LAW OFFICES
GOLDBERG & SPECTOR
1920 N STREET, N. W.
SUITE 650
WASHINGTON, D. C. 20036

HENRY GOLDBERG
PHILLIP L. SPECTOR

(202) 429-4900

November 7, 1983

Mr. William J. Tricarico, Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

Dear Mr. Tricarico:

Submitted on behalf of National Exchange, Inc. ("NEX") is an application for authority to construct and operate a new domestic communications satellite system in the Fixed-Satellite Service using frequencies in the 4/6-GHz band.

NEX's 4/6-GHz satellite system will operate with 24 transponders and is the 4/6-GHz element of NEX's "SpotNet" satellite system. The initial 12/14-GHz segment of the system was the subject of NEX's April 26, 1983, filing (FCC File Nos. 1824-27-DSS-P/L-83, 1828-DSS-P-83). An amended 12/14-GHz application is being filed contemporaneously herewith.

The 4/6-GHz satellites will be co-located in orbit with the 12/14-GHz satellites in the vicinity of 101° West Longitude and 75° West Longitude.

The application consists of two parts: Part I contains a public-interest showing and requisite showings of the applicant's legal, technical and financial qualifications; and Part II contains three separate applications for two in-orbit satellites and one ground spare.

Any questions with respect to this application should be directed to the undersigned.

Respectfully submitted,

Henry Goldberg
Attorney for
National Exchange, Inc.

APPLICATION OF

NATIONAL EXCHANGE, INC.

FOR A

DOMESTIC COMMUNICATIONS SATELLITE SYSTEM

TO OPERATE AT 4/6 GHz

TABLE OF CONTENTS

PART II. INDIVIDUAL SATELLITE APPLICATIONS

PREFACE

PREFACE

PREFACE

The 4/6-GHz and 12/14-GHz Components of the SpotNet System

On April 26, 1983, National Exchange, Inc. ("NEX") filed an application for a new, technologically advanced, spot beam, 12/14-GHz satellite system -- called "SpotNet" -- comprised of four in-orbit satellites, at only two orbital locations, and one ground spare (FCC File Nos. 1824-27-DSS-P/LA-83, 1828-DSS-P-83). NEX today is filing an amended application to supplement that April 1983 filing with the information required by the Commission's Report and Order in CC Docket No. 81-704,[1/] in the format suggested in the Memorandum Opinion and Order (FCC 83-185) (August 12, 1983) ("1983 Processing Order"). NEX is also filing today a companion application for two in-orbit satellites and one ground spare, to operate in the 4/6-GHz frequency band and be located at the same orbital locations as the 12/14-GHz satellites. Those 12/14- and 4/6-GHz space segments are to be known, respectively, as "SpotNet (K)" and "SpotNet (C)."

The two applications being filed today are separable in the sense that NEX would proceed to construct and operate the space segments covered by one application even if the other

---

[1/] Licensing of Space Stations in the Domestic Fixed-Satellite Service and Related Revisions, 48 Fed. Reg. 40233 (1983) (hereafter "2° Order").

application were not granted. When both are granted, NEX will offer services on a single, integrated SpotNet system comprised of four 12/14-GHz, spot-beam-configured satellites and two 4/6-GHz, continental-beam-configured satellites, all from the same two orbital positions.

Since submitting its initial application for two orbital positions for its SpotNet satellite system, National Exchange has further studied market needs and technology trends, and has concluded that the addition of 4/6-GHz-band satellite capacity at both orbital positions would enhance the system both in terms of greater service to the public and in terms of more efficient spectrum utilization. As a result of this addition, a user employing a single earth station will be able to receive signals in both frequency bands from multiple satellites at each of two orbital locations. Not only will the user be able to enjoy a substantially wider variety of telecommunications services, but also each service will be provided in whichever band is the most effective and efficient for that service.

Because of the need for frequency coordination with users of terrestrial microwave, most 4/6-GHz services employ relatively few uplink locations. The 4/6-GHz segment is useful primarily for high-traffic-density, point-to-point services and for nationwide, one-way distribution services. Where large antennas can be installed and justified economically, 4/6-GHz continental coverage beams can provide efficient spectrum use for point-to-point services. In most point-to-point applications, however, there is not enough traffic to justify a large earth station, and using continental coverage beams to carry services from one office to another with small antennas is not spectrum-efficient.

NEX has studied the arguments pro and con regarding hybrid satellites. NEX recognizes the undesirability of combining 4/6-GHz- and 12/14-GHz-band transponders on single hybrid satellites that do not make full use of the spectrum in both frequency bands. With full use of both bands, however, there are significant service advantages to co-locating 4/6-GHz and 12/14-GHz satellites while maintaining full spectrum efficiency. See 2° Order, ¶¶ 77-79. However, such co-location of 4/6-GHz- and 12/14-GHz-band capacity does not require both frequency bands to be accessible from the same physical satellite. Indeed, as shown in the original SpotNet application, optimal spectrum use of an orbital position increasingly will require multiple satellites to carry the service most appropriate to each frequency band, as a more flexible and economic alternative to a single extremely large and complex hybrid satellite. (See id., n. 73.)

While "cross-strapping" 4/6-GHz and 12/14-GHz transponders has been cited as an advantage of hybrid satellites, it is useful in practice in only a few specialized applications. Most hybrid satellites proposed to date make less than full use of each of the two frequency bands combined on one satellite as a means for a start-up satellite system to gain the benefits of both bands without the investment required to make use of the spectrum available at a given orbital position (Id., ¶ 78).

The SpotNet system, at orbital locations available for use of both 4/6-GHz and 12/14-GHz satellites, made possible by uniform 2° spacing, will be used as an integrated system in which 4/6-GHz, 12/14-GHz and combined 4/6-GHz-12/14-GHz earth stations aimed at one orbital position can access whichever frequency band is appropriate for the required service. The 4/6-GHz segment will be used primarily for high-density point-to-point trunking (particularly into areas of high rainfall) and for point-to-multipoint broadcast distribution services, such as teletext and analog video distribution. The 12/14-GHz segment will be used primarily for low-density, point-to-point voice, text, facsimile and teleconferencing services. The 4/6-GHz segment will in part provide backup for 12/14-GHz services during periods of high rainfall. Such backup can be used to cover all spot beams efficiently because of its nationwide coverage and the low probability of high rain attenuation in many geographic locations simultaneously.

NEX does not at this time believe cross-strapping 4/6-GHz and 12/14-GHz services at a common orbital position is necessary. If, however, there proves to be strong demand, which cannot be accommodated by those satellite operators with cross-strapped frequency bands on the same satellite, NEX will modify its design to allow cross-strapping through intersatellite links.

Technical and engineering analyses contained in the present application, including the spacecraft technical studies, coverage predictions and interference analyses, have been performed by NEX's consultant, Rubin, Bednarek and Associates, Washington, D.C.

PART I - System Proposal/Description

PART I

SYSTEM PROPOSAL/DESCRIPTION

November 7, 1983

TABLE OF CONTENTS

PART I

LIST OF TABLES

LIST OF FIGURES

PART I. SYSTEM PROPOSAL/DESCRIPTION

A. Applicant Name and Address

National Exchange, Inc.
11726 San Vicente Boulevard
Los Angeles, California 90049
(213) 820-5454

B. Correspondence

Correspondence relating to this application should be sent to the following person at the address in Paragraph A above (unless otherwise indicated):

Clay T. Whitehead
President

with a copy to:

Henry Goldberg, Esq.
Goldberg & Spector
1920 N Street, N.W.
Washington, D.C. 20036
(202) 429-4914

C. General Description of Overall System Facilities, Operations and Services

1. System Facilities and Operations

The SpotNet (C) satellites will operate in the 4/6-GHz frequency band from the same two orbital positions as the 12/14-GHz SpotNet (K) satellites, one in the vicinity of 101° West Longitude, for 50-state coverage, and one in the vicinity of 75° West Longitude. The satellites will have encrypted Telemetry, Tracking and Command ("TT&C") circuits, and all signaling channels will be encrypted as well. The satellites will be designed to be launched on either the Shuttle, the Delta 3920 PAM/D or Ariane. NEX plans to launch its first SpotNet (C) satellite in late 1987.

The SpotNet (C) space segment will utilize conventional CONUS-wide beams, with spot beams for Alaska and Hawaii, allowing coverage of all of the U.S. Each SpotNet (C) satellite will have 24 transponders. Each transponder will use a 9-watt solid state power amplifier and 36-MHz bandwidth, and one or more transponders will feed each of the beams. The transponders will be linearly cross-polarized, 12 vertical and 12 horizontal, for 1,000 MHz effective bandwidth for each satellite at each orbital location.

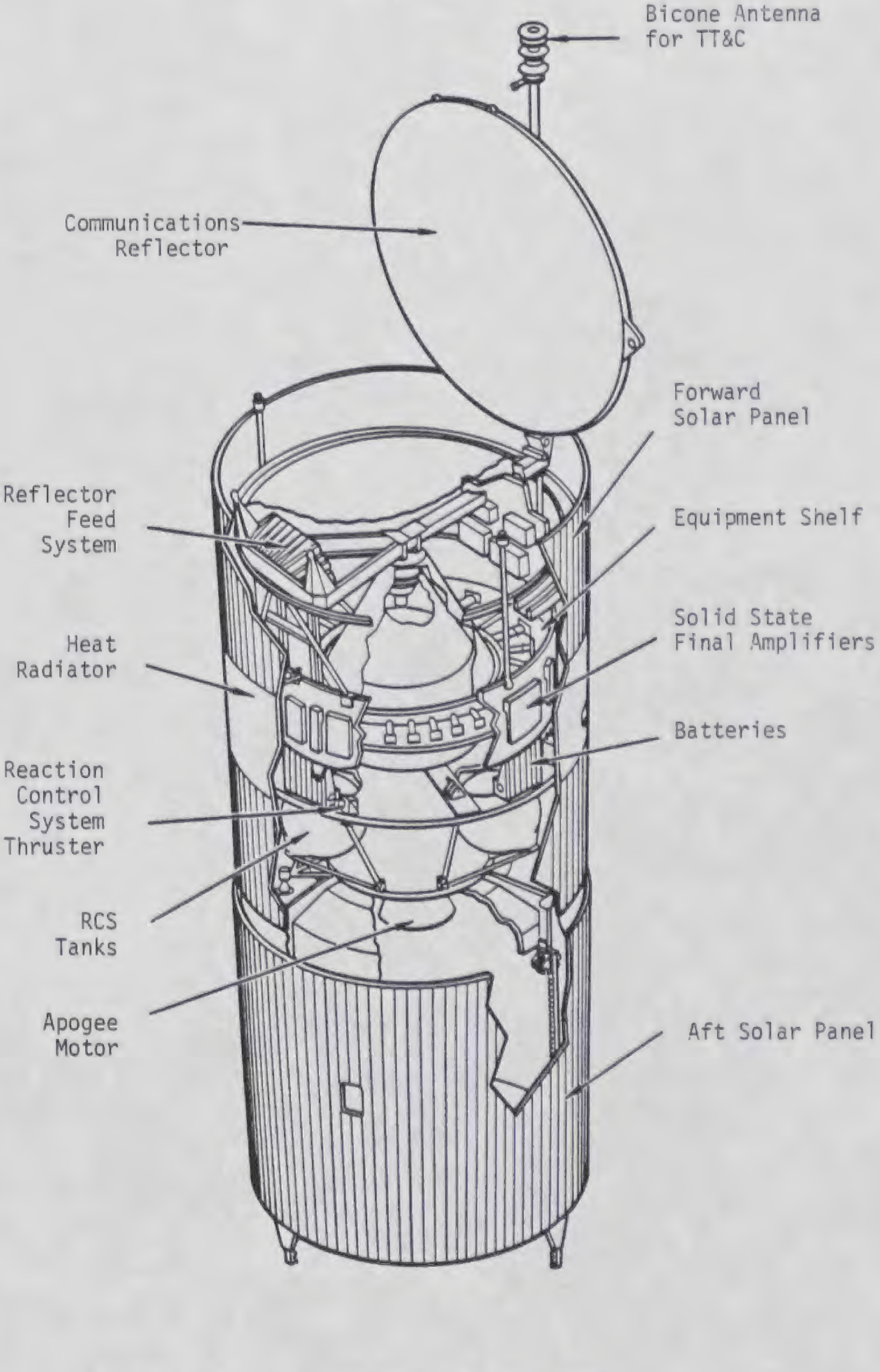
The SpotNet (C) segment of the SpotNet system will consist of two satellites in orbit and a ground spare. NEX is considering use of the Hughes and RCA standard C-band satellite designs. Both of these designs are capable of providing the type of 4/6-GHz space segment which NEX desires to implement. For illustrative purposes, a diagram of the proposed SpotNet (C) satellite configuration based on a Hughes HS-376 bus is given in Figure 1. The characteristics of the SpotNet (C) satellite are presented in tabular form in Table 1.

Two TT&C ground stations wil be built, one on each coast, both co-located with the TT&C facilities described in the SpotNet (K) application for tracking, monitoring, range-finding, and command functions. The TT&C stations will include 10-meter-diameter antennas that will operate in the 4/6-GHz bands and can additionally be used for communications.

The TT&C station to be located on the East Coast will be designated the primary center, and will be co-located with one of two fully redundant Network Control Centers ("NCC's"). The NCCs will handle the functions associated with the allocation, assignment, and adjustment of SpotNet system capacity and characteristics. The TT&C station to be located on the West Coast, designated the secondary center, will be co-located with the second NCC, and will provide a redundant backup for all TT&C functions. All TT&C channels will be encrypted to avoid unauthorized access and possible harm to the satellites.

2. Proposed Services

The Commission explicitly has recognized "the difficulties of new entrants in specifying precise services." (*Id.* at 597.) Taking these difficulties into account, NEX has developed a marketing plan for the balance of the Eighties. As the American economy shifts toward new information technologies and more information-intensive industries in the next decade, there will be an accelerating increase in the need for



SPOTNET (C) SPACECRAFT CONFIGURATION

FIGURE 1

Parameter	Characteristic
Launch Vehicle	Shuttle or Delta 3920/PAM-D
Satellite lifetime	9 years
Stationkeeping	
North-south	±0.1°
East-west	±0.1°
Stabilization	spin stabilized
Eclipse operation	All 24 transponders
RF amplifier output	9 watts/per final amplifier
Channelization	24 channels, one per 36MHz transponder
EIRP per transponder	CONUS: 34 dBW
	Alaska:* 30 dBW
	Hawaii:* 27 dBW
	Puerto Rico: 28 dBW
Commandable gain steps	Four: 0, -3, -6, -9 (min.)
EIRP for TT&C	3.0 dBW, reflector
	4.5 dBW, bicone
Satellite receive G/T	CONUS: -5.9 dB/K
	Alaska:* -8.4 dB/K
	Hawaii:* -10.4 dB/K
	Puerto Rico: -10.0 dB/K
Frequency bands:	
Transmit	3.700 to 4.200 GHz
Receive	5.925 to 6.425 GHz
Telemetry	4198 MHz
Command	5.925 to 5.930 GHz launch
	6.420 to 6.425 GHz in-orbit
Polarizations:	
Communications:Transmit	12 channel linear horizontal
Receive	12 channel linear vertical
TT&C: Telemetry-orbit	horizontal
-launch	vertical
Command-orbit	vertical
launch	horizontal

---

* Depends on orbit location. Value true for 101°WL

SATELLITE CHARACTERISTICS

TABLE 1

communication systems capable of supporting those shifts. The expected use of electronic mail, video teleconferencing, teletext and other wideband information transmissions threatens to outpace the capacity and capability of the existing telecommunication network. The current rapid growth of business and institutional use of mainframe computers, minicomputers, personal computers, digital terminals, local area networks (LAN's), digital PBX systems, and two-way cable TV confirms the need to expand the capabilities of existing telecommunications systems.

NEX's proposed communication systems responds to this need. The SpotNet system will allow NEX to offer rates to private users that are highly competitive with current rates offered by carriers of intracompany information transmissions. The implementation of the system is expected to grow in tandem with the rapidly growing demand for wideband city-to-city communications originating and terminating at customer-premise earth stations.

NEX anticipates that its SpotNet (K) satellite system will serve primarily business users in the information industries, where users will be attracted by the substantial cost savings and inherent flexibility associated with originating and terminating at customer-premise earth stations.

The SpotNet (C) space segment described herein will be used for more general-purpose communications, in addition to supplementing the SpotNet (K) space segment for point-to-multipoint message distribution and for analog video and audio broadcast program distribution. The use of two orbital locations is necessary for protection against solar outage and further eclipse protection, as well as for in-orbit redundancy. The exact nature of the traffic being carried will depend on customer requirements, and in turn will determine the design of user earth terminals, with stations varying from 10 meters for analog video and FDM/FM telephony, to 4.5-meter stations for TV and radio receive-only and narrowband SCPC telephony.

D. General Technical Information

1. Radio Frequency Plan

The SpotNet (C) satellites will operate in the 4/6-GHz bands (3700- to 4200-MHz space-to-earth and 5925- to 6425-MHz earth-to-space). Within these currently authorized bands, the frequency and polarizations of the 24 transponders is given in Figure 2. The frequency plan illustrated is similar to others currently in use or proposed, in that overlapping channels are cross-polarized to minimize interference between adjacent transponders. The frequency difference between adjacent co-polarized transponders will be 40 MHz, and between adjacent orthogonally-polarized transponders, 20 MHz. Each transponder will have a usable bandwidth of 36 MHz.

Emission designators for the various signals will depend on the bandwidth used and the type of signal or traffic being carried. In the case of the TT&C system, telemetry data will be angle-modulated and will use a bandwidth of 100 KHz. Thus the signal has an emission designator of 100 F9. The satellite's beacon will have an emission designator of 5000 F9. The emission designator for ranging will be 1000 F9, and for command transmissions 5000 F9.

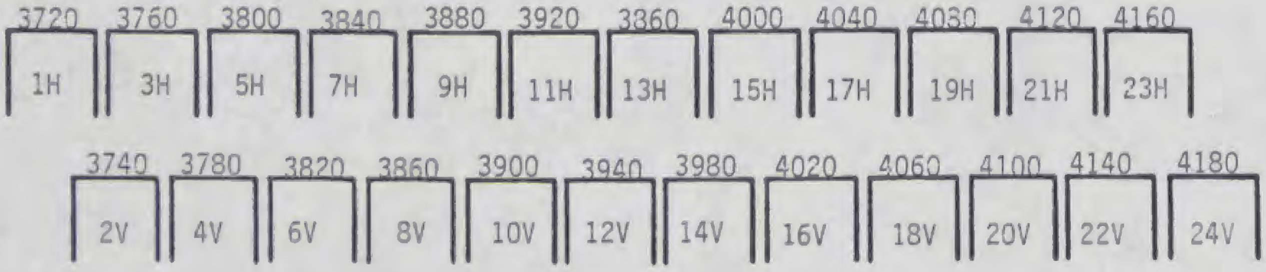
For purposes of systems and interference analyses, it has been assumed that transponders may carry any of the major modulation types identified in the FCC's report FCC/OST R83-2, May 1983, including FDM/FM, Video/FM (FM/TV), wideband digital and narrowband SCPC.

In the FDM/FM mode, transponders can carry one or more carriers, depending on the nature and volume of traffic. Thus emission designators would include 2000 F9 up to 36000 F9 for 960-channel multiplex telephony.

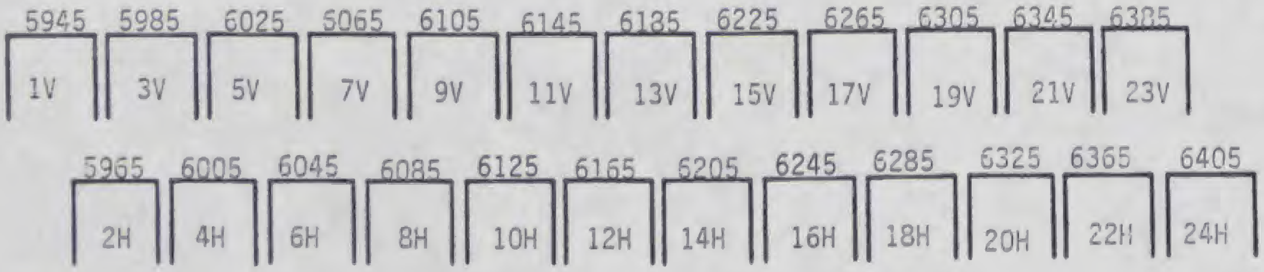
In the TV/FM mode, each transponder may be carrying a single video channel and associated audio channel(s) occupying the entire transponder, with an associated emission designator of 36000 F5. In this mode, energy dispersal*/ of 2 MHz will be

---

*/ Energy dispersal can be either "artificial" (special waveform) or natural (minimum video modulations achieve 2 MHz dispersal).



DOWNLINK CENTER FREQUENCIES & POLARIZATIONS



UPLINK CENTER FREQUENCIES & POLARIZATIONS

V = Vertical Polarization
H = Horizontal Polarization

SPOTNET (C)
COMMUNICATIONS
FREQUENCY AND POLARIZATION PLAN

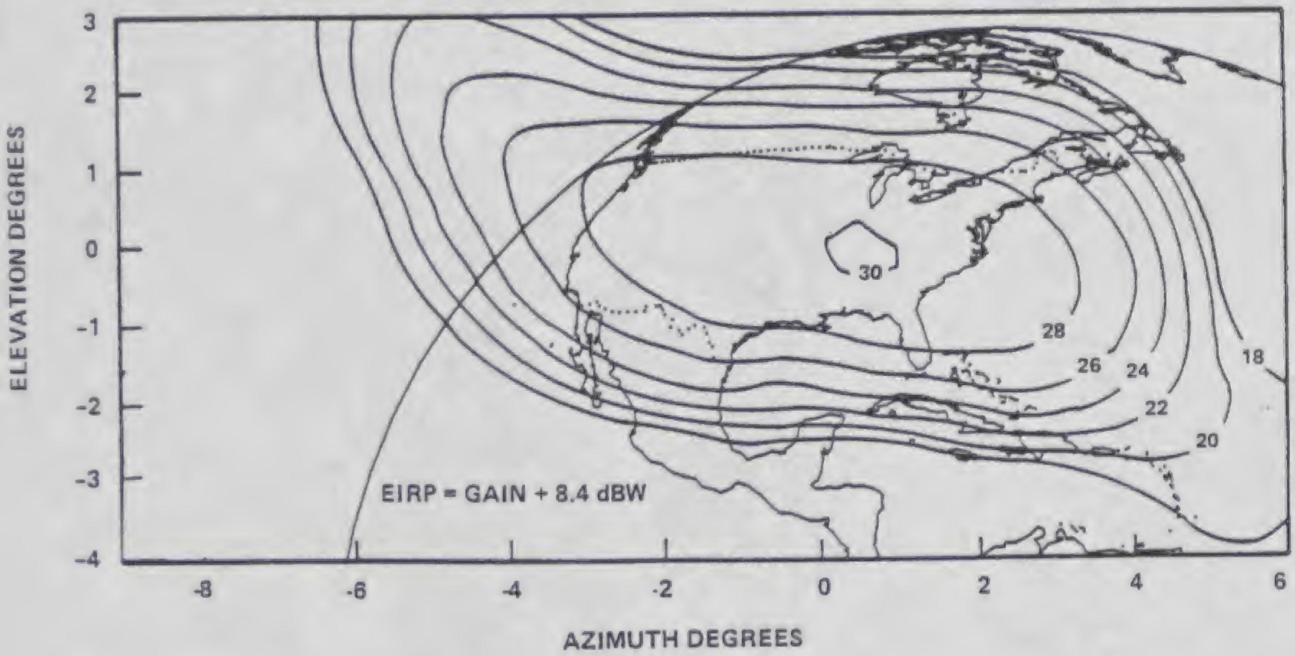
FIGURE 2

employed to minimize interference to terrestrial microwave transmissions and to co-channel transponders, particularly those carrying single-channel-per-carrier (SCPC) traffic.

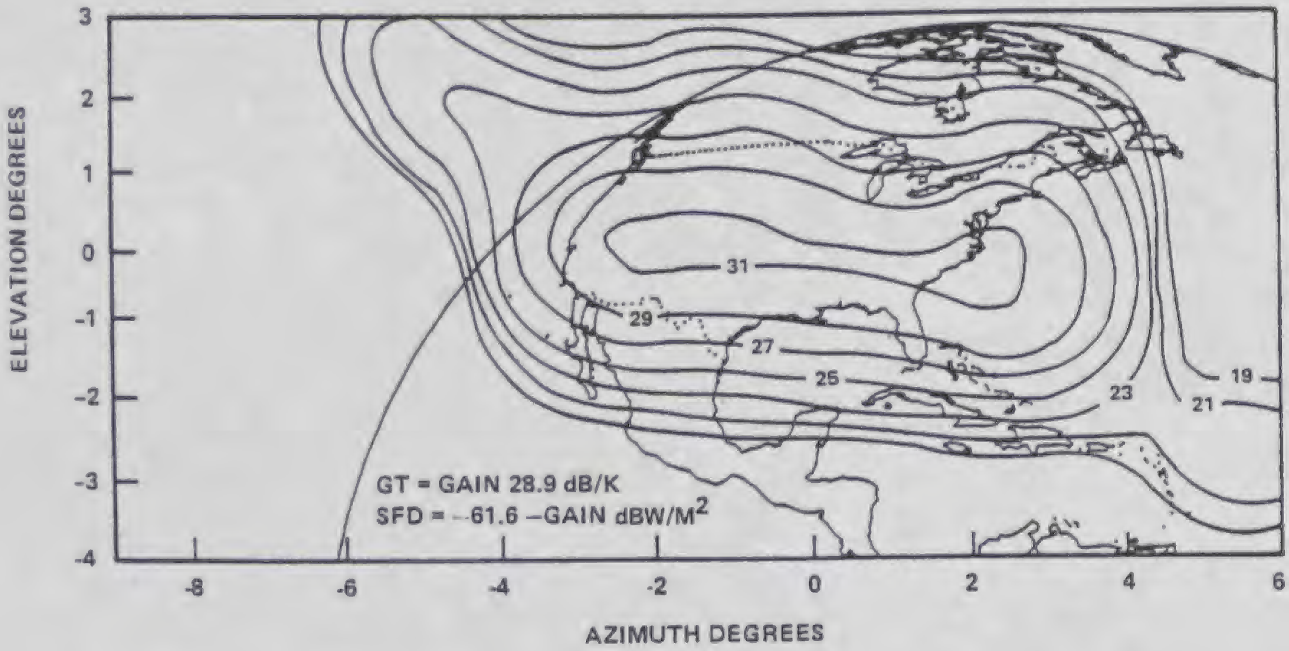
In the wideband digital mode, a transponder will be capable of handling many types of traffic from single digitized 56-Kbps channels (SCPC/PSK) to a 960-channel supergroup of voice channels. This mode would also carry teleconferenced video channels, typically four carriers to a transponder, each having a data rate of 6.4 Mbps and occupying a 4-MHz channel for an emission designator of 4000 F5.

The traffic capacity of the transponder in SCPC operation is significantly increased by taking advantage of the increased linearity of the solid-state final amplifiers utilized in this satellite as compared with traditional traveling wave tubes. Typical emission designators for the SCPC mode would vary from 20 F9 for SCPC/FM to 50 F9 for SCPC/PSK.

The horizontal and vertical polarization patterns of the satellite antenna gain contours are provided in Figures 3 through 6 for the two preferred orbital locations of 101° West Longitude and 75° West Longitude.

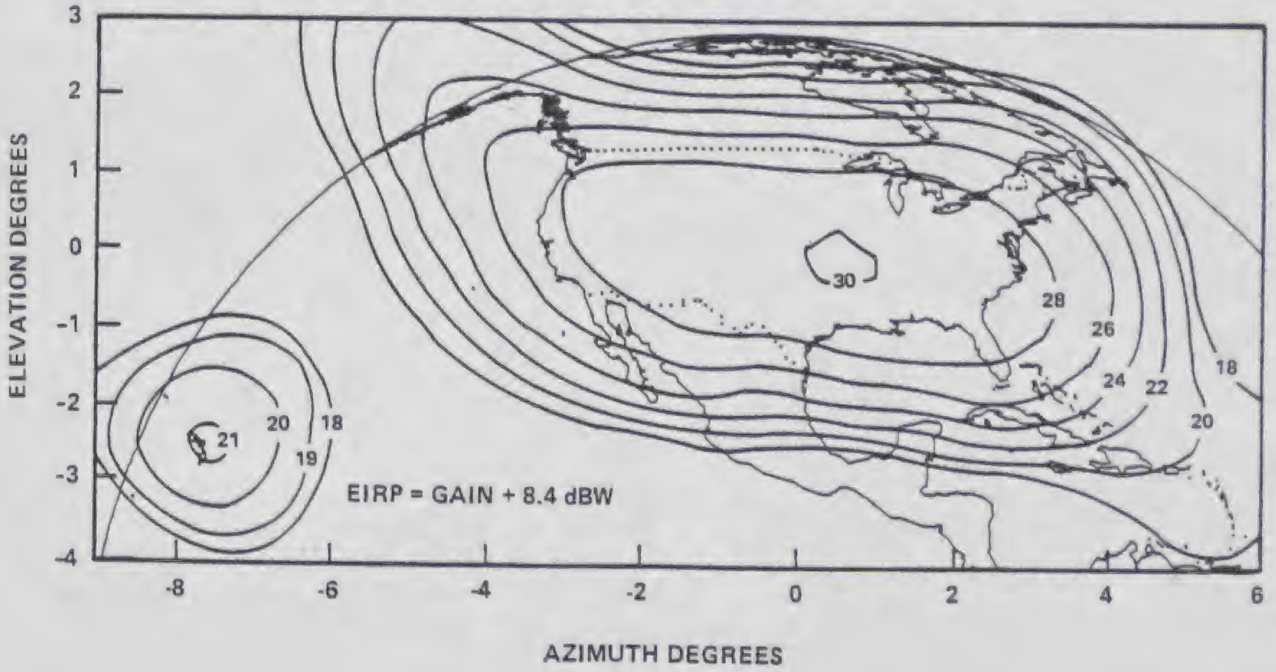


a) TRANSMIT

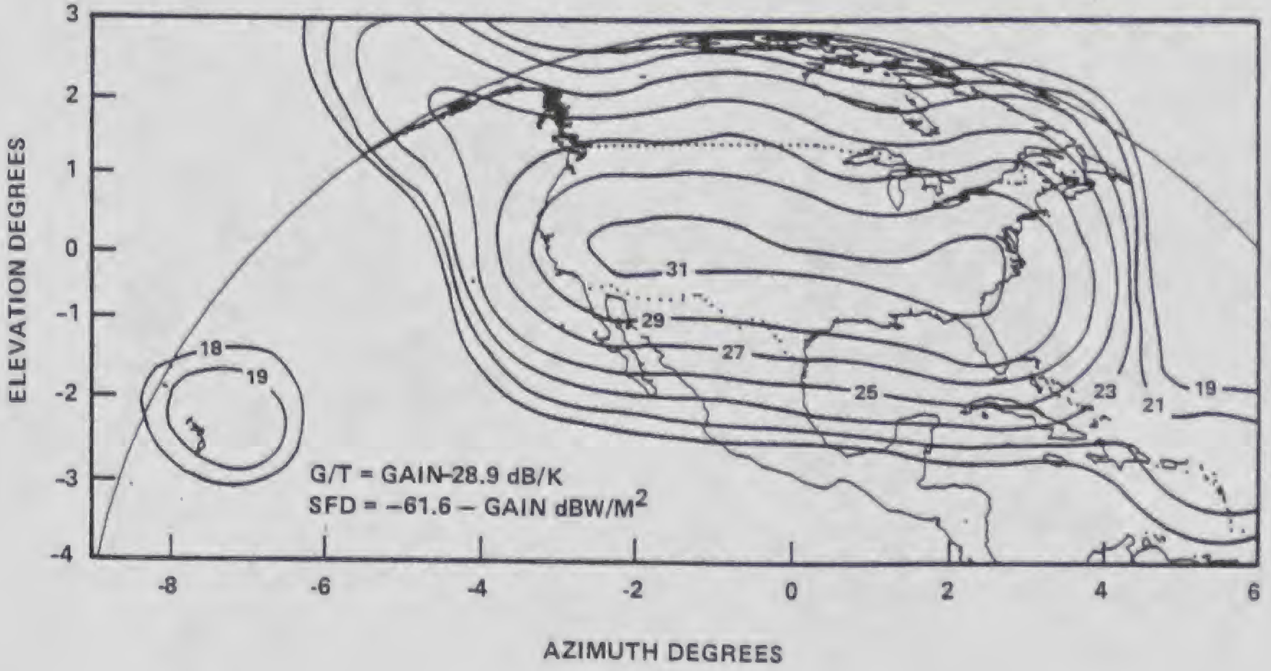


b) RECEIVE

Figure 3 Horizontal Gain Contours (74° West)

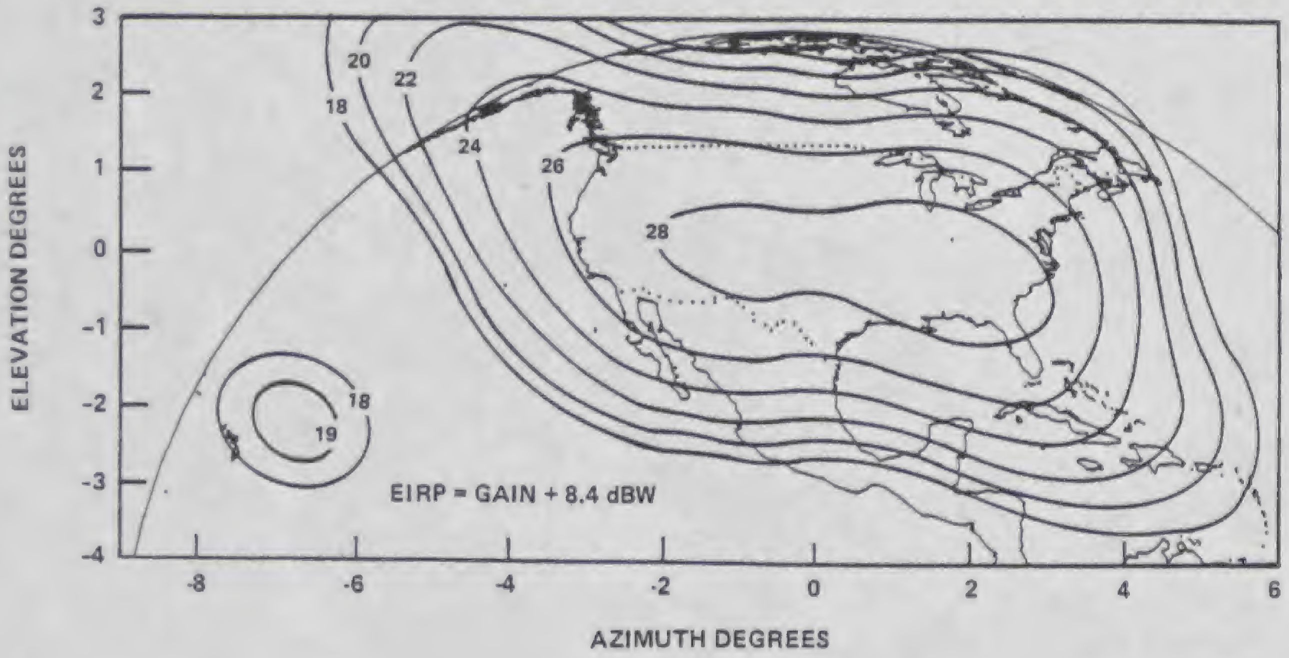


a) TRANSMIT

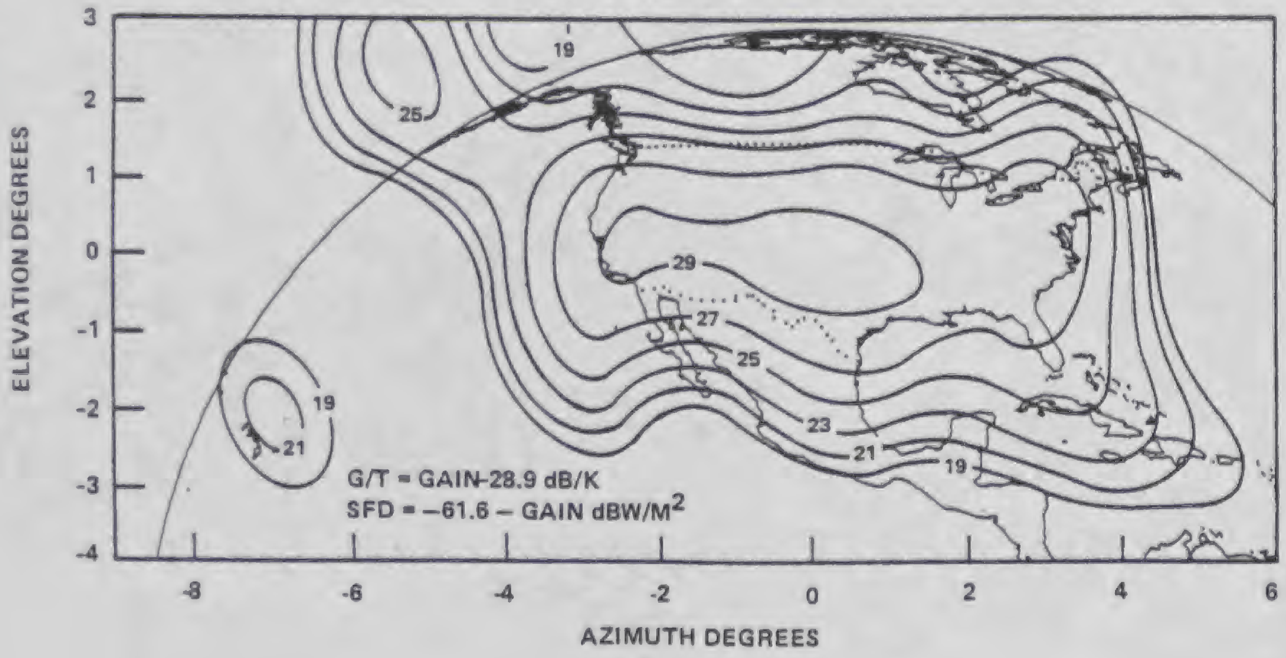


b) RECEIVE

Figure 4 Horizontal Gain Contours (101° West)

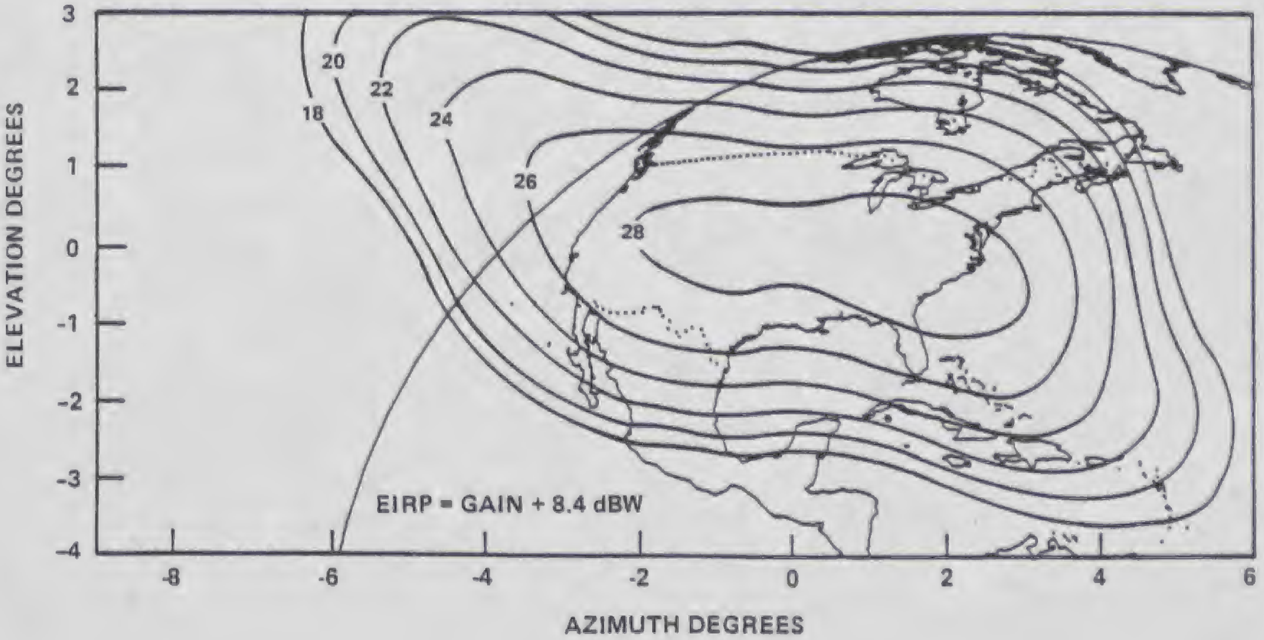


a) TRANSMIT

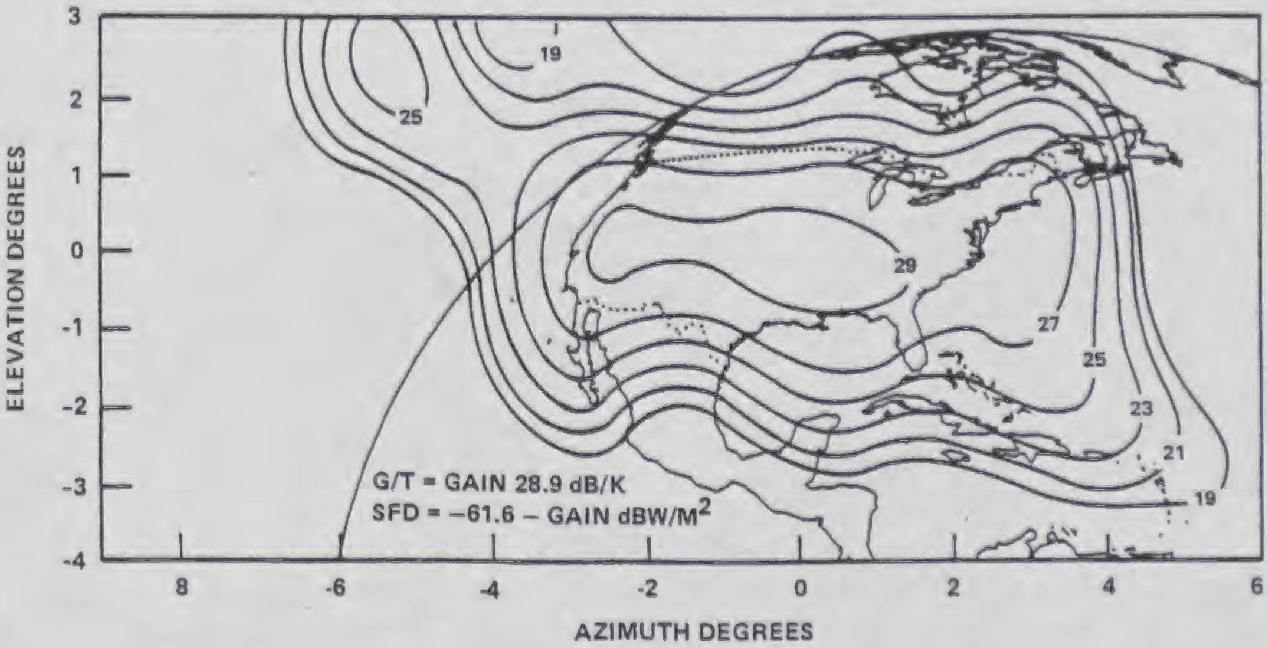


b) RECEIVE

Figure 5 Vertical Gain Countours (101° West)



a) TRANSMIT



b) RECEIVE

Figure 6 Vertical Gain Contours (74° West)

2. Calculations of Power Flux Density Levels Within Each Coverage Area and Nature of Energy Dispersal Required for Compliance With Section 25.208 of the Rules

Using the satellite antenna contours described in Figures 3 through 6 and power input to the satellite antenna for the TV/FM mode, and assuming a spreading loss of 162.5 dB from the satellite to the antenna boresight, the power flux density will be -127.1 dBW per square meter at the edge of coverage, and -124.1 dBW at the boresight. Assuming that the worst energy concentration results from an unmodulated TV/FM carrier with artificial energy dispersal of 2 MHz, the maximum power flux density per square meter in any 4-KHz band will be -154.1 dBW per square meter at the edge of coverage, and -151.1 dBW at the antenna boresight. These values are derived from the horizontal transmit antenna pattern, which has a maximum boresight gain of 30 dB. The more critical values are at edge of coverage, where, particularly in the northern and northeastern areas, the satellite elevation angle from a terrestrial microwave station will be on the order of 5°. The value of -154.1 dBW m^2/4KHz in this case is still 2 dB below the most stringent limit given in the ITU radio regulations and in the FCC implementation thereof. If energy dispersal were reduced to 1 MHz, the PFD at edge of coverage would then be 1 dB above the

-152 dBW/m^2/4 KHz. That result would occur, however, only in the extreme northeastern United States and corresponding portion of Canada. In summary, it is NEX's intention to maintain PFD at or below -152 dBW/m^2/4KHz, especially where the station elevation angle would be 0° to 5° to the satellite from a fixed terrestrial station.

Coverage of Puerto Rico/Virgin Islands and Alaska and Hawaii (where possible) involves power flux densities several dB below those given for the continental United States (nominally, -159 dBW/m^2/4KHz for Alaska, -162 dbW/m^2/4KHz for Hawaii, and -161 dBW/m^2/4KHz for Puerto Rico/Virgin Islands). In those areas, SpotNet (C) users will utilize earth terminals with correspondingly better G/T's to maintain optimal levels of service.

3. Number of Satellites

The space segment of the SpotNet (C) satellite system will consist of three satellites and two launch vehicles. Two of the satellites will be placed in orbit, while the third will serve as a ground spare to be launched in the event of failure or degradation of one of the two operational satellites.

4. Estimated Number and Geographic Distribution of Earth Stations

a. Transmit/receive. One TT&C station will be co-located on each coast with a SpotNet (K) TT&C station and NCC. NEX plans to construct a number of 4/6-GHz two-way earth stations for customer use, which will be the subject of a subsequent application. Numerous additional satellite ground facilities will be located on customer premises, the exact number to be a factor of market demand. A number of the earth stations will be equipped for both 4/6-GHz and 12/14-GHz operation.

b. Receive-only. The majority of SpotNet (C) earth stations will be located on customer premises, the exact number to be determined by market demand.

c. Transmit-only. NEX does not expect to establish transmit-only stations as part of either of its satellite networks, with the possible exception of mobile earth stations that may be proposed at a future date.

5. Physical Characteristics of the Space Station

NEX proposes to launch two satellites with identical capabilities, and to hold a third as a ground spare. The communications payload of each satellite will consist of 24 transponders. NEX plans to use an existing satellite bus such as a Hughes spin-stabilized bus or the RCA three-axis stabilized bus for this program with the final choice of the satellite manufacturer and launch system to be made during the procurement process. The satellites will be either three-axis stabilized or spin-stabilized, with the actual technique being selected during the satellite procurement process.

The NEX satellites will be designed to maintain the inclination of the orbit to ± 0.1 degrees or less and the longitude position within ± 0.01 degrees. The antenna pointing accuracy for all satellites will be maintained within ± 0.01 degrees.

The electrical power subsystem will be designed so that at the end of the spacecraft life, sufficient power will be available to operate all 24 active transponder channels and the housekeeping loads. Sufficient battery capacity will be available to provide full transponder power during the eclipse periods at the end of life.

The primary source of power will be solar cells with energy-storage batteries for eclipse operation. No single failure in the electrical power system will cause spacecraft failure.

a. Weight and Dimensions of Spacecraft

The weight and dimensions of the spacecraft will be provided to the Commission after selection of a spacecraft vendor.

b. Estimated Operational Lifetime of Space Stations

Each SpotNet (C) satellite will be designed for an on-orbit and minimum mission life of nine years. These goals will be achieved by careful evaluation of the effects of the space environment on the solar array, the effects of charge and discharge cycling on the satellite batteries, and wear-out characteristics of the 24 primary and six spare final amplifiers, and the strict stationkeeping requirements specified. Materials and processes will be selected so that aging or wearing effects will not adversely affect spacecraft performance over the estimated life. A complete failure mode and effects analysis will be required of the spacecraft manufacturer, and both active and passive redundancy will be employed to assure that the objectives are met. Further assurance of obtaining the useful life and reliability goals will be achieved by relying upon a space-proven hardware.

The propulsion subsystem will be sized for and loaded with sufficient propellant to maintain operational attitude and stationkeeping control for at least nine years. Additional propellant will also be incorporated to provide correction of the initial orbit, initial attitude acquisition, satellite spin or despin if required, and for limited orbital repositioning. Sufficient propellant will also be reserved for removing the spacecraft from orbit after its mission is complete.

6. Systems Reliability, Redundancy and Link Availability

a. Satellite

A single SpotNet (C) satellite system link consists of the earth station transmitting chain, the uplink path, the satellite itself, the downlink path, and the associated control equipment. The overall availability of each SpotNet (C) link is enhanced by the use of two orbital positions with access to both SpotNet (C) satellites and, in some circumstances, to the co-located SpotNet (K) satellites.

Since outages can result from, among other things, failure of the power and attitude control subsystems of the satellite, active redundancy and standby redundancy will be employed in these two critical subsystems, respectively. Based on the proven reliability of standard 4/6-GHz satellites, a high probability of having all 24 transponders operating at the end of the nine-year mission is expected. Two orbital positions are necessary to permit continued system use during solar outage. Solar noise outage periods will be computed by NEX, and customers with access to only one orbital position will be notified well in advance of the anticipated outage times.

b. Earth Stations

A fail-safe design with significant redundancy will be incorporated to ensure a high level of availability for earth stations over which NEX has operational control, including TT&C stations. In the event of a signal loss, automatic switchover of equipment will be effected. The co-location of the TT&C stations with the main transmit/receive stations and with the SpotNet (K) stations will ensure extra maintenance personnel at these locations, as well as a high measure of redundancy. The co-location of the east coast facilities with the Network Control Center, in addition, will ensure the availability of timely servicing by qualified technicians.

c. Solar Noise Outages

At the time of the local equinoxes (both vernal and autumnal), when the ecliptic intersects the celestial equator, the sun may pass directly behind the SpotNet (C) satellites as seen by certain earth terminals, causing a significant increase in noise power on the received signal. At these times, there can be local solar noise outages. Since these outages are predictable well in advance of their occurrence, it is our experience that such outages as may occur can be easily programmed around. In addition, given that not all stations experience outages at the same time, the number affected at any one time is usually small. For those stations that cannot program around such noise outages, dual antennas could be employed to permit users to switch between satellites at different orbital positions and thus avoid service interruption. This will be much less expensive for the SpotNet systems since a small 12/14-GHz earth station pointing at the alternate orbit position would allow low-cost backup for the limited periods of the solar outage. Use of TT&C control stations on both the east coast and west coast stations would prevent outages from affecting the management of the system.

d. Eclipse Conditions

Satellite eclipse outages occur when the satellite is shadowed from the sun's rays, thus causing a loss of power for the on-board equipment. During these periods, the satellite's power system shifts to the batteries that are an integral part of the spacecraft design. The SpotNet (C) design includes sufficient battery power to operate all vital systems, including all communications transponders during eclipse periods.

7. Vehicle and Arrangements for Procuring Launch Services

The NEX satellites will be compatible with a launch by either the Space Shuttle, Ariane or the Delta 3920 PAM/D. Each launch vehicle alternative has distinct advantages and disadvantages, and the final selection will depend upon reliability, scheduling, availability, cost, and spacecraft configuration trade-offs.

Launch support arrangements have not been completed, since they depend in part upon the launch vehicle chosen, exact scheduling and other factors. During the launch phase, TT&C facilities may be leased throughout the United States and other parts of the world. After positioning into the geostationary orbit, the TT&C functions will be accomplished from NEX's own TT&C facilities.

8. Arrangements for Tracking, Telemetry and Control

The ground segment of the SpotNet system will include a primary TT&C/NCC facility to be located on the East Coast, and a secondary or backup facility to be located on the West Coast. Each TT&C station will include two 10-meter-diameter antennas, and will operate at 4/6 GHz. These facilities will be staffed around the clock, and they will have the responsibility for assuring the proper operation of the satellites using the tracking, monitoring, range-finding and command functions associated with the TT&C system. They will also have the responsibilities associated with the allocation, assignment, and adjustment of SpotNet (C) communications capacity and characteristics. These ground segment facilities will employ standard, proven, reliable designs with proven fail-safe capabilities and equipment redundancy to ensure a high level of availability.

E. Communication System Characteristics and Description

1. Types of Services to be Provided, Estimated Demand for Such Services and Areas and Entities to be Served

The SpotNet (C) space segment will be capable of providing the following services: broadcast video and audio; teleconferencing; FDM/FM multichannel telephony; SCPC audio and text; and SCPC telephony. In the provision of such services, all 24 transponders will be available for all services.

2. Transmission Characteristics, Modulation Parameters, and Performance Objectives

For broadcast video, each transponder will be capable of handling a single video channel and associated audio. A number of additional audio carriers can also be carried in such a configuration. The total number of carriers depends on the power assigned to each carrier. Techniques to expand further the useful transmission capabilities of each transponder for multi-channel and high-definition video are being explored using coding schemes and advanced digital modulation techniques. NEX presently plans to carry four video-teleconferencing channels per transponder. A full complement of 960 FDM/FM multiplex telephony channels will be carried on the transponders designated for that purpose. Because of the increased linearity of those devices and the solid-state final amplifiers in this design, NEX anticipates that more than 20 SCPC program audio channels (plus additional text channels) can be carried per transponder. That total does not include text channels that might be encoded in the vertical blanking interval of television signals. In the case of SCPC telephony, approximately 1,600 SCPC telephony channels can be accomodated in a single transponder. NEX will be able to carry up to 1,000 56-Kbps digital channels per transponder.

Overall link performance objectives are given in Table 2. In the case of telephony, the calculations are governed primarily by the noise objective for an individual telephone channel pursuant to CCIR Recommendation 353-2. The standard objective of 10,000 pWop is divided as follows:

Ground station equipment	1,000 pWop
Ground station interference.	500 pWop
Satellite interference	1,000 pWop
Satellite thermal.	7,500 pWop

For a single carrier having 960 telephone channels, the weighted test-tone-to-noise per channel is 7,328 pWop. The additional noise due to two adjacent overlapping cross-polarized channels is less than 10 pWop. The total intrasystem noise is therefore below the value of 7,500 pWop given above.

For full-bandwidth video transmission, NEX plans to employ a 10-meter uplink terminal and either 10-meter or 4.5-meter receive terminals. The link power budgets for both of those cases are shown in Table 3.

For teleconferencing, NEX plans to transmit four teleconference video channels in each transponder assigned to that service, each employing time-division-multiplex techniques. Bit rates will be 6.4 Mbps per channel, and the bit energy-to-noise ratio of 13 dB will ensure a BER (bit-error-rate)

Table 2

Overall Communications Performance Objectives

Video	
Broadcast Quality Video	55 dB p-p signal-to-weighted-rms-noise ratio
TVRO Video	50 dB p-p signal-to-weighted-rms-noise ratio
Video Teleconference	10^{-6} BER
Telephony	
FDM-FM Telephony	50 dB weighted test-tone-to-noise ratio
SCPC/FM Telephony	35 dB test-tone-to-weighted-rms-noise ratio (uncompandered)

of less than 10^{-6} for coherent QPSK. Summary information on this link is contained in Table 4.

For SCPC telephony, each of the SCPC carriers will be voice-activated and will frequency-modulate their carriers. The voice baseband will be pre-emphasized and compandered. Major link parameters for this mode are given in Table 5.

F. 2° Adjacent Satellite Interference Analysis

1. Introduction

An interference analysis was performed to assess the interference potential between the SpotNet (C) satellites and other authorized space stations. The analysis was performed using a spacing of 2° from each of the currently authorized space stations. The analysis presented here is based upon the assumptions, techniques, computer program and system characteristics contained in the FCC report "Reduced Domestic Satellite Orbital Spacing at 4/6 GHz" (OST Report, FCC/OST R83-2, May, 1983) and uses the most recent data available from the Commission regarding satellite characteristics for currently authorized space stations.

In this analysis NEX has used parameter values employed by the Commission in their analysis even in those cases in which other values might be used in practice. For example, an energy

Table 3

Communications Link Budget - Video

Uplink, 6,175 MHz	
Transmitter EIRP	78.0 dBW
Path loss	- 200.1 dB
Other losses	- 0.3 dB
Satellite G/T (for hor.pol.)	- 4.0 db/K
Boltzman's constant	- 228.6 dB/K Hz
C/N per hz.	102.2 dB-Hz
C/N_{uplink}	26.6 dB
Downlink, 4,000 Mhz for 10-meter receive antenna	
Satellite EIRP at CONUS beam edge	34.0 dBW
Path loss	- 196.5 dB
Other losses	- 0.3 dB
Receive station antenna gain	50.7 dB
Receive carrier power	- 112.1 dBW
Boltzman's constant	- 228.6 dB/K-Hz
LNA temperature (125° K)	21.0 dbK
Received noise power	- 207.6 dBW/Hz
C/N per hz	95.5 db-Hz
C/N downlink	19.9 dB
C/N_{total}	19.0 dB
Downlink, 4,000 MHz for 4.5-meter receive antenna	
Satellite EIRP at CONUS beam edge	34.0 dBW
Path loss	- 196.5 dB
Other losses	- 0.6 dB
Receive station antenna gain	44.0 dB
Receive carrier power	- 119.9 dBW
Boltzman's constant	- 228.6 dB/K-Hz
LNA temperature (125° K)	21.0 dBK
Received noise power	- 207.6 dBW/Hz
C/N per hz.	88.5 db-Hz
C/N downlink	12.9 dB
C/N_{total}	12.6 dB

Table 4

Communications Link Budget - Teleconferencing

Uplink at 6,175 MHz	
Transmitter EIRP	65.0 dBW
Path loss	- 200.0 dBW
Other losses	- 0.3 dB
Satellite G/T (for hor.pol.)	- 4.0 db/K
Bit rate, B (6.4 MBS)	68.1 db-Hz
C/N up per channel	21.2 dB
Downlink at 4,000 Mhz for 10-meter antenna	
Satellite EIRP	34.0 dBW
SSPA backoff	- 2.3 dB
Number of video channels	- 6.0 dB
Path loss	- 196.0 dB
Other losses	- 0.2 dB
Earth station antenna gain	50.7 dB
Received carrier power	- 119.5 dBW
Received noise power	- 207.6 dBW/Hz
Bit rate, B	68.1 db-Hz
Noise power for bit rate B	- 139.1 dBW
$C/N_{downlink}$	19.6 dB
C/N_{uplink}	21.2 dB
$C/N_{intermod}$	16.0 dB
E/N_{total}	13.4 dB

Table 5

Communications Link Budget - SCPC Telephony

Uplink for 10 meter antenna	
Transmitter EIRP	78.0 dBW
Number of carriers - 1600	-32.0 dB
Voice activation	+ 4.0 dB
Input backoff	- 7.0 dB
EIRP per voice channel	45.0 dB
Path Loss	-200.0 dB
Satellite G/T (for horiz. pol.)	- 4.0 dB
C/T uplink	-161.0 dBW/K
C/N uplink	67.6 dB-Hz
Channel bandwidth (20 Khz)	43.0 dB-Hz
C/N total uplink	24.6 dB
Number of carriers for 4.5 m. antenna is 1000	-30.0 dB
C/N total uplink for 4.5 m antenna system	26.6 dB
Downlink for 10 meter antenna	
Satellite EIRP	34.0 dBW
Power split	-32.0 dB
SSPA backoff	2.3 dB
Voice Activation gain	+4.0 dB
Path Loss	-196.0 dB
Antenna gain (10 meters)	50.7 dB
Loss due to tracking error	0.2 dB
Received carrier power	-143.8 dBW
Boltzman's constant	-228.6 dBW/K-Hz
Receive bandwidth (20 KHz)	43.0 dB-Hz
Receiver noise temperature (125°K)	21.0 dBK
Noise power received	164.6 dBW
C/N downlink	22.8 dB
C/N intermod	16.0 dB
C/N uplink	24.6 dB
C/N total	14.7 dB
Margin above threshold	7.0 dB
Downlink for 4.5 meter antenna (noting items changed only)	
Power split	30.0 dB
Antewnna gain (4.5 meters)	44.0 dB
Loss due to tracking error	-0.5 dB
Received carrier power	-148.8 dBW
C/N downlink	17.8 dB
C/N uplink	26.6 dB
C/N total	13.6 dB

dispersal of 1.2 MHz was used in the FCC analysis. The actual value of energy dispersal used in practice would be that value most compatible with the traffic parameters of co-channel transponders in adjacent satellites. Earlier in this application we described a situation in which 2 MHz would be contemplated.

The following sections describe the system characteristics, interference model and interference analysis performed.

2. SpotNet (C) Signal Formats and Characteristics

The signal formats to be used by the SpotNet (C) satellite system are similar to those used by other currently authorized systems and are described in Table 6. The signal formats and characteristics used for all other satellites are the most recent data available from the Commission (October 1983).

3. Interference Model

The interference model used to analyze the potential for interference between satellites is the Adjacent Satellite Interference Program described in OST Report FCC/OST R83-2. This report describes in detail the interference computation formulas used and the theoretical basis behind the computer model. In addition to the standard, conservative assumptions implicit in the model, the following additional assumptions were made:

1. The interference spectrum used for TV/FM signals is a 1.2-MHz energy dispersal spectrum.

Table 6

Model Signal Formats And Signal Characteristics

Modulation Type	FDM/FM	TV/FM	Digital	SCPC/FM
RF Bandwidth (MHz)	36.0	36.0	4.0	.020
Number of Channels	960	1	4	398
Code Rate/Mod. Index	1.097	2.619	---	5.6
Bottom Mod. Freq. (MHz)	.060	.020	---	0.000
Top Mod. Freq. (MHz)	4.028	4.200	---	0.003
Average Talker Level (dBMO)	-15	---	---	---
Compander Preemphasis Noise Weighting (dB)	0.0	12.8	---	23.5
Phases	---	---	4	---
Data Rate (Mbps)	---	---	6.4	---
Channel Spacing	---	---	8.0	.080*
Transponder Frequency (GHz)				
Up	6.145	6.145	6.145	6.145
Down	3.920	3.920	3.920	3.920
Polarization - Up	Vert.	Vert.	Vert.	Vert.
Polarization - Down	Horz.	Horz.	Horz.	Horz.
Earth Station Transmitter				
Power (dBW)	27.0	27.0	11.0	-2.5
Diameter (m)	10	10	10	4.5
Gain (dBi)	54.0	54.0	54.0	47.1
Satellite Receiver				
Gain (dBi)	24.8	24.8	24.8	24.8
Temperature (°K)	800	800	800	800
Satellite Transmit				
EIRP (dBW)	34.0	34.0	24.0	3.7
Earth Station Receiver				
Diameter (m)	10	4.5	10	4.5
Gain (dBi)	50.7	44.0	50.7	44.0
Temperature (°K)	125	125	125	125

---

* Avoids ± MHz at transponder center.

2. SCPC and small FDMA carriers have transponder frequency plans which avoid frequencies within ± 1.5 MHz of the transponder center frequency.
3. Earth station antenna radiation patterns follow a 29-25 log X curve where X is the geocentric angle between satellites, in degrees.
4. A maximum off-axis cross-polarization isolation in the earth station of 10 dB.

The model calculates its results by assuming that each of the satellite carrier types is carried by a satellite located 2° away from each other carrier type. Given this assumption, the carrier-to-interference ratio (C/I) is calculated for the carrier and used to determine the interference level in the receiver. The interference level is then compared to the appropriate interference criterion for the victim receiver to determine whether the interfering signal meets the criterion. If the criterion is not met, the ratio of the interfering signal to the interference criterion is calculated, in dB. This process is carried out for each potential interferer/victim pair.

4. Interference Analysis

The interference model of the previous section, when applied in conjunction with the SpotNet (C) satellite characteristics, produces the results contained in Tables 7 through 9. Table 7 contains the input parameters used in the model, including the SpotNet (C) characteristics (lines 61-64),

2. SCPC and small FDMA carriers have transponder frequency plans which avoid frequencies within ± 1.5 MHz of the transponder center frequency.

3. Earth station antenna radiation patterns follow a 29-25 log X curve where X is the geocentric angle between satellites, in degrees.

4. A maximum off-axis cross-polarization isolation in the earth station of 10 dB.

The model calculates its results by assuming that each of the satellite carrier types is carried by a satellite located 2° away from each other carrier type. Given this assumption, the carrier-to-interference ratio (C/I) is calculated for the carrier and used to determine the interference level in the receiver. The interference level is then compared to the appropriate interference criterion for the victim receiver to determine whether the interfering signal meets the criterion. If the criterion is not met, the ratio of the interfering signal to the interference criterion is calculated, in dB. This process is carried out for each potential interferer/victim pair.

4. Interference Analysis

The interference model of the previous section, when applied in conjunction with the SpotNet (C) satellite characteristics produces the results contained in Tables 7 through 11. Table 7 contains the input parameters used in the model, including the SpotNet (C) characteristics (lines 61-64),

```
                                            I N P U T   P A R A M E T E R S             [illegible]   26 OCT 84
                                       CCIR P
        T   RF          LINE   RMS    TOP    AVE.  PREMP H                   TRANSPONDER   POL EARTH STATION  -SATELLITE-    EARTH STATION
        Y  BAND    NO.  RATE/  MOD.   MOD.  TALKER NOISE A   DATA    CHAN.   FREQUENCY          TRANSMITTER   RECEIVER  SAT     RECEIVER
CAR COM P  WIDTH   OF    MOD.  FREQ.  FREQ.  LEVEL WEIGH S   RATE    SPACE    UP     DN    U D POWR DIAM GAIN GAIN TEMP EIRP  DIAM GAIN TEMP
IER PANY E (MHZ)  CHAN  INDEX (MHZ)  (MHZ)  (DBMO)  (DB) E  (MBPS)   (MHZ)  (GHZ)  (GHZ)   P N (DBW) (M)  (DB) (DB)  (K)  (DBW)  (M) (DB)  (K)
  1 ALAS 4   0.029  800 2.024 0.000  0.003   0.0  16.8 0   0.000  0.045   6.145  3.920  0 1  -6.6  5.0 47.3 28.2  250.   5.2 15.0 55.4 100
  2 ALAS 4   0.029  800 2.024 0.000  0.003   0.0  16.8 0   0.000  0.045   6.145  3.920  0 1  -8.2 15.0 57.8 28.2  250.   7.2  5.0 44.5 120
  3 ASC  0  36.000 1800 0.388 0.060  7.860 -15.0  10.3 0   0.000  0.000   6.145  3.920  0 1  25.0 13.0 56.0 25.0  800.  34.0 11.0 52.0  80
  4 ASC  0  12.000  132 0.908 0.012  1.550  20.0   0.0 0   0.00012.000    6.145  3.920  0 1  10.7 10.0 53.5 25.0  800.  22.0 15.0 50.5  56
  5 ASC  1  32.000    1 2.560 0.025  4.200   0.0  12.8 0   0.000  0.000   6.145  3.920  0 1  27.5 10.0 53.5 25.0  850.  34.0  5.0 44.5 125
  6 ASC  2  36.000    1 0.000 0.000  0.000   0.0   0.0 4  64.000  0.000   6.145  3.920  0 1  24.5 10.0 53.5 25.0  800.  33.0 11.0 51.5  71
  7 ASC  2   9.600    1 0.000 0.000  0.000   0.0   0.0 4   7.200  0.000   6.145  3.920  0 1  24.5 10.0 53.5 25.0  800.  33.0  3.0 39.5 140
  8 ASC  2   3.750    8 0.000 0.000  0.000   0.0   0.0 4   4.000  4.000   6.145  3.920  0 1  11.5 10.0 53.5 25.0  800.  21.0 10.0 50.5  87
  9 ASC  2   1.100   12 0.000 0.000  0.000   0.0   0.0 4   1.544  1.300*  6.145  3.920  0 1   3.7 10.0 53.5 25.0  800.  14.8 10.0 50.5  85
 10 ASC  2   1.100   32 0.000 0.000  0.000   0.0   0.0 4   1.544  1.300*  6.145  3.920  0 1   3.1 10.0 53.5 25.0  800.  14.1 10.0 50.5  56
 11 ASC  3   0.040  160 0.000 0.000  0.000   0.0   0.0 4   0.056  0.200*  6.145  3.920  0 1   1.1  5.0 47.3 25.0  800.   7.5  5.0 44.5 125
 12 ASC  3   0.040  620 0.000 0.000  0.000   0.0   0.0 4   0.056  0.040*  6.145  3.920  0 1  -9.5 10.0 53.5 25.0  800.   1.0 10.0 50.5  89
 13 AT&T 5  34.000 7800 0.000 1.000 17.000 -22.0   0.0 0   0.000  0.000   6.145  3.920  1 1  19.4 30.0 62.3 24.5  900.  28.6 30.0 59.1  54
 14 AT&T 5  30.000 6000 0.000 1.000 15.000 -22.0   0.0 0   0.000  0.000   6.145  3.920  1 1  27.6 12.0 55.1 24.5  900.  29.8 12.0 52.5  71
 15 AT&T 01 36.000 1800 0.351 0.564  8.524 -20.0   0.0 0   0.000  0.000   6.145  3.920  1 1  20.3 30.0 62.3 24.5  900.  35.0 30.0 59.3  54
 16 AT&T 1  36.000    1 2.571 0.025  4.200   0.0  12.8 0   0.000  0.000   6.145  3.920  1 1  27.5 10.0 53.5 24.5  900.  35.0  7.0 47.5 125
 17 AT&T 2  36.000    1 0.000 0.000  0.000   0.0   0.0 4  60.000  0.000   6.145  3.920  1 1  27.0 12.0 55.1 24.5  900.  34.2 12.0 52.5  71
 18 AT&T 2  36.000    1 0.000 0.000  0.000   0.0   0.0 8  90.000  0.000   6.145  3.920  1 1  21.6 30.0 62.3 24.5  900.  33.0 30.0 59.3  54
 19 AT&T 2   1.060   24 0.000 0.000  0.000   0.0   0.0 4   1.544  1.300*  6.145  3.920  1 1  11.5 12.0 55.1 24.5  900.  15.7 12.0 52.5  71
 20 AT&T 2   1.060   24 0.000 0.000  0.000   0.0   0.0 4   1.544  1.300*  6.145  3.920  1 1  13.1 10.0 53.5 24.5  900.  15.7 10.0 50.5  71
 21 AT&T 2   1.053    5 0.000 0.000  0.000   0.0   0.0 4   1.544  5.000   6.145  3.920  1 1  13.5 10.0 53.5 24.5  900.  24.0  3.0 39.5 130
 22 RCA  5  34.000 5820 0.000 1.000 17.000  21.0   7.8 0   0.000  0.000   6.145  3.920  0 1  18.0 13.0 56.0 24.0  750.  30.0 13.0 51.0  80
 23 RCA  0  36.000 2092 0.523 0.012 12.388  18.0  11.1 0   0.000  0.000   6.145  3.920  0 1  25.9 13.0 56.0 24.0  750.  34.0 13.0 52.0  80
 24 RCA  0  36.000 1932 0.385 0.012  8.120  15.0  10.3 0   0.000  0.000   6.145  3.920  0 1  25.0 13.0 56.0 24.0  750.  34.0 13.0 52.0  80
 25 RCA  0  20.700  432 1.501 0.012  1.796  15.0   0.0 0   0.00018.000    6.145  3.920  0 1  14.9 13.0 56.0 24.0  750.  25.5 13.0 52.0  80
 26 RCA  1  36.000    1 2.560 0.025  4.200   0.0  12.8 0   0.000  0.000   6.145  3.920  0 1  25.0 13.0 56.0 24.0  750.  34.0 13.0 52.0  80
 27 RCA  1  36.000    1 2.560 0.025  4.200   0.0  12.8 0   0.000  0.000   6.145  3.920  0 1  26.2 11.0 54.1 24.0  750.  34.0 11.0 51.3  80
 28 RCA  1  18.000    1 1.500 0.025  4.200   0.0  12.8 0   0.000  0.000   6.145  3.920  0 1  22.7 11.0 54.3 24.0  750.  33.0  7.5 47.5  80
 29 RCA  1  36.000    1 2.560 0.025  4.200   0.0  12.8 0   0.000  0.000   6.145  3.920  0 1  27.5 10.0 53.5 24.0  750.  34.0  4.5 44.0 125
 30 RCA  1  36.000    1 2.560 0.025  4.200   0.0  12.8 0   0.000  0.000   6.145  3.920  0 1  27.5 10.0 53.5 24.0  750.  34.0  7.0 47.5 125
 31 RCA  1  18.000    2 1.500 0.025  4.200   0.0  12.8 0   0.00016.000    6.145  3.920  0 1  21.5 10.0 53.5 24.0  750.  30.0  4.5 44.0 125
 32 RCA  1  18.000    2 1.500 0.025  4.200   0.0  12.8 0   0.00016.000    6.145  3.920  0 1  21.5 10.0 53.5 24.0  750.  30.0 10.0 50.5 112
 33 RCA  2  36.000    1 0.000 0.000  0.000   0.0   0.0 4  60.000  0.000   6.145  3.920  0 1  26.2 11.0 54.1 24.0  750.  34.0 11.0 51.3 107
 34 RCA  2  16.600    1 0.000 0.000  0.000   0.0   0.0 2   8.800  0.000   6.145  3.920  0 1  22.5 13.0 56.0 24.0  750.  33.0  3.1 39.5 130
 35 RCA  2   1.030   32 0.000 0.000  0.000   0.0   0.0 4   1.544  1.300*  6.145  3.920  0 1   7.9 11.0 54.3 24.0  750.  15.0 11.0 51.3 107
 36 RCA  3   0.064  100 0.000 0.000  0.000   0.0   0.0 2   0.064  0.280*  6.145  3.920  0 1   7.6  5.0 47.4 24.0  750.   9.0  5.0 44.5 125
 37 RCA  4   0.037  620 4.412 0.000  0.003   0.0  25.8 0   0.000  0.048*  6.145  3.920  0 1  -1.0 10.0 53.5 24.0  750.   0.0 10.0 50.5 112
 38 RCA  6   0.450   80 0.000 0.000  0.000   0.0  13.7 2   0.010  0.450   6.145  3.920  0 1  19.8  1.4 36.2 24.0  750.  10.0  1.4 32.8 120
 39 W.U. 0  36.000 1500 0.527 0.060  6.748 -15.0   0.0 0   0.000  0.000   6.145  3.920  1 0  23.2 15.0 57.8 25.0  800.  34.0 15.0 54.7  54
 40 W.U. 0   4.500   60 2.053 0.060  0.300 -15.0   0.0 0   0.000  5.000   6.145  3.920  1 0   2.2 15.0 57.8 25.0  800.  18.0 15.0 54.7  54
 41 W.U. 1  36.000    1 2.619 0.025  4.200   0.0  12.8 0   0.000  0.000   6.145  3.920  1 0  25.1 11.0 54.3 25.0  800.  34.0 11.0 51.3  54
 42 W.U. 2  36.000    1 0.000 0.000  0.000   0.0   0.0 4  62.000  0.000   6.145  3.920  1 0  20.2 15.0 57.8 25.0  800.  33.0 15.0 54.7  54
 43 NPR  4   0.180   21 5.000 0.000  0.015   0.0  29.0 0   0.000  PLAN    6.145  3.920  1 0  12.0  4.6 46.5 25.0  800.  16.5  4.6 43.5 125
 44 MUZK 4   0.120    7 3.000 0.000  0.015   0.0  29.0 0   0.000  PLAN    6.145  3.920  1 0  10.7 10.0 53.5 25.0  800.  22.0  1.2 31.5 230
 45 A.P. 3   0.038   56 0.000 0.000  0.000   0.0   0.0 4   0.056  0.500*  6.145  3.920  1 0  -0.5 10.0 53.5 25.0  800.  12.0  3.0 39.5 140
 46 A.P. 3   0.174    6 0.000 0.000  0.000   0.0   0.0 4   0.256  5.000*  6.145  3.920  1 0   6.5 10.0 53.5 25.0  800.  18.6  3.0 39.5 148
 47 MBS  4   0.200    6 5.667 0.000  0.015   0.0  29.0 0   0.000  PLAN    6.145  3.920  1 0   6.7 11.0 54.3 25.0  800.  19.0  1.8 34.5 140
 48 EDU  6   4.915    6 0.000 0.000  0.000   0.0  24.1 2   0.010  6.000   6.145  3.920  1 0   4.8 18.3 58.2 25.0  800.  20.0  0.6 26.0 120
 49 HUGH 0  36.000  960 1.097 0.060  4.028 -15.0   0.0 0   0.000  0.000   6.145  3.920  1 0  27.0 10.0 54.0 24.8  800.  34.0 10.0 50.7 125
 50 HUGH 1  36.000    1 2.619 0.020  4.200   0.0  12.8 0   0.000  0.000   6.145  3.920  1 0  27.0 10.0 54.0 24.8  800.  34.0  4.5 44.0 125
 51 HUGH 2   4.000    4 0.000 0.000  0.000   0.0   0.0 4   6.400  8.000   6.145  3.920  1 0  11.0 10.0 54.0 24.8  800.  24.0 10.0 50.7 125
 52 HUGH 4   0.020  398 5.600 0.000  0.003   0.0  23.5 0   0.000  0.080*  6.145  3.920  1 0  -2.5  4.5 47.1 24.8  800.   3.7  4.5 44.0 125
 53 SPC  0  36.000 1872 0.407 0.012  7.868  15.0  10.3 0   0.000  0.000   6.145  3.920  1 0  27.0 10.0 54.0 26.0  750.  34.0 10.0 50.5 112
 54 SPC  0  17.500  432 1.019 0.564  2.074 -15.0   0.0 0   0.00018.000    6.145  3.920  1 0  19.0 10.0 54.0 26.0  750.  30.0 10.0 50.5 112
 55 SPC  1  36.000    1 2.690 0.025  4.200   0.0  13.0 0   0.000  0.000   6.145  3.920  1 0  27.0 10.0 54.0 26.0  750.  34.0  7.0 47.5 120
 56 SPC  1  36.000    1 2.690 0.025  4.200   0.0  13.0 0   0.000  0.000   6.145  3.920  1 0  27.0 10.0 54.0 26.0  750.  34.0  5.0 45.0 120
 57 SPCW 0  36.000 1872 0.407 0.012  7.868  15.0  10.3 0   0.00040.000    6.145  3.920  0 1  15.2 13.0 56.3 26.0  750.  42.0 13.0 52.0  80
 58 SPCW 1  36.000    2 2.690 0.025  4.200   0.0  13.0 0   0.00040.000    6.145  3.920  0 1  17.5 10.0 54.0 26.0  750.  32.0  7.0 47.5 120
 59 SPCW 1  36.000    2 2.690 0.025  4.200   0.0  13.0 0   0.00040.000    6.145  3.920  0 1  17.5 10.0 54.0 26.0  750.  32.0  5.0 45.0 120
 60 SPCW 2  72.000    1 0.000 0.000  0.000   0.0   0.0 4 125.000  0.000   6.145  3.920  0 1  24.0 10.0 54.0 26.0  750.  35.7 10.0 50.5 112
 61 NEX  0  36.000  960 1.097 0.060  4.028 -15.0   0.0 0   0.000  0.000   6.145  3.920  1 0  27.0 10.0 54.0 24.8  800.  34.0 10.0 50.7 125
 62 NEX  1  36.000    1 2.619 0.020  4.200   0.0  12.8 0   0.000  0.000   6.145  3.920  1 0  27.0 10.0 54.0 24.8  800.  34.0  4.5 44.0 125
 63 NEX  2   4.000    4 0.000 0.000  0.000   0.0   0.0 4   6.400  8.000   6.145  3.920  1 0  11.0 10.0 54.0 24.8  800.  24.0 10.0 50.7 125
 64 NEX  4   0.020  398 5.600 0.000  0.003   0.0  23.5 0   0.000  0.080*  6.145  3.920  1 0  -2.5  4.5 47.1 24.8  800.   3.7  4.5 44.0 125
```

Table 7 Input Parameters

```
                                   T H E R M A L   N O I S E   S U M M A R Y                         10:13:56     26 OCT-83
             EARTH - TO - SPACE           SPACE  TO  EARTH
                  POINT                        POINT                                                                    SINGLE ENTRY INTER
                 -ING SPACE   RCV              ING SPACE   RCV    C/KT - (DB/HZ)        C/N - (DB)        TOTAL THERMAL NOISE  FERENCE OBJECTIVE
CAR- COM-   EIRP LOSS+LOSS*    G/T  EIRP LOSS+LOSS*    G/T                                                       S/N ER/KT            S/I    C/I
RIER PANY  (DBW) (DB)   (DB)(DB/K) (DBW) (DB)   (DB)(DB/K)     UP     DN  TOTAL    UP    DN TOTAL  (PWOP)  (DB)  (DB)  (PWOP)   (DB)   (DB)
   1 ALAS   40.7  0.0  199.8  -0.6  -5.7  0.2  196.2  35.4   68.9   61.9   61.1  24.3  17.3  16.5   4185.  53.8                        24.7
   2 ALAS   49.6  0.3  199.8  -0.6   7.2  0.0  196.2  23.7   77.5   63.3   63.1  32.9  18.7  18.5   2623.  55.8                        22.4
   3 ASC    81.0  0.3  199.8  -4.0  34.0  0.2  196.2  33.0  105.5   99.2   98.3  30.0  23.7  22.8   3660.  54.4          600.   62.2
   4 ASC    64.2  0.3  199.8  -4.0  22.0  0.2  196.2  33.0   88.7   87.2   84.9  17.9  16.4  14.1  10196.  49.9          600.   62.2
   5 ASC    81.0  0.3  199.8  -4.0  34.0  0.0  196.2  23.5  105.5   89.9   89.8  30.4  14.9  14.8          52.0                 -53.2   22.0
   6 ASC    78.0  0.3  199.8  -4.0  33.0  0.2  196.2  33.0  102.5   98.2   96.8  26.9  22.6  21.2                18.7                 28.0
   7 ASC    78.0  0.3  199.8  -4.0  33.0  0.0  196.2  18.4  102.5   83.8   83.7  32.6  13.9  13.9                14.8                 20.0
   8 ASC    65.0  0.3  199.8  -4.0  23.0  0.2  196.2  31.0   89.5   86.2   84.5  23.7  20.5  18.8                18.5                 28.0
   9 ASC    57.2  0.3  199.8  -4.0  14.8  0.2  196.2  31.0   81.7   78.0   76.5  21.3  17.6  16.0                14.6                 27.1
  10 ASC    56.6  0.3  199.8  -4.0  14.1  0.2  196.2  33.0   81.1   79.3   77.1  20.7  18.9  16.7                15.2                 27.1
  11 ASC    48.4  0.0  199.8  -4.0   7.5  0.0  196.2  23.5   73.2   63.4   63.0  27.1  17.4  17.0                15.5                 24.0
  12 ASC    44.0  0.3  199.8  -4.0   1.0  0.2  196.2  31.0   68.5   64.2   62.8  22.4  18.2  16.8                15.3                 24.0
  13 AT&T   81.7  0.5  199.8  -5.0  28.6  0.2  196.2  42.0   66.0   63.9   61.8  30.0  27.8  25.8   7267.  51.4         3548.   54.5
  14 AT&T   82.7  0.3  199.8  -5.0  29.8  0.1  196.2  34.0   68:4   58.3   57.9  32.4  22.3  21.9  17846.  47.5         3548.   54.5
  15 AT&T   90.6  0.5  199.8  -5.0  35.0  0.2  196.2  42.0  113.9  109.2  107.9  38.3  33.6  32.3   1643.  57.8          600.   62.2
  16 AT&T   81.0  0.3  199.8  -5.0  35.0  0.1  196.2  26.5  104.5   93.8   93.5  28.9  18.3  17.9          55.2                 =58.2   27.0
  17 AT&T   82.1  0.3  199.8   5.0  34.2  0.1  196.2  34.0  105.6  100.5   99.3  30.0  24.9  23.7                21.5                 28.0
  18 AT&T   83.9  0.5  199.8  -5.0  33.0  0.2  196.2  42.0  107.2  107.2  104.2  31.6  31.6  28.6                24.6                 32.2
  19 AT&T   66.6  0.3  199.8  -5.0  15.7  0.1  196.2  34.0   90.1   82.0   81.4  29.8  21.7  21.1                19.5                 27.1
  20 AT&T   66.6  0.3  199.8  -5.0  15.7  0.1  196.2  32.0   90.1   80.0   79.6  29.8  19.7  19.3                17.7                 25.5
  21 AT&T   67.0  0.3  199.8  -5.0  24.0  0.1  196.2  18.4   90.5   74.7   74.5  27.8  12.0  11.9                12.7                 24.4
  22 RCA    74.0  0.3  199.8  -4.8  30.0  0.2  196.2  34.0   60.1   58.5   56.2  24.1  22.5  20.2   5477.  52.6          600.   62.2
  23 RCA    81.0  0.3  199.8  -4.8  34.0  0.2  196.2  33.0  104.7   99.2   98.1  29.2  23.6  22.5   3659.  54.4          600.   62.2
  24 RCA    81.0  0.3  199.8  -4.8  34.0  0.2  196.2  33.0  104.7   99.2   98.1  29.2  23.6  22.5   4127.  53.8          600.   62.2
  25 RCA    69.9  0.3  199.8  -4.8  25.5  0.2  196.2  33.0   93.6   90.7   88.9  20.5  17.5  15.7   5423.  52.7          600.   62.2
  26 RCA    81.0  0.3  199.8  -4.8  34.0  0.2  196.2  33.0  104.7   99.2   98.1  29.2  23.6  22.5          59.8                  67.0  =35.8
  27 RCA    81.0  0.3  199.8  -4.8  34.0  0.2  196.2  32.3  104.7   98.5   97.6  29.2  22.9  22.0          59.3                  67.0  =35.8
  28 RCA    77.0  0.3  199.8  -4.8  33.0  0.1  196.2  28.5  100.7   93.8   93.0  28.2  21.2  20.4          51.5                  65.5  =39.0
  29 RCA    81.0  0.3  199.8  -4.8  34.0  0.0  196.2  23.0  104.7   89.4   89.3  29.2  13.9  13.7          51.0                 =53.2   22.0
 30' RCA    81.0  0.3  199.8   4.8  34.0  0.1  196.2  26.5  104.7   92.8   92.6  29.2  17.3  17.0          54.3                 =53.2   22.0
  31 RCA    75.0  0.3  199.8  -4.8  30.0  0.0  196.2  23.0   98.7   85.4   85.2  26.2  12.9  12.7          43.8                 =48.5   22.0
  32 RCA    75.0  0.3  199.8  -4.8  30.0  0.2  196.2  30.0   98.7   92.2   91.3  26.2  19.7  18.8          49.9                 =48.5   22.0
  33 RCA    81.0  0.3  199.8   4.8  34.0  0.2  196.2  31.0  104.7   97.2   96.5  29.2  21.6  20.9                18.7                 28.0
  34 RCA    78.5  0.3  199.8   4.8  34.0  0.0  196.2  18.4  102.2   84.8   84.7  30.0  12.6  12.5                15.2                 20.0
  35 RCA    62.2  0.3  199.8  -4.8  15.0  0.2  196.2  31.0   85.9   78.2   77.5  25.8  18.1  17.4                15.6                 27.1
  36 RCA    55.0  0.0  199.8  -4.8   9.0  0.0  196.2  23.5   79.0   64.9   64.8  31.0  16.9  16.7                16.7                 21.5
  37 RCA    52.5  0.3  199.8  -4.8   0.0  0.2  196.2  30.0   76.2   62.2   62.0  30.6  16.5  16.4     175.  67.6                        23.2
  38 RCA    56.0  0.0  199.8  -4.8  10.0  0.0  196.2  12.0   80.0   54.4   54.4  23.5  -2.1  -2.1                14.6                 11.0
  39 W.U.   81.0  0.3  199.8  -4.0  34.0  0.2  196.2  37.4  105.5  103.6  101.4  29.9  28.0  25.8   8567.  50.7          600.   62.2
  40 W.U.   60.0  0.3  199.8  -4.0  18.0  0.2  196.2  37.4   84.5   87.6   82.7  17.9  21.0  16.2   4580.  54.5          600.   62.2
  41 W.U.   79.4  0.3  199.8   4.0  34.0  0.2  196.2  34.0  103.9  100.2   98.6  28.3  24.6  23.1          60.6                  67.0  =35.6
  42 W.U.   78.0  0.3  199.8  -4.0  33.0  0.2  196.2  37.4  102.5  102.6   99.5  26.9  27.0  23.9                21.6                 28.0
  43 NPR    58.5  0.0  199.8   4.0  16.5  0.0  196.2  22.5   83.3   71.4   71.2  30.7  18.9  18.6      39.  74.1                        23.3
  44 MUZK   64.2  0.3  199.8   4.0  22.0  0.0  196.2   7.9   88.7   62.3   62.3  37.9  11.5  11.5     829.  60.8                         2.1
  45 A.F.   53.0  0.3  199.8   4.0  12.0  0.0  196.2  17.8   77.5   62.2   62.1  31.7  16.4  16.3                14.6                  2.4
  46 A.F.   60.0  0.3  199.8   4.0  18.6  0.0  196.2  17.8   84.5   68.8   68.7  32.1  16.4  16.3                14.6                 24.0
  47 MBS    61.0  0.3  199.8   4.0  19.0  0.0  196.2  12.8   85.5   64.2   64.2  32.5  11.2  11.2     150.  68.2                        22.0
  48 EDU    63.0  0.3  199.8  -4.0  20.0  0.0  196.2   5.2   87.5   57.6   57.6  20.6  -9.3  -9.3                17.8                  0.6
  49 HUGH   81.0  0.3  199.8  -4.2  34.0  0.2  196.2  29.7  105.3   95.9   95.5  29.7  20.4  19.9   4989.  53.0          600.   62.2
  50 HUGH   81.0  0.3  199.8  -4.2  34.0  0.0  196.2  23.0  105.3   89.4   89.3  29.7  13.9  13.8          51.3                 =53.4   22.0
  51 HUGH   65.0  0.3  199.8  -4.2  24.0  0.2  196.2  29.7   89.3   85.9   84.3  23.2  19.9  18.3                16.2                 28.0
  52 HUGH   44.6  0.0  199.8  -4.2   3.7  0.0  196.2  23.0   69.2   59.1   58.7  26.2  16.1  15.7     195.  64.0                        23.2
  53 SPC    81.0  0.3  199.8  -2.8  34.0  0.2  196.2  30.0  106.7   96.2   95.8  31.2  20.6  20.3   6032.  52.2          600.   62.2
  54 SPC    73.0  0.3  199.8  -2.8  30.0  0.2  196.2  30.0   98.7   92.2   91.3  26.3  19.8  18.9   6710.  51.7          600.   62.2
  55 SPC    81.0  0.3  199.8   2.8  34.0  0.1  196.2  26.7  106.7   93.0   92.8  31.2  17.4  17.3          55.3                 =53.6   22.0
  56 SPC    81.0  0.3  199.8   2.8  34.0  0.0  196.2  24.2  106.7   90.6   90.5  31.2  15.0  14.9          53.0                 =54.6   22.0
  57 SPCW   71.5  0.3  199.8   2.8  32.0  0.2  196.2  33.0   97.2   97.2   94.2  21.7  21.6  18.6   8802.  50.6          600.   62.2
  58 SPCW   71.5  0.3  199.8  -2.8  32.0  0.1  196.2  26.7   97.2   91.0   90.1  21.7  15.4  14.5          52.6                 =54.6   22.0
  59 SPCW   71.5  0.3  199.8   2.8  32.0  0.0  196.2  24.2   97.2   88.6   88.1  21.7  13.0  12.5          50.5                 =53.6   22.0
  60 SPCW   78.0  0.3  199.8   2.8  35.7  0.2  196.2  30.0  103.7   97.9   96.9  25.2  19.3  18.3                15.9                 28.0
  61 NEX    81.0  0.3  199.8  -4.2  34.0  0.2  196.2  29.7  105.3   95.9   95.5  29.7  20.4  19.9   4989.  53.0          600.   62.2
  62 NEX    81.0  0.3  199.8  -4.2  34.0  0.0  196.2  23.0  105.3   89.4   89.3  29.7  13.9  13.8          51.3                 =54.4   22.0
  63 NEX    65.0  0.3  199.8   4.2  24.0  0.2  196.2  29.7   89.3   85.9   84.3  23.2  19.9  18.3                16.2                 28.0
  64 NEX    44.6  0.0  199.8   4.2   3.7  0.0  196.2  23.0   69.2   59.1   58.7  26.2  16.1  15.7     195.  64.0                        23.2
```

Table 8 Thermal Noise Summary

```
                              *** F O O T N O T E S ***

                               I N P U T   P A R A M E T E R S

                                                                  POLARIZATION  ISOLATION  MATRIX
  SIGNAL              POLARIZATION TYPE INDEX
   TYPE                                                                   INTERFERING SENSE
  INDEX                                                                0     1     2     3     4     5

0 = FDM/FM            0 = HORIZONTAL                              0    0.0  10.0   0.0   6.9   3.0   3.0
1 = TV/FM             1 = VERTICAL
2 = DIGITAL                                                     D 1   10.0   0.0   6.9   0.0   3.0   3.0
3 = SCPC/PSK          2 = 20 DEG CANTED HORIZONTAL              E
4 = SCPC/FM           3 = 20 DEG CANTED VERTICAL                S 2    0.0   6.9   0.0  10.0   3.0   3.0
5 = CSSB/AM                                                     I
6 = SS/PSK            4 = LEFT-HAND CIRCULAR                    R 3    6.9   0.0  10.0   0.0   3.0   3.0
                      5 = RIGHT-HAND CIRCULAR                   E
                                                                D 4    1.5   1.5   1.5   1.5   0.0   6.0

                                                                  5    1.5   1.5   1.5   1.5   6.0   0.0
SPECTRA ASSUMMED FOR INTERFERENCE INTO SCPC & PSK

      TV/FM:   1.2 MHZ SPREADING ONLY

      FDM/FM:  GAUSSIAN, EXCEPT FOR THOSE MARKED
               WITH "+" UNDER SIGNAL TYPE

* INDICATES SCPC AND SMALL FDMA CARRIERS WHOSE TRANSPONDER
  FREQUENCY PLANS AVOID +- 1.5 MHZ AT THE TRANSPONDER CENTER.

"PLAN" UNDER CHANNEL SPACING INDICATES A FIXED FREQUENCY PLAN.


                          T H E R M A L   N O I S E   S U M M A R Y

+ POINTING LOSS INCLUDED IN THERMAL NOISE ONLY, NOT IN INTERFERENCE CALCULATIONS.

* FREE SPACE LOSS (10 DEG ELEV. ANG.) & ATMOSPHERIC LOSSES
               = 199.6 +  0.2 DB (UPLINK)
               = 196.1 +  0.1 DB (DOWNLINK)

= FOR TV/FM, INDICATES THE OBJECTIVE'S EQUIVALENT LEVEL FOR INTERFERENCE FROM ITSELF,
  FOR COMPARISON ONLY, NOT USED AS THE SINGLE ENTRY OBJECTIVE.
```

Table 9 Footnotes

```
W                   FAILS TO MEET SINGLE ENTRY INTERFERENCE OBJECT     (DB)                  10:13:56     26 OCT 83
A       ( 2.00 DEGREE SPACING)    29.0    25.0 LOG(A)           # A = GEOCENTRIC ANGLE
N               INTERFERING
T|   |              1 1|1 1 1 1 1 1 1 1 2|2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3|3 4 4 4|4 4 4 4 4 4|4 5 5 5|5 5 5 5 5 5 5 6|6 6 6 6|
E|1 2|3 4 5 6 7 8 9 0 1|2 3 4 5 6 7 8 9 0|1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8|9 0 1 2|3 4 5 6 7 8|9 0 1 2|3 4 5 6 7 8 9 0|1 2 3 4|
D|   |                 |                 |                                   |       |           |       |               |       |
 1|  5|9   * 3 * 3     8|      * * 1 1   1|7   8 9 1 * * * * * * * 5 8 2 * 4 *|    4  |2 5   1    |  5    |1   5 5 4     2|  5    |  ALAS
 2|   |3   8   5       1|      9 8        |2   2 3   8 8 6 8 8 4 4   2   2   *|       |           |       |               |       |
 3|  3|2   4 1 1        |        3 1      |    1     3 4 2 4 4 2 2 2 1   1   *|       |           |       |              1|       |
 4|2 8|* 2 * 8 * 5 2 1 4|2   3 * * 6 5 1 1|4 4 * * 2 * * * * * 6 6 9 * 4 7 7 *|2   4  |           |3 5    |4   5 5       6|3 5    |
 5|  1|                 |      1          |                                  5|       |           |       |               |       |
 6|  2|1   2 1 1        |      1 1        |    1 1   1 1   2 2 1 1 2 1   1   *|       |           |       |               |       |
 7|   |3   3   2        |      3 4        |    2 3   3 3 2 3 3       3       1|       |           |       |               |       |  ASC
 8|  3|9   * 3 9 1     1|      8 8 2 1    |1   8 8 1 9 * 7 * * 5 5 5 8   4 3 *|       |           |  1    |    1 1       2|  1    |
 9|  5|* 2 * 5 * 5     2|    1 * 5 4 3   1|6 2 * * 2 * * 8 * * * * 7 * 2 6 5 *|       |           |1 1    |2   1 1 7 * * 4|1 1    |
10|1 6|* 2 * 6 * 5 1   3|1   2 * 9 5 4 1 1|7 2 * * 3 * * 9 * * * * 8 * 2 6 5 *|1   1  |  1        |1 1    |2   1 1 8 * * 4|1 1    |
11|  1|5       6 1     3|      3          |5   4 5             7 7 1 5   5   *|       |  2        |       |        1      |       |
12|  2|7     1 8 2     5|      4   1      |6   6 7             9 9 3 6   9 1 *|       |  4        |       |        1      |       |
13|  1|3   8   4       1|      9 *        |4   1 2   8 8 7 8 8 4 4   2   1   *|    5  |4 6 1 1    |1 7    |2   7 7        |1 7    |
14|  6|7   * 1 8 2     5|      * * 2 1 1 1|8   6 7   * * * * * 8 8 2 7   4   *|    5  |3 6 2 2 1  |  6    |1   6 6       1|  6    |
15|  1|                 |      1 2        |                                  1|       |           |       |               |       |
16|  2|1   1            |      2 2 1      |    1 1                 1 1       2|       |           |       |               |       |  AT & T
17|   |                 |                 |                                  1|       |           |       |               |       |
18|   |                 |      1          |                                  3|       |           |       |               |       |
19|  1|5   4   6        |      8 6 1 1    |3   4 5   4 4 3 4 4 7 7 1 5       1|       |           |       |1              |       |
20|  2|6   4   6 1      |      8 6 1 1    |3   5 6   4 4 3 4 4 7 7 1 6       1|       |           |       |        1      |       |
21|  6|* 1 * 4 * 5      |    2 * * 5 4 1 1|7 1 9 * 2 * * * * *     5 *       2|1   7  |           |1 8    |3   8 8       4|1 8    |
22|2 7|* 1 * 4 * 4 1   *|1     * * 2 1 1 1|8 1 9 * 1 * * * * * * * 6 9 3 * 6 *|    5  |3 6 2 2 1  |  6    |1   6 6 4     2|  6    |
23|  2|    2 1 1        |        1 1      |          1 2   2 2 1 1 2 1   1   *|       |           |       |              1|       |
24|  3|    4 1 1        |        3 1      |    1 2   4 4 2 4 4 2 2 2 1   1   *|       |           |       |              1|       |
25|  3|      2 4        |          1      |    1               4 4 4 3   2 2 *|       |           |       |              2|       |
26|  2|1   8            |      1 7        |    1 1   7 7 5 8 8 2 2 1 1       *|       |           |       |               |       |
27|  2|2   8 1 1        |      2 7 1      |    2 2   7 8 6 8 8 3 3 2 1       *|       |           |       |              1|       |
28|1 9|*   * 8 * 5 2 1 4|2 1 4 * * 8 7 2 2|4 4 * *   * * * * * 9 9 9 * 3 6 5 *|    5  |           |1 6    |1   6 6 3 3 3 7|1 6    |
29|  2|                 |      1 1        |                                  6|       |           |       |               |       |  RCA
30|   |                 |                 |                                  6|       |           |       |               |       |
31|  3|2   4 1 2        |      3 4 1      |    2 2   3 3 2 4 4     1 2       9|       |           |       |              1|       |
32|   |                 |                 |                                  9|       |           |       |               |       |
33|  1|    1            |                 |                1 1               *|       |           |       |               |       |
34|  1|2   2   1        |      3 3        |    2 2   2 2 1 2 2     1 2       3|       |           |       |               |       |
35|  3|8   8 3 9 2      |      8 7 2 1    |5   7 8 1 7 7 6 8 8 * * 4 8   2 1 *|       |           |       |        6 * * 2|       |
36|   |3       3        |      1          |3   2 2             4 4   2   1   7|       |           |       |               |       |
37|  1|5       5 1     2|      3          |5   4 5             6 6 1 5   3   9|       |  2        |       |        1      |       |
38|1 *|* * * * * * 9 9 8|8 7 9 * * * * * *|* * * * * * * * * * * * * * * 9 7 8|8   * 2|6 9   5 6  |7 * 3  |8 6 * * *     *|7 * 3  |
39|   |                 |    6 7 8 5 1 3 5|                                  *|8   9 4|5 2 1      |9 * 1 4|8 7 * *        |9 * 1 4|
40|   |                 |    6 *   5   3 4|                                  9|7     1|5 3        |9     1|* 5            |9     1|  WU
41|   |                 |      1 6        |                                  5|2   8  |           |3 8    |3   8 8        |3 8    |
42|   |                 |                 |                                  4|       |           |1 1    |1   1 1        |1 1    |
43|   |                 |                 |                                   |2      |3 7   4 4  |2      |3 1            |2      |  NPR
44|   |                 |                 |                                   |       |           |       |               |       |
45|   |                 |                 |                                   |       |           |       |               |       |
46|   |                 |                 |                                   |4      |5 *   6 6  |4      |5              |4      |  MUZK
47|  1|4       4        |      2          |    3 4             5 5   4        |* 6   8|* * 8 * * 6|*   6 5|* *            |*   6 5|  etc.
48|   |                 |                 |                                   |9   7 5|3 4 1   1  |9 7 3 1|9 8 7 7        |9 7 3 1|
49|   |                 |      2 1        |                                  3|4   3  |           |5 4    |5   4 4        |5 4    |
50|   |                 |                 |                                   |       |           |       |               |       |
51|   |                 |    4 2   3   1 2|                                  8|5     1|5 2        |7   1 1|7 2            |7   1 1|  HUGH
52|   |                 |      1          |1                                 4|5      |7 * 8 9 7  |5   1 2|6 3            |5   1 2|
53|   |                 |        1        |                                  4|1   4 1|           |3 5    |4 4 5 5        |3 5    |
54|   |                 |    3     2   1 2|                                  8|      1|2          |3     1|1 5            |3     1|
55|   |                 |                 |                                   |       |           |       |               |       |
56|   |                 |                 |                                   |       |           |       |               |       |  SPC
57|  2|    6 3         1|        1        |          4 5 2 6 6 4 4 4   1 5 4 *|       |           |       |        2 4 4 4|       |
58|   |                 |                 |                                  *|       |           |       |               |       |
59|   |                 |                 |                                  *|       |           |       |               |       |
60|  1|    1            |                 |            1   1 1     1         *|       |           |       |              1|       |
61|   |                 |      2 1        |                                  3|4   3  |           |5 4    |5   4 4        |5 4    |
62|   |                 |                 |                                   |       |           |       |               |       |
63|   |                 |    4 2   3   1 2|                                  8|5     1|5 2        |7   1 1|7 2            |7   1 1|
64|   |                 |      1          |1                                 4|5      |7 * 8 9 7  |5   1 2|6 3            |5   1 2|  NEX
 ALAS       ASC              AT & T                      RCA                  WU        NPR        HUGH        SPC
                                                                                        MUZK
```

Table 10 Potential Interference Situations ("Hughes/Westar" Polarization)

FAILS TO MEET SINGLE ENTRY INTERFERENCE OBJECTIVE (DB)   14141124   26-OCT-83

(2.00 DEGREE SPACING)   29.0   25.0 (INDIA)   (A = GEOCENTRIC ANGLE

INTERFERING

WANTED	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	
1		5	9		*	3	*	3			8				*	*	1	1		1	7		8	9	1	*	*	*	*	*	*	*	5	8	2	*	4	*			4		2	5			1			5			1		5	5	4			2	9	*	2	5	ALAS
2			3		8		5				1				9	8					2		2	3		8	8	6	8	8	4	4		2		2		*																							2	8			
3		3	2		4	1	1									3	1						1			3	4	2	4	4	2	2	2	1		1		*																					1	2	4			ASC
4	2	8	*	2	*	8	*	5	2	1	4	2		3	*	*	6	5	1	1	4	4	*	*	2	*	*	*	*	*	6	6	9	*	4	7	7	*	2		4								3	5			4		5	5				6	*	*	4	5	
5		1													1																							5																										
6		2	1		2	1	1								1	1							1	1		1	1		2	2	1	1	2	1		1		*																							2	2			
7			3		3		2								3	4							2	3		3	3	2	3	3				3				1																							2	3			
8		3	9		*	3	9	1			1				8	8	2	1			1		8	8	1	9	*	7	*	*	5	5	5	8		4	3	*												1					1	1				2	9	*		1	
9		5	*	2	*	5	*	5			2			1	*	9	4	3		1	6	2	*	*	2	*	*	8	*	*	*	*	7	*	2	6	5	*											1	1			2		1	1	7	*	*	4	*	*	4	2	
10	1	6	*	2	*	6	*	5	1		3	1		2	*	9	5	4	1	1	7	2	*	*	3	*	*	9	*	*	*	*	8	*	2	6	5	*	1		1			1					1	1			2		1	1	8	*	*	4	*	*	5	3	
11		1	5				6	1			3				3						5		4	5							7	7	1	5		5		*						2												1				4				
12		2	7			1	8	2			5				4		1				6		6	7							9	9	3	6		9	1	*						4												1				7		1	1	
13		1	3		8		4				1				9	*					4		1	2		8	8	7	8	8	4	4		2		1		*			5		4	6	1	1			1	7			3		7	7					1	8			AT & T
14		6	7		*	1	8	2			5				*	*	2	1	1	1	8		6	7		*	*	*	*	*	8	8	2	7		4		*			5		3	6	2	2	1			6			1		6	6				1	5	*	2	3	
15		1													1	2																						1																										
16		2	1		1										2	2	1						1	1									1	1				2																								1				
17																																						1																										
18															1																							3																										
19		1	5		4		6								8	6	1	1			3		4	5		4	4	3	4	4	7	7	1	5				1															1								4	4	1		
20		2	6		4		6	1							8	6	1	1			3		5	6		4	4	3	4	4	7	7	1	6				1																			1				4	4	1		
21		6	*	1	*	4	*	5						2	*	*	5	4	1	1	7	1	9	*	2	*	*	*	*	*			5	*				2	1		7								1	8			3		8	8				4	9	*	3		
22	2	7	*	1	*	4	*	4	1		*	1			*	*	2	1	1	1	8	1	9	*	1	*	*	*	*	*	*	*	6	9	3	*	6	*			5		3	6	2	2	1			6			1		6	6	4			2	*	*	3	8	RCA
23		2			2	1	1									1	1									1	2		2	2	1	1	2	1		1		*																					1		2			
24		3			4	1	1									3	1						1	2		4	4	2	4	4	2	2	2	1		1		*																					1	2	4			
25		3				2	4										1						1								4	4	4	3		2	2	*																					2	3				
26		2	1		8										1	7							1	1		7	7	5	8	8	2	2	1	1				*																						2	7			
27		2	2		8	1	1								2	7	1						2	2		7	8	6	8	8	3	3	2	1				*																					1	2	8			
28	1	9	*		*	8	*	5	2	1	4	2	1	4	*	*	8	7	2	2	4	4	*	*		*	*	*	*	*	9	9	9	*	3	6	5	*			5								1	6			1		6	6	3	3	3	7	*	*	3	4	
29		2													1	1																						6																										
30																																						6																										
31		3	2		4	1	2								3	4	1						2	2		3	3	2	4	4			1	2				9																					1	2	4			
32																																						9																										
33		1			1																								1	1								*																						1				
34		1	2		2		1								3	3							2	2		2	2	1	2	2			1	2				3																						2	2			
35		1	8		8	3	9	2							8	7	2	1			5		7	8	1	7	7	6	8	8	*	*	4	8		2	1	*																			6	*	*	2	7	7	2		
36			3				3								1						3		2	2							4	4		2		1		7																						1				
37		1	5				5	1			2				3						5		4	5							6	6	1	5		3		9						2												1				4				
38	1	*	*	*	*	*	*	*	9	9	8	8	7	9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	9	7	8	8		*	2	6	9			5	6	7	*	3		8	6	*	*	*			*	*	*	*	8	
39														6	7	8	5	1	3	5																		*	8		9	4	5	2	1				9	*	1	4	8	7	*	*									WU
40														6	*		5		3	4																		9	7			1	5	3					9			1	*	5											
41															1	6																						5	2		8								3	8			3		8	8									
42																																						4											1	1			1		1	1									
43																																							2				3	7			4	4	2				1	1											NPR MUZK etc.
44																																																																	
45																																																																	
46																																							4				5	*			6	6	4				5												
47		1	4				4								2								3	4							5	5		4					*	6		8	*	*	8	*	*	6	*		6	5	*	*							3				
48																																							9		7	5	3	4	1			1	9	7	3	1	9	8	7	7									
49															2	1																						3	4		3								5	4			5		4	4									HUGH
50																																																																	
51														4	2		3		1	2																		8	5			1	5	2					7		1	1	7	2											
52															1						1																	4	5				7	*	8	9	7		5		1	2	6	3											
53																1																						4	1		4	1							3	5			4	4	5	5									SPC
54														3			2		1	2																		8				1	2						3			1	1	5											
55																																																																	
56																																																																	
57		2			6	3					1					1										4	5	2	6	6	4	4	4		1	5	4	*																				2	4	4	4		6		2	
58																																						*																										
59																																						*																										
60		1			1																						1		1	1			1					*																					1	1	1			
61		2	4		4	1	1								4	3	1						4	4		3	4	2	4	4	1	1	1	1				*																					1	5	4			NEX
62		2													1	1																						6																										
63		3	6			3					1					1						6	6									5	5		4	3	*																					1	7		1	1	
64		3	6				6	1			5				3						6		5	6							7	7	1	5		6		*						3												2				5		1	2	
	ALAS		ASC										AT & T									RCA																	WU				NPR MUZK etc.						HUGH				SPC								NEX				

Table 11 Potential Interference Situations ("RCA" Polarization)

and the characteristics of all other space stations (lines 1-60). Table 8 summarizes the thermal noise characteristics of each carrier. Table 9 summarizes the input assumptions made and contains footnotes applicable to the preceding tables. Table 11 summarizes the interference interactions between each pair of carriers. Since there are 64 carriers, there are 4,096 possible interactions. The table details the number of dB by which an interfering signal exceeds the interference criterion of the desired signal. A blank entry for any interaction indicates that the interference criterion is met. An asterisk indicates that the interference exceeds the criterion by more than 9.5 dB. As can be seen in Table 10, SpotNet (C) is a relatively low-interference satellite system. This is due to an RF system and signal design that is highly compatible with existing satellites. Those systems having the most interference entries include satellites that are co-polarized with the SpotNet (C) system. As stated in OST Report FCC/OST R83-2, polarization interleaving between satellites is necessary for achievement of two-degree satellite spacing.

NEX currently plans to use the "Hughes/Western Union" polarization/channelization plan for the CNEX satellite system. Depending uon the final assignment of orbital location, it may be desirable, from the standpoint of interference potential, to use the complementary "RCA" polarization/channelization plan. This situation currently occurs at 101° West Longitude between the Canadian Anik D-1 satellite (104.5° West) and the Western Union Westar 4 satellite (98.5° West). Table 11 presents an analysis of the potential interference interactions between a SpotNet (C) satellite using the "RCA" polarization/channelization scheme and all other authorized satellites. The same information presented in Table 10 is presented in Table 11, with the exception that the polarizations of SpotNet (C) have been reversed. Instead of being vertically polarized as given in Table 6, the uplink is polarized horizontally. The downlink polarization is similarly reversed. Therefore, as can be seen in the table, SpotNet (C) is relatively compatible both in the complementary polarization scheme and in its primary polarizations. In particular, it can be seen that those satellites that are shown in Table 11 to have some potential interference interactions with SpotNet (C) are relatively interference-free when operating adjacent to the complementary-polarized SpotNet (C) in Table 6.

G. Preferred Range of Locations of Satellites and Reasons Therefor

The NEX SpotNet satellite system will require the assignment of two orbital positions. As described above, NEX intends to operate the SpotNet (C) and SpotNet (K) space segments in the same two orbital positions. This co-location of 4/6 and

12/14-GHz capacity is made possible by the Commission's uniform 2° spacing policy. Use of separate satellites, but co-located, for 4/6 and 12/14 GHz, together with the unique spot beam design of SpotNet (K), will enable NEX to add additional satellites at its two orbital locations, greatly expanding the overall spectrum utilizations efficiency and total communications capacity at each location. There are two major considerations that bear on the choice of the intial orbital locations. The first consideration is that of 50-state coverage. NEX intends to provide coverage to Alaska and Hawaii, and will do so if the Commission assigns the requested 101° West Longitude or similar location. The second consideration is the adverse effects of heavy rain on 12/14 GHz operations, particularly in the eastern and southeastern regions of the country. This means that orbital locations toward the center of the domestic geostationary arc are desirable to permit high elevation angles that minimize rainfall attenuation and depolarization effects. A final consideration is that since SpotNet (K) will have less flexibility in beam shaping than satellites with CONUS or regional coverage beams employed by other applications, locations near the center of the arc are necessary in order to allow coverage of the beams to be controlled more effectively. Controlled beam coverage is essential in achieving intensive frequency reuse while matching beams to areas of traffic density. Therefore, NEX is seeking as its second orbital position in the vicinity of 75° West Longitude, which is an acceptable location for CONUS coverage for both SpotNet (C) and SpotNet (K).

In view of the inherent public benefits flowing from the intense frequency reuse in the SpotNet system, and because of the public benefits associated with providing innovative services to Alaska and Hawaii, NEX requests that the locations assigned be near the middle portion of the arc at or near the requested 101° and 75° West Longitude positions.

As the Commission has described in its orbital assignment policy for new entrants:

> New entrants relying on speculative satellite traffic are initially assigned the minimum number of orbital locations needed to establish market presence.

Orbital Deployment Plan-Domestic Satellite, supra, at 588. In this regard, the Commission has stated that it initially assigns "two orbital locations to each new entrant who relies on speculative satellite traffic." Id. at 603. Furthermore, the Commission has adopted a companion policy in which satellite operators are afforded "an opportunity to develop innovative services to all 50 states in an efficient manner over the same satellite." Id. at 605. This has meant that satellite operators have been assigned at least one 50-state coverage position.

Application of these policies to NEX would mean that NEX would receive one 50-state coverage position and one CONUS

H. Dates by Which Signficant Milestones are Planned to be Achieved

Detailed schedules specifying concrete dates by which significant milestones in establishment of the SpotNet satellite system are planned to be achieved are included at Table 12 and Figure 7.

I. & J. Detailed Schedule of Estimated Investment Costs, Operating Costs and Revenue Requirements for Proposed System by Year

NEX has analyzed the costs associated with the satellites, TT&C, Network Control Center, marketing, and management of the initially configured satellite communication system that is the subject of this application, as set out in Table 13. Each major component of the total system has been divided into logical subcomponents, with assigned costs based on established prices and published data. Based on this detailed analysis, the financial projections of the company have been determined.

Working with the investment banking and securities firm of Saloman Brothers Inc, NEX has made substantial progress in completing the financial arrangements supporting its business plans, as stated in the attached letter, dated November 3, 1983, from Saloman Brothers Inc. As each element of those arrangements is completed, NEX will notify the Commission and

Table 12

Schedule of Implementation

Negotiations Completed and Contracts Executed

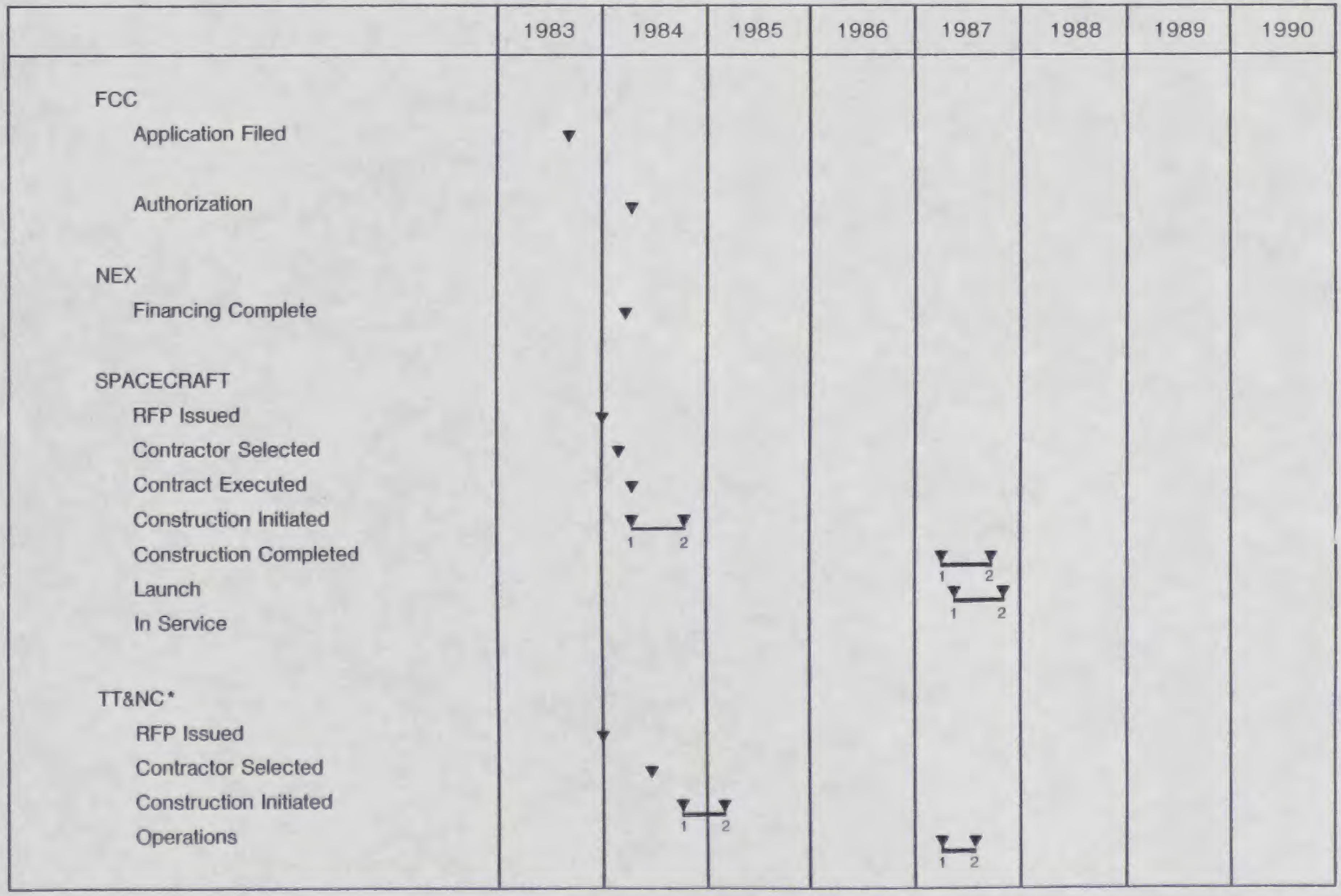
a.	Spacecraft RFP Issued	12/83
b.	Spacecraft Contractor Selected	2/84
c.	Spacecraft Contract Executed	3/84
d.	Launch Services Contract Executed	4/84
e.	Financing Completed	2/84

Spacecraft Implementation

Satellite Due Date

Event	SpotNet (C) 1	SpotNet (C) 2
Spacecraft Construction Begun	2/84	9/84
Spacecraft Construction Complete	3/87	9/87
Spacecraft Launched	4/87	10/87
Spacecraft in Service	5/87	11/87

SYSTEM SCHEDULE



*Telemetry Tracking and Network Control.
Numbers Indicate Individual Spacecraft and TT&NC Units.

Figure 7

Table 13

NEX COSTS & REVENUE REQUIREMENTS

($M)

Fiscal Year

	1984*	1985*	1986*	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Working Capital**																
Development	1.9	2.2	2.5													
Marketing	1.1	3.7	6.7	13.5	15.5	16.7	18.0	16.2	14.0	11.3	8.2					
Operations	0.6	0.8	1.6	31.3	52.4	53.3	54.2	54.7	55.2	55.8	29.5	10.8	5.3			
Administration	0.6	0.8	1.1	1.3	1.9	2.0	2.2	2.3	2.5	2.7	2.9	2.4	1.7			
On-Orbit Insurance				1.0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.7			
Capital Expenditures																
Satellite Construction	18.0	32.5	36.0	18.0												
Satellite Launch Service	7.5	15.3	21.5	5.8												
Launch Insurance			4.5	4.5												
TT&NC**	0.5	1.5	2.0													
Depreciation			12.2	23.9	23.9	23.9	23.9	11.8								
Revenue Requirements				54.1	83.5	93.1	94.0	94.7	95.5	96.2	97.0	97.6	24.6			

---

* FY 84-86 working capital costs are preoperational expenses.

** Working Capital and TT&NC expenses reflect cost sharing with the SpotNet Satellite System.

Member of the New York Stock Exchange, Inc

One New York Plaza
New York, N.Y. 10004 (212) 747-7000

Salomon Brothers Inc

November 3, 1983

Mr. Clay T. Whitehead
President
National Exchange, Inc.
11726 San Vicente Blvd.
Suite 244
Los Angeles, CA 90049

Dear Mr. Whitehead:

On April 25, 1983, Salomon Brothers Inc, after reviewing the preliminary business plan of National Exchange, Inc. (the "Company"), wrote you concerning the possibility of various equity investors and additional funding sources for the Company. We understand that the Company included our letter of April 25 in an application with the Federal Communications Commission to obtain certain authorizations and licenses in order to implement the proposed business plan. We are writing now to describe the status of efforts to arrange financing for the Company. We understand that this letter will also be provided to the FCC as part of the application process.

Salomon Brothers is a leading international investment banking and securities firm. Our firm has been one of the leading banking . firms serving companies in the telecommunications industry for several years. Salomon Brothers has been involved in offerings of equity and debt securities for a wide variety of telecommunications companies and ventures.

Since April 25, 1983, National Exchange, Inc. has met with a variety of financial and industrial organizations to attempt to raise the funds necessary for the Company to execute its proposed business plan. At this point, several large and financially sophisticated organizations have expressed strong interest in making equity investments and related commitments to enable the Company to implement its plan. Although we cannot be certain that the proposed financing will be ultimately forthcoming until definitive agreements have been put in place, discussions have advanced to the stage where we believe

Atlanta/Boston/Chicago/Dallas/London (Affiliate)/Los Angeles/San Francisco/Tokyo (Affiliate)

it is probable that mutually acceptable agreements will be reached. If discussions with one or more of these organizations do not reach a successful conclusion, we believe the other organizations already identified will provide the proposed financing or that additional organizations will join the group.

Sincerely,

Denis A. Bovin
Managing Director

DAB/nea

provide requisite information to be associated with its application.

The sources and amounts of estimated revenues or income from the proposed satellite operations on a year-by-year basis are shown on Table 13. A detailed financial statement of the applicant is not being submitted, since NEX will not rely on such a statement in making its showing of financial qualifications.

As shown in Table 13, the estimated total construction and pre-operational costs for the two in-orbit and one ground-spare satellite system are as follows: space segment - $167 million; ground segment - $4 million; operating, engineering and administrative - $23.6 million. Annual operating costs inclusive of inflation beginning in 1989, when the two-satellite system will be operational, are projected to be $73.4 million. Revenue requirements are estimated to be $93.1 million in 1989.

K. Legal Qualifications of Applicant

A Common Carrier and Satellite Radio Licensee Qualification Report (FCC Form 430) is on file for NEX (see FCC File Nos. 1824-27-DSS-P/L-83, 1828-DSS-P-83).

L. Statement as to Whether Space Station is to be Operated on Common Carrier or Non-Common Carrier Basis

As stated in NEX's original application, the SpotNet system is intended primarily as a non-common carrier system, in that NEX itself will deal with its customers on a non-carrier basis. NEX, however, recognizes that it is not yet in a position to supply the detailed information, required by Paragraph 55 of the Commission's Transponder Sales Order, 90 F.C.C.2d 1238 (1982), to enable the Commission to apply the NARUC I test to NEX's marketing plans, and to make a public-interest determination as to its non-common carrier proposal. Therefore, NEX is prepared to pursue its applications and to offer its services on a common carrier basis until such time as it receives authorization from the Commission to operate on a non-common carrier basis. Full and detailed information as required by Section 63.01 of the Rules concerning its proposal to provide service as a common carrier is provided in this application.

M. Public Interest Considerations

The essence of the Commission's successful open-entry policy for the domestic satellite industry is the desire

> to allow room and incentive for the development of innovative services and technologies. Orbit Deployment Plan-Domestic Satellite, 84 F.C.C.2d 584, 601 (1981).

NEX's SpotNet system proposal, in both its 4/6-GHz and 12/14-GHz aspects, represents a significant advance in the conception of satellite communication system design and use, promising great benefits to customers of satellite services and the public at large.

The spectrum and orbital efficiency that characterizes the SpotNet system also contributes to the substantial public benefit of offering the user small, low-cost, highly reliable, easily located customer-premise earth stations. In terms of cost to the user and operational flexibility, NEX's SpotNet represents a significant advance over any other present or presently proposed satellite system.

The NEX application represents the fruition of the FCC's open-entry domestic satellite policy. Pursuant to that policy, new entrants, such as National Exchange, are given the incentive to advance the state of the art of satellite communications, to develop proposals that are efficient in both the spectrum and economic senses, and to serve the Commission's objective, expressed as "the timely and innovative application of satellite technology to satisfy the telecommunications needs of this country." 2° Order, ¶ 83.

PART II - Individual Satellite Applications

PART II

INDIVIDUAL SATELLITE APPLICATIONS

November 7, 1983

TABLE OF CONTENTS

PART II. INDIVIDUAL SATELLITE APPLICATIONS

PART II

LIST OF TABLES

LIST OF FIGURES

I

II

III

I.

Application for Authority to Construct, Launch, and Operate a Domestic Communications Satellite to be Fixed in Geosynchronous Orbit in the Vicinity of 101° West Longitude

Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D.C. 20554

In the Matter of)
the Application of)
)
NATIONAL EXCHANGE, INC.) File No. __________
)
For Authority to Construct,)
Launch and Operate a)
Domestic Communications)
Satellite to be Fixed in)
Geosynchronous Orbit in the)
Vicinity of 101° West Longitude)

APPLICATION

National Exchange, Inc. ("NEX"), pursuant to Sections 308, 309 and 319 of the Communications Act of 1934, as amended, hereby applies for authority to construct, launch and operate a domestic communications satellite that will function in the 12- and 6-GHZ frequency bands. The specific satellite for which authorization is being sought in this application is referred to as SpotNet (C)-1. NEX requests that the Commission reserve a geosynchronous orbital position in the vicinity of 101° West Longitude for this satellite. In support of this application, NEX respectfully states:

A. Applicant

The name, post office address and telephone number of the Applicant are as follows:

National Exchange, Inc.
11726 San Vicente Boulevard
Los Angeles, California 90049
(213) 820-5454

B. Correspondence

Correspondence with respect to this application may be addressed to the following at the above address and telephone number:

Clay T. Whitehead
President

with a copy to

Henry Goldberg, Esq.
Goldberg & Spector
Suite 650
1920 N Street, N.W.
Washington, D.C. 20036
(202) 429-4914

C. Technical Description Including Radio Frequency and Polarization Plan

The satellite for which construction, launch and operating authority is requested herein is an integral part of the SpotNet domestic communications satellite system that is being proposed by NEX. The satellite will perform communications and tracking, telemetry and command ("TT&C") functions in the 4-GHz (downlink) and 6-GHz (uplink) frequency bands. The satellite is one of two in-orbit satellites that NEX proposes to construct, launch and position at two orbital locations and to operate in the 4/6-GHz bands. Four additional in-orbit satellites that NEX proposes to operate in the 12/14-GHz bands are the subject of a separate, amended application being filed simultaneously with this request.

The SpotNet (C)-1 satellite will carry 24 operational transponders, with 34-DbW EIRP center-of-beam coverage of the contiguous 48 states, Puerto Rico and the Virgin Islands. Coverage of Hawaii and Alaska is dependent on assignment by the Commission of orbital locations from which service to those areas is feasible. This application requests a location in the vicinity of 101° West Longitude, at which it would be co-located with NEX's 12/14-GHz SpotNet (K) system.

The satellite will be controlled in its orbit by the telemetry, tracking and command system (TT&C). The TT&C functions will be carried out at the edges of the communications band using the communications transponders. There are two antennas that are part of the satellite's TT&C system: A biconical antenna, which is used during launch and transfer orbit and assures that the command and telemetry links remain above threshold regardless of the spacecraft attitude, and a reflector antenna, which is used for on-station operations.

The spacecraft will be stabilized in orbit either by spinning or by 3-axis stabilization means, and will maintain its attitude, orientation and orbital position through use of a reaction control system (RCS) consisting of a series of sensors, thrusters, and propellant. Enough propellant will be included to ensure that the satellite has at least a nine-year lifetime. To provide directivity of its communications system, the spacecraft main antenna and equipment shelf would be despun in the spin-stabilized version, allowing the reflector antenna to be pointed accurately at the satellite's major service areas. In the 3-axis version, highly accurate pointing would be provided by the on-board antenna control system. These elements of the satellite's management are under the control of the satellite's command system, which is part of the TT&C system.

The satellite is designed to be launched by either the Space Transporation System (Shuttle) or by a Delta 3920 (PAM/D). The satellite's RCS not only maintains the satellite's orientation with respect to the earth, but is also used to control its inclination and orbital position at the desired celestial longitude. During launch, the RCS is also used in getting the satellite on-station and in position to begin its mission.

The satellite will have 24 transponders operating in the standard 4/6-GHz domestic fixed bands. Table 1 details the exact channel center frequency assignments and polarizations for each transponder. The telemetry, tracking and command system also uses the satellite's communications transponders to carry out the TT&C functions. The frequencies used for those functions are as follows:

Command frequency during launch - 5925 to 5930 MHz
Command frequency on station - 6420 to 6425 MHz
Telemetry frequency - 4193-4200 MHz
Telemetry polarization - vertical during launch
horizontal on-station
Command polarization - horizontal during launch
vertical on-station

Emission designators will vary with the communications traffic. In the TT&C system, emission designators are as follows:

Telemetry System - 100 F9
Tracking beacon - 5000 F9
Ranging - 1000 F9
Command system - 5000 F9

Emission designators for the communications functions will vary with the precise nature of traffic being carried. The following list reflects the best estimates NEX can make regarding traffic in the proposed system:

Satellite-to-Earth		Earth-to-Satellite	
Frequency,MHz	Polarization	Frequency,MHz	Polarization
3720	Horizontal 1	5945	Vertical 1
3740	Vertical 2	5965	Horizontal 2
3760	Horizontal 3	5985	Vertical 3
3780	Vertical 4	6005	Horizontal 4
3800	Horizontal 5	6025	Vertical 5
3820	Vertical 6	6045	Horizontal 6
3840	Horizontal 7	6065	Vertical 7
3860	Vertical 8	6085	Horizontal 8
3880	Horizontal 9	6105	Vertical 9
3900	Vertical 10	6125	Horizontal 10
3920	Horizontal 11	6145	Vertical 11
3940	Vertical 12	6165	Horizontal 12
3960	Horizontal 13	6185	Vertical 13
3980	Vertical 14	6205	Horizontal 14
4000	Horizontal 15	6225	Vertical 15
4020	Vertical 16	6245	Horizontal 16
4040	Horizontal 17	6265	Vertical 17
4060	Vertical 18	6285	Horizontal 18
4080	Horizontal 19	6305	Vertical 19
4100	Vertical 20	6325	Horizontal 20
4120	Horizontal 21	6345	Vertical 21
4140	Vertical 22	6365	Horizontal 22
4160	Horizontal 23	6385	Vertical 23
4180	Vertical 24	6405	Horizontal 24

TRANSPONDER CENTER FREQUENCIES

TABLE 1

FDM/FM - 200 F9 up to 36000 F9

TV/FM - 36000 F5

Teleconferencing - 4000 F5

SCPC/FM 20 F9

SCPC/FM 50 F9

The satellite's communications system will utilize solid-state final amplifiers. These amplifiers will have an RF output of 9 watts (9.5 dBW). Losses between the final amplifier and the input port of the reflector antenna amount to 1.1 dB. This output and loss combination together with the CONUS contour for the reflector antenna provides a minimum EIRP of 34.0 dBW. EIRP for Puerto Rico and the Virgin Islands will be 28 dBW.

All transponders are connected to each antenna beam.

D. Orbital Location Information

By this application, NEX requests an orbital location for this satellite in the vicinity of 101° West Longitude. It is NEX's intention to colocate its 4/6-GHz satellites with its 12/14-GHz satellites that are the subject of a separate amended application. The use of the same orbital location is spectrum and orbit-efficient, since it allows a single ground-control system to provide management of both spacecraft, utilizing a single TT&C station. The co-location further provides for backup of the communications system in the event of an unlikely failure of one of the systems. The rationale for such an assignment in the public interest is discussed in Part I, Section H, of the application for overall system authority. They are incorporated herein by reference.

E. Predicted Space Station Coverage Contours for Each Antenna Beam and Nominal Orbital Location Requested

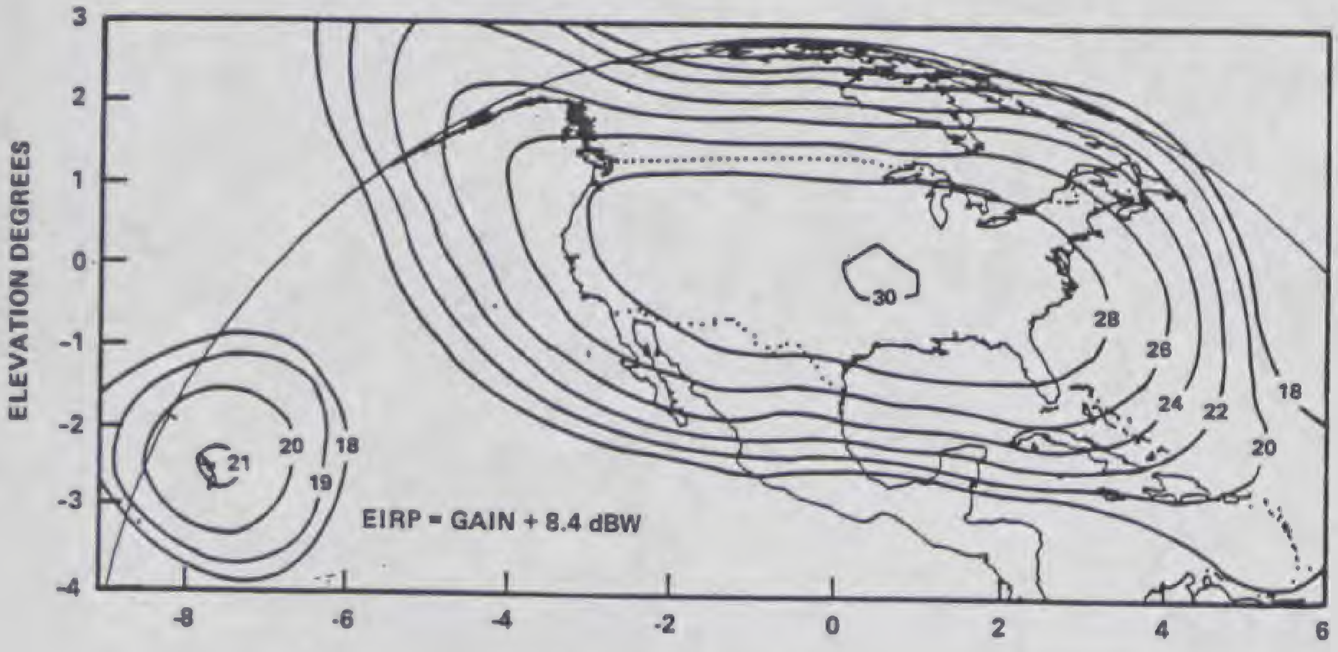
The coverage contours for the space station applied for in this application are contained in Figures 1 and 2 for the vertically polarized receive and transmit antennas and horizontally polarized receive and transmit antennas. The contours provided are overlaid on perspective maps as seen from the geostationary orbit and show the coverage for each satellite and the satellite horizon from that point.

EIRP contours can be determined from the gain contour figures by adding 8.4 dBW to the transmit gain contour values. Similarly, G/T contours can be obtained by subtracting 28.9 dB/K from the receive gain contour values. The transponder saturation flux density (SFD) can be obtained by adding -61.6 dBW/m^2 to the receive gain contours.

Figure 3 is a typical functional block diagram of the satellite's communication system.

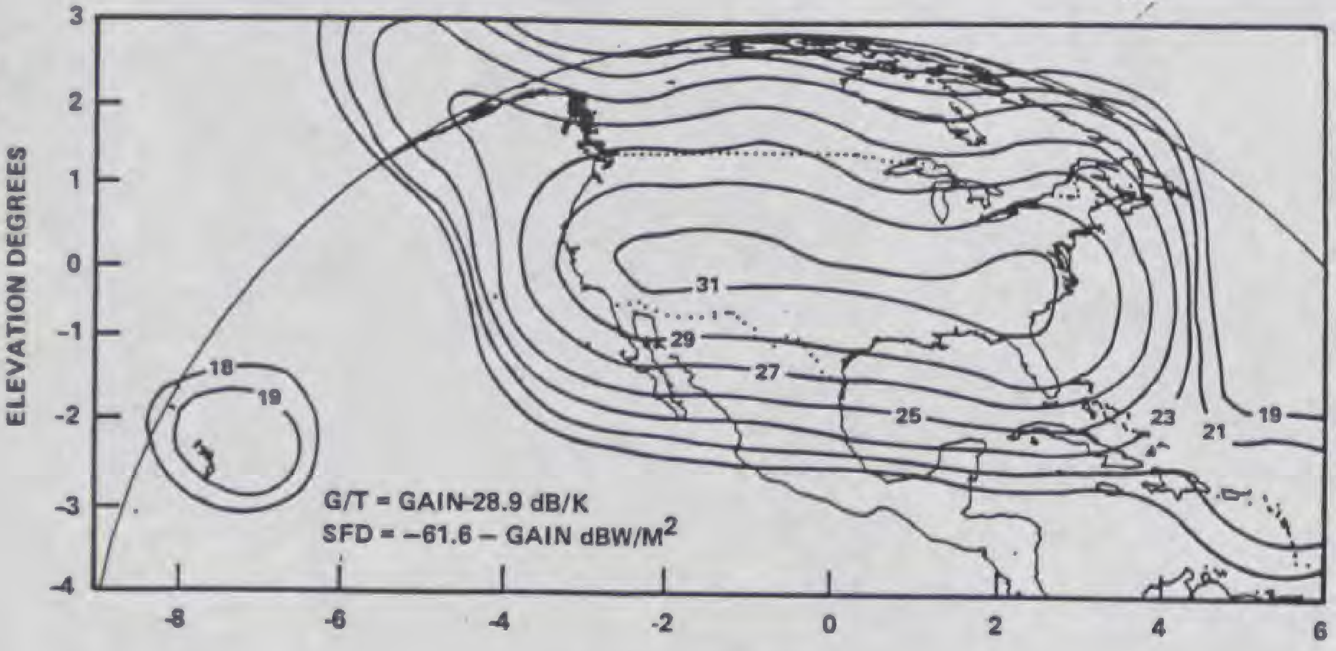
F. Physical Characteristics of Space Station

1. Accuracy With Which Orbital Parameters Will be Maintained



AZIMUTH DEGREES

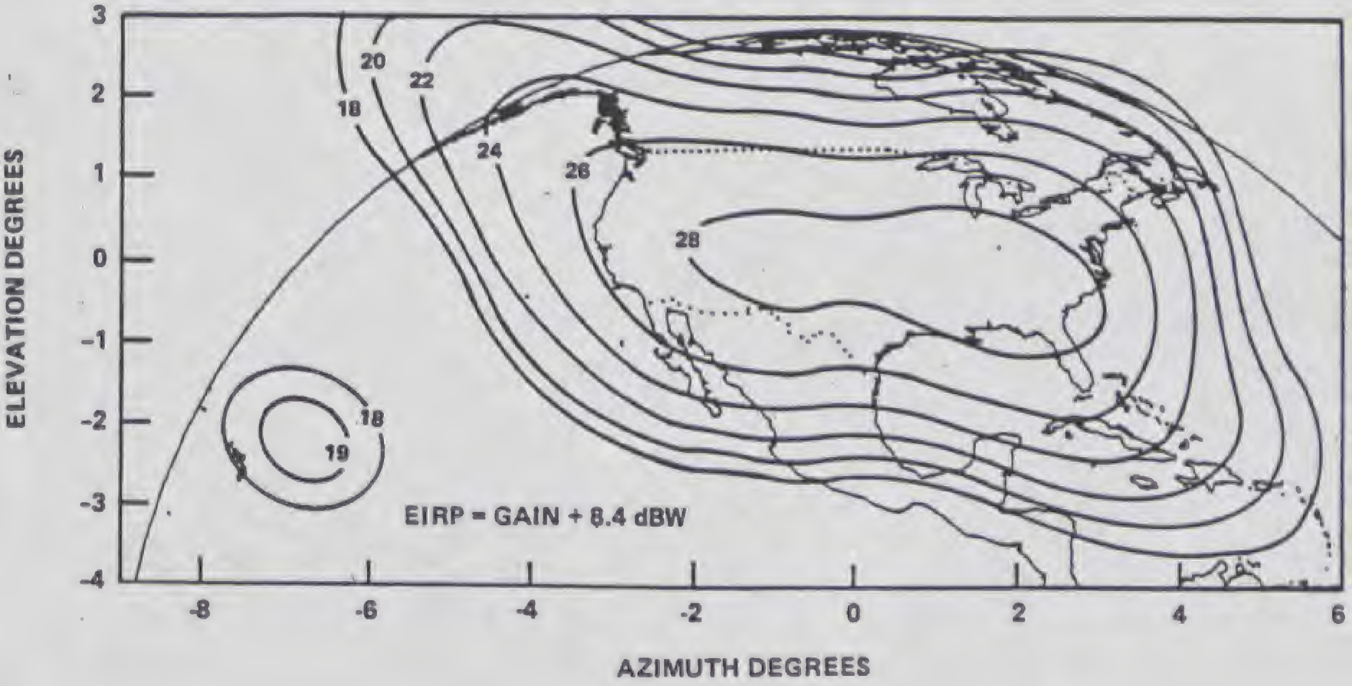
a) TRANSMIT



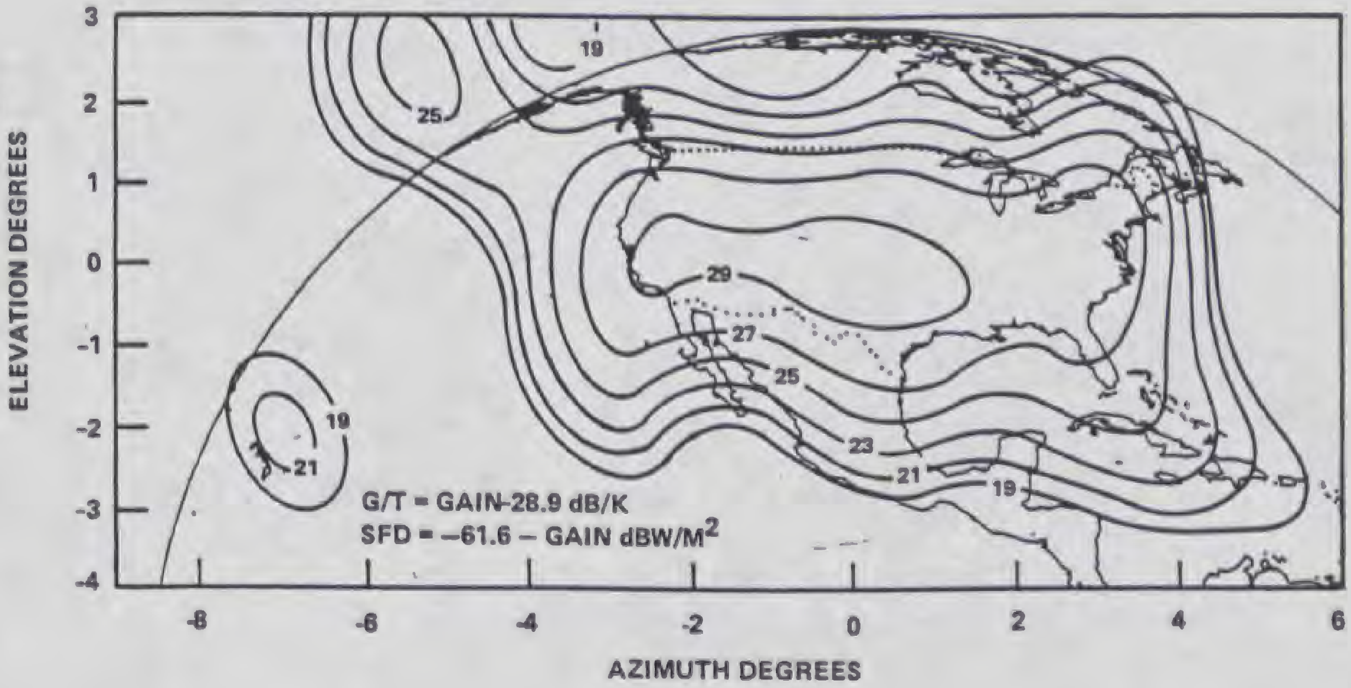
AZIMUTH DEGREES

b) RECEIVE

Figure 1 Horizontal Gain Contours (101° West)



a) TRANSMIT

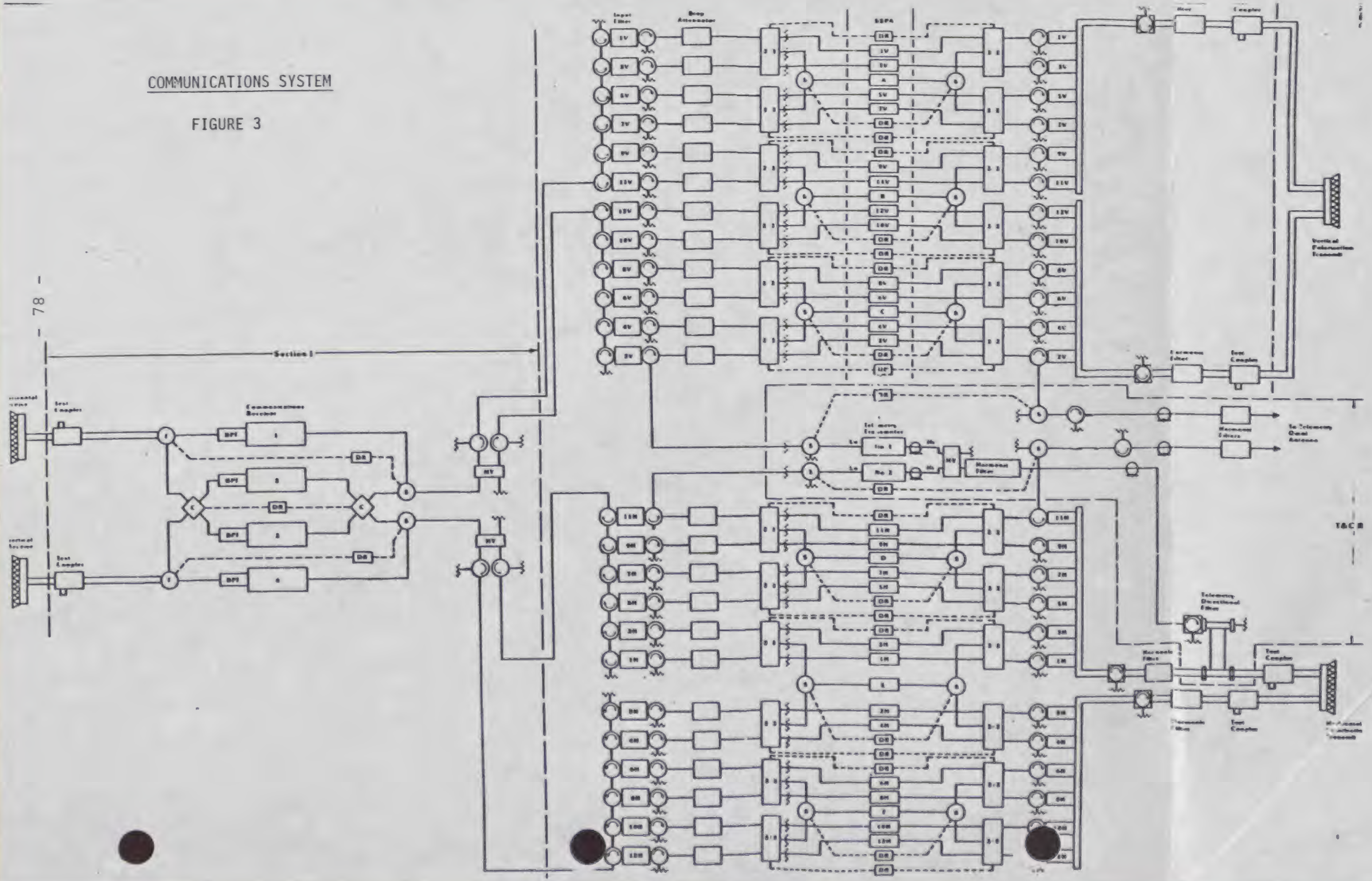


b) RECEIVE

Figure 2 Vertical Gain Countours (101° West)

COMMUNICATIONS SYSTEM

FIGURE 3



a. Orbital Inclination

The satellite's orbital inclination will be maintained to within ±0.1°

b. Antenna Axis Attitude/ Longitudinal Drift

Longitudinal drift will be maintained to within ±0.1°. The attitude of the satellite antenna axis will be maintained to within ±0.1°.

2. Accuracy of Spacecraft Antenna Pointing Toward the Earth

The accuracy of the spacecraft antenna pointing toward the earth will be 0.1° in pitch and roll, and 1.0° in yaw, the latter becoming more important as the antenna pattern becomes less symmetrical.

3. Estimated Lifetime of Satellite In-Orbit

The estimated lifetime of the satellite is nine years. This value is based upon the following elements:

a) sufficient propellant capacity for nine years' worth of stationkeeping plus at least two orbital maneuvers;

b) sufficient prime electrical power generation equipment (solar cells) to ensure that after nine years of environmental degradation, the solar cells are still capable of providing enough energy to operate all satellite systems and transponders;

c) adequate charge-discharging cycling of the Nickel-Cadmium battery system;

d) redundant subsystems wherever possible; and

e) use of materials and processes suited to the design lifetime.

The satellite reliability is 0.78 for 7 years, and 0.67 for 8 ½ years, with both estimates based on 20 of 24 channels operating successfully at the time.

4. Description of Spacecraft Attitude Stabilization and Station-Keeping Systems

The satellites will be either three-axis stabilized or spin-stabilized, with the actual technique being selected during the satellite procurement process. The satellites will include an attitude control subsystem to provide pointing accuracies consistent with the achievement of the specified communications performance and inclusive of all error sources (*e.g.*, attitude perturbations, thermal-induced distortions, misalignments, orbital tolerances, and perturbations produced by station-keeping maneuvers).

5. Electrical Energy System Description

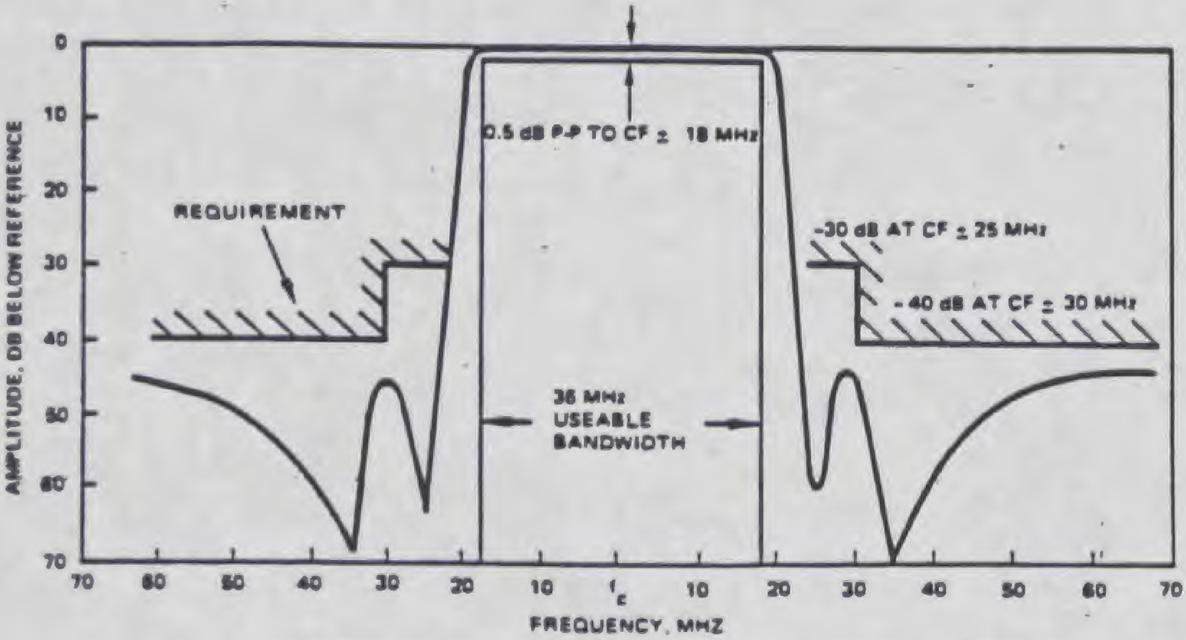
The satellite's electrical power will be provided by an array of solar cells that convert solar energy into electrical power. The cells used in this design are known as K7 cells and have a high conversion efficiency. Two Nickel-Cadmium batteries that are kept charged by the solar array will provide communications when the satellite is in eclipse conditions. As described earlier, the power subsystem has been sized so that it will produce sufficient electrical energy at the end of life to operate all transponders as well as perform the housekeeping functions of the satellite.

G. Emission Limitations

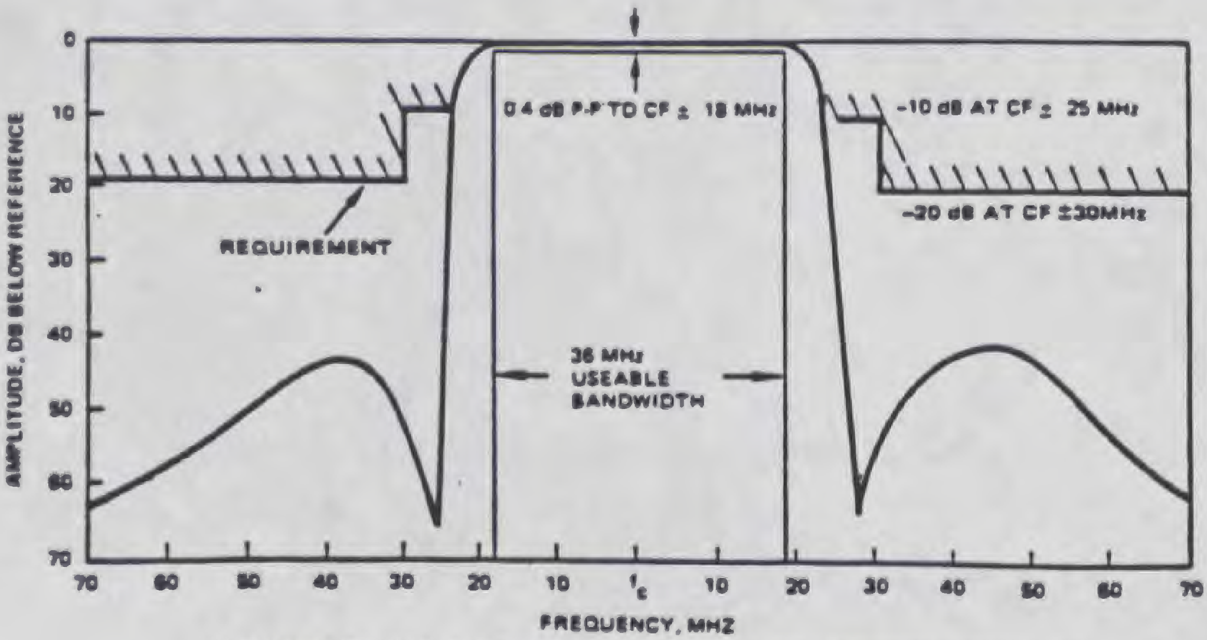
The overall selectivity of the input and output multiplex filtering will reduce all spurious emissions to values well below those specified in Section 25.202 of the FCC's Rules and Regulations. In fact, the intrasystem requirements dictate that to avoid unacceptable interaction between transponders, the input and output multiplex filters for each channel will have a combined attenuation of 40 dB between 20 and 30 MHz from the center frequency of the channel, and an attenuation of greater than 60 dB at frequencies greater than 30 MHz from the center frequency of the channel. Figure 4 describes typical input and output filter characteristics of the satellite.

H. Date By Which Construction Will be Commenced and Completed, Launch Date, and Estimated Date of Placement into Service

A detailed schedule specifying concrete dates by which significant milestones in establishment of the SpotNet (C) satellite system are planned to be achieved is included as Table 12 in Part I of the overall application.



a) NARROWBAND INPUT MULTIPLEXER FREQUENCY RESPONSE



b) NARROWBAND OUTPUT MULTIPLEXER FREQUENCY RESPONSE

INPUT AND OUTPUT

FILTER RESPONSES

FIGURE 4

I. Waiver of Claims

The Applicant waives any claim to the use of any particular frequency or of the ether 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 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.

J. Public Interest Considerations

Part I of NEX's application set forth the public interest considerations and the financial, legal and technical qualifications of the Applicant, as well as other information pertinent to this application, and that information is incorporated herein by reference.

K. Certification of Person Responsible for Preparing Engineering Information Submitted 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 that I am familiar with Parts 21 and 25 of the Commission's Rules. In preparing this application, I relied upon the expertise of Mr. Jack Kelleher and Systematics General Corporation of Sterling, Virginia, for certain information. Mr. Kelleher and Systematics General Corporation worked under my supervision. I certify that this application is complete and accurate to the best of my knowledge.

By Philip A Rubin

Philip A. Rubin
Rubin, Bednarek and
Associates
1776 K Street, N.W.
Washington, D.C. 20066
(202) 357-1789

Dated: November 7, 1983

The undersigned certifies individually and for NEX 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, NEX requests that the Commission grant this application.

Respectfully submitted,

NATIONAL EXCHANGE, INC.

By
Clay T. Whitehead
President

Dated: November 7, 1983

II.

Application for Authority to Construct, Launch, and Operate a Domestic Communications Satellite to be Fixed in Geosynchronous Orbit in the Vicinity of 75° West Longitude

Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D.C. 20554

In the Matter of the Application of	)	
NATIONAL EXCHANGE, INC.	)	File No. __________
For Authority to Construct, Launch and Operate a Domestic Communications Satellite to be Fixed in Geosynchronous Orbit in the Vicinity of 75° West Longitude	)	

APPLICATION

National Exchange, Inc. ("NEX"), pursuant to Sections 308, 309 and 319 of the Communications Act of 1934, as amended, hereby applies for authority to construct, launch and operate a domestic communications satellite that will function in the 12- and 6-GHZ frequency bands. The specific satellite for which authorization is being sought in this application is referred to as SpotNet (C)-2. NEX requests that the Commission reserve a geosynchronous orbital position in the vicinity of 75° West Longitude for this satellite. In support of this application, NEX respectfully states:

A. Applicant

The name, post office address and telephone number of the Applicant are as follows:

National Exchange, Inc.
11726 San Vicente Boulevard
Los Angeles, California 90049
(213) 820-5454

B. Correspondence

Correspondence with respect to this application may be addressed to the following at the above address and telephone number:

Clay T. Whitehead
President

with a copy to

Henry Goldberg, Esq.
Goldberg & Spector
Suite 650
1920 N Street, N.W.
Washington, D.C. 20036
(202) 429-4914

C. Technical Description Including Radio Frequency and Polarization Plan

The satellite for which construction, launch and operating authority is requested herein is an integral part of the SpotNet domestic communications satellite system that is being proposed by NEX. The satellite will perform communications and tracking, telemetry and command ("TT&C") functions in the 4-GHz (downlink) and 6-GHz (uplink) frequency bands. The satellite is one of two in-orbit satellites that NEX proposes to construct, launch and position at two orbital locations and to operate in the 4/6-GHz bands. Four additional in-orbit satellites that NEX proposes to operate in the 12/14-GHz bands are the subject of a separate, amended application being filed simultaneously with this request.

The SpotNet (C)-2 satellite will carry 24 operational transponders, with 34-DbW EIRP center-of-beam coverage of the contiguous 48 states, Puerto Rico and the Virgin Islands. Coverage of Hawaii and Alaska is dependent on assignment by the Commission of orbital locations from which service to those areas is feasible. This application requests a location in the vicinity of 75° West Longitude, at which it would be co-located with NEX's 12/14-GHz SpotNet (K) system.

The satellite will be controlled in its orbit by the telemetry, tracking and command system (TT&C). The TT&C functions will be carried out at the edges of the communications band using the communications transponders. There are two antennas that are part of the satellite's TT&C system: A biconical antenna, which is used during launch and transfer orbit and which assures that the command and telemetry links remain above threshold regardless of the spacecraft attitude, and a reflector antenna, which is used for on-station operations.

The spacecraft will be stabilized in orbit either by spinning or by 3-axis stabilization means, and will maintain its attitude, orientation and orbital position through use of a reaction control system (RCS) consisting of a series of sensors, thrusters, and propellant. Enough propellant will be included to ensure that the satellite has at least a nine-year lifetime. To provide directivity of its communications system, the spacecraft main antenna and equipment shelf would be despun in the spin-stabilized version, allowing the reflector antenna to be pointed pointed at the satellite's major service areas. In the 3-axis version, highly accurate pointing would be provided by the on-board antenna control system. These elements of the satellite's management are under the control of the satellite's command system, which is part of the TT&C system.

The satellite is designed to be launched by either the Space Transporation System (Shuttle) or by a Delta 3920 (PAM/D). The satellite's RCS not only maintains the satellite's orientation with respect to the earth, but is also used to control its inclination and orbital position at the desired celestial longitude. During launch, the RCS is also used in getting the satellite on-station and in position to begin its mission.

The satellite will have 24 transponders operating in the standard 4/6-GHz domestic fixed bands. Table 1 details the exact channel center frequency assignments and polarizations for each transponder. The telemetry, tracking and command system also uses the satellite's communications transponders to carry out the TT&C functions. The frequencies used for those functions are as follows:

Command frequency during launch - 5925 to 5930 MHz
Command frequency on station - 6420 to 6425 MHz
Telemetry frequency - 4193-4200 MHz
Telemetry polarization - vertical during launch
horizontal on-station
Command polarization - horizontal during launch
vertical on-station

Emission designators will vary with the communications traffic. In the TT&C system, emission designators are as follows:

Telemetry System - 100 F9
Tracking beacon - 5000 F9
Ranging - 1000 F9
Command system - 5000 F9

Emission designators for the communications functions will vary with the precise nature of traffic being carried. The following list reflects the best estimates NEX can make regarding traffic in the proposed system:

Satellite-to-Earth		Earth-to-Satellite	
Frequency,MHz	Polarization	Frequency,MHz	Polarization
3720	Horizontal 1	5945	Vertical 1
3740	Vertical 2	5965	Horizontal 2
3760	Horizontal 3	5985	Vertical 3
3780	Vertical 4	6005	Horizontal 4
3800	Horizontal 5	6025	Vertical 5
3820	Vertical 6	6045	Horizontal 6
3840	Horizontal 7	6065	Vertical 7
3860	Vertical 8	6085	Horizontal 8
3880	Horizontal 9	6105	Vertical 9
3900	Vertical 10	6125	Horizontal 10
3920	Horizontal 11	6145	Vertical 11
3940	Vertical 12	6165	Horizontal 12
3960	Horizontal 13	6185	Vertical 13
3980	Vertical 14	6205	Horizontal 14
4000	Horizontal 15	6225	Vertical 15
4020	Vertical 16	6245	Horizontal 16
4040	Horizontal 17	6265	Vertical 17
4060	Vertical 18	6285	Horizontal 18
4080	Horizontal 19	6305	Vertical 19
4100	Vertical 20	6325	Horizontal 20
4120	Horizontal 21	6345	Vertical 21
4140	Vertical 22	6365	Horizontal 22
4160	Horizontal 23	6385	Vertical 23
4180	Vertical 24	6405	Horizontal 24

TRANSPONDER CENTER FREQUENCIES

TABLE 1

FDM/FM - 200 F9 up to 36000 F9

TV/FM - 36000 F5

Teleconferencing - 4000 F5

SCPC/FM 20 F9

SCPC/FM 50 F9

The satellite's communications system will utilize solid-state final amplifiers. These amplifiers will have an RF output of 9 watts (9.5 dBW). Losses between the final amplifier and the input port of the reflector antenna amount to 1.1 dB. This output and loss combination together with the CONUS contour for the reflector antenna provides a minimum EIRP of 34.0 dBW. EIRP for Puerto Rico and the Virgin Islands will be 28 dBW.

All transponders are connected to each antenna beam.

D. Orbital Location Information

By this application, NEX requests an orbital location for this satellite in the vicinity of 75° West Longitude. It is NEX's intention to colocate its 4/6-GHz satellites with its 12/14-GHz satellites that are the subject of a separate amended application. The use of the same orbital location is spectrum- and orbit-efficient, since it allows a single ground-control system to provide management of both spacecraft, utilizing a single TT&C station. The co-location further provides for backup of the communications system in the event of an unlikely failure of one of the systems. The rationale for such an assignment in the public interest is discussed in Part I, Section H, of the application for overall system authority. They are incorporated herein by reference.

E. Predicted Space Station Coverage Contours for Each Antenna Beam and Nominal Orbital Location Requested

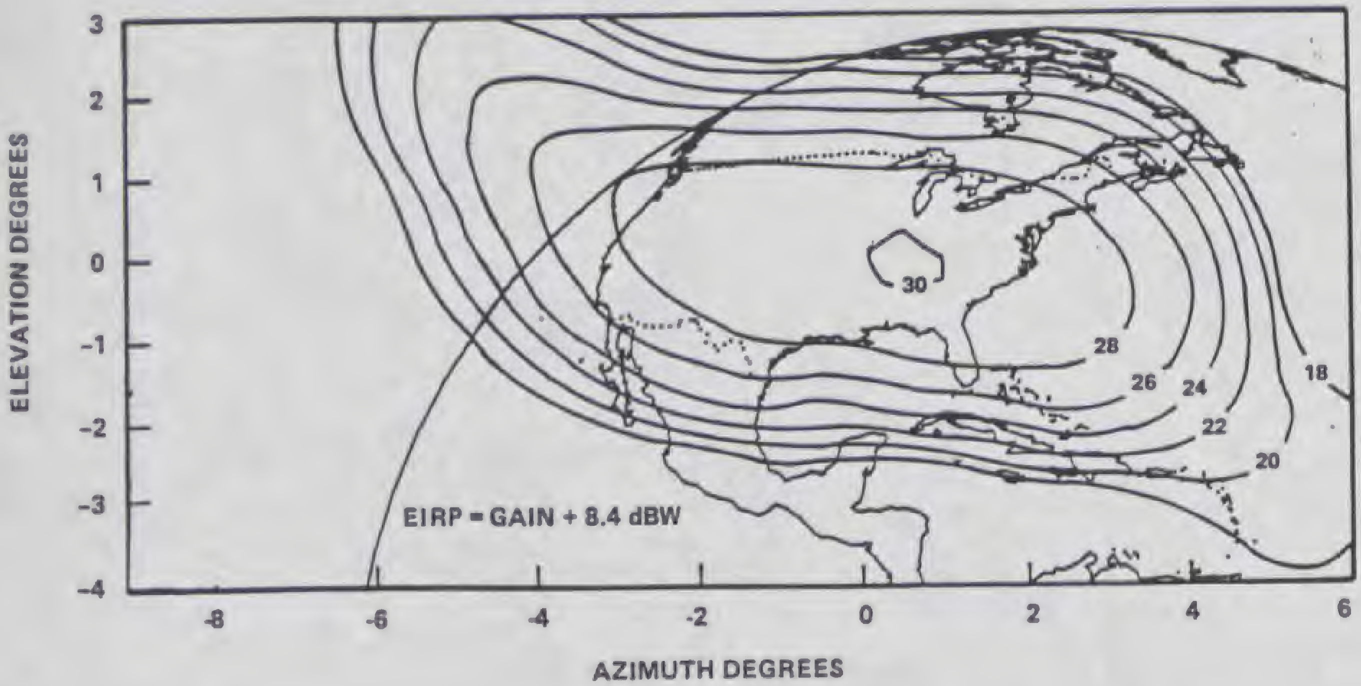
The coverage contours for the space station applied for in this application are contained in Figures 1 and 2 for the vertically polarized receive and transmit antennas and horizontally polarized receive and transmit antennas. The contours provided are overlaid on perspective maps as seen from the geostationary orbit and show the coverage for each satellite and the satellite horizon from that point.

EIRP contours can be determined from the gain contour figures by adding 8.4 dBW to the transmit gain contour values. Similarly, G/T contours can be obtained by subtracting 28.9 dB/K from the receive gain contour values. The transponder saturation flux density (SFD) can be obtained by adding -61.6 dBW/m^2 to the receive gain contours.

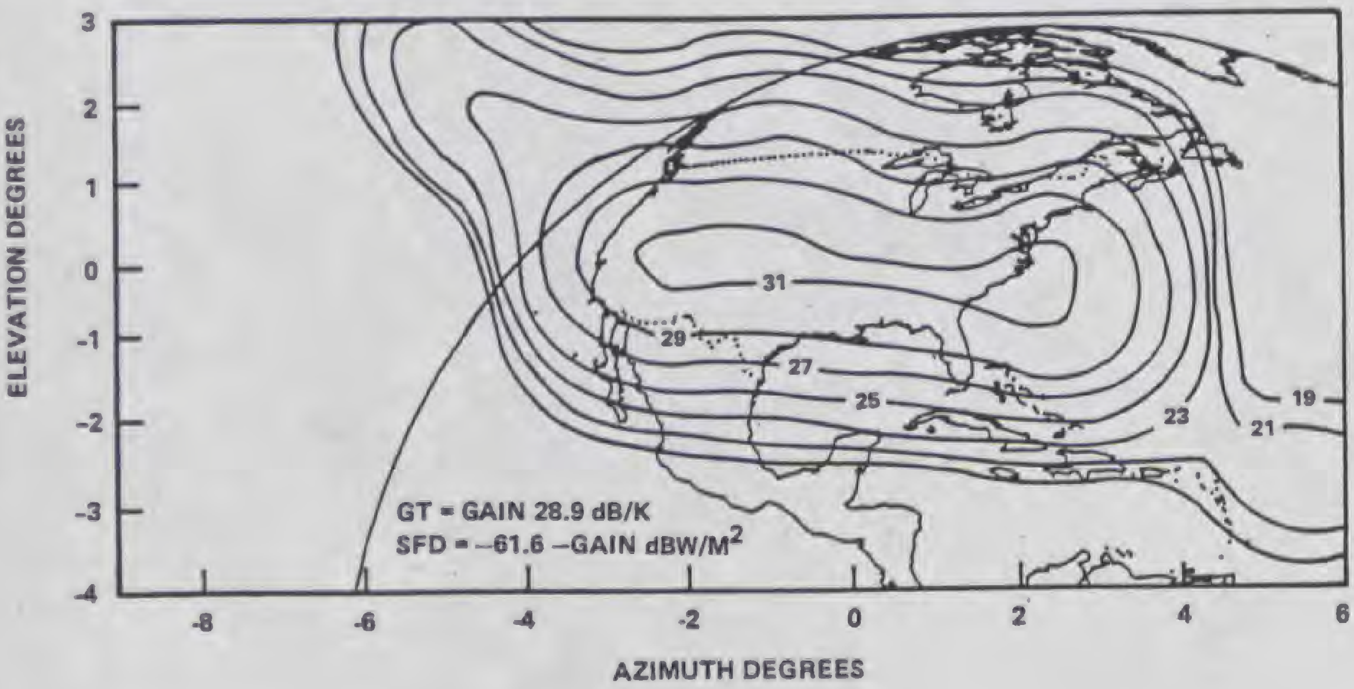
Figure 3 is a typical functional block diagram of the satellite's communication system.

F. Physical Characteristics of Space Station

1. Accuracy With Which Orbital Parameters Will be Maintained

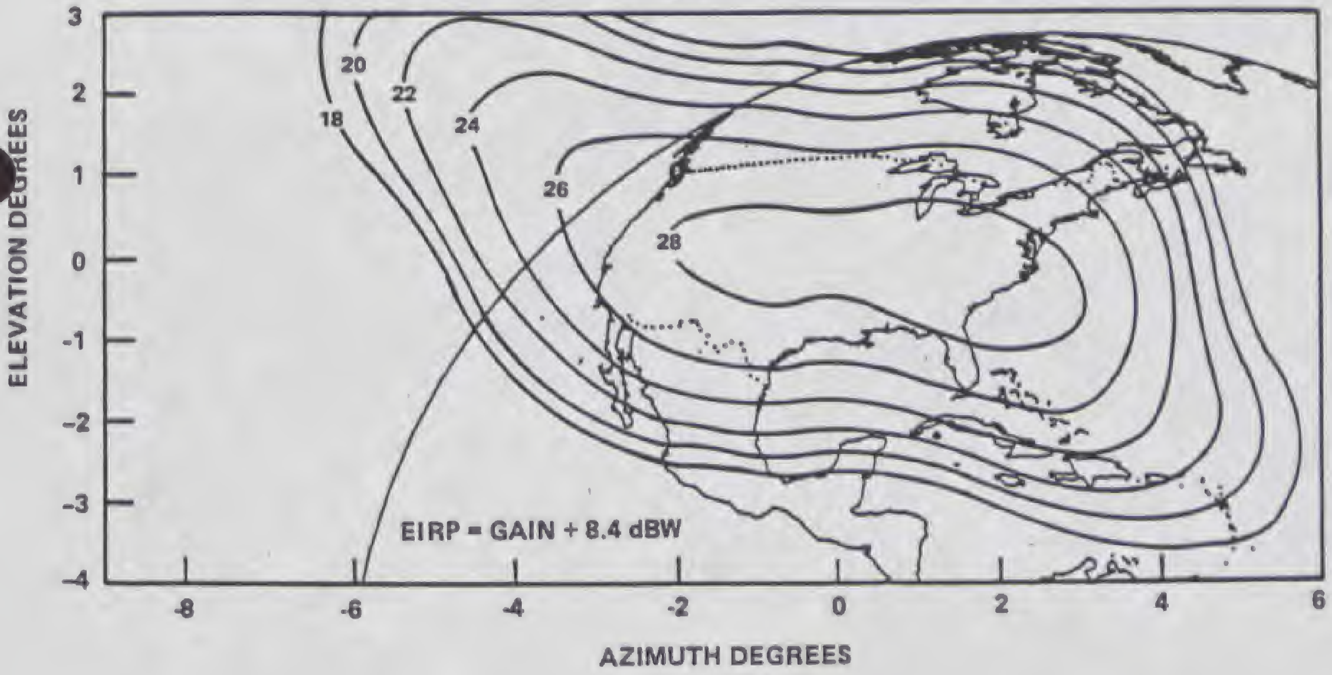


a) TRANSMIT



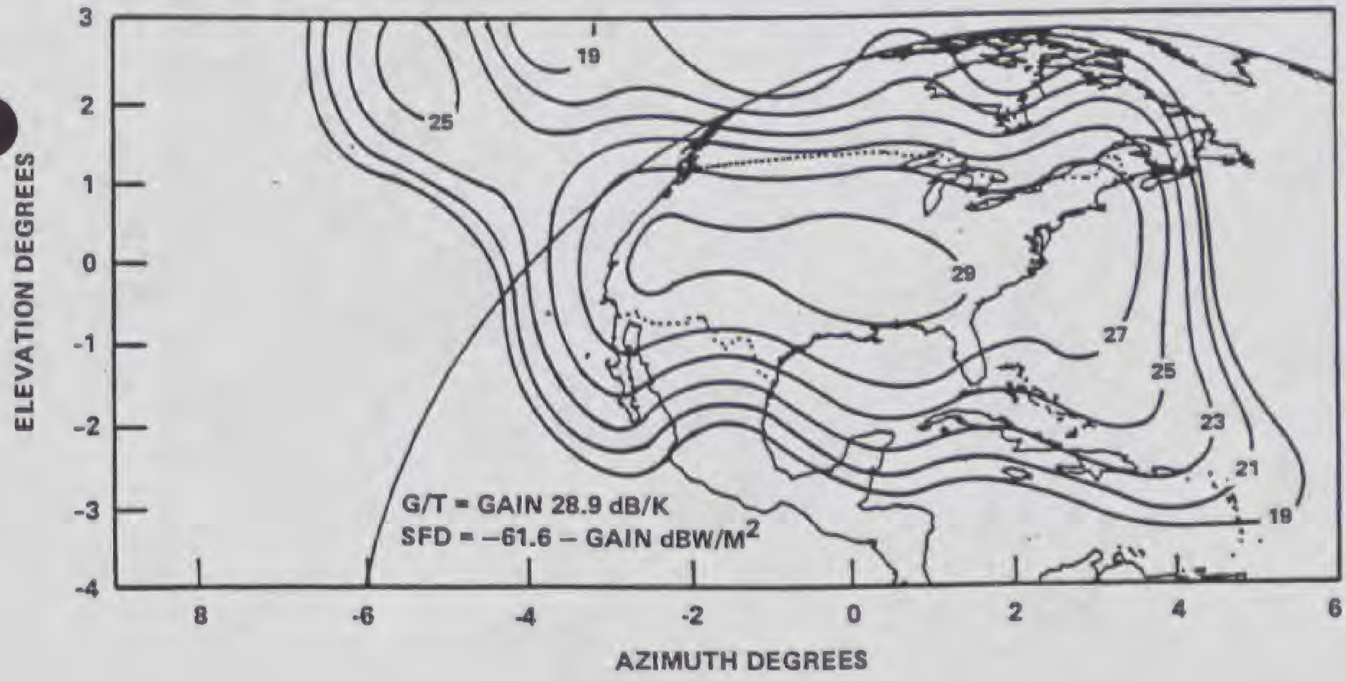
b) RECEIVE

Figure 1 Horizontal Gain Contours (74° West)



EIRP = GAIN + 8.4 dBW

a) TRANSMIT



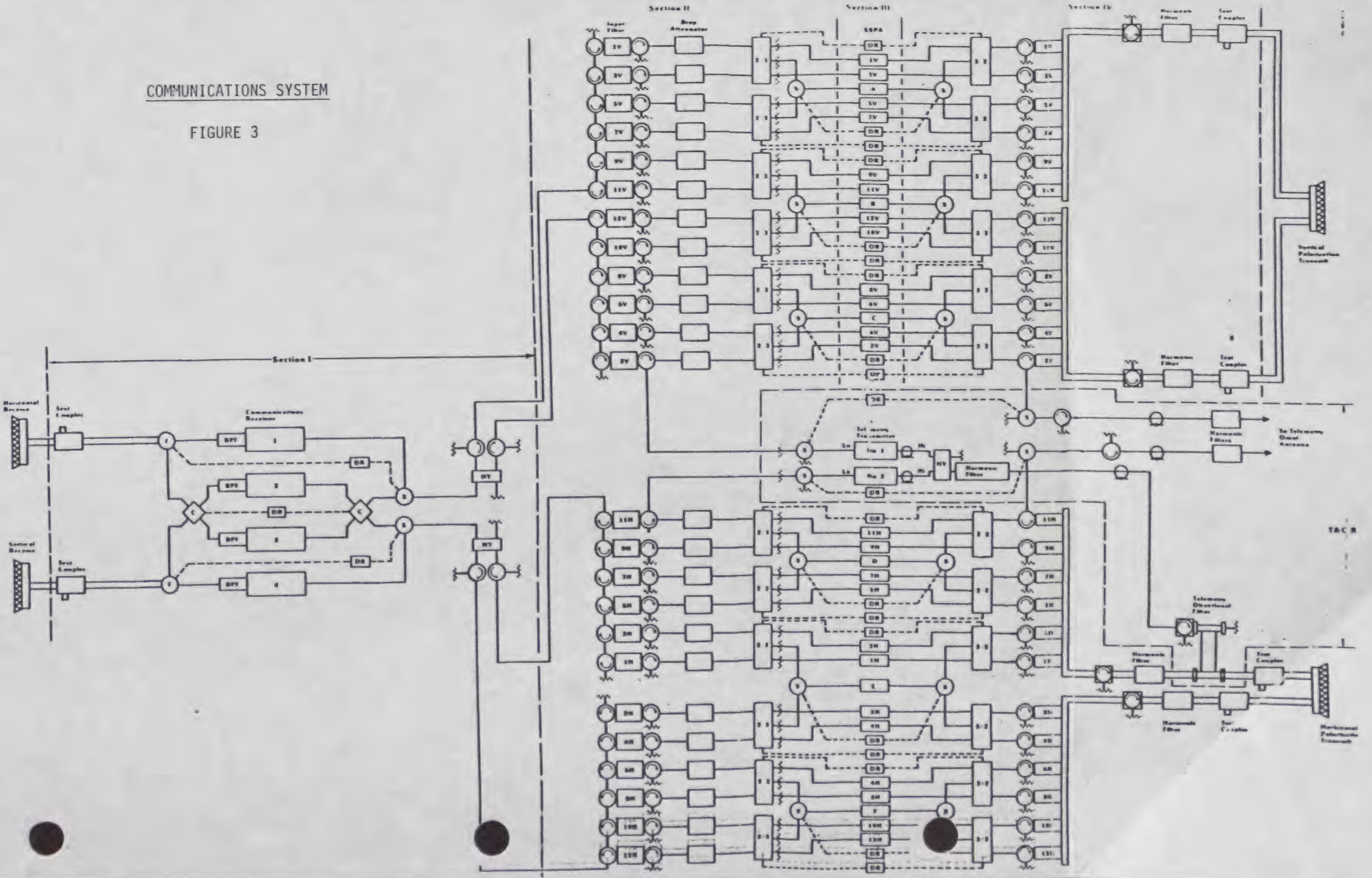
G/T = GAIN 28.9 dB/K
SFD = −61.6 − GAIN dBW/M^2

b) RECEIVE

Figure 2 Vertical Gain Contours (74° West)

COMMUNICATIONS SYSTEM

FIGURE 3



a. Orbital Inclination

The satellite's orbital inclination will be maintained to within ±0.1°

b. Antenna Axis Attitude/ Longitudinal Drift

Longitudinal drift will be maintained to within ±0.1°. The attitude of the satellite antenna axis will be maintained to within ±0.1°.

2. Accuracy of Spacecraft Antenna Pointing Toward the Earth

The accuracy of the spacecraft antenna pointing toward the earth will be 0.1° in pitch and roll, and 1.0° in yaw, the latter becoming more important as the antenna pattern becomes less symmetrical.

3. Estimated Lifetime of Satellite In-Orbit

The estimated lifetime of the satellite is nine years. This value is based upon the following elements:

a) sufficient propellant capacity for nine years' worth of stationkeeping plus at least two orbital maneuvers;

b) sufficient prime electrical power generation equipment (solar cells) to ensure that after nine years of environmental degradation, the solar cells are still capable of providing enough energy to operate all satellite systems and transponders;

c) adequate charge-discharging cycling of the Nickel-Cadmium battery system;

d) redundant subsystems wherever possible; and

e) use of materials and processes suited to the design lifetime.

The satellite reliability is 0.78 for 7 years, and 0.67 for 8 ½ years, with both estimates based on 20 of 24 channels operating successfully at the time.

4. Description of Spacecraft Attitude Stabilization and Station-Keeping Systems

The satellites will be either three-axis stabilized or spin-stabilized, with the actual technique being selected during the satellite procurement process. The satellites will include an attitude control subsystem to provide pointing accuracies consistent with the achievement of the specified communications performance and inclusive of all error sources (*e.g.*, attitude perturbations, thermal-induced distortions, misalignments, orbital tolerances, and perturbations produced by station-keeping maneuvers).

5. Electrical Energy System Description

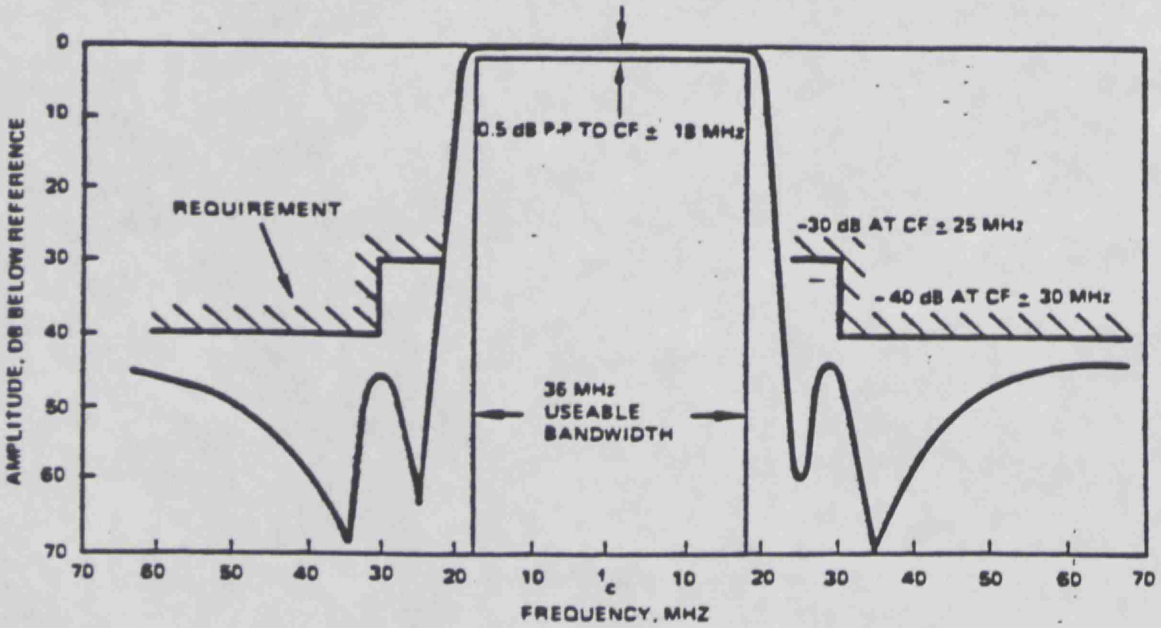
The satellite's electrical power will be provided by an array of solar cells that convert solar energy into electrical power. The cells used in this design are known as K7 cells and have a high conversion efficiency. Two Nickel-Cadmium batteries that are kept charged by the solar array will provide communications when the satellite is in eclipse conditions. As described earlier, the power subsystem has been sized so that it will produce sufficient electrical energy at the end of life to operate all transponders as well as perform the housekeeping functions of the satellite.

G. Emission Limitations

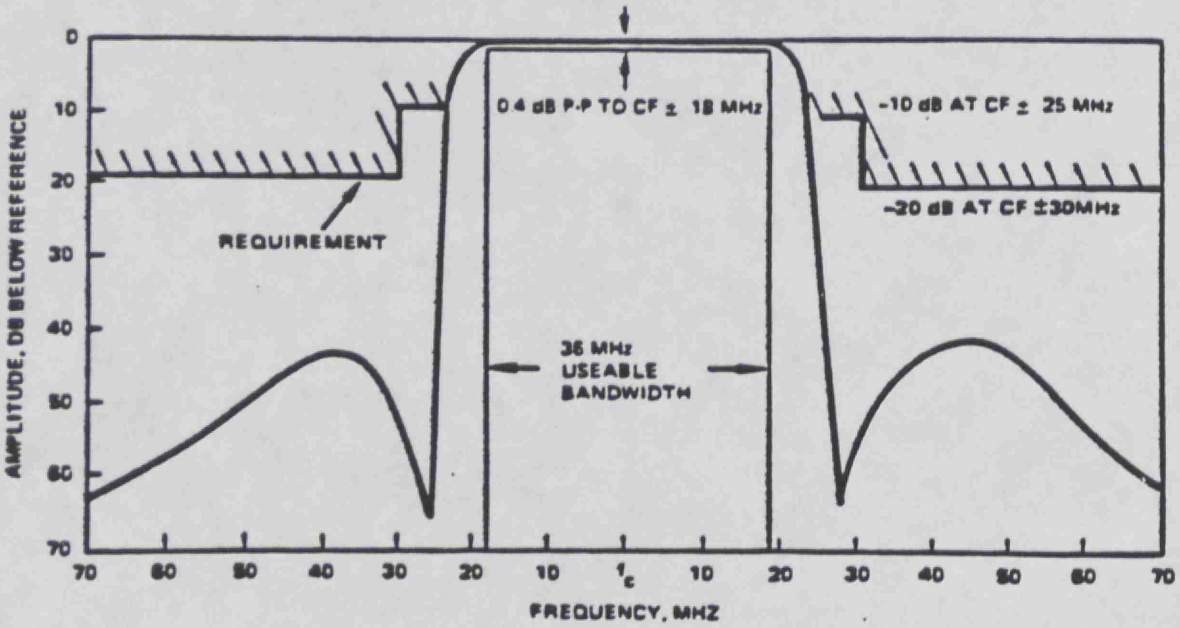
The overall selectivity of the input and output multiplex filtering will reduce all spurious emissions to values well below those specified in Section 25.202 of the FCC's Rules and Regulations. In fact, the intrasystem requirements dictate that to avoid unacceptable interaction between transponders, the input and output multiplex filters for each channel will have a combined attenuation of 40 dB between 20 and 30 MHz from the center frequency of the channel, and an attenuation of greater than 60 dB at frequencies greater than 30 MHz from the center frequency of the channel. Figure 4 describes typical input and output filter characteristics of the satellite.

H. Date By Which Construction Will be Commenced and Completed, Launch Date, and Estimated Date of Placement into Service

A detailed schedule specifying concrete dates by which significant milestones in establishment of the SpotNet (C) satellite system are planned to be achieved is included as Table 12 in Part I of the overall application.



a) NARROWBAND INPUT MULTIPLEXER FREQUENCY RESPONSE



b) NARROWBAND OUTPUT MULTIPLEXER FREQUENCY RESPONSE

INPUT AND OUTPUT

FILTER RESPONSES

FIGURE 4

I. Waiver of Claims

The Applicant waives any claim to the use of any particular frequency or of the ether 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 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.

J. Public Interest Considerations

Part I of NEX's amended application for 12/14-GHz space segment sets forth the public-interest considerations and the financial, legal and technical qualifications of the Applicant, as well as other information pertinent to this application, and that information is incorporated herein by reference.

K. Certification of Person Responsible for Preparing Engineering Information Submitted 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 that I am familiar with Parts 21 and 25 of the Commission's Rules. In preparing this application, I relied upon the expertise of Mr. Jack Kelleher and Systematics General Corporation of Sterling, Virginia, for certain information. Mr. Kelleher and Systematics General Corporation worked under my supervision. I certify that this application is complete and accurate to the best of my knowledge.

By Philip A Rubin
Philip A. Rubin
Rubin, Bednarek and
Associates
1776 K Street, N.W.
Washington, D.C. 20066
(202) 357-1789

Dated: November 7, 1983

The undersigned certifies individually and for NEX 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, NEX requests that the Commission grant this application.

Respectfully submitted,

NATIONAL EXCHANGE, INC.

By
Clay T. Whitehead
President

Dated: November 7, 1983

III.

Application for Authority to Construct, Launch, and Operate a Domestic Communications Satellite to Hold It In Reserve as a Ground Spare

Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D.C. 20554

In the Matter of the Application of	)	
NATIONAL EXCHANGE, INC.	)	File No. __________
For Authority to Construct, Launch and Operate a Domestic Communications Satellite to Hold It In Reserve as a Ground Spare	)	

APPLICATION

National Exchange, Inc. ("NEX"), pursuant to Sections 308, 309 and 319 of the Communications Act of 1934, as amended, hereby applies for authority to construct a domestic communications satellite that will function in the 12- and 6-GHZ frequency bands and to hold that satellite in reserve as a ground spare. The specific satellite for which authorization is being sought in this application is referred to as SpotNet (C)-3.

A. Applicant

The name, post office address and telephone number of the Applicant are as follows:

National Exchange, Inc.
11726 San Vicente Boulevard
Los Angeles, California 90049
(213) 820-5454

B. Correspondence

Correspondence with respect to this application may be addressed to the following at the above address and telephone number:

Clay T. Whitehead
President

with a copy to

Henry Goldberg, Esq.
Goldberg & Spector
Suite 650
1920 N Street, N.W.
Washington, D.C. 20036
(202) 429-4914

C. Technical Description Including Radio Frequency and Polarization Plan

The satellite for which construction authority is requested herein is an integral part of the SpotNet domestic communications satellite system that is being proposed by NEX. The satellite, if launched, will perform communications and tracking, telemetry and command ("TT&C") functions in the 4-GHz (downlink) and 6-GHz (uplink) frequency bands. The satellite is a spare for the two in-orbit satellites that NEX proposes to construct, launch and position at two orbital locations and to operate in the 4/6-GHz bands. Four additional in-orbit satellites that NEX proposes to operate in the 12/14-GHz bands are the subject of a separate, amended application being filed simultaneously with this request.

The SpotNet (C)-3 satellite will carry 24 operational transponders, with 34-DbW EIRP center-of-beam coverage of the contiguous 48 states, Puerto Rico and the Virgin Islands. Coverage of Hawaii and Alaska is dependent on assignment by the Commission of orbital locations from which service to those areas is feasible.

The satellite will be controlled in its orbit by the telemetry, tracking and command system (TT&C). The TT&C functions will be carried out at the edges of the communications band using the communications transponders. There are two antennas that are part of the satellite's TT&C system: A biconical antenna, which is used during launch and transfer orbit and which assures that the command and telemetry links remain above threshold regardless of the spacecraft attitude, and a reflector antenna, which is used for on-station operations.

The spacecraft will be stabilized in orbit either by spinning or by 3-axis stabilization means, and will maintain its attitude, orientation and orbital position through use of a reaction control system (RCS) consisting of a series of sensors, thrusters, and propellant. Enough propellant will be included to ensure that the satellite has at least a nine-year lifetime. To provide for directivity of its communications system, the spacecraft main antenna and equipment shelf would be despun in the spin-stabilized version, allowing the reflector antenna to be pointed accurately at the satellite's major service areas. In the 3-axis version, highly accurate pointing would be provided by the on-board antenna control system. These elements of the satellite's management are under the control of the satellite's command system, which is part of the TT&C system.

The satellite is designed to be launched by either the Space Transporation System (Shuttle) or by a Delta 3920 (PAM/D). The satellite's RCS not only maintains the satellite's orientation with respect to the earth, but is also used to control its inclination and orbital position at the desired celestial longitude. During launch, the RCS is also used in getting the satellite on-station and in position to begin its mission.

The satellite will have 24 transponders operating in the standard 4/6-GHz domestic fixed bands. Table 1 details the exact channel center frequency assignments and polarizations for each transponder. The telemetry, tracking and command system also uses the satellite's communications transponders to carry out the TT&C functions. The frequencies used for those functions

Satellite-to-Earth		Earth-to-Satellite	
Frequency,MHz	**Polarization**	**Frequency,MHz**	**Polarization**
3720	Horizontal 1	5945	Vertical 1
3740	Vertical 2	5965	Horizontal 2
3760	Horizontal 3	5985	Vertical 3
3780	Vertical 4	6005	Horizontal 4
3800	Horizontal 5	6025	Vertical 5
3820	Vertical 6	6045	Horizontal 6
3840	Horizontal 7	6065	Vertical 7
3860	Vertical 8	6085	Horizontal 8
3880	Horizontal 9	6105	Vertical 9
3900	Vertical 10	6125	Horizontal 10
3920	Horizontal 11	6145	Vertical 11
3940	Vertical 12	6165	Horizontal 12
3960	Horizontal 13	6185	Vertical 13
3980	Vertical 14	6205	Horizontal 14
4000	Horizontal 15	6225	Vertical 15
4020	Vertical 16	6245	Horizontal 16
4040	Horizontal 17	6265	Vertical 17
4060	Vertical 18	6285	Horizontal 18
4080	Horizontal 19	6305	Vertical 19
4100	Vertical 20	6325	Horizontal 20
4120	Horizontal 21	6345	Vertical 21
4140	Vertical 22	6365	Horizontal 22
4160	Horizontal 23	6385	Vertical 23
4180	Vertical 24	6405	Horizontal 24

TRANSPONDER CENTER FREQUENCIES

TABLE 1

are as follows:

Command frequency during launch - 5925 to 5930 MHz

Command frequency on station - 6420 to 6425 MHz

Telemetry frequency - 4193-4200 MHz

Telemetry polarization - vertical during launch
horizontal on-station

Command polarization - horizontal during launch
vertical on-station

Emission designators will vary with the communications traffic. In the TT&C system, emission designators are as follows:

Telemetry System - 100 F9

Tracking beacon - 5000 F9

Ranging - 1000 F9

Command system - 5000 F9

Emission designators for the communications functions will vary with the precise nature of traffic being carried. The following list reflects the best estimates NEX can make regarding traffic in the proposed system:

FDM/FM - 200 F9 up to 36000 F9

TV/FM - 36000 F5

Teleconferencing - 4000 F5

SCPC/FM 20 F9

SCPC/FM 50 F9

The satellite's communications system will utilize solid-state final amplifiers. These amplifiers will have an RF output of 9 watts (9.5 dBW). Losses between the final amplifier and the input port of the reflector antenna amount to 1.1 dB. This output and loss combination together with the CONUS contour for the reflector antenna provides a minimum EIRP of 34.0 dBW. EIRP for Puerto Rico and the Virgin Islands will be 28 dBW.

All transponders are connected to each antenna beam.

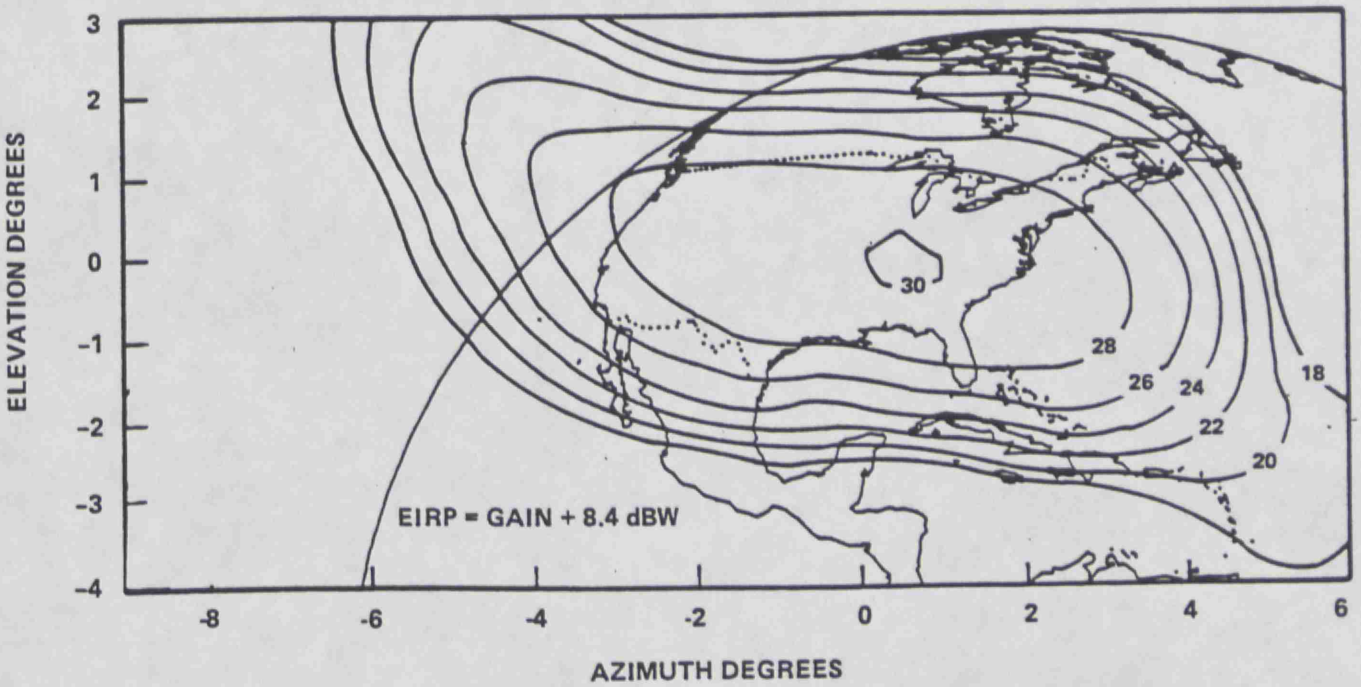
D. Orbital Location Information

This application is for a spare and therefore no orbital location is being requested.

E. Predicted Space Station Coverage Contours for Each Antenna Beam and Nominal Orbital Location Requested

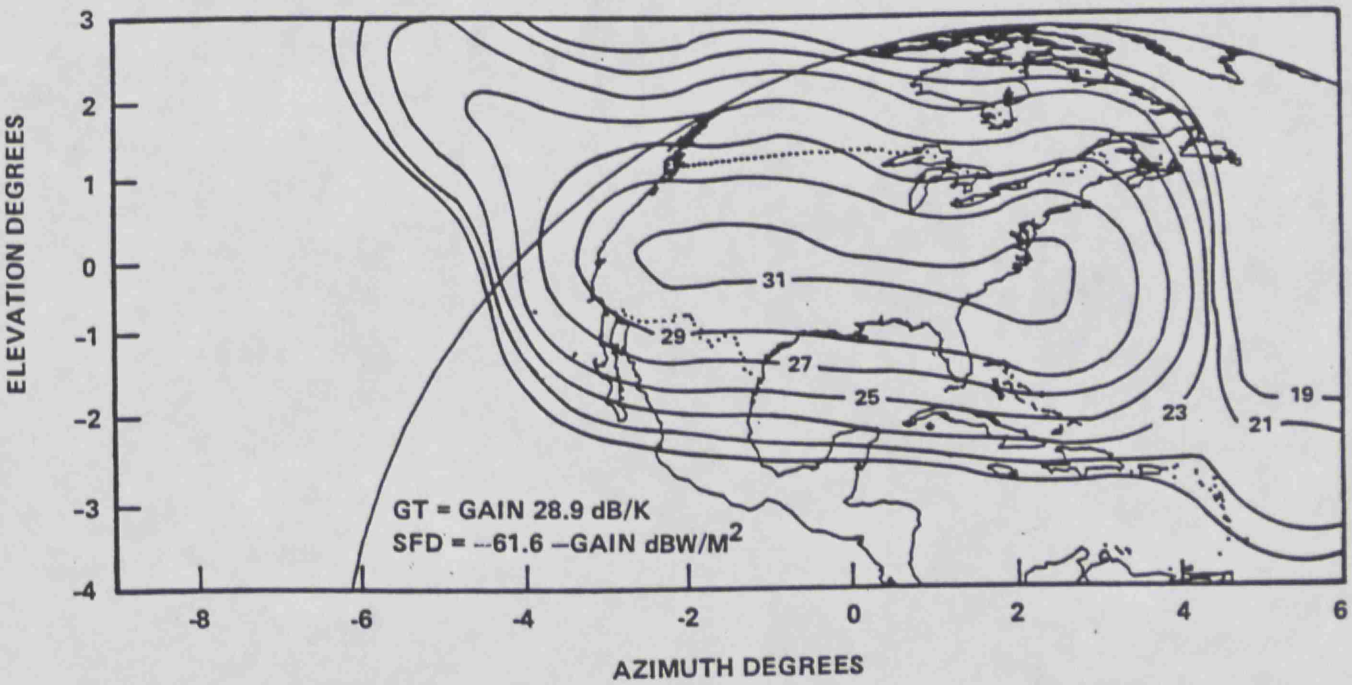
The coverage contours for the space station applied for in this application, should that space station be launched, are contained in Figures 1 through 4 for the vertically polarized receive and transmit antennas and horizontally polarized receive and transmit antennas. The contours provided are overlaid on perspective maps as seen from the geostationary orbit and show the coverage for each satellite and the satellite horizon from that point.

EIRP contours can be determined from the gain contour figures by adding 8.4 dBW to the transmit gain contour values.



EIRP = GAIN + 8.4 dBW

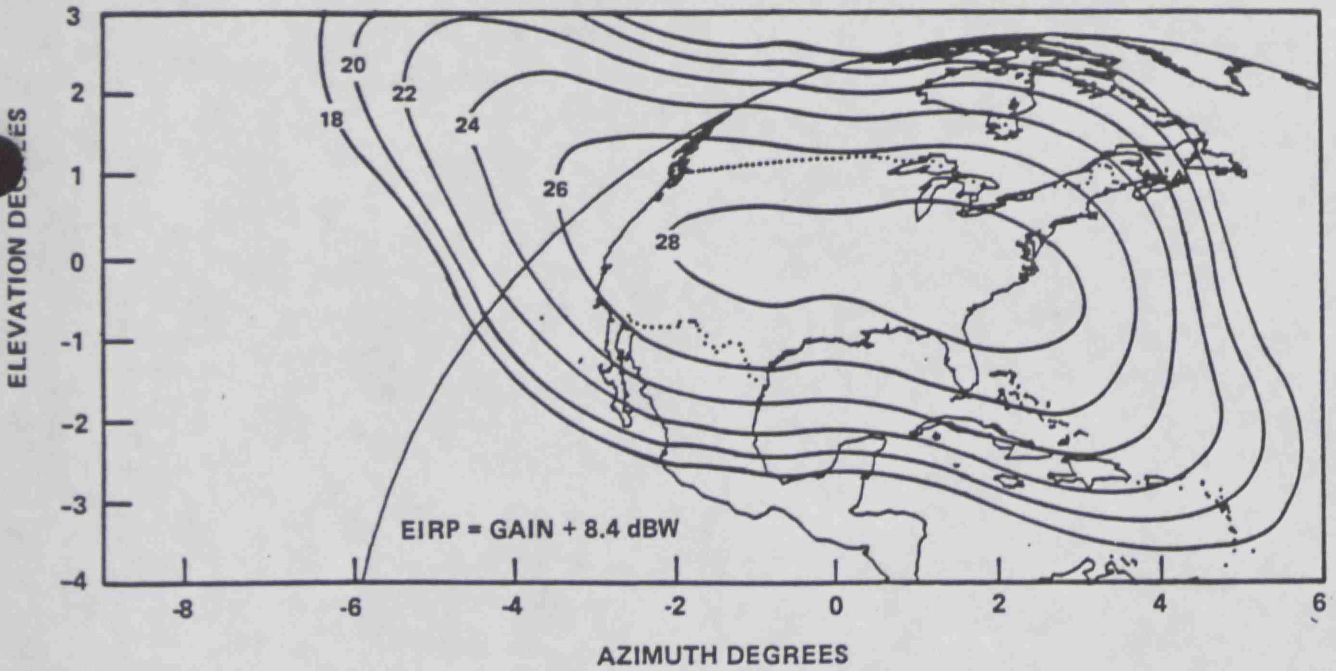
a) TRANSMIT



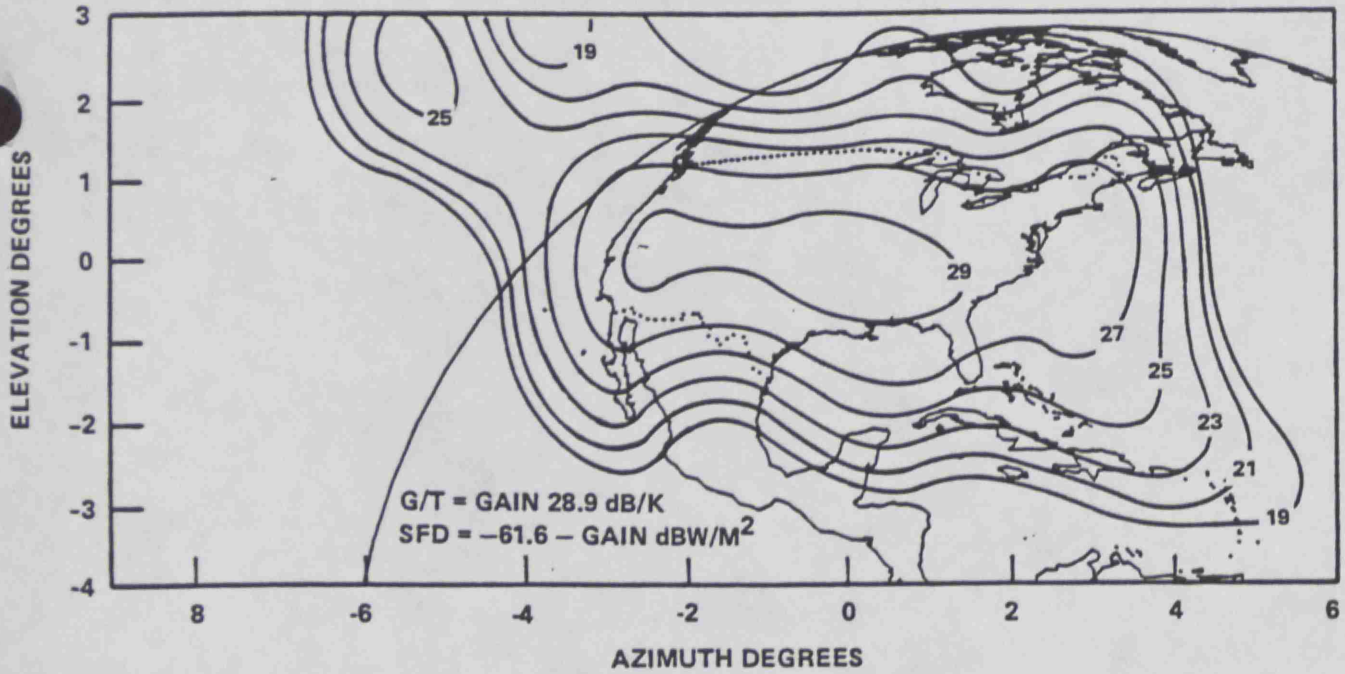
GT = GAIN 28.9 dB/K
SFD = –61.6 –GAIN dBW/M^2

b) RECEIVE

Figure 1 Horizontal Gain Contours (74° West)

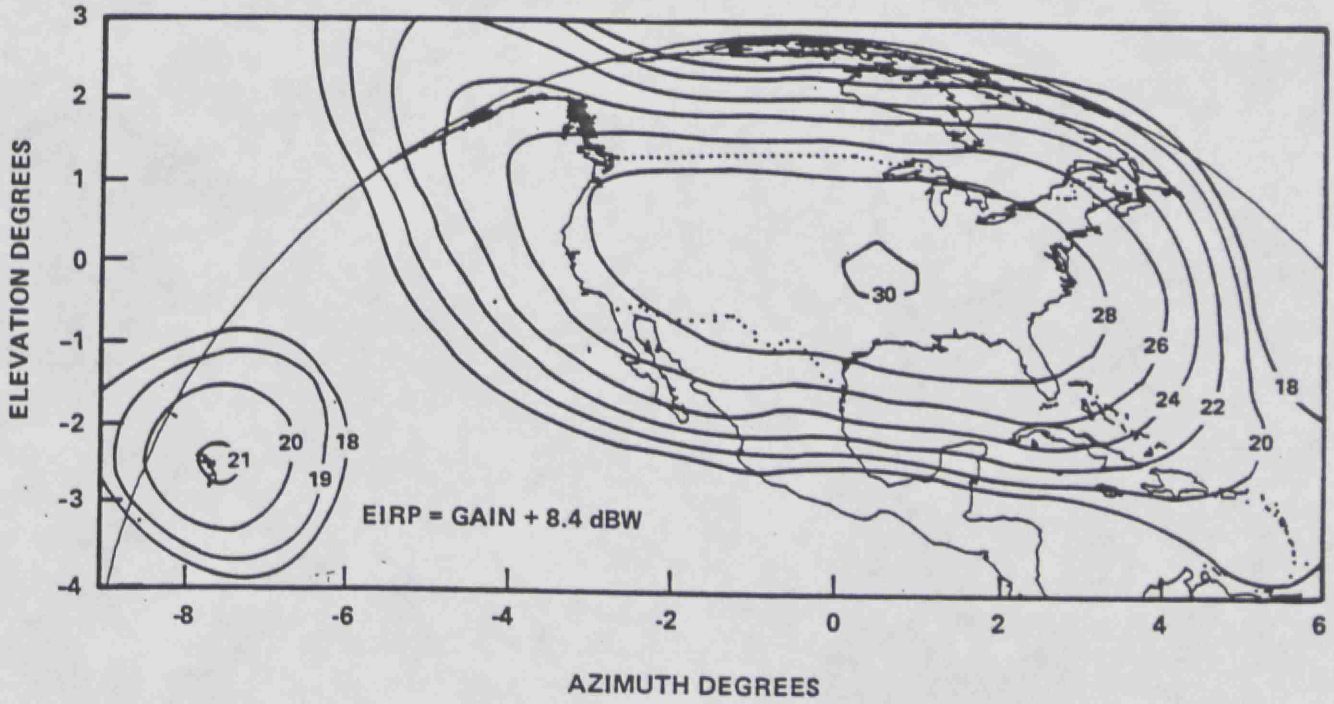


a) TRANSMIT



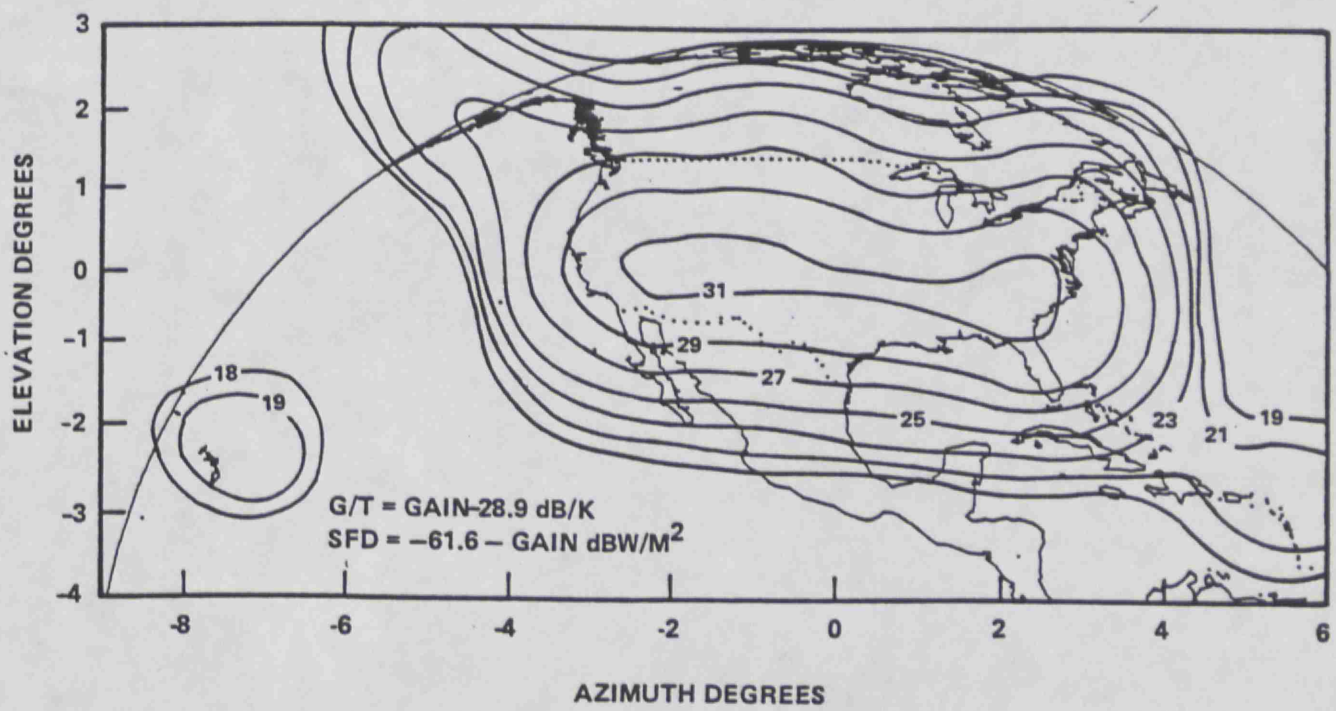
b) RECEIVE

Figure 2 Vertical Gain Contours (74° West)



EIRP = GAIN + 8.4 dBW

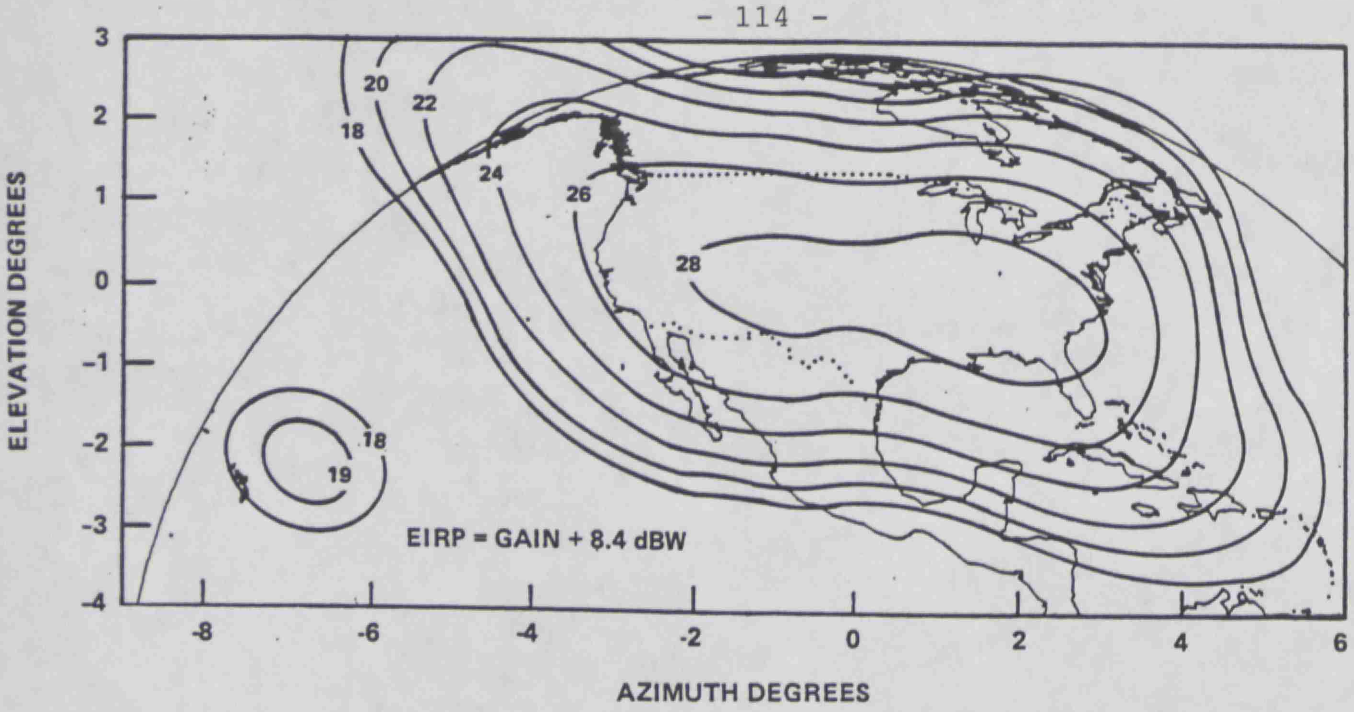
a) TRANSMIT



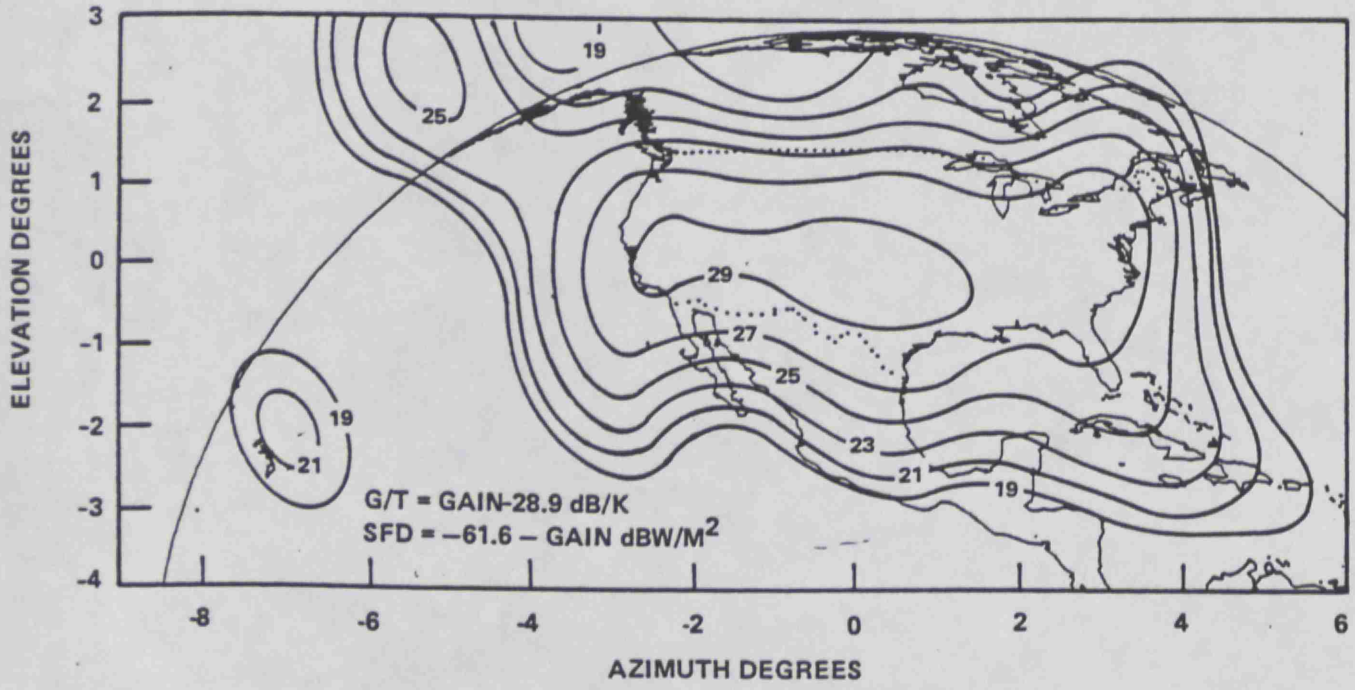
G/T = GAIN-28.9 dB/K
SFD = −61.6 − GAIN dBW/M^2

b) RECEIVE

Figure 3 Horizontal Gain Contours (101° West)



a) TRANSMIT



b) RECEIVE

Figure 4 Vertical Gain Countours (101° West)

Similarly, G/T contours can be obtained by subtracting 28.9 dB/K from the receive gain contour values. The transponder saturation flux density (SFD) can be obtained by adding -61.6 dBW/m^2 to the receive gain contours.

Figure 5 is a typical functional block diagram of the satellite's communication system.

F. Physical Characteristics of Space Station

1. Accuracy With Which Orbital Parameters Will be Maintained

a. Orbital Inclination

The satellite's orbital inclination will be maintained to within ±0.1°

b. Antenna Axis Attitude/ Longitudinal Drift

Longitudinal drift will be maintained to within ±0.1°. The attitude of the satellite antenna axis will be maintained to within ±0.1°.

2. Accuracy of Spacecraft Antenna Pointing Toward the Earth

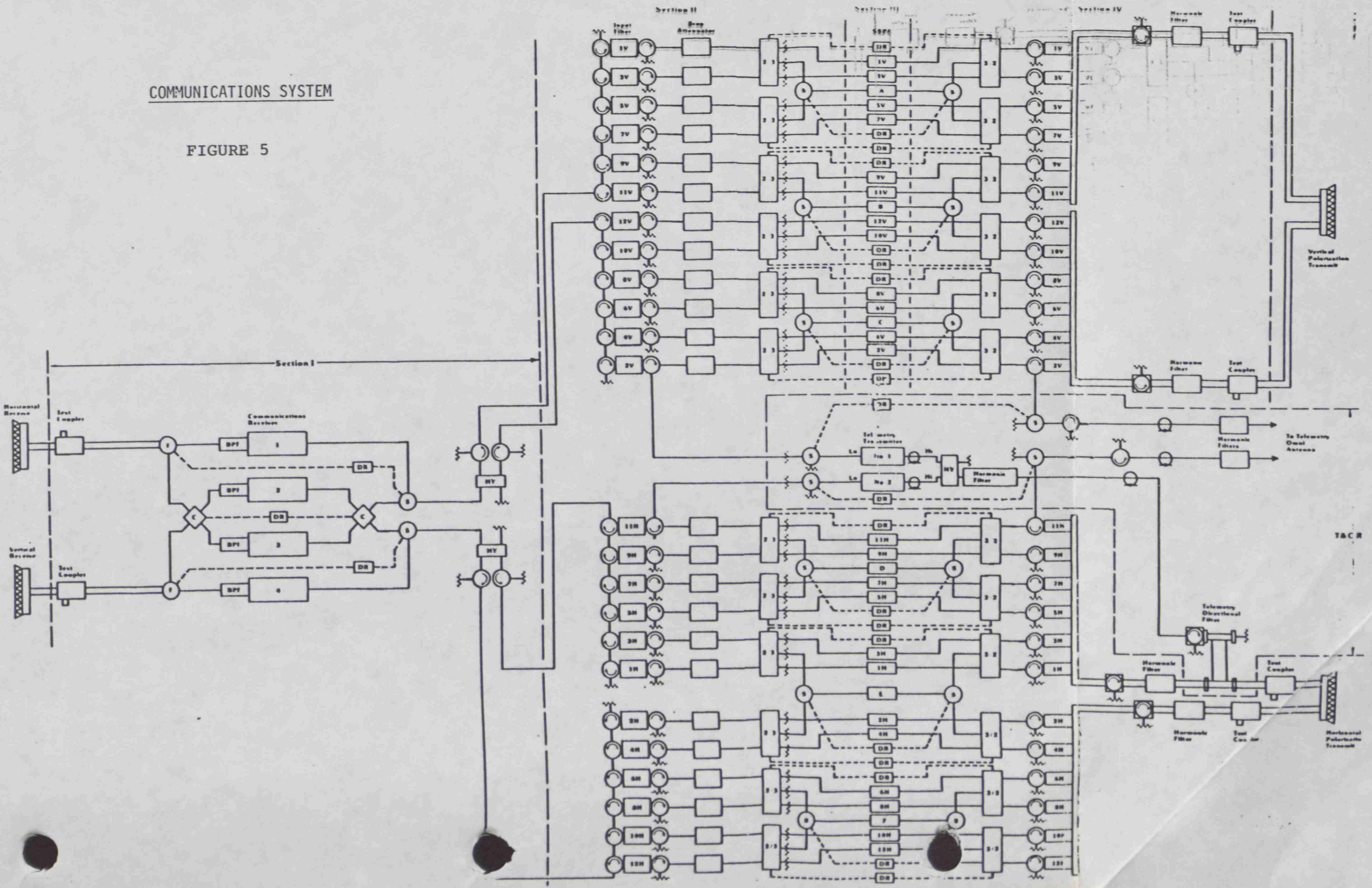
The accuracy of the spacecraft antenna pointing toward the earth will be 0.1° in pitch and roll, and 1.0° in yaw, the latter becoming more important as the antenna pattern becomes less symmetrical.

3. Estimated Lifetime of Satellite In-Orbit

The estimated lifetime of the satellite is nine

COMMUNICATIONS SYSTEM

FIGURE 5



years. This value is based upon the following elements:

a) sufficient propellant capacity for nine years' worth of stationkeeping plus at least two orbital maneuvers;

b) sufficient prime electrical power generation equipment (solar cells) to ensure that after nine years of environmental degradation, the solar cells are still capable of providing enough energy to operate all satellite systems and transponders;

c) adequate charge-discharging cycling of the Nickel-Cadmium battery system; and

d) redundant subsystems wherever possible; and

e) use of materials and processes suited to the design lifetime.

The satellite reliability is 0.78 for 7 years, and 0.67 for 8 ½ years, with both estimates based on 20 of 24 channels operating successfully at the time.

4. Description of Spacecraft Attitude Stabilization and Station-Keeping Systems

The satellites will be either three-axis stabilized or spin-stabilized with the actual technique being selected during the satellite procurement process. The satellites will include an attitude-control subsystem to provide pointing accuracies consistent with the achievement of the specified communications performance and inclusive of all error sources (*e.g.*, attitude perturbations, thermal-induced distortions, misalignments, orbital tolerances, and perturbations produced by station-keeping maneuvers).

5. Electrical Energy System Description

The satellite's electrical power will be provided by an array of solar cells that convert solar energy into electrical power. The cells used in this design are known as K7 cells and have a high conversion efficiency. Two Nickel-Cadmium batteries that are kept charged by the solar array will provide communications when the satellite is in eclipse conditions. As described earlier, the power subsystem has been sized so that it will produce sufficient electrical energy at the end of life to operate all transponders as well as perform the housekeeping functions of the satellite.

G. Emission Limitations

The overall selectivity of the input and output multiplex filtering will reduce all spurious emissions to values well below those specified in Section 25.202 of the FCC's Rules and Regulations. In fact, the intrasystem requirements dictate that to avoid unacceptable interaction between transponders, the input and output multiplex filters for each channel will have a combined attenuation of 40 dB between 20 and 30 MHz from the center frequency of the channel, and an attenuation of greater than 60 dB at frequencies greater than 30 MHz from the center frequency of the channel. Figure 6 describes typical input and output filter characteristics of the satellite.

H. Date By Which Construction Will be Commenced and Completed, Launch Date, and Estimated Date of Placement into Service

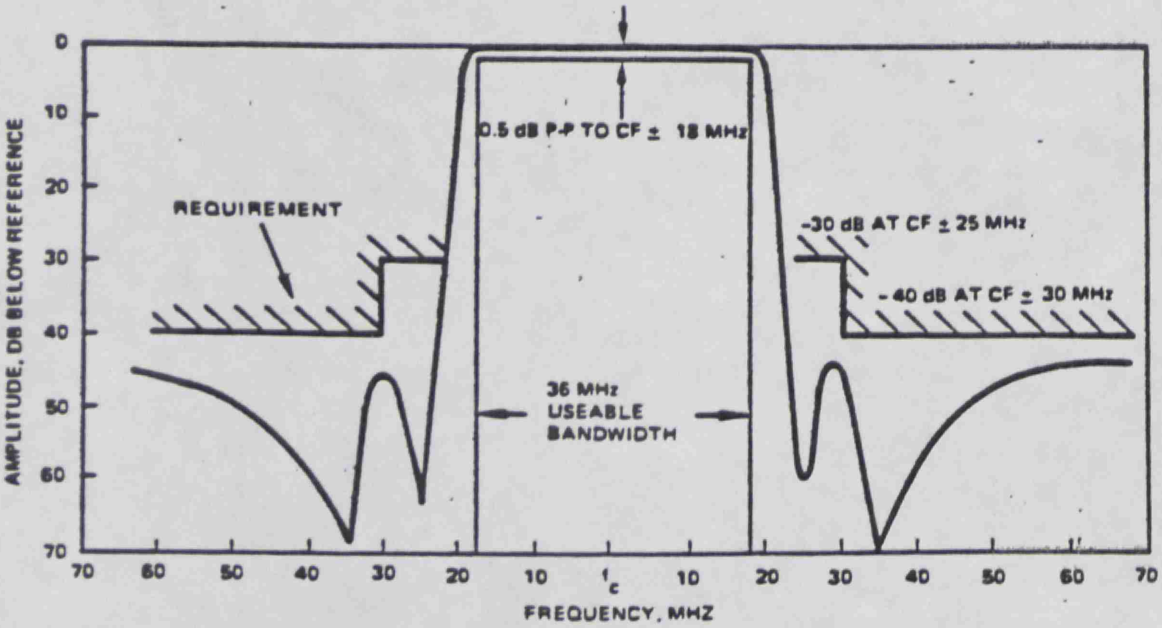
A detailed schedule specifying concrete dates by which significant milestones in establishment of the SpotNet (C) satellite system are planned to be achieved is included as Table 12 in Part I of the overall application.

I. Waiver of Claims

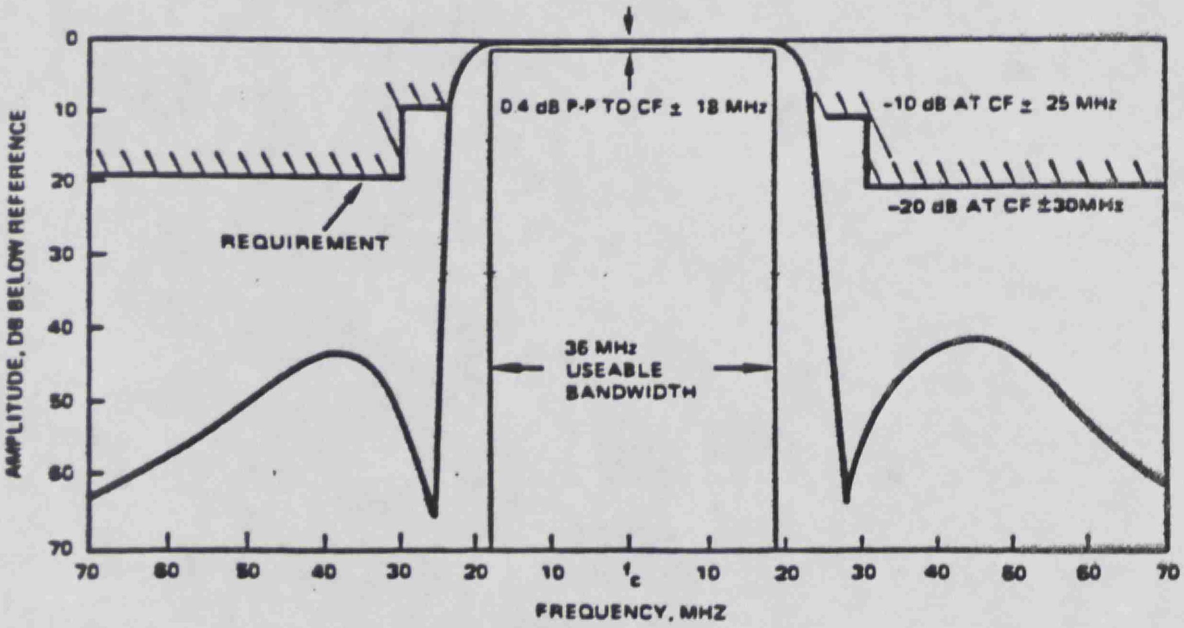
The Applicant waives any claim to the use of any particular frequency or of the ether as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests construction and launch authority in accordance with this application. All statements made in the attached exhibits are a material part hereof, and are incorporated herein as if set out in full in this application.

J. Public Interest Considerations

Part I of NEX's application set forth the public interest considerations and the financial, legal and technical qualifications of the Applicant, as well as other information pertinent to this application, and are incorporated herein by reference.



a) NARROWBAND INPUT MULTIPLEXER FREQUENCY RESPONSE



b) NARROWBAND OUTPUT MULTIPLEXER FREQUENCY RESPONSE

INPUT AND OUTPUT

FILTER RESPONSES

FIGURE 6

K. Certification of Person Responsible for Preparing Engineering Information Submitted 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 that I am familiar with Parts 21 and 25 of the Commission's Rules. In preparing this application, I relied upon the expertise of Mr. Jack Kelleher and Systematics General Corporation of Sterling, Virginia, for certain information. Mr. Kelleher and Systematics General Corporation worked under my supervision. I certify that this application is complete and accurate to the best of my knowledge.

By Philip A Rubin
Philip A. Rubin
Rubin, Bednarek and
  Associates
1776 K Street, N.W.
Washington, D.C. 20066
(202) 357-1789

Dated: November 7, 1983

The undersigned certifies individually and for NEX 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, NEX requests that the Commission grant this application.

Respectfully submitted,

NATIONAL EXCHANGE, INC.

By

Clay T. Whitehead
President

Dated: November 7, 1983