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 19. 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.

TABLE 19

BEX COSTS & REVENUE REQUIREMENTS
($M)
FISCAL YEAR

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
WORKING CAPITAL															
Development	1.2	2.5	3.7	2.5	1.0										
Marketing	1.1	2.4	4.5	6.8	8.2	17.2	24.0	31.6	34.0	36.6	39.4	42.4	45.7	32.1	10.4
Operations	0.5	1.1	1.4	1.8	4.4	24.2	48.6	62.4	87.1	101.9	113.2	118.2	121.3	116.8	110.1
Administration	0.8	1.0	1.3	1.5	1.7	2.0	2.2	2.3	2.5	2.6	2.7	2.9	3.0	3.2	2.3
Total	3.6	7.0	10.9	12.6	15.3	43.4	74.8	96.3	123.6	141.1	155.3	163.5	170.0	152.1	122.8
CAPITAL EXPENDITURES															
Satellite Construction															
Spotnet 1		5.0	15.0	30.0	30.0	20.0									
Spotnet 2			20.0	30.0	30.0	20.0									
Spare				20.0	20.0	20.0	20.0								
Satellite Launch Service															
2 Satellites		1.0	12.0	20.0	27.0	20.0									
Launch Insurance															
2 Satellites		1.0	8.0	18.0	18.0	10.0									
TT&C		3.9	5.2	4.7	3.5	0.7									
Total	0	10.9	60.2	122.7	128.5	90.7	20.0								
Depreciation						20.3	90.8	71.3	57.7	53.8	53.8	53.8	42.3		
Revenue Requirement						25.4	128.6	212.6	280.6	327.4	380.2	390.1	420.1	405.9	380.1

As shown in Table 19, the estimated construction, launch, and other pre-operational costs for the two in-orbit and one ground spare satellite system total \$504.1 million. First year annual operating expenses (inclusive of inflation), beginning in the 1993-94 time frame, when the two-satellite system is proposed to become operational, are projected to be \$59.1 million. In order to fund the construction, launch, and first-year operation of the SpotNet system, NEX has obtained the firm commitment of BNI, its corporate parent, that the necessary funds, in an amount in excess of \$563.2 million, will be made available for this purpose. Attached hereto as Exhibit A is a letter from Mr. Gerald Grinstein, BNI's Vice Chairman, certifying to the foregoing. Also contained in Exhibit A are copies of the most recent Form 10Ks filed by BNI and its primary wholly-owned subsidiary, Burlington Northern Railroad Company, which provide the supporting documentation required by 47 C.F.R. § 25.391(d).

K. <u>Legal Qualifications of Applicant.</u>

A Common Carrier and Satellite Radio Licensee Qualification Report (FCC Form 430) is being filed simultaneously herewith. A copy is attached hereto as Exhibit B.

L. <u>Statement of Whether Space Station is to be Operated on Common Carrier or Non-Common Carrier Basis.</u>

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 recognizes, however, that it is not yet in a position to supply the detailed information required by the Commission in Transponder Sales Order, 90 F.C.C.2d 1238, 1260 (1982), to enable the agency 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, 47 C.F.R. § 63.01, 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." 1981 Orbital Assignment, 84 F.C.C.2d at 601. The FCC has known for some time that the use of multiple narrow spot beams results in a highly efficient, high-capacity satellite design; indeed, even while denying NEX's 1983 application, the Commission acknowledged the potential superiority of NEX's spot beam technology over the proposals of others. See National Exchange, Inc., supra, 1 FCC Rcd at 689 n.35. Nonetheless, the Commission's declared policy is not to dictate particular designs, leaving such choices to the individual applicants, who are in the best position to make the "complex trade-offs between technical, economic, operational and marketing factors." 1981 Orbital Assignments, 84 F.C.C.2d at 594; 2° Order, 54 R.R.2d at 612.

The Commission has also made clear, however, that in the face of the growing congestion of the orbital arc, it places a premium on efficient use of available orbital locations, and that it would look carefully at system design in terms of satellite capacity at each orbital location. See 1981 Orbital Assignments at 595-96; 2° Order at 598. Clearly, grant of NEX's SpotNet application, the technological basis of which the Commission has already acknowledged is directly responsive to this policy, see National Exchange, Inc., supra, 1 FCC Rcd at 689 n.35, would serve the public interest.

The SpotNet system 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 design has the practical effect of expanding the capacity of the 12/14-GHz-frequency band. This capability -- together with the communication payload power to sustain operation in this large bandwidth and SpotNet's unique capability to interconnect traffic among all the antenna patterns of a satellite -- expands the utility of SpotNet many times as compared to a conventional satellite system.

The spectrum and orbital efficiency that characterize the SpotNet system also contribute to the substantial public benefit of offering its customers full interconnectivity using small, low-cost, highly reliable and easily installed customer-premise earth stations. In terms of both cost to the user and operational flexibility, NEX's SpotNet represents a significant advance over any other existing or proposed satellite system.

In brief, the NEX application entirely fulfills the goals of the FCC's open-entry domestic satellite policy. It has proposed an "innovative application of satellite technology to satisfy the telecommunications needs of this country." 2' Order, 54 R.R.2d at 602. Its application should be granted.

Appendix A

APPENDIX A

1. Ku-Band Interference Analysis.

The methodology and assumptions used in the Ku-Band interference assessment are essentially those used by the Commission in the past (Ref: FCC/OST R83-2). The major assumptions are discussed below:

(1) all earth station antennas conform to the standard 29 -25 Log(theta) sidelobe envelope.

(2) a nominal angular separation of 2° is used in all calculations, (*i.e.*, the topocentric separation is approximated by the geocentric separation and station keeping errors are ignored).

(3) the path loss differentials on both the uplink and the downlink are negligible.

(4) both the wanted and interfering earth stations lie on their respective -3dB contours.

(5) the wanted and interfering signals are co-polarized.

Given these assumptions, the following uplink and downlink C/I ratios result:

$$(C/I)_u = Pt + G_1 - p_t - g_1\,(\text{theta}) + Q$$

$$(C/I)_d = E + G_4 - e - G_4\,(\text{theta}) + Q$$

where:

$(C/I)_u$	=	uplink wanted-to-interfering carrier ratio
$(C/I)_d$	=	downlink wanted-to-interfering carrier ratio
P_t	=	transmit power of the wanted carrier at the input to the wanted earth station antenna
p_t	=	transmit power of the interfering carrier at the input to the interfering earth station antenna
G_1	=	transmit antenna gain of the wanted earth station
g_1 (theta)	=	antenna gain of the interfering earth station in the direction of the wanted satellite
E	=	E.I.R.P. of the wanted carrier
e	=	E.I.R.P. of the interfering carrier
G_4	=	receive gain of the wanted earth station in the direction of the wanted satellite
G_4 (theta)	=	receive gain of the wanted earth station in the direction of the interfering satellite
Q	=	ratio of total carrier power to the effective total interfering power within the wanted carrier receiver pass band. For multiple interfering carriers, Q is simply 10 Log(N_i) where N_i is the number of interfering carriers. For single carriers, Q is a function of the carrier power spectral density.

The total link carrier-to-interference ratio, $(C/I)_{tot}$, is the power ratio sum of $(C/I)_u$ and $(C/I)_d$.

It should also be noted that when calculating the interference caused to narrow band carriers by a TV/FM carrier, the latter is assumed to have a normalized interference spectral power density of -74 dB/Hz; i.e., it is implicitly assumed that narrowband carriers will not be placed on the same frequency as adjacent satellite TV carriers.

In order to assess the likelihood of harmful interference into adjacent satellite systems, a total of thirty-three carriers have been examined, which are believed to be broadly representative of the full range of Ku-Band carriers likely to be employed in the 1990s. The transmission parameters for these carriers were obtained from various satellite applications and FCC documents. Although some of the carriers in this set are from systems that are no longer planned, they represent services likely to be provided on other satellites at some future date and have, for that reason, been included in this analysis.

Table A-1 shows the potential interference into adjacent satellite carriers from NEX "medium network" 1.544 mbps digital carriers. With only a few minor exceptions, the aggregate $(C/I)_{tot}$ meets or exceeds generally accepted (C/I) interference objectives.

Table A-2 shows the potential interference into the NEX "medium network" carrier from adjacent satellite carriers. As this table demonstrates, the NEX medium network carrier is relatively insensitive to interference from adjacent satellite carriers.

Table A-3 shows the potential interference into adjacent satellite carriers from NEX "small network" in-route carriers, i.e., from the 96 kbps TDMA carrier transmitted from small 1.2

meter remote terminals to a 3 meter hub station. In all cases, the aggregate $(C/I)_{tot}$ exceeds generally accepted (C/I) interference objectives.

Table A-4 shows the potential interference into NEX "small network" in-route carriers from adjacent satellite carriers. As indicated, this carrier is somewhat sensitive to uplink interference and some degree of coordination will be necessary with adjacent satellite TV carriers. However, by virtue of the fact that acceptable performance is achieved at an operating (C/N+I) as low as 4.3 dB, interference from other carrier types is not expected to be significant.

Table A-5 shows the potential interference into adjacent satellite carriers from the NEX "small network" out-route carrier, i.e., from the 96 kbps TDM carrier transmitted from a 3 meter hub station to small 1.2 meter remote terminals. With only a few minor exceptions, the aggregate $(C/I)_{tot}$ meets or exceeds generally accepted (C/I) interference objectives.

Table A-6 shows the potential interference into the NEX "small network" out-route carrier from adjacent satellite carriers. As this table demonstrates, the NEX "small network" out-route carrier is relatively insensitive to interference from adjacent satellite carriers.

As the analysis described above demonstrates, NEX Ku-Band carriers will not cause excess interference into adjacent satellite systems, even at an orbital separation of 2°. Indeed, by virtue of the fact that the NEX Ku-Band payload is not intended for the transmission of TV/FM carriers, it will produce far less interference than other existing and authorized Ku-Band satellites.

TABLE A-1

INTERFERENCE INTO ADJACENT SATELLITE
CARRIERS FROM THE NEX "MEDIUM NETWORK" CARRIER

CARRIER ID NUMBER :	1	2	3	4	5
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	TV/FM	TV/FM
BANDWIDTH (MHz):	36	36	36	36	22
DATA RATE (MBPs):	N/A	N/A	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	53.6	53.6	53.6	53.6	53.6
(C/I)dn (DB):	44.2	46.9	39.2	41.9	30.8
(C/I)tot [1 carrier] (DB):	43.8	46.1	39.1	41.6	30.8
(C/I)tot [multiple] (DB):	29.6	31.9	24.9	27.5	18.8
BASEBAND S/I (DB):	69.8	72.1	63	65.5	50.7
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	6	7	8	9	10
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	DIGITAL	DIGITAL
BANDWIDTH (MHz):	26	26	16	54	36
DATA RATE (MBPs):	N/A	N/A	N/A	90	60
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	59.2	54.2	53.1	56.1	56.1
(C/I)dn (DB):	32.5	33.7	31.9	49.5	41.5
(C/I)tot [1 carrier] (DB):	32.5	33.7	31.9	48.7	41.4
(C/I)tot [multiple] (DB):	19.8	20.9	21.3	32.7	27.2
BASEBAND S/I (DB):	54.8	56	50.7	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	11	12	13	14	15
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	15	10	3.9	.14	54
DATA RATE (MBPs):	6	12	1.544	.056	90
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	45.3	44.1	39.3	36.7	53.6
(C/I)dn (DB):	31.5	32.5	25.5	20.4	43.2
(C/I)tot [1 carrier] (DB):	31.3	32.2	25.3	20.3	42.8
(C/I)tot [multiple] (DB):	21.0	23.6	20.8	20.3	26.9
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	16	17	18	19	20
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	54	36	36	54	16.6
DATA RATE (MBPs):	90	60	60	80	8.8
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	53.6	53.6	53.6	59.4	59.2
(C/I)dn (DB):	39.2	41.9	39.2	42.8	32.5
(C/I)tot [1 carrier] (DB):	39.1	41.6	39.1	42.7	32.5
(C/I)tot [multiple] (DB):	23.1	27.5	24.9	26.8	21.7
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

TABLE A-1 (Cont'd)

INTERFERENCE INTO ADJACENT SATELLITE
CARRIERS FROM THE NEX "MEDIUM NETWORK" CARRIER

CARRIER ID NUMBER :	21	22	23	24	25
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	1.030	43.0	43	43	1.229
DATA RATE (MBPs):	1.544	50	50	50	.512
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	35.9	56.8	53.9	53.9	25.4
(C/I)dn (DB):	24.5	43.6	40.9	43.9	15.6
(C/I)tot [1 carrier] (DB):	24.2	43.4	40.7	43.5	15.2
(C/I)tot [multiple] (DB):	24.2	28.5	25.8	28.6	15.2
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	26	27	28	29	30
CARRIER TYPE :	DIGITAL	SCPC/PSK	SCPC/PSK	SCPC/PSK	SCPC/PSK
BANDWIDTH (MHz):	1.229	.039	.039	.064	.064
DATA RATE (MBPs):	.512	.056	.056	.056	.056
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	37.4	40.5	40.5	42.0	36.0
(C/I)dn (DB):	11.3	21.6	24.3	24.7	18.7
(C/I)tot [1 carrier] (DB):	11.3	21.6	24.2	24.6	18.6
(C/I)tot [multiple] (DB):	11.3	21.6	24.2	24.6	18.6
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	31	32	33
CARRIER TYPE :	SCPC/FM	SCPC/FM	SCPC/FM
BANDWIDTH (MHz):	.180	.018	.037
DATA RATE (MBPs):	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1
(C/I)up (DB):	33.0	28.8	32.4
(C/I)dn (DB):	23.1	24.8	27.6
(C/I)tot [1 carrier] (DB):	22.6	23.3	26.4
(C/I)tot [multiple] (DB):	22.6	23.3	26.4
BASEBAND S/I (DB):	62.1	63.3	77.6
BASEBAND NOISE (pWOp):	606	457	17

TABLE A-2

INTERFERENCE INTO THE NEX "MEDIUM NETWORK" CARRIER FROM ADJACENT SATELLITE CARRIERS

CARRIER ID NUMBER :	1	2	3	4	5
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	TV/FM	TV/FM
BANDWIDTH (MHz):	36	36	36	36	22
DATA RATE (MBPs):	N/A	N/A	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	19.5	22.2	19.5	22.2	18.4
(C/I)dn (DB):	25.7	25.7	30.7	30.7	25.7
(C/I)tot [1 carrier] (DB):	18.6	20.6	19.2	21.7	17.7
(C/I)tot [multiple] (DB):	18.6	20.6	19.2	21.7	17.7

CARRIER ID NUMBER :	6	7	8	9	10
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	DIGITAL	DIGITAL
BANDWIDTH (MHz):	26	26	16	54	36
DATA RATE (MBPs):	N/A	N/A	N/A	90	60
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	15.8	18.1	13.0	22.1	20.3
(C/I)dn (DB):	31.7	36.2	19.7	26.1	32.3
(C/I)tot [1 carrier] (DB):	15.7	18.1	12.2	20.6	20.0
(C/I)tot [multiple] (DB):	15.7	18.1	12.2	20.6	20.0

CARRIER ID NUMBER :	11	12	13	14	15
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	15	10	3.9	.14	54
DATA RATE (MBPs):	6	12	1.544	.056	90
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	26.8	26.7	26.9	31.3	21.8
(C/I)dn (DB):	37.5	35.7	37.6	44.5	29.1
(C/I)tot [1 carrier] (DB):	26.4	26.2	26.6	31.1	21.0
(C/I)tot [multiple] (DB):	26.4	26.2	26.6	22.4	21.0

CARRIER ID NUMBER :	16	17	18	19	20
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	54	36	36	54	16.6
DATA RATE (MBPs):	90	60	60	80	8.8
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	21.8	23.8	21.1	21.4	14.0
(C/I)dn (DB):	33.1	32.3	32.3	35.1	29.9
(C/I)tot [1 carrier] (DB):	21.4	23.2	20.8	21.2	13.9
(C/I)tot [multiple] (DB):	21.4	23.2	20.8	21.2	13.9

TABLE A-2 (Cont'd)

INTERFERENCE INTO THE NEX "MEDIUM NETWORK" CARRIER FROM ADJACENT SATELLITE CARRIERS

CARRIER ID NUMBER :	21	22	23	24	25
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	1.030	43.0	43	43	1.229
DATA RATE (MBPs):	1.544	50	50	50	.512
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	29.0	20.6	20.6	20.6	20.6
(C/I)dn (DB):	37.5	31.4	31.4	28.4	43.6
(C/I)tot [1 carrier] (DB):	28.5	20.2	20.2	19.9	20.6
(C/I)tot [multiple] (DB):	28.4	20.2	20.2	19.9	20.6

CARRIER ID NUMBER :	26	27	28	29	30
CARRIER TYPE :	DIGITAL	SCPC/PSK	SCPC/PSK	SCPC/PSK	SCPC/PSK
BANDWIDTH (MHz):	1.229	.039	.039	.064	.064
DATA RATE (MBPs):	.512	.056	.056	.056	.056
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	24.8	34.3	37.0	28.9	34.9
(C/I)dn (DB):	31.9	50.0	50.0	43.5	49.5
(C/I)tot [1 carrier] (DB):	24.1	34.2	36.8	28.8	34.8
(C/I)tot [multiple] (DB):	24.1	19.9	22.5	16.7	22.7

CARRIER ID NUMBER :	31	32	33
CARRIER TYPE :	SCPC/FM	SCPC/FM	SCPC/FM
BANDWIDTH (MHz):	.180	.018	.037
DATA RATE (MBPs):	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1
(C/I)up (DB):	34.0	42.0	45.8
(C/I)dn (DB):	36.5	43.6	47.5
(C/I)tot [1 carrier] (DB):	32.1	39.7	43.6
(C/I)tot [multiple] (DB):	24.5	22.1	29.1

TABLE A-3

INTERFERENCE INTO ADJACENT SATELLITE CARRIERS
FROM NEX "SMALL NETWORK" IN-ROUTE CARRIERS

CARRIER ID NUMBER :	1	2	3	4	5
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	TV/FM	TV/FM
BANDWIDTH (MHz):	36	36	36	36	22
DATA RATE (MBPs):	N/A	N/A	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	61.5	61.5	61.5	61.5	61.5
(C/I)dn (DB):	56.2	58.9	51.2	53.9	42.8
(C/I)tot [1 carrier] (DB):	55.1	57.0	50.8	53.2	42.8
(C/I)tot [multiple] (DB):	33.9	35.9	29.7	32.1	23.8
BASEBAND S/I (DB):	74.1	76.1	67.7000	70.1	55.7
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	6	7	8	9	10
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	DIGITAL	DIGITAL
BANDWIDTH (MHz):	26	26	16	54	36
DATA RATE (MBPs):	N/A	N/A	N/A	90	60
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	67.1	62.1	61.0	64.0	64.0
(C/I)dn (DB):	44.5	45.7	43.9	61.5	53.5
(C/I)tot [1 carrier] (DB):	44.5	45.6	43.8	59.6	53.2
(C/I)tot [multiple] (DB):	24.8	25.9	26.2	36.7	32.0
BASEBAND S/I (DB):	59.8	61	55.7	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	11	12	13	14	15
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	15	10	3.9	.14	54
DATA RATE (MBPs):	6	12	1.544	.056	90
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	53.2	52.0	47.2	37.6	61.5
(C/I)dn (DB):	43.5	44.5	37.5	25.4	55.2
(C/I)tot [1 carrier] (DB):	43.1	43.8	37.1	25.1	54.3
(C/I)tot [multiple] (DB):	25.7	28.2	25.6	25.1	31.4
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	16	17	18	19	20
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	54	36	36	54	16.6
DATA RATE (MBPs):	90	60	60	80	8.8
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	61.5	61.5	61.5	67.3	67.1
(C/I)dn (DB):	51.2	53.9	51.2	54.8	44.5
(C/I)tot [1 carrier] (DB):	50.8	53.2	50.8	54.6	44.5
(C/I)tot [multiple] (DB):	27.9	32.1	29.7	31.7	26.7
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

TABLE A-3 (Cont'd)

INTERFERENCE INTO ADJACENT SATELLITE CARRIERS
FROM NEX "SMALL NETWORK" IN-ROUTE CARRIERS

CARRIER ID NUMBER :	21	22	23	24	25
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	1.030	43.0	43	43	1.229
DATA RATE (MBPs):	1.544	50	50	50	.512
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	43.1	64.7	61.8	61.8	33.3
(C/I)dn (DB):	35.8	55.6	52.9	55.9	27.6
(C/I)tot [1 carrier] (DB):	35.1	55.1	52.4	54.9	26.6
(C/I)tot [multiple] (DB):	29.4	33.2	30.5	33.0	20.1
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	26	27	28	29	30
CARRIER TYPE :	DIGITAL	SCPC/PSK	SCPC/PSK	SCPC/PSK	SCPC/PSK
BANDWIDTH (MHz):	1.229	.039	.039	.064	.064
DATA RATE (MBPs):	.512	.056	.056	.056	.056
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	45.3	41.4	41.4	42.9	36.9
(C/I)dn (DB):	23.3	26.6	29.3	29.7	23.7
(C/I)tot [1 carrier] (DB):	23.3	26.5	29.1	29.5	23.5
(C/I)tot [multiple] (DB):	16.8	26.5	29.1	29.5	23.5
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	31	32	33
CARRIER TYPE :	SCPC/FM	SCPC/FM	SCPC/FM
BANDWIDTH (MHz):	.180	.018	.037
DATA RATE (MBPs):	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1
(C/I)up (DB):	33.9	29.7	33.3
(C/I)dn (DB):	28.1	29.8	32.6
(C/I)tot [1 carrier] (DB):	27.1	26.7	30.0
(C/I)tot [multiple] (DB):	27.1	26.7	30.0
BASEBAND S/I (DB):	66.5	66.8	81.1
BASEBAND NOISE (pWOp):	219	208	7

TABLE A-4

INTERFERENCE INTO NEX "SMALL NETWORK" IN-ROUTE
CARRIERS FROM ADJACENT SATELLITE CARRIERS

CARRIER ID NUMBER :	1	2	3	4	5
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	TV/FM	TV/FM
BANDWIDTH (MHz):	36	36	36	36	22
DATA RATE (MBPs):	N/A	N/A	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	14.9	17.6	14.9	17.6	13.8
(C/I)dn (DB):	24.7	24.7	29.7	29.7	24.7
(C/I)tot [1 carrier] (DB):	14.5	16.9	14.8	17.4	13.5
(C/I)tot [multiple] (DB):	14.5	16.9	14.8	17.4	13.5

CARRIER ID NUMBER :	6	7	8	9	10
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	DIGITAL	DIGITAL
BANDWIDTH (MHz):	26	26	16	54	36
DATA RATE (MBPs):	N/A	N/A	N/A	90	60
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	11.2	13.5	8.4	17.4	15.7
(C/I)dn (DB):	30.7	35.2	18.7	25.0	31.3
(C/I)tot [1 carrier] (DB):	11.2	13.5	8.0	16.8	15.6
(C/I)tot [multiple] (DB):	11.2	13.5	8.0	16.8	15.6

CARRIER ID NUMBER :	11	12	13	14	15
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	15	10	3.9	.14	54
DATA RATE (MBPs):	6	12	1.544	.056	90
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	22.2	22.1	22.3	19.7	17.1
(C/I)dn (DB):	36.5	34.7	36.6	36.5	28.0
(C/I)tot [1 carrier] (DB):	22.0	21.9	22.2	19.6	16.8
(C/I)tot [multiple] (DB):	22.0	21.9	22.2	17.9	16.8

CARRIER ID NUMBER :	16	17	18	19	20
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	54	36	36	54	16.6
DATA RATE (MBPs):	90	60	60	80	8.8
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	17.1	19.2	16.5	16.7	9.4
(C/I)dn (DB):	32.0	31.3	31.3	34.0	28.9
(C/I)tot [1 carrier] (DB):	17.0	18.9	16.3	16.7	9.4
(C/I)tot [multiple] (DB):	17.0	18.9	16.3	16.7	9.4

TABLE A-4 (Cont'd)

INTERFERENCE INTO NEX "SMALL NETWORK" IN-ROUTE
CARRIERS FROM ADJACENT SATELLITE CARRIERS

CARRIER ID NUMBER :	21	22	23	24	25
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	1.030	43.0	43	43	1.229
DATA RATE (MBPs):	1.544	50	50	50	.512
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	23.8	16.0	16.0	16.0	16.0
(C/I)dn (DB):	35.9	30.4	30.4	27.4	42.6
(C/I)tot [1 carrier] (DB):	23.5	15.8	15.8	15.7	16.0
(C/I)tot [multiple] (DB):	23.5	15.8	15.8	15.7	16.0

CARRIER ID NUMBER :	26	27	28	29	30
CARRIER TYPE :	DIGITAL	SCPC/PSK	SCPC/PSK	SCPC/PSK	SCPC/PSK
BANDWIDTH (MHz):	1.229	.039	.039	.064	.064
DATA RATE (MBPs):	.512	.056	.056	.056	.056
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	20.2	22.7	25.4	17.3	23.3
(C/I)dn (DB):	30.9	42.0	42.0	35.5	41.5
(C/I)tot [1 carrier] (DB):	19.9	22.7	25.3	17.3	23.3
(C/I)tot [multiple] (DB):	19.9	15.4	18.0	12.1	18.1

CARRIER ID NUMBER :	31	32	33
CARRIER TYPE :	SCPC/FM	SCPC/FM	SCPC/FM
BANDWIDTH (MHz):	.180	.018	.037
DATA RATE (MBPs):	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1
(C/I)up (DB):	22.4	30.4	34.2
(C/I)dn (DB):	28.5	35.6	39.5
(C/I)tot [1 carrier] (DB):	21.5	29.3	33.1
(C/I)tot [multiple] (DB):	20.8	18.6	25.6

TABLE A-5

INTERFERENCE INTO ADJACENT SATELLITE CARRIERS
FROM NEX "SMALL NETWORK" OUT-ROUTE CARRIERS

CARRIER ID NUMBER :	1	2	3	4	5
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	TV/FM	TV/FM
BANDWIDTH (MHz):	36	36	36	36	22
DATA RATE (MBPs):	N/A	N/A	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	63.2	63.2	63.2	63.2	63.2
(C/I)dn (DB):	51.2	53.9	46.2	48.9	37.8
(C/I)tot [1 carrier] (DB):	51.0	53.4	46.1	48.8	37.8
(C/I)tot [multiple] (DB):	29.8	32.3	25.0	27.6	18.8
BASEBAND S/I (DB):	70	72.5	63.1	65.7000	50.7
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	6	7	8	9	10
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	DIGITAL	DIGITAL
BANDWIDTH (MHz):	26	26	16	54	36
DATA RATE (MBPs):	N/A	N/A	N/A	90	60
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	68.8	63.8	62.7	65.7	65.7
(C/I)dn (DB):	39.5	40.7	38.9	56.5	48.5
(C/I)tot [1 carrier] (DB):	39.5	40.7	38.9	56.0	48.4
(C/I)tot [multiple] (DB):	19.8	21.0	21.3	33.1	27.3
BASEBAND S/I (DB):	54.8	56	50.7	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	11	12	13	14	15
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	15	10	3.9	.14	54
DATA RATE (MBPs):	6	12	1.544	.056	90
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	54.9	53.7	48.9	39.3	63.2
(C/I)dn (DB):	38.5	39.5	32.5	20.4	50.2
(C/I)tot [1 carrier] (DB):	38.4	39.4	32.4	20.3	50.0
(C/I)tot [multiple] (DB):	21.1	23.8	20.9	20.3	27.1
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	16	17	18	19	20
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	54	36	36	54	16.6
DATA RATE (MBPs):	90	60	60	80	8.8
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	63.2	63.2	63.2	69.0	68.8
(C/I)dn (DB):	46.2	48.9	46.2	49.8	39.5
(C/I)tot [1 carrier] (DB):	46.1	48.8	46.1	49.8	39.5
(C/I)tot [multiple] (DB):	23.2	27.6	25.0	26.9	21.7
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

TABLE A-5 (Cont'd)

INTERFERENCE INTO ADJACENT SATELLITE CARRIERS
FROM NEX "SMALL NETWORK" OUT-ROUTE CARRIERS

CARRIER ID NUMBER :	21	22	23	24	25
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	1.030	43.0	43	43	1.229
DATA RATE (MBPs):	1.544	50	50	50	.512
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	44.8	66.4	63.5	63.5	35.0
(C/I)dn (DB):	30.8	50.6	47.9	50.9	22.6
(C/I)tot [1 carrier] (DB):	30.7	50.5	47.8	50.7	22.4
(C/I)tot [multiple] (DB):	24.9	28.6	25.9	28.8	15.9
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	26	27	28	29	30
CARRIER TYPE :	DIGITAL	SCPC/PSK	SCPC/PSK	SCPC/PSK	SCPC/PSK
BANDWIDTH (MHz):	1.229	.039	.039	.064	.064
DATA RATE (MBPs):	.512	.056	.056	.056	.056
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	47.0	43.1	43.1	44.6	38.6
(C/I)dn (DB):	18.3	21.6	24.3	24.7	18.7
(C/I)tot [1 carrier] (DB):	18.3	21.6	24.3	24.6	18.6
(C/I)tot [multiple] (DB):	11.8	21.6	24.3	24.6	18.6
BASEBAND S/I (DB):	N/A	N/A	N/A	N/A	N/A
BASEBAND NOISE (pWOp):	N/A	N/A	N/A	N/A	N/A

CARRIER ID NUMBER :	31	32	33
CARRIER TYPE :	SCPC/FM	SCPC/FM	SCPC/FM
BANDWIDTH (MHz):	.180	.018	.037
DATA RATE (MBPs):	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1
(C/I)up (DB):	35.6	31.4	35.0
(C/I)dn (DB):	23.1	24.8	27.6
(C/I)tot [1 carrier] (DB):	22.8	23.9	26.9
(C/I)tot [multiple] (DB):	22.8	23.9	26.9
BASEBAND S/I (DB):	62.3	64	78.1
BASEBAND NOISE (pWOp):	579	397	15

TABLE A-6

INTERFERENCE INTO NEX "SMALL NETWORK" OUT-ROUTE
CARRIERS FROM ADJACENT SATELLITE CARRIERS

CARRIER ID NUMBER :	1	2	3	4	5
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	TV/FM	TV/FM
BANDWIDTH (MHz):	36	36	36	36	22
DATA RATE (MBPs):	N/A	N/A	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	20.6	23.3	20.6	23.3	19.5
(C/I)dn (DB):	22.4	22.4	27.4	27.4	22.4
(C/I)tot [1 carrier] (DB):	18.4	19.8	19.8	21.9	17.7
(C/I)tot [multiple] (DB):	18.4	19.8	19.8	21.9	17.7

CARRIER ID NUMBER :	6	7	8	9	10
CARRIER TYPE :	TV/FM	TV/FM	TV/FM	DIGITAL	DIGITAL
BANDWIDTH (MHz):	26	26	16	54	36
DATA RATE (MBPs):	N/A	N/A	N/A	90	60
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	16.9	19.2	14.1	23.1	21.4
(C/I)dn (DB):	28.4	32.9	16.4	22.7	29.0
(C/I)tot [1 carrier] (DB):	16.6	19.0	12.1	19.9	20.7
(C/I)tot [multiple] (DB):	16.6	19.0	12.1	19.9	20.7

CARRIER ID NUMBER :	11	12	13	14	15
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	15	10	3.9	.14	54
DATA RATE (MBPs):	6	12	1.544	.056	90
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	27.9	27.8	28.0	25.4	22.8
(C/I)dn (DB):	34.2	32.4	34.3	34.2	25.7
(C/I)tot [1 carrier] (DB):	27.0	26.5	27.1	24.9	21.0
(C/I)tot [multiple] (DB):	27.0	26.5	27.1	23.2	21.0

CARRIER ID NUMBER :	16	17	18	19	20
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	54	36	36	54	16.6
DATA RATE (MBPs):	90	60	60	80	8.8
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	22.8	24.9	22.2	22.4	15.1
(C/I)dn (DB):	29.7	29.0	29.0	31.7	26.6
(C/I)tot [1 carrier] (DB):	22.0	23.5	21.4	22.0	14.8
(C/I)tot [multiple] (DB):	22.0	23.5	21.4	22.0	14.8

TABLE A-6 (Cont'd)

INTERFERENCE INTO NEX "SMALL NETWORK" OUT-ROUTE
CARRIERS FROM ADJACENT SATELLITE CARRIERS

CARRIER ID NUMBER :	21	22	23	24	25
CARRIER TYPE :	DIGITAL	DIGITAL	DIGITAL	DIGITAL	DIGITAL
BANDWIDTH (MHz):	1.030	43.0	43	43	1.229
DATA RATE (MBPs):	1.544	50	50	50	.512
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	29.5	21.7	21.7	21.7	21.7
(C/I)dn (DB):	33.6	28.1	28.1	25.1	40.3
(C/I)tot [1 carrier] (DB):	28.0	20.8	20.8	20.0	21.7
(C/I)tot [multiple] (DB):	28.0	20.8	20.8	20.0	21.7

CARRIER ID NUMBER :	26	27	28	29	30
CARRIER TYPE :	DIGITAL	SCPC/PSK	SCPC/PSK	SCPC/PSK	SCPC/PSK
BANDWIDTH (MHz):	1.229	.039	.039	.064	.064
DATA RATE (MBPs):	.512	.056	.056	.056	.056
NO. CHANNELS PER CARRIER :	1	1	1	1	1
(C/I)up (DB):	25.9	28.4	31.1	23.0	29.0
(C/I)dn (DB):	28.6	39.7	39.7	33.2	39.2
(C/I)tot [1 carrier] (DB):	24.1	28.1	30.6	22.6	28.6
(C/I)tot [multiple] (DB):	24.1	20.8	23.3	17.5	23.5

CARRIER ID NUMBER :	31	32	33
CARRIER TYPE :	SCPC/FM	SCPC/FM	SCPC/FM
BANDWIDTH (MHz):	.180	.018	.037
DATA RATE (MBPs):	N/A	N/A	N/A
NO. CHANNELS PER CARRIER :	1	1	1
(C/I)up (DB):	28.1	36.1	39.9
(C/I)dn (DB):	26.2	33.3	37.2
(C/I)tot [1 carrier] (DB):	24.1	31.5	35.4
(C/I)tot [multiple] (DB):	23.4	20.9	27.8

2. C-Band Interference Analysis.

The C-Band interference model, when applied in conjunction with the SpotNet C-Band characteristics, produces the results contained in Tables A-7 through A-9. Table A-7 contains the input parameters used in the model, including the SpotNet C-Band characteristics (lines 61-64), and the characteristics of all other space stations (lines 1-60). Table A-8 summarizes the thermal noise characteristics of each carrier. Table A-9 summarizes the input assumptions made and contains footnotes applicable to the preceding tables. Table A-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 A-10, SpotNet is a relatively low-interference C-Band 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 copolarized with the SpotNet system. As stated in OST Report FCC/OST R83-2, polarization interleaving between satellites is necessary for achievement of 2° satellite spacing.

NEX currently plans to use the "Hughes/Western Union" polarization/channelization plan for the C-Band portions of the NEX satellite system. Depending upon the final assignment of other satellites to adjacent orbital locations, it may be desirable, from the standpoint of interference potential, to use the complementary "RCA" polarization/channelization plan. This situation currently occurs, for example, at 101° W.L. between the Canadian Anik D-1 satellite (104.5° W.L.) and the Western Union Westar 4 satellite (98.5° W.L.).

Table A-11 presents the results of an analysis of the potential interference interactions between the SpotNet C-Band subsystem using the "RCA" polarization/channelization scheme and all other authorized satellites. The same information presented in Table A-10 is presented in Table A-11, with the exception that the polarizations of SpotNet have been reversed. Instead of being vertically polarized, the uplink is polarized horizontally. The downlink polarization is similarly reversed.

The results of these analysis show that SpotNet 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 A-11 to have some potential interference interactions with SpotNet are relatively interference-free when operating adjacent to the complementary-polarized SpotNet in Table A-10.

INPUT PARAMETERS 10111156 26 08 83

CAR LINK	TYPE	RF BAND WIDTH (MHZ)	NO. OF CHAN	CONF RATE/MOD INDEX	RMS MOD FREQ (MHZ)	TOP MOD FREQ (MHZ)	AVE TALKER LEVEL (DBMO)	EMPH NOISE WEIGHT (DB)	BAND S	DATA RATE (MBPS)	CHAN SPACE (MHZ)	TRANSPONDER FREQUENCY UP (GHZ)	DN (GHZ)	U	D	EARTH STATION TRANSMITTER (DBW)	(DB)	GAIN (DB)	SATELLITE GAIN (DB)	TEMP (K)	LINE (DBW)	EARTH STATION RECEIVE (DB)	GAIN (DB)	TEMP (K)
1 ALAS	4	0.029	800	2.024	0.000	0.001	0.0	16.0	0	0.000	0.045	6.145	3.920	0	1	6.6	5.0	47.3	28.2	750.	5.7	15.0	32.6	100
2 ALAS	4	0.029	800	2.024	0.000	0.001	0.0	16.0	0	0.000	0.045	6.145	3.920	0	1	8.2	15.0	52.0	28.2	750.	7.2	5.0	44.5	130
3 ASC	0	15.000	1800	0.308	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.	14.0	13.0	52.0	80
4 ASC	0	12.000	432	0.908	0.012	1.550	20.0	0.0	0	0.000	12.000	6.145	3.920	0	1	10.7	10.0	51.5	25.0	800.	22.0	10.0	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	51.5	25.0	800.	14.0	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	26.5	10.0	51.5	25.0	800.	11.0	11.0	50.5	71
7 ASC	2	9.600	1	0.000	0.000	0.000	0.0	0.0	4	7.700	0.000	6.145	3.920	0	1	24.5	10.0	51.5	25.0	800.	11.0	3.0	39.5	150
8 ASC	3	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	51.5	25.0	800.	21.0	10.0	50.5	87
9 ASC	3	1.100	32	0.000	0.000	0.000	0.0	0.0	4	1.544	1.3008	6.145	3.920	0	1	6.7	10.0	51.5	25.0	800.	14.0	10.0	50.5	89
10 ASC	3	1.100	32	0.000	0.000	0.000	0.0	0.0	4	1.544	1.3008	6.145	3.920	0	1	1.1	10.0	51.5	25.0	800.	14.1	10.0	50.5	56
11 ASC	4	0.040	160	0.000	0.000	0.000	0.0	0.0	4	0.056	0.2008	6.145	3.920	0	1	1.1	5.0	47.3	25.0	800.	7.5	5.0	44.5	125
12 ASC	4	0.048	620	0.000	0.000	0.000	0.0	0.0	4	0.056	0.0488	6.145	3.920	0	1	9.5	10.0	51.5	25.0	800.	1.0	10.0	50.5	89
13 ATLT	5	14.000	7000	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	63.4	24.5	900.	20.6	10.0	59.4	54
14 ATLT	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 ATLT	01	36.000	1800	0.451	0.544	8.524	20.0	0.0	0	0.000	0.000	6.145	3.920	1	1	26.3	30.0	63.4	24.5	900.	35.0	10.0	59.4	54
16 ATLT	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	51.5	24.5	900.	9.0	7.0	47.5	125
17 ATLT	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	24.0	12.0	55.1	24.5	900.	14.2	12.0	52.5	71
18 ATLT	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	63.4	24.5	900.	33.0	30.0	59.4	54
19 ATLT	2	1.060	24	0.000	0.000	0.000	0.0	0.0	4	1.544	1.3008	6.145	3.920	1	1	11.5	12.0	55.1	24.5	900.	15.7	12.0	52.5	71
20 ATLT	2	1.060	24	0.000	0.000	0.000	0.0	0.0	4	1.544	1.3008	6.145	3.920	1	1	13.1	10.0	51.5	24.5	900.	15.7	10.0	50.5	71
21 ATLT	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	14.5	10.0	51.5	24.5	900.	24.6	3.0	39.5	140
22 RCA	5	14.000	5820	0.000	1.000	17.000	21.0	7.8	0	0.000	0.000	6.145	3.920	0	1	10.0	13.0	56.0	24.0	750.	10.0	13.0	51.0	80
23 RCA	0	36.000	2092	0.324	0.012	12.388	18.0	11.1	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
24 RCA	0	36.000	1932	0.405	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	0.000	18.000	6.145	3.920	0	1	13.9	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	26.7	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	19.7	11.0	54.1	24.0	750.	11.0	7.0	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	51.5	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	51.5	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	0.000	16.000	6.145	3.920	0	1	21.5	10.0	51.5	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	0.000	16.000	6.145	3.920	0	1	21.5	10.0	51.5	24.0	750.	30.0	10.0	50.5	117
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	26.7	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	8.000	0.000	6.145	3.920	0	1	25.5	13.0	56.0	24.0	750.	34.0	3.3	39.5	140
35 RCA	2	1.030	32	0.000	0.000	0.000	0.0	0.0	4	1.544	1.3008	6.145	3.920	0	1	7.9	11.0	54.1	24.0	750.	15.0	11.0	51.3	107
36 RCA	3	0.044	100	0.000	0.000	0.000	0.0	0.0	2	0.044	0.2008	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	0.0488	6.145	3.920	0	1	-1.0	10.0	51.5	24.0	750.	0.0	10.0	50.5	117
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	0.040	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	0.040	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	51.1	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 MPR	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	41.5	175
44 MUZA	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	0.5008	6.145	3.920	1	0	0.5	10.0	53.5	25.0	800.	17.0	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	5.0008	6.145	3.920	1	0	6.5	10.0	53.5	25.0	800.	18.4	3.0	39.5	140
47 MBG	4	0.200	6	5.667	0.000	0.015	0.0	29.0	0	0.000	PLAN	6.145	3.920	1	0	4.7	11.0	54.1	25.0	800.	19.0	1.8	34.5	140
48 FOU	6	4.915	6	0.000	0.000	0.000	0.0	24.1	2	0.010	4.000	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	4.020	-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	0.001	0.0	23.5	0	0.000	0.0808	6.145	3.920	1	0	2.5	4.5	47.1	24.8	800.	3.7	4.5	44.0	125
53 BPC	0	36.000	1872	0.407	0.013	7.848	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	117
54 BPC	0	17.500	432	1.019	0.564	2.074	-15.0	0.0	0	0.000	18.000	6.145	3.920	1	0	19.0	10.0	54.0	26.0	750.	30.0	10.0	50.5	117
55 BPC	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 BPC	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.	14.0	5.0	45.0	120
57 BPCW	0	36.000	1872	0.407	0.012	7.848	15.0	10.3	0	0.000	40.000	6.145	3.930	0	1	15.2	13.0	56.3	26.0	750.	12.0	13.0	52.0	80
58 BPCW	1	36.000	2	2.690	0.025	4.200	0.0	13.0	0	0.000	40.000	6.145	3.920	0	1	17.5	10.0	54.0	26.0	750.	32.0	7.0	47.5	120
59 BPCW	1	36.000	2	2.690	0.025	4.200	0.0	13.0	0	0.000	40.000	6.145	3.920	0	1	17.5	10.0	54.0	26.0	750.	32.0	5.0	45.0	120
60 BPCW	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.	32.7	10.0	50.5	117
61 MEX	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 MEX	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 MEX	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 MEX	4	0.020	398	5.600	0.000	0.001	0.0	23.5	0	0.000	0.0808	6.145	3.920	1	0	-2.5	4.5	47.1	24.8	800.	3.7	4.5	44.0	125

TABLE A-7

INPUT PARAMETERS

THERMAL NOISE SUMMARY

CAR-RIER	COM-PANY	EARTH TO SPACE: EIRP (DBW)	POINTING LOSS (DB)	SPACE LOSS (DB)	RCV G/T (DB/K)	SPACE TO EARTH: EIRP (DBW)	POINTING LOSS (DB)	SPACE LOSS (DB)	RCV G/T (DB/K)	C/KT (DB/HZ) UP	DN	TOTAL	C/N (DB) UP	DN	TOTAL	TOTAL (PWOP)	THERMAL S/N (DB)	NOISE EE/KT (DB)	SINGLE ENTRY (PWOP)	S/I (DB)	OBJECTIVE C/I (DB)
1	ALAB	40.7	0.0	199.0	0.6	5.7	0.2	196.2	35.4	60.9	61.9	61.1	24.3	17.3	16.5	4105.	53.0				24.7
2	ALAB	49.6	0.3	199.0	0.6	7.2	0.0	196.2	21.7	77.5	64.1	63.1	[illegible]	18.7	18.5	2621.	55.0				72.4
3	ASC	81.0	0.3	199.0	4.0	34.0	0.3	196.2	11.0	105.5	99.2	98.1	30.0	21.7	21.0	1660.	54.4		600.	62.2	
4	ASC	64.2	0.3	199.0	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	ABC	81.0	0.3	199.0	4.0	34.0	0.0	196.2	21.5	105.5	89.9	89.8	30.4	14.9	14.8		54.0			51.3	22.0
6	ABC	78.0	0.3	199.0	4.0	33.0	0.2	196.2	33.0	102.5	98.2	96.8	26.9	22.6	21.2			10.7			20.0
7	ABC	78.0	0.3	199.0	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	ABC	65.0	0.3	199.0	-4.0	23.0	0.2	196.2	31.0	89.5	86.3	84.5	23.7	20.5	18.8			10.5			20.0
9	ABC	57.2	0.3	199.0	4.0	14.0	0.2	196.2	31.0	81.7	78.0	76.5	21.3	17.6	16.0			14.6			27.1
10	ABC	56.6	0.0	199.0	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	ABC	48.4	0.0	199.0	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	ABC	44.0	0.3	199.0	-4.0	1.0	0.2	196.2	31.0	60.5	64.2	62.0	22.4	18.2	16.8			15.3			24.0
13	AT&T	81.7	0.5	199.0	-5.0	20.6	0.2	196.2	47.0	66.0	63.9	61.8	30.0	27.0	25.8	7267.	51.4		1540.	54.5	
14	AT&T	82.7	0.3	199.0	5.0	29.0	0.1	196.2	34.0	60.4	58.1	57.9	32.4	22.1	21.9	17066.	47.5		1540.	54.5	
15	AT&T	90.6	0.5	199.0	-5.0	35.0	0.2	196.2	42.0	111.9	109.2	107.9	38.3	31.4	32.3	1643.	57.0		600.	62.2	
16	AT&T	81.0	0.3	199.0	5.0	35.0	0.1	196.2	26.5	104.5	93.0	93.5	30.9	18.3	17.9		55.2			58.2	17.0
17	AT&T	82.1	0.3	199.0	5.0	34.2	0.1	196.2	34.0	105.6	100.5	99.3	30.0	24.9	21.7			21.5			28.0
18	AT&T	83.9	0.5	199.0	5.0	33.0	0.2	196.2	42.0	107.2	107.2	104.2	31.6	31.6	28.6			24.6			33.2
19	AT&T	66.6	0.3	199.0	-5.0	15.7	0.1	196.2	34.0	90.1	82.0	81.4	29.0	21.7	21.1			19.5			27.1
20	AT&T	66.6	0.3	199.0	-5.0	15.7	0.1	196.2	32.0	90.1	80.0	79.6	29.0	19.7	19.3			17.7			25.5
21	AT&T	67.0	0.3	199.0	5.0	24.0	0.1	196.2	18.4	90.5	74.7	74.5	27.0	12.0	11.9			12.7			24.4
22	RCA	74.0	0.3	199.0	-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	199.0	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	199.0	-4.8	34.0	0.2	196.2	33.0	104.7	99.2	98.1	29.2	23.6	22.5	4137.	53.8		600.	62.2	
25	RCA	69.9	0.3	199.0	-4.8	25.5	0.2	196.2	31.0	91.6	90.7	88.9	20.5	17.5	15.7	5423.	52.7		600.	62.2	
26	RCA	81.0	0.3	199.0	-4.8	34.0	0.2	196.2	33.0	104.7	99.2	98.1	29.2	23.6	22.5		59.0			67.0	15.0
27	RCA	81.0	0.3	199.0	4.8	14.0	0.2	196.2	37.3	104.7	98.5	97.6	29.2	23.9	22.0		59.1			67.0	15.0
28	RCA	77.0	0.3	199.0	4.8	13.0	0.1	196.2	28.5	100.7	93.0	93.0	28.2	21.2	20.4		51.5			65.5	19.0
29	RCA	81.0	0.3	199.0	4.8	34.0	0.0	196.2	23.0	104.7	89.4	89.3	29.2	13.9	13.7		51.0			51.2	23.0
30*	RCA	81.0	0.3	199.0	4.8	34.0	0.1	196.2	26.5	104.7	92.0	92.6	29.2	17.3	17.0		54.1			51.2	23.0
31	RCA	75.0	0.3	199.0	4.8	30.0	0.0	196.2	23.0	98.7	85.4	85.2	26.2	12.9	12.7		41.8			40.5	23.0
32	RCA	75.0	0.3	199.0	4.8	30.0	0.2	196.2	30.0	98.7	92.2	91.3	26.2	19.7	18.8		49.9			40.5	23.0
33	RCA	81.0	0.3	199.0	4.8	34.0	0.2	196.2	31.0	104.7	97.2	96.5	29.2	21.6	20.9			10.7			28.0
34	RCA	70.5	0.3	199.0	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	199.0	4.8	15.0	0.0	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	199.0	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	199.0	4.8	0.0	0.2	196.2	30.0	76.2	63.2	63.0	30.4	16.5	16.4	175.	67.6				23.2
38	RCA	56.0	0.0	199.0	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	199.0	4.0	34.0	0.2	196.2	17.4	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	199.0	4.0	18.0	0.2	196.2	17.4	84.5	87.6	82.7	17.9	21.0	16.2	5500.	54.5		700.	72.2	
41	W.U.	79.4	0.3	199.0	4.0	36.0	0.2	196.2	34.0	103.9	100.2	98.6	28.1	24.6	23.1		60.6			67.0	15.6
42	W.U.	78.0	0.3	199.0	4.0	33.0	0.2	196.2	17.4	102.5	102.6	99.5	26.9	27.0	23.9			21.6			20.0
43	WPR	50.5	0.0	199.0	4.0	14.5	0.0	196.2	22.5	83.1	71.4	71.2	30.7	18.9	18.4	19.	74.1				21.1
44	WUIR	64.2	0.3	199.0	4.0	22.0	0.0	196.2	7.9	88.7	62.1	62.3	37.9	11.5	11.5	829.	60.0				[illegible]
45	A.F.	51.0	0.3	199.0	4.0	12.0	0.0	196.2	17.0	77.5	62.2	62.1	31.7	16.4	16.3			14.6			[illegible]
46	A.F.	60.0	0.3	199.0	4.0	18.6	0.0	196.2	17.0	84.5	68.0	68.7	32.1	16.4	16.1			14.6			24.0
47	HHS	61.0	0.3	199.0	4.0	19.0	0.0	196.2	12.0	85.5	64.2	64.2	32.5	11.2	11.2	150.	[illegible]				[illegible]
48	LRU	63.0	0.3	199.0	4.0	20.0	0.0	196.2	5.2	87.5	57.6	57.6	20.6	-9.3	-9.3			17.0			0.6
49	HAWN	81.0	0.3	199.0	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.	[illegible]	
50	HAWN	81.0	0.3	199.0	4.2	34.0	0.0	196.2	23.0	105.3	89.4	89.3	29.7	13.9	13.8		51.3			51.4	[illegible]
51	HAWN	65.0	0.1	199.0	4.2	24.0	0.7	196.2	29.7	89.3	85.9	84.3	23.2	19.9	18.3			[illegible]			[illegible]
52	HAWN	44.6	0.0	199.0	4.2	3.7	0.6	196.2	24.0	69.2	59.1	58.7	26.2	16.1	15.7	195.	64.0				[illegible]
53	SPC	81.0	0.3	199.0	2.0	34.0	0.2	196.2	30.0	106.7	96.2	95.0	33.2	20.6	20.3	6032.	[illegible]		600.	[illegible]	
54	SPC	73.0	0.1	199.0	2.0	10.0	0.2	196.2	30.0	98.7	92.2	91.1	26.1	19.0	18.9	6710.	51.7		600.	[illegible]	
55	SPC	81.0	0.3	199.0	2.0	34.0	0.1	196.2	26.7	106.7	93.0	92.8	33.2	17.4	17.3		55.1			51.6	[illegible]
56	SPC	81.0	0.1	199.0	2.0	34.0	0.0	196.2	24.2	106.7	90.6	90.5	33.2	15.0	14.9		51.0			51.6	[illegible]
57	WTCM	71.5	0.3	199.0	2.0	12.0	0.2	196.2	11.0	97.2	97.2	94.2	21.7	21.6	18.6	8002.	50.6		600.	[illegible]	
58	WTCM	71.5	0.3	199.0	2.0	12.0	0.1	196.2	26.7	97.2	91.0	90.1	21.7	15.4	14.5		55.5			51.6	22.0
59	WTCM	71.5	0.3	199.0	2.0	12.0	0.0	196.2	24.2	97.2	88.6	88.1	21.7	11.0	10.5		50.5			51.6	[illegible]
60	WTCM	70.0	0.1	199.0	2.0	15.7	0.2	196.2	30.0	103.7	97.9	96.9	[illegible]	19.3	18.1			15.9			[illegible]
61	MX	81.0	0.3	199.0	4.2	14.0	0.3	196.2	29.7	105.1	95.9	95.5	29.7	20.4	19.9	4989.	51.0		600.	[illegible]	
62	MX	81.0	0.1	199.0	4.2	34.0	0.0	196.2	23.0	105.1	89.4	89.3	29.7	11.9	11.8		51.1			51.4	[illegible]
63	MX	65.0	0.1	199.0	4.2	24.0	0.2	196.2	29.7	89.1	85.9	84.3	23.2	19.9	18.3			[illegible]			[illegible]
64	MX	44.6	0.0	199.0	4.2	3.7	0.0	196.2	24.0	69.2	59.1	58.7	26.2	16.1	15.7	195.	64.0				[illegible]

TABLE A-8

THERMAL NOISE SUMMARY

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

SIGNAL TYPE INDEX

0 = FDM/FM
1 = TV/FM
2 = DIGITAL
3 = SCPC/PSK
4 = SCPC/FM
5 = CSSB/AM
6 = SS/PSK

POLARIZATION TYPE INDEX

0 = HORIZONTAL
1 = VERTICAL

2 = 20 DEG CANTED HORIZONTAL
3 = 20 DEG CANTED VERTICAL

4 = LEFT-HAND CIRCULAR
5 = RIGHT-HAND CIRCULAR

POLARIZATION ISOLATION MATRIX

		INTERFERING SENSE					
		0	1	2	3	4	5
	0	0.0	10.0	0.0	6.9	3.0	3.0
D	1	10.0	0.0	6.9	0.0	3.0	3.0
E							
S	2	0.0	6.9	0.0	10.0	3.0	3.0
I							
R	3	6.9	0.0	10.0	0.0	3.0	3.0
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 ASSUMED 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 A-9

FOOTNOTES

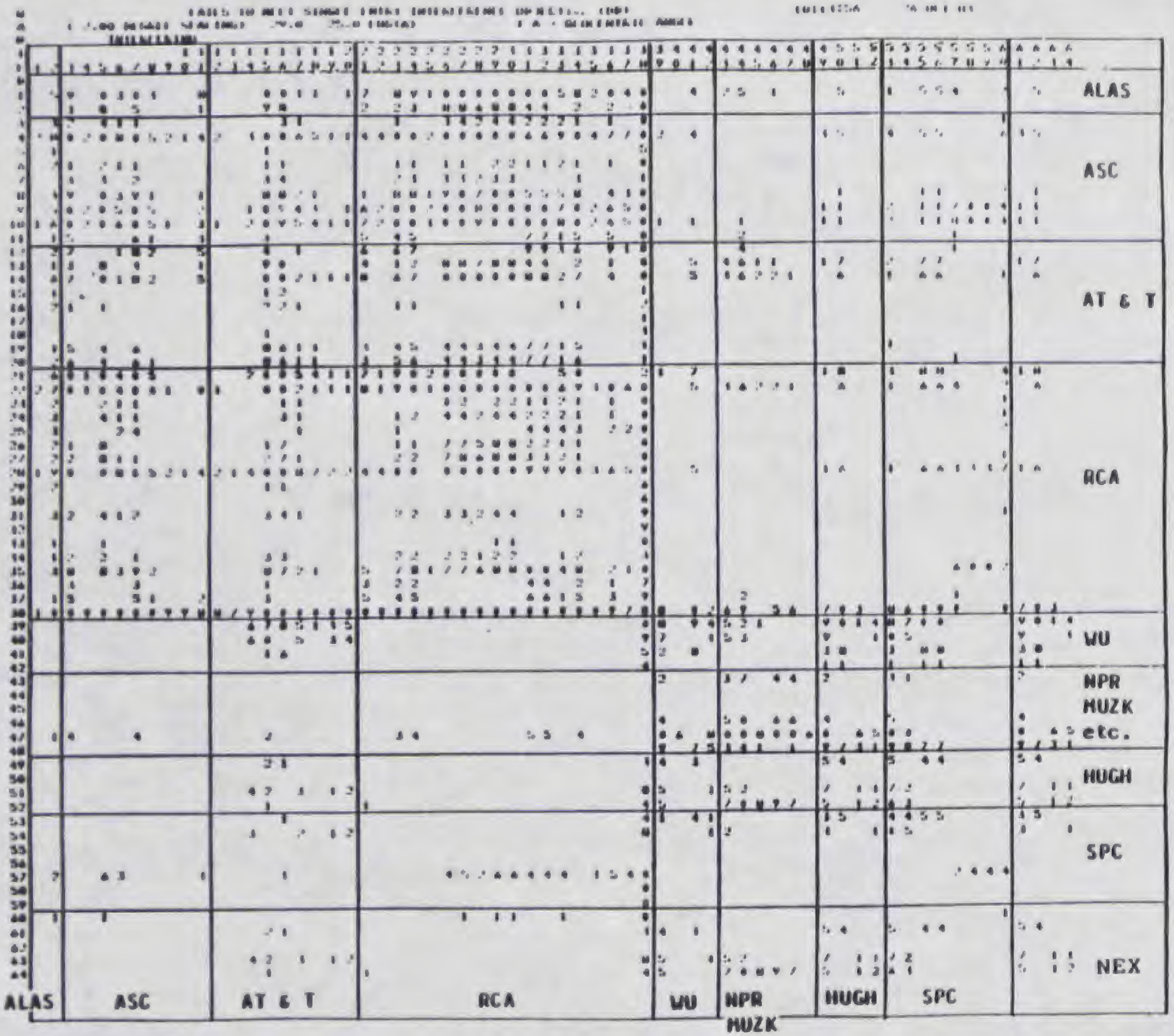


TABLE A-10

POTENTIAL INTERFERENCE SITUATIONS
("HUGHES/WESTAR" POLARIZATION)

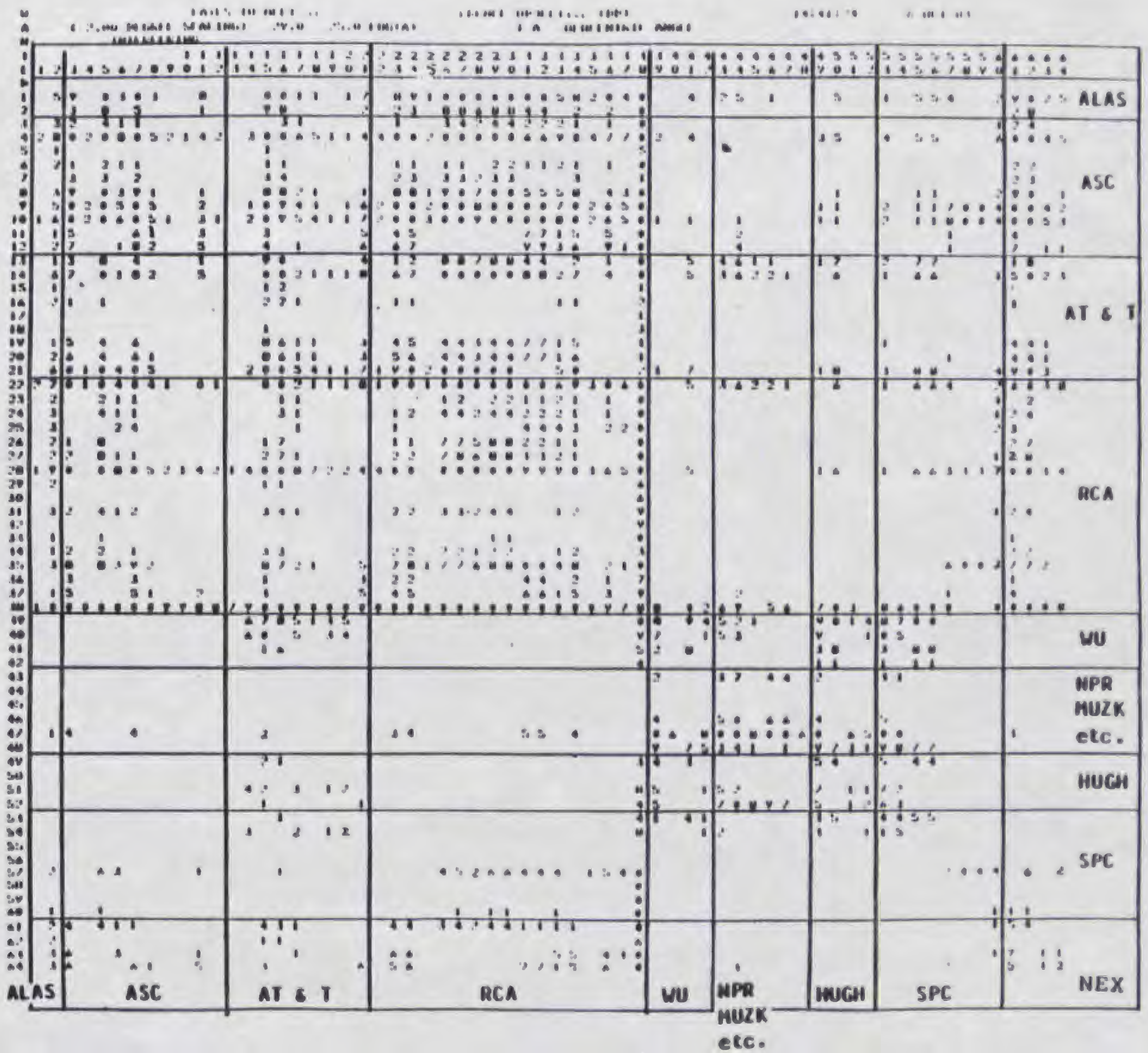


TABLE A-11

POTENTIAL INTERFERENCE SITUATIONS
("RCA" POLARIZATION)

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

In re Application of	)	
	)	
NATIONAL EXCHANGE, INC.	)	File No. ________
	)	
For Authority to Construct,	)	
Launch and Operate	)	
a 4/6-GHz and 12/14-GHz	)	
Hybrid Satellite System	)	
in the Domestic Fixed-	)	
Satellite Service.	)	

To: The Commission

APPLICATION

Henry Goldberg
Jeffrey H. Olson

GOLDBERG & SPECTOR
1229 Nineteenth Street, N.W.
Washington, D.C. 20036
(202) 429-4900

Counsel for
National Exchange, Inc.

September 15, 1987

TABLE OF CONTENTS

I. THE SPOTNET SATELLITE SYSTEM.

A. Applicant Name and Address.

National Exchange, Inc.
1505 Planning Research Drive
McLean, Virginia 22102
(703) 883-8833

B. Correspondence.

Correspondence relating to this application should be sent to the following person at the address in Paragraph 1 above (unless otherwise indicated):

George S. Kush
Executive Vice President

with a copy to:

Henry Goldberg, Esq.
Jeffrey H. Olson, Esq.
Goldberg & Spector
1229 Nineteenth Street, N.W.
Washington, D.C. 20036
(202) 429-4900

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

1. System Facilities and Operations.

In this Application, National Exchange, Inc. ("NEX"), is applying for authority to construct and operate a satellite system employing levels of technical sophistication well beyond anything presently in operation. Known as "SpotNet," the NEX system represents a significant advance in satellite communications system design and use, thereby providing great benefits to customers of satellite services and the public at large.

The key features that are unique to the SpotNet system are (1) the use of multiple Ku-Band coverage patterns that are adapted to the traffic load of the United States; (2) a frequency domain method of switching traffic between those patterns which requires no active control at the satellite; (3) figure-of-merit and EIRP-per-Hertz ratings that permit access to the network with small customer-premise transmit/receive earth stations, which, unlike present hub-and-spoke VSAT networks, will allow full interconnectivity among such small earth stations; and (4) multiple reuse of orbital frequencies such that up to 4,000 MHz of usable bandwidth is available for the Ku-Band service at each orbital location (instead of the 1,000 MHz available with conventional satellite design). These features make the SpotNet system capable of far more extensive and effective use of orbital and frequency resources than any other present or proposed satellite system, domestic or international.

The SpotNet satellite configuration described herein is based on studies of traffic types and densities across the U.S., and reflects a design that meets those traffic needs. However, the final payload configuration may vary, based on detailed design studies performed by the satellite manufacturer in order to achieve the best balance of traffic flexibility, cost, complexity, and performances, particularly at Ku-Band.

The SpotNet space segment will consist of two in-orbit satellites, each operating in the 12/14 GHz frequency range and in the 4/6 GHz frequency range. NEX requests that the SpotNet satellites be assigned to operate from two orbital positions, one at 101° W.L. and one at 93° W.L., both having the capacity to provide full CONUS coverage plus service to Puerto Rico, the Virgin Islands, Hawaii and major portions of southern Alaska. The satellites will have encrypted telemetry, tracking and command ("TT&C") circuits, and all signalling channels will be encrypted as well. Domestic ELVs will be the prime candidates for launching the SpotNet satellites; they will also be compatible with the Ariane and the Long March vehicles. NEX plans to launch its first satellite during 1993 or early 1994.

a. Ku-Band.

Each SpotNet satellite will support eighteen distinct coverage patterns for the Ku-Band service. These patterns range in size from very small near-circular spots covering eastern and western urban areas to one-fifth CONUS coverage of areas with lower population density. These patterns are the outcome of analyses conducted by NEX as to how best to provide spot beam service to the United States and reflect an excellent correlation between the traffic base and the capacity of the satellite. The satellite antenna gains for these patterns range from 7 dB to 21 dB higher than for single pattern coverage of CONUS and, thus, permit the satellite's Ku-Band downlink power to be used very effectively, making practical the use of small aperture earth stations with moderately sized final amplifiers. Moreover, the smaller coverage patterns permit frequency reuse, in a manner analogous to that used for cellular telephone systems.

High reliability, low cost and low maintenance will be essential features of the Ku-Band portion of the SpotNet system. In some situations, customer locations will have multiple antennas, which -- depending on which satellite(s) the antennas are pointed toward and which frequency band(s) they are operating in -- will allow simultaneous operation with satellites in both orbital positions (enhancing routing diversity), add reliability during rainstorms, and/or avoid sun-outage and eclipse interruptions. In addition, the 4/6-GHz capability will substantially increase the routing diversity and rain/sun-outage and eclipse protection that will be available for the overall SpotNet system. The system thus offers flexibility of routing and redundancy that is unusually innovative and responsive to customer needs.

b. C-Band.

The SpotNet C-Band subsystem will utilize conventional CONUS-wide beams, with spot beams for southern Alaska, Hawaii, Puerto Rico and the Virgin Islands. 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 C-band bandwidth for each satellite at each orbital location.

c. TT&C and NCC.

The ground segment of the SpotNet satellite system will consist of two TT&C earth stations for tracking, monitoring, range-finding and command functions. Each TT&C station will include two 5.5-meter diameter antennas, operating in the 12/14-GHz frequency band. 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 ("NCCs"). 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 command channels will be encrypted to avoid unauthorized access and possible harm to the satellites.

2. Proposed Services.

As the American economy's demand for more sophisticated and efficient information technologies continues to grow, the existence of communications systems capable of supporting this demand will be of vital import. During the next decade, the expected use of wideband information services threatens to outpace the capacity and capability of the existing telecommunications network. Across-the-board increases in capacity -- both terrestrial, particularly including costly optical fiber, and space-based -- will be required to meet the growing demand that is being driven by the rapid growth of business and institutional use of mainframe computers, minicomputers, personal computers, digital terminals, local area networks (LANs), digital PBX systems. As a whole generation of satellites are retired from service during the early to mid-1990s, renewal of this resource, particularly by satellites with expanded capabilities, is vital to the public interest.

NEX's satellite system will respond to this need. It will allow NEX to offer new services to virtually every business location in the country, at rates that are highly competitive with current rates offered on much more limited systems by carriers of intracompany information transmissions. The use 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-premises earth stations.

NEX anticipates that its Ku-Band 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 the SpotNet high-capacity spot beam design. The SpotNet Ku-Band capability also can provide economical service to small telephone companies in rural and remote areas, thus helping to ensure that residences and businesses in hard-to-serve areas will have access to the same low-cost, high-performance services available in more populous regions. No other satellite system provides the Ku-Band EIRP, antenna gain, or flexibility of the SpotNet system. The spot beam design allows much less costly earth stations, thus allowing customers a lower overall circuit cost than other domestic satellite systems.

In addition to supplementing the Ku-Band capability for point-to-multipoint message distribution, the C-Band capability described herein will fill the need, anticipated for the 1993-94 period and beyond, for continuation of the current C-Band broadcast video distribution functions. Two of the major broadcast networks, CBS and ABC, currently depend, for all practical purposes, entirely on C-Band satellite capacity to distribute network programming; these facilities employ approximately 350 C-Band earth station antennas. The existing satellite transmission systems are expected to remain operative only until the 1994 time-frame at the latest, thus requiring that new C-Band capacity be available to insure uninterrupted service. Moreover, other major users of C-Band satellite capacity -- companies such as Hughes Television Network ("HTN"), which currently provides video backhaul service for sports events -- are similarly situated. They, too, are dependent on the continued existence of considerable C-Band satellite capacity in order to provide services to their customers.

The exact nature of the traffic being carried will depend on customer requirements, which will, in turn, determine the design of user earth terminals. For C-Band, stations may vary from 10-meters or smaller for analog video and FDM/FM telephony to 4.5-meter stations or smaller for TV, radio receive-only and narrowband SCPC telephony. For Ku-Band, 2.0-meter or smaller stations for 64 Kbps and 1.544 Mbps will be the norm.

D. General Technical Information

The SpotNet system will consist of two in-orbit hybrid satellites, with one proposed to operate at 101° W.L. and the other at 93° W.L. Overall coverage from these two orbital locations is shown in Figure 1. This application deals only with the space segment of the SpotNet system. Separate applications for the ground segment, including TT&C stations and customer-premise earth stations, will be filed in the future.

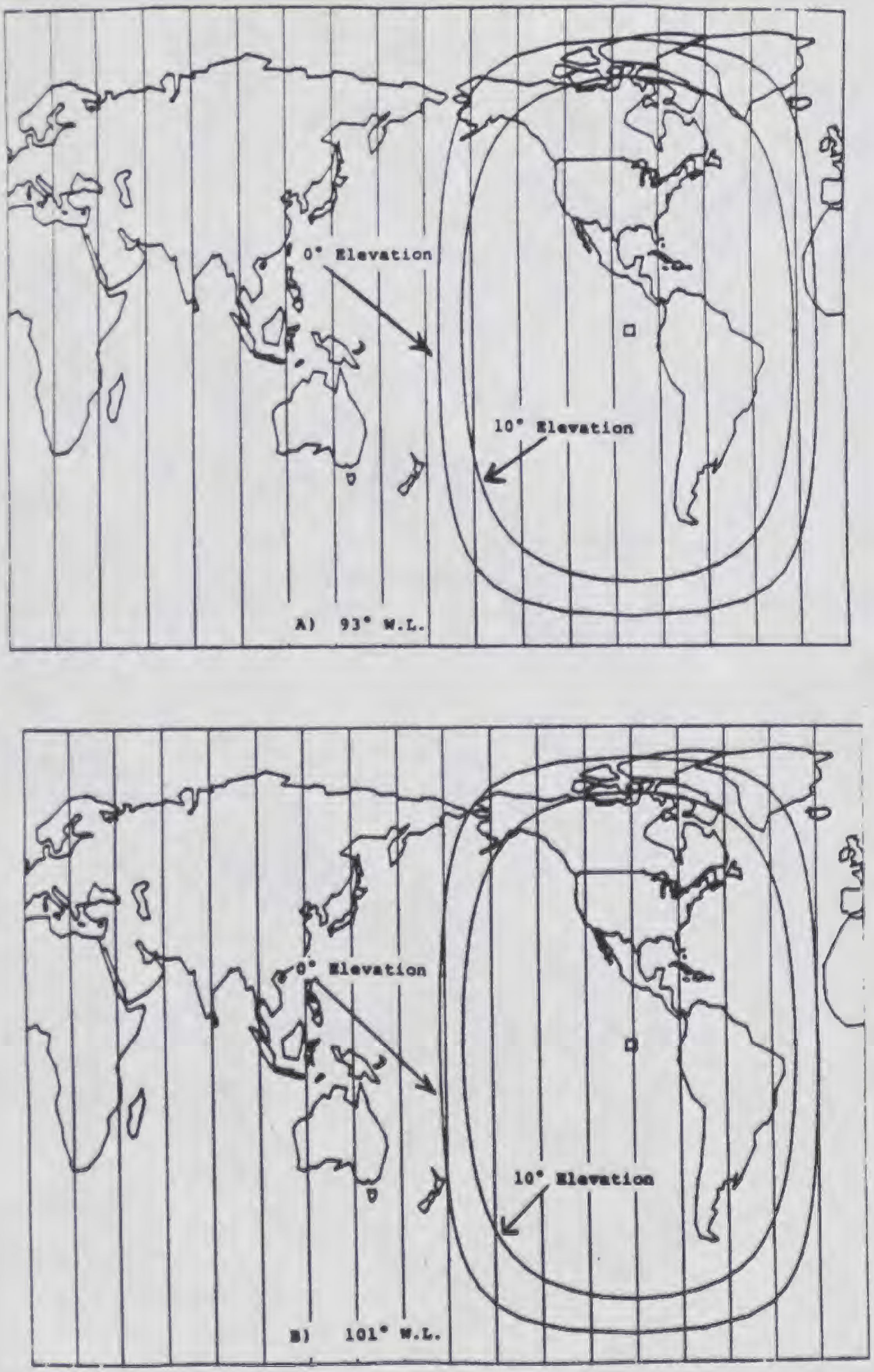


Figure 1. Satellite Coverage Contours

1. Radio Frequency Plan.

a. Ku-Band.

The eighteen SpotNet patterns are divided into two sets of nine each. One set, referred to as "beams" herein, has vertical polarization; the other set, "spots", is horizontally polarized. In the SpotNet architecture, the dense urban traffic is served by the higher gain spots while regional coverage is obtained by the lower gain beams. Based on traffic studies (and subject to change based on more detailed satellite design studies), the beams would be allocated a 167 MHz bandwidth, and the spots 250 MHz. The saturation boresight EIRP for the beams is 61 dBW, except for three beams west of the Mississippi, which are 60 dBW. The boresight EIRP is 63 dBW for each of the nine spots, reflecting the proportionately larger bandwidth available in a spot. The final amplifiers for the satellite downlinks are rated from 10 to 120 watts per pattern, which reflects the variation in antenna gain across the patterns.

The traditional concept of a "transponder" is inappropriate to the SpotNet Ku-Band payload, because of the separate handling of uplink and downlink processes by the SpotNet system. Based on the total reusable frequency, SpotNet's capacity would correspond to the equivalent of 90 transponders (prorated at the usual 12 per 500 MHz in current practice). Drawing a similar analogy, the proportional saturated EIRP for SpotNet is equivalent to 55 dBW per transponder on a conventional satellite with 36 MHz transponders. Since all SpotNet downlinks are multi-carrier, the final amplifiers are always operated in a "backed-off" mode, such that the actual EIRP will not exceed the equivalent of 52 dBW in a conventional transponder; these figures are 1 dB less for the three beams west of the Mississippi.

By spatial isolation, the SpotNet Ku-Band payload design reuses the lower-half spectrum five times and the upper-half four times, and each of the third-band beam frequencies is reused three times. Altogether, the SpotNet design would provide a reuse ratio of 7.5 (accounting for both polarization and spatial separation) for a total workable bandwidth of 3,750 MHz. Depending on the final design chosen, this total workable bandwidth could vary from 2,000 to 4,000 MHz.

A functional block diagram of the SpotNet Ku-Band payload is shown at Figure 2. The overall use of the Ku-Band spectrum by space, polarity, and frequency is exhibited at Figure 3. The two in-orbit satellites and the ground spare will be identical in design and construction except for slight variations in the antenna patterns and for assignment of the frequency bands to spatial regions.

~~3-5 times re~~
~~3-5 times reused~~
spatial reuse factor

Spat reuse factor

3-5 times freq reused

towards the end of life of new system, full use at that time there could be a max of

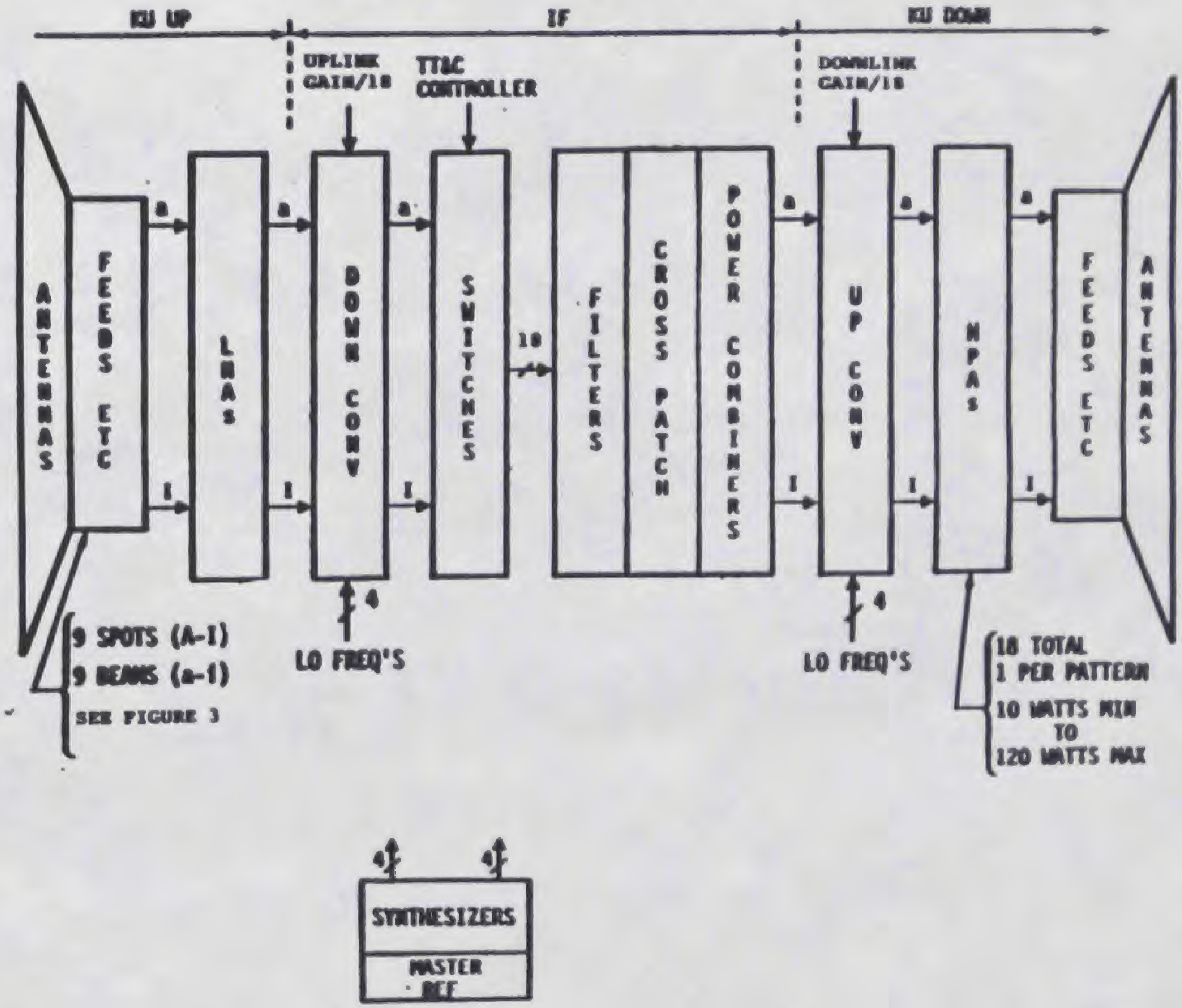


Figure 2. Organization of the Ku-Band Payload for Spotnet Satellite

NOTES: 1. ASSUMED 14' (4.3M) ANTENNA ON SPACECRAFT.

2. UPPER CASE DESIGNATES "SPOT" - HORIZONTALLY POLARIZED - 250 MHz BW's.

3. LOWER CASE DESIGNATES "BEAM" - VERTICALLY POLARIZED - 167 MHz BW's.

4 NUMBERS INDICATE ANTENNA BORESIGHT GAIN IN DBI.

POTENTIAL REUSE RATIO = 7.5

LEGEND:

VERTICAL LOWER 3rd

VERTICAL MIDDLE 3rd

VERTICAL UPPER 3rd

HORIZONTAL LOWER HALF

HORIZONTAL UPPER HALF

Figure 3 Frequency and Polarization Usage

b. C-Band.

The SpotNet satellites will also operate in the 4/6-GHz bands (3,700-to-4,200-MHz space-to-earth and 5,925-to-6,425-MHz earth-to-space). A functional block diagram of the C-Band subsystem is shown in Figure 4. The frequency and polarizations of the 24 C-Band transponders is given in Figure 5. 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.

For purposes of systems and interference analyses, it has been assumed that the C-Band 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.

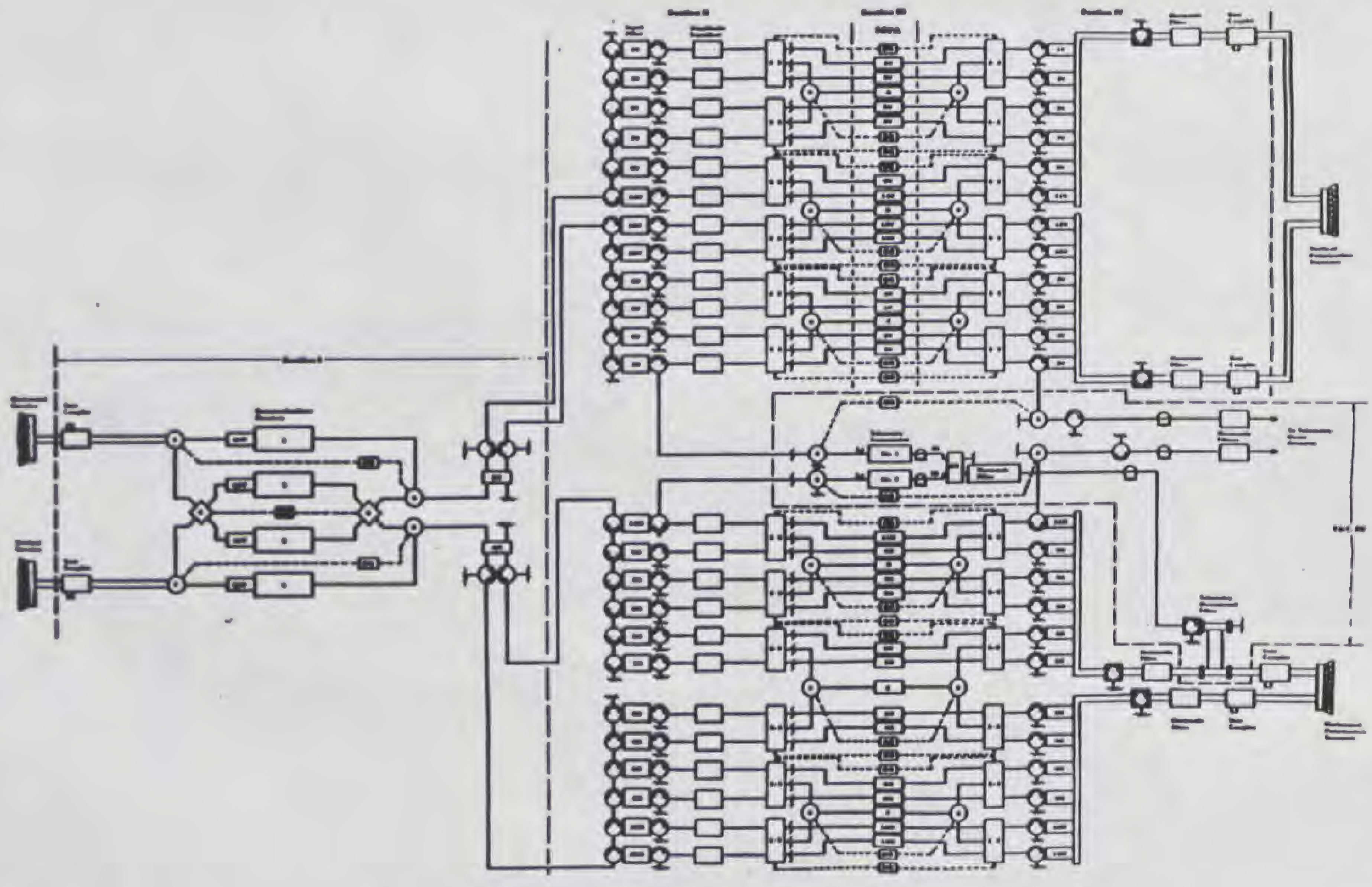
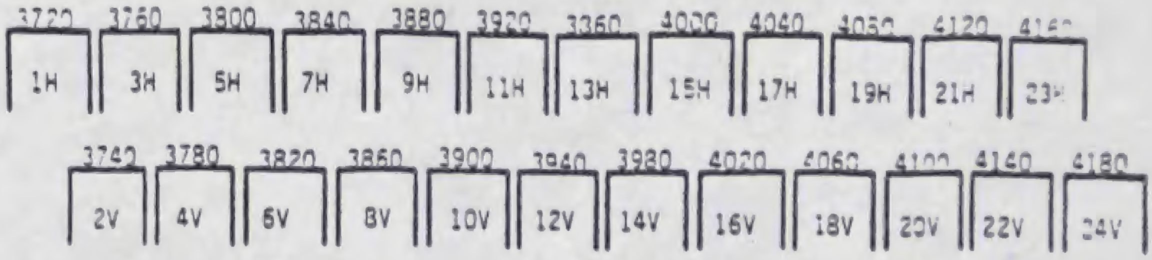
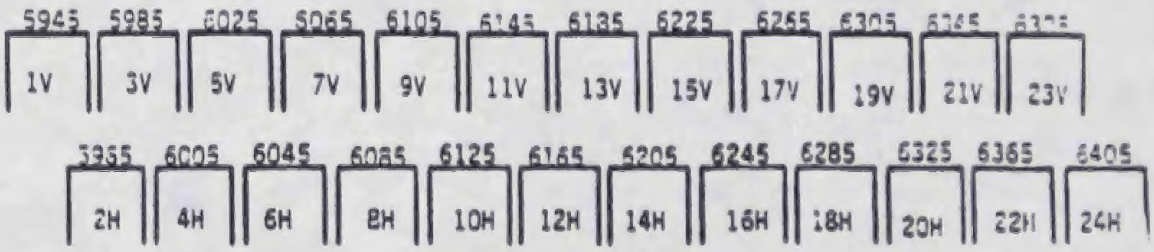


Figure 4. C-Band Subsystem



DOWNLINK CENTER FREQUENCIES & POLARIZATIONS



UPLINK CENTER FREQUENCIES & POLARIZATIONS

V = Vertical Polarization
H = Horizontal Polarization

COMMUNICATIONS
FREQUENCY AND POLARIZATION PLAN

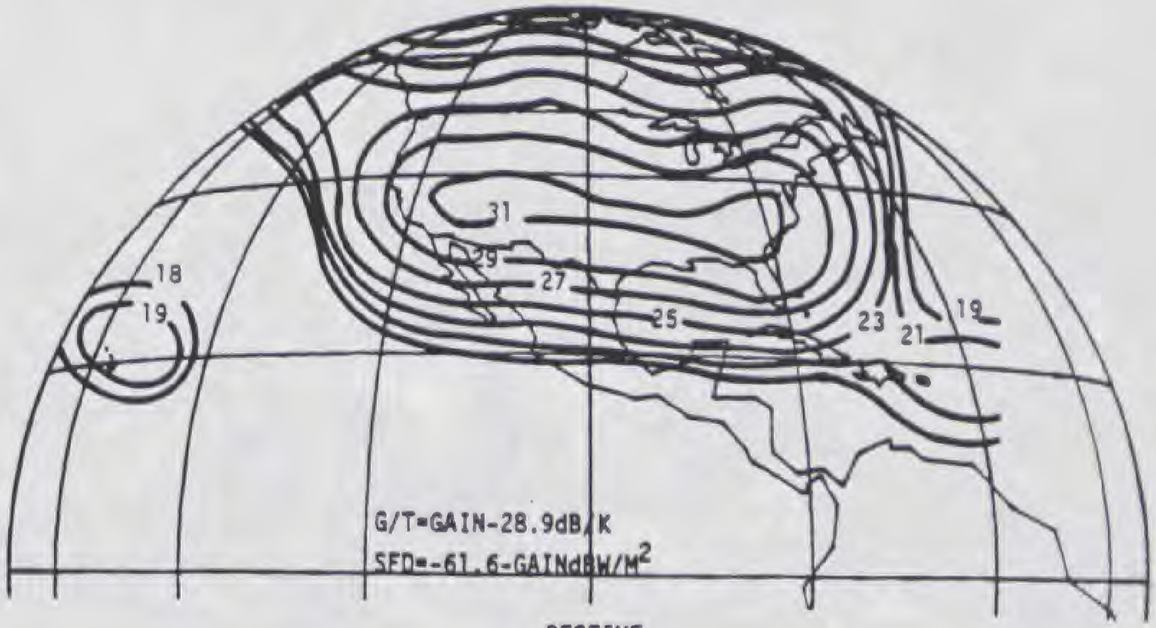
Figure 5.

In the FDM/FM mode, transponders can carry one or more carriers, depending on the nature and volume of traffic. In the TV/FM mode, each transponder may be carrying a single video channel and associated audio channel(s) occupying the entire transponder. In this mode, energy dispersal of 2 MHz will be 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.

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.

The horizontal and vertical polarization patterns of the satellite antenna gain contours are provided in Figures 6 through 9 for the two requested orbital locations of 101° W.L. and 93° W.L.



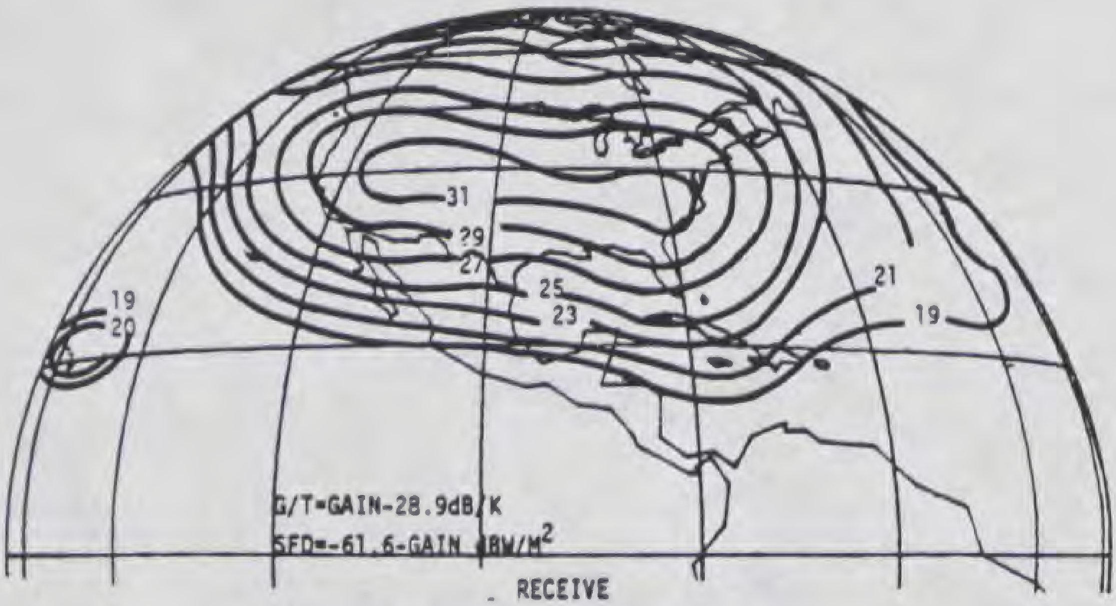
RECEIVE

HORIZONTAL GAIN CONTOURS (101° WEST)

TRANSMIT

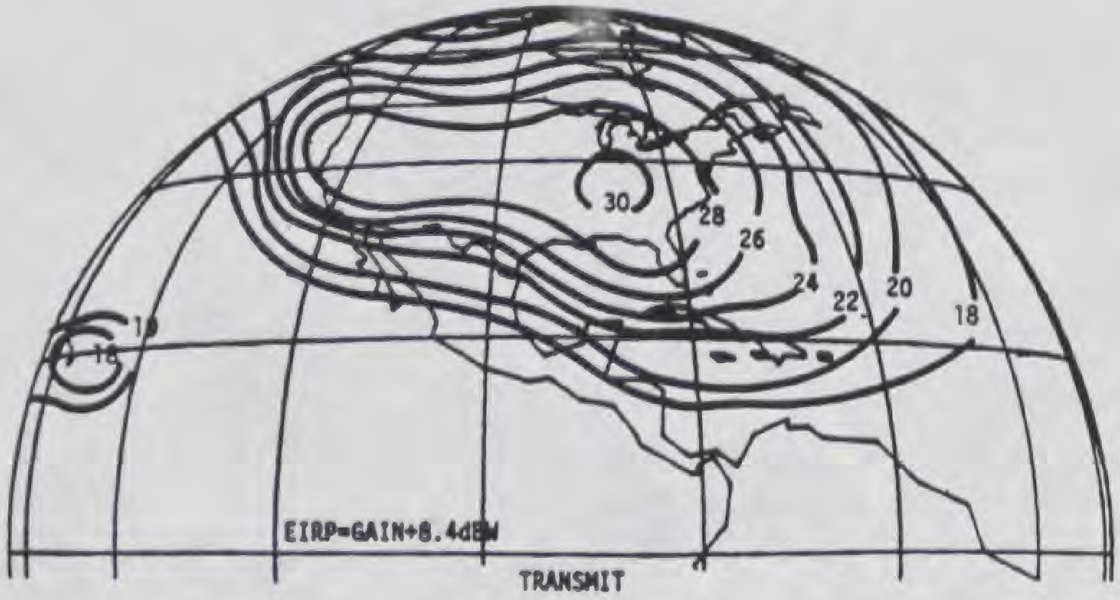
HORIZONTAL GAIN CONTOURS (101° WEST)

Figure 6 Horizontal Gain Countours (101° W.L.)



RECEIVE

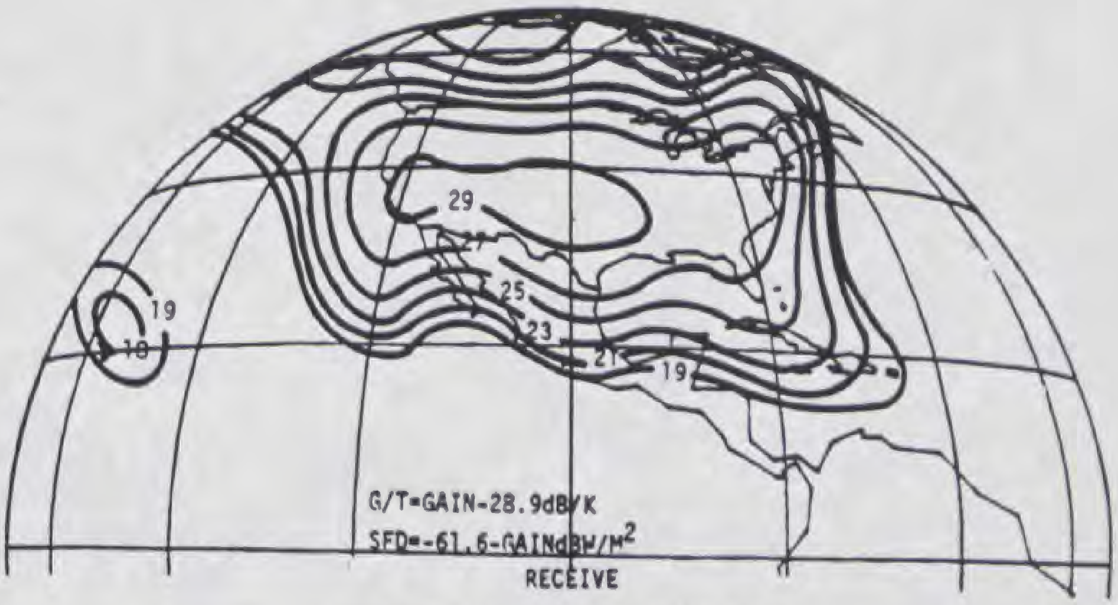
HORIZONTAL GAIN CONTOURS (93° WEST)



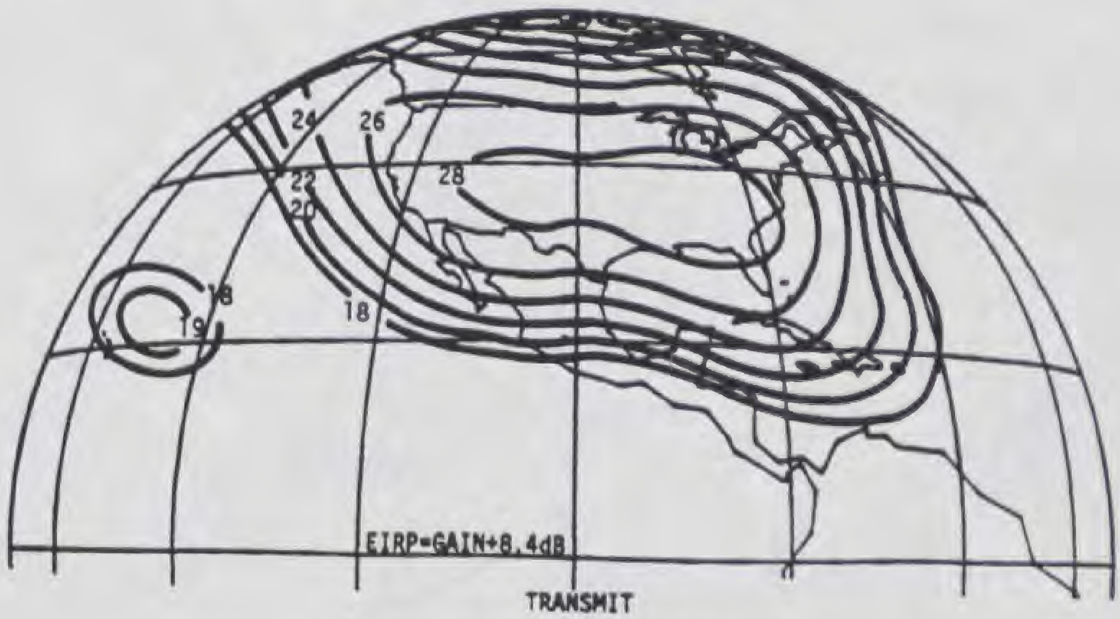
TRANSMIT

HORIZONTAL GAIN CONTOURS (93° WEST)

Figure 7 Horizontal Gain Countours (93° W.L.)

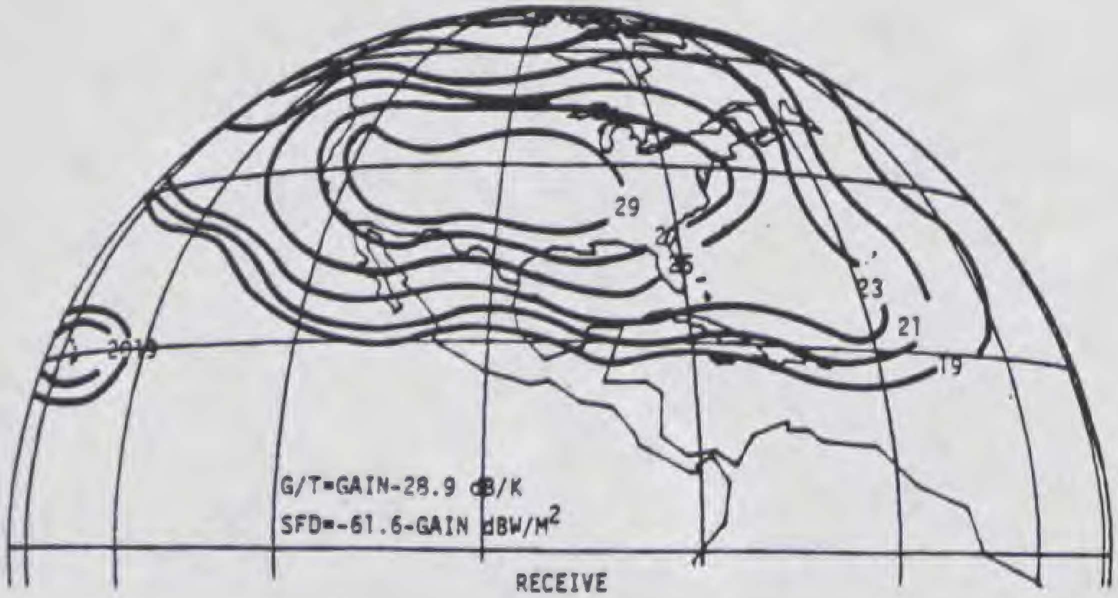


VERTICAL GAIN CONTOURS (101° WEST)



VERTICAL GAIN CONTOURS (101° WEST)

Figure 8 Vertical Gain Countours (101° W.L.)



VERTICAL GAIN CONTOURS (93° WEST)

VERTICAL GAIN CONTOURS (93° WEST)

Figure 9 Vertical Gain Countours (93° W.L.)

2. Calculations of Power Flux Density Levels Within Each Coverage Area and Energy Dispersal Needed for Compliance with Section 25.208.

The power flux density limits specified in Section 25.208 of the Commission's rules do not apply to the 11.7 - 12.2-GHz band. The following relates to the 3.7 - 4.2-GHz band.

Using the satellite antenna contours described in Figures 6 through 9 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 the 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 the 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 limit given in the ITU radio regulations and in the FCC implementation thereof. 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 less than 5° to the satellite from a fixed terrestrial station.

Coverage of Puerto Rico, the Virgin Islands, Hawaii, and portions of Alaska 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 users will utilize earth terminals with correspondingly better G/Ts to maintain optimal levels of service.

3. Number of Satellites.

The space segment of the SpotNet satellite system will consist of three hybrid 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 operational satellites.

4. Estimated Number and Geographic Distribution of Earth Stations.

The vast majority of the SpotNet Ku-Band earth stations will be located on the premises of NEX's customers, and distributed at sites throughout the United States. The exact number will be a factor of market demand.

NEX estimates the capacity of the Ku-Band segment of the payload as 50,000 full duplex calls among a network of as many as 12,000 medium-scale two-way terminals, with a concurrently operative sub-network of some 100,000 small data terminals, also transmit/receive.

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.

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

5. Physical Characteristics of the Space Stations.

NEX proposes to launch two SpotNet satellites with capabilities that are essentially identical. A third satellite will be held as a ground spare. The communications payload of each satellite will consist of eighteen transmitters and receivers operating in the 12/14 GHz system and 24 transponders in the 4/6 GHz system. NEX plans to use an existing satellite bus, such as a Hughes spin-stabilized HS-393 or an RCA three-axis stabilized RCA-S-5000, with the final choice of satellite type, satellite manufacturer and launch system to be made during the procurement process.

The SpotNet satellites will be designed to maintain the inclination of the orbit to ± 0.05 degrees or less, and the longitude position within ± 0.05 degrees. The antenna-pointing accuracy for all satellites will be maintained within ± 0.05 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 active transponder channels and the housekeeping loads. Sufficient battery capacity will be provided to deliver power for all housekeeping functions, and approximately half-power for the transponders during the eclipse periods at the end of the satellite's useful life.

The primary source of power will be solar cells with energy-storage batteries for eclipse operation. No single failure in the electrical energy system will cause spacecraft failure. The following Table 1 provides further details.

Table 1
Operational Satellite Characteristics

Parameter	Type or Value
Launch vehicle	Domestic ELV, Ariane or Long March
Launch date	See Schedule
Satellite mission life/ design life	10 years
North-south stationkeeping accuracy	0.05°
East-west stationkeeping accuracy	0.05°
Eclipse capability	100%
Stabilization	Spin or 3-axis stabilized
RF output power	Ku-Band: 3 @ 10 watts 4 @ 15 watts 1 @ 20 watts 2 @ 30 watts 1 @ 50 watts 4 @ 75 watts 3 @ 120 watts C-Band: 24 @ 9 watts
Communications channelization	Ku-Band: 9 "Spots" @ 250 MHz 9 "Beams" @ 167 MHz C-Band: 24 transponders @ 36 MHz
Communications EIRP	Ku-Band: 9 "Spots" @ 63 dBW/250 MHz 6 "Beams" @ 61 dBW/167 MHz 3 "Beams" @ 60 dBW/167 MHz C-Band: CONUS, 34 dBW Alaska, 30 dBW Hawaii, 27 dBW Puerto Rico, 28 dBW
Communications Receive G/T	Ku-Band: 3 western "Beams" at +5 dB/K; other patterns from +8 to +19 dB/K C-Band: CONUS at -5.9 dB/°K Alaska at -8.4 dB/°K Hawaii at -10.4 dB/°K Puerto Rico at -10.0dB/°K
Communications Receive SFD	C-Band: -89.9 to -96.9 dBW/m^2 Ku-Band: No direct equivalent parameter; uplink power is controlled to a level of -110 dBW/m^2 (or less) per 1.5 MHz channel.

12/14-GHz communications frequencies:	
Transmit	11.700 to 12.200 GHz
Receive	14.000 to 14.500 GHz
4/6-GHz communications frequencies:	
Transmit	3.700 to 4.200 GHz
Receive	5.925 to 6.425 GHz
TT&C EIRP	To be determined (TBD)
TT&C Receive	TBD
flux density	TBD
TT&C frequencies:	
Telemetry	TBD
Command	TBD
Communications polarization:	Ku-Band: 9 "Spot" patterns horizontal on uplink and downlink; 9 "Beams" patterns vertical on uplink and downlink
	C-Band: 12 transponders with vertical uplink and horizontal downlink, 12 transponders with horizontal uplink and vertical downlink
TT&C polarization	
Telemetry	TBD
Command	TBD

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 satellite will be designed for an on-orbit minimum mission life of 10 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 primary and spare SSPAs and TWTAs. 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 space-proven hardware.

The propulsion subsystem will be sized for and loaded with sufficient propellant to maintain operational attitude and station-keeping control for at least 10 years. Additional propellant will also be incorporated to provide correction of the initial orbit, initial attitude acquisition, satellite spin or despin as 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 single SpotNet satellite system link consists of the earth station transmitting chain, including the encoder and modulator, the uplink path, the satellite itself, the downlink path and receiving earth station, and the associated control equipment. The overall availability of each link is enhanced by: (1) the two-satellite, two-orbit-location system; (2) the multiple-spot-beam coverage; (3) designing the system to permit very small earth stations; (4) designing earth stations that can access any uplink channel; (5) incorporating both active and passive redundancy into the SpotNet satellite; and (6) a conservative approach to the specification of communications link performance. The overall availability of each link, in addition, is enhanced by simultaneous operation of the SpotNet C-Band and Ku-Band subsystems.

Since outages can also result from failure of the power and attitude control subsystems of the satellite, active redundancy and standby redundancy will respectively, be employed in these critical subsystems. Two orbital positions are necessary to permit continued system use during eclipse and solar outage. Eclipse and 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. Because

NEX does not anticipate significant usage during eclipse periods, on-board battery capacity will be provided to power all required spacecraft functions, but for only reduced transponder power levels. Customers who require uninterrupted service during eclipse and solar noise outage periods can obtain such protection through the installation of dual antenna systems looking at both satellites.

Protection from outages due to heavy rainfall can be achieved by application of space-frequency diversity principles in any area. Such diversity is made economically possible by the small earth stations employed, as well as by the superior efficiency with which the SpotNet satellite system employs the geostationary orbit.

The SpotNet satellites will be designed for an operational and mission life of 10 years, a factor determined primarily by the amount of station-keeping propellant that is carried and the accuracy of orbit injection. The reliability of the Ku-Band electronics power amplifiers is such that a high probability of continuous acceptable performance of all eighteen Ku-Band patterns is assured over the lifespan of the SpotNet satellite. Use of SSPA technology with redundant final amplifiers is a key component of the SpotNet Ku-Band reliability strategy, as is the wide use of common filtering components in the Ku-Band switching facility. Similarly, the C-Band transponder configuration provides a high degree of reliability by means of a 30-for-24 TWTA redundancy.

Life and reliability of the other components and subsystems will be maximized by using space-proven hardware.

The ground segment TT&C equipment will also employ standard designs of proven reliability, with proven fail-safe capabilities and equipment redundancy to ensure a high level of availability. The use of two widely separated TT&C stations, as described earlier, will further add to system reliability and orbit determination.

7. Vehicle and Arrangements for Procuring Launch Services.

The SpotNet satellites will be compatible with a launch by a domestic ELV, Ariane, or the Long March. 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 appropriate 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 5.5-meter-diameter antennas, operating at 12/14 GHz. These facilities will be staffed around the clock, and will have the responsibility for assuring proper operation of the satellites using the tracking, monitoring, rangefinding and command functions associated with the TT&C system. They will also have the responsibilities associated with the allocation, assignment, and adjustment of SpotNet 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.

NEX proposes to provide two basic services -- described herein as a "medium" and a "small" network -- via its Ku-Band satellite system. Other special services also could be provided.

In the medium network, each station will be able to achieve full mesh interconnectivity, with all medium network terminals served by a single satellite, using frequency agility and multi-carrier TDMA/FDMA access methods. The TDMA burst rate is presently planned to be approximately 1,200 kilosymbols/second and is based on a traffic quantum of 32 Kbps per entry (or slot) with 50 slots per TDMA frame. Each medium station has the capability to have 24 slots active concurrently, representing a full T-1 loading of independently targeted calls; larger stations could also be accommodated. TDMA channels are located on nominal 1.5 MHz centers with a total of 324 such channels being formed from the 500 MHz bandwidth available at Ku-Band. With the 7.5 frequency reuse, this yields a total of 2,430 such TDMA channels with over 100,000 slots.

These slots provide a general omnibus digital connection for the transport of speech, electronic mail, video conferencing, computer-aided design/manufacturing, and other forms of information transfer for which full network switchability is essential.

In the small network, large sets of very small aperture stations are organized in a star configuration with a central hub. The small sub-networks use TDM out-routes and sub-channel TDMA in-routes as are typically found in VSAT architectures. These sub-channels are derived by dividing a medium network channel into five parts with an occupied bandwidth of 300 KHz per sub-channel. The transmission rate in the small network is 240 kilosymbols/ second. NEX has optimized the SpotNet small network for applications such as point-of-sale terminals where the traffic is bursty and the average data rate is low.

The SpotNet C-Band system 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 C-Band transponders will be available.

2. Transmission Characteristics, Modulation Parameters, and Performance Objectives.

a. Ku-Band.

Typical use of the SpotNet Ku-Band system will be activities in the small or medium network described supra. NEX has concluded since the filing of its 1983 application that a "large" (e.g., 45 Mbps) network is not a feasible part of the Ku-Band SpotNet offering, and service of this type is, therefore, no longer proposed for the Ku-Band payload.) Performance objectives for these services are shown in Table 2; key transmission parameters are summarized in Table 3.

Table 2

Overall Ku-Band Link Availability Due to Weather

Network	Objective
"Small"	BER no worse than 10^{-6} for 99.5% of time
"Medium"	BER no worse than 10^{-6} for 99.5% of time

Table 3

Typical Ku-Band Earth Station Parameters

Parameter	Medium Network	Small Network
Bandwidths of channel centers	1500 KHz	300 KHz
Access methods	TDMA/FDMA	TDM/FDMA (out) TDMA/FDMA (in)
Frequency accessibility	Agile to all channels in up & downlinks	Fixed
Network topology	Mesh	Star
Transmission speed	1200 Ksym/sec	240 Ksym/sec
Modulation form	QPSK	BPSK
Convolutional code rate and constraint length	3/4 45	1/2 36
Decoding method	Sequential	Sequential
Net thruput/channel	1536 Kbps	96 Kbps
Frame efficiency	0.667 bits/dim.	0.400 bits/dim.
Antenna	1.8 meter	1.2 meter
HPA rating	2.0 watts (4.0 watts in western beams)	0.5 watts
LNA rating	250°K	300°K
Features	Uplink power control	* * * *

b. C-Band.

For broadcast video, each C-Band transponder will be capable of handling a single video channel and associated audio channels. A number of additional audio or digital subcarriers can also be carried in such a configuration. The total number of subcarriers depends on the power assigned to each carrier. Techniques to further expand the useful transmission capabilities of each transponder for multichannel 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 the solid-state final amplifiers in this design, NEX anticipates that more than 60 SCPC program audio channels (plus additional text channels) can be carried per transponder. In the case of SCPC telephony, approximately 1,600 SCPC telephony channels can be accommodated in a single transponder. NEX will be able to carry approximately 720 56-Kbps digital channels per transponder.

Overall C-Band link performance objectives are given in Table 4.

Table 4

Overall C-Band 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 (uncompanded)

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 C-Band 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 5.

Table 5

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

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

Table 6

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
C/N_{total}	13.4 dB

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 companded. Major link parameters for this mode are given in Table 7.

Table 7

Communications Link Budget - SCPC Telephony

Uplink for 10 meter antenna (6,170 MHz)	
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 hor. 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 (4,000 MHz)	
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
Antenna 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

3. Space Communications Subsystem.

The Ku-Band payload, as presently conceived, is diagrammed in Figure 2, *supra*. Each uplink pattern is intercepted by SpotNet's large antenna and is served by a dedicated set of feed horns which determine its characteristic coverage pattern.

After initial amplification at 14 GHz, the broadband signals from each pattern (which typically include up to 108 or 162 channels of nominal T-1 TDMA) are downconverted to a common intermediate frequency, resulting in the spectrum for each pattern having its lower edge referenced to 2500 MHz. (This figure is representative and is used to facilitate discussion: the actual value of the IF frequency will be determined during the detailed spacecraft design.)

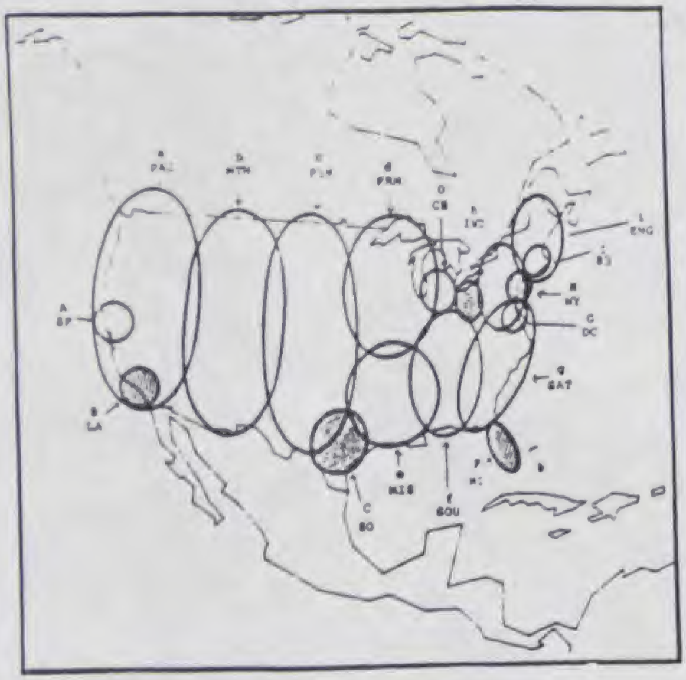
A major innovation contained in the SpotNet Ku-Band payload is the use of frequency sensitive switching through the satellite. In the present configuration, each of the eighteen downlink patterns is accessible from each of the eighteen uplink patterns as a consequence of each uplink being separated into eighteen distinct parts, as illustrated in the block labelled "FILTERS" in Figure 2. Following the separation of the uplinks into inter-pattern spectra, the resultant IF signals are routed to the downlink electronics by means of the cross patch. Each of the eighteen downlink patterns is formed as the sum of eighteen of these signals, one each from filtered outputs of the eighteen uplink patterns. NEX has devised an arrangement of the inter-pattern frequency allocations for the uplinks such that the cross patch signals can be simply added together to form the various downlink patterns. As a result of this scheme, which is known as "permutation routing," no conflicts arise in the placement of spectral components in the pattern's downlink process and no unusable gaps exist in the downlink bandwidth. The downlink spectra are next re-translated to Ku-Band. Five different downlink spectra types are formed in this up-conversion, corresponding to the regions shown in Figure 10, infra.

The final amplifiers for each of the downlink patterns have a power rating which varies inversely with the antenna gain for the pattern and directly with the bandwidth allocated to the pattern. As a consequence, the resultant EIRP per Hertz is essentially constant across the patterns so that a similar quality of service is provided by the SpotNet Ku-Band payload to all geographic regions. An exception to this occurs in the western three beams. Because of the large relative size of these beams, and because of the reduced incidence of rain fading in these regions, NEX has elected to reduce the EIRP by one dB for these three cases.

The SpotNet Ku-Band final amplifiers will always be operated with ample back-off from their saturation points. The smaller amplifiers will be SSPAs, while the higher power amplifiers may be paralleled SSPAs, or backed-off TWTAs, to achieve the necessary combination of linearity, power, and efficiency.

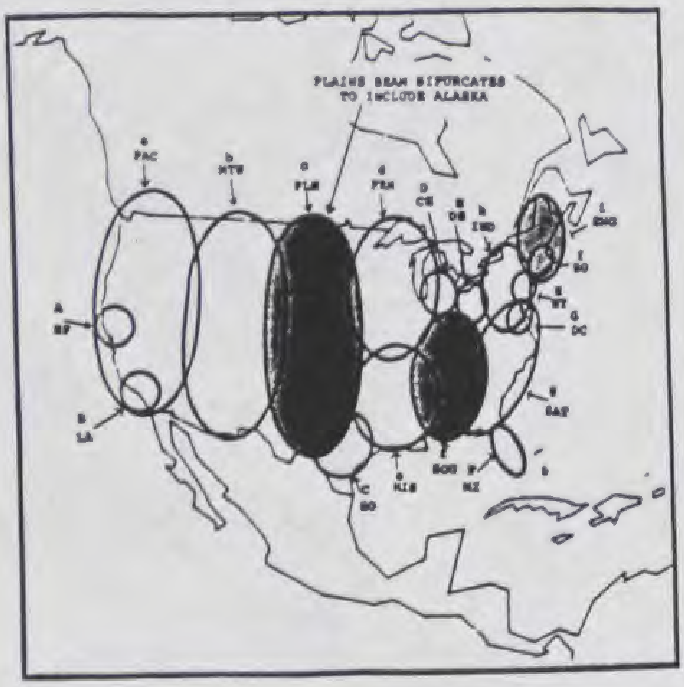
The geographic coverage patterns of the downlink are formed using a large, 4.2 meter aperture antenna. This large antenna, when illuminated via the complex feed system of the SpotNet Ku-Band downlink, permits spot patterns of small radius to be formed over dense traffic areas, such as the urban Northeast, and also has the flexibility to provide the various larger coverage patterns required by SpotNet.

Both uplink and downlink antenna patterns for the SpotNet Ku-Band payload will be designed with careful attention to isolation between orthogonally polarized patterns and between spatially separated pairs of patterns that employ the same frequency and polarization. Design goals, which studies have confirmed to be achievable, are for no less than 30 dB of polarization isolation and 24 dB of spatial isolation. A set of five figures depicting the spatial relation among the patterns with frequency/polarization reuse appears at Figure 10. The SpotNet Ku-Band communication performance is summarized in Table 8.



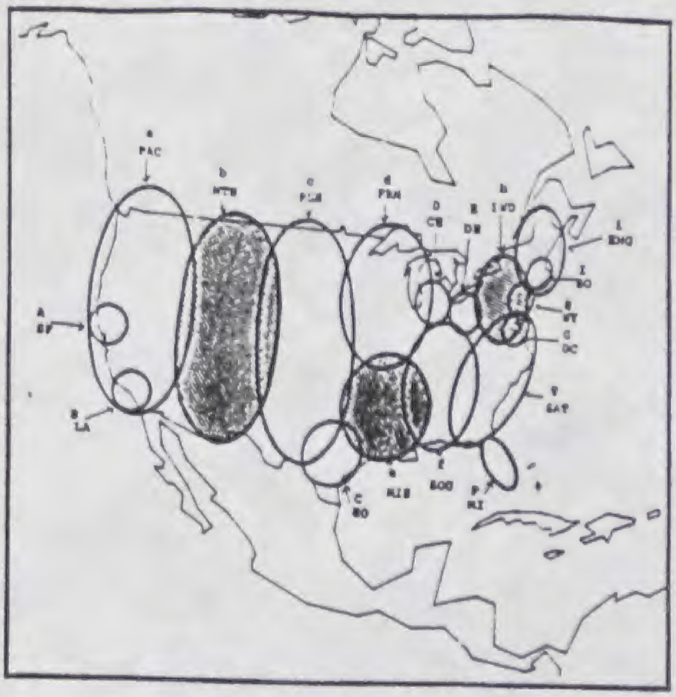
(A) REUSE OF HORIZONTAL - LOWER 250 MHz
(SPOTS B, C, E, F, H)

(B) REUSE OF HORIZONTAL - UPPER 250 MHz
(SPOTS A, D, G, I)

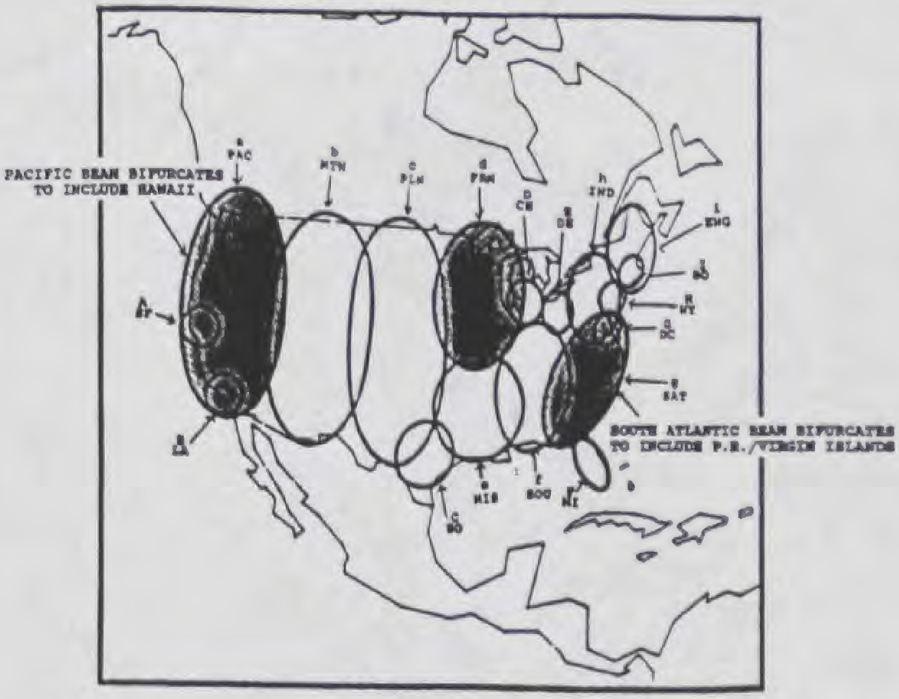


(C) REUSE OF VERTICAL - MIDDLE 167 MHz
(BEAMS c, f, i)

Figure 10. Ku-Band Patterns at 101° W.L.
(1 of 2)



(D) REUSE OF VERTICAL - MIDDLE 167 MHz
(BEAMS b, e, h)



(E) REUSE OF VERTICAL - LOWER 167 MHz
(BEAMS a, d, g)

Figure 10. Ku-Band Patterns at 101° W.L.
(2 of 2)

Table 8

Summary of SpotNet Ku-Band Communication Performance

Uplink antenna gains (boresight)	40 to 54 dBi
System Temperature	1000°K
Figure of merit (edge of coverage)	+5 dB/K or better
Downlink antenna gains (edge of coverage)	35 to 47 dBi
HPA ratings	10 to 125 watts
Total RF power	880 watts
EIRPs (edge of coverage)	56 to 59 dBW
Design EIRP per T-1 equivalent channel (edge of coverage)	36 dBW (downlink) 49 dBW (uplink) 52 dBW (western beam uplinks)
Gain controls	18 up and 18 down -5 dB to +5 dB by 0.5 dB
Isolation	30 dB cross polarization 24 dB nearest patterns with same polarization and frequency.

4. Typical or Baseline Earth Station Characteristics.

Table 9 provides the primary transmission characteristics for the "small" and "medium" Ku-band network stations. The medium network stations have a peak capacity of 1536 Kbps, an antenna aperture of 1.8 meters, a final amplifier rated at 2.0 watts (the amplifier rating is increased to 4.0 watts for the Pacific, Mountain, and Plains patterns (beams a, b, and c in Figure 10), which yields an EIRP of 49 dBW (52 dBW in beams a, b, and c). Under clear sky conditions, the medium network stations use a reduced power that is 2 dB below these rated values. The additional power is held in reserve to compensate for uplink rain fading and may be adjusted upward in increments of 0.5 dB, as required. The figure-of-merit for an earth station in the medium network is 20.2 dB/K. Medium network stations have full frequency agility and may access any T-1 channel in the uplink and downlink frequencies serving the station's pattern.

The small network stations have a peak capacity of 96 Kbps, an antenna aperture of 1.2 meters, and an HPA of 0.5 watts, resulting in an inroute EIRP of 39.4 dBW. The figure-of-merit of a small network station is 16.5 dB/K with an out-route downlink EIRP of 29.0 dBW per subcarrier being provided. Small network hub earth stations have 3.0-meter antenna apertures with corresponding transmit and receive antenna gains of 50.3 and 49.0 dBi, respectively.

Table 9

Typical Earth Station Characteristics

Parameter	Medium	Small	Hub	
Uplink antenna gain (boresight)	46.6	42.9	50.3	dBi
Clear sky uplink EIRP	47.0/50.0	39.4	40.0/43.0	dBW
Reserve for uplink power control	2.0	N/A	2.0	dB
Downlink antenna gain (boresight)	45.0	41.7	49.0	dBi
Figure of merit	20.0	16.5	23.8	dB/K

NOTE: EIRP figures are actual as opposed to rated values and larger EIRP figures apply to stations located in western beams (a, b, & c).

5. Link Budget and Overall Performance Analysis.

Link equations for SpotNet Ku-band service using the "medium" and the "small" networks have been developed and are presented in this section. These analyses assume earth stations in the three western beams (a, b, and c of Figure 10); for earth stations located in all other patterns, slightly better performance may be expected due to the higher G/T and EIRP per carrier for those patterns. To be conservative, the earth stations in the analysis are assumed to be at the edge of coverage of the patterns. Note, however, that earth stations situated at points of higher gain within a pattern's coverage will have their uplink power adjusted such that, under clear sky conditions, the received signal levels in the various slots of a T-1 equivalent carrier will appear essentially equal at the satellite, regardless of the earth station's site within the coverage pattern. This strategy is used by NEX to ensure that the downlink power developed by SpotNet does not fluctuate markedly due to variations in the origin of the traffic load.

a. Medium Network Service.

The bulk of the Ku-band traffic handled by the SpotNet satellite will use the "medium" network transmission method. This involves the division of the spectrum into numerous T-1 equivalent channels, each assigned a band of 1.5 MHz, of which 1.2 MHz is occupied within the half-power points of the spectrum. Each such channel is used in a fully synchronized TDMA format, with a burst rate of 1,200 QPSK symbols per second and a 45 millisecond frame organized into 50 slots, each of 900 microseconds duration. Medium network earth stations are assigned capacity in terms of channels and slots by the NCC. Each such channel slot assignment constitutes a capacity unit of 32 Kbps, which may be used for digital voice, in-band data, or combined into multiple slots for teleconferencing, digital fax, etc.

The link budgets for medium network transmission are exhibited at Tables 10 and 11. The PA rating of 6.0 dBW applies only to the three "beam" patterns west of the Mississippi. All other medium network stations (approximately 90% of the earth stations) are amply powered with a 3.0 dBW final amplifier, due to the superior figure-of-merit present in patterns with a smaller coverage. Calculations performed by NEX revealed, however, that the benefits of higher uplink G/T in combatting uplink thermal noise reach a point of diminishing returns around +10 dB/K, due to adjacent system interference effects. Thus, NEX proposes to use the same uplink EIRP of 49 dBW (including a dB uplink fade power reserve) for all fifteen patterns other than the Western beams (a, b, and c from Figure 10), which, as shown in Table 10, have 52 dBW.

Table 10

Medium Network Uplink Budget

Frequency	14.0	GHz	
PA	6.0	dBW	(4 watts)
Earth Station OBO	0.0	dBW	
Line Loss	0.5	dB	
Antenna Gain (1.8 M)	46.6	dBi	Efficiency = 0.65
Antenna Pointing Loss	0.1	dB	
Earth Station EIRP	52.0	dBW	
Path Loss	207.5	dB	EL = 20°
Rain Loss	2.0	dB	99.5% availability
*Spacecraft G/T	5.0	dB/°K	edge of coverage
Uplink C/T	-152.5	dB/°K	
Boltzmann's Constant	-228.6	dB/°K-Hz	
Uplink C/N_o	76.1	dBHz	
Burst Rate (1.2 msps)	60.8	dBHz	
Uplink $C/N = C/N_o - 10 \log 1.2$ MHz	15.3	dB	
Uplink C/I	14.1	dB	
Uplink C/B	11.7	dB	

C/N - Carrier to (thermal) noise ratio
C/I - Carrier to Interference ratio
C/B - Carrier to Background (thermal plus interference) ratio

* G_{CONUS} = 28 dBi edge of coverage. Size of the west beam is 1/5 of the CONUS beam thus $G_{WEST} = G_{CONUS} + 10 \log 5 = 35$ dBi, T = 1000°K = 30 dB °K and G/T = 5 dB/°K

Table 11

Medium Network Downlink Budget

Frequency	12.0	GHz	
Spacecraft EIRP/T1	36.0	dBW	
Path Loss	205.9	dB	EL = 20°
Rain Loss	2.0	dB	99.5% availability
RX Antenna Gain	45.0	dBi	Efficiency = 0.65
System Temperature	300.0	°K	
Earth Station G/T	20.2	dBi/°K	
Antenna Pointing Loss	0.1	dB	
Downlink C/T	-151.8	dB/°K	
Boltzmann's Constant	-228.6	dB/°K-Hz	
Downlink C/N_o	76.8	dBHz	
Burst Rate (1.2 msps)	60.8	dBHz	
Downlink C/N	16.0	dB	
Downlink C/I	14.7	dB	
Downlink C/B	12.3	dB	
Uplink C/B	11.7	dB	
Link C/B	9.0	dB	
Minimum Required C/B for BER = 10^{-6}	8.9	dB	
Margin	0.1	dB	

Post HPA line losses are low (0.5 dB) in the medium network earth stations, since no post HPA filtering is employed in these terminals due to the need for full frequency agility on the uplink (to permit access to all other stations in the network). Since the earth terminals may be operated with some non-linearity, (worst case design value is for operation of the SSPA at the 1 dB gain compression point), there is a contribution to the link background due to spectrum regrowth. This effect has been included in the link analysis conducted by NEX.

An antenna efficiency of 65% is used in the analysis, which is representative of the performance anticipated for the offset feed structure proposed for the medium network earth stations. Since the SpotNet satellite will have very precise station keeping, the pointing loss for these stations is small.

The uplink EIRP of 52 dBW shown in Table 10 represents a worst case for the SpotNet medium network, due to the conservative assumptions made in the Table which include: lowest G/T uplink pattern; edge of coverage; and deployment of the uplink fading power reserve. The lowest value of uplink EIRP for a T-1 equivalent channel is 43 dBW (where the reduction of 9 dB results from a 3 dB lower rating of the uplink in most patterns), a 4 dB difference between boresight and edge of coverage, and the holding in reserve of the 2 dB uplink fading power reserve. In general, uplink EIRP is maintained, throughout the SpotNet medium network, at a level which produces a downlink EIRP of 36 dBW per T-1 equivalent channel, except under conditions where uplink fading exceeds 2.0 dB.

The remainder of the medium network uplink budget is straight forward and results in a value of C/N of 15.3 dB. Uplink interference effects include: (1) adjacent SpotNet uplink patterns; (2) cross-polarized SpotNet uplink patterns; (3) spectrum regrowth effects with SpotNet passbands; and (4) adjacent satellite interference. The combined uplink background level due to noise and interference is then 11.7 dB below the carrier.

The medium network downlink analysis in Table 11 is based on a standard downlink EIRP of 36 dBW per T-1 equivalent carrier. This power level is compensated for antenna feed losses and includes a 2 dB margin for downlink fading; the link analysis is conservatively premised on the presence of the fading. Under clear sky conditions, the downlink performance will be enhanced by the presence of the margin power. The downlink link analysis assumes that the receiving earth terminal is at the edge of coverage of the pattern. Stations more centrally located within a pattern will have a further enhancement in downlink carrier level.

The earth terminal system temperature of 300 degrees assumed in Table 11 includes contributions due to sky noise as well as thermal noise. The resultant downlink C/N of 16.0 dB due to thermal effects may be overridden by the down link carrier to interference ratio of 14.7 dB predicted by NEX's conservative downlink interference analysis. The sources of interference included in the model included: adjacent SpotNet downlink beams; cross polarized SpotNet downlinks; intermodulation effects arising in the final amplifiers in the Ku-band SpotNet payload; and signals from adjacent satellites. The intermodulation background produced by the satellite's high power Ku-band amplifiers is based on their operation at an output back-off of 3 dB under worst case conditions.

Together, the noise and interference in the downlink result in a carrier-to-background ratio of 12.3 dB, which is of the same order of magnitude as the uplink C/B value of 11.7 dB.

The resultant composite link value for the medium network is 9.0 dB, compared to the figure of 8.9 dB that NEX believes to be a conservatively margined value for an error rate of 10^{-6}. Calculation of the 8.9 dB figure for minimum acceptable C/B is based on the use of QPSK modulation, rate 3/4 convolutional coding with sequential decoding to yield a coding gain of 5.3 dB, and an implementation margin of 1.8 dB. Within this implementation margin are contributions for phase noise, timing jitter, gain fluctuations, and other processing imperfections.

b. <u>Small Network Service</u>.

The SpotNet Ku-band payload will also support a small network with a star architecture which uses very small and low cost earth terminals for transaction oriented digital communications, such as point-of-sale terminals, reservation systems, etc. The small network uses sub-channels derived from the T-1 equivalent channels described above, with each T-1 channel yielding five small channels of 300 KHz each. The small network 240 kilosymbol/second traffic occupies 240 KHz between the spectral half-power points. These small network earth stations connect with a hub station and use TDM and TDMA access on their out-routes and in-routes, respectively. The net transport rate in either direction is 96 Kbps for the small network links.

Because of the need for low cost in the small network terminals, trade-offs between efficiency and cost have generally been resolved in favor of low cost for these terminals. The impact on the overall SpotNet Ku-band efficiency is minor, however, since the percentage of traffic handled by the small network is not expected to exceed 15% of the Ku-band total.

The link budgets for the small network are displayed in Tables 12 through 15. The transmission system is asymmetric in the small network, as is frequently the case for a system of VSAT terminals, so that two distinct composite link analyses are required to define the operation of the small network. The following paragraphs provide additional explanation on the small network transmission.

Table 12

Small Network Inroute Uplink Budget

Frequency	14.0	GHz	
PA	-3.0	dBW	(0.5 watts)
Earth Station OBO	0.0	dB	
Line Loss	0.5	dB	
Antenna Gain (1.2 M)	42.9	dBi	Efficiency = 0.65
Antenna Pointing Loss	0.1	dB	
Earth Station EIRP	39.4	dBW	
Path Loss	207.5	dB	EL = 20°
Rain Loss	2.0	dB	99.5% availability
*Spacecraft G/T	5.0	dB/°K	edge of coverage
Uplink C/T	-165.1	dB/°K	
Boltzmann's Constant	-228.6	dB/°K-Hz	
Uplink C/N_o	63.5	dBHz	
Burst Rate (240 ksps)	53.8	dBHz	
Uplink C/N	9.7	dB	
Uplink C/I	8.9	dB	
Uplink C/B	6.3	dB	

* G_{CONUS} = 28 dBi edge of coverage. Size of the west beam is 1/5 of the CONUS beam thus $G_{WEST} = G_{CONUS} + 10 \log 5 = 35$ dBi, T = 1000°K = 30 dB °K and G/T = 5 dB/°K

Table 13

Small Network Inroute Downlink Budget

Frequency	12.0	GHz	
Spacecraft EIRP/Carrier	23.3	dBW	
Path Loss	205.9	dB	EL = 20°
Rain Loss	2.0	dB	99.5% availability
RX Antenna Gain (3-m)	49.0	dBi	Efficiency = 0.55
System Temperature	330.0	°K	
Earth Station G/T	23.8	dBi/°K	
Antenna Pointing Loss	0.1	dB	
Downlink C/T	-160.9	dB/°K	
Boltzmann's Constant	-228.6	dB/°K-Hz	
Downlink C/N_o	67.7	dBHz	
Burst Rate (240 ksps)	53.8	dBHz	
Downlink C/N	13.9	dB	
Downlink C/I	11.0	dB	
Downlink C/B	9.2	dB	
Uplink C/B	6.3	dB	
Link C/B	4.5	dB	
Minimum Required C/B for BER = 10^{-6}	4.3	dB	
Margin	0.2	dB	

Table 14

Small Network Outroute Uplink Budget

Frequency	14.0	GHz	
PA	0.0	dBW	(1 watt)
Earth Station OBO	4.7	dB	
Line Loss	0.5	dB	
Antenna Gain (1.8 M)	50.3	dBi	Efficiency = 0.55
Antenna Pointing Loss	0.1	dB	
Earth Station EIRP	45.0	dBW	
Path Loss	207.5	dB	EL = 20°
Rain Loss	2.0	dB	99.5% availability
*Spacecraft G/T	5.0	dB/°K	edge of coverage
Uplink C/T	-159.6	dB/°K	
Boltzmann's Constant	-228.6	dB/°K-Hz	
Uplink C/N_o	69.0	dBHz	
Burst Rate (240 ksps)	53.8	dBHz	
Uplink C/N	15.2	dB	
Uplink C/I	14.1	dB	
Uplink C/B	11.6	dB	

* G_{CONUS} = 28 dBi edge of coverage. Size of the west beam is 1/5 of the CONUS beam thus $G_{WEST} = G_{CONUS} + 10 \log 5 = 35$ dBi, T = 1000°K = 30 dB °K and G/T = 5 dB/°K

Table 15

Small Network Outroute Downlink Budget

Frequency	12.0	GHz	
Spacecraft EIRP/Carrier	29.0	dBW	
Path Loss	205.9	dB	EL = 20°
Rain Loss	2.0	dB	99.5% availability
RX Antenna Gain (1.2m)	41.7	dBi	Efficiency = 0.65
System Temperature	330.0	°K	
Earth Station G/T	16.5	dBi/°K	
Antenna Pointing Loss	0.1	dB	
Downlink C/T	-162.5	dB/°K	
Boltzmann's Constant	-228.6	dB/°K-Hz	
Downlink C/N_o	66.1	dBHz	
Burst Rate (240 ksps)	53.8	dBHz	
Downlink C/N	12.3	dB	
Downlink C/I	13.6	dB	
Downlink C/B	9.9	dB	
Uplink C/B	11.6	dB	
Link C/B	7.7	dB	
Minimum Required C/B for BER = 10^{-6}	4.3	dB	
Margin	3.4	dB	

All small network earth stations are provided with a 0.5 watt amplifier which, together with a 1.2 meter antenna, generates a 39.4 dBW in-route uplink EIRP, after accounting for various losses. This value of EIRP is adequate to power the in-route from a station at the edge of coverage in the largest patterns (beams a, b, and c in Figure 10) and with a 2.0 dB margin for in-route uplink fading. Power control is not used for the small network, since these signals constitute a small fraction of the total pattern power. For the case analyzed at Table 12, which corresponds to the Pacific beam (designated "a"), the resultant uplink C/N is 9.7 dB at the faded limit. Interference, including effects from SpotNet's own medium network, results in an in-route uplink C/I ratio of 8.9 dB, according to a conservative analysis performed by NEX. The resultant in-route uplink carrier-to-background ratio is 6.3 dB.

The small network traffic traverses the same Ku-band payload as the medium network traffic. For the signal levels set out in Table 12, the in-route downlink EIRP per subcarrier will be 23.3 dBW. In most cases the in-route downlink EIRP will be higher than this, as a result of more favorably sited uplink stations, the superior G/T of most other uplink patterns, and the absence of fading in the uplink.

The in-route downlink EIRP of 23.3 dBW includes a 2.0 dB allowance as a margin for downlink fading. When received at a hub with a G/T of 23.8 dB/K, the in-route downlink exhibits a carrier to noise ratio of 13.9 dB. Interference effects are conservatively predicted to induce a C/I of 11.0 dB on the in-route downlink, for a carrier-to-background ratio of 9.2 dB. When combined with the uplink background, the composite link carrier-to-background noise ratio is 4.5 dB for the small network in-route, and meets its performance objective of 4.3 dB established by NEX for a bit error rate of 10^{-6} or better.

The 4.3 dB figure for in-band carrier-to-background is derived based on BPSK modulation, rate 1/2 coding with sequential decoding and a coding gain of 6.3 dB, and an impairment budget of 3.0 dB to cover phase noise, amplitude instabilities, and various other degradations from ideal performance.

The small network out-route uplink (hub-to-satellite) is designed to have the same power spectral density as the medium network (see Table 12) and hence yields the same uplink carrier to background ratio of 11.6 dB as shown in Table 14 at the faded out-route uplink limit of 2.0 dB. Power control is employed by the hub to maintain a nearly constant uplink illumination of the satellite over the fading design range of 2.0 dB, thereby avoiding excess downlink EIRP during clear sky operation.

The out-route downlink for the small network also has the same power spectral density as the medium network. (Since the symbol rate of the small network transmissions is one fifth that of the medium network, the actual EIRP is 7 dB less or 36 - 7 = 29 dBW). A 2.0 dB rain margin is built into the downlink carrier:

Table 15 cancels this margin against an assumed 2.0 dB outroute downlink fade.

When received by a very small aperture earth station of the small network (G/T = 16.5 dB/K), the resultant carrier-to-background noise ratio is 9.9 dB for the small network out-route downlink. When combined with the out-route uplink, a composite out-route carrier-to-background ratio of 7.7 dB results. This value is 3.4 dB above the minimum value of 4.3 dB needed for satisfactory out-route performance, and indicates that the small network out-route is very robust for VSAT operations.

F. Interference Analysis.

In Assignment of Orbital Locations to Space Stations in the Domestic Fixed-Satellite Service, 54 R.R.2d 550 (1983) ("1983 Orbital Assignments"), the Commission authorized eight domestic satellite systems in the 4/6-GHz and 12/14-GHz bands and assigned 12 orbital positions for the space stations, of those systems. In its Assignment of Orbital Locations to Space Stations in the Domestic Fixed-Satellite Service, FCC 85-396, released August 27, 1985 ("1985 Orbital Assignments"), the Commission authorized the construction of 23 additional space stations plus the assignment of 22 orbital locations. The compatibility of the various domestic systems within the context of the 2° Order has therefore become a major system-design consideration.

The 12/14-GHz band interference analysis has been performed in accordance with the assignments made in 1983 and 1985 at a spacing of 2° between satellites.

The 4/6-GHz band analysis was also performed using a spacing of 2° from each of the currently authorized C-Band 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). In its analysis, NEX has used parameter values employed by the Commission, even in those cases in which other values might be used in practice.

1. Ku-Band Interference Analysis.

In NEX's previously discussed 1983 applications, detailed interference calculations were presented for the there-proposed Ku-Band operation. These analyses concluded that "the interference caused by the NEX SpotNet system will generally allow carrier-to-interference ratios for adjacent satellite systems of greater than 20 dB." *See* Application, File No. 1824-27-DSS-P/L-83, at 65.

While the Ku-Band payload and transmission parameters described in the current application are different in several respects from the previous application, the cited conclusion regarding the compatibility of the SpotNet Ku-band system with other typical Ku-Band satellites remains valid, as the interference analysis presented in Appendix A demonstrates.

The results of the analysis given in Appendix A are summarized in Tables 16 and 17, infra. The first of these tables shows the interference that the three basic NEX carriers could cause to the carriers of other authorized or previously proposed Ku-Band systems. The carrier-to-interference ratios shown in Table 16 have been calculated for a nominal orbital separation of 2° using the methodology and assumptions described in OST Report FCC/OST R83-2, May 1983. A total of thirty-three different carriers have been examined which are believed to be broadly representative of the full range of carrier types likely to be employed in the 1990s; the transmission parameters for these carriers were extracted from various applications and amendments thereto.

As Table 16 demonstrates, the interference levels likely to be experienced by adjacent satellite carriers are, with minor exceptions, well within established guidelines. Moreover, NEX will not be transmitting high density (e.g., TV/FM and FDM/FM) Ku-Band carriers that are the primary source of unacceptably high adjacent satellite interference.

The interference that NEX carriers would experience due to the presence of adjacent satellite carriers is shown in Table 17. As indicated, interference from adjacent satellite carriers is not generally expected to be of concern, although it will be necessary for NEX to avoid co-frequency operation with adjacent satellite TV/FM carriers.

TABLE 16

POTENTIAL INTERFERENCE INTO ADJACENT SATELLITE CARRIERS FROM NEX CARRIERS

ID	CARRIER TYPE	BAND-WIDTH (MHz)	SYSTEM	Up - Link E.S. PWR (dBW)	Up - Link E.S. GAIN (dB)	Down-Link SAT. EIRP (dBW)	Down-Link E.S. GAIN (dB)	(C/I)tot Link-A (dB)	(C/I)tot Link-B (dB)	(C/I)tot Link-C (dB)
1	TV/FM	36.0	GTE	23.2	56.3	47.0	54.7	29.6	33.9	29.8
2	TV/FM	36.0	GTE	20.5	59.0	47.0	57.4	31.9	35.9	32.3
3	TV/FM	36.0	GTE	23.2	56.3	42.0	54.7	24.9	29.7	25.0
4	TV/FM	36.0	GTE	20.5	59.0	42.0	57.4	27.5	32.1	27.6
5	TV/FM	22.0	GTE	24.3	55.2	47.0	41.3	18.8	23.8	18.8
6	TV/FM	26.0	RCA	26.9	58.2	41.0	49.0	19.8	24.8	19.8
7	TV/FM	26.0	RCA	24.6	55.5	36.5	54.7	20.9	25.9	21.0
8	TV/FM	16.0	SBS	23.7	55.3	47.0	42.4	21.3	26.2	21.3
9	DIGITAL/ 90.0 MBPS	54.0	ASC	24.0	58.0	50.0	57.0	32.7	36.7	33.1
10	DIGITAL/ 60.0 MBPS	36.0	ASC	24.0	58.0	42.0	57.0	27.2	32.0	27.3
11	DIGITAL/ 6.0 MBPS	15.0	ASC	13.7	57.5	33.0	56.0	21.0	25.7	21.1
12	DIGITAL/ 12.0 MBPS	12.0	ASC	12.0	58.0	33.0	57.0	23.6	28.2	23.8
13	DIGITAL/ 1.554 MBPS	3.90	ASC	7.7	57.5	27.0	56.0	20.8	25.6	20.9
14	DIGITAL/ 0.056 MBPS	0.14	ASC	-1.8	55.0	15.0	53.5	20.3	25.1	20.3
15	DIGITAL/ 90.0 MBPS	54.0	GTE	24.3	55.2	47.0	53.7	26.9	31.4	27.1
16	DIGITAL/ 90.0 MBPS	54.0	GTE	24.3	55.2	43.0	53.7	23.1	27.9	23.2
17	DIGITAL/ 60.0 MBPS	36.0	GTE	20.5	59.0	42.0	57.4	27.5	32.1	27.6
18	DIGITAL/ 60.0 MBPS	36.0	GTE	23.2	56.3	42.0	54.7	24.9	29.7	25.0
19	DIGITAL/ 80.0 MBPS	54.0	RCA	24.7	60.6	41.0	59.3	26.8	31.7	26.9
20	DIGITAL/ 8.8 MBPS	16.6	RCA	26.9	58.2	41.0	49.0	21.7	26.7	21.7
21	DIGITAL/ 1.544 MBPS	1.03	RCA	0.5	60.6	22.0	59.3	24.2	29.4	24.9
22	DIGITAL/ 50.0 MBPS	43.0	SBS	24.5	58.2	43.7	57.4	28.5	33.2	28.6
23	DIGITAL/ 50.0 MBPS	43.0	SBS	24.5	55.3	43.7	54.7	25.8	30.5	25.9
24	DIGITAL/ 50.0 MBPS	43.0	SBS	24.5	55.3	46.7	54.7	28.6	33.0	28.8
25	DIGITAL/ 0.512 MBPS	1.229	SCHL	9.0	42.3	16.0	57.1	15.2	20.1	15.9
26	DIGITAL/ 0.512 MBPS	1.229	SCHL	4.8	58.5	27.7	41.1	11.3	16.8	11.8
27	SCPC/PSK 0.056 MBPS	0.039	GTE	-4.8	56.3	9.5	54.7	21.6	26.5	21.6
28	SCPC/PSK 0.056 MBPS	0.039	GTE	-7.5	59.0	9.5	57.4	24.2	29.1	24.3
29	SCPC/PSK 0.056 MBPS	0.064	RCA	0.6	54.5	16.0	53.4	24.6	29.5	24.6
30	SCPC/PSK 0.056 MBPS	0.064	RCA	-5.4	54.5	10.0	53.4	18.6	23.5	18.6
31	SCPC/FM - Audo	0.180	WU	-4.5	55.1	23.0	49.3	22.6	27.1	22.8
32	SCPC/FM - Voice	0.018	FAS	-12.5	48.9	15.9	48.1	23.3	26.7	23.9
33	SCPC/FM - Voice	0.037	RCA	-16.3	59.5	12.0	58.0	26.4	30.0	26.9

NOTE: Link A - Aggregate interference from NEX "medium" network carriers.
Link B - Aggregate interference from NEX "small" network carriers in the inbound direction, i.e., from the remote terminals to the Hub.
Link C - Aggregage interference from NEX "small" network carriers in the outbound direction, i.e., from the Hub to the remote terminals.

TABLE 17

POTENTIAL INTERFERENCE INTO NEX CARRIERS
FROM ADJACENT SATELLITE CARRIERS

ID	CARRIER TYPE	BAND-WIDTH	SYSTEM	Up - Link E.S. PWR	Up - Link E.S. GAIN	Down-Link SAT. EIRP	Down-Link E.S. GAIN	(C/I)tot Link-A	(C/I)tot Link-B	(C/I)tot Link-C
		(MHz)		(dBW)	(dB)	(dBW)	(dB)	(dB)	(dB)	(dB)
1	TV/FM	36.0	GTE	23.2	56.3	47.0	54.7	18.6	14.5	18.4
2	TV/FM	36.0	GTE	20.5	59.0	47.0	57.4	20.6	16.9	19.8
3	TV/FM	36.0	GTE	23.2	56.3	42.0	54.7	19.2	14.8	19.8
4	TV/FM	36.0	GTE	20.5	59.0	42.0	57.4	21.7	17.4	21.9
5	TV/FM	22.0	GTE	24.3	55.2	47.0	41.3	17.7	13.5	17.7
6	TV/FM	26.0	RCA	26.9	58.2	41.0	49.0	15.7	11.2	16.6
7	TV/FM	26.0	RCA	24.6	55.5	36.5	54.7	18.1	13.5	19.0
8	TV/FM	16.0	SBS	23.7	55.3	47.0	42.4	12.2	8.0	12.1
9	DIGITAL/ 90.0 MBPS	54.0	ASC	24.0	58.0	50.0	57.0	20.6	16.8	19.9
10	DIGITAL/ 60.0 MBPS	36.0	ASC	24.0	58.0	42.0	57.0	20.0	15.6	20.7
11	DIGITAL/ 6.0 MBPS	15.0	ASC	13.7	57.5	33.0	56.0	26.4	22.0	27.0
12	DIGITAL/ 12.0 MBPS	12.0	ASC	12.0	58.0	33.0	57.0	26.2	21.9	26.5
13	DIGITAL/ 1.554 MBPS	3.90	ASC	7.7	57.5	27.0	56.0	26.6	22.2	27.1
14	DIGITAL/ 0.056 MBPS	0.14	ASC	-1.8	55.0	15.0	53.5	22.4	17.9	23.2
15	DIGITAL/ 90.0 MBPS	54.0	GTE	24.3	55.2	47.0	53.7	21.0	16.8	21.0
16	DIGITAL/ 90.0 MBPS	54.0	GTE	24.3	55.2	43.0	53.7	21.4	17.0	22.0
17	DIGITAL/ 60.0 MBPS	36.0	GTE	20.5	59.0	42.0	57.4	23.2	18.9	23.5
18	DIGITAL/ 60.0 MBPS	36.0	GTE	23.2	56.3	42.0	54.7	20.8	16.3	21.4
19	DIGITAL/ 80.0 MBPS	54.0	RCA	24.7	60.6	41.0	59.3	21.2	16.7	22.0
20	DIGITAL/ 8.8 MBPS	16.6	RCA	26.9	58.2	41.0	49.0	13.9	9.4	14.8
21	DIGITAL/ 1.544 MBPS	1.03	RCA	0.5	60.6	22.0	59.3	28.4	23.5	28.0
22	DIGITAL/ 50.0 MBPS	43.0	SBS	24.5	58.2	43.7	57.4	20.2	15.8	20.8
23	DIGITAL/ 50.0 MBPS	43.0	SBS	24.5	55.3	43.7	54.7	20.2	15.8	20.8
24	DIGITAL/ 50.0 MBPS	43.0	SBS	24.5	55.3	46.7	54.7	19.9	15.7	20.0
25	DIGITAL/ 0.512 MBPS	1.229	SCHL	9.0	42.3	16.0	57.1	20.6	16.0	21.7
26	DIGITAL/ 0.512 MBPS	1.229	SCHL	4.8	58.5	27.7	41.1	24.1	19.9	24.1
27	SCPC/PSK 0.056 MBPS	0.039	GTE	-4.8	56.3	9.5	54.7	19.9	15.4	20.8
28	SCPC/PSK 0.056 MBPS	0.039	GTE	-7.5	59.0	9.5	57.4	22.5	18.0	23.3
29	SCPC/PSK 0.056 MBPS	0.064	RCA	0.6	54.5	16.0	53.4	16.7	12.1	17.5
30	SCPC/PSK 0.056 MBPS	0.064	RCA	-5.4	54.5	10.0	53.4	22.7	18.1	23.5
31	SCPC/FM - Audo	0.180	WU	-4.5	55.1	23.0	49.3	24.5	20.8	23.4
32	SCPC/FM - Voice	0.018	FAS	-12.5	48.9	15.9	48.1	22.1	18.6	20.9
33	SCPC/FM - Voice	0.037	RCA	-16.3	59.5	12.0	58.0	29.1	25.6	27.8

NOTE: Link A - Interference into NEX "medium" network carriers.
Link B - Interference into NEX "small" network carriers in the inbound direction, i.e., from the remote terminals to the Hub.
Link C - Interference into NEX "small" network carriers in the outbound direction, i.e., from the Hub to the remote terminals.

2. C-Band.

The interference model used to analyze the potential for C-Band 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.

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 ration (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.

The results of the analysis of the C-band interference are contained in Appendix A. These results confirm that the NEX spectrum is compatible with other C-Band uses at 2° spacing. Interference from and to NEX is within the limits set forth in the Commission's Report on 2° spacing in almost all cases, and in those few instances where the limits are exceeded, coordination between users can resolve the problem.

G. Preferred Locations of the SpotNet Satellites and Reasons Therefor.

The SpotNet satellite system will require the assignment of only two orbital locations. The advantage of combined system operation in the 4/6-GHz and 12/14-GHz frequency range from the same orbital locations were discussed _supra_.

Three major considerations shaped NEX's decision to request the 101° W.L. and 93° W.L. orbital locations. The first consideration is that of 50-state coverage. As Figure 1 illustrates, while neither slot can facilitate full 50-state coverage, NEX intends to provide both C-Band and Ku-Band coverage to the southern portion of Alaska and to Hawaii.[1] The second

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[1] As the Commission stated in _1985 Orbital Assignments_, _supra_, FCC 85-396, Ku-Band operations require a minimum elevation angle of 10°. _See id_. at 6 n.16. Figure 1B, _supra_, illustrates that although portions of southern Alaska can be covered from 101° W.L. in Ku-Band, coverage of the entire state from that orbital position cannot be achieved. Thus, while it is clear that 93°
(continued...)

consideration is the adverse effect of heavy rain on 12/14-GHz operations, particularly in the eastern and southeastern regions of the country; 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 will have less flexibility in beam shaping than satellites with CONUS or large regional coverage beams, since controlled beam coverage is essential in achieving intensive frequency reuse while matching beams to areas of traffic density. Locations near the center of the arc are necessary in order to allow coverage of the beams to be controlled more effectively.

In developing its orbital assignment policy, the Commission stated that "[n]ew entrants relying on speculative satellite traffic are initially assigned the minimum number of orbital locations needed to establish market presence." Assignment of Orbital Locations to Space Stations in the Domestic Fixed-Satellite Service, 84 F.C.C.2d 584, 588 (1981) ("1981 Orbital Assignments"). Generally, this has meant the assignment of two slots to new entrants. Id. at 603; see also 1985 Orbital Assignments at ¶ 17. Further, the Commission has adopted a

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[1](...continued)
W.L. is not a 50-state location, see Figure 1A, supra, it may be open to reasonable debate as to whether 101° W.L. so qualifies for Ku-Band. The point here is that even if 101° W.L. is held to be a 50-state location, it is the only one NEX has requested, in compliance with Commission policy.

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." 1981 Orbital Assignments at 605; see also 1985 Orbital Assignments at ¶¶ 7, 17. Generally, this has resulted in new satellite operators being assigned at least one 50-state coverage position. Id.

Under these policies, NEX should be entitled to receive at least one 50-state coverage orbital position. NEX's proposal, however, is not dependent upon having full 50-state coverage, thus enabling it to request the 101° W.L. and 93° W.L. locations.

H. Dates by Which Significant Milestones Are Likely to be Achieved.

A detailed schedule specifying concrete dates by which significant milestones in establishment of the SpotNet satellite system are planned to be achieved is included at Table 18.

TABLE 18

Schedule of Implementation

Negotiations Completed and Contracts Executed

a.	Spacecraft RFP Issued	--	January 1989
b.	Spacecraft Contractor Selected	--	May 1989
c.	Spacecraft Contract Executed	--	July 1989
d.	Launch Services Contract Executed	--	November 1989
e.	Financing Complete	--	November 1989

Spacecraft Implementation

Satellite Due Date

Event	SpotNet 1	SpotNet 2	Spare
Spacecraft Construction Begun	August 1989	July 1990	January 1991
Spacecraft Construction Complete	January 1993	July 1993	January 1994
Spacecraft Launched	March 1993	September 1993	
Spacecraft in Service	June 1993	December 1993	