RECEIVED
OCT 1 19
Domestic Facilities Division
Satellite Radio Branch

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

66/67/68-DSS-P-90

Application of

GTE Spacenet Corporation

To Construct
Replacement Communications Satellites
in the Domestic Fixed-Satellite Service

SEPTEMBER 27, 1990

Tables

Exhibits

Figures

Application To Construct Replacement Satellites

TABLE OF CONTENTS[1]

---

1 GTE Spacenet Corporation is submitting this information in the form suggested by the Commission in Appendix B "Information Required for Domestic Satellite Space Station Applications" 93 FCC 2d. 1260, 1265 (1983) (Appendix B).

TABLE OF CONTENTS (Cont'd)

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

In the Matter of the Application of	)	
	)	
GTE SPACENET CORPORATION	)	File Nos.
	)	
For Authority To Construct Replacement Communications Satellites in the Domestic Fixed-Satellite Service	)	

APPLICATION

GTE Spacenet Corporation ("GTE Spacenet") pursuant to Sections 308, 309 and 319 of the Communications Act of 1934, as amended, 47 C.F.R. § 301 et. seq. hereby requests Commission authority to construct two replacement hybrid SPACENET satellites and one replacement Ku-Band GSTAR satellite. Simultaneously with the filing of this application, GTE Spacenet is turning in the authorizations it had previously obtained for construction and launch authority for two replacement hybrid SPACENET satellites and one replacement GSTAR satellite and construction-only authority for another SPACENET satellite.[1] As GTE Spacenet will explain more fully below, these simultaneous actions stem from changes which have occurred in the U.S. domestic satellite regulatory environment, as well as in GTE Spacenet's business plans, since GTE Spacenet filed its prior replacement satellite applications in September 1987.[2]

1 Order and Authorization, GTE Spacenet Corporation, FCC 88-378, released December 7, 1988, ("GTE Spacenet 1988 Authorization").

2 See Application of GTE Spacenet Corporation to Launch and Operate Communications Satellites in the Domestic Fixed-Satellite Service ("GTE Spacenet's 1987 Application"), filed September 15, 1987, pursuant to Public Notice, Report No. DS-635, released June 10, 1987 establishing the "1987 Processing Round".

I. General Information and Basis For Application

A. Action Regarding Current Replacement Satellite Authority

At the time the 1987 Processing Round was established, the Commission maintained a long-standing practice of granting replacement satellite applications only within the framework of a group satellite processing round. GTE Spacenet, therefore, decided to file for replacement satellite capacity in the 1987 Processing Round based on the assumption that the next group processing round might not occur until sometime in 1991, with no other available avenue for obtaining replacement authority in the interim.[3] As a result of the long lead time necessary to procure a new satellite, execute a contract with a spacecraft manufacturer, and construct new spacecraft, GTE Spacenet believed that if it did not obtain authority to construct its replacement satellites in the 1987 Processing Round, it might have found itself in the position whereby its replacement satellites would not have been constructed and ready for launch when the existing in-orbit spacecraft which they were to replace reached the end of their in-orbit-lives. This belief was due in part to both the FCC's practice of group satellite application processing at widely spaced intervals as well as uncertainties with respect to the in-orbit life of GTE Spacenet's operational satellites at that time due to the relatively short time in which they had been in orbit.[4]

---

3 See p. I-7 of GTE Spacenet's 1987 Application.

4 GTE Spacenet is in a better position today to assess the anticipated in-orbit lives of its currently operational satellites than it was in 1987 because of the additional years of experience it has gained through operating these specific satellites.

Subsequent to the 1987 Processing Round cut-off date, however, the Commission accepted replacement satellite applications[5] and acted on them outside of a group processing round.[6] GTE Spacenet applauds this action by the Commission which it believes is a positive step in the direction of recognizing a domestic satellite replacement expectancy which GTE Spacenet and other licensees have called for during the past several years.[7] In granting GE Americom's C-Band replacement satellite application outside of a group processing round, the Commission correctly concluded that because replacement satellite applications, by definition, do not require additional orbital assignments to accommodate the applicants' request, they can be acted on outside of a group

---

5 Public Notice Report No. DS-765, 3 FCC Rcd. 4795 (1988).

6 See, Application of Hughes Communications Galaxy, Inc. For C-Band Domestic Replacement Satellites, filed January 1988, granted December 7, 1988; and GE American Communications, Application for C-Band Replacement Communications Satellites, filed September 1988, granted August 25, 1989. While it may appear that the Hughes' replacement application was acted on within the context of a processing group, its application was actually filed some three months after the September 15, 1987 cut-off date for the 1987 Processing Round and was placed on Public Notice, separate from the 1987 Processing Round applications. Because Hughes' replacement applications were unopposed and pending at the time the 1988 Orbital Assignment Plan (infra, note 18) was issued, the Commission acted on Hughes' applications simultaneously with those in the 1987 Processing Round; See, also, Application of Hughes Communications Galaxy, Inc. and Satellite Transponder Leasing Corporation, File No. 20-DSS-P/LA-90, filed March 8, 1990, placed on Public Notice March 28, 1990. This application seeks replacement authority for SBS-IV.

7 See e.g., In the Matter of the Processing of the 1987 Domestic Fixed Satellite Applications, DS-684, January 19, 1988, Comments of GTE Spacenet, Section VII, pp. 29-30; Comments of Hughes Communications Galaxy, Inc., pp. 3-4; and Reply Comments of Contel ASC, Section IV, pp. 5-6. Comments of GTE Spacenet Corporation, CC Docket No. 86-496, RM 4206, filed June 8, 1987 at 57-58; Comments of GTE Spacenet Corporation and GTE Satellite Corporation, CC Docket No. 85-135, filed June 7, 1985 at 28-29; and Comments of GTE Spacenet Corporation, Ref. No. DS-265, filed May 15, 1984 at 22-34.

processing round.[8] Likewise, the Commission has stated its view that uncontested replacement satellite applications are of a routine nature,[9] thus providing the basis for grant of subsequent replacement applications outside of a group processing round. Had GTE Spacenet been aware in 1987 that the Commission would modify its replacement satellite authorization practices and act on replacement satellite applications outside of a group processing round, GTE Spacenet would have delayed filing its replacement applications until a time which more closely approximated the time the replacement capacity was needed.[10]

1. Re: SPACENET Replacement Satellites

Since Commission grant of GTE Spacenet's 1987 replacement applications in December 1988,[11] it has become apparent to GTE Spacenet that the SPACENET I and II satellites will exceed GTE Spacenet's 1987 expectations as to in-orbit life and are now expected to remain operational until at least 1997. As a result, GTE Spacenet did not need to begin construction of the SPACENET I and II replacement satellites as early as required by the due diligence milestone dates established by the Commission in GTE Spacenet's 1988 Authorization, i.e., March and May 1990, respectively. Because the Commission's policies permit it to

---

8 See Order and Authorization, GE American Communications, Inc., FCC 89-250, released August 25, 1989, fn. 5.

9 See Order and Authorization, Contel ASC, FCC 88-372 released December 7, 1988, at para. 4; Order and Authorization, GE American Communications, Inc. FCC 89-250, released August 25, 1989 at para. 6; and Order and Authorization, Hughes Communications Galaxy, Inc., FCC 88-379, released December 7, 1988 at para. 10.

10 At the time GTE Spacenet filed its 1987 replacement applications it believed there was a possibility that the SPACENET I and II satellites could reach their end of in-orbit operational lives in the late 1993-1994 timeframe.

11 Supra, note 1.

extend due diligence milestone dates only for circumstances beyond a licensee's control,[12] but not for economic or business reasons which the licensee may voluntarily choose to consider,[13] GTE Spacenet is not requesting an extension of the construction commencement milestone dates specified by the Commission for the SPACENET I and II replacement satellites. Clearly, the delay in construction commencement is not beyond GTE Spacenet's control. Rather, it is a prudent business decision to delay capital expenditures toward the construction of spacecraft which would have to remain in storage, on the ground or in-orbit, after construction until they are needed to be placed into service. Similarly, it is a business decision to maximize the in-orbit life of existing spacecraft, permitting existing customers to defer transition to a replacement satellite.

While GTE Spacenet would favor a Commission policy which allowed licensees who have proven their commitment to providing quality service to the public to extend due diligence milestone dates for economic and business reasons, as long as such an extension is based on concrete plans for continuing the provision of uninterrupted service to the public and does not result in "warehousing" orbital assignments, GTE Spacenet understands the Commission's public policy rationale for refusing to grant such extensions. By granting extensions only for "circumstances beyond a licensee's control", the Commission avoids making subjective determinations about the veracity of any particular extension request, and avoids situations where a request for extension may be based on purely speculative business plans.

---

12 2 FCC Rcd. 233 62 Rad. Reg. 2nd 72.

13 See Rock City Broadcasting, Inc., 52 FCC 2d. 1246, 1250 (1975); Community Telecasters of Cleveland, Inc., 58 FCC 2d. 1296, 1300 (1976); and letter from Chief, Domestic Facilities Division to Alan Naftalin, re Alascom, Inc., dated April 24, 1986.

Thus, because business decisions called for a delay in the construction commencement dates for the previously-authorized SPACENET I and II replacement satellites, GTE Spacenet is turning in these authorizations and simultaneously submitting this new application for authorization to construct the SPACENET I and II replacement satellites at a later time. Moreover, while GTE Spacenet's specified milestone dates for construction commencement of the third SPACENET on-ground spare satellite[14] and the GSTAR replacement satellite[15] have not yet passed, GTE Spacenet is hereby turning in these authorizations for reasons similar to those causing it to turn in the previously-granted SPACENET I and II replacement authorizations.

The specified construction commencement milestone date for the SPACENET III replacement is January 1991. If the SPACENET III satellite, currently operating at its assigned location of 87°W.L., experiences the same operational benefits presently expected for SPACENET I and II, then SPACENET III is not expected to reach its end of operational life until July, 1999 at the earliest. As such, it is impractical from a business perspective to begin construction of a replacement satellite which will not be needed for service until nine years in the future. Ample time exists for securing the necessary replacement authority for the SPACENET III replacement satellite closer to the time of anticipated expiration of SPACENET III. It is, therefore, unnecessary to obtain construction authority at this time.[16]

---

14 GTE Spacenet 1988 Authorization, supra, note 1 at para. 17.

15 Id.

16 Should some unforseen failure occur in any of the three currently operational SPACENET satellites prior to the end of their projected in-orbit lives, GTE Spacenet would utilize the replacement authority it is seeking today to replace that satellite as soon as possible and then avail itself of the opportunity to file for an emergency

2. Re: GSTAR Replacement Satellites

As for the GSTAR I replacement satellite, GTE Spacenet's 1988 Authorization specified a March 1991 construction commencement date for that satellite in anticipation of an early 1994 launch. As will be discussed more fully below, GTE Spacenet does not need to begin construction for this satellite until a later date because it is not possible to launch the GSTAR I replacement until some time in 1997. Consequently, GTE Spacenet is also turning in this authorization, while simultaneously seeking construction authority for another replacement GSTAR satellite.

As a result of the U.S./Canadian/Mexican Trilateral Agreement ("Trilateral Agreement") which the U.S. entered into in the summer of 1988,[17] the U.S. orbital assignments adjacent to each end of the Canadian/Mexican arc were modified. As a result, GTE Spacenet can not replace the GSTAR I satellite with an all Ku-Band satellite at its currently-assigned location of 103°W.L., because once GSTAR I ceases operating at 103°W.L., that location will become a U.S. hybrid location[18] designated for GTE Spacenet's SPACENET I replacement satellite.[19] The GSTAR I replacement satellite location has been designated as 121°W.L., a new U.S. Ku-

---

replacement satellite to replace this "lost" capacity.

17 See exchange of letters: Gerald P. Vaughan, F.C.C., to Mexican Director General Jose Longoria, August 3, 1988; K. T. Hepburn, Canadian Department of Communications to Gerald Brock, F.C.C., August 12, 1988; and Jose Longoria, Mexican Director General to Gerald P. Vaughan, F.C.C., August 15, 1988. See also, FCC's Public Notice regarding Finalization of a U.S./Canadian/Mexican Trilateral Agreement, FCC Mimeo Number 4406, September 2, 1988.

18 Id.; see also, Memorandum, Opinion and Order, FCC 88-373, Assignment of Orbital Locations to Space Stations in the Domestic Fixed-Satellite Service, released December 7, 1988, 3 FCC Rcd. 6972 (1988), ("1988 Orbital Assignment Plan").

19 1988 Orbital Assignment Plan, supra, note 18.

Band location created through the Trilateral Agreement.[20] Since, as GTE Spacenet has indicated earlier, its SPACENET I hybrid satellite will still be operational at 120°W.L. into 1997, it will not be possible to launch and operate the GSTAR I replacement satellite at 121°W.L. before SPACENET I reaches the end of its operational life.[21] Continuity of service will be provided to the GSTAR I users at 103°W.L., however, because GTE Spacenet plans to launch the SPACENET I replacement satellite into 103°W.L. in 1995 when GSTAR I is expected to reach the end of its operational life. GTE Spacenet will delay constructing the GSTAR I replacement until a date closer to when it will be possible to place that replacement Ku-Band satellite into service at 121°W.L. after SPACENET I reaches its end-of-operational-life.

In lieu of seeking GSTAR I replacement capacity at this time, GTE Spacenet seeks here to obtain construction authority to replace its GSTAR II satellite currently assigned to, and operating at, 105°W.L. The GSTAR II satellite is presently expected to reach its operational end-of-life in early 1995, thus, to ensure that continuous service is available for all those users currently taking service from GSTAR II at 105°W.L., it is necessary to obtain construction authority for the GSTAR II replacement satellite at this time.

3. Re: Summary of Action Taken Herein

In summary then, GTE Spacenet is, simultaneously with the filing of this application, turning in its existing authorizations for the three SPACENET

---

20 The Trilateral Agreement changed the orbital location for GSTAR I's replacement from 103°W.L. to 121°W.L., as well as the orbital location for SPACENET I's replacement from 120°W.L. to 103°W.L.

21 With only one degree of orbital separation between 120°W.L. and 121°W.L., it is technically infeasible to operate these two satellites simultaneously at Ku-Band.

replacement satellites and the one replacement GSTAR satellite which were granted as part of the 1987 Processing Round. By this application, GTE Spacenet seeks Commission authorization to construct three new satellites as replacements for SPACENET I, SPACENET II and GSTAR II. GTE Spacenet is seeking construction-only authority at this time in consideration of the fact that the in-orbit lives of the satellites it is seeking to replace may exceed their currently projected in-orbit lives. In that event, the launch dates authorized for these replacement satellites could slip beyond the Commission's five-year launch window,[22] necessitating further Commission action to extend the launch milestone dates beyond those established. While GTE Spacenet is not seeking launch authority at this time, its application includes all information relevant to obtaining launch authority in order to put the FCC and interested parties on notice as to GTE Spacenet's plans for these replacement satellites as well as to facilitate expeditious processing of the launch authority applications at such time as they are filed.

In deciding to proceed in this manner to obtain Commission authority to replace its existing SPACENET I, SPACENET II, and GSTAR II satellites, GTE Spacenet is relying on the Commission's recent practice of granting replacement satellite applications outside of a group processing round. Acting on this application in a group processing round would likely lead to the very delay GTE Spacenet feared in 1987, thus placing GTE Spacenet in the position it sought to avoid at that time--not having its replacement satellites available for launch at the time they are required. Moreover, in seeking construction-only authority at this time, GTE Spacenet is relying on the Commission's policy of authorizing

---

[22] See Report and Order, CC Docket 85-135, FCC 85-395, released August 29, 1985, para 28.

a licensee to place its replacement satellites in the same locations as its currently-operating satellites unless there are instances where, for various reasons, that location is not available to the replacement satellite.[23] While one of those instances enumerated by the Commission is an issue in this application--namely that the location may not be available to a particular U.S. satellite as a result of an international treaty or law, i.e., the Trilateral Agreement, GTE Spacenet believes its plan for the orbital occupancy of these replacement satellites is consistent with Commission-stated policies on replacement satellite locations.

Because the Trilateral Agreement essentially flip-flopped a U.S. hybrid location on one side of the Canadian arc (120°W.L.), with a U.S. Ku-Band location on the other side of the arc (103°W.L.),[24] and because both of these locations are assigned to, and occupied by, GTE Spacenet satellites, GTE Spacenet is confident that these locations are in fact the locations which the Commission would view as the replacement locations for GTE Spacenet's replacement satellites (as it did in the 1988 Orbital Assignment Plan). Furthermore, while never formally articulated, the Commission has historically declined to assign an orbital location to another applicant if the licensee currently assigned to, and operating in, that location, has sought Commission authority to replace that existing capacity in that same location. This implied policy no doubt stems from the Commission's express recognition that:

> "given the capital-intensive nature of the domestic satellite industry there should be some assurance that operators will be able to continue to serve their customers. To do otherwise would discourage investment

---

23 Supra, note 19 at fn. 31.

24 This exchange does not have to be implemented until the end-of-life of the currently operational satellites.

> and impose large costs on users...[W]hen the location is available for assignment to a satellite with the technical characteristics of the proposed replacement saellites, we will generally authorize the replacements at the same location.[25]

GTE Spacenet believes the Commission intends to apply this conditional replacement expectancy at the same location to replacement satellites for which the licensee has obtained construction authority. Given the very substantial fee now required for obtaining launch authority for a spacecraft,[26] coupled with the Commission's five year launch window limitation; launch delays which may in the future be experienced by launch services providers; and the recent imposition of additional fees for extending launch dates, GTE Spacenet believes it is prudent business practice to delay obtaining launch authority until the required time of launch is more certain. Given the nature of replacement satellite applications, and assuming that the licensee has not constructed a spacecraft which will substantially change the operating environment of adjacent satellites, subsequent grant of launch authority for a replacement satellite previously authorized for construction should be able to be handled on a fairly routine basis.

GTE Spacenet believes that the approach it has taken in this filing represents the best way to maintain consistency with important Commission policy on domestic satellite authorization and to accomplish GTE Spacenet's objectives with respect to assuring that it will have the necessary replacement capacity

---

25 Supra, note 31.

26 Supplemental Order on the Establishment of a Fee Collection Program, 2 FCC Rcd. 1882 (1987), 52 R.F. 10226 (March 31, 1987); Memorandum Opinion and Order, 3 FCC Rcd. 5987 (1988), 53 R.F. 40884 (October 19, 1988). The current fee for satellite launch authority is $70,000.

at the required orbital locations in the appropriate time-frames to meet the needs of its customers.

B. Summary Description of Proposed Replacement Applications

The replacement satellites for which GTE Spacenet is seeking authority today, i.e., SPACENET IR, SPACENET IIR and GSTAR IIR, are essentially the same design as those applied for and authorized in 1988.[27] The SPACENET C-Band payload is identical to that previously authorized by the Commission, but some modifications have been made to the Ku-Band payloads of the SPACENET and GSTAR satellites in order to be more responsive to stated customer requirements.[28] The power levels on the SPACENET replacement satellites will remain unchanged from that previously authorized, i.e., 16.0 watt high power amplifiers for the C-Band transponders and 50 watt traveling wave tube amplifiers ("TWTAs") for the Ku-Band transponders. As for the GSTAR replacement, the power level has been slightly increased from 70 watts to 75 watts. This modification has been made to take advantage of currently available state-of-the-art TWTA technology and has negligable operational impact. Additional minor modifications to the SPACENET and GSTAR Ku-Band transponders include the addition of linearizers to optimize multicarrier operations, limiters to optimize full transponder operations, and the capability to switch the 54 MHz transponders into two 27 MHz transponders. As such, the operating environment for these satellites

27 Supra, note 1.

28 The previously- authorized SPACENET replacement satellites would have contained 24-36 MHz C-Band transponders and 8-27 MHz; 4-36 MHz; and 10-54 MHz Ku-Band transponders with cross-strapping capability for the 4-36 MHz Ku-Band transponders. The new replacement design will contain 24-36 MHz C-Band and 16-27 MHz and 8-54 MHz Ku-Band transponders with no cross-strapping capability. The new GSTAR replacement design will remain the same as initially authorized, i.e. 16-27 MHz and 8-54 MHz Ku-Band transponders.

will remain unchanged relative to adjacent satellite interference.

As GTE Spacenet indicated earlier in this filing, while it is not seeking launch authority for these satellites at this time, it plans to launch these satellites as follows:

SPACENET IR into 103°W.L. in May 1995[29]

SPACENET IIR into 69°W.L. in April 1997

GSTAR IIR into 105°W.L. in December 1994

In order to meet this anticipated launch schedule, GTE Spacenet requests that the Commission authorize GTE Spacenet to begin construction of the SPACENET IR satellite by February 1992, the SPACENET IIR satellite by January 1994, and the GSTAR IIR satellite by December 1991.

The public interest will be served by granting GTE Spacenet this replacement authority to enable it to provide continuity of service to its current customers as well as to other users who will require domestic fixed-satellite capacity at the time when GTE Spacenet's currently operational spacecraft expire.

---

29 While GTE Spacenet will launch the SPACENET IR replacement into 103°W.L. in 1995 when the GSTAR I satellite currently operating at 103°W.L. reaches its end-of-life, GTE Spacenet plans, consistent with the implementation of the intent of the Trilateral Agreement, to continue operating the SPACENET I satellite at 120°W.L. until it reaches its end-of-life in 1997. GTE Spacenet will seek the appropriate Commission authority i.e., Special Temporary Authority ("STA") or extension of license term pursuant to the Communications Admendments Act 47 C.F.R. §22.45 (48 FR 2725, released June 9, 1983), once GTE Spacenet's ten year license term for SPACENET I at 120°W.L. expires in late-1994.

II. System Proposal/Description

A. Name/Address of Applicant

GTE Spacenet Corporation
1700 Old Meadow Road
McLean, Virginia 22102

B. Correspondence

Inquiries or correspondence regarding this application should be directed to either:

Troy D. Ellington
Vice President,
Engineering and Development
1700 Old Meadow Road
McLean, Virginia 22102
(703) 848-1400

Terri B. Natoli
Industry Relations Manager
1700 Old Meadow Road
McLean, Virginia 22102
(703) 848-1515

C. General System Description

GTE Spacenet owns and operates an extensive satellite system consisting of six (6) in-orbit spacecraft and one spacecraft scheduled for launch in November 1990. The satellite system includes two distinct spacecraft types--the hybrid C- and Ku-Band SPACENET satellites and the all--Ku-Band GSTAR satellites.

The SPACENET space segment currently consists of three in-orbit satellites, SPACENETs I, II, and III, located at 120°W.L., 69°W.L., and 87°W.L. respectively. The GSTAR space segment currently consists of three in-orbit satellites, GSTARs I, II and III located at 103°W.L., 105°W.L. and 93°W.L, respectively, and GSTAR IV awaiting launch in November 1990. The ground segment for both the SPACENET and GSTAR systems is comprised of a Satellite Control Center in McLean, Virginia which operates the on-orbit space segment through Telemetry, Tracking and Command (TT&C) facilities at Woodbine, Maryland and Grand

Junction, Colorado. All customer access to the SPACENET and GSTAR systems is controlled through a Video Control Center (VCC) located in McLean, Virginia, which has visibility to every transponder on each satellite and which is operated 24-hours a day.

The currently operational SPACENET I, SPACENET II, and GSTAR II satellites will be replaced by the three spacecraft requested in this application, enabling GTE Spacenet to provide continuous communications services through the first decade of the next century. The main performance requirements of these spacecraft are as follows:

- Continuation of existing satellite services at both C-Band and Ku-Band;
- Provision of full connectivity satellite services (50 states plus Puerto Rico and the Virgin Islands) for both business and broadcasting networks; and
- Flexibility to offer innovative new services at both C and Ku-Band to business network and broadcast users.

These requirements have influenced the design of the replacement spacecraft to include the specific features described below.

The replacement satellites for which authority is sought will operate in the 4/6 GHz and 12/14 GHz bands (the SPACENETs) and in the 12/14 GHz frequency band (the GSTAR). All the new satellites will employ full frequency re-use and contain appropriate power levels, coverage patterns and a variety of bandwidths to flexibly address numerous telecommunications applications.

The SPACENETs will have twenty-four (24) 36 MHz transponders operating in the 4/6 GHz band and sixteen (16) 27 MHz and eight (8) 54 MHz transponders operating in the 12/14 GHz band.

The SPACENET 4/6 GHz transponders will utilize a high power amplifier output power of 16.0 watts. The increased geographic coverage area of the satellites will disperse the power spectral density so that it is always in compliance with Commission power density requirements. The SPACENET 12/14 GHz transponders will utilize a traveling wave tube amplifier (TWTA) with an output power of 50 watts. Both the 4/6 GHz and the 12/14 GHz transponders will employ orthogonal linear polarization with full (two times) frequency re-use.

The GSTAR satellite will contain sixteen (16) 27 MHz transponders and eight (8) 54 MHz transponders all operating in the 12/14 GHz band and employing orthogonal linear polarization with full (two times) frequency re-use. The GSTAR transponders will have a TWTA output power of 75 watts regardless of whether the channel bandwidth is 27 MHz or 54 MHz.

The Ku-Band TWTAs on both the SPACENET and GSTAR spacecraft will employ linearizers to maximize transponder utilization for multi-carrier operations, and limiters to minimize the effects of uplink fade for full transponder operations. Additionally, the 54 MHz Ku-Band transponders on both the SPACENET and GSTAR spacecraft will be individually switchable by ground command to two-27 MHz transponders. The additional transponders in this configuration will be powered by spare TWTAs.

All transponders on both the SPACENET and GSTAR spacecraft will nominally provide 50-state coverage plus coverage of Puerto Rico and the Virgin Islands. However, due to the eastern orbital location of SPACENET IIR at 69°W.L., Hawaii and Alaska coverage will not be possible from this satellite.

GTE Spacenet has developed numerous satellite service offerings to respond to customer requirements. These offerings take advantage of the unique capabilities of satellite transmission, particularly its ability to serve virtually any point within the satellite coverage area. Other satellite attributes GTE Spacenet has utilized in developing service offerings are its virtual interference-free environment for data transmission, the insensitivity of cost to distance and the lack of dependence on installation of local loop connections. The latter factor, in particular, has led to GTE Spacenet's development of a variety of end-to-end network offerings which enable rapid deployment of customers' systems, along with certainty of costs and operating environment.

GTE Spacenet currently offers a wide variety of satellite services for both the transponder services and network services markets. Transponder services include fulltime transponder service for high-density traffic, partial transponders for lower volume traffic and occasional use for intermittent requirements. Network services include the Skystar[R] family of services which provide data network services linking computers and data bases at company headquarters to multiple sites, and Metered Channel Services, which provide digital point-to-point links on demand. GTE Spacenet foresees continuing demand for both C- and Ku-Band services, as currently provided by SPACENET I, II and III, and GSTAR I, II, and III well beyond the year 2000. It is expected that the customers utilizing GTE Spacenet's satellites will require the continued service that will be provided by SPACENET IR, IIR, and GSTAR IIR.

D. General Technical Information

D.1 Transponder Frequency and Polarization Plan

D.1.1 SPACENET Plan

The proposed SPACENET replacement satellites will transmit (downlink) and receive (uplink) in C-Band within the two 500 MHz-wide frequency bands defined by 3700 MHz to 4200 MHz and 5295 MHz to 6425 MHz, respectively. In Ku-Band the replacements will transmit (downlink) and receive (uplink) within the two 500 MHz-wide frequency bands defined by 11700 MHz to 12200 MHz and 14000 MHz to 14500 MHz respectively. The SPACENET replacement satellites will contain twenty-four (24) narrowband (36-MHz) C-Band transponders, sixteen (16) narrowband (27 MHz) Ku-Band transponders, and eight (8) wideband (54 MHz) Ku-Band transponders employing orthogonal linear polarization with full (two times) frequency reuse in both the C-Band and the Ku-Band channels. Alternatively, each of the 54 MHz transponders will be individually switchable by ground command to two 27 MHz transponders. The frequency plans for the replacement SPACENET C and Ku-Band transponders are depicted in Figures II-1 and II-2.

D.1.2 GSTAR Plan

The GSTAR replacement will transmit (downlink) and receive (uplink) within the two 500 MHz-wide Ku-Band frequency bands defined by 11700 MHz to 12200 MHz and 14000 MHz to 14500 MHz, respectively. The GSTAR replacement will contain sixteen (16) narrowband (27 MHz) Ku-Band transponders and eight (8) wideband (54 MHz) transponders employing orthogonal linear polarization with full (two times) frequency re-use. Alternatively, each of the 54 MHz transponders will be individually switchable by ground command to two-27 MHz transponders. The frequency plan for the GSTAR Ku-Band transponders is depicted in Figures II-3 and II-4.

D.1.3 Emission Designators

The emission types used by the transponders and the TT&C units are provided below:

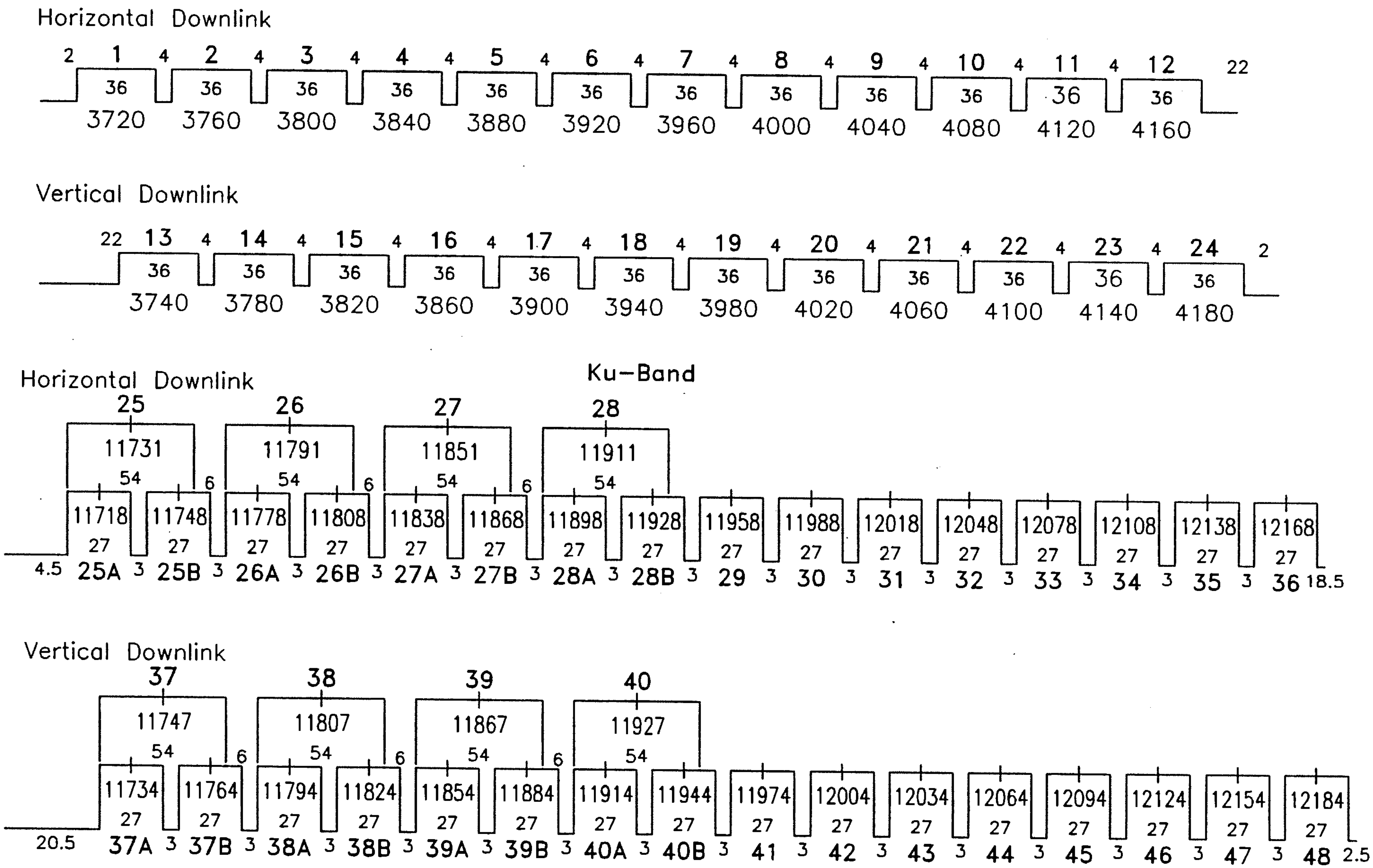
D.1.3.1 SPACENET

C-Band:	36M0F4F	Single Carrier FM/TV
	36M0G7D	Wideband Digital TDMA

Figure II-1

SPACENET REPLACEMENT FREQUENCY PLAN
C-Band

All Frequencies and Spacing in MHz.
All Frequencies are Downlinks.



CAD EG-003

Figure II-2

SPACENET Replacement Satellite Frequency/Polarization Plan

Channel	Polarization (Up/Down)	Bandwidth (MHz)	Uplink Center Frequency (MHz)	Downlink Center Frequency (MHz)
1	V/H	36	5945	3720
2	V/H	36	5985	3760
3	V/H	36	6025	3800
4	V/H	36	6065	3840
5	V/H	36	6105	3880
6	V/H	36	6145	3920
7	V/H	36	6185	3960
8	V/H	36	6225	4000
9	V/H	36	6265	4040
10	V/H	36	6305	4080
11	V/H	36	6345	4120
12	V/H	36	6385	4160
13	H/V	36	5965	3740
14	H/V	36	6005	3780
15	H/V	36	6045	3820
16	H/V	36	6085	3860
17	H/V	36	6125	3900
18	H/V	36	6165	3940
19	H/V	36	6205	3980
20	H/V	36	6245	4020
21	H/V	36	6285	4060
22	H/V	36	6325	4100
23	H/V	36	6365	4140
24	H/V	36	6405	4180
25	V/H	54	14031	11731
25A	V/H	27	14018	11718
25B	V/H	27	14048	11748
26	V/H	54	14091	11791
26A	V/H	27	14078	11778
26B	V/H	27	14108	11808
27	V/H	54	14151	11851
27A	V/H	27	14138	11838
27B	V/H	27	14168	11868
28	V/H	54	14211	11911
28A	V/H	27	14198	11898
28B	V/H	27	14228	11928
29	V/H	27	14258	11958
30	V/H	27	14288	11988
31	V/H	27	14318	12018
32	V/H	27	14348	12048
33	V/H	27	14378	12078
34	V/H	27	14408	12108
35	V/H	27	14438	12138
36	V/H	27	14468	12168
37	H/V	54	14047	11747
37A	H/V	27	14034	11734

Figure II-2 (Con't)

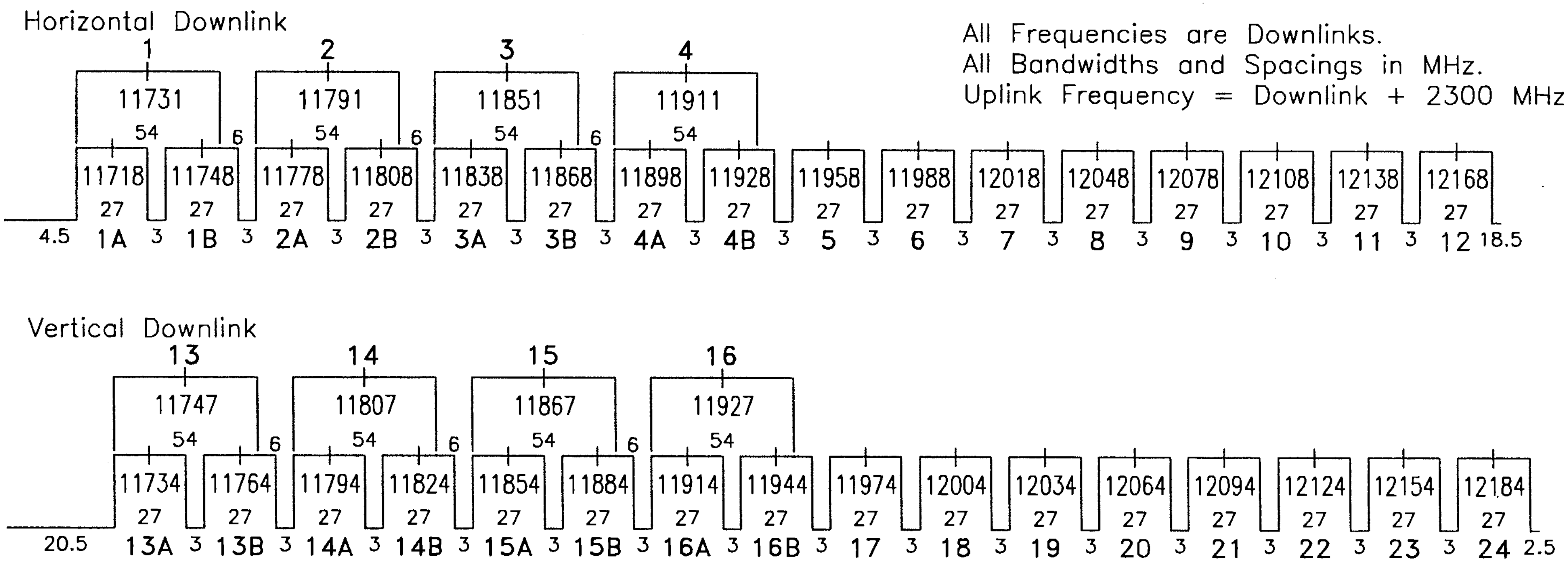
SPACENET Replacement Satellite Frequency/Polarization Plan

Channel	Polarization (Up/Down)	Bandwidth (MHz)	Uplink Center Frequency (MHz)	Downlink Center Frequency (MHz)
37B	H/V	27	14064	11764
38	H/V	54	14107	11807
38A	H/V	27	14094	11794
38B	H/V	27	14124	11824
39	H/V	54	14167	11867
39A	H/V	27	14154	11854
39B	H/V	27	14184	11884
40	H/V	54	14227	11927
40A	H/V	27	14214	11914
40B	H/V	27	14244	11944
41	H/V	27	14274	11974
42	H/V	27	14304	12004
43	H/V	27	14334	12034
44	H/V	27	14364	12064
45	H/V	27	14394	12094
46	H/V	27	14424	12124
47	H/V	27	14454	12154
48	H/V	27	14484	12184

V = Vertical Polarization
H = Horizontal Polarization

Figure II-3

GSTAR REPLACEMENT FREQUENCY PLAN
Ku-Band



CAD EG-005
REV-

Figure II-4

GSTAR Replacement Satellite Frequency/Polarization Plan

Channel	Polarization (Up/Down)	Bandwidth (MHz)	Uplink Center Frequency (MHz)	Downlink Center Frequency (MHz)
1	V/H	54	14031	11731
1A	V/H	27	14018	11718
1B	V/H	27	14048	11748
2	V/H	54	14091	11791
2A	V/H	27	14078	11778
2B	V/H	27	14108	11808
3	V/H	54	14151	11851
3A	V/H	27	14138	11838
3B	V/H	27	14168	11868
4	V/H	54	14211	11911
4A	V/H	27	14198	11898
4B	V/H	27	14228	11928
5	V/H	27	14258	11958
6	V/H	27	14288	11988
7	V/H	27	14318	12018
8	V/H	27	14348	12048
9	V/H	27	14378	12078
10	V/H	27	14408	12108
11	V/H	27	14438	12138
12	V/H	27	14468	12168
13	H/V	54	14047	11747
13A	H/V	27	14034	11734
13B	H/V	27	14064	11764
14	H/V	54	14107	11807
14A	H/V	27	14094	11794
14B	H/V	27	14124	11824
15	H/V	54	14167	11867
15A	H/V	27	14154	11854
15B	H/V	27	14184	11884
16	H/V	54	14227	11927
16A	H/V	27	14214	11914
16B	H/V	27	14244	11944
17	H/V	27	14274	11974
18	H/V	27	14304	12004
19	H/V	27	14334	12034
20	H/V	27	14364	12064
21	H/V	27	14394	12094
22	H/V	27	14424	12124
23	H/V	27	14454	12154
24	H/V	27	14484	12184

V = Vertical Polarization
H = Horizontal Polarization

	1M00G7D	Digital SCPC (T1)
	36K8F3E	Analog SCPC
Ku-Band:	36M0F4F	Single Carrier FM/TV
	24M0F4F	Dual Carrier FM/TV
	36M0G7D	Wideband Digital TDMA
	1M00G7D	Digital SCPC (T1)
	41K6G7D	Broadcast Data
	83K2G7D	Digital Data
	25K0F3E	Analog SCPC
TT&C:	2K00G1D	Telemetry
	60K0G2D	Command

D.1.3.2 GSTAR

Ku-Band:	36M0F4F	Single Carrier FM/TV
	24M0F4F	Dual Carrier FM/TV
	36M0G7D	Wideband Digital TDMA
	1M00G7D	Digital SCPC (T1)
	41K6G7D	Broadcast Data
	83K2G7D	Digital Data
	25K0F3E	Analog SCPC
TT&C:	2K00G1D	Telemetry
	60K0G2D	Command

D.1.4 Final Amplifier Output Power

D.1.4.1 SPACENET

The SPACENET replacement satellites will have a C-Band high power amplifier output power of 16 watts with an estimated net loss of less than 2 dB between the output of the amplifier and the antenna input. The Ku-Band traveling wave tube amplifier (TWTA) output power will be 50 watts (regardless of whether the channel bandwidth is 27 MHz or 54 MHz) with an estimated net loss of less than 2.5 dB between the output of the TWTA and the antenna input.

D.1.4.2 GSTAR

The GSTAR replacement satellite will have a Ku-Band traveling wave tube amplifier (TWTA) output power of 75 watts (regardless of whether the channel bandwidth is 27 MHz or 54 MHz) with an estimated net loss of less than

3 dB between the output of the TWTA and the antenna input.

D.2 Power Flux Density Levels

Tables II-1 and II-2 describe the SPACENET satellites' C-Band power flux density compliance with Section 25.208 of the FCC Rules, 47 C.F.R. § 25.208.

D.3 Number of Satellites

GTE Spacenet plans to launch three satellites, SPACENET IR, SPACENET IIR, and GSTAR IIR, to replace three currently active satellites, SPACENET I, SPACENET II, and GSTAR II. Once these actions have been completed, GTE Spacenet will have a total of seven active satellites. They will be SPACENET IR (103°W.L.), SPACENET IIR (69°W.L.), SPACENET III (87°W.L.), SPACENET I (120°W.L.), GSTAR IIR (105°W.L.), GSTAR III (93°W.L.), and GSTAR IV (125°W.L.). There will be no on-ground spare satellites.

D.4 Description of Earth Stations

As in the current SPACENET and GSTAR systems, the earth stations in the replacement satellite systems will be primarily customer owned, and will include transmit and receive, receive-only, and transmit-only types of stations.

Transmit and receive earth stations are primarily used for point-to-point and point-to-multipoint data networks consisting of hundreds or thousands of earth stations, typically ranging from 7 meter to 13 meter at C-Band and from 2.4 to 7.0 meters at Ku-Band, dispersed over the entire coverage area.

Receive-only earth stations will be used for the receipt of various types of FM/TV broadcasts, analog SCPC, and broadcast data services. There will be thousands of these types of earth stations distributed throughout the coverage area, with sites ranging from 2.8 meter to 5.0 meter at C-Band and from 1.8 meter to 3.6 meter at Ku-Band.

Table II-1

Maximum Power Density Objective from the 47 CFR § 25.208

Elevation Angle	0 ~ 5°	5 ~ 25°	25 ~ 90°
Max PFD ($dBw/m^2/4kHz$)	-152	-152 ~ -142	-142

Table II-2

Summary of PFD from SPACENET

Carrier Type	TV/FM 1 MHz dispersal	TV/FM Unmod 2 MHz dispersal	60 Mbps TDMA	Digital SCPC (1.544 Mbps)	Analog SCPC	Digital SCPC (32 kbps)
EIRP (dBW)	36.8	36.8	36.6	22.8	2.8	10
Minimum Path Spreading (dB/m^2)	-162.2	-162.2	-162.2	-162.2	-162.2	-162.2
Max Power Density per 4kHz relative to Carrier EIRP (dB/4kHz)	-38	-27	-38.8	-22.9	-5	-6
Max Power Density on Surface of Earth ($dBW/m^2/4kHz$)	-163.4	-152.4	-164.4	-162.3	-164.4	-158.2

Transmit-only earth stations will provide such services as broadcast FM/TV, radio and data. The number of transmit-only earth stations will be much smaller, but they will also be dispersed throughout the coverage area. The size of these stations will typically range from 7 meter to 13 meter at C-Band, and from 2.4 meter to 7 meter at Ku-Band.

D.5 Satellite Characteristics

D.5.1 SPACENET

A rendering of the replacement SPACENET satellite is shown in Figure II-5. The major SPACENET spacecraft characteristics are provided in Figure II-6. The weight and power summaries for the SPACENET replacement satellites are contained in Figure II-7.

D.5.2 GSTAR

A rendering of the GSTAR replacement satellite is shown in Figure II-8. The major GSTAR spacecraft characteristics are provided in Figure II-9. The weight and power summaries for the GSTAR replacement satellite are contained in Figure II-10.

D.6 System Reliability

To ensure a high degree of reliability for SPACENET and GSTAR system users, the communications payloads will incorporate the redundancy indicated in Figures II-6 and II-9, respectively. Additionally, all other subsystems will be designed to incorporate redundancy for all critical components.

Both SPACENET and GSTAR spacecraft will include batteries to power all satellite subsystems during eclipse periods to ensure continuity of service. The battery capacity for each spacecraft will be sufficient to power the payloads in the nominal configuration (i.e., 24 C-Band transponders and 24 Ku-Band transponders for SPACENET and 24 Ku-Band transponders for GSTAR) at end-of-

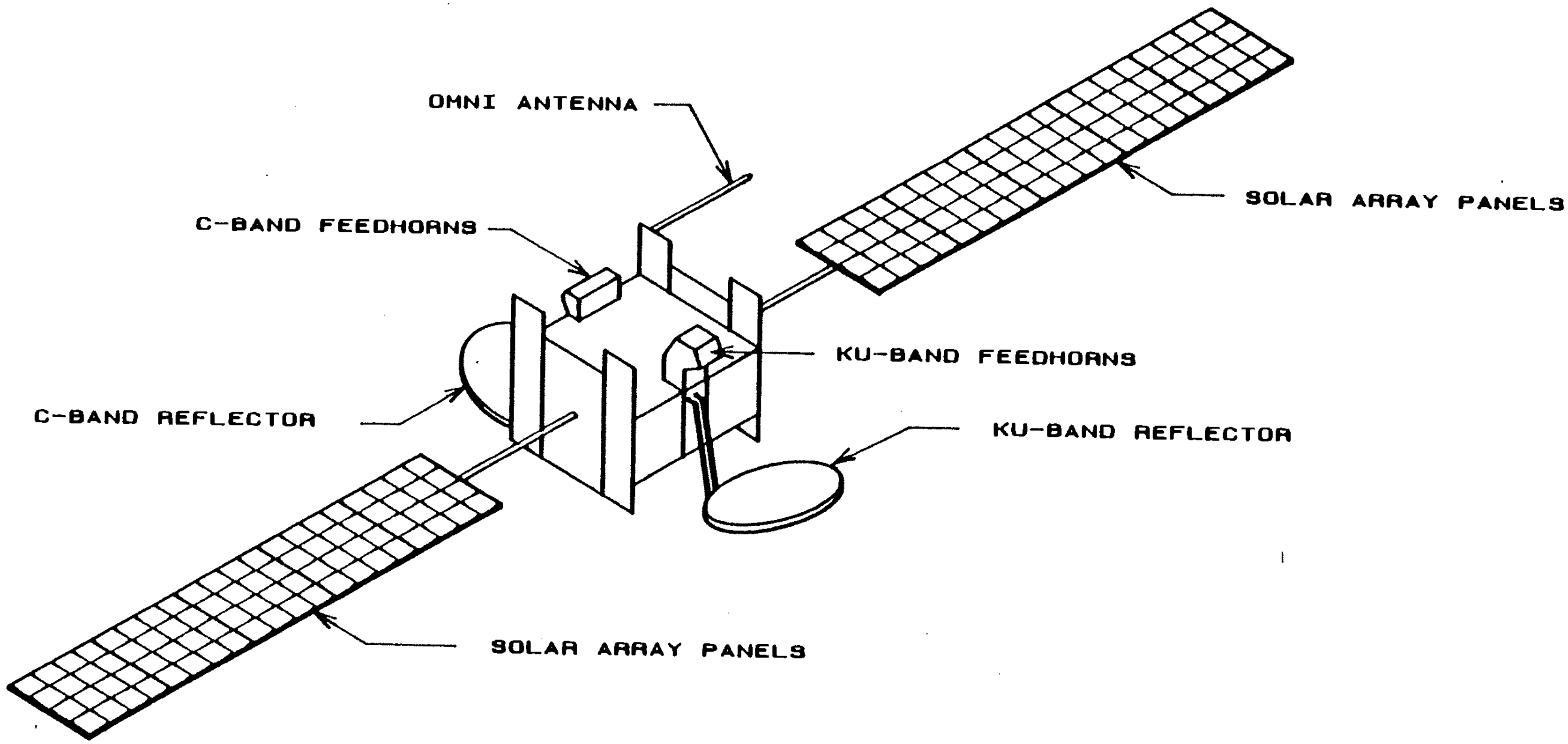


FIGURE II-5

SPACENET REPLACEMENT SATELLITE

Figure II-6

Major SPACENET Spacecraft Characteristics

General

Launch Vehicle	Ariane IV, Titan, Atlas-Centaur, or equivalent
Satellite Launch Weight	5455 lbs.
Stabilization	Three-axis
Stationkeeping	± 0.05 degree N-S, E-W
Antenna Pointing	± 0.1 degree
EOL Power Required	4262 W.
Eclipse Capability	100%
Batteries	4-50 Ampere-hour $Ni\text{-}H_2$
Minimum Fuel Available	12 years

System Description

TT&C Earth Stations located at Woodbine, Maryland and Grand Junction, Colorado
Frequency Bands: C-Band (4/6 GHz) and Ku-Band (12/14 GHz)
Total Useable Bandwidth Available per Satellite: 1728 MHz

Transponders

C-Band

Twenty-four (24)-36 MHz transponders using 16.0W high power amplifiers

Ku-Band

Sixteen (16)-27 MHz transponders using 50W traveling wave tube amplifiers
Eight (8)-54 MHz transponders using 50W traveling wave tube amplifiers, individually switchable by ground command to sixteen (16) - 27 MHz transponders using 50W traveling wave tube amplifiers

Redundancy

High Power Amplifiers	7 for 6 SSPAs (C-Band only) 16 for 12 TWTAs (Ku-Band only-nominal configuration)
Receivers	4 for 2

Polarization Plan

C-Band

Linear Polarization with Full (two times) Frequency Re-use
Cross-polarization Isolation in CONUS > 30 dB

Ku-Band

Linear Polarization with Full (two times) Frequency Re-use
Cross-polarization Isolation in CONUS > 30 dB

Figure II-7

A. SPACENET Spacecraft Weight Summary
(Assuming Ariane IV Launch Vehicle)

	Ariane IV Option
Subsystem Total	2465 (includes balance wts and margin)
Apogee Expendables	2140
Propellant	850
S/C Lift Off Weight	5455

B. SPACENET Spacecraft Power Summary
(EOL Peak Required)

Subsystem	Power (Watts)
Communications	3720
Bus Subsystems	300
Battery Charging (Eclipse)	242
Total	4262

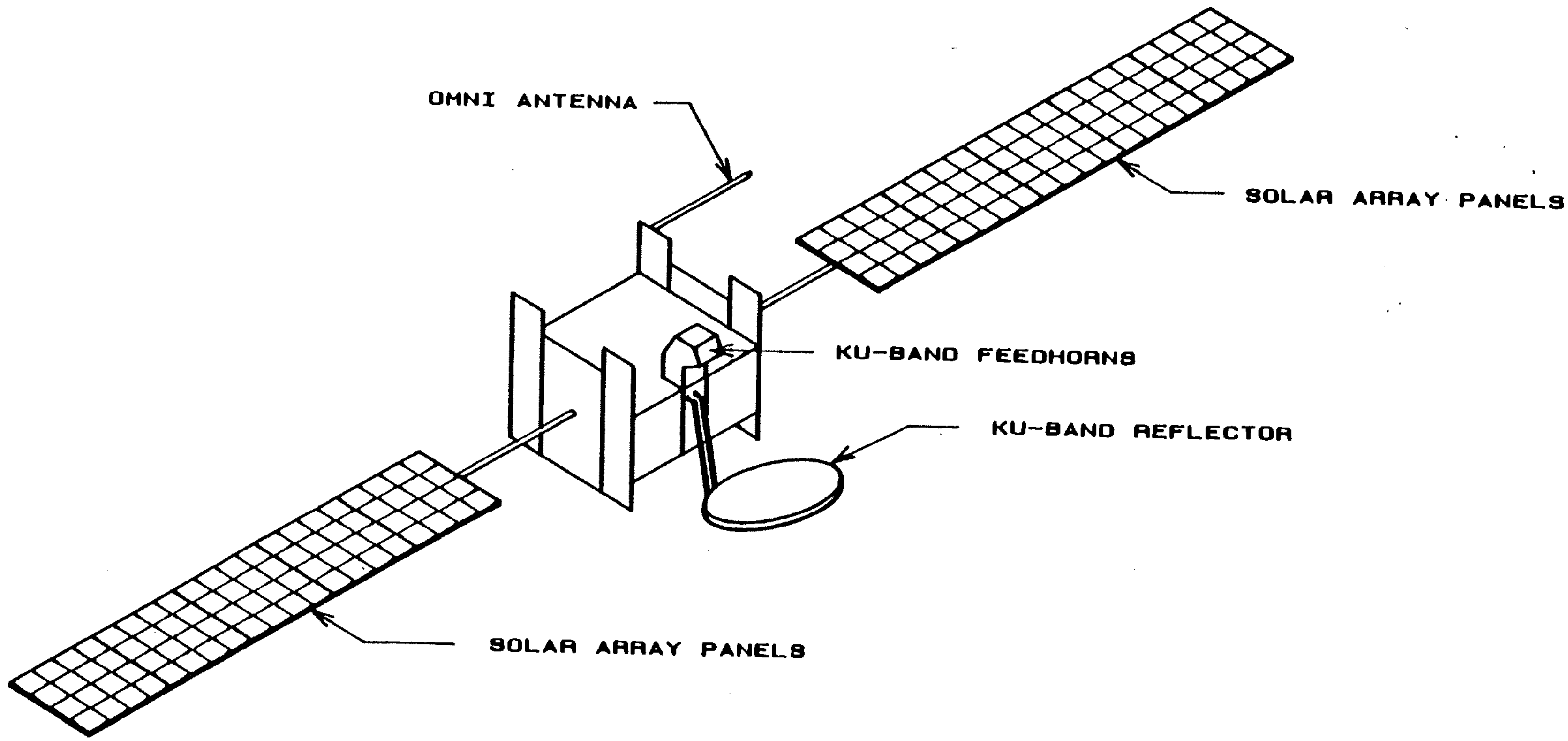


FIGURE II-8

GSTAR REPLACEMENT SATELLITE

Figure II-9

Major GSTAR Spacecraft Characteristics

General

Launch Vehicle	Ariane IV, Titan, Atlas-Centaur, or equivalent
Satellite Launch Weight	5320 lbs.
Stabilization	Three-axis
Stationkeeping	± 0.05 degree N-S, E-W
Antenna Pointing	± 0.1 degree
EOL Power Required	4155 W.
Eclipse Capability	100%
Batteries	4-50 Ampere-hour Ni-H_2
Minimum Fuel Available	12 years

System Description

TT&C Earth Stations located at Woodbine, Maryland and Grand Junction, Colorado
Satellite Control Center located at McLean, Virginia
Frequency Bands: Ku-Band (12/14 GHz)
Total Useable Bandwidth Available per Satellite: 864 MHz

Transponders

Ku-Band

Sixteen (16)-27 MHz transponders using 75W traveling wave tube amplifiers
Eight (8)-54 MHz transponders using 75W traveling wave tube amplifiers, individually switchable by ground command to sixteen (16) 27 MHz transponders using 75W TWTA's

Redundancy

High Power Amplifiers	16 for 12
Receivers	4 for 2

Polarization Plan

Ku-Band

Linear Polarization with Full (two times) Frequency Re-use
Cross-polarization Isolation in CONUS > 30 dB

Figure II-10

A. GSTAR Spacecraft Weight Summary
(Assuming Ariane IV Launch Vehicle)

	Ariane IV Option
Subsystem Total	2380 (includes balance wts and margin)
Apogee Expendables	2090
Propellant	850
S/C Lift Off Weight	5320

B. GSTAR Spacecraft Power Summary
(EOL Peak Required)

Subsystem	Power (Watts)
Communications	3620
Bus Subsystems	300
Battery Charging (Eclipse)	235
Total	4155

life.

The link availability for the various services provided by GTE Spacenet in its replacement satellite systems will be driven by customer requirements. Typical link availabilities will be on the order of 99.9% and above for C-Band services and 99.5% to 99.8% for Ku-Band services. In order to maximize Ku-Band availability for full transponder services, SPACENET and GSTAR Ku-Band transponders will be ground-commandable to a limiting mode of operation which significantly decreases the effects of uplink fade on link performance.

D.7 Launch Vehicle

The SPACENET and GSTAR replacement satellites are designed to be launched by the Ariane-4, Titan, Atlas-Centaur or other compatible launch vehicles.

D.8 Telemetry, Tracking, and Command

Existing facilities installed at GTE Spacenet's two TT&C stations at Woodbine, Md. and Grand Junction, Co. will be used to support SPACENET and GSTAR on-orbit operations. Existing RF, IF and Ground Control Equipment (GCE) will also be used.

Each satellite will include a command, ranging, and telemetry subsystem to control all satellite modes and telemeter information necessary for the management and control of the satellite during all phases of the mission. The command and telemetry capabilities together will enable a range measuring capability. The command and telemetry subsystem will be completely redundant and designed so that no single failure will permit system service interruption. In addition, this subsystem will operate simultaneously with communications operation without interference or degradation to either system.

The command part of the subsystem will provide the capability for reliable control of all operating modes, attitude, and orbital velocity of the satellite. It will decode commands that are received from the TT&C stations, generate verification signals, and execute commands upon receipt of a ground generated execute signal. In addition, the command subsystem will provide an uplink channel for ranging signals. The C-Band command carrier will be received via the C-Band communications antenna or the orbit or launch omni antennas. The Ku-Band command carrier will be recieved via the Ku-Band communications antenna.

The telemetry subsystem will continuously transmit to the TT&C stations sufficient information regarding satellite attitude, status, and performance to enable rapid fault isolation and correction from the ground. The telemetry subsystem will provide a downlink channel for ranging and beacons for earth station antenna tracking of the satellite. The beacon carrier will be able to provide combined coverage of CONUS, Alaska, Hawaii, and Puerto Rico.

The SPACENET replacement satellite will be capable of receiving uplink commands and of transmitting downlink telemetry in both C-Band and Ku-Band frequencies.[30] The C-Band command uplink will be vertically polarized with a nominal frequency of 6423.5 MHz. The two C-Band telemetry downlinks will have nominal frequencies of 3700.5 MHz and 4199.5 MHz with vertical and horizontal polarizations, respectively. The Ku-Band command uplink will be horizontally polarized with a nominal frequency of 14001.5 MHz, the same as the current GSTAR system. The two Ku-Band telemetry dowlinks will have nominal frequencies of 11702 MHz and 12198 MHz with vertical and horizontal polarizations respectively. The command uplinks will be encrypted to provide the necessary command system security.

---

30 The C-Band telemetry subsystems will be identical to that of the current SPACENET system.

The GSTAR replacement telemetry subsystem will be identical to that of the current GSTAR system. The GSTAR replacement satellite will receive Ku-Band uplink commands at a nominal frequency of 14001.5 MHz with horizontal polarization. The two Ku-Band telemetry downlinks will have nominal frequencies of 11702 MHz and 12198 MHz with vertical and horizontal polarizations respectively. The uplink command will be encrypted to provide the necessary command system security.

All SPACENET command requirements will be met with the following power flux density levels:

-60 to -81 dBW/m^2 at the launch omni (C-Band) antenna
-60 to -81 dBW/m^2 at the orbit omni (C-Band) antenna
-75 to -96 dBW/m^2 at the C-Band communications antenna
-44 to -94 dBW/m^2 at the Ku-Band communciations antenna

The GSTAR command requirements will be met with the Ku-Band power flux density levels shown above.

E. Description of Services

E.1 General Service Description

E.1.1 Transponder Services

GTE Spacenet offers transponders as full, partial and occasional service offerings. Occasional Use Services encompass a number of offerings, including dual video on a single satellite transponder, News Express for satellite news gathering, and Turnaround Service for increased multipoint distribution by converting C-Band to Ku-Band or Ku-Band to C-Band.

GTE Spacenet provides Occasional Use transponder service as needed and on call, with flexible scheduling available in increments as short as 15 minutes. Customers can also commit to a minimum number of hours per year, or a Term Account, suitable for regularly scheduled transmission. Ku-Band

Occasional Use service is available at varying rates, depending on prime-time and non-prime-time usage.

News Express, through GTE Spacenet's existing multiple satellite system, provides customers with the latest technology in Satellite News Gathering - live coverage from almost any location. With News Express, GTE Spacenet can give a customer 24 hour voice connectivity, "dialtone on demand", via satellite, with or without video transmission. Voice circuits independent of the video signal allow the producer to direct the news crew and on-site talent. News Express includes the use of up to four voice channels for customer's use.

GTE Spacenet has developed a sophisticated Video Control Center for handling Occasional Use and News Express service which enables efficient and accurate uplinking and which maximizes use of the satellite facilities and accommodation of numerous customers.

GTE Spacenet's Turnaround Service is a value-added video service for Occasional Use customers, which allows compatibility between Ku-Band and C-Band earth stations. Turnaround Service, now provided through GTE Spacenet's TT&C facilities, widens the use of existing C-Band earth stations by picking up feeds from Ku-Band transportables for C-Band downlinking, or vice versa.

Full transponder applications include FM TV broadcast to network and cable TV stations, as well as to backyard earth stations for news, entertainment, and educational services. GTE Spacenet has one transponder now dedicated to the health-care field, for service to hospitals and medical facilities. In addition, GTE Spacenet provides services to US Sprint for 120 Mbps TDMA transmission of voice and data to residential and business customers.

E.1.2 Network Services

Utilizing Very Small Aperture Terminals (VSATs) at a customer's premises, GTE Spacenet offers its Skystar family of network services.

Skystar Point-to-Point Data Service offers Ku-Band digital 56 kbps data exchange, eliminating dependence on terrestrial systems and local connections between any two computer sites. Using 2.4m or smaller, low maintenance VSATs, GTE Spacenet can provide the customer with a service package including: satellite terminals with standard transmission services; engineering and installation; operations, maintenance and spares.

Skystar Interactive Network Data Services provide retail point-of-sale applications, including centralized inventory control, inquiry response, reservation systems, order entry and file transfer of data. Financial institutions and other customers use GTE Spacenet's Interactive Network Services for cost effective, low bit-error rate transmissions.

GTE Spacenet's Skystar Television provides a one-way, receive-only service, which broadcasts from one location to multiple sites. Using this service, corporations, public agencies and educational institutions can distribute live and taped training and informational programs.

Internationally, GTE Spacenet provides digital private communications service from U.S. locations to overseas locations, with its Skystar International Service. Applications for such services are similar to domestic applications including data exchange, document distribution, remote printing, electronic funds transfer, and even video conferencing. This service is provided via INTELSAT facilities with U.S. connections handled via GTE Spacenet facilities or terrestrial links.

An additional family of services presently offered by GTE Spacenet is Metered Channel Services, which provides Ku-Band high-speed digital point-to-point communications on demand between terminals ranging from 2.4m to 4.6m.

Metered Channel Services' inherent flexibility is characterized by the capability for symmetric or asymmetric links, the availability of transponder capacity on demand, and cost effectiveness due to the use of space segment only as required. This has resulted in the successful implementation of the service for various applications including pre-press printing, disaster recovery data communications, and video-conferencing.

GTE Spacenet also presently offers a variety of transborder services including one-way broadcast services and point-to-point and point-to-multipoint data services. These services have been coordinated under INTELSAT Article XIV(d) regulations. GTE Spacenet intends to continue to offer transborder services on its replacement satellites.

Thus, GTE Spacenet is utilizing its currently operational satellites for a wide variety of services and expects to continue evolving those services and developing new ones to meet customer requirements. It is expected that the use of SPACENET I and II and GSTAR II will continue to grow over their design lives, and significant transponder utilization is expected as these satellites reach the end of their design lives. Many of GTE Spacenet's current customers require continued uninterrupted service beyond the satellites' estimated end-of-life. Continuing and expanded requirements of these customers plus additional customers necessitate the implementation of the requested replacement satellites.

E.1.3 <u>Projected Service Demand</u>

GTE Spacenet projects continuing growth of demand for satellite services at various rates, depending on the application and frequency band. (See Exhibit 1.) The demand for C-Band capacity is expected to grow moderately for GTE Spacenet satellites, primarily for video broadcast applications. This will be due partly to the expansion of current customers as they add channels of entertainment programming for their markets. GTE Spacenet also expects to attract additional video programmers in the future as other C-Band satellite capacity expires. These programmers will be looking for satellites with significant remaining design life, such as the GTE Spacenet system. The demand for video services will remain stable into the early 2000s, due to the large installed base of C-Band TVROs and uplinks at TV stations, cable facilities, institutions, and residential backyards.

There will also be ongoing requirements for transmission of C-Band analog SCPC signals to the large installed base of TVROs for voice and music services at radio stations and commercial buildings. Some C-Band data services will continue due to the installed base of dedicated or shared earth station facilities currently providing service to government and corporate customers.

The demand for GTE Spacenet Ku-Band satellite services is expected to grow significantly beyond the design lives of SPACENET I and II and GSTAR II. The greatest growth in demand will be for interactive corporate data networks, each comprised of hundreds or thousands of VSATs dispersed over a broad geographic area. These corporate customers will also utilize video transponders to broadcast education, promotion, or management programming to these remote locations using the same VSAT network. Demand for one way broadcast data networks will also grow for corporate services, utilizing the economy of small, mass produced VSATs in many remote locations. The demand for other data applications of Ku-Band satellite capacity is projected to grow over the lives of the current SPACENET satellites and their replacements, including point-to-multi point transmission of digital SCPC data at rates up to 1.544 Mbps for computer communications, video conferencing, and other specialized applications.

GTE Spacenet predicts continued strong growth of the use of Ku-Band capacity by broadcast network and cable TV networks for news, entertainment, and educational programs. The growth of satellite news gathering services by the networks and TV stations will rapidly expand the proliferation of Ku-Band facilities at TV stations, providing extensive opportunities to expand into other sports and entertainment applications.

The Ku-Band transponder configurations specified for SPACENET IR and IIR and GSTAR IIR were designed to best serve the applications described above. The 27 MHz transponders are designed for transmission of powerful, high-quality video signals to the VSATs used in corporate networks. The 54 MHz transponders are most effective for the transmission of interactive or broadcast data signals to the corporate data networks, as well as other uniqúe data requirements, utilizing the bandwidth to prevent interference between carriers. The 54 MHz transponders can also be used for dual carrier video broadcast to larger earth stations.

E.2 Service Technical Parameters

E.2.1 C-Band Transponders

Several representative examples of planned C-Band transponder applications are listed below, along with their associated operational parameters. Link budget calculations for these services are shown in Section E.3.

1. TV/FM

Baseband bandwidth: 4.2 MHz

Video deviation: 10.75 and 13.8 MHz

RF bandwidth: 30 MHz and 36 MHz

Required S/N (clear): 50.0 dB and 54dB

Uplink E.S. diameter: 11 meters and 13 meters

Downlink E.S. diameter: 2.8 - 5 meters

2. Wideband TDMA

Transmission rate: 60 Mbps

Modulation: QPSK

RF bandwidth: 36 MHz

Required C/N: 14.5 dB

Uplink E.S. diameter: 13 meters

Downlink E.S. diameter: 13 meters

3. Digital SCPC

Transmission rate: 1.544 Mbps

Modulation: QPSK

RF bandwidth: 850 kHz

Required C/N: 9.3 dB

Uplink E.S. diameter: 7 meters

Downlink E.S. diameter: 7 meters

4. Analog SCPC

Modulation: FM, 15 kHz peak deviation

Highest modulating freq.: 3.4 kHz

Voice grade channel bandwidth: 3.1 kHz

RF bandwidth: 36.8 kHz

Required C/N: 9.3 dB

Uplink E.S. diameter: 13 meters

Downlink E.S. diameter: 13 meters

E.2.2 Ku-Band Wideband (54 MHz) Transponders

Several representative examples of planned Ku-Band transponder applications are listed below, along with their associated operational parameters. Link budget calculations for these services are depicted in Section E.3.

1. TV/FM - Network Broadcast

	Single Carrier	Dual Carrier
Baseband bandwidth:	4.2 MHz	4.2 MHz
Video deviation:	13.8 MHz	9.1 MHz
RF bandwidth:	36 MHz	24 MHz
Required S/N (clear):	56 dB	50 dB
Uplink E.S. diameter:	2.4 meters	2.4 meters
Downlink E.S. diameter:	3.6 meters	5.5 meters

2. Wideband TDMA

Transmission rate: 60 Mbps

Modulation: QPSK

RF bandwidth: 36 MHz

Required C/N: 14.5 dB

Uplink E.S. diameter: 7 meters

Downlink E.S. diameter: 7 meters

3. Digital SCPC

Transmission rate: 1.544 Mbps

Modulation: QPSK

RF bandwidth: 850 MHz

Required C/N: 9.3 dB

Uplink E.S. diameter: 3.6 meters

Downlink E.S. diameter: 3.6 meters

4. Corporate Data/Voice (Interactive)

	Inbound	Outbound
Transmission rate:	32 Kbps-156 Kbps	56-772 Kbps
Modulation:	BPSK/QPSK	BPSK/QPSK
RF bandwidth:	20 kHz-202 kHz	112 kHz-850 kHz
Required C/N (clear):	7-10 dB	7-10dB
Uplink E.S. diameter:	1.8m	7m
Downlink E.S. diameter:	7m	1.8m

5. Corporate Broadcast Data

Transmission rate: 64 Kbps

Modulation: BPSK/QPSK

RF bandwidth: 40 kHz-84 kHz

Required C/N: 7-10 dB

Uplink E.S. diameter: 7 meters

Downlink E.S. diameter: 1.8 meters

6. Analog SCPC

Modulation: Companded FM

Deviation: 9.2 kHz

Highest Modulation Freq.: 3.4 kHz

RF bandwidth: 25 kHz

Required C/N: 7 dB

Uplink E.S. diameter: 2.4 meters

Downlink E.S. diameter: 4.5 meters

E.2.3 Ku-Band Narrowband (27 MHz) Transponders

1. TV/FM - Corporate

Baseband bandwidth: 4.2 MHz

Video deviation: 9.2 MHz

RF bandwidth: 24 MHz

Required S/N (clear): 46 dB

Uplink E.S. diameter: 7 meters

Downlink E.S. diameter: 1.8 meters

E.3 System Performance Calculations

System performance calculations for the services identified in Section E.2 for SPACENET are provided in Tables II-3 through II-16 following. System performance calculations for GSTAR are similar to the SPACENET Ku-Band calculations, the only difference being the downlink EIRP value. The end results of the GSTAR calculations are tabulated in Table II-17. Both sets of calculations are referenced to CONUS edge of coverage locations (-2dB EIRP and G/T contours for SPACENET; -4dB EIRP and G/T contour for GSTAR). The system performance calculation results indicate that the services to be provided by SPACENET and GSTAR satellites are compatible with 2-degree orbital spacing.

F. Orbital Inter-Satellite Interference Analysis

The adjacent satellite interference analysis conducted by GTE Spacenet considers a series of equally-spaced satellites, with the desired satellite placed in the middle. A "single-entry approach" is employed wherein

Table II-3

C-Band Transponder
Single TV/FM

Uplink (13-meter)

Saturation Flux Density	-86 dBW/m²
Transponder Input Backoff	0 dB
Number of Carriers	1
Input Backoff/Carrier	0 dB
Effective Area of Isotropic Aperture	-37.5 dBm²
Free-Space Path Loss	200.5 dB
EIRP/Carrier	77 dBW
Satellite G/T	0 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	75.6 dB Hz
Uplink Carrier-to-Noise Ratio	29.5 dB

Downlink (5-meter)

Saturation EIRP	36.8 dBW
Transponder Output Backoff	0 dB
Number of Carriers	1
Output Backoff/Carrier	0 dB
Free-Space Path Loss	196.8 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	75.6 dB Hz
Earth Station G/T	24 dB/K
Downlink Carrier-to-Noise Ratio	17 dB

Combined Carrier-to-Noise Ratio	16.8 dB
Intermodulation Carrier-to-Interference Ratio	(N/A) dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	19.6 dB

Total Carrier-to-Noise Ratio, Including Interference	15.0 dB
Video Signal-to-Noise Ratio	55.4 dB

(N/A) = Not Applicable

Table II-4

C-Band Transponder
Single TV/FM (30 MHz)

Uplink (11-meter)

Saturation Flux Density	-86 dBW/m²
Transponder Input Backoff	0 dB
Number of Carriers	1
Input Backoff/Carrier	0 dB
Effective Area of Isotropic Aperture	-37.5 dBm²
Free-Space Path Loss	200.5 dB
EIRP/Carrier	77 dBW
Satellite G/T	0 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	74.8 dB Hz
Uplink Carrier-to-Noise Ratio	30.3 dB

Downlink (5-meter)

Saturation EIRP	36.8 dBW
Transponder Output Backoff	0 dB
Number of Carriers	1
Output Backoff/Carrier	0 dB
Free-Space Path Loss	196.8 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	74.8 dB Hz
Earth Station G/T	24.0 dB/K
Downlink Carrier-to-Noise Ratio	17.8 dB

Combined Carrier-to-Noise Ratio	17.6 dB
Intermodulation Carrier-to-Interference Ratio	(N/A) dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	19.6 dB

Total Carrier-to-Noise Ratio, Including Interference	15.5 dB
Video Signal to Noise Ratio	53 dB

(N/A) = Not Applicable

Table II-5

C-Band Transponder
Wideband TDMA (60 Mbps)

Uplink (13-meter)

Saturation Flux Density	-80 dBW/m²
Transponder Input Backoff	2 dB
Number of Carriers	1
Input Backoff/Carrier	2 dB
Effective Area of Isotropic Aperture	-37.5 dBm²
Free-Space Path Loss	200.5 dB
EIRP/Carrier	81 dBW
Satellite G/T	0 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	75.6 dB Hz
Uplink Carrier-to-Noise Ratio	33.5 dB

Downlink (13-meter)

Saturation EIRP	36.8 dBW
Transponder Output Backoff	0.2 dB
Number of Carriers	1
Output Backoff/Carrier	0.2 dB
Free-Space Path Loss	196.8 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	75.6 dB Hz
Earth Station G/T	32.5 dB/K
Downlink Carrier-to-Noise Ratio	25.3 dB

Combined Carrier-to-Noise Ratio	24.7 dB
Intermodulation Carrier-to-Interference Ratio	(N/A) dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	25.1 dB

Total Carrier-to-Noise Ratio, Including Interference	21.9 dB

(N/A) = Not Applicable

Table II-6

C-Band Transponder
Digital SCPC (1.544 Mbps)

Uplink (7-meter)

Saturation Flux Density	-80 dBW/m²
Transponder Input Backoff	8.0 dB
Number of Carriers	10.0
Input Backoff/Carrier	18.0 dB
Effective Area of Isotropic Aperture	-37.5 dBm²
Free-Space Path Loss	200.5 dB
EIRP/Carrier	65 dBW
Satellite G/T	0 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	59.3 dB Hz
Uplink Carrier-to-Noise Ratio	33.8 dB

Downlink (7-meter)

Saturation EIRP	36.8 dBW
Transponder Output Backoff	4.0 dB
Number of Carriers	10.0
Output Backoff/Carrier	14.0 dB
Free-Space Path Loss	196.8 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	59.3 dB Hz
Earth Station G/T	27.5 dB/K
Downlink Carrier-to-Noise Ratio	22.8 dB

Combined Carrier-to-Noise Ratio	22.5 dB
Intermodulation Carrier-to-Interference Ratio	21.0 dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	16.2 dB

Total Carrier-to-Noise Ratio, Including Interference	14.3 dB

Table II-7

C-Band Transponder
Analog SCPC (36.8 kHz)

Uplink (13-meter)

Saturation Flux Density	-77 dBW/m^2
Transponder Input Backoff	10 dB
Number of Carriers	800
Input Backoff/Carrier	39 dB
Effective Area of Isotropic Aperture	-37.2 dBm^2
Free-Space Path Loss	200.5 dB
EIRP/Carrier	47.0 dBW
Satellite G/T	0 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	45.7 dB Hz
Uplink Carrier-to-Noise Ratio	29.4 dB

Downlink (13-meter)

Saturation EIRP	36.8 dBW
Transponder Output Backoff	5 dB
Number of Carriers	800
Output Backoff/Carrier	34 dB
Free-Space Path Loss	196.8 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	45.7 dB Hz
Earth Station G/T	32.5 dB/K
Downlink Carrier-to-Noise Ratio	21.4 dB

Combined Carrier-to-Noise Ratio	20.8 dB
Intermodulation Carrier-to-Interference Ratio	16 dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	14.3 dB

Total Carrier-to-Noise Ratio, Including Interference	11.5 dB

Table II-8

Ku-Band Transponder (54 MHz)
Single Network TV/FM Carrier

Uplink (2.4-meter)

Saturation Flux Density	-89 dBW/m²
Transponder Input Backoff	0 dB
Number of Carriers	1
Input Backoff/Carrier	0 dB
Effective Area of Isotropic Aperture	-44.5 dBm²
Free-Space Path Loss	207.5 dB
EIRP/Carrier	74 dBW
Satellite G/T	2 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	75.6 dB Hz
Uplink Carrier-to-Noise Ratio	21.5 dB

Downlink (3.6-meter)

Saturation EIRP	43.8 dBW
Transponder Output Backoff	0 dB
Number of Carriers	1
Output Backoff/Carrier	0 dB
Free-Space Path Loss	205.9 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	75.6 dB Hz
Earth Station G/T	28.6 dB/K
Downlink Carrier-to-Noise Ratio	19.5 dB

Combined Carrier-to-Noise Ratio	17.4 dB
Intermodulation Carrier-to-Interference Ratio	(N/A) dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	22.6 dB

Total Carrier-to-Noise Ratio, Including Interference	16.3 dB
Video Signal to Noise Ratio	56.7 dB

(N/A) = Not Applicable

Table II-9

Ku-Band Transponder (54 MHz)
Dual Network TV/FM Carriers

Uplink (2.4-meter)	
Saturation Flux Density	-83 dBW/m^2
Transponder Input Backoff	2 dB
Number of Carriers	2
Input Backoff/Carrier	5 dB
Effective Area of Isotropic Aperture	-44.5 dBm^2
Free-Space Path Loss	207.5 dB
EIRP/Carrier	75.0 dBW
Satellite G/T	2 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	73.8 dB Hz
Uplink Carrier-to-Noise Ratio	24.3 dB
Downlink (5.5-meter)	
Saturation EIRP	43.8 dBW
Transponder Output Backoff	1.5 dB
Number of Carriers	2
Output Backoff/Carrier	4.5 dB
Free-Space Path Loss	205.9 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	73.8 dB Hz
Earth Station G/T	32.2 dB/K
Downlink Carrier-to-Noise Ratio	20.4 dB
Combined Carrier-to-Noise Ratio	18.9 dB
Intermodulation Carrier-to-Interference Ratio	(N/A) dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	23.8 dB
Total Carrier-to-Noise Ratio, Including Interference	17.7 dB
Video Signal to Noise Ratio	51.5 dB

(N/A) = Not Applicable

Table II-10

Ku-Band Transponder (54 MHz)
Wideband TDMA (60 Mbps)

Uplink (7-meter)	
Saturation Flux Density	-80 dBW/m^2
Transponder Input Backoff	2 dB
Number of Carriers	1
Input Backoff/Carrier	2 dB
Effective Area of Isotropic Aperture	-44.5 dBm^2
Free-Space Path Loss	207.5 dB
EIRP/Carrier	81 dBW
Satellite G/T	2 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	75.6 dB Hz
Uplink Carrier-to-Noise Ratio	28.5 dB
Downlink (7-meter)	
Saturation EIRP	43.8 dBW
Transponder Output Backoff	0.2 dB
Number of Carriers	1
Output Backoff/Carrier	0.2 dB
Free-Space Path Loss	205.9 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	75.6 dB Hz
Earth Station G/T	34.3 dB/K
Downlink Carrier-to-Noise Ratio	25.0 dB
Combined Carrier-to-Noise Ratio	23.4 dB
Intermodulation Carrier-to-Interference Ratio	(N/A) dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	27.9 dB
Total Carrier-to-Noise Ratio, Including Interference	22.1 dB

(N/A) = Not Applicable

Table II-11

Ku-Band Transponder (54 MHz)
Digital SCPC (1.544 Mbps)

Uplink (3.6-meter)

Saturation Flux Density	-80 dBW/m^2
Transponder Input Backoff	8 dB
Number of Carriers	30
Input Backoff/Carrier	22.8 dB
Effective Area of Isotropic Aperture	-44.5 dBm^2
Free-Space Path Loss	207.5 dB
EIRP/Carrier	60.2 dBW
Satellite G/T	2 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	59.3 dB Hz
Uplink Carrier-to-Noise Ratio	24 dB

Downlink (3.6-meter)

Saturation EIRP	43.8 dBW
Transponder Output Backoff	4 dB
Number of Carriers	30
Output Backoff/Carrier	18.8 dB
Free-Space Path Loss	205.9 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	59.3 dB Hz
Earth Station G/T	28.6 dB/K
Downlink Carrier-to-Noise Ratio	17.0 dB

Combined Carrier-to-Noise Ratio	16.2 dB
Intermodulation Carrier-to-Interference Ratio	18 dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	24.3 dB

Total Carrier-to-Noise Ratio, Including Interference	13.6 dB

Table II-12

Ku-Band Transponder (54 MHz)
Analog SCPC

Uplink (2.4-meter)

Saturation Flux Density	-77 dBW/m²
Transponder Input Backoff	10 dB
Number of Carriers	700
Input Backoff/Carrier	38.5 dB
Effective Area of Isotropic Aperture	-44.5 dBm²
Free-Space Path Loss	207.5 dB
EIRP/Carrier	47.5 dBW
Satellite G/T	2.0 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	44.0 dB Hz
Uplink Carrier-to-Noise Ratio	26.6 dB

Downlink (4.5-meter)

Saturation EIRP	43.8 dBW
Transponder Output Backoff	5 dB
Number of Carriers	700
Output Backoff/Carrier	33.5 dB
Free-Space Path Loss	205.9 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	44.0 dB Hz
Earth Station G/T	30.5 dB/K
Downlink Carrier-to-Noise Ratio	19.5 dB

Combined Carrier-to-Noise Ratio	18.7 dB
Intermodulation Carrier-to-Interference Ratio	16 dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	15.1 dB

Total Carrier-to-Noise Ratio, Including Interference	11.6 dB

Table II-13

Ku-Band Transponder (54 MHz)
Corporate Data/Voice Inbound (32 kbps)

Uplink (1.8-meter)

Saturation Flux Density	-83 dBW/m^2
Transponder Input Backoff	10 dB
Number of Carriers	400
Input Backoff/Carrier	36 dB
Effective Area of Isotropic Aperture	-44.5 dBm^2
Free-Space Path Loss	207.5 dB
EIRP/Carrier	44 dBW
Satellite G/T	2 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	42.5 dB Hz
Uplink Carrier-to-Noise Ratio	24.6 dB

Downlink (7-meter)

Saturation EIRP	43.8 dBW
Transponder Output Backoff	5 dB
Number of Carriers	400
Output Backoff/Carrier	31 dB
Free-Space Path Loss	205.9 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	42.5 dB Hz
Earth Station G/T	34.3 dB/K
Downlink Carrier-to-Noise Ratio	27.3 dB

Combined Carrier-to-Noise Ratio	22.7 dB
Intermodulation Carrier-to-Interference Ratio	20 dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	16.1 dB

Total Carrier-to-Noise Ratio, Including Interference	14 dB

Table II-14

Ku-Band Transponder
Corporate Data/Voice Outbound (772 kbps)

Uplink (7-meter)

Saturation Flux Density	-80 dBW/m^2
Transponder Input Backoff	6 dB
Number of Carriers	13
Input Backoff/Carrier	17.1 dB
Effective Area of Isotropic Aperture	-44.5 dBm^2
Free-Space Path Loss	207.5 dB
EIRP/Carrier	65.9 dBW
Satellite G/T	2 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	56.3 dB Hz
Uplink Carrier-to-Noise Ratio	32.7 dB

Downlink (1.8-meter)

Saturation EIRP	43.8 dBW
Transponder Output Backoff	3 dB
Number of Carriers	13
Output Backoff/Carrier	14.1 dB
Free-Space Path Loss	205.9 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	56.3 dB Hz
Earth Station G/T	20.9 dB/K
Downlink Carrier-to-Noise Ratio	17.0 dB

Combined Carrier-to-Noise Ratio	16.9 dB
Intermodulation Carrier-to-Interference Ratio	20 dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	16.1 dB

Total Carrier-to-Noise Ratio, Including Interference	12.6 dB

Table II-15

Ku-Band Transponder (54 MHz)
Corporate Broadcast (64 kbps)

Uplink (7-meter)	
Saturation Flux Density	-80 dBW/m^2
Transponder Input Backoff	8 dB
Number of Carriers	130
Input Backoff/Carrier	29.1 dB
Effective Area of Isotropic Aperture	-44.5 dBm^2
Free-Space Path Loss	207.5 dB
EIRP/Carrier	53.9 dBW
Satellite G/T	2 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	45.5 dB Hz
Uplink Carrier-to-Noise Ratio	31.5 dB
Downlink (1.8-meter)	
Saturation EIRP	43.8 dBW
Transponder Output Backoff	4 dB
Number of Carriers	130
Output Backoff/Carrier	25.1 dB
Free-Space Path Loss	205.9 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	45.5 dB Hz
Earth Station G/T	20.9 dB/K
Downlink Carrier-to-Noise Ratio	16.8 dB
Combined Carrier-to-Noise Ratio	16.7 dB
Intermodulation Carrier-to-Interference Ratio	23 dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	16.2 dB
Total Carrier-to-Noise Ratio, Including Interference	13.0 dB

Table II-16

Ku-Band Transponder (27 MHz)
Single TV/FM

Uplink (7-meter)

Saturation Flux Density	-86 dBW/m^2
Transponder Input Backoff	0 dB
Number of Carriers	1
Input Backoff/Carrier	0 dB
Effective Area of Isotropic Aperture	-44.5 dBm^2
Free-Space Path Loss	207.5 dB
EIRP/Carrier	77 dBW
Satellite G/T	2 dB/K
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	73.8 dB Hz
Uplink Carrier-to-Noise Ratio	26.3 dB

Downlink (1.8-meter)

Saturation EIRP	43.8 dBW
Transponder Output Backoff	0 dB
Number of Carriers	1
Output Backoff/Carrier	0 dB
Free-Space Path Loss	205.9 dB
Boltzmann's Constant, k	228.6 dBW/HzK
Bandwidth	73.8 dB Hz
Earth Station G/T	20.9 dB/K
Downlink Carrier-to-Noise Ratio	13.6 dB

Combined Carrier-to-Noise Ratio	13.4 dB
Intermodulation Carrier-to-Interference Ratio	(N/A) dB
Aggregate Adjacent-Satellite Carrier-to-Interference Ratio	19.9 dB

Total Carrier-to-Noise Ratio, Including Interference	12.5 dB
Video Signal-to-Noise Ratio	46.3 dB

(N/A) = Not Applicable

Table II-17

Summary of Link Performance via GSTAR Transponders (dB)

Carrier	Uplink C/N	Downlink C/N	Combined Link C/N	C/IM**	C/I***	Total C/N	Video S/N
Single TV/FM	21.5	20.5	18.0		22.6	16.7	57.1
Dual TV/FM	24.3	21.4	19.6		23.8	18.2	52.0
Wideband TDMA	28.5	26.0	24.1		27.9	22.6	
Digital SCPC	24.0	18.0	17.0	18	24.3	14.0	
Analog SCPC	19.6	19.5	16.5	16	15.1	11.1	
Corporate Data							
Inbound	24.6	28.3	23.1	20	16.1	14.0	
Outbound	32.7	18.0	17.9	20	16.1	12.9	
Broadcast	31.5	17.8	17.6	23	16.2	13.3	
TV/FM-Corporate	26.3	14.6	14.3		19.9	13.2	47.0

** Carrier-to-Intermodulation Ratio
*** Carrier-to-Interference Ratio

the single-entry carrier-to-interference ratio, $(C/I)_{se}$ is first calculated for one of the closest adjacent satellites. The aggregate adjacent-satellite carrier-to-interference ratio. $(C/I)_{as}$ is then computed by subtracting 4 dB from $(C/I)_{se}$.

F.1 Assumptions Used in the Analysis

The assumptions incorporated into the interference analysis are listed below:

- 2° Geocentric Orbital Spacing

  This equates to a topocentric spacing of 2.2°; this angle is used to determine the off-axis discrimination of the uplink and downlink earth stations in the direction of the interfered-with and interfering satellites, respectively.

- FCC Specified Antenna Sidelobes

  Earth Station antenna sidelobe performance is assumed to conform to the 29-25 log θ sidelobe specification, where θ equals the topocentric satellite spacing.

- Homogeneous Satellite Environment

  Both wanted and adjacent satellites were assumed to have the same EIRP and G/T levels for the interference analysis, since the replacement satellites for SPACENET and GSTAR, as well as the replacements for other existing satellites are expected to employ similar "state-of-the-art" technologies, and therefore will have similar characteristics. Further, the downlink EIRP of interfering Ku-Band satellites was assumed to be 1 dB higher than SPACENET satellites.

  For worst-case consideration, co-frequency assignment of both

Table II-18

Summary of Inter-Satellite Interference*

C-Band

Carrier	Uplink (C/I)	Downlink (C/I)	$(C/I)_{se}$	$(C/I)_{as}$
Single TV/FM	33.6	24.1	23.6	19.6
Wideband TDMA	32.4	31.9	29.1	25.1
Digital SCPC	29.3	20.8	20.2	16.2
Analog SCPC	24.9	19.4	18.3	14.3
		Ku-Band		
Single TV/FM	29.1	30.2	26.6	22.6
Dual TV/FM	29.1	33.8	27.8	23.8
Wideband TDMA	34.3	35.7	31.9	27.9
Digital SCPC	32.7	30.2	28.3	24.3
Analog SCPC	22.6	21.6	19.1	15.1
32 kbps Data	20.6	29.4	20.1	16.1
772 kbps Data	28.7	20.7	20.1	16.1
Corporate Data	31.2	20.5	20.2	16.2
TV/FM (27 MHz)	38.4	24.1	23.9	19.9

* given in dB

wanted and interfering carriers was assumed whenever possible. Since the type of traffic and carrier frequency assignment plan for the interfering systems (replacement satellites in mid-1990s) are not known and SPACENET's carriers represent most of the applications, interference analysis is confined to the SPACENET carriers.

- For worst-case consideration, TV/FM carriers were assumed as interfering carriers in most cases; and the video mask recommended by the FCC Advisory Committee was used.

A detailed description of the technical parameters of the carriers used in this analysis is provided in Section E.2. The link performance analysis for each type of carrier is contained in Section E.3. Included in the system performance analysis is the adjacent satellite carrier-to-interference ratio calculated as described below.

F.2 Adjacent Satellite Interference Calculations

The carrier-to-interference ratios are summarized in Table II-18. Detailed assumptions are shown in the following paragraphs.

F.2.1 C-Band Transponder Services

TV/FM

The worst-case adjacent-satellite interference to TV/FM will be that from another saturated transponder TV/FM signal which is transmitted at the same frequency and polarization. For this case, the uplink and downlink carrier-to-interference ratios are simply equal to the angular discrimination of the interfering uplink and desired signal downlink earth station antennas.

Wideband TDMA

For this service, worst-case interference will result from a co-frequency, saturated transponder signal in the adjacent satellite. For this case, the uplink and downlink carrier-to-interference ratios will be equal to the angular discrimination of the interfering uplink and desired-signal downlink earth station antennas minus the input and output TDMA transponder backoffs, respectively.

Digital SCPC

The worst-case interference from an adjacent satellite into a digital SCPC carrier will be from a co-frequency, co-polarized saturated TV/FM carrier. Assuming 1-2 MHz energy dispersal of the TV/FM signal, a 3 MHz guardband around the center frequency of the interfering carrier will generally provide for a maximum interference spectral power density of -67 dB/Hz, relative to an assumed transponder saturation EIRP of 36.8 dBW.

In the uplink, assuming equal saturation flux density levels for both interfering and desired signals, the carrier-to-interference ratio is calculated by adding the uplink interfering earth station antenna discrimination to the desired signal operation flux density and subtracting the interference signal flux density. The single-entry downlink carrier-to-interfering ratio is equal to the receive earth station antenna discrimination plus the desired signal power minus the interfering signal power.

Analog SCPC

As with digital SCPC carrier applications, when a co-channel transponder in an adjacent satellite carries a TV/FM signal at saturation, a 3 MHz guardband around the center of the interfering signal will be avoided in the assignment of the analog SCPC carrier frequencies. If this constraint is followed, then the maximum spectral power density can once again be assumed to be -67 dB/Hz relative to saturation EIRP. The carrier-to-interference ratio is then computed in the same manner as for the digital SCPC carrier.

F.2.2 Ku-Band Transponder Services

Single TV/FM

For calculating a representative carrier-to-interference ratio for single TV/FM carrier per SPACENET's 54 MHz transponder, interfering signals were assumed to be single TV/FM carriers operating in the co-frequency and co-polarized transponders in the adjacent satellites.

Dual-Carrier TV/FM

For calculating a representative carrier-to-interference ratio for dual-carrier TV/FM applications per 54 MHz transponder, interfering signals were assumed to be also dual carrier TV/FM carriers operating in the co-polarized adjacent-satellite transponders.

Wideband TDMA

For calculating a representative carrier-to-interference ratio for wideband TDMA applications, the interference signal was assumed to be also a wideband TDMA signal operating a saturation, employing a SFD of -80 dBW/m.

Digital SCPC

For determining a representative carrier-to-interference ratio for digital SCPC, an equivalent SCPC system (i.e., 30 carriers) was assumed as the interference source operating in a co-frequency and co-polarized transponder. Both the wanted and unwanted SCPC systems are assumed to employ a SFD of -80 dBW/m^2 and operate as described in Table II-11.

Analog SCPC

For calculating a representative carrier-to-interference ratio, it was assumed that satellite transponders on adjacent satellites carry TV/FM carriers. As before, a 3 MHz guardband around the center of the interfering carriers was assumed.

Corporate Data

For calculating a representative carrier-to-interference ratio, interfering signals were assumed to be single TV/FM carriers in the adjacent satellite transponders. Again, 3 MHz around the TV/FM carrier center frequency was used as a guardband. The SPACENET transponder was assumed to have a SFD of -83 dBW/m^2 while interfering transponders were assumed to have a SFD of -86 dBW/m^2.

TV/FM Corporate (27 MHz)

For calculating a representative carrier-to-interference ratio for corporate TV/FM applications, interfering signals were assumed to be also corporate TV/FM carriers operating in the adjacent satellite transponders.

G. Orbital Locations and Coverage Area

G.1 Orbital Location Requirements

The satellite authorizations requested by GTE Spacenet in this application are replacements for the presently operational SPACENET I, SPACENET II, and GSTAR II spacecraft located at 120°W.L., 69°W.L., and 105°W.L., respectively. As a result of the Trilateral Agreement between the U.S., Canada, and Mexico[31] and the FCC's December, 1988 Orbital Assignment Plan,[32] GTE Spacenet

---

[31] Supra, note 17.

is presently authorized to locate hybrid C- and Ku-Band satellites at 69°W.L., 87°W.L., and 103°W.L., and Ku-Band satellites at 105°W.L., 121°W.L., and 125°W.L. In addition, GTE Spacenet has received temporary authority to operate a Ku-Band satellite at 93°W.L. GTE Spacenet has determined that in order to provide maximum continuity of service to existing customers while increasing opportunities for provision of new services, the hybrid satellite SPACENET II at 69°W.L. will be replaced with a hybrid spacecraft SPACENET IIR, the Ku-Band GSTAR I satellite at 103°W.L. will be replaced with a hybrid SPACENET IR, and the Ku-Band GSTAR II satellite at 105°W.L. wil be replaced with a Ku-Band spacecraft GSTAR IIR.

GTE Spacenet is currently successfully operating satellites at all three orbital locations requested for the replacement satellites. It is therefore expected that the operational procedures presently undertaken by GTE Spacenet to ensure an interference-free environment for both its customers and customers on adjacent satellites will enable the successful operation of the replacement satellites in the requested locations.

G.2 Coverage Area

At the present time, all SPACENET transponders at C-Band on SPACENET I and II provide connectivity of the continental United States and either Alaska/Hawaii or Puerto Rico. Currently, only SPACENET III provides 50-state coverage plus coverage of Puerto Rico and the Virgin Islands. However, many broadcast and information networks require simultaneous connectivity to both Alaska/Hawaii and Puerto Rico.

---

[32] Supra, note 18.

This demand has prompted the need for increased geographical coverage in both C and Ku-Band. Thus, all the proposed replacement satellites are designed for 50-state as well as Puerto Rico/Virgin Islands coverage. However, the location of SPACENET IIR at 69°W.L. will not permit coverage of Alaska and Hawaii.

G.2.1 SPACENET C-Band and Ku-Band Coverage

The coverage contours for SPACENET IR at 103°W.L. and SPACENET IIR at 69°W.L. depicting the estimated EIRP and G/T provided are included in the individual SPACENET IR and SPACENET IIR applications included with this general application. Both satellites are designed to provide simultaneous coverage of 50 states plus Puerto Rico and the Virgin Islands with all C-Band and Ku-Band transponders. However, SPACENET II at 69°W.L. will not be capable of providing coverage to Alaska and Hawaii. Both satellites are designed to provide, at a minimum, the EIRP and G/T performance depicted in Table II-19. All normal voice, data and video services provided by the SPACENET replacement satellite transponders available in the contiguous United States also will be available at all offshore locations serviced by SPACENET. Similarly, comparable earth station facilities may be employed at offshore locations. Minor differences will exist among earth station facilities at contiguous U.S. and offshore locations, commensurate with the SPACENET performance contours, and user cost/performance tradeoffs.

G.2.2 GSTAR Ku-Band Coverage

The GSTAR replacement satellite's coverage contours depicting the estimated EIRP and G/T provided from 105°W.L. are included in the individual GSTAR IIR application included with this general application. All of the Ku-Band transponders will provide 50 state coverage plus coverage of Puerto Rico

Table II-19

SPACENET Replacement Satellite EIRP and G/T Minimum Performance

C-Band

Coverage Area	Minimum EIRP	Minimum G/T
Alaska*	33.8	-3
Puerto Rico & Virgin Islands	28.8	-8
Hawaii	30.0	-7
CONUS	35.0	-2

50 State plus Puerto Rico & Virgin Islands Mode

Ku-Band

Coverage Area	Minimum EIRP	Minimum G/T
Alaska*	40.0	-2
Puerto Rico & Virgin Islands	37.8	-4
Hawaii	41.8	0
CONUS	40.8	-1

* at Anchorage

and the Virgin Islands. The GSTAR replacement satellite is designed to provide, at a minimum, the EIRP and G/T performance depicted in Table II-20.

H. Schedule of Planned Milestone Dates

The following specifies the dates which GTE Spacenet plans to follow with respect to the replacement satellites applied for herein:

Schedule of Planned Dates

Satellite	Spacecraft RFP Issued	Contractor Selected	Spacecraft Contract Executed
SPACENET IR	Aug 1991	Dec 1991	Jan 1992
SPACENET IIR	July 1993	Nov 1993	Dec 1993
GSTAR IIR	Aug 1991	Oct 1991	Nov 1991

	Construction Commenced	Launch Services Contract Executed	Construction Completed	Expected Launch
SPACENET IR	Feb 1992	May 1993	Feb 1995	May 1995
SPACENET IIR	Jan 1994	April 1995	Jan 1997	April 1997
GSTAR IIR	Dec 1991	Dec 1992	Oct 1994	Dec 1994

I. System Costs and Revenue Requirement

The total estimated capital investment and operating costs for the replacement satellite system applied for herein, when launched, is $671.24 million. A detailed schedule of the estimated investment and operating costs, including satellite construction, launch services and insurance, annual depreciation, maintenance and operating costs, has been calculated. No funds will be needed for research and development. Exhibit 2 provides this information on a year-by-year basis. These estimates, which are based on the construction

Table II-20

GSTAR Replacement Satellite EIRP and G/T Minimum Performance

50 State plus Puerto Rico & Virgin Islands Mode

Coverage Area	Minimum EIRP	Minimum G/T
Alaska*	43.3	0.5
Hawaii	42.8	0
CONUS	43.8	1
Puerto Rico & Virgin Islands	40.8	-2

---

* at Anchorage

and launch of three satellites, rely on the best information available to GTE Spacenet at this time including estimates from spacecraft manufacturers and launch services providers. The revenue requirements are calculated using estimates of GTE Spacenet's tax rate, cost of capital and investment base.

J. Financial Qualifications

GTE Spacenet Corporation is a wholly owned subsidiary of the GTE Corporation. The financial qualifications of GTE Corporation are a matter of record at the Commission. The construction and launch of the proposed replacement satellites will utilize revenue generated by GTE Spacenet's operational satellites as well as funds provided by the GTE Corporation. Exhibit 3 attached hereto provides projected revenues for the replacement system, when launched, on a year-by-year basis. A copy of GTE Corporation's most recent Annual Report containing its balance sheet and operating income statement are also attached hereto as Exhibit 4. Exhibit 5 provides the 1990 second quarter consolidated financial results.

K. Legal Qualifications

GTE Spacenet has been a licensee in the domestic-fixed satellite service since January 30, 1981.[33] Since that time GTE Spacenet has participated in three additional domestic-satellite processing round proceedings wherein the Commission, pursuant to Section 25.391 of its Rules, 47 C.F.R. § 25.391, found GTE Spacenet legally qualified, and authorized it to construct, launch and

---

33 See Memorandum, Opinion, Order and Authorization, 84 FCC 2d 650, FCC 80-713, released January 30, 1981.

operate new and replacement satellites.[34] Attached hereto as Exhibit 6 is a copy of GTE Spacenet's most recently filed "Common Carrier and Satellite Radio License Qualification Report" (FCC Form 430).

L. Whether the Spacecraft Will Be Operated On a Common Carrier or Non-Common Carrier Basis

On March 31, 1987, GTE Spacenet obtained authority from the Commission to offer up to 80 of its total 136 authorized transponders on a non-common carrier basis.[35] The satellites for which this authority currently pertains includes: three hybrid SPACENET satellites i.e. SPACENET I, SPACENET II, and SPACENET III;[36] and four Ku-Band GSTAR satellites i.e. GSTAR I, II, III and IV.[37] Thus, a total of 59% of GTE Spacenet's authorized capacity is permitted to be offered on non-common carrier basis. Furthermore, this authority permits GTE Spacenet to utilize its transponder sales authority on a system-wide basis without regard to the specific number of transponders authorized for any given satellite. This system-wide authority provides GTE Spacenet with the flexibility to respond more quickly to the needs of its customers.

With respect to the replacement satellites proposed herein, GTE Spacenet

34 See, Order and Authorization, Southern Pacific Communications Company, FCC 83-194, released August 4, 1983, at fn. 4.; Order and Authorization, GTE Satellite Corporation, FCC 85-414, released August 29, 1985, at para 9; Order and Authorization, GTE Spacenet Corporation, FCC 88-378, released December 7, 1988, at para 13.

35 See, Letter from James R. Keegan, Chief, Domestic Facilites Division, to Leslie A. Taylor, March 31, 1987, Mimeo Number 61330.

36 It also pertained to the SPACENET satellite involved in a launch failure in September, 1985.

37 Order and Authorization, FCC 88-378, File Nos. 2760-DSS-MP/PL-87 et al, released December 7, 1988, para 13.

requests that it be permitted to extend its transponder sales authority to these facilities on the same system-wide basis conditioned on it not exceeding a total of 59% of all its operational transponders.

M. Public Interest

The public interest will be served by granting the GTE Spacenet replacement satellite authority requested herein for a number of reasons. First, it will permit GTE Spacenet to provide continuity of service to those users of its currently operational satellite capacity. The SPACENET I replacement satellite will permit continuity of service to those users of Ku-Band capacity on the GSTAR I satellite currently operating at 103°W.L. when GSTAR I reaches its end-of-life in 1995. Furthermore, it will provide the necessary C-Band capacity for transition from the SPACENET I satellite currently operating at 120°W.L. when that satellite reaches its projected end-of-life in 1997.[38] Likewise, the SPACENET II replacement will permit those users of the currently operational SPACENET II satellite to receive continuous, uninterrupted service through launching the SPACENET IIR satellite into 69°W.L. just prior to the end-of-life of SPACENET II. Similarly, and critically important for the GSTAR II users at 105°W.L. which employ thousands of VSAT earth stations, is the benefit of having continuous uninterrupted service provided from the 105°W.L. location. As the Commission is aware,[39] were GTE Spacenet not permitted to replace its

38 It is anticipated that the SPACENET I Ku-Band customers will transition to the GSTAR I replacement satellite at 121°W.L. in 1997. Construction authority for the GSTAR I replacement will be sought at a later time as was explained at Section I.A.2 herein.

39 See GTE Spacenet's Comments, filed March 7, 1988, pgs 8-10, on the Tentative Decision, RCA American Communications, Inc., FCC 88-1 released January 26, 1988 for a discussion of the significant expense and severe disruption to VSAT users when faced with repointing their

GSTAR II satellite at 105°W.L., extensive disruption and expense would befall these VSAT customers in repointing their antennas to another orbital location.

Second, as GTE Spacenet has indicated to the Commission on numerous occasions,[40] the public interest requires that satellite operators and customers have a reasonable degree of certainty with respect to replacement satellites at the end-of-life of the satellites currently operational. Because many customers contract for specialized services tailored specifically to their needs, they depend upon the continued existence of a particular satellite capacity supplier. Granting GTE Spacenet the replacement authority it is seeking herein will provide those customers and others with the assurance of the continued availability of the satellite services they require, from the orbital locations they desire.

Finally, Commission action on this application outside of a processing round proceeding will go far toward assuring the industry, both licensees and users alike, that the Commission 1) recognizes the need for a replacement expectancy for those licensees who have faithfully and in good stead met their license obligations in bringing service to the public, and; 2) realizes that such an expectancy will promote stability and confidence in the domestic satellite industry.

As required by Section 304 of the Communications Act of 1934 as amended, GTE Spacenet waives claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same whether by license or otherwise.

---

antennas.

40 Supra, note 7.

Wherefore, for the foregoing reasons, GTE Spacenet respectfully requests that the Commission grant these applications for construction authority for a SPACENET I, SPACENET II and GSTAR II replacement satellite.

Respectfully submitted,

GTE SPACENET CORPORATION

By: [signature]
Troy D. Ellington
Vice President, Engineering
and Development
1700 Old Meadow Road
McLean, Virginia 22102

September 27, 1990

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

In the Matter of the Application of	)	
	)	
GTE SPACENET CORPORATION	)	File Nos.
	)	
For Authority To Construct a SPACENET Replacement Satellite in the Domestic Fixed-Satellite Service (SPACENET IR)	))))	

APPLICATION

GTE Spacenet Corporation ("GTE Spacenet") pursuant to Sections 308, 309 and 319 of the Communications Act of 1934, as amended, 47 C.F.R. § 301 et. seq. hereby requests Commission authority to construct one replacement hybrid C- and Ku-Band SPACENET IR satellite.

A. Name/Address of Applicant

GTE Spacenet Corporation
1700 Old Meadow Road
McLean, Virginia 22102

B. Correspondence

Inquiries or correspondence regarding this application should be directed to either:

Troy D. Ellington
Vice President, Engineering
and Development
1700 Old Meadow Road
McLean, Virginia 22102
(703) 848-1400

Terri B. Natoli
Industry Relations Manager
1700 Old Meadow Road
McLean, Virginia 22102
(703) 848-1515

C. General Technical Information

C.1 Transponder Frequency and Polarization Plan

The proposed SPACENET I replacement will transmit (downlink) and receive (uplink) in C-Band within the two 500 MHz-wide frequency bands defined by 3700 MHz to 4200 MHz and 5295 MHz to 6425 MHz respectively. In Ku-Band the replacement will transmit (downlink) and receive (uplink) within the two 500 MHz-wide frequency bands defined by 11700 MHz to 12200 MHz and 14000 MHz to 14500 MHz respectively. SPACENET IR will contain twenty-four (24) narrowband (36-MHz) C-Band transponders, sixteen (16) narrowband (27 MHz) Ku-Band transponders, and eight (8) wideband (54 MHz) Ku-Band transponders employing orthogonal linear polarization with full (two times) frequency reuse in both the C-Band and the Ku-Band channels. Each 54 MHz Ku-Band transponder will also be switchable by ground command to two 27 MHz transponders. The frequency and polarization plans for SPACENET IR are provided in Figure II-1 and II-2 of the general application.

C.2 TT&C Frequencies and Polarization

The SPACENET replacement satellite will be capable of receiving uplink commands and of transmitting downlink telemetry in both C-Band and Ku-Band frequencies. The C-Band command uplink will be vertically polarized with a nominal frequency of 6423.5 MHz, the same as in the current SPACENET system. The two C-Band telemetry downlinks will have nominal frequencies of 3700.5 MHz and 4199.5 MHz with vertical and horizontal polarizations respectively, the same as in the current SPACENET system. The Ku-Band command uplink will be horizontally polarized with a nominal frequency of 14001.5 MHz, the same as in the current GSTAR system. The two Ku-Band telemetry downlinks will have nominal frequencies of 11702 MHz and 12198 MHz with vertical and horizontal polarizations respectively. The command uplinks will be encrypted to provide the necessary command system security.

C.3 Emission Designators

The emission types used by the transponders and the TT&C units are provided below:

C-Band:	36M0F4F	Single Carrier FM/TV
	36M0G7D	Wideband Digital TDMA
	1M00G7D	Digital SCPC (T1)
	36K8F3E	Analog SCPC
Ku-Band:	36M0F4F	Single Carrier FM/TV
	24M0F4F	Dual Carrier FM/TV
	36M0G7D	Wideband Digital TDMA
	1M00G7D	Digital SCPC (T1)
	41K6G7D	Broadcast Data
	83K2G7D	Digital Data
	25K0F3E	Analog SCPC
TT&C:	2K00G1D	Telemetry
	60K0G2D	Command

C.4 Final Amplifier Output Power

SPACENET IR will have a C-Band high power amplifier output power of 16 watts with an estimated net loss of less than 2 dB between the output of the amplifier and the antenna input. The Ku-Band traveling wave tube amplifier (TWTA) output power is 50 watts (regardless of whether the channel bandwidth is 27 MHz or 54 MHz) with an estimated net loss of less than 2.5 dB between the output of the TWTA and the antenna input.

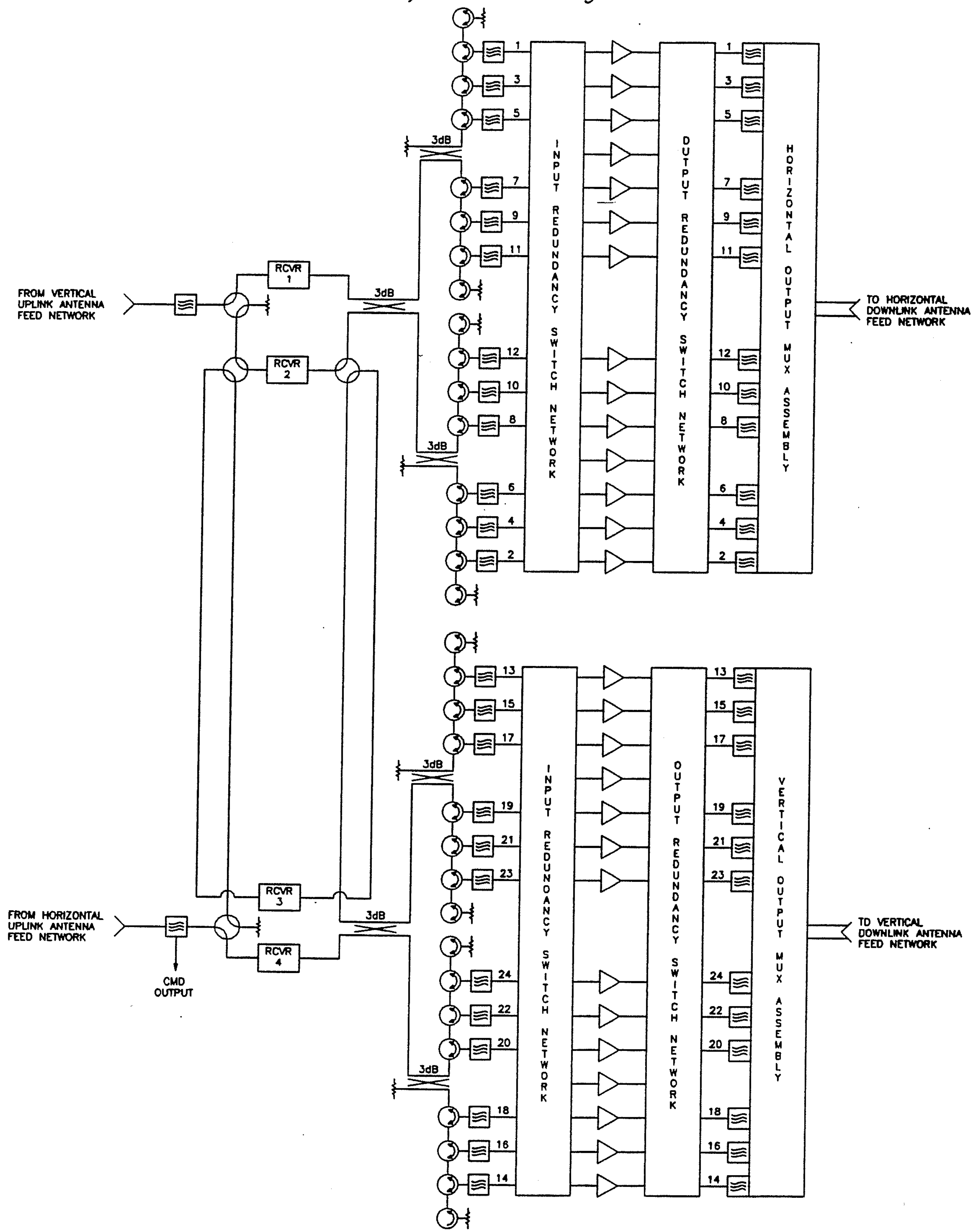
C.5 Antenna Beam Configurations

All C-Band and Ku-Band transponders and TT&C equipment will provide fifty (50) state coverage plus coverage of Puerto Rico and the Virgin Islands. The block diagrams in Figures 1 and 2 illustrate SPACENET IR's C-Band and Ku-Band communications subsystems, respectively.

C.6 Receiving System Noise Temperature

Nominal values for the SPACENET IR receive system noise temperatures are provided below:

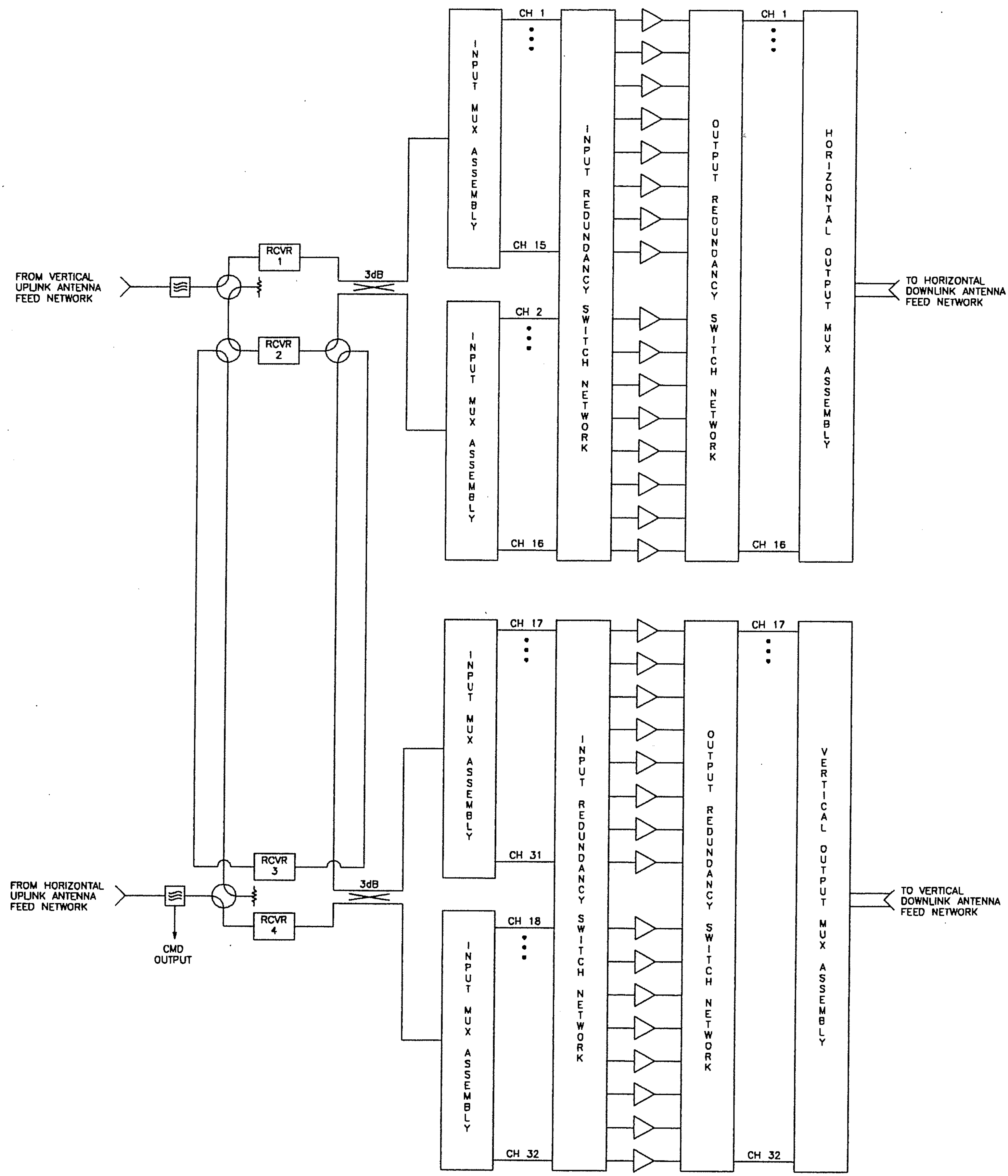
SPACENET C-Band Communications
Subsystem Block Diagram



CAD EG-001

SPACENET Ku-Band Communications
Subsystem Block Diagram

Figure 2



CAD EG-004
REV-

Narrowband (36 MHz) C-Band Transponders	550°K
Narrowband (27 MHz) Ku-Band Transponders	550°K
Wideband (54 MHz) Ku-Band Transponders	550°K

C.7 Transponder Channel Gains and Controls

The estimated transponder saturated channel gains for SPACENET IR are provided below:

Narrowband (36 MHz) C-Band Transponders	109 dB
Narrowband (27 MHz) Ku-Band Transponders	123.5 dB
Wideband (54 MHz) Ku-Band Transponders	123.5 dB

On-orbit control of the channel gains of the above three types of transponders is achieved through the employment of ground commandable attenuators. The following defines the transponder type/bandwidth, the applicable attenuator range and the number of commandable steps/step value for each:

Transponder Type/Bandwidth	Attenuator Range	No. of Steps/Value
C-Band/36 MHz	12 dB	5/3 dB
Ku-Band/27 MHz	21 dB	8/3 dB
Ku-Band/54 MHz	21 dB	8/3 dB

The Ku-Band transponders will also employ limiters, switchable by ground command, to reduce the effects of uplink fade on full transponder operations. In the limiting mode, each transponder will be capable of saturation for a 15 dB range of input power levels. Each Ku-Band transponder will also employ a ground-commandable linearizer in order to optimize TWTA utilization for multicarrier operations.

C.8 Receive Channel Filter Response Characteristics

SPACENET IR's transponder receive out-of-band response is defined from the input of the receive antenna to the input of the power amplifier. The receive response of any narrowband C-Band transponder is specified to be at least 30.0 dB below the center frequency response for signals more than ± 25 MHz from center frequency and at least 35.0 dB below the center frequency response for signals more than ± 27 MHz from center frequency.

The receive response for any narrowband Ku-Band transponder is specified to be at least 30.0 dB below the center frequency response for signals more than ± 18 MHz from center frequency and at least 40.0 dB below center frequency response for signals more than ± 22 MHz from center frequency.

The receive response for any wideband Ku-Band transponder is specified to be 30.0 dB below the center frequency response for signals more than ± 38 MHz from center frequency and at least 40.0 dB below center frequency response for signals more than ± 45 MHz from center frequency.

C.9 <u>Transmit Channel Filter Response Characteristics</u>

The SPACENET IR transponder transmit out-of-band response is defined from the input of the power amplifier to the output of the transmit antenna. The transmit response of any narrowband C-Band transponders is specified to be at least 8.5 dB below the frequency response for signals more than ± 25 MHz from center frequency and at least 20.0 dB below the center frequency response for signals more than ± 30 MHz from center frequency.

The transmit response for any narrowband Ku-Band transponder is specified to be at least 10.0 dB below the center frequency response for signals more than ± 17 MHz from center frequency and at least 20.0 dB below center frequency response for signals more than ± 18 MHz from center frequency.

The transmit response for any wideband Ku-Band transponder is specified to be 10.0 dB below the center frequency response for signals more than ± 34 MHz from center frequency and at least 20.0 dB below center frequency response for signals more than ± 36 MHz from center frequency.

D. Orbital Location

SPACENET IR is planned as a near term replacement for GSTAR I at 103°W.L. and eventually for the C-Band capacity on SPACENET I at 120°W.L., GSTAR I currently occupies an orbital location authorized for both C and Ku-Band satellites as a result of the U.S./Canadian/Mexican Trilateral Agreement.[1] A hybrid C- and Ku-Band SPACENET replacement satellite has previously been authorized for assignment to 103°W.L.[2] This will allow continuation of service for Ku-Band customers, as well as expansion of service to meet the demand for C-Band capacity. From this location, SPACENET IR will be able to provide 50-state coverage plus coverage of Puerto Rico and the Virgin Islands on all C-Band and Ku-Band transponders.

E. Predicted SPACENET IR C-Band and Ku-Band Coverage

SPACENET IR coverage contours depicting the estimated EIRP and G/T provided from 103°W.L. are included in Figures 3 and 4 of this application. The satellite is designed to provide simultaneous coverage of 50 states plus Puerto Rico and the Virgin Islands with all C-Band and Ku-Band transponders. The satellite is designed to provide, at a minimum, the EIRP and G/T performance depicted in Table II-19. Functional block diagrams of the satellite communication subsystems and switching capabilities for both C and Ku-Band are

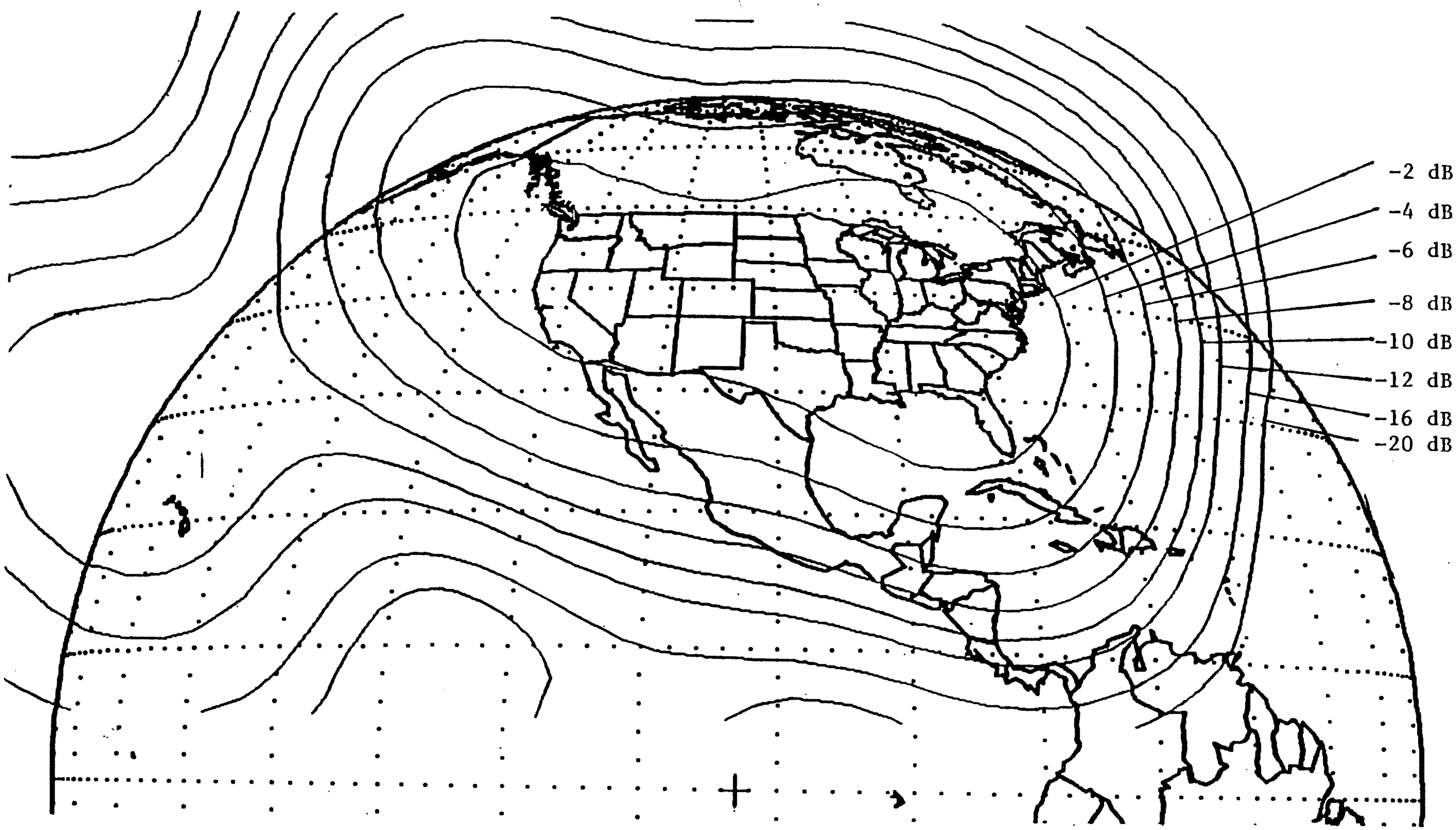
---

1 See exchange of letters: Gerald P. Vaughan, F.C.C., to Mexican Director General Jose Longoria, August 3, 1988; K. T. Hepburn, Canadian Department of Communications to Gerald Brock, F.C.C., August 12, 1988; and Jose Longoria, Mexican Director General to Gerald P. Vaughan, F.C.C., August 15, 1988. See also, FCC's Public Notice regarding Finalization of a U.S./Canadian/Mexican Trilateral Agreement, FCC Mimeo Number 4406, September 2, 1988.

2 See, Memorandum, Opinion and Order, FCC 88-373, Assignment of Orbital Locations to Space Stations in the Domestic Fixed-Satellite Service, released December 7, 1988, 3 FCC Rcd. 6972 (1988), ("1988 Orbital Assignment Plan").

Figure 3

SPACENET IR (103° WL) C-BAND COVERAGE CONTOURS



Peak EIRP	Peak G/T
38.8 dBW	2 dB/K

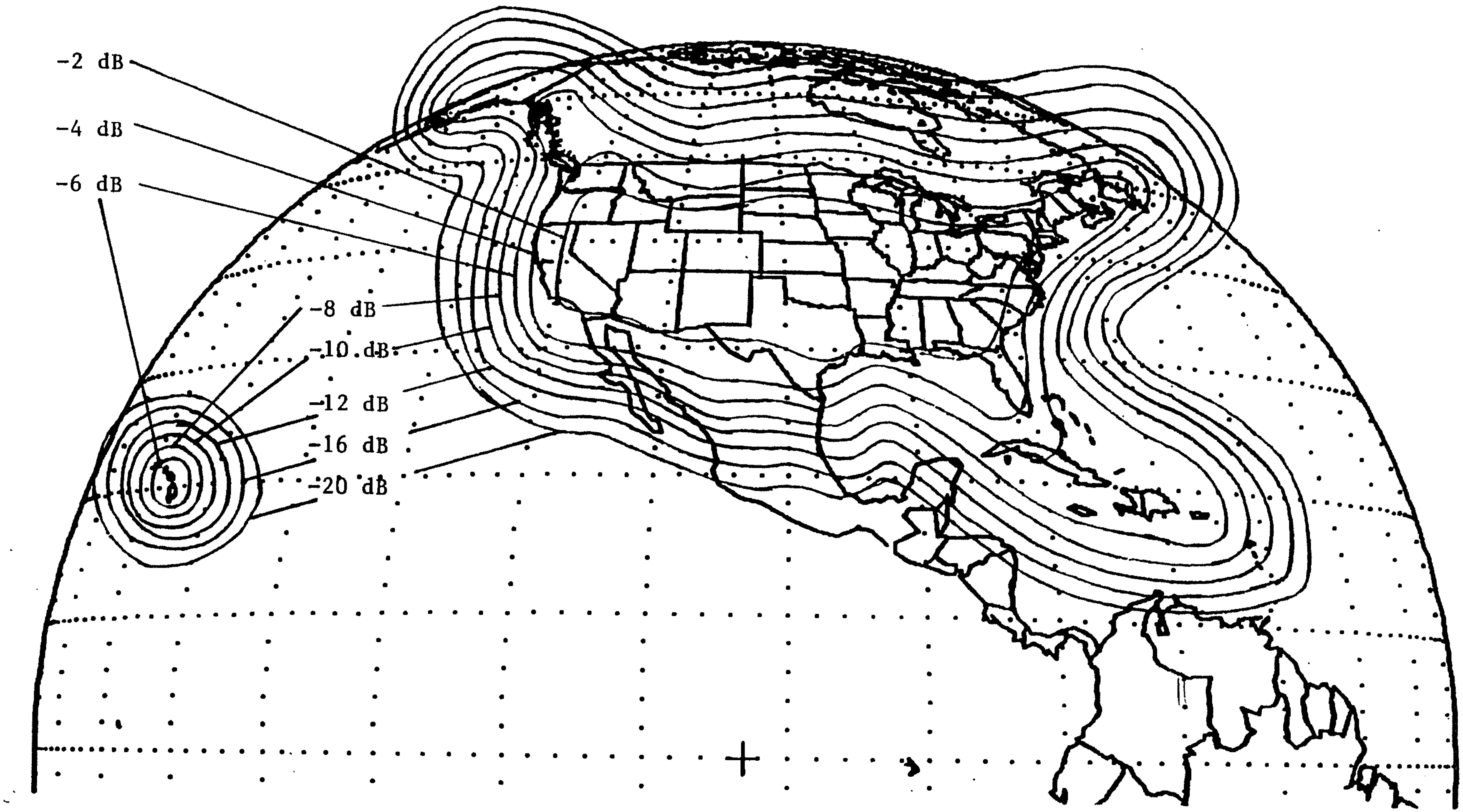
Minimum SFD = -91 dBW/m^2

Tx Gain (peak) = 28.8 dB

Rx Gain (peak) = 29.4 dB

Figure 4

SPACENET IR (103°WL) KU-BAND COVERAGE CONTOURS



Peak EIRP	Peak G/T
47.8 dBW	6 dB/K

Minimum SFD = -97 dBW/m^2

Tx Gain (peak) = 33.3 dB

Rx Gain (peak) = 33.3 dB

provided in Section C.5 of this application.

F. Physical Characteristics of Space Station

F.1 Stationkeeping Parameters

The SPACENET IR spacecraft will be maintained within +/-0.05 degrees, in both the North-South and East-West directions, of its assigned orbital location of 103°W.L. The stationkeeping maneuvers will be performed by ground-commandable reaction control thrusters located on the North, East, and West faces of the spacecraft.

F.2 Spacecraft Antenna Pointing

The SPACENET IR spacecraft communications antenna will be maintained within +/-0.1 degrees in both East-West (pitch) and North-South (roll) directions of its nominal boresight position during both normal spacecraft operations and stationkeeping maneuver operations.

F.3 In-Orbit Lifetime

The SPACENET IR spacecraft will be designed for a minimum on-orbit lifetime of twelve (12) years. The spacecraft design lifetime will be ensured by a propellant supply sufficient to maintain the required stationkeeping accuracy for the specified mission life, in addition to propellant required for intermediate stage burns, transfer orbit maneuvers, and orbit injection trim.

F.4 Attitude Control Subsystem

The SPACENET IR Attitude Control Subsystem (ACS) will provide satellite attitude control beginning with spacecraft separation from the launch vehicle and continuing through transfer to geosynchronous orbit, and will provide station acquisition and on-station attitude control. The ACS design will incorporate sun and horizon sensors, accelerometers, momentum wheels, and thrusters to perform its required functions.

F.5 Electrical Power Subsystem

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

G. Emission Limitations

Spurious emissions will be attenuated below the mean power output of the transponder by the following amounts.

		Attenuation in any 4kHz band
1)	For any frequency removed from the assigned frequency by 50 to 100%	25dB
2)	For any frequency removed from the assigned frequency by 100 to 250%	35dB
3)	For any frequency removed from the assigned frequency by more than 250%	55 dB (C-Band) 60 dB (Ku-Band)

H. Schedule of Planned Milestone Dates

The dates which GTE Spacenet plans to follow with respect to the SPACENET IR satellite are:

Construction Commencement	Construction Completion	Expected Launch Date
February 1992	February 1995	May 1995

Section 304 Waiver

As required by Section 304 of the Communications Act of 1934, as amended, GTE Spacenet waives claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests construction authority in accordance with this application.

Certification

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

The undersigned certifies individually and for GTE Spacenet that the statements made in this application are true, complete, and correct to the best of his knowledge and belief, and are made in good faith.

Wherefore, GTE Spacenet requests that the Commission authorize the construction of SPACENET IR in accordance with this application.

Respectfully submitted,

GTE SPACENET CORPORATION

By: Troy D. Ellington

Troy D. Ellington
Vice President, Engineering
and Development

September 27, 1990

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

In the Matter of the Application of GTE SPACENET CORPORATION For Authority To Construct a SPACENET Replacement Satellite in the Domestic Fixed-Satellite Service (SPACENET IIR)	))))))))	File Nos.

APPLICATION

GTE Spacenet Corporation ("GTE Spacenet") pursuant to Sections 308, 309 and 319 of the Communications Act of 1934, as amended, 47 C.F.R. § 301 et. seq. hereby requests Commission authority to construct one replacement hybrid C- and Ku-Band SPACENET IIR satellite.

A. Name/Address of Applicant

GTE Spacenet Corporation
1700 Old Meadow Road
McLean, Virginia 22102

B. Correspondence

Inquiries or correspondence regarding this application should be directed to either:

Troy D. Ellington
Vice President, Engineering
and Development
1700 Old Meadow Road
McLean, Virginia 22102
(703) 848-1400

Terri B. Natoli
Industry Relations Manager
1700 Old Meadow Road
McLean, Virginia 22102
(703) 848-1515

C. General Technical Information

C.1 Transponder Frequency and Polarization Plan

The proposed SPACENET II Replacement will transmit (downlink) and receive (uplink) in C-Band within the two 500 MHz-wide frequency bands defined by 3700 MHz to 4200 MHz and 5295 MHz to 6425 MHz respectively. In Ku-Band the replacement will transmit (downlink) and receive (uplink) within the two 500 MHz-wide frequency bands defined by 11700 MHz to 12200 MHz and 14000 MHz to 14500 MHz respectively. SPACENET IIR will contain twenty-four (24) narrowband (36-MHz) C-Band transponders, sixteen (16) narrowband (27 MHz) Ku-Band transponders, and eight (8) wideband (54 MHz) Ku-Band transponders employing orthogonal linear polarization with full (two times) frequency reuse in both the C-Band and the Ku-Band channels. Each 54 MHz Ku-Band transponder will also be switchable by ground command to two 27 MHz transponders. The frequency and polarization plans for SPACENET IR are provided in Figures II-1 and II-2 of the general application.

C.2 TT&C Frequencies and Polarization

The SPACENET replacement satellite will be capable of receiving uplink commands and of transmitting downlink telemetry in both C-Band and Ku-Band frequencies. The C-Band command uplink will be vertically polarized with a nominal frequency of 6423.5 MHz, the same as in the current SPACENET system. The two C-Band telemetry downlinks will have nominal frequencies of 3700.5 MHz and 4199.5 MHz with vertical and horizontal polarizations respectively, the same as in the current SPACENET system. The Ku-Band command uplink will be horizontally polarized with a nominal frequency of 14001.5 MHz, the same as in the current GSTAR system. The two Ku-Band telemetry dowlinks will have nominal frequencies of 11702 MHz and 12198 MHz with vertical and horizontal polarizations respectively. The command uplinks will be encrypted to provide the necessary command system security.

C.3 Emission Designators

The emission types used by the transponders and the TT&C units are provided below:

C-Band:	36M0F4F	Single Carrier FM/TV
	36M0G7D	Wideband Digital TDMA
	1M00G7D	Digital SCPC (T1)
	36K8F3E	Analog SCPC
Ku-Band:	36M0F4F	Single Carrier FM/TV
	24M0F4F	Dual Carrier FM/TV
	36M0G7D	Wideband Digital TDMA
	1M00G7D	Digital SCPC (T1)
	41K6G7D	Broadcast Data
	83K2G7D	Digital Data
	25K0F3E	Analog SCPC
TT&C:	2K00G1D	Telemetry
	60K0G2D	Command

C.4 Final Amplifier Output Power

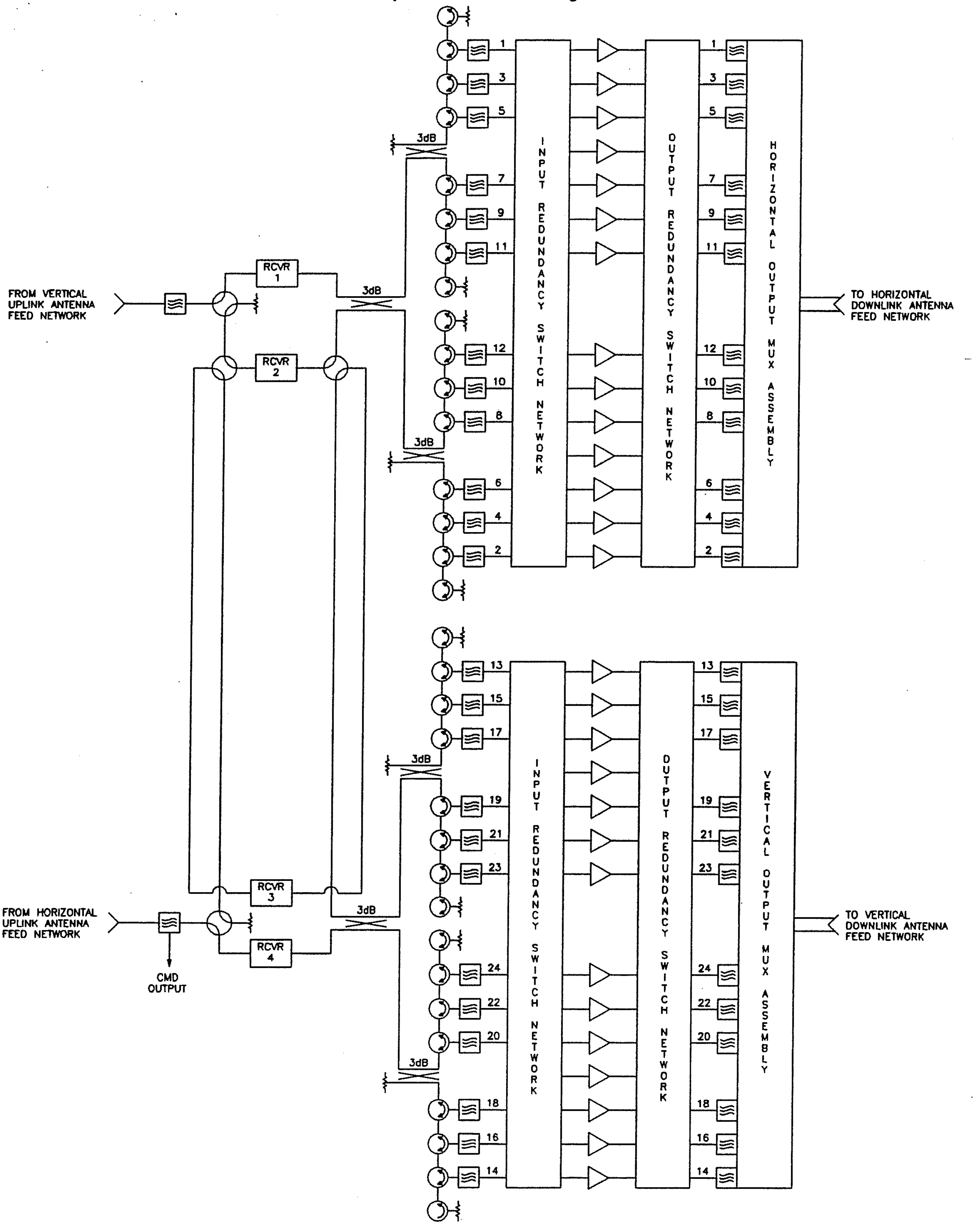
SPACENET IIR will have a C-Band high power amplifier output power of 16 watts with an estimated net loss of less than 2 dB between the output of the amplifier and the antenna input. The Ku-Band traveling wave tube amplifier (TWTA) output power is 50 watts (regardless of whether the channel bandwidth is 27 MHz or 54 MHz) with an estimated net loss of less than 2.5 dB between the output of the TWTA and the antenna input.

C.5 Antenna Beam Configurations

All of the narrowband C-Band and Ku-Band transponders and TT&C equipment are capable of providing fifty (50) state coverage plus coverage of Puerto Rico and the Virgin Islands. However, SPACENET IIR's assignment to 69°W.L. will preclude coverage of Alaska and Hawaii. The block diagrams in Figures 1 and 2 illustrate SPACENET IIR's C-Band and Ku-Band communications subsystems, respectively.

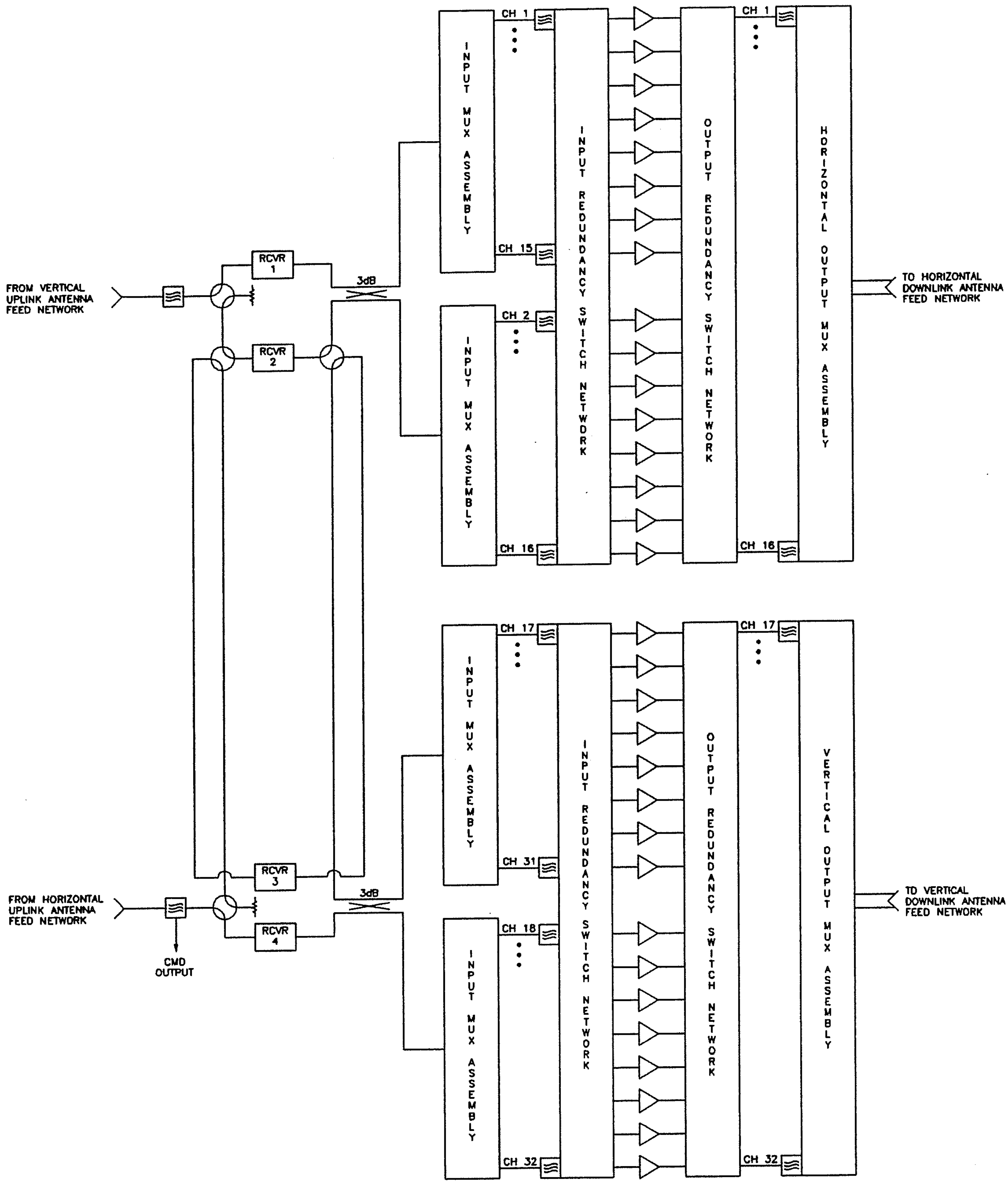
SPACENET C-Band Communications
Subsystem Block Diagram

Figure 1



CAD EG–001
REV–

SPACENET Ku-Band Communications
Subsystem Block Diagram



CAD EG-004
REV-