(RESERVED)

(Read instructions carefully BEFORE proceeding.)

FEDERAL COMMUNICATIONS COMMISSION

FCC REMITTANCE ADVICE

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

PAGE NO. 1 OF _____

SPECIAL USE: 23-SAT-P/LA-96

FCC USE ONLY: FCC/MELLON NOV 09 1995

PAYOR INFORMATION

(1) FCC ACCOUNT NUMBER: 3 0 1 2 5 8 3 2 0 0

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

(2) TOTAL AMOUNT PAID (dollars and cents): $ 82,695 • 00

(3) PAYOR NAME (If paying by credit card, enter name exactly as it appears on your card)

Orion Asia Pacific Corporation

(4) STREET ADDRESS LINE NO. 1

2440 Research Boulevard

(5) STREET ADDRESS LINE NO. 2

Suite 400

(6) CITY: Rockville

(7) STATE: MD

(8) ZIP CODE: 20850

(9) DAYTIME TELEPHONE NUMBER (Include area code)

(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
		B B Y	1	$ 2330.00

(17A) FCC CODE 1

(18A) FCC CODE 2

(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
		B N Y		$ 80,360.00

(17B) FCC CODE 1

(18B) FCC CODE 2

(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

☐ Visa

EXPIRATION DATE: Month Year

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

AUTHORIZED SIGNATURE DATE

VERNER · LIIPFERT
BERNHARD · MCPHERSON AND HAND
CHARTERED

901 - 15TH STREET, N.W.
WASHINGTON, D.C. 20005-2301
(202) 371-6000
FAX: (202) 371-6279

WRITER'S DIRECT DIAL
(202) 371-6111

November 9, 1995

HAND-DELIVERED

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
International Bureau - Satellites
P.O. Box 358210
Pittsburgh, PA 15251-5210

Re: Application of Orion Asia Pacific Corporation for Authority to Construct, Launch and Operate a Separate International Communications Satellite System

Dear Mr. Secretary:

Transmitted herewith in triplicate on behalf of Orion Asia Pacific Corporation ("OAPC") is an application for authority to construct, launch and operate a new separate international communications satellite system. The proposed satellite is to be located at 139° East Longitude.

OAPC's application involves only one proposed space station at this orbital location. Nevertheless, pursuant to the September 28, 1995 Public Notice (No. 56031), OAPC will submit any further payment, if required by the Commission, within thirty days of notification from the Commission that an additional payment remains due.

Enclosed is a check in the amount of $82,695.00, representing two filing fees in accordance with Section 1.1105 of the Commission's Rules, one for authority to construct the satellite ($2,335.00); and the other for authority to launch and operate the satellite ($80,360.00). Also, enclosed is FCC Form 159 to accompany the filing fees.

HOUSTON, TEXAS OFFICE
2600 TEXAS COMMERCE TOWER
600 TRAVIS
HOUSTON, TEXAS 77002
(713) 237-9034
FAX: (713) 237-1216

AUSTIN, TEXAS OFFICE
SAN JACINTO CENTER
98 SAN JACINTO BLVD., SUITE 1440
AUSTIN, TEXAS 78701
(512) 703-6000
FAX: (512) 703-6003

HONOLULU, HAWAII OFFICE
HAWAII TIMES BUILDING
928 NUUANU AVE., SUITE 400
HONOLULU, HAWAII 96817
(808) 566-0999
FAX: (808) 566-0995

MCLEAN, VIRGINIA OFFICE
8280 GREENSBORO DRIVE
SUITE 601
MCLEAN, VIRGINIA 22102
(703) 749-6000
FAX: (703) 749-6027

Kindly direct any questions regarding this application to the undersigned.

Respectfully submitted,

Julian L. Shepard
Sari Zimmerman

Enclosures

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

Application of

ORION ASIA PACIFIC CORPORATION

for

Authority to Construct, Launch and Operate
the Orion-F5 Separate International
Communications Satellite System

ORION ASIA PACIFIC CORPORATION
2440 Research Blvd., Suite 400
Rockville, Maryland 20850
(301) 258-3200

November 9, 1995

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

In the Matter of the Application of	)	
	)	
Orion Asia Pacific Corporation	)	File No.
	)	
For Authority to Construct, Launch and Operate the Orion-F5 Separate International Communications Satellite System	)	

APPLICATION

Orion Asia Pacific Corporation ("OAPC") applies for authority, pursuant to Sections 308, 309 and 319 of the Communications Act of 1934, as amended ("Communications Act") and Section 25.114 of the Commission's Rules, to construct, launch and operate the Orion-F5 Satellite in the Ka-band, on a non-common carrier basis. The preferred orbital location for the Orion-F5 satellite is 139° East Longitude ("E.L."), which is currently an unassigned orbital location in the Ka-Band.

BACKGROUND

Orion Asia Pacific Corporation ("OAPC") is a Delaware corporation with headquarters in Rockville, Maryland. OAPC's affiliated company, Orion Satellite Corporation, is the general partner of International Private Satellite Partners, L.P. (known as "Orion Atlantic") which holds a Commission license to operate a separate international satellite system consisting of two Atlantic Ocean Region ("AOR") satellites, the Orion-F1 satellite located at 37.5° West Longitude, and the Orion-F2 satellite located at 47° West Longitude.[1/] The Orion-F1 satellite was launched in November, 1994, and became fully operational in January, 1995. On September 25, 1995, Orion Satellite Corporation received conditional authority to construct the Orion-F3 Ku-band satellite at 12° W.L. in the AOR as an international separate satellite system (File No. CSS-91-009), Orion Satellite Corporation, DA 95-2027 (released September 25, 1995). OAPC has an application pending for the Orion-F6 satellite at 126° E.L. (File No. CSS-94-009). On November 1, 1995, the Commission accepted for filing the amendment of Orion Asia Pacific Corporation to its pending application at 126° E.L. to include a Ka-band payload (File No. 206-SAT-AMEND-95).

1/ See Memorandum Opinion, Order, and Authorization, 5 F.C.C. Rec. 4937 (Aug. 6, 1990); and Memorandum Opinion, Order, and Authorization 6 F.C.C. Rec. 4201 (June 28, 1991), respectively.

DETAILED INFORMATION IN SUPPORT OF THE APPLICATION

The following information is provided in accordance with the correspondingly-numbered subsections of Section 25.114 (b) of the Commission's Rules:

(1) NAME, ADDRESS AND TELEPHONE NUMBER OF APPLICANT

Orion Asia Pacific Corporation
2440 Research Blvd., Suite 400
Rockville, MD 20850
301-258-3200

(2) NAME, ADDRESS AND TELEPHONE NUMBER OF COUNSEL

Thomas J. Keller, Esq.
Julian L. Shepard, Esq.
Sari Zimmerman, Esq.
Verner, Liipfert, Bernhard, McPherson & Hand
901 15th Street, N.W.
Washington, D.C. 20005
Telephone: (202) 371-6060
Fax: (202) 371-6279

(3) TYPE OF AUTHORIZATION REQUESTED

OAPC is requesting authorization from the Federal Communications Commission to construct, launch and operate a separate international fixed communications satellite system.

(4) GENERAL DESCRIPTION OF OVERALL SYSTEM, FACILITIES, OPERATIONS AND SERVICES

The Orion-F5 satellite will be an advanced Ka-band satellite and will be co-located with the Orion AP-1 satellite. The Orion-F5 satellite will form an important part of the Orion global satellite network to meet the growing demand for domestic and international

communications. The satellite lifetime is expected to be 13 years, and the satellite will be equipped with sufficient battery power to enable operation at full capacity during periods of solar eclipse. Sufficient solar power will be available to operate all active transponders throughout the lifetime of the satellite.

The satellite will be a 3-axis stabilized spacecraft combining a total of 32 traveling wave tube power amplifiers and 25 fixed spot beams and 2 steerable spot beams, to produce high levels of EIRP on the earth at Ka-band frequencies. Orion-F5 may utilize intersatellite links, and this application shall be amended accordingly, if necessary. The Orion-F5 satellite will provide coverage to the Asia Pacific Region, including China, Japan, Southeast Asia, India, Australia and Hawaii.

A full range of communication services are anticipated for the Orion-F5 satellite, including, but not limited to, digital carriers; wideband and narrowband TDMA; digital audio; digitally-compressed video; SNG video from small, transportable uplinks; wideband, high-definition video and audio; and voice and multimedia services. Additional types of services may be added as they are developed and become available.

(5) TECHNICAL DESCRIPTION OF RADIOFREQUENCY ASPECTS OF SYSTEM

Detailed descriptions of the radio frequencies, polarization plan, power, antenna characteristics and other aspects of the technical design of the proposed satellite system are set forth in the attached Technical Exhibit (Exhibit 1) entitled "Technical Description ORION-F5 Satellite at 139°E for Ka-Band Services."

(6) INFORMATION REGARDING ORBITAL LOCATION

The preferred orbital location for the Orion-F5 Satellite is 139° E.L., which is currently an unassigned orbital location in the Ka-band.

(7) SPACE STATION ANTENNA GAIN CONTOUR

Information regarding the space station antenna gain contours is set forth in Exhibit 1.

(8) ESTIMATED NUMBER AND GEOGRAPHIC DISTRIBUTION OF EARTH STATIONS

Information regarding the estimated number and geographic distribution of earth stations is set forth in Exhibit 1.

(9) DESCRIPTION OF SERVICES TO BE PROVIDED, INTERFERENCE ANALYSIS AND DEMAND FOR SERVICES

1. Services to be provided: A full range of video, voice and data services are anticipated for the Orion-F5, including, but not limited to, the following digital transmission services:

- Digital Carriers from 384 Kb/s, 1.544 Mb/s and 3.088 Mb/s
- SCPC/FDMA uplink and TDMA downlink access techniques
- PC-based computer data networks
- Fully meshed networks
- Digitally compressed video for teleconferencing and entertainment

A wide variety of digital services can be accommodated by the Orion-F5 satellite. The link budgets in the attached Technical Exhibit demonstrate that the on-board baseband processing (OBP) payload can support high quality digital services using small customer premises terminals (0.7m to 1.2m). For example, a 1.2 meter terminal with a 3-watt solid-state power amplifier will support a T-1 transmission rate, using a 1.544 Mb/s FDMA uplink and a 90 Mb/s TDM downlink.

Other services may be added as they are developed and become available.

2. Interference analysis:

Information regarding interference analysis is set forth in Exhibit 1.

(10) INFORMATION REGARDING ORBITAL INCLINATION, ANTENNA AXIS ATTITUDE AND LONGITUDINAL DRIFT

Information on orbital inclination, antenna axis attitude and longitudinal drift is set forth in Exhibit 1.

(11) POWER FLUX DENSITY

Information on power flux density is set forth in Exhibit 1.

(12) LAUNCH VEHICLES

The Orion-F5 spacecraft is compatible with a wide range of available commercial launch vehicles, such as the Atlas II AS, the European Ariane 4/5, the Russian Proton, and the Long March vehicles. A decision on the actual launch vehicle to be used has not been made yet.

(13) TRACKING, TELEMETRY AND CONTROL

Information on tracking, telemetry and control is set forth in Exhibit 1.

(14) PHYSICAL CHARACTERISTICS OF SPACE STATION

Information on the physical characteristics of the space station is set forth in Exhibit 1.

(15) SERVICE TO ALASKA, HAWAII, PUERTO RICO AND THE VIRGIN ISLANDS

The Orion-F5 satellite will provide coverage to Hawaii. See Figures 2 and 3 in Exhibit 1.

(16) ADDITIONAL OR REPLACEMENT SATELLITES

Information on this subject is not applicable to the Orion-F5 satellite.

(17) ESTIMATED INVESTMENT AND OPERATING COSTS

See Exhibit 2 for a description of estimated investment and operating costs.

(18) OAPC'S FINANCIAL QUALIFICATIONS

The Commission currently allows the financial qualification showing required of separate satellite system applicants to be accomplished in two stages in order to accommodate

the unique circumstances applicable to the international satellite environment.[2/] OAPC plans to raise funds in the capital markets to finance the construction, launch and operation of the satellite. OAPC will make a complete and final financial showing following conclusion of the INTELSAT consultation for Orion F5.

(19) OAPC'S LEGAL QUALIFICATIONS

OAPC's legal qualifications are documented fully in its FCC Form 430, most recently filed on September 20, 1994, which is incorporated by reference herein.

(20) REGULATORY STATUS

The Orion-F5 Satellite will provide service on a non-common carrier basis. The non-common carrier transactions will consist, typically, of private sales of transponder capacity and related satellite communications services.

(21) CONSTRUCTION AND LAUNCH MILESTONES

Attached as Exhibit No. 3 is a schedule showing the dates by which construction will be commenced and completed, the launch date, and the estimated date of placing the satellite into service.

2/ Establishment of Satellite Systems Providing International Communications, 101 F.C.C.2d 1046, 1164 (1985), recon. 61 RR2d 649 (1986), further recon., 1 FCC Rec. 439 (1986).

(22) PUBLIC INTEREST CONSIDERATIONS

Grant of OAPC's application is in the public interest for several reasons. The Commission's goals for separate satellite systems will be achieved by authorization of the Orion-F5 satellite.[3/] Recently, consumer demand has grown rapidly for satellite communications services. OAPC is well-suited to satisfy that demand and provide a wide range of services to domestic consumers. Orion has been particularly responsive to customer demand in the design of the services now being offered by the Orion-F1 satellite in the transatlantic market. The success and reliability of Orion's existing international system has been established. With the Orion-F5 satellite, OAPC will continue to build upon its successful track record in the provision of state-of-the-art technology and services to users of satellite communications. The Orion-F5 satellite will make a significant contribution to the further development of global information infrastructure.

The Orion-F5 Satellite also satisfies the Commission's objective to provide broad-based coverage. The Orion-F5 Satellite will provide high performance spot-beam coverage of the Asia Pacific Region, including China, Japan, Southeast Asia, India, Australia and Hawaii.

3/ See Establishment of Satellite Systems Providing International Communications, 101 F.C.C. 2d 1046 (1985), ¶¶ 68-86.

CORPORATE CERTIFICATION AND WAIVER

The undersigned, an officer of Orion Asia Pacific Corporation acting on its behalf, certifies that the statements made in this application are true, complete and correct to the best of his knowledge, information and belief, and are made in good faith. Orion Asia Pacific Corporation hereby waives any claims to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States of America because of the previous use of same, whether by license or otherwise. Applicant hereby certifies that no party to the application is subject to a denial of federal benefits, including FCC benefits, pursuant to Section 5301 of the Anti-Drug Abuse Act of 1985, 21 U.S.C. §862.

OAPC respectfully requests that the Commission grant this application.

ORION ASIA PACIFIC CORPORATION

April McClain-Delaney
Director of Regulatory
Affairs; Assistant Secretary

Date: November 9, 1995

Exhibit 1

Technical Description

ORION-F5 at 139° E.L.

for

Ka-Band Services

Exhibit 1
Technical Description of ORION F5 Satellite

1. Introduction and Orbital Location

The requested orbital location for the ORION F5 is 139° E longitude. This satellite which will be co-located with the Orion AP-1 satellite will operate at Ka-band and form an important part of the Orion global satellite network. The satellite will provide a variety of digital services throughout the Asia Pacific Region using a number of fixed spot beams and steerable spot beams. The spacecraft will implement on-board baseband processing (OBP) and baseband switching.

The on-board processing repeater approach enables full interconnectivity to be provided among the multiple beams with improved transmission performance for digital services. The uplink access to the satellite will be by frequency division multiple access (FDMA), typically from small customer premises earth terminals using any of three fixed carrier rates (3.088 Mb/s, 1.544 Mb/s, and 384 kb/s). The downlink transmission for each transponder channel uses a single time division multiplexed (TDM) carrier at a fixed transmission rate of 90 Mb/s, including robust error-correction coding.

The ORION F5 satellite will provide full operational flexibility to meet the changing market needs for various customer requirements including video, voice and multimedia services throughout the Asia Pacific Region. The services envisaged include customer-premise offerings which can be provided with small low-cost terminals.

2. Ka-Band Coverage

The satellite provides 25 fixed spot beams over the Asia Pacific Region. In addition, there are two steerable spot beams. The steerable beams are movable anywhere to provide coverage to these areas not served by the fixed beams or can be overlaid on existing fixed beams to increase capacity to a particular location. The half power beam-width of each spot beam is 1 degree, providing coverage to an area of approximately 400 miles in diameter on the surface of the earth.

3. Frequency and Polarization Plan

The frequency bands employed are 28.35-28.60 GHz, 29.25-29.5 GHz and 29.50-30.00 GHz for uplink bands, and 18.55-18.80 GHz, 19.45-19.7 GHz and 19.70-20.20 GHz for downlink bands. These frequency band segments have been proposed recently by the FCC for GEO FSS on a primary or co-primary basis. Full frequency reuse of these bands is achieved, for both uplink and downlink, by means of polarization and spatial isolation.

The center frequencies and polarizations of the transponders are shown in Figure 1 for the uplink and downlink, respectively. A total of 32 active transponders is possible each having a usable bandwidth of 114 MHz. The transponder center frequency spacing is 125 MHz. Frequency reuse by means of spatial and polarization isolation is used among the spot beams. Up to two transponders can be allocated to selected fixed downlink beams. An additional two transponders are possible into any fixed beam by means of overlaying one of the steerable spot beam.

The on-station command frequency will be at 30.0 GHz and the telemetry frequency at 18.55 GHz. Both these frequencies are selected subject to successful coordination. During transfer orbit the command and telemetry function will be done at Ku-band.

A telemetry beacon signal will be used for the purpose of earth station alignment and reference for uplink power control. The beacon will be located between 19.701-19.703 GHz subject to successful coordination.

4. Satellite Transmit Capability

Figure 2 shows the satellite antenna gain contours for each of the transmit spot beams. The figure shows the -4 dB contours for each beam. The steerable spot beams are identical to the fixed beams.

The Ka-band payload contains a total of 32 active traveling wave tubes (TWTAs) each having 60 Watts of saturated power. Adequate redundancy provisions for the TWTAs by means of four 10 for 8 redundancy rings will be used to meet the reliability objectives.

The EIRP budget for each beam is the following:

Parameter	Beam Peak	-4 dB Contour
Saturated TWTA output power	17.8 dBW	17.8 dBW
Output circuit loss	-2.5 dB	-2.5 dB
Transmit antenna gain	44.2 dBi	40.2 dBi
EIRP	59.5 dBW	55.5 dBW

5. Satellite Receive Capability

Figure 3 shows the satellite antenna gain contours for each of the receiving spot beams. The figure shows the -4 dB contours for each beam. The steerable spot beams are identical to the fixed beams.

Figure 1. Frequency and Polarization Plan

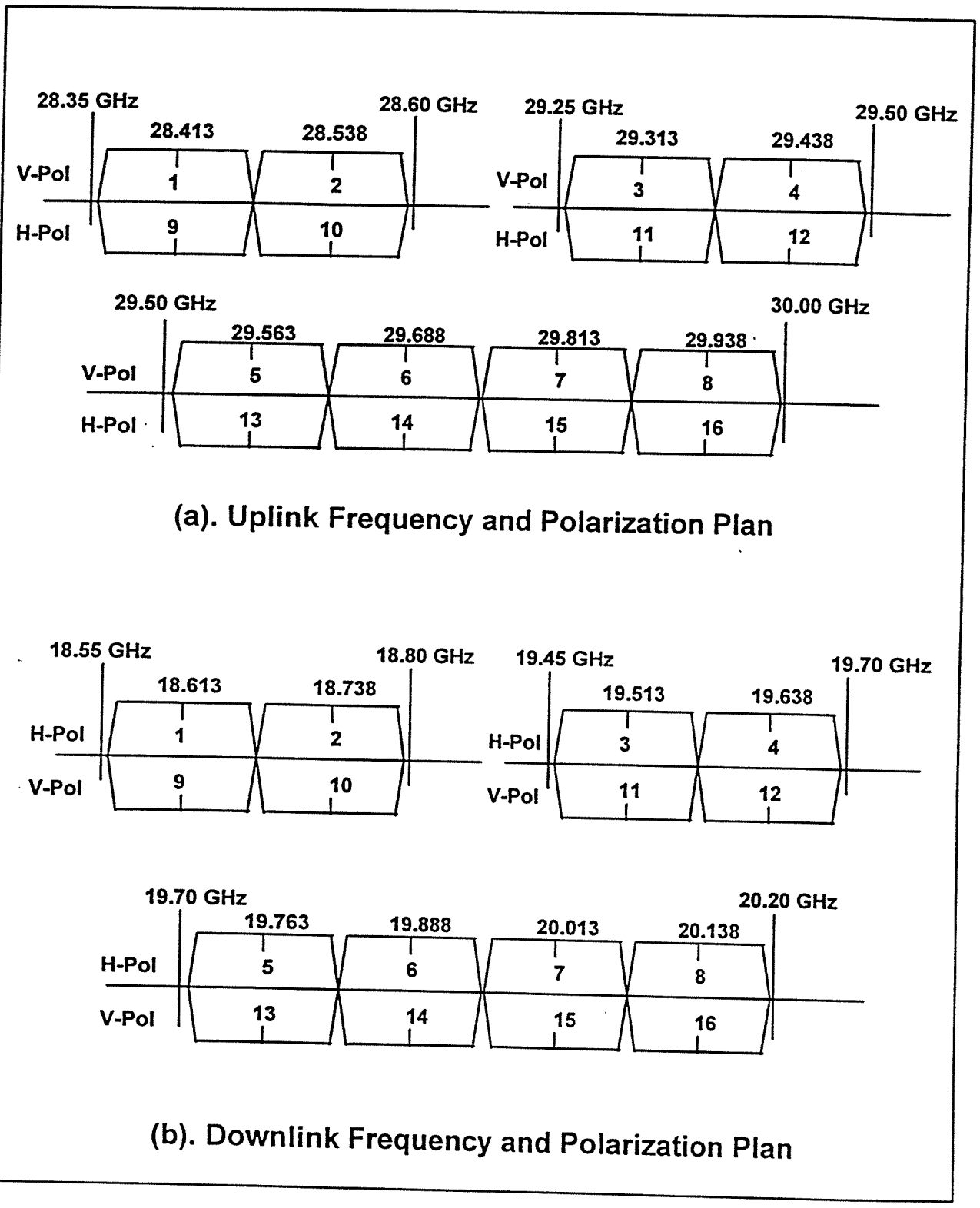


Figure 2. Satellite Transmit Spot Beam Coverages

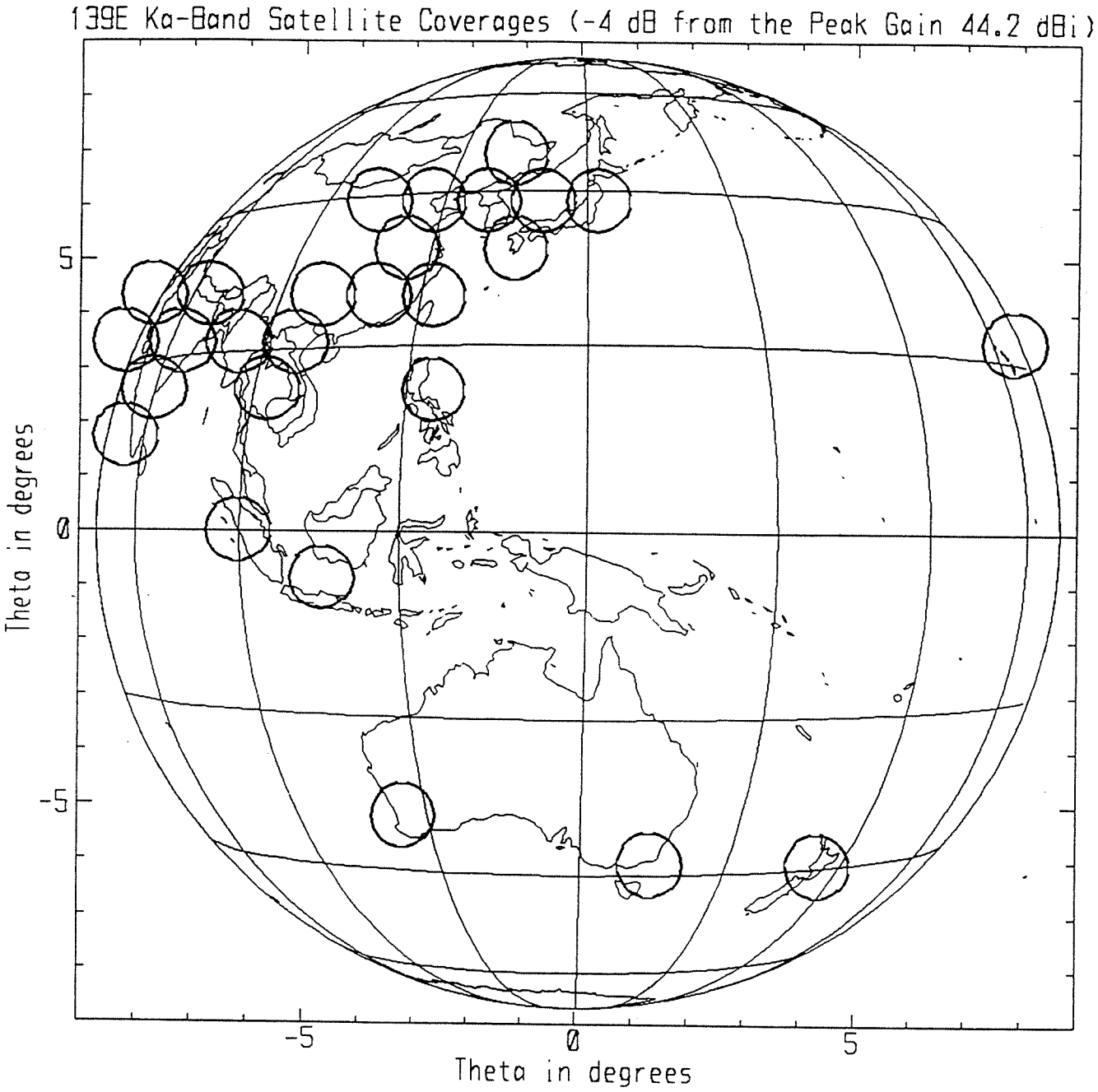
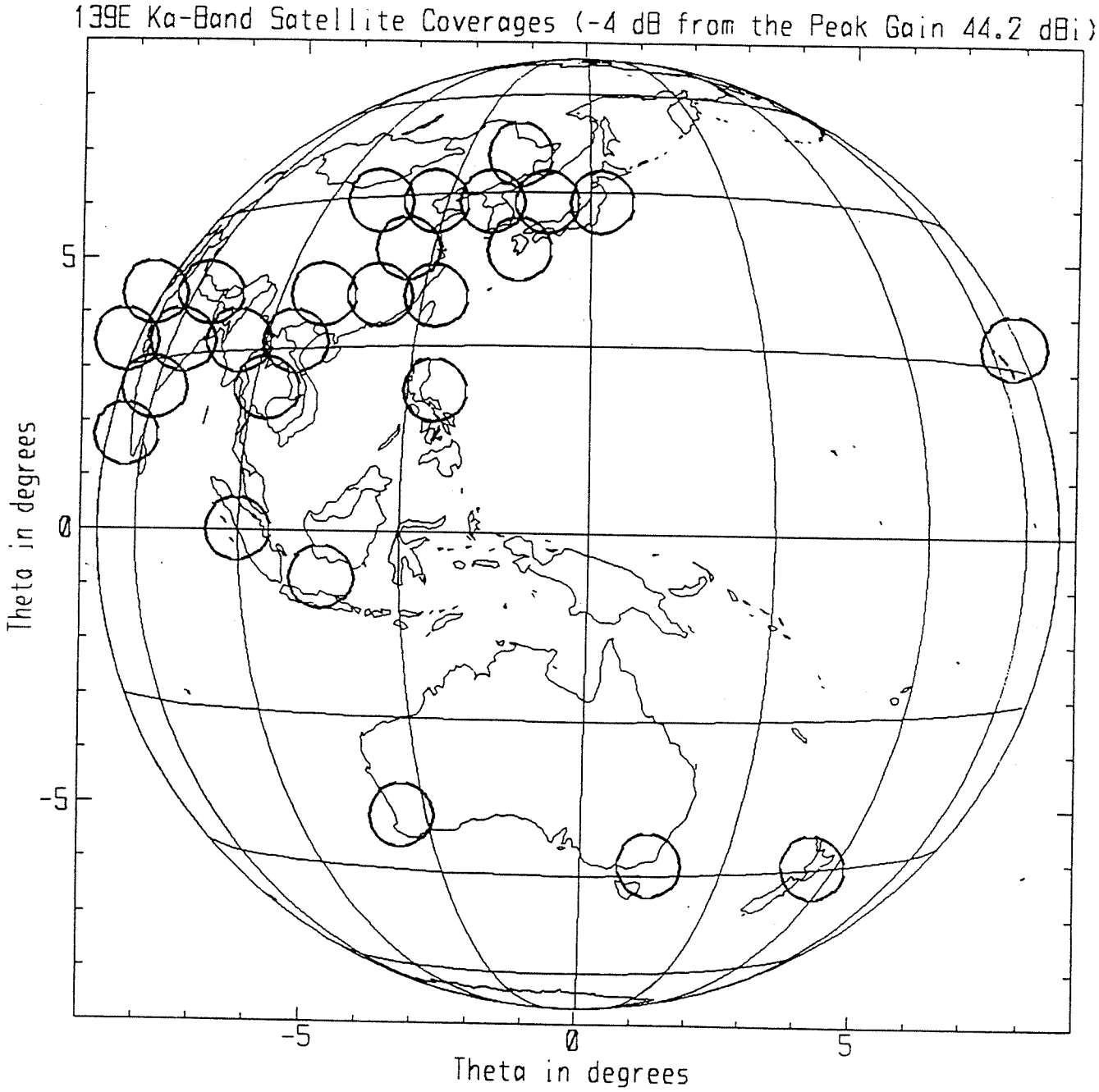


Figure 3. Satellite Receive Spot Beam Coverages



The satellite receiving system noise temperature is approximately 600 K. The budget for the satellite system figure of merit (G/T) is the following:

Parameter	Beam Peak	-4 dB Contour
Receive antenna gain	44.2 dBW	40.2 dBi
System noise temperature	27.8 dB/K	27.8 dB/K
Receive G/T	16.4 dB/K	12.4 dB/K

6. Connectivity

The OBP payload provides dynamic traffic routing on the packet-by-packet basis. The various data rate carriers uplinking in FDMA are digitally demultiplexed, demodulated and bits regenerated. The regenerated packets are rerouted individually to the designated downlink beam according to their burst address. The resulting bit stream of each downlink channel is then time-domain-multiplexed and transmitted to the designated downlink beams at a 90 Mbits rate.

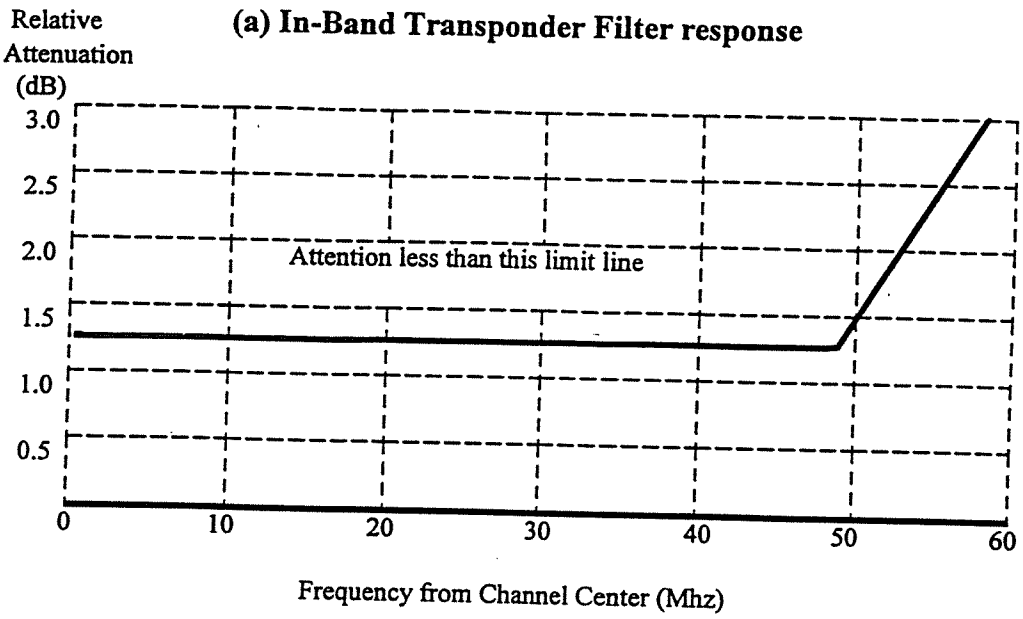
7. Transponder Gain Control and Saturation Flux Density

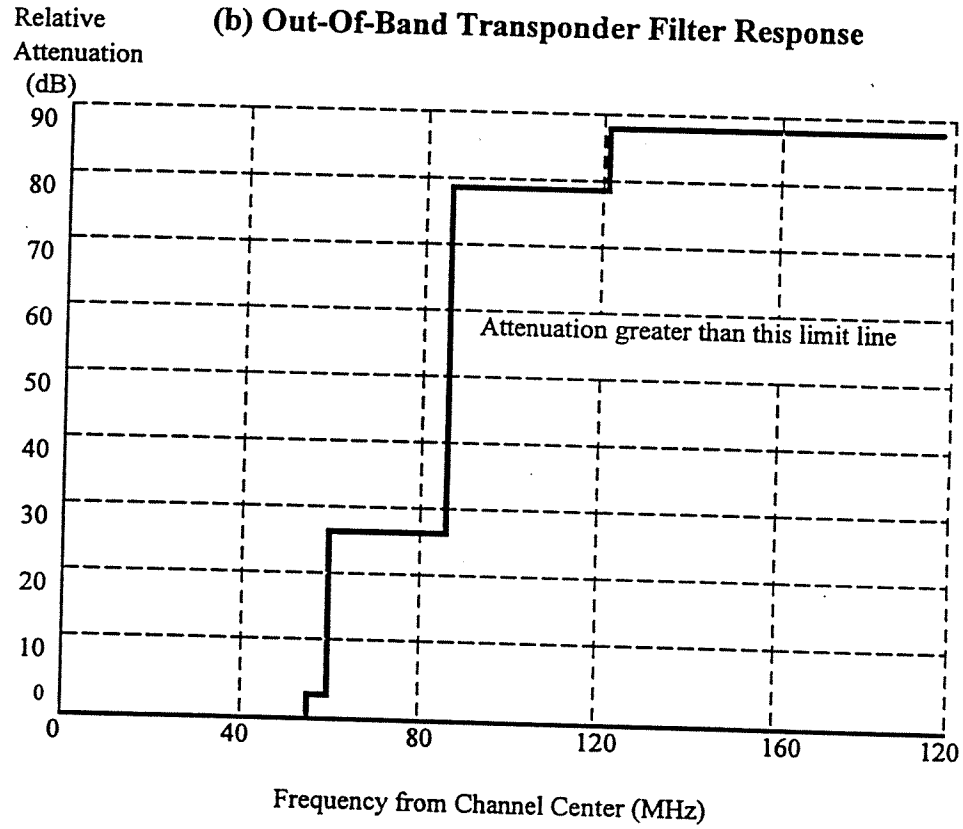
The repeater will include an automatic gain control circuit (AGC) which operates with a 30 dB dynamic range. The repeater with on-board baseband processor provides constant downlink TDM carrier power independent of the uplink signal level, and the saturation flux density concept, which was used for the conventional "bent pipe" transponders, is not applicable.

8. Satellite Transponder Filter Response

The overall frequency response of a transponder is specified by the in-band and out-of-band attenuation masks shown in Figure 4. The in-band attenuation, relative to the peak in-band gain, does not exceed the limit shown in Figure 4a. The out-of-band attenuation, relative to the peak in-band gain exceeds the limit shown in Figure 4b.

Figure 4. Transponder Filter Characteristics





9. Emission Designators and Allocated Bandwidth of Emission

The following list provides a representative list of the emission designators for the system:

Transmission Type	Emission Designators	Directions
Digital TDM (90 Mb/s, FEC rate-1/2 with R-S)	114MG1W	Downlink
Digital SCPC (3.088 Mb/s, FEC rate-1/2 with R-S)	4M00G7W	Uplink
Digital SCPC (1.544 Mb/s, FEC rate-1/2 with R-S)	2M00G7W	Uplink
Digital SCPC (384 kb/s, FEC rate-1/2 with R-S)	500KG7W	Uplink
Command	1M50X9D	Uplink
Telemetry	300KG9D	Downlink
Beacon	40K0N0 X	Downlink

R-S: Reed-Solomon coding

10. Earth Stations

A variety of customer premise type earth stations ranging from 0.7 m to 2.4 m antenna will be used depending on the types of service required. For the information rates that will be used the RF terminal power requirements range from between 0.5-7 Watts.

All earth stations accessing the ORION-F5 satellite must adhere to Orion's established operational procedures. The sidelobe performance of all antennas operating in the 20/30 GHz bands will meet the FCC requirements of $29-25\log(\theta)$, thus ensuring compatible operation with adjacent satellites at spacings of 2 degrees. All transmissions will be monitored by Orion's Communications Systems Monitor (CSM) which determines the frequency and power level of each carrier to ensure they are within specification.

All operational procedures of the ORION-F5 satellite network will be compliant with the Commission's rules, sections 25.271 to 25.277.

11. Communications Services and Link Budgets

A full range of digital communications services will be provided. Typical services include the following:

- Digital services at 384 kb/s, 1.544 Mb/s and 3.088 Mb/s
- SCPC/FDMA uplink and TDM downlink access techniques
- PC-based computer data networks
- Fully meshed networks
- Digitally compressed video for teleconferencing and entertainment.

For many of these services, advanced FEC techniques, such as concatenated Reed-Solomon coding on top of Viterbi coding will be employed. In general availabilities greater than 99.5 % will be provided for all services. For higher availabilities uplink power control will be used at the transmit site.

Sample link budgets for the three uplink rates are shown in Figures 5-7.

Figure 5 shows a link budget for 0.7 m terminals for the 384 kb/s FDMA uplink and 90 Mb/s TDM downlink. QPSK modulation with FEC rate-1/2 and Reed-Solomon outer codes for error correction is used. Uplink Eb/No of 8 dB for the FDMA and downlink Eb/No of 5 dB for the TDM provide the target BER performance of 10^{-10}. The link budget shows that 0.7 m terminals with 1 W solid-state power amplifier (SSPA) can support the 384 kb/s transmission.

Figure 6 shows a representative link budget for 1.544 Mb/s FDMA uplink and 90 Mb/s TDM downlink using 1.2 m terminals. The transmission also employs QPSK modulation with FEC rate-1/2 and Reed-Solomon outer codes for error correction. Uplink Eb/No of 8 dB for the FDMA and downlink Eb/No of 5 dB for the TDM is used to meet the target BER performance of 10^{-10}. The link budget shows that 1.2 m terminals with 3 W solid-state power amplifier (SSPA) can support the T1 rate transmission.

Figure 7 shows a representative link budget for 3.088 Mb/s FDMA uplink and 90 Mb/s TDM downlink using 1.2 m terminals. The transmission also employs QPSK modulation with FEC rate-1/2 and Reed-Solomon outer codes for error correction. Uplink Eb/No of 8 dB for the FDMA and downlink Eb/No of 5 dB for the TDM is used to meet the target BER performance of 10^{-10}. The link budget shows that 1.2 m terminals with 7 W solid-state power amplifier (SSPA) can support the data rate transmission

The above link budgets demonstrate that the OBP payload can support high quality digital services using small customer premises terminals (0.7 m to 1.2 m).

Figure 5. Sample Link Budget for 384 kb/s Service using 0.7 m Terminals

On-Board Processing Satellite Link Performance Calculation				
Link parameters:	**Unit**	**Value**		
Uplink frequency	GHz	30.00		
Uplink data rate	kbps	384.00		
Modulation/Access		QPSK/FDMA		
FEC		Rate-1/2 with Reed-Solomon		
Occupied bandwidth	kHz	500.00		
Uplink required Eb/No	dB	8.00		
Downlink frequency	GHz	20.00		
Downlink data rate	Mbps	90.00		
Modulation/Access		QPSK/TDM		
FEC		Rate-1/2 with Reed-Solomon		
Occupied bandwidth	MHz	114.00		
Downlink required Eb/No	dB	5.00		
Earth terminal antenna	m	0.70		
Uplink budget:	**Edge of coverage**	**Clear sky**	**Uplink fade**	
Transmit power	dBW	-0.73	-0.73	
Transmit loss	dB	1.00	1.00	
Transmit antenna gain	dBi	44.20	49.00	
Uplink free space loss	dB	214.00	214.00	
Atmospheric loss	dB	0.90	0.90	
Rain loss	dB	0.00	9.00	
Satellite G/T	dB/K	12.40	12.40	
Boltzmann's constant	dBW/K/Hz	228.60	228.60	
Bit rate	dBHz	55.84	55.84	
Uplink thermal Eb/No	dB	12.73	8.53	
Cross-pol Eb/Io	dB	22.00	22.00	
Copol Eb/Io	dB	22.00	22.00	
Intersystem interference Eb/Io	dB	22.50	22.50	
Uplink total Eb/(No+Io)	dB	11.45	8.00	
Excess Margin	dB	3.45	0.00	
Downlink budget:	**Edge of coverage**	**Clear sky**		**Downlink fade**
Transmit power	dBW	17.78		17.78
Transmit loss	dB	2.00		2.00
Transmit antenna gain	dBi	40.20		40.20
Downlink free space loss	dB	210.00		210.00
Atmosperic loss	dB	0.80		0.80
Rain loss	dB	0.00		6.00
Earth terminal G/T	dB/K	18.00		18.00
Boltzmann's constant	dBW/K/Hz	228.60		228.60
Bit rate	dBHz	79.54		79.54
Downlink thermal Eb/No	dB	12.24		6.24
Cross-pol Eb/Io	dB	22.00		22.00
Copol Eb/Io	dB	22.00		22.00
Intersystem interference Eb/Io	dB	20.00		20.00
Downlink total Eb/(No+Io)	dB	10.84		5.84
Excess Margin	dB	5.84		0.84

Figure 6. Sample Link Budget for 1.544 Mb/s Service using 1.2 m Terminals

On-Board Processing Satellite Link Performance Calculation				
Link parameters:	**Unit**	**Value**		
Uplink frequency	GHz	30.00		
Uplink data rate	kbps	1,544.00		
Modulation/Access		QPSK/FDMA		
FEC		Rate-1/2 with Reed-Solomon		
Occupied bandwidth	kHz	2,000.00		
Uplink required Eb/No	dB	8.00		
Downlink frequency	GHz	20.00		
Downlink data rate	Mbps	90.00		
Modulation/Access		QPSK/TDM		
FEC		Rate-1/2 with Reed-Solomon		
Occupied bandwidth	MHz	114.00		
Downlink required Eb/No	dB	5.00		
Earth terminal antenna	m	1.20		
Uplink budget:	**Edge of coverage**	**Clear sky**	**Uplink fade**	
Transmit power	dBW	5.32	5.32	
Transmit loss	dB	1.00	1.00	
Transmit antenna gain	dBi	49.00	49.00	
Uplink free space loss	dB	214.00	214.00	
Atmospheric loss	dB	0.90	0.90	
Rain loss	dB	0.00	9.00	
Satellite G/T	dB/K	12.40	12.40	
Boltzmann's constant	dBW/K/Hz	228.60	228.60	
Bit rate	dBHz	61.89	61.89	
Uplink thermal Eb/No	dB	17.53	8.53	
Cross-pol Eb/Io	dB	22.00	22.00	
Copol Eb/Io	dB	22.00	22.00	
Intersystem interference Eb/Io	dB	22.50	22.50	
Uplink total Eb/(No+Io)	dB	14.45	8.00	
Excess Margin	dB	6.45	0.00	
Downlink budget:	**Edge of coverage**	**Clear sky**		**Downlink fade**
Transmit power	dBW	17.78		17.78
Transmit loss	dB	2.00		2.00
Transmit antenna gain	dBi	40.20		40.20
Downlink free space loss	dB	210.00		210.00
Atmosperic loss	dB	0.80		0.80
Rain loss	dB	0.00		6.00
Earth terminal G/T	dB/K	22.60		22.60
Boltzmann's constant	dBW/K/Hz	228.60		228.60
Bit rate	dBHz	79.54		79.54
Downlink thermal Eb/No	dB	16.84		10.84
Cross-pol Eb/Io	dB	22.00		22.00
Copol Eb/Io	dB	22.00		22.00
Intersystem interference Eb/Io	dB	20.00		20.00
Downlink total Eb/(No+Io)	dB	13.63		9.78
Excess Margin	dB	8.63		4.78

Figure 7. Sample Link Budget for 3.088 Mb/s Service using 1.2 m Terminals

On-Board Processing Satellite Link Performance Calculation				
Link parameters:	**Unit**	**Value**		
Uplink frequency	GHz	30.00		
Uplink data rate	kbps	3,088.00		
Modulation/Access		QPSK/FDMA		
FEC		Rate-1/2 with Reed-Solomon		
Occupied bandwidth	kHz	4,000.00		
Uplink required Eb/No	dB	8.00		
Downlink frequency	GHz	20.00		
Downlink data rate	Mbps	90.00		
Modulation/Access		QPSK/TDM		
FEC		Rate-1/2 with Reed-Solomon		
Occupied bandwidth	MHz	114.00		
Downlink required Eb/No	dB	5.00		
Earth terminal antenna	m	1.20		
Uplink budget:	**Edge of coverage**	**Clear sky**	**Uplink fade**	
Transmit power	dBW	8.33	8.33	
Transmit loss	dB	1.00	1.00	
Transmit antenna gain	dBi	49.00	49.00	
Uplink free space loss	dB	214.00	214.00	
Atmospheric loss	dB	0.90	0.90	
Rain loss	dB	0.00	9.00	
Satellite G/T	dB/K	12.40	12.40	
Boltzmann's constant	dBW/K/Hz	228.60	228.60	
Bit rate	dBHz	64.90	64.90	
Uplink thermal Eb/No	dB	17.53	8.53	
Cross-pol Eb/Io	dB	22.00	22.00	
Copol Eb/Io	dB	22.00	22.00	
Intersystem interference Eb/Io	dB	22.50	22.50	
Uplink total Eb/(No+Io)	dB	14.45	8.00	
Excess Margin	dB	6.45	0.00	
Downlink budget:	**Edge of coverage**	**Clear sky**		**Downlink fade**
Transmit power	dBW	17.78		17.78
Transmit loss	dB	2.00		2.00
Transmit antenna gain	dBi	40.20		40.20
Downlink free space loss	dB	210.00		210.00
Atmosperic loss	dB	0.80		0.80
Rain loss	dB	0.00		6.00
Earth terminal G/T	dB/K	22.60		22.60
Boltzmann's constant	dBW/K/Hz	228.60		228.60
Bit rate	dBHz	79.54		79.54
Downlink thermal Eb/No	dB	16.84		10.84
Cross-pol Eb/Io	dB	22.00		22.00
Copol Eb/Io	dB	22.00		22.00
Intersystem interference Eb/Io	dB	20.00		20.00
Downlink total Eb/(No+Io)	dB	13.63		9.78
Excess Margin	dB	8.63		4.78

13. Interference Analysis

The Orion Ka-band all digital satellite network is designed to be compatible with the 2° orbital spacing environment. The earth stations accessing the Orion space segment will meet the established antenna sidelobe performance standard of 29-25log(θ) dBi.

The following summary of intersystem interference analysis, using representative system parameters, demonstrate that there will be no significant interference problem between two adjacent satellite systems that are spaced at least 2° away from each other.

Interference into Orion Network

Uplink Interference:		
Interfering carrier	Digital SCPC	Analog TV-FM
Bandwidth (MHz)	3.0	26.0
Power flux density (dBW/m^2)	-107	-78
Transmit antenna (m)	1.2	10.0
Sidelobe discrimination (dB)	28	45.5
Interferer spectral power flux density ($dBW/m^2/Hz$).	-199.7	-197.6
Orion carrier	Digital SCPC	Digital TDM
Bandwidth (MHz)	3.0	114
Power flux density (dBW/m^2)	-111.4	-92.0
Spectral power flux density ($dBW/m^2/Hz$)	-176.2	-172.6
Orion uplink C/I (dB)	23.5	25.0
Downlink Interference:		
Interfering carrier	Digital SCPC	Analog TV-FM
Carrier EIRP (dBW/carrier)	38.9	53
Sidelobe discrimination (dB)	22	22
Interferer spectral power density (dBW/Hz)	-47.8	-43.1
Orion carrier	Digital SCPC	Digital TDM
Carrier EIRP (dBW/carrier)	36.7	55.5
Spectral power density (dBW/Hz)	-28.1	-25.0
Orion downlink C/I (dB)	19.7	18.1

Orion's BER performance criteria can be met with downlink Eb/No of 5 to 8 dB depending on the error correcting code rates. Therefore, the degradation in link performance due to the intersystem interference is negligible.

Similarly, the interference into an adjacent system is shown as the following:

Interference into Adjacent Satellite System

Uplink Interference:		
Orion carrier	Digital SCPC	Digital TDM
Bandwidth (MHz)	3.0	114
Power flux density (dBW/m^2)	-111.4	-85.0
Transmit antenna (m)	1.2	5.0
Sidelobe discrimination (dB)	28	39.5
Interferer spectral power flux density ($dBW/m^2/Hz$)	-204.1	-205.0
Adjacent satellite carrier	Digital SCPC	Analog TV-FM
Bandwidth (MHz)	3.0	26.0
Power flux density (dBW/m^2)	-107	-78
Spectral power flux density ($dBW/m^2/Hz$)	-171.8	-152.1
Adjacent satellite uplink C/I (dB)	32.3	52.9
Downlink interference:		
Orion carrier	Digital SCPC	Digital TDM
Carrier EIRP (dBW/carrier)	36.7	59.5
Sidelobe discrimination (dB)	22	22
Spectral power density (dBW/Hz)	-50.1	-43.0
Adjacent satellite carrier	Digital SCPC	Analog TV-FM
Carrier EIRP (dBW/carrier)	40.9	55
Interferer spectral power density (dBW/Hz)	-23.8	-19.1
Adjacent satellite downlink C/I (dB)	26.3	23.9

The uplink and downlink C/I ratio exceeds 23 dB, and there is no significant intersystem interference.

14. Station Keeping and Antenna Pointing Accuracy

The orbital inclination and longitudinal drift will be maintained within ±0.05° of nominal. The Ka-band spacecraft antenna pointing will be maintained within ±0.05° of nominal during normal mode of operation, and ±0.1° during station keeping maneuvers.

15. Maximum Power Flux Density (PFD)

The maximum EIRP at the center of beam of each transponder channel is 59.5 dBW, which provides the maximum PFD of -102.9 dBW/m^2 on the ground for an unmodulated carrier. However, all traffic carriers are digitally modulated, and the power flux density in any 1 MHz band, within a 114 MHz transponder, is -123.5 dBW/m^2 which is at least 8.5 dB below the zero to 5 degrees elevation PFD limits specified by the Commission's rules (47 CFR Section 25.208(c)). Therefore, the maximum downlink PFD is well within the FCC limits.

16. Launch Vehicle

The spacecraft design is compatible with a wide range of available commercial launch vehicles such as Atlas IIAS, Ariane 4/5, Proton, and Long March. The actual launch vehicle will be selected on a competitive basis.

17. TT&C Arrangement

Orion plans to use an existing TT&C facility that will be located in the Asia Pacific Region. The most likely location for this facility will either Guam or the Marshall Islands. This facility will be connected to the Orion Control Center in Rockville, Maryland.

18. Spacecraft Characteristics

The major characteristics of the ORION F5 spacecraft are given in the table below.

Characteristics of ORION F5 Satellite

Parameter	Characteristics
Spacecraft stabilization:	
Transfer Orbit	3-axis stabilized
On-station	3-axis stabilized
Mission life	13 years
Reliability:	75% of achieving full performance at end of life
Station keeping accuracy	±0.05° E-W and N-S
Antenna pointing accuracy	±0.05° normal
	±0.1° during station keeping maneuver
Eclipse capability	100%
Mass summary:	
Spacecraft dry mass	1550 kg
Propellant	2150 kg
Launch mass	3700 kg
Power summary:	
Spacecraft requirement	6330 W
Solar Array at EOL	7000 W
Solar Array at BOLL	8200 W
Dimension:	
Spacecraft platform	Approx. 2.2 m x 2.2 m x 2.4 m
Solar array wing span	Approx. 26 m

A detailed breakdown of the satellite's mass and power budgets are given in the tables below.

Spacecraft Mass Budget Summary

Parameter	Mass
Spacecraft dry mass:	
Communications payload	500 kg
TT&C	50 kg
AOCS	90 kg
Structure	200 kg
Mechanism	90 kg
Propulsion	110 kg
Power (Solar array and batteries	370 kg
Thermal	90 kg
Others	50 kg
Propellant and pressurant	2150 kg
Total mass:	3700 kg

Spacecraft Power Budget Summary

Parameter	Power
Subsystem:	
Communication payload	5000 W
TT&C	100 W
Attitude & orbit control	110 W
Thermal (Equinox)	350 W
Battery charging	650 W
Other	120 W
Total requirement:	6330 W
Solar array power capability:	
Beginning-of-life (BOL)	8200 W
End-of-life (EOL)	7000 W
Margin at EOL:	670 W

Engineering Certification

I hereby certify that I am the technically qualified person responsible for the preparation of the engineering information contained in the Technical Exhibit of this Application, that I am familiar with Part 25 of the Commission's rules, and that the technical information is complete and accurate to the best of my knowledge.

Robert M. Sorbello, Ph.D.
Director, Systems Engineering
Orion Satellite Corporation

Exhibit No. 2

ESTIMATED CAPITAL REQUIREMENTS

Description	Estimated Costs
Spacecraft, launch and insurance*	$240 million
TT&C Construction**	$3 million
Operations (1st year)	$10 million

* Orion intends to use turnkey arrangements which result in a single, integrated price from the principal spacecraft and launch vendors.

** Modification of existing TT&C facilities

EXHIBIT NO. 3

ESTIMATED DEPLOYMENT SCHEDULE

Description	Date
Commencement of Construction	May 1998
Completion of Construction	July 2000
Launch	September 2000
Placement into Service	October 2000