency bands" and, therefore, waiver would "not frustrate the underlying purpose of the freeze." In the Matter of PanAmSat L.P., 8 FCC Rcd 3905 (1993).

between and among countries in North and South America, the Caribbean, and Europe. PanAmSat anticipates that PAS-1 will continue to provide these services until the end of the satellite's useful life. The PAS-1R satellite will enhance and support these services and provide new services to users in South America, Africa, and Europe while PAS-1 remains in service, and continue the services provided by PAS-1 when that satellite ceases operations.

In support of this Application, PanAmSat submits the following information:

Item A. Name, Address, and Telephone Number of Applicant

PanAmSat Corporation
One Pickwick Plaza
Greenwich, CT
(203) 622-6664

Item B. Correspondence

Inquiries or correspondence with respect to this application should be sent to the following person at the above address and telephone number:

James W. Cuminale
Senior Vice President, General Counsel and Secretary

With a copy to:

Joseph A. Godles, Esq.
Goldberg, Godles, Wiener And Wright
1229 19th Street, N.W.
Washington, D.C. 20036
(202) 429-4900

Items C. System Description

See attached technical description (Exhibit 1).

Item D. General Technical Information

See attached technical description (Exhibit 1).

Item E. Financial Qualifications

Exhibit 2 and the attached full financial showing demonstrate that PanAmSat has the current financial ability to meet the estimated costs of constructing PAS-1R, launching the satellite, and operating it for one year.

Item F. Legal Qualifications

The portion of this application appearing on FCC Form 312 establishes PanAmSat's legal qualifications, which are a matter of public record. See Hughes Communications, Inc. et al., File Nos. 2-SAT-AL-97(11) et. al.

Item G. Type of Operations

PanAmSat proposes to market all of the transponders on PAS-1R on a non-common carrier basis, pursuant to the Commission's decisions in Domestic Fixed-Satellite Transponder Sales, 90 F.C.C.2d 1238 (1982), and Martin Marietta Communications Systems, Inc., 60 R.R. 2d 779 (1986). PanAmSat will retain the flexibility to market transponders to common carriers and resellers. Thus, although common carrier services may be offered using its transponders, they will not be offered by the applicant, PanAmSat.

Item H. Schedule

A schedule specifying dates by which significant milestones in the PAS-1R satellite program are planned to be achieved is included in Exhibit 3, hereto.

Item I. Public Interest Considerations

Grant of this Application will enable PanAmSat to continue to provide service to customers that have come to rely on satellite facilities aboard the PAS-1 space station. Moreover, the addition of PAS-1R to the PanAmSat fleet will allow PanAmSat to satisfy a rapidly growing demand for satellite services in South America and Africa, and to expand the range of services available to its current customers. Grant of this Application, therefore, will avoid unnecessary expense and disruption for current customers and expand the competitive choices available to new customers.

Prompt grant of this Application will help provide the assurance necessary to justify the substantial capital expenditures that a project of this magnitude involves. The provision of satellite services involves not only one-time outlays for satellite hardware itself but also ongoing expenditures for ground support equipment and personnel necessary to continue to upgrade the quality of customer service. Approval of replacement capacity, moreover, will provide the public with the long-term assurance that satellite providers will be able to provide reliable satellite communication services over the long-term, and that they will continue to compete with other providers of telecommunications services into the twenty-first century.

PanAmSat is an experienced, reliable, and financially sound operator and is recognized as an industry leader in the provision of satellite services. PanAmSat's excellent track record plus its solid financial footing are strong evidence that it will carry out the Commission's policy of ensuring that satellite authorizations are used to provide service effectively.

WAIVERS/CERTIFICATIONS

PanAmSat 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 construction and launch and operating authority in accordance with this Application. All statements made in the attached exhibits are a material part hereof, and are incorporated herein as if set out in full in this Application.

The undersigned certifies individually and for PanAmSat 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.

The undersigned also certifies that neither PanAmSat nor any party to this Application is subject to a denial of federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. § 853a.

CONCLUSION

For the foregoing reasons, PanAmSat respectfully requests that the Commission grant this Application.

Respectfully submitted,

PANAMSAT LICENSEE CORP.

By: Kalpak S. Gude

Kalpak Gude
Vice President &
Associate General Counsel

Of Counsel:

Henry Goldberg, Esq.
Joseph A. Godles, Esq.
Goldberg, Godles, Wiener & Wright
1229 19th Street, N.W.
Washington, D.C. 20036

DATE: 1/25/99

EXHIBIT 1

Item D. General Technical Information

Satellite Operational Characteristics

a. Frequency Plan

The PAS-1R satellite will be constructed to operate in the C- and Ku- frequency bands. The radio frequency and polarization plans are described in Tables 1a and 1b. Both the C-Band payload and the Ku-Band payload consist of 36 active transponders, each with a bandwidth of 36 MHz. In this way, the satellite employs full frequency reuse through dual linear polarization and geographic isolation.

In addition to the communications channel frequencies, two Ku-Band command uplinks, two Ku-Band telemetry downlinks, and two Ku-Band beacon downlink frequencies are planned. During transfer orbit, command signals will be received through an omni-directional antenna (bicone) at the band-edge of the Ku-Band receive frequencies. When the satellite is at its final orbit position, the primary command uplink will be received at the edge of the standard Ku-Band frequencies. This will occur through the Ku-Band pipe, with the bicone antenna available as a backup. The command uplink will use government-approved command encryption. The two Ku-Band telemetry frequencies shown in the plan will allow simultaneous transmission of two separate or redundant telemetry data streams. The Ku-Band downlink beacon signals will be continuously transmitted by the satellite and used by earth station operators as a calibrated reference to compensate for rain attenuation and to adjust antenna pointing.

The satellite communication subsystem will include appropriate filtering at the inputs and outputs of the satellite to minimize internal interchannel interference, noise effects outside the satellite frequency band, and out-of-band spurious transmissions.

Table 1a. C-Band Frequency Assignments

Transponder	Uplink Pol	Uplink Frequency (MHz)	Downlink Pol	Downlink Frequency (MHz)	Channel Bandwidth (MHz)
1	H	5960	V	3735	36
2	H	6000	V	3775	36
3	H	6040	V	3815	36
4	H	6080	V	3855	36
5	H	6120	V	3895	36
6	H	6160	V	3935	36
7	H	6200	V	3975	36
8	H	6240	V	4015	36
9	H	6280	V	4055	36
10	H	6320	V	4095	36
11	H	6360	V	4135	36
12	H	6400	V	4175	36
13	V	5960	H	3735	36
14	V	6000	H	3775	36
15	V	6040	H	3815	36
16	V	6080	H	3855	36
17	V	6120	H	3895	36
18	V	6160	H	3935	36
19	V	6200	H	3975	36
20	V	6240	H	4015	36
21	V	6280	H	4055	36
22	V	6320	H	4095	36
23	V	6360	H	4135	36
24	V	6400	H	4175	36
25	V	5960	H	3735	36
26	V	6000	H	3775	36
27	V	6040	H	3815	36
28	V	6080	H	3855	36
29	V	6120	H	3895	36
30	V	6160	H	3935	36
31	V	6200	H	3975	36
32	V	6240	H	4015	36
33	V	6280	H	4055	36
34	V	6320	H	4095	36
35	V	6360	H	4135	36
36	V	6400	H	4175	36

Pol = Polarization

V = Vertical Polarization
H = Horizontal Polarization

Table 1b. Ku-Band Frequency Assignments

Transponder	Uplink Pol	Uplink Frequency (MHz)	Downlink Pol	Downlink Frequency (MHz)	Channel Bandwidth (MHz)
1	V	13770	H	10970	36
2	H	13770	V	10970	36
3	V	13810	H	11010	36
4	H	13810	V	11010	36
5	V	13850	H	11050	36
6	H	13850	V	11050	36
7	V	13890	H	11090	36
8	H	13890	V	11090	36
9	V	13930	H	11130	36
10	H	13930	V	11130	36
11	V	13970	H	11170	36
12	H	13970	V	11170	36
13	V	14020	H	11470	36
14	H	14020	V	11470	36
15	V	14060	H	11510	36
16	H	14060	V	11510	36
17	V	14100	H	11550	36
18	H	14100	V	11550	36
19	V	14140	H	11590	36
20	H	14140	V	11590	36
21	V	14180	H	11630	36
22	H	14180	V	11630	36
23	V	14220	H	11670	36
24	H	14220	V	11670	36
25	V	14270	H	11720	36
26	H	14270	V	11720	36
27	V	14310	H	11760	36
28	H	14310	V	11760	36
29	V	14350	H	11800	36
30	H	14350	V	11800	36
31	V	14390	H	11840	36
32	H	14390	V	11840	36
33	V	14430	H	11880	36
34	H	14430	V	11880	36
35	V	14470	H	11920	36
36	H	14470	V	11920	36

Pol = Polarization

V = Vertical Polarization
H = Horizontal Polarization

b. Emission Designators

Commands to the satellite from the TT&C station will be angle-modulated with a large deviation on the uplink carrier. The satellite will be equipped with government-approved command encryption equipment in order to secure command transmissions. Telemetry data from the satellite will be angle-modulated on the downlink carrier. The emission designators for the communications, TT&C, and downlink beacon signals are as follows:

Table 2. Emissions Designators

Signal	Emission Designator
Command	300KF9DXX
Telemetry/Ranging	120KF9DXX
Downlink Beacon	25KONON
Single carrier TV	32M0F3FNN
High Speed Data	25M7G1WDN
Digital (Tl) data	1M17G1WDF
Digital (inroute) data	307KG1WDW
Digital voice	24K3G1WDF
Digital (outroute) data	1M23G1WDF
Digital (64 kbps) data	48K6G1WDF
FM Audio (Narrow-Band)	50K0F3EJF
FM Audio (Wide-Band)	150KF3EJF

Communications Coverage

The PAS-1R receive/transmit patterns are depicted in Figures 1 through 11. As shown, coverage is provided over North America, Central and South America and Europe/Africa in both bands.

Figure 1. C-Band US/Latin America Uplink Coverage

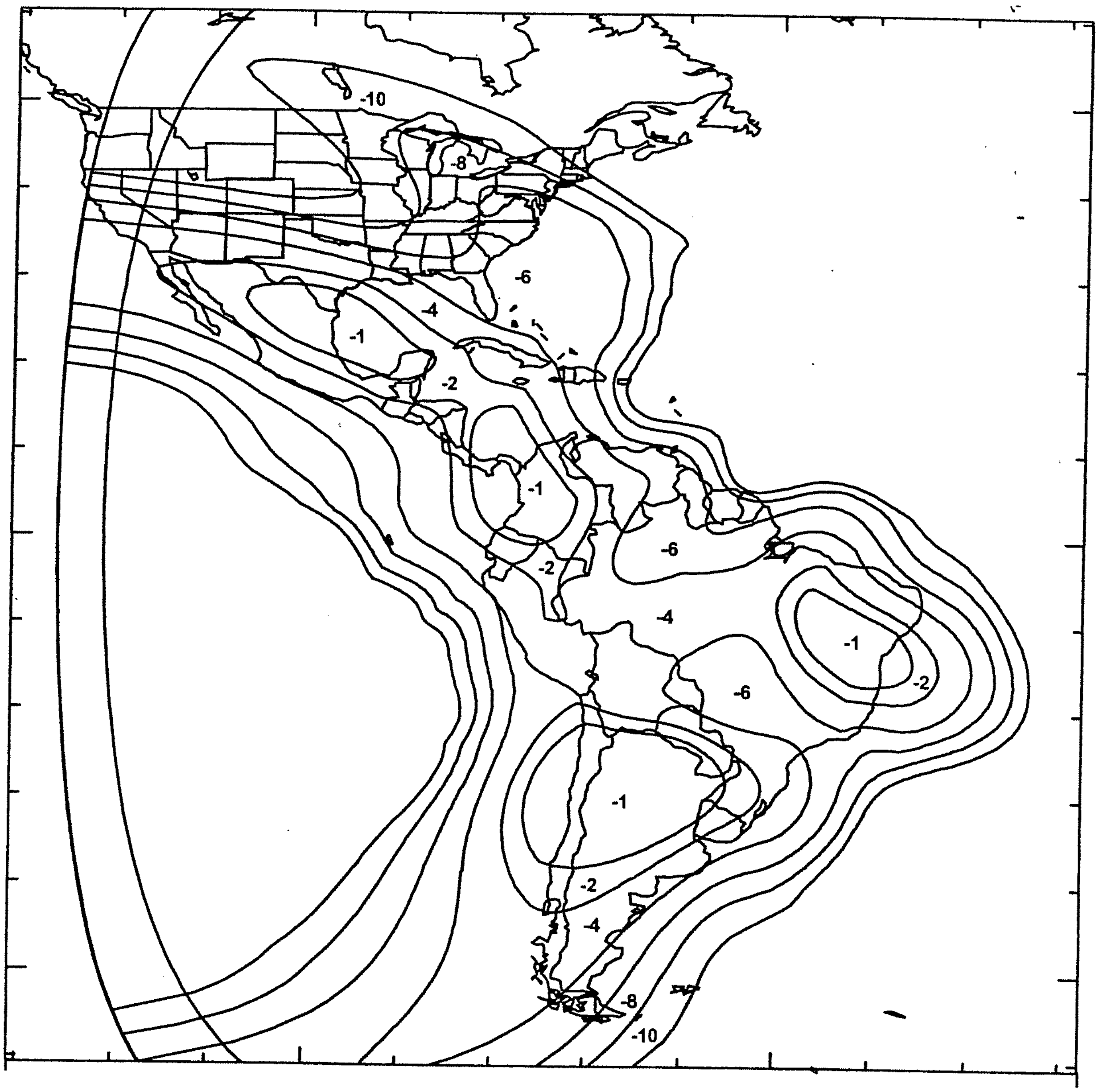


Figure 2. C-Band US/Latin America Downlink Coverage

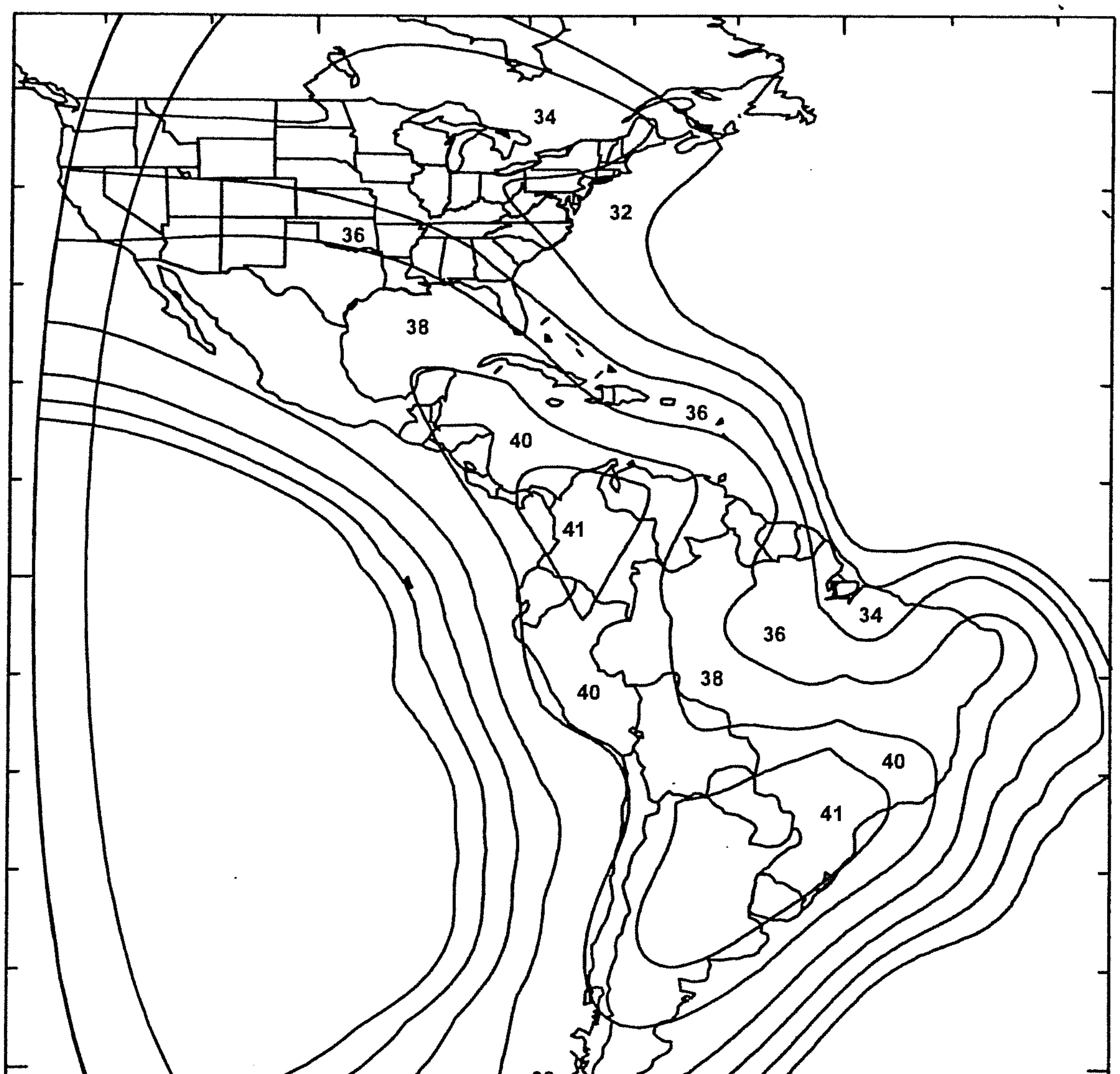


Figure 3. Ku-Band US/Mexico Uplink Coverage

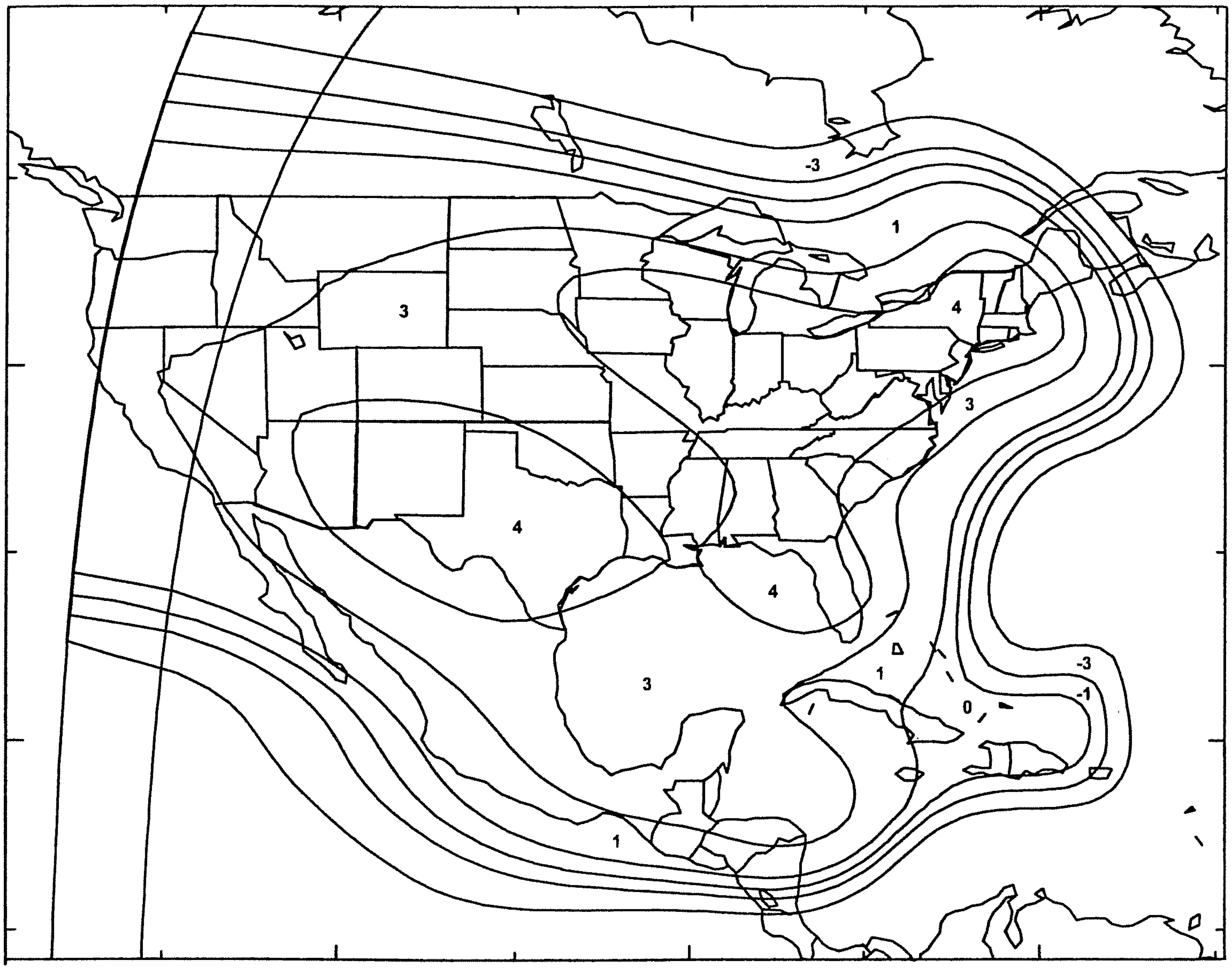


Figure 4. Ku-Band US/Mexico Downlink Coverage

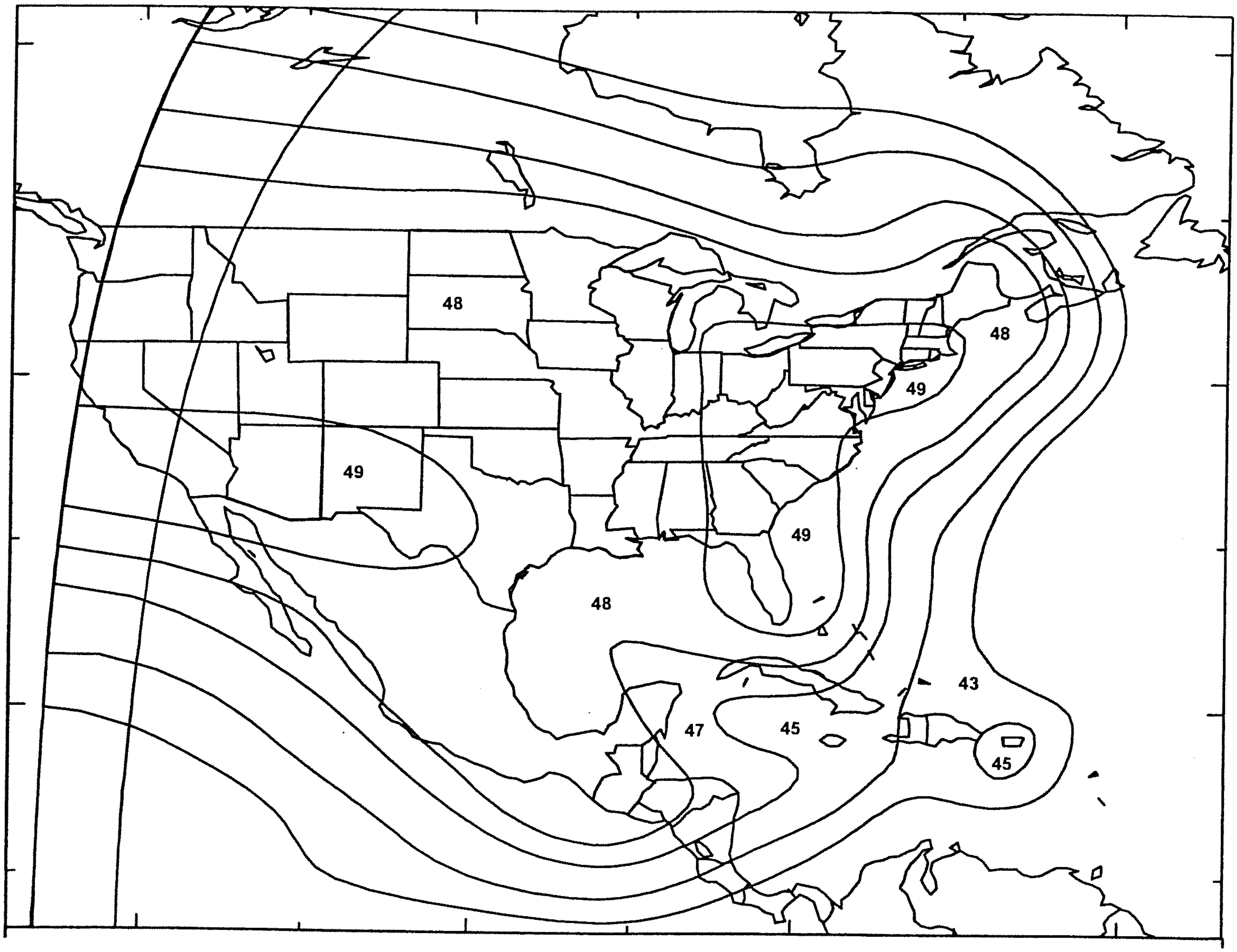


Figure 5. C-Band Europe/Africa Uplink Coverage

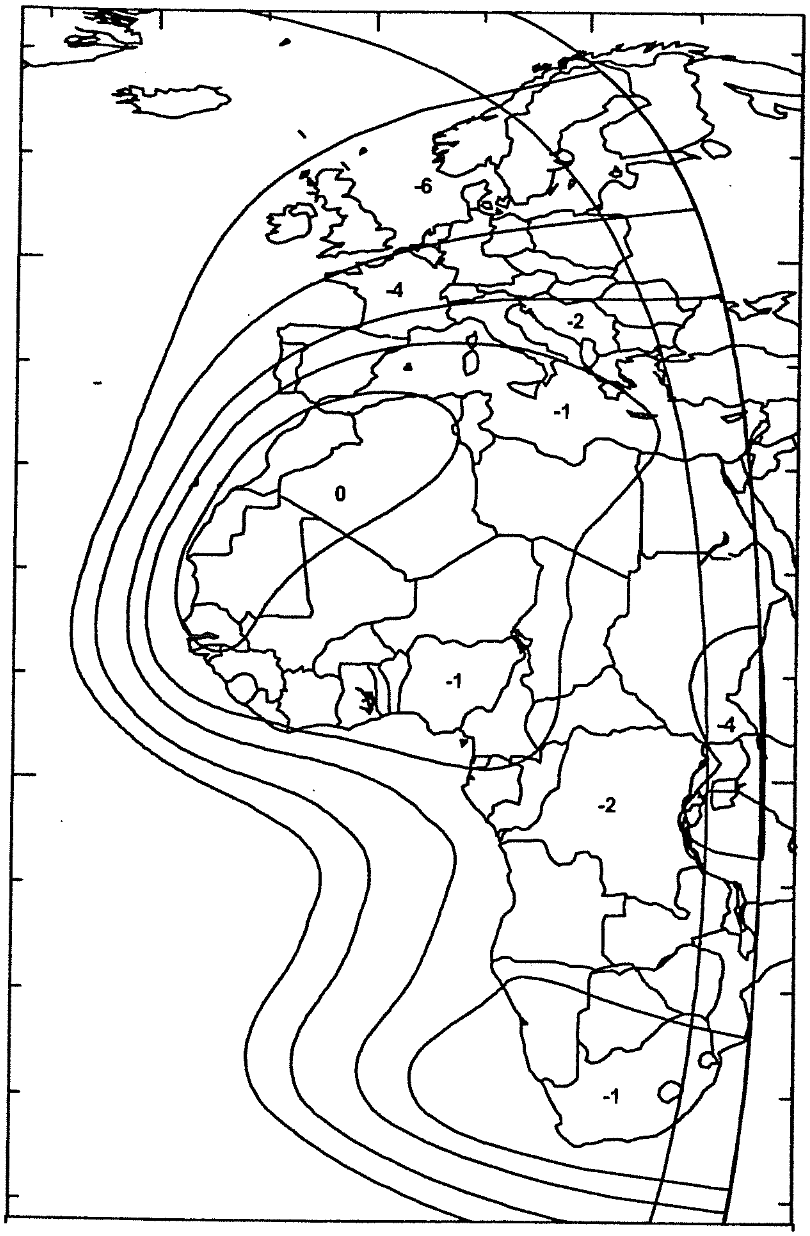


Figure 6. C-Band Europe/Africa Downlink Coverage

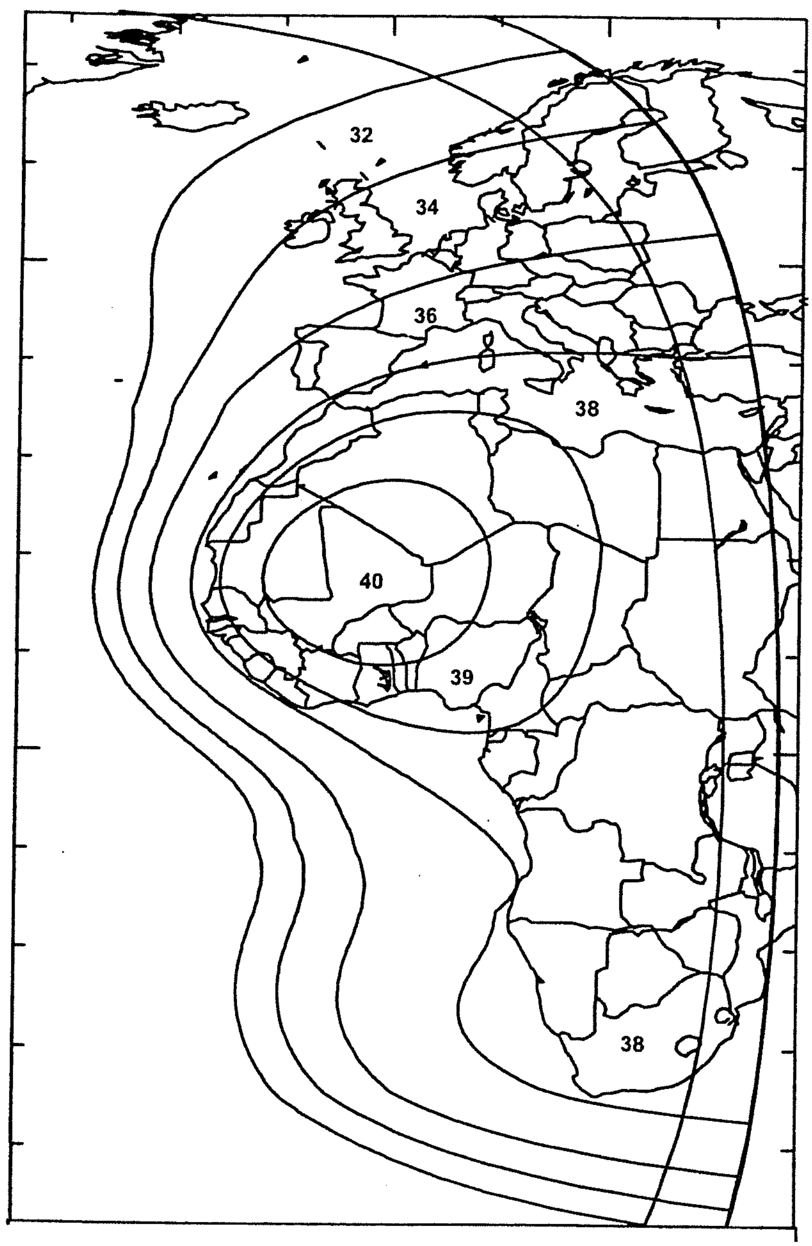


Figure 7. Ku-Band Europe/Africa Uplink Coverage

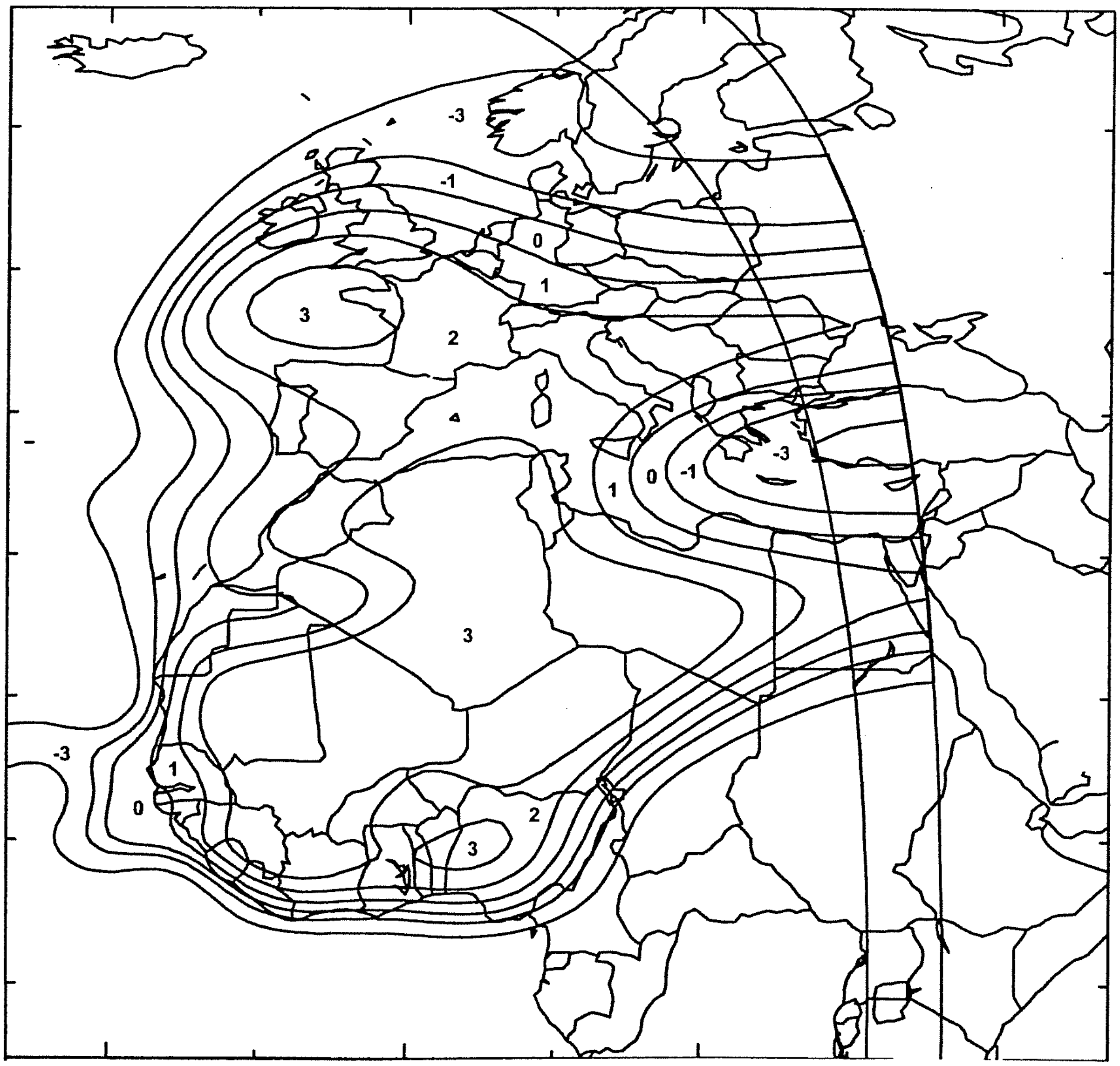


Figure 8. Ku-Band Europe/Africa Downlink Coverage

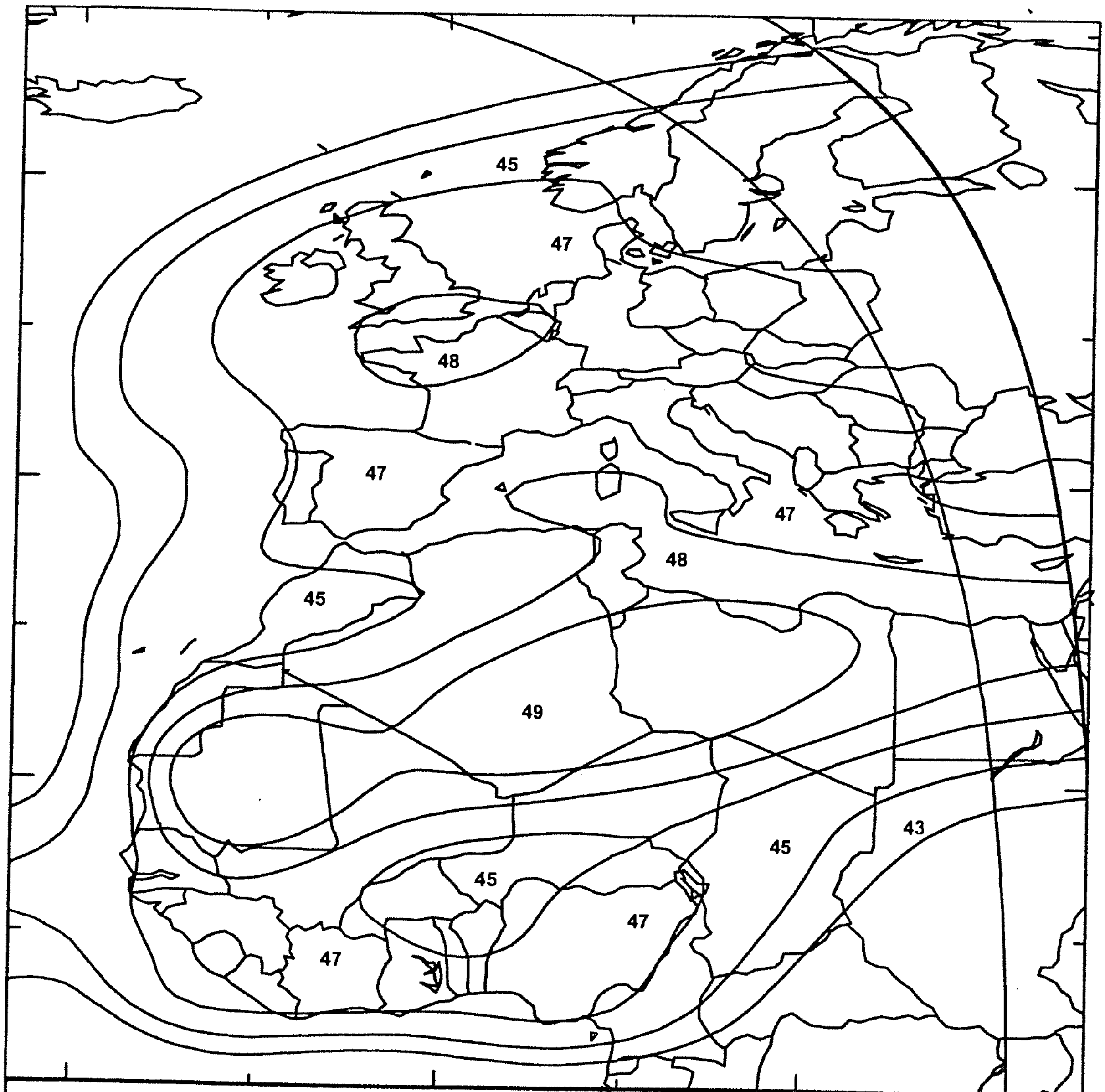


Figure 9. Ku-Band South America Uplink Coverage

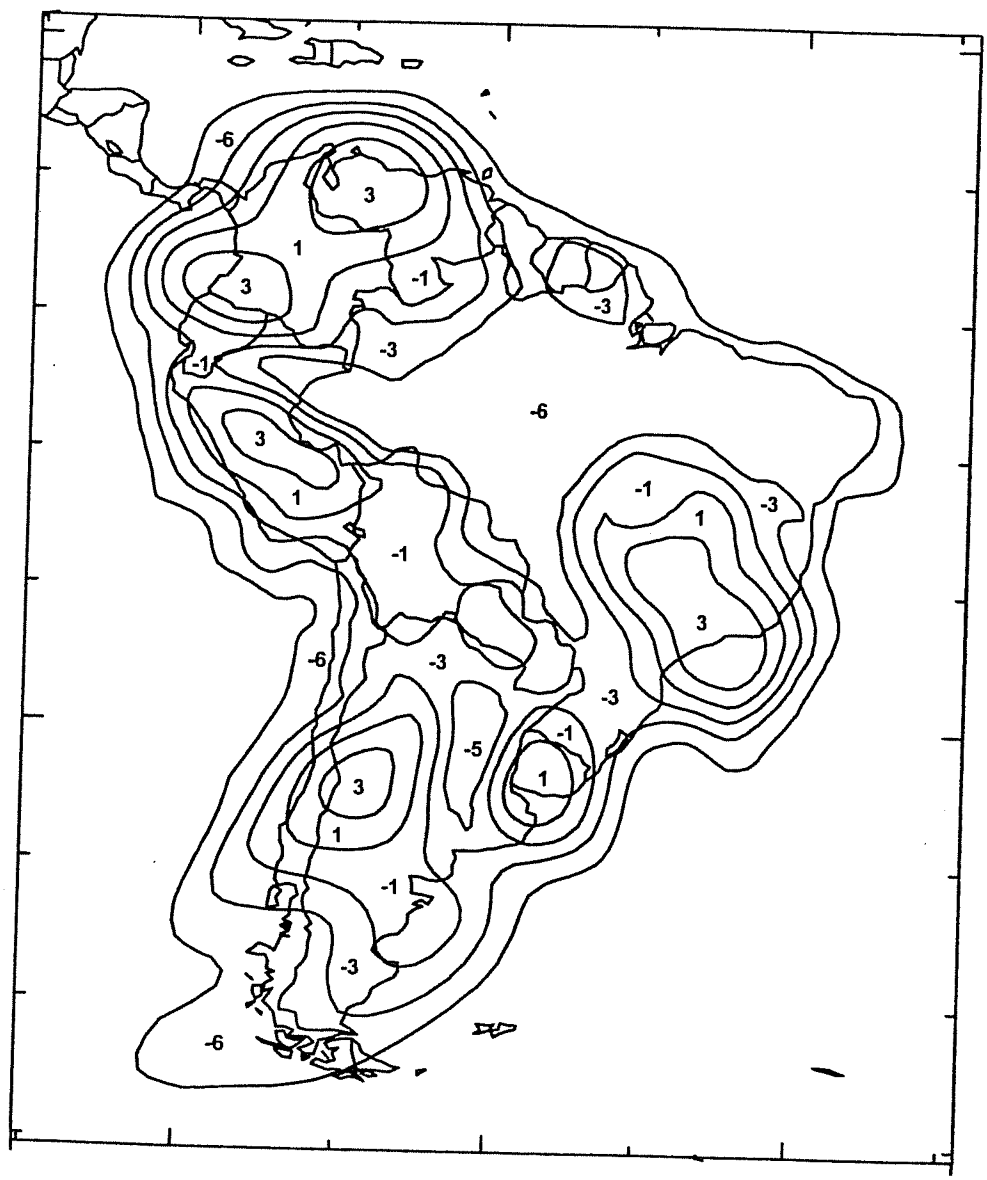


Figure 10. Ku-Band South America Downlink Coverage

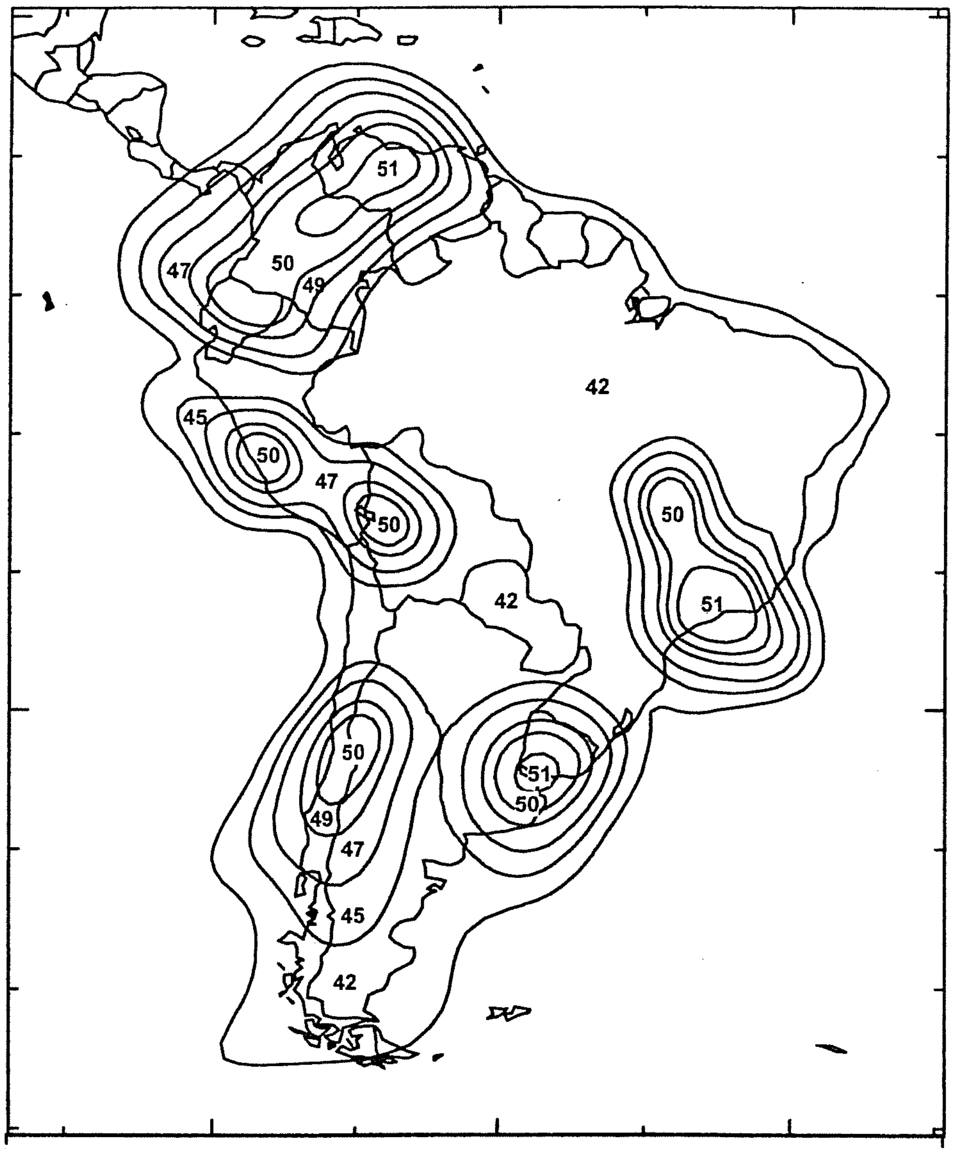
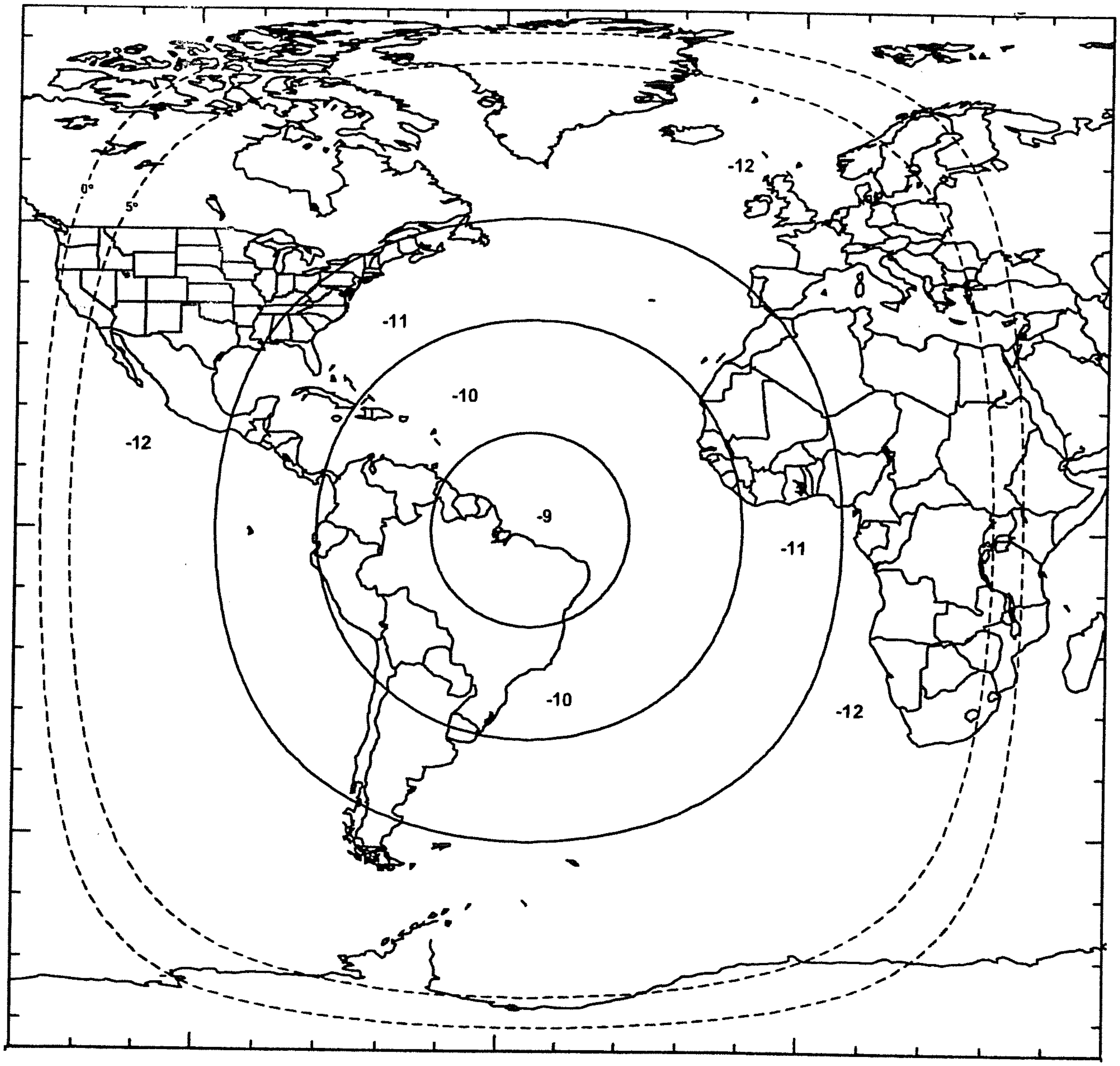


Figure 11. C-Band Global Uplink



d. Power Flux Density Level

The power flux density limits for space stations are specified in Section 25.208 of the FCC Rules. Using the downlink contours in Figures 1 through 11 it will be shown that the PAS-1R satellite will meet the Commission's regulations.

For the C-Band US/Latin America beams:

Maximum EIRP in Beam (dBW)	41.0
Path Loss to beam boresite (dB)	-196.0
Gain of 1m^2 Antenna (dB)	42.8
Bandwidth of Digital TV Carrier (dB)	-75.6
Conversion to 4kHz (dB)	36.0
Maximum Power Flux Density (dBW/m^2/4kHz)	-151.8

For the C-Band Europe/Africa beam:

Maximum EIRP in beam (dBW)	40.0
Path Loss to beam boresite (dB)	-196.0
Gain of 1m^2 Antenna (dB)	42.8
Bandwidth of Digital TV Carrier (dB)	-75.6
Conversion to 4kHz (dB)	36.0
Maximum Power Flux Density (dBW/m^2/4kHz)	-152.8

For the Ku-Band North America beam:

Maximum EIRP in beam (dBW)	50.0
Path Loss to beam boresite (dB)	-205.0
Gain of $1m^2$ Antenna (dB)	42.8
Bandwidth of Digital TV Carrier (dB)	-75.6
Conversion to 4kHz (dB)	36.0
Maximum Power Flux Density ($dBW/m^2/4kHz$)	-151.8

For the Ku-Band Europe/Africa beam:

Maximum EIRP in beam (dBW)	50.0
Path Loss to beam boresite (dB)	-205.0
Gain of $1m^2$ Antenna (dB)	42.8
Bandwidth of Digital TV Carrier (dB)	-75.6
Conversion to 4kHz (dB)	36.0
Maximum Power Flux Density ($dBW/m^2/4kHz$)	-151.8

For the Ku-Band South America beam:

Maximum EIRP in beam (dBW)	50.8
Path Loss to beam boresite (dB)	-205.0
Gain of $1m^2$ Antenna (dB)	42.8
Bandwidth of Digital TV Carrier (dB)	-75.6
Conversion to 4kHz (dB)	36.0
Maximum Power Flux Density ($dBW/m^2/4kHz$)	-151.0

The results of the calculations clearly show that none of PAS-1R beams exceed the flux density limitations employed by the Commission and ITU.

2. Satellite characteristics

The major characteristics of the spacecraft are shown below in Table 3. The estimated weight and power budgets, listed in Tables 4 and 5, are based on a mission life of 15 years and assume sufficient redundancy to allow for random failures.

Tables 6 and 7 show the estimated receive gain-to-noise temperature (G/T) and EIRP budgets, respectively.

Table 3. Spacecraft Characteristics

General	
spacecraft bus	Hughes, HS-702
stabilization	3 axis, momentum bias
mission life	15 years
eclipse capability	100 percent
stationkeeping	
north-south	±0.05°
east-west	±0.05°
antenna pointing	±0.1° n-s and e-w
Communications	
frequency	
receive	13750 to 14500 MHz 5925 to 6425 MHz
transmit	11450 to 11950 MHz 10950 to 11200 MHz 3700 to 4200 MHz
polarization	uplink: H and V linear downlink: H and V linear

Table 3. (cont'd.)

number of transponders	72
transponder bandwidth	36 MHz
saturated transponder gain	170 to 195 dB
receive saturation at -2 dB/K contour and adjustable by ground command in 2 dB steps	-100 to -82.5 dBW/m^2
transmitter RF power	125W TWTA's at Ku-Band 140W TWTA's at Ku-Band 34 W SSPA's at C-Band 55 W TWTA's at C-Band
transmitter redundancy	45 for 36 (C-Band) 46 for 36 (Ku-Band)
emission limitations (percentage of authorized bandwidth)	
50 to 100%	>20 db attenuation in any 4kHz
100 to 250%	>40 db attenuation in any 4kHz
greater than 250%	>50 db attenuation in any 4kHz

Table 3. (cont'd.)

telemetry/ranging	vertical, linear
peak deviation	
command, ranging	±300 kHz
modulation index	
telemetry/ranging	1.0 ± 0.1 radians
telemetry eirp	
transfer orbit	7.0 dBW maximum
on station	22.0 dBW maximum
command threshold (flux density)	
transfer orbit	-82.0 dBW/m^2
on station	-111.0 dBW/m^2
coverage	
command	
transfer orbit	bicone
on station	pipe
telemetry	
transfer orbit	bicone
on station	pipe

<u>Tracking, Telemetry And Command</u>

frequency	
command, ranging	14498.5 MHz transfer orbit 13995 MHz on station
telemetry, ranging	11696 MHz, 11696 MHz
ULPC beacon	11699 MHz, LHCP and RHCP
polarization	
command	
transfer orbit	horizontal, linear
on station	LHCP
telemetry	
transfer orbit	vertical, linear
on-station	LHCP

Table 4. Weight Budget

Category	Weight, kgs.
communications subsystem weight	1,200
bus weight	1,500
estimated spacecraft dry weight	2,700
fuel, expendables	1,800
total launch weight	4,500

Table 5. Power Budget

Category	Power, watts
communications subsystem power	9,720
bus power	1,200
total power requirement	10,920
beginning-of-life array capability	11,980
beginning-of-life margin	1,060
end-of-life array capability(12 years)	10,995
end-of-life margin	75

3. Satellite Description

a. General

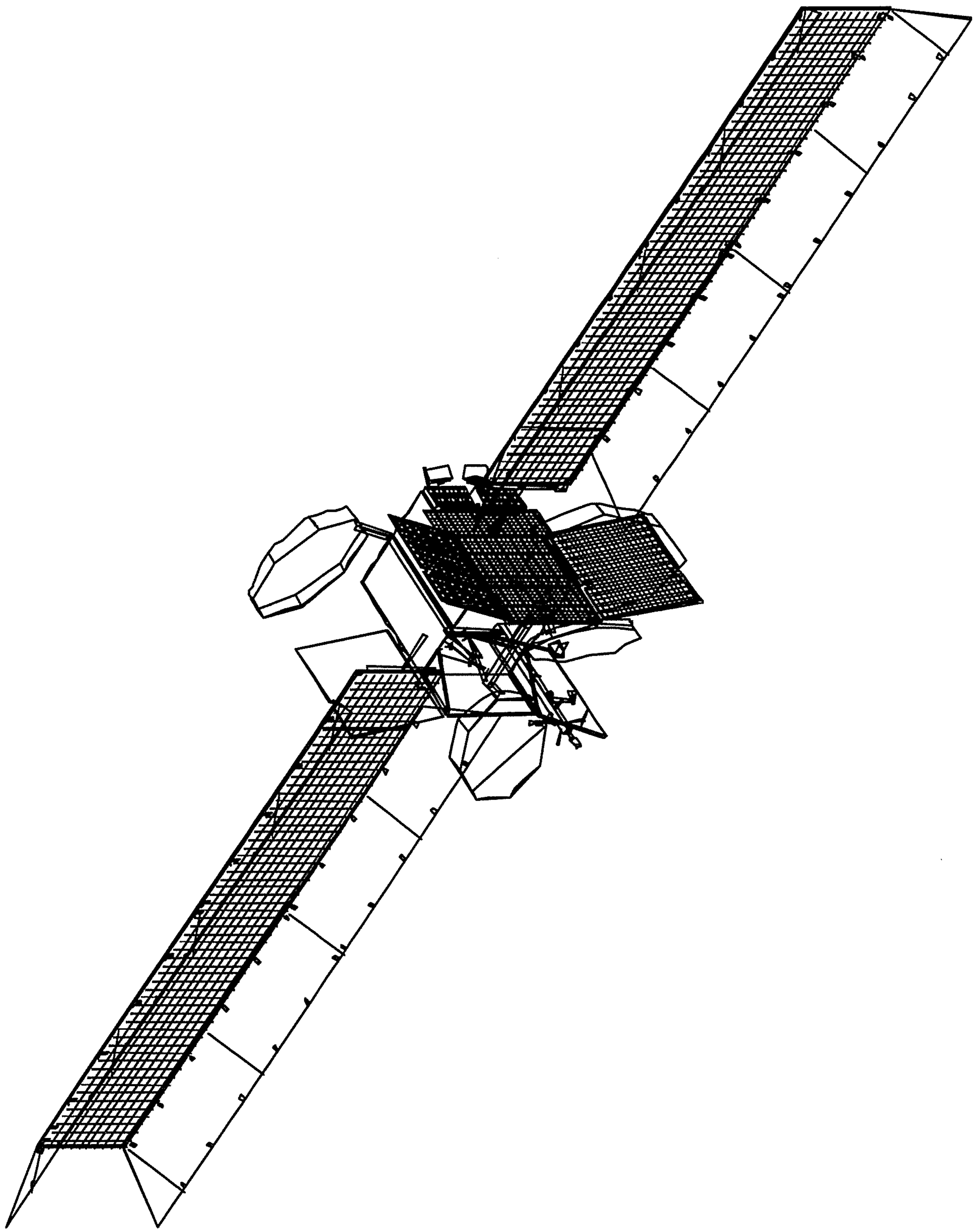
The on-orbit satellite configuration for PAS-1R is shown in Figure 12. The spacecraft bus is based upon the Hughes Space and Communications HS-702 series body-stabilized bus. The satellite design is compatible with launch by one of the currently available commercial launch vehicles. Final injection into geosynchronous orbit will be accomplished by an on-board liquid apogee motor (LAM).

Deployment of antennas and solar wings takes place in several separate operations. The omni antenna, used for command, telemetry, and ranging, is launched in a transfer orbit configuration. After the spacecraft has been injected into synchronous orbit, the communications antennas and radiator panels are deployed and the solar wings are extended.

b. Structural Design

The spacecraft takes advantage of a modular design for ease of manufacturing and integration. Communications equipment is mounted on the payload module that forms the forward portion of the spacecraft. Propulsion equipment is mounted on a central structure with tank loads being carried by a four bolt interface to the launch vehicle. A bus module forms the aft portion of the spacecraft.

Figure 12. On Orbit Configuration



c. Thermal Control

Thermal control is accomplished with a heat pipe network, a radiator design, doublers, heaters and temperature sensors. A new design includes the use of deployable radiators. Battery temperatures are maintained within limits by using direct radiating surfaces plus heaters.

d. Power

Satellite power will be provided by a solar array of fused silica-covered gallium arsenide solar cells that convert solar energy to the required electrical power. The five panel solar wings are deployed after the satellite attains synchronous orbit. Nickel-Hydrogen batteries provide sufficient electrical power during eclipse to operate the full communications and housekeeping loads. The electrical power subsystem has been designed so that no single failure in the subsystem will cause a spacecraft failure. Sufficient power will be available at the end of the satellite's life to support all 72 active transponder channels and the housekeeping loads.

e. Attitude Control

The Attitude Control Subsystem (ACS) maintains the spacecraft attitude during the transfer orbit, initial acquisition period, and geostationary operations. The ACS employs sun and earth sensors to perform all attitude determination functions. Control of attitude and spacecraft orbit is accomplished by using reaction wheels and by pulsed or continuous firing of selected thrusters by the ACS during ground controlled maneuvers.

f. Propulsion

The spacecraft will use both a liquid bipropellent and a Xenon Ion Propulsion System (XIPS). The liquid bipropellant system is based on proven technology from earlier PanAmSat programs and will be used for the liquid apogee engine and some early maneuvers in transfer orbit and during deployments. The use of XIPS technology for long-term attitude control has already been proven by the PAS-9 satellite and has been incorporated into Galaxy VIII(I) satellite, and will also be used in other spacecraft under construction by PanAmSat.

g. Communication Payload

(i) Antenna Subsystem

The PAS-1R satellite antenna subsystem contains four east-west reflectors and four nadir reflectors. Each reflector is fed by feed horns which are frequency diplexed to allow each horn to be used for transmit and receive functions. Relative to the desired polarization, the cross-polarization component of the receive and transmit signals will be at least 30 dB over the required coverage regions.

(ii) Communications Subsystem

The communications subsystem consists of four types of communications repeaters:

(1) a C-Band repeater employing 34 watt SSPAs,

(1) a C-Band repeater employing 55 watt TWTAs,

(3) a Ku-Band repeater employing 75 watt TWTAs,

(3) a Ku-Band repeater employing 140 watt TWTAs.

Subsystem components are selected to optimize performance in conjunction with ground terminals on customer premises.

A block diagram of the communication subsystem is provided in Figures 13 and 14.

Figure 13. Ku-Band Subsystem Simplified Block Diagram

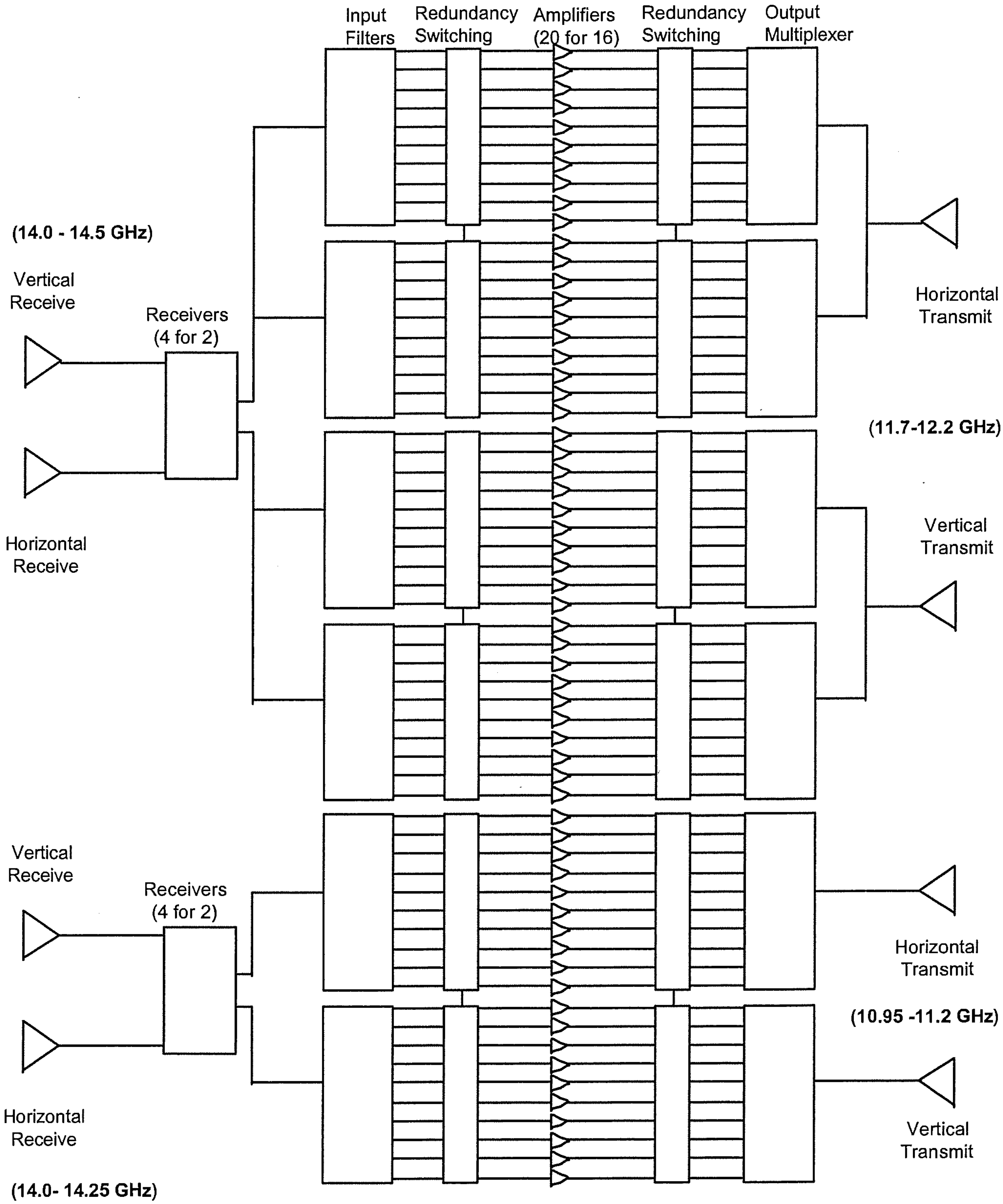
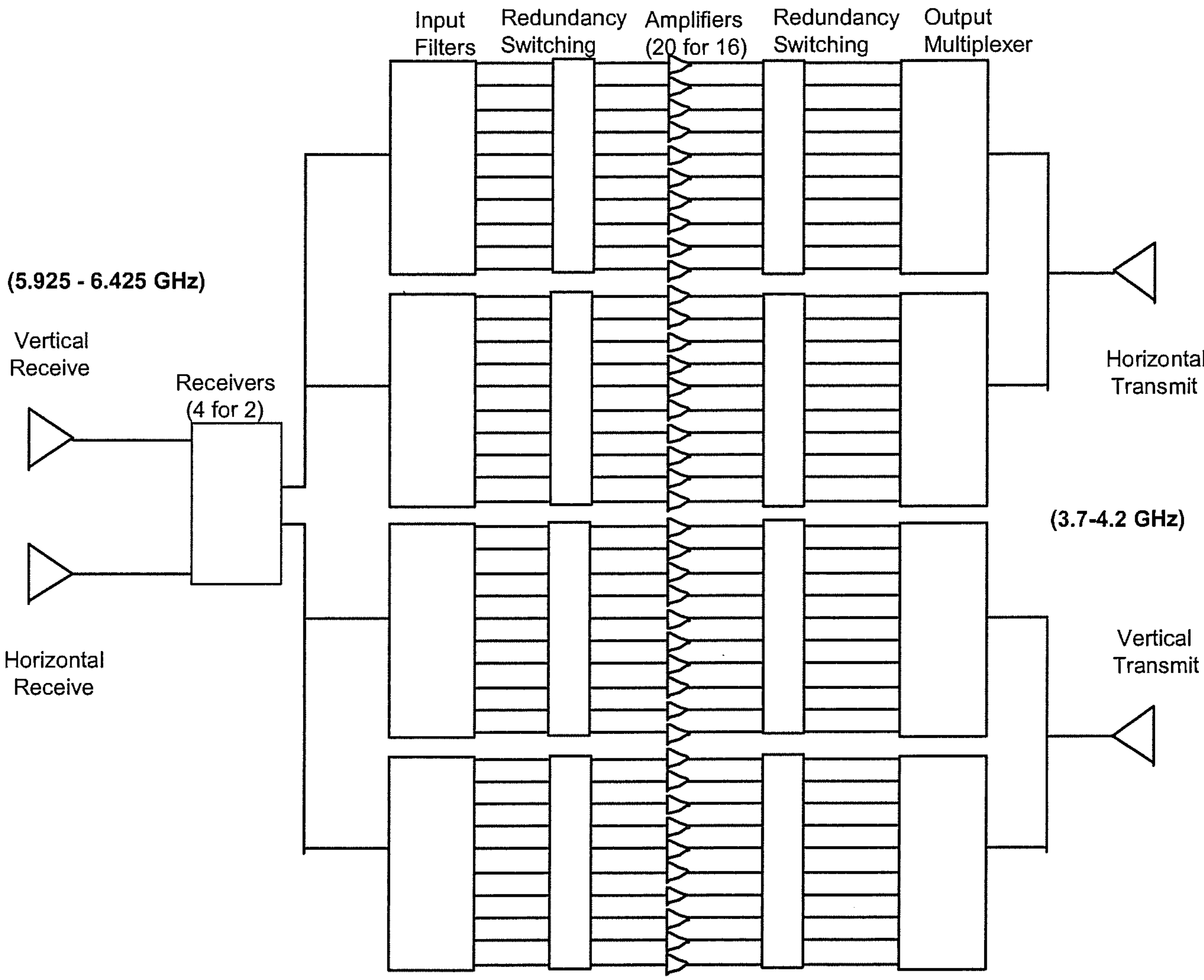


Figure 14. C-Band Subsystem Simplified Block Diagram



Redundant wideband receivers will be connected directly to all receive antennas (a total of eight receivers). Each wideband receiver has been designed to have high sensitivity (good noise performance) and low crosstalk coefficients (good linearity characteristics). High sensitivity is required for detection and amplification of extremely low-level signals received by the satellite from the earth station transmitters. The low crosstalk coefficients are necessary since many separate signals pass through the wide-Band receivers prior to channelization by the narrow bandpass filters. A highly linear receiver is necessary in order to minimize coupling of interference among these signals in the receiver.

The wideband receiver will consist of a low noise amplifier followed by a downconverter that will translate the input frequencies to the satellite transmit frequencies without frequency inversion. Variations in net translation frequency over one day will not exceed a total of one part in 10^6, including eclipse effects. Following the downconverter will be a medium-level amplifier that will amplify the translated signals sufficiently to drive the channel amplifier in each transponder.

Following the input filters is a bank of redundancy switches and combining hardware which form the channel amplifier redundancy combining network. Next, the commandable step attenuators provide ground commandable attenuation of up to 30.0 dB in 1 dB increments. Finally, the high powered amplifiers

(HPAs) output the signals to a redundancy combining network followed by the output multiplexer filters.

Spurious emissions that are beyond the usable bandwidth of each transponder and within the C- and Ku- transmission bands are attenuated by a combination of input and output multiplexer filters. Out-of-band emissions beyond the C- and Ku transmission bands, including harmonics, are attenuated by a combination of the output multiplexer filter and low pass filtering.

h. Satellite Useful Lifetime

The design lifetime of the satellite is 15 years. This has been determined by a conservative evaluation of the effect of the synchronous orbit environment on the solar array, the effect of the charge-discharge cycling on the life of the battery, and the wearout of the amplifiers. The mass allocation of propellant for spacecraft stationkeeping is 15 years. To enhance the probability of survival, spacecraft equipment will be redundant wherever possible. Materials and processes will be selected so that aging or wearing effects will not adversely affect spacecraft performance over the estimated life. The following paragraphs discuss dominant lifetime factors.

(i) Fuel

A conservative mission analysis indicates a 15 year lifetime. The mission has not yet been optimized since the exact sequence of maneuvers will be determined after the actual selection of the launch vehicle. Any remaining spacecraft weight margin can be converted to fuel life.

(ii) Battery

Life testing to date indicates that a longevity of 15 years can be achieved. In order to ensure this longevity, the spacecraft design incorporates the following required provisions: a depth of discharge of 80%, a C/20 charge rate at end of life, thermal control during all phases, and proper selection of battery cell components.

(iii) Solar Array

Predictions concerning the useful life of the solar array are backed by decades of the manufacturer's (Hughes Space and Communications, HSC's) experience in predicting and measuring in-orbit solar panel performance. These predictions are based on conservative assumptions concerning the radiation environment.

(iv) Electronics

All critical electronics units and components are redundant. There is a 4 for 2 receiver redundancy employed for each communications payload and at least 15 for 12 redundancy rings employed for the power amplifier chains. For other electronic units a minimum of two-for-one redundancy is employed. The electrical design follows well-established criteria regarding parts selection, testing and design, among others.

(v) Non-Electronic

Full redundancy has been employed for non-electronic components wherever possible.

i. Satellite Stationkeeping

Inclination of the satellite orbit will be maintained to ±0.05 degrees or less, and the satellite will be maintained to within ±0.05 degrees of the nominal longitude position. Attitude of the satellite will be maintained to an accuracy consistent with the achievement of the specified communications performance, after taking into account all error sources (e.g., attitude perturbations, thermal distortions, misalignments, orbital tolerances, and thruster perturbations).

In addition to the propellant required for operational attitude and orbital control, extra propellant will be incorporated to provide correction of the initial orbit, initial attitude acquisition, and one orbital repositioning maneuver at a drift rate of 1 degree per day. Sufficient propellant will be included in the satellite to permit a 15-year operational life.