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156-SAT-P/LA-97(80)

FCC 312
Main Form

Approved by OMB 3060-0677

Est. Avg Burden Hour Per Response 10 Hrs

FEDERAL COMMUNICATIONS COMMISSION

APPLICATION FOR SATELLITE SPACE AND EARTH STATION AUTHORIZATIONS

PAYOR AND FILING FEE INFORMATION

a. Payor Name: Globalstar, L.P.				b. Daytime Telephone Number: (408) 933-4000
c. Mailing Street Address or P.O. Box: 3200 Zanker Road				d. FCC Account Number: 0133759024
e. City: San Jose		f. State: CA	g. Zip Code: 95134	h. Country Code (if not U.S.A.)
i. Payment Type Code: CLW	j. Quantity: 1	k. Fee Due for Payment Type Code in (i): $255,080.00	l. Total Amount Paid: $255,080.00	FCC Use Only

APPLICANT INFORMATION

1. Legal Name of Applicant: Globalstar, L.P.			2. Voice Telephone Number: (408) 933-4000
3. Other Name Used for Doing Business (if any)			4. Fax Telephone Number: (408) 933-4950
5. Mailing Street Address or P.O. Box: 3200 Zanker Road ATTENTION: William F. Adler	6. City: San Jose	7. State / Country (if not U.S.A.): California	8. Zip Code: 95134
9. Name of Contact Representative (If other than applicant): William D. Wallace			10. Voice Telephone Number: (202) 624-2807
11. Firm or Company Name: Crowell & Moring LLP			12. Fax Telephone Number: (202) 628-5116
13. Mailing Street Address or P.O. Box: 1001 Pennsylvania Avenue, N.W. ATTENTION:	14. City: Washington	15. State / Country (if not U.S.A.): D.C.	16. Zip Code: 20004

CLASSIFICATION OF FILING

17. Place an "X" in the box next to the classification that applies to this filing for both questions a. and b. Mark only one box for 17a and only one box for 17b.

a. [ ] a1. Earth Station
[X] a2. Space Station

b. [X] b1. Application for License of New Station
[ ] b2. Application for Registration of New Domestic Receive-Only Station
[ ] b3. Amendment to a Pending Application
[ ] b4. Modification of License or Registration
[ ] b5. Assignment of License or Registration
[ ] b6. Transfer of Control of License or Registration
[ ] b7. Notification of Minor Modification
[ ] b8. Other (Please Specify):

18. If this filing is in reference to an existing station, enter:
Call sign of station: N/A

19. If this filing is an amendment to a pending application enter:
(a) Date pending application was filed: N/A
(b) File number of pending application:

ORIGINAL 1838

TYPE OF SERVICE

20. NATURE OF SERVICE: This filing is for an authorization to provide or use the following type(s) of service(s): Place an "X" in the box(es) next to all that apply.

[X] a. Fixed Satellite [ ] b. Mobile Satellite [ ] c. Radiodetermination Satellite [ ] d. Earth Exploration Satellite [ ] e. Other (please specify) _____

21. STATUS: Place an "X" in the box next to the applicable status. Mark only one box.

[ ] a. Common Carrier [X] b. Non-Common Carrier

22. If earth station applicant, place an "X" in the box(es) next to all that apply

[ ] a. Using U.S. licensed satellites [ ] b. Using Non-U.S. licensed satellites

23. If applicant is providing INTERNATIONAL COMMON CARRIER service, see instructions regarding Sec. 214 filings. Mark only one box. Are these facilities:

[ ] a. Connected to the Public Switched Network [ ] b. Not connected to the Public Switched Network

24. FREQUENCY BAND(S): Place an "X" in the box(es) next to all applicable frequency band(s).

[ ] a. C-Band (4/6 GHz)
[ ] b. Ku-Band (12/14 GHz) [X] c. Other (Please specify) 38/49 GHz

TYPE OF STATION

25. CLASS OF STATION: Place an "X" in the box next to the class of station that applies. Mark only one box.

[ ] a. Fixed Earth Station [ ] b. Temporary-Fixed Earth Station [ ] c. 12/14 GHz VSAT Network [ ] d. Mobile Earth Station [X] e. Space Station [ ] f. Other (Specify) _____

If space station applicant, go to Question 27.

26. TYPE OF EARTH STATION FACILITY Mark only one box.

[ ] a. Transmit/Receive [ ] b. Transmit-Only [ ] c. Receive-Only

PURPOSE OF MODIFICATION OR AMENDMENT

27. The purpose of this proposed modification or amendment is to: Place an "X" in the box(es) next to all that apply.

[ ] a -- authorization to add new emission designator and related service
[ ] b -- authorization to change emission designator and related service
[ ] c -- authorization to increase EIRP and EIRP density
[ ] d -- authorization to replace antenna
[ ] e -- authorization to add antenna
[ ] f -- authorization to relocate fixed station
[ ] g -- authorization to change assigned frequency(ies)
[ ] h -- authorization to add Points of Communication (satellites & countries)
[ ] i -- authorization to change Points of Communication (satellites & countries)
[ ] j -- authorization for facilities for which environmental assessment and radiation hazard reporting is required
[ ] k -- Other (Please Specify) _____

ENVIRONMENTAL POLICY

28. Would a Commission grant of any proposal in this application or amendment have a significant environmental impact as defined by 47 CFR 1.1307? [ ] YES [X] NO
If YES, submit the statement as required by Sections 1.1308 and 1.1311 of the Commission's rules, 47 C.F.R. §§ 1.1308 and 1.1311, as Exhibit A to this application.

A Radiation Hazard Study must accompany all applications as Exhibit B for new transmitting facilities, major modifications, or major amendments. Refer to OET Bulletin 65

ALIEN OWNERSHIP

29. Is the applicant a foreign government or the representative of any foreign government?	☐ YES	☒ NO
30. Is the applicant an alien or the representative of an alien?	☐ YES	☒ NO
31. Is the applicant a corporation organized under the laws of any foreign government?	☐ YES	☒ NO
32. Is the applicant a corporation of which more than one-fifth of the capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?	☐ YES	☒ NO
33. Is the applicant a corporation directly or indirectly controlled by any other corporation of which more than one-fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?	☐ YES	☒ NO See Exhibit C
34. If any answer to questions 29, 30, 31, 32 and/or 33 is Yes, attach as Exhibit C an identification of the aliens or foreign entities, their nationality, their relationship to the applicant, and the percentage of stock they own or vote.		

BASIC QUALIFICATIONS

35. Does the applicant request any waivers or exemptions from any of the Commission's Rules? If Yes, attach as Exhibit D, copies of the requests for waivers or exceptions with supporting documents.	☒ YES	☐ NO
36. Has the applicant or any party to this application had any FCC station authorization or license revoked or had any application for an initial, modification or renewal of FCC station authorization, license, or construction permit denied by the Commission? If Yes, attach as Exhibit E, an explanation of the circumstances.	☐ YES	☒ NO
37. Has the applicant, or any party to this application, or any party directly or indirectly controlling the applicant ever been convicted of a felony by any state or federal court?	☐ YES	☒ NO
38. Has any court finally adjudged the applicant, or any person directly or indirectly controlling the applicant, guilty of unlawfully monopolizing or attempting unlawfully to monopolize radio communication, directly or indirectly, through control of manufacture or sale of radio apparatus, exclusive traffic arrangement or any other means or unfair methods of competition?	☐ YES	☒ NO
39. Is the applicant, or any person directly or indirectly controlling the applicant, currently a party in any pending matter referred to in the preceeding two items?	☐ YES	☒ NO
40. By checking Yes, the undersigned certifies, that neither the applicant nor any other party to the application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance. See 47 CFR 1.2002(b) for the meaning of "party to the application" for these purposes.	☒ YES	☐ NO

41. Description. (Summarize the nature of the application and the services to be provided).

The applicant is requesting authority to launch and operate a low-earth orbiting constellation of 80 nongeostationary satellites at 1440 kilometers above the surface of the Earth in the frequencies proposed for NGSO FSS at 38/49 GHz. The applicant is requesting at least 1 GHz of spectrum for both the user uplinks and user downlinks, specifically 48.2-49.2 GHz for the uplinks and 37.5-38.5 GHz for the downlinks. The GS-40 system will provide an array of modern communication services, including global internet access and trunking services for connecting buildings, wireline and wireless telephone switching offices with each other, and remote terrestrial cellular sites to the Public Switched Telephone Network and Public Land Mobile Network.

CERTIFICATION

The Applicant waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests an authorization in accordance with this application. The applicant certifies that grant of this application would not cause the applicant to be in violation of the spectrum aggregation limit in 47 CFR Part 20. All statements made in exhibits are a material part hereof and are incorporated herein as if set out in full in this application. The undersigned, individually and for the applicant, hereby certifies that all statements made in this application and in all attached exhibits are true, complete and correct to the best of his or her knowledge and belief, and are made in good faith.

42. Applicant is a (an): (Place an "X" in the box next to applicable response.)

☐ a. Individual ☐ b. Unincorporated Association ☒ c. Partnership ☐ d. Corporation ☐ e. Governmental Entity ☐ f. Other (Please specify) _____

43. Typed Name of Person Signing	44. Title of Person Signing
Douglas G. Dwyre	President, Globalstar, L.P.
45. Signature: Douglas G. Dwyre	46. Date: 24 Sept 97

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND/OR IMPRISONMENT (U.S. Code, Title 18, Section 1001), AND/OR REVOCATION OF ANY STATION AUTHORIZATION (U.S. Code, Title 47, Section 312(a)(1)), AND/OR FORFEITURE (U.S. Code, Title 47, Section 503).

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In re Application of	)	
	)	
GLOBALSTAR, L.P.	)	File No. _____
	)	
For Authority to Launch and Operate	)	
Operate a Fixed-Satellite Service	)	156-SAT-P/LA-97(80)
System in the 38/49 GHz Frequency Bands	)	
	)	

APPLICATION

William D. Wallace
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1001 Pennsylvania Avenue, N.W.
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(202) 624-2500

William F. Adler
Vice President and Division Counsel
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September 1997

EXECUTIVE SUMMARY

Globalstar, L.P. is seeking authority to launch and operate a global network of non-geostationary satellites that will deliver a broad array of high data rate services to residential and business customers throughout the world. By combining the use of low-earth orbit satellites with existing terrestrial communications systems and innovative, highly efficient technologies, the GS-40 system will provide users in the United States and throughout the world with low-cost and reliable global communications.

System Design and Spectrum Plan. The GS-40 system uses a constellation of 80 non-geostationary (NGSO) satellites to provide coverage for the United States, including Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands, and significantly populated regions of the globe. The 80 satellite constellation is divided into ten orbital planes which are equally spaced around the equator with eight satellites in each plane.

The system is designed to operate with 1 GHz of spectrum for uplink communications in the 48.2 - 49.2 GHz band and 1 GHz for downlink communications in the 37.5 - 38.5 GHz band. Both the user High Rate Terminals and the Gateway earth stations will be able to operate simultaneously within a beam in these bands, and so, no additional spectrum is required for feeder links. Each satellite uses 30 pairs of uplink and downlink antenna beams formed in an active phased array to track intended targets on the surface of the earth. The high antenna gains allow high data rates even with relatively low transmitter

power. In addition, the spacecraft are equipped with transmit filters to minimize out-of-band emissions and interference into other services plus narrowband receive and transmit filters to reduce adjacent-channel interference and to select channels.

Services Offered. The GS-40 system will provide an array of modern telecommunications services designed to augment the mobile voice, data, paging and fax services which will be provided by the first-generation Globalstar™ system. These services will further enhance the worldwide free flow of information by connecting distant and remote users of communication services to the rest of world. GS-40 will offer trunking services which will allow remote pockets of terrestrial cellular sites to interconnect with the rest of world. It will enable LAN-to-LAN communications by connecting routers at remote locations through satellite channels. In addition, GS-40 will offer global access to the Internet to connect rural and remote areas with the National and Global Information Infrastructure.

Compatibility. The GS-40 system design can be modified to accommodate sharing in the service links should such sharing be required. Moreover, techniques exist which can be used to mitigate the interference between multiple NGSO systems. These capabilities enable the Commission to further its multiple entry objectives by authorizing competing systems.

Public Interest Considerations. The proposed GS-40 satellite system will further the public interest in a variety of ways. The system's flexible technical design will provide low-cost global communications services to users in the United

States and around the world. The GS-40 system will also enhance competition in domestic and international telecommunications markets.

Moreover, grant of this application has the potential to stimulate economic growth. Investment in the network will create many new jobs for skilled workers, and the system itself, by virtue of the advanced telecommunications services it offers, will increase the efficiency of many existing businesses and lead to the development of new ones. The system also promotes the communications and information policy goals of the United States by providing continuous modern communications service to all areas of the globe including many regions which are still not covered by terrestrial landline services. The GS-40 system will further the Commission's stated goal of establishing the United States' leadership in mobile, personal, and satellite communications.

Potential Augmentation of GS-40 System. For information purposes, Globalstar has provided a general description of three different potential augmentations of the GS-40 system. These include constellations of NGSO satellites with dual payloads (either 40 GHz plus 1.6/2.4 GHz or 40 GHz plus 2 GHz) or three payloads (40 GHz plus 1.6/2.4 GHz plus 2 GHz). Each of these potential configurations would combine two or more communication payloads on the same satellite and would incorporate satellite antenna-to-antenna connectivity features, such as feeder link turn-around, to enable gateway-to-gateway links. The information provided herein illustrates the possible applications of

interconnecting and describes how these multi-payload configurations would differ from the GS-40 stand-alone system.

Waiver Requests. With this application, Globalstar is requesting waiver of certain parts of the Commission's Rules. Specifically, Globalstar requests a waiver of Sections 25.210 and 25.140 because these provisions create requirements intended for a GSO system, not an NGSO system like the system proposed herein. Globalstar also requests waiver of Sections 2.106 and 25.202 to the extent required to use any of the frequency bands proposed herein.

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EXHIBIT C

OWNERSHIP INFORMATION

The Applicant, Globalstar, L.P., is a Delaware limited partnership, and has two general partners, Loral Qualcomm Satellite Services, L.P. (LQSS), and Globalstar Telecommunications Limited (GTL).[1] LQSS, a Delaware limited partnership, is the managing general partner. GTL, a Bermuda company, is publicly-traded. The sole general partner of LQSS is Loral/Qualcomm Partnership, L.P. (LQP), whose legal qualifications are a matter of record at the Commission.[2] The Globalstar™ authorization was issued to LQP, and later assigned to L/Q Licensee, Inc. (LQL), a wholly-owned subsidiary of LQP (File No. 148-SAT-AL-95). Loral Space & Communications Ltd. (Loral Space) ultimately controls LQP, as explained in the application to transfer control of LQL to Loral Space (File No. 69-SAT-TC-96), granted by an order dated March 15, 1996. Loral Space is a company incorporated in the Islands of Bermuda.

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[1] Hence, the information provided in response to questions 36-40 on FCC 312 is provided only for Globalstar, L.P., GTL and LQSS.

[2] See Loral/Qualcomm Partnership, L.P., 10 FCC Rcd 2333 (Int'l Bur. 1995) (File Nos. 19-DSS-P-91(48), CSS-91-014, 13-SAT-LA-94, 14-SAT-AMEND-94, 21-SAT-MISC-95).

EXHIBIT D

REQUESTED RULE WAIVERS

In connection with obtaining the authority for the system proposed herein, Globalstar respectfully requests waiver of certain of the Commission's Rules.

Waiver of Sections 2.106 and 25.202. The Applicant proposes use of frequencies which have not yet been allocated for FSS.[1] To the extent required, Globalstar requests a waiver of Sections 2.106 and 25.202 of the Commission's rules to use any of the bands proposed herein.

Waiver of Section 25.210. The GS-40 system proposed herein satisfies the intent of Section 25.210 by using the required bandwidth in the uplink and downlink bands in a manner that maximizes system capacity. However, because the proposed system is an NGSO design, it is incapable of satisfying the explicit requirements of this section, which was intended to apply to GSO systems. Accordingly, Globalstar requests a waiver of Section 25.210 to the extent that the GS-40 system is incapable of complying with the rule pending a modification of the rule to meet the design needs of NGSO systems.

Waiver of Section 25.140. The Applicant has provided a complete description of the GS-40 system and all information required by Section 25.114. The Applicant requests a waiver of Section 25.140 of the Commission's Rules to the extent that the requirements of Section 25.140 -- other than those incorporated

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[1] See Allocation and Designation of Spectrum for Fixed Satellite Services in the 37.5 - 38.5 GHz, 40.5 - 41.5 GHz, and 48.2 - 50.2 GHz, FCC 97-85 (released Mar. 24, 1997) ("40 GHz NPRM").

by reference to Section 25.114 -- may be deemed applicable to NGSO FSS systems at 38/49 GHz. By its express terms, Section 25.140 refers only to GSO satellite systems, which were the systems for which the rule was originally adopted;[2] therefore, the requirements specified in Section 25.140 are not applicable to NGSO FSS systems. Moreover, the Commission has stated that the specific licensing and service requirements FSS systems at 38/49 GHz will be considered in a future proceeding.[3] Accordingly, Globalstar requests a waiver of any Section 25.140 requirements for FSS systems which are inconsistent with, or not required by, the information requests in Section 25.114.

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[2] See, e.g., 47 C.F.R. § 25.140(b)(2) (discussing orbital locations for FSS systems).

[3] See 40 GHz NPRM, ¶ 9.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In re Application of	)	
	)	
GLOBALSTAR, L.P.	)	File No. _____
	)	
For Authority to Launch and Operate	)	
Operate a Fixed-Satellite Service	)	
System in the 38/49 GHz Frequency Bands	)	
	)	

APPLICATION
(Section 25.114(c) Narrative)

Pursuant to Sections 308, 309 and 319 of the Communications Act of 1934, as amended, and Section 25.114 of the Commission's Rules, and in response to Public Notice, Report No. SPB-89 (released July 22, 1997), as amended by Public Notice, Report No. SPB-95 (released Aug. 13, 1997) and Public Notice, Report No. SPB-99 (released Sept. 4, 1997), Globalstar, L.P. hereby requests authority to launch and operate a Fixed-Satellite Service (FSS) system in the 38/49 GHz frequency bands. This application includes a comprehensive proposal for the proposed GS-40 system,[1] a constellation of non-geostationary (NGSO) satellites.[2]

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[1] Globalstar's legal qualifications are set forth in the attached FCC 312.

[2] In response to Public Notice, SPB-88 (released July 22, 1997), Globalstar is also filing an application for authority to launch and operate a Mobile-Satellite Service system in the 2 GHz frequency bands. As described in this application, were Globalstar authorized to operate in both sets of frequencies, it may configure one constellation of satellites to carry both communications payloads. This configuration of satellites would comply with the technical parameters imposed upon any 38/49 GHz authorization obtained by Globalstar as a result of this application in the Commission's processing round for 38/49 GHz.

As described more fully below, GS-40 would allow Globalstar to serve new markets to address the anticipated increase in demand for satellite services following the introduction of the first-generation Globalstar™ system (hereafter "Globalstar").

I. THE APPLICANT

The name, address and telephone number of the Applicant is provided below:

Globalstar, L.P.
3200 Zanker Road
San Jose, CA 95134
(408) 933-4000

The Applicant, Globalstar is a Delaware limited partnership, and has two general partners, Loral Qualcomm Satellite Services, L.P. (LQSS), and Globalstar Telecommunications Limited (GTL). LQSS is the managing general partner. GTL is a publicly-traded company. The sole general partner of LQSS is Loral/Qualcomm Partnership, L.P. (LQP), whose legal qualifications are a matter of record at the Commission.[3] The names and addresses of the individual partners in Globalstar are set forth in Appendix A.

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[3] See Loral/Qualcomm Partnership, L.P., 10 FCC Rcd 2333 (Int'l Bur. 1995) (File Nos. 19-DSS-P-91(48), CSS-91-014, 13-SAT-LA-94, 14-SAT-AMEND-94, 21-SAT-MISC-95). The Globalstar™ authorization was issued to LQP, and later assigned to L/Q Licensee, Inc. (LQL), a wholly-owned subsidiary of LQP (File No. 148-SAT-AL-95). Loral Space & Communications Ltd. (Loral Space) ultimately controls LQP, as explained in the application to transfer control of LQL to Loral Space (File No. 69-SAT-TC-96), granted by an order dated March 15, 1996.

II. PERSONS TO CONTACT

The name, address and telephone number of persons to whom inquiries and correspondence should be directed are as follows:

Douglas G. Dwyre
President
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(408) 933-4000

Robert A. Wiedeman
Vice President of Engineering
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Legal contacts

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(408) 933-4401

William D. Wallace
Crowell & Moring LLP
1001 Pennsylvania Ave., N.W.
Washington, DC 20004
(202) 624-2807

III. AUTHORITY REQUESTED

Globalstar is requesting authority to launch and operate its proposed constellation of 80 non-geostationary satellites in the frequencies proposed for allocation for NGSO FSS at 38/49 GHz.[4] In this application, Globalstar describes its proposed GS-40 system using 1 GHz of spectrum each for user uplinks and

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[4] See Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5 - 38.5 GHz, 40.5 - 41.5 GHz, and 48.2 - 50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5 - 42.5 GHz Frequency Band, Allocation of Spectrum in the 46.9 - 47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0 - 38.0 GHz and 40.0 - 40.5 GHz Bands for Government Operations, FCC 97-85 (released Mar. 24, 1997) ("40 GHz NPRM").

user downlinks; however, it ultimately requests authority for whatever spectrum is allocated for NGSO FSS within the United States.

IV. SYSTEM DESCRIPTION

4.1. GS-40 System Overview. GS-40 is a low-earth orbiting (LEO) satellite system using a constellation of 80 satellites at 1440 kilometers above the surface of the Earth. The constellation is designed to provide satellite coverage for the United States, including Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands, and all significantly populated regions of the globe. Globalstar is requesting at least 1 GHz of spectrum for both the user uplinks and user downlinks, specifically, 48.2 - 49.2 GHz for the uplinks and 37.5 - 38.5 GHz for the downlinks.

GS-40 will provide an array of communications services. It will offer services to fixed High Rate Terminals (HRT) to all areas of the globe. It will offer trunking services for connecting buildings, wireline and wireless telephone switching offices with each other, and remote terrestrial cellular sites to the Public Switched Telephone Network (PSTN) and Public Land Mobile Network (PLMN). GS-40 will also offer Internet access services to connect rural and remote areas with the National and Global Information Infrastructures. GS-40 will thus augment the mobile voice, data, paging and fax services which will be provided by the first-generation Globalstar system.

GS-40 consists of three major segments: the space segment, the ground segment, and the user segment.[5] The space segment is composed of a constellation of 80 LEO satellites at 1440 km altitude to provide global coverage between 70 degrees north and south latitudes. The satellite payload is a "bent-pipe" transponder that includes: service uplink and downlink antenna arrays, which form 30 spot beams on the Earth's surface for links between users and/or gateways and the satellite; horn antennas for telemetry and command; beam switch matrices and frequency selection filters.

The ground segment consists of Gateways, a Satellite Operations Control Center, a Ground Operations Control Center, and a Business Office. These may or may not be the same ones as used by the present Globalstar system. That is a business decision that will be made at a future time. The system will have Gateways distributed around the world.

The user segment features High-Rate Terminals (HRTs) which provide service at a data rate of 2.048 Mbps at 38/49 GHz. A number of the GS-40 applications will not use Gateways, but just connect the facilities of customers, such as connecting remote cellular base stations to their main cell sites.

Satellite diversity will be used in this system, either by combining signals or switching between them in a dynamic manner. Diversity overcomes the adverse effects of propagation such as blocking, shadowing and fading. With this

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[5] This application is for the space segment only. Separate applications will be filed for the associated ground and user stations.

constellation, double satellite coverage is available nearly 100% of the time and therefore user terminals can be provided diversity as required. Both forward and reverse link power controls are used to adjust the Gateway and HRT powers to minimum required to maintain high performance. The power is increased only as needed, which results in less interference to other users and increased capacity.

4.2. **Constellation Description.** The constellation's orbital parameters were selected to effectuate several criteria. First, the constellation will provide continuous coverage of a given range of latitudes which correspond to a major portion of the populated Earth. Second, the system will maximize the elevation angles to improve availability to end-users. Third, the constellation will provide the ability to share spectrum with other systems. Fourth, the constellation will meet any requirements of the Commission and the International Telecommunications Union (ITU). Fifth, the system will be cost-effective and will minimize the total number of required satellites. Finally, the constellation will provide the ability to deliver the maximum capacity and quality of service.

The technical details of GS-40 are provided in Table 4.2.-1.

Number of Satellites	80
Orbital Altitude	1440 km
Number of Planes	10
Inclination	52°
Argument of perigee	90°
Eccentricity	0
Plane spacing at equator	36°
Relative phasing between satellites in adjacent planes	4.5°
Orbit period	114.66 min.

Table 4.2-1. GS-40 Constellation Description

The 38/49 GHz constellation consists of eighty satellites in circular orbits at an altitude of 1440 km. There are ten orbital planes which are equally spaced around the equator. The equal spacing of the orbital planes provides a 4.5 degree relative phase shift between the satellites of the adjacent planes. Each orbital plane has eight satellites and an inclination angle of 52 degrees. The constellation is 80/10/1 Walker. Figure 4.2-A illustrates the global coverage configuration of the constellation. The system will provide coverage to all 50 United States, Puerto Rico, the U.S. Virgin Islands, and the majority of the populated regions of the world.

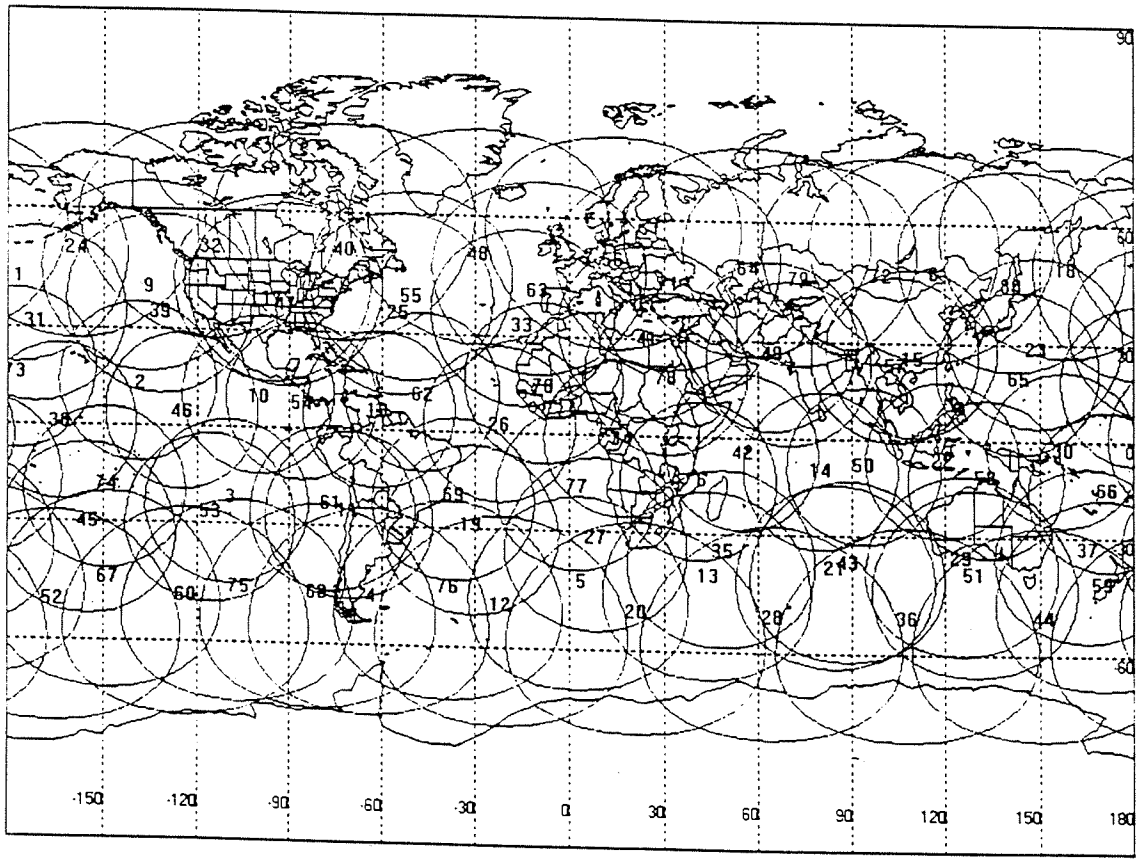

Figure 4.2-A. GS-40 Constellation Antenna Coverage

The GS-40 constellation consists of 80 satellites in ten planes. These planes are separated by angles of 36 degrees. Each orbit plane has a distinct Right Ascension of the Ascending Node (RAAN), since the RAAN gives the location of the northward equatorial crossing point of each plane with respect to a reference direction. The eight satellites in an orbit plane share a common RAAN. Each plane is designated by a letter, A-J, as shown in Table 4.2-2. The eight satellites in each orbit plane are numbered consecutively, 1-8.

The RAANs of the orbit planes are at 36 degree intervals. The RAAN of any orbit plane changes by -3.0 degrees per day, or 3.0 degrees to the west each day, due to a perturbation known as nodal regression. Accordingly, the RAANs of all the satellites change as functions of time, as shown in Table 4.2-2. The RAAN of each orbit plane cycles through 360 degrees in about 120 days, or approximately three times per year. The RAAN value at an epoch will be specified when launch documents are prepared.

The argument of perigee (ARGP) for a satellite is the angle measured around the orbit in the direction of motion of the satellite from the ascending node to the perigee. The position of the perigee, and the ARGP, varies with time because of perturbations arising from the fact that the Earth's mass is not uniformly distributed.

For the GS-40 constellation, specific choices of orbital eccentricity (or shape) and the ARGP operate to minimize the rates of change for mean eccentricity and mean ARGP. These mean values are the values of the two orbital elements

averaged over one orbital revolution. The mean eccentricity will be on the order of 0.001 and the mean ARGP will be set to 90 degrees as shown in Table 4.2-2.

Plane		RAAN, degrees *	ARGP, degrees
A.	Satellites A1-A8	0-3.0T	90
B.	Satellites B1-B8	36-3.0T	90
C.	Satellites C1-C8	72-3.0T	90
D.	Satellites D1-D8	108-3.0T	90
E.	Satellites E1-E8	144-3.0T	90
F.	Satellites F1-F8	180-3.0T	90
G.	Satellites G1-G8	216-3.0T	90
H.	Satellites H1-H8	252-3.0T	90
I.	Satellites I1-I8	288-3.0T	90
J.	Satellites J1-J8	324-3.0T	90

* T is time in days.

Table 4.2-2. RAAN and ARGP for GS-40 Constellation

4.3. Frequency Plan and Transmission Parameters. The system design requires 1 GHz for uplink communications (48,200 - 49,200 MHz) and 1 GHz for downlink communications (37,500 - 38,500 MHz).[5] Both the High Rate Terminals (HRTs) and the Gateways will be able to operate simultaneously within a beam in these bands. Table 4.3-1 describes the frequency and polarization plan.

[5] Globalstar's requested frequencies are consistent with the allocation proposals in the 40 GHz NPRM. In the event that additional or different spectrum is made available for NGSO FSS, Globalstar intends to request all available NGSO FSS frequencies.

Satellite Link	Frequency Band	Polarization
HRT to Satellite and Gateway to Satellite	48,200 - 49,200 MHz	LHCP
Satellite to HRT and Satellite to Gateway	37,500 - 38,500 MHz	RHCP

Table 4.3-1. Frequency and Polarization Plan

The transmission rates and modulation characteristics for the data, telemetry and command carriers are summarized in Table 4.3-2. The corresponding emission designators are shown in Table 4.3-3.

Satellite Link	Transmission Rate, Mbps	Modulation Format	Channel Bandwidth, MHz
HRT to Satellite and Satellite to HRT	10.24 *	QPSK	18
Gateway to Satellite and Satellite to Gateway	10.24 * 51.84 *	QPSK QPSK	18 90
Telemetry Carrier	1 kbps	PCM/Bi-ϕ-L/BPSK	0.007
Command Carrier	2 kbps	PCM/NRZ/BPSK/FM	0.076

* Uncoded burst rate; coding is K=9, r=1/2 convolutional, concatenated with Reed-Solomon.

Table 4.3-2. Summary of Transmission Rates and Modulation Characteristics

Satellite Link	Emission Designators
HRT to Satellite and Satellite to HRT	18M0G7W
Gateway to Satellite and Satellite to Gateway	18M0G7W 90M0G7W
Telemetry Channel	7K00G1D
Command Channel	76K0F2D

Table 4.3-3. Emission Designators

4.4. **Communications Subsystem.** This section provides a general overview of the communications subsystem for the 38/49 GHz system.

4.4.1. **Dedicated Antennas**. The communications payload and the telemetry and command functions each have dedicated antennas. This allows the provision of telemetry and command coverage during launch and orbit insertion.

4.4.2. **Communications Payload.** The system is designed to utilize a 38/49 GHz transponder with uplink communications at 49 GHz and downlink communications at 38 GHz. The payload has 30 transponder channels of various bandwidths which are connected, in six groups of five beams, to 30 uplink and downlink antenna beams in a satellite-switched TDMA fashion. In addition, any of the five uplink beams in a group can be directly connected in a non-TDMA fashion to any of the five downlink beams via selection switches. This configuration provides the highest rate communication links. A block diagram of the communications payload is shown in Figure 4.4-A.

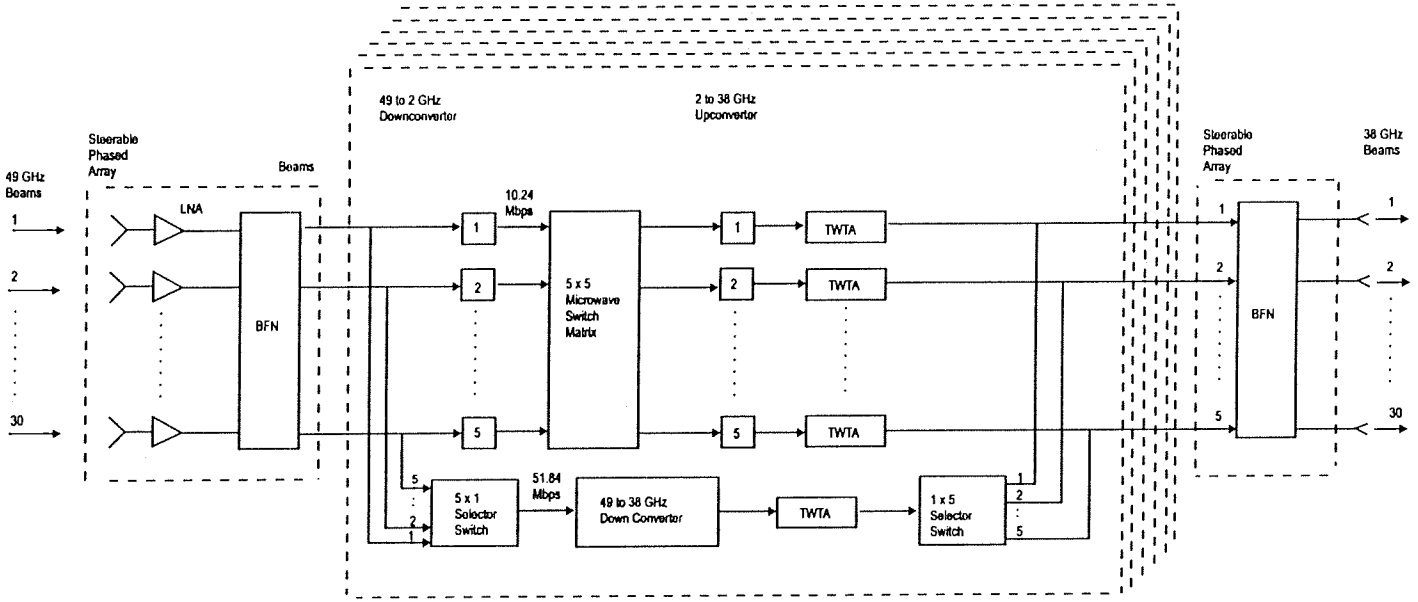

Figure 4.4-A. GS-40 Communications Payload

The antenna pattern designed for the 38/49 GHz system provides coverage for selected points on the visible part of the earth. The 30 pairs of 38/49 GHz antenna beams are 2° half-power beamwidth (HPBW). The beams are formed in an active phased array which allows them to track their intended targets as the satellite passes over the area. The 38 and 49 GHz beams operate together, thereby providing both uplink and downlink coverage. The high antenna gains allow high data rates, up to 51.84 megabits per second (Mbps), even with relatively low transmitter power.

The spacecraft is equipped with transmit filters to minimize out-of-band emissions and interference into other services plus narrowband receive and transmit filters to reduce adjacent-channel interference and select channels.

The communication upconverters and downconverters contain attenuators, which are commanded from the ground, to adjust the transponder gain over a nominal 25 dB range in 1 dB steps. Nominal transponder gains are shown in the link budget. See Section 4.8.1.

It should be noted that the transmission line and component losses are accounted for in the links by the term "TX power at the antenna flange." This means that the powers shown must be 1-2 dB higher at the power amplifier output to account for the circuit losses. It is expected that virtually all of the circuitry at 38 and 49 GHz will be waveguide, so the losses are not so critical.

The major communications payload parameters are summarized in Table 4.4-1.

Number of beams 49 GHz Uplink 38 GHz Downlink	 30 (electronically steered phased array) 30 (electronically steered phased array)
Bandwidth per 38/49 GHz beam	1 GHz
Satellite Receive G/T	4.5 dB/K (49 GHz)
Maximum EIRP capability per beam	52 dBW (38 GHz)

Table 4.4-1. GS-40 Communications Payload Summary

4.5. Power Flux Density Compliance. For the space-to-Earth links in the band 37,500 - 38,500 MHz, the system operating levels will not exceed the pfd values in ITU Radio Regulation 2581.

4.6. Telemetry and Command System.

4.6.1. General Description. The system design contains the capability to operate telemetry and command systems on two sets of frequencies: a C-band or C/Ku-band system for launch operations which will be supplemented by next-generation Globalstar Gateway antennas; and a 38/49 GHz system for on-orbit operations. Both systems will be operational at launch.

The space station will have dual-mode 5, 7 and 15 GHz patch antennas designed to approximate an isoflux pattern. For on-orbit operations, the system will radiate and receive via a 38/49 GHz horn antenna facing the earth, with additional horn(s) facing off-earth for emergency operation support. Antenna gain contours for the 38/49 GHz on-orbit T&C horn are shown in Figure 4.6-A. These horns might be higher mode horns to compensate for variable space loss.

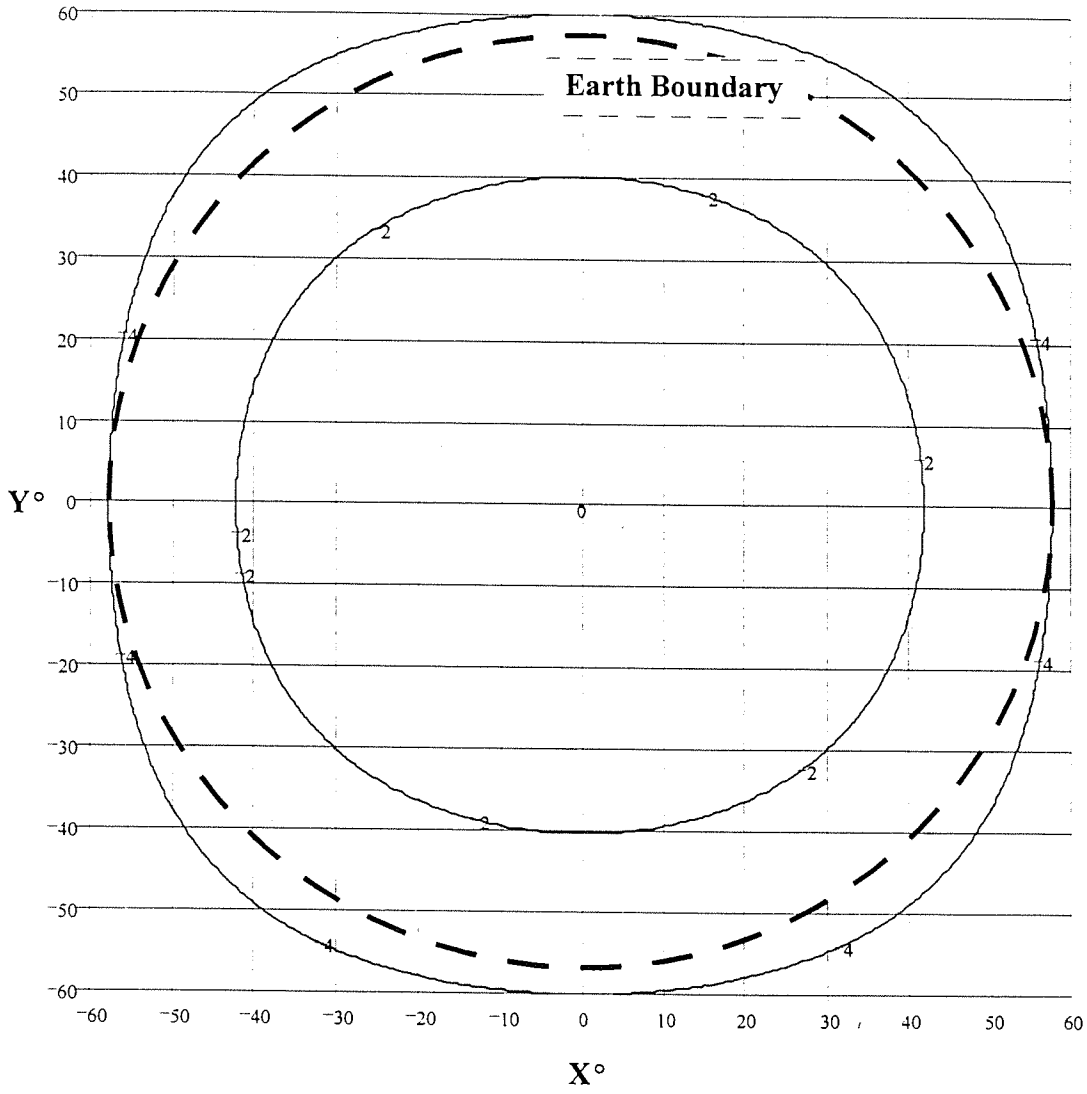

Figure 4.6-A. Antenna Gain Contours for the 38/49 GHz On-Orbit T&C Horn

The T&C network will also include system control ground stations (Gateways) and a Space Operations Control Center (SOCC). The Gateways, which will be located in various parts of the world, will perform the telemetry and command function. They will be connected by a terrestrial network to the SOCC which will coordinate the telemetry received from, and commands sent to, all of the spacecraft.

4.6.2. Characteristics and Frequency Plan. The Telemetry and Command system operates with Manchester-encoded, phase-modulated telemetry and frequency-modulated commanding. The system's 12 telemetry channels allow the ground stations to separate satellites during multiple launches. The characteristics of the T&C system, including the operating frequencies, are summarized in Table 4.6-1.

Frequencies: launch: on-orbit:	 5.092 or 15.451 GHz cmd 6.879 GHz tlm * 48.21 GHz cmd 38.51 GHz tlm
Command data rate	2 kbps
Telemetry rate	1 kbps
Satellite Antennas: launch: on-orbit	 patch antennas horn antennas with 100° HPBW (visible earth, 20° elevation)
Polarization	TLM (RHCP); CMD (LHCP)

* Total of 12 telemetry channels spaced at 0.1 MHz intervals starting at 6.879 GHz.

Table 4.6-1. Telemetry and Command Properties

4.6.3. Telemetry and Command Link Budgets. The on-orbit Telemetry and Command Link Budgets are shown in Appendix B.

4.7. Space Station Characteristics. Figure 4.7-A depicts the spacecraft configuration of the 38/49 GHz satellite. The satellite is designed to minimize manufacturing costs while maximizing reliability and the useful life of the satellite.

The payloads are mounted on the earth-facing panel of the satellite to allow for efficient communications. The antennas are fixed-mounted, and the transmit antennas use heat pipes and radiating panels to dissipate their phased array antenna heat.

The mechanical configuration is designed to efficiently minimize launch costs. The shape of the satellite body allows "stacking" on larger launch vehicles, allowing an economy of launch. All satellites have the same cross-section dimensions.

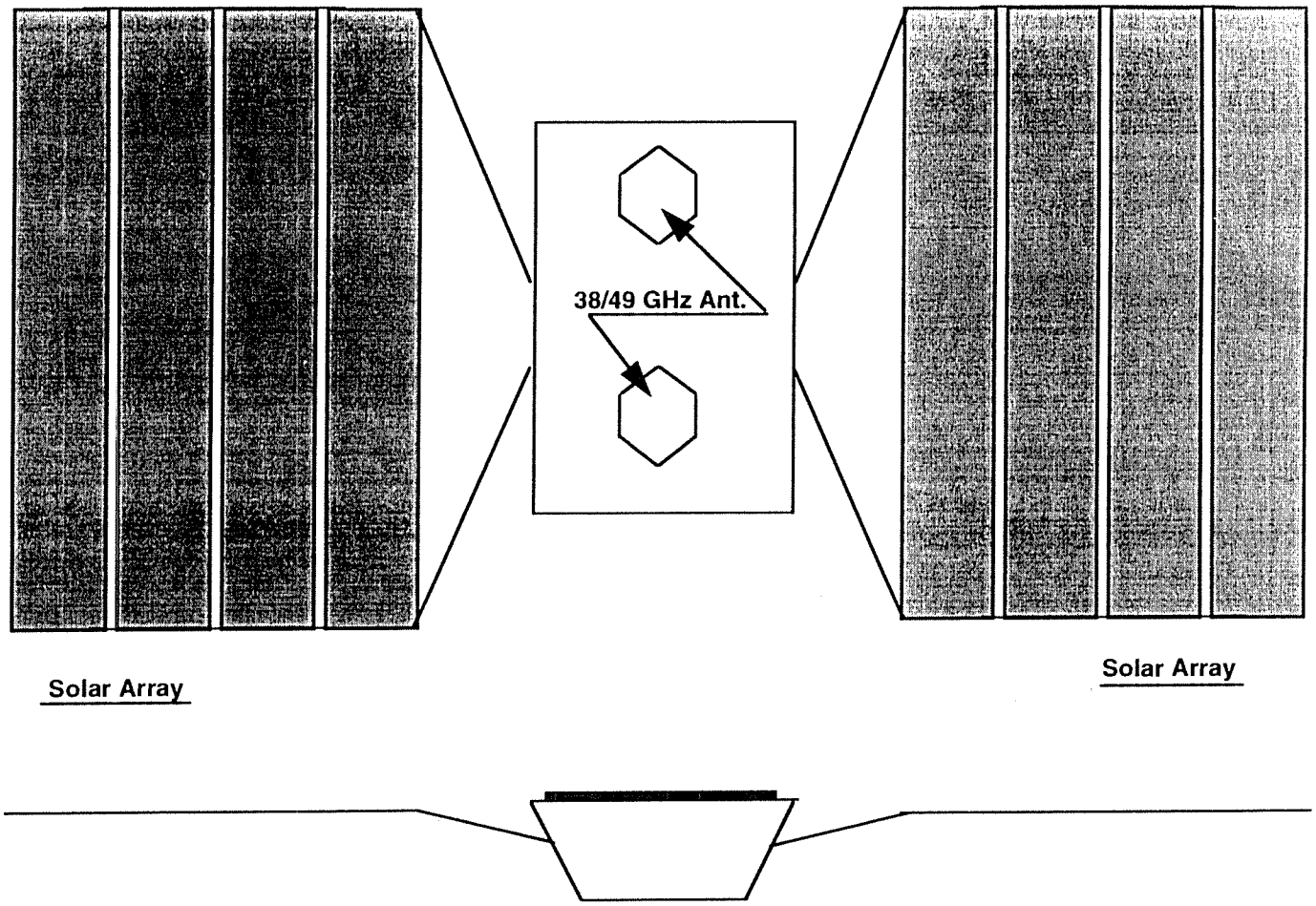

Figure 4.7-A. GS-40 38/49 GHz Spacecraft Configuration

Table 4.7.1 shows the physical characteristics of the spacecraft and the weight and power budgets.

Spacecraft Dimensions Length Width Height	 3.5 m 2.1 m 1.5 m
Peak dc Power	4.5 kW end-of-life
Orbit Average dc Power	2.28 kW end-of-life
Mission life	7.5 years
Stabilization	3-axis, momentum bias, magnetic torquers
Stationkeeping	100 m nominal
Satellite dry mass	992 kg
Propellant	234 kg
Reliability	0.89 for 7.5 years

Table 4.7-1. Space Station Characteristics

4.7.1. Spacecraft Bus. The satellite is a three-axis stabilized design with sun-pointing solar arrays. The bus is a derivative of Globalstar and other proven spacecraft systems and employs a structural assembly, electrical power system, propulsion system, attitude determination and control system, thermal control system and a telemetry and command system. The spacecraft is designed for multiple units to be launched on existing expendable launch vehicle systems.

4.7.2. Structural Subsystem. The structural subsystem is constructed of light weight metallic and composite materials. The structure is designed to accommodate the loads during the ascent and orbit phase of the mission, to minimize the cost of fabrication and integration and is optimized for

assembly-line production. The structural subsystem is configured to maximize the number of units that can be efficiently integrated into the launch vehicle fairing. The structure provides a flat front (earth facing) surface for the mounting of the integral payload assembly. The internal volume of the spacecraft houses various electronic components, the propellant tank and the attitude control system. The solar array is a deployable system with multiple panels that are stowed during ascent and deployed on orbit. The structure also provides for radiation protection of the internal electronic boxes to minimize the radiation effects on the electronic components.

4.7.3. Attitude Control System (ACS). The ACS performs several attitude pointing functions during the satellite life, including attitude steering during orbit raising, and antenna pointing and yaw steering during normal on-orbit operation. In addition, it provides various attitude control features required for orbit maintenance, contingency operations and end-of-life shutdown. The use of on-orbit yaw steering allows the satellite solar arrays to be accurately sun-pointed with only a single-axis array drive system.

All of the above functions are performed by using a conventional momentum-bias control system, consisting of a redundant set of four momentum wheels, magnetic torquers for transfer orbit control and wheel unloading and redundant sets of horizon sensors, sun sensors and magnetometers. The use of simple, proven hardware results in a highly reliable subsystem implementation.

In addition, the ACS receives both orbit position and backup attitude data from the on-board GPS receiver.

4.7.4. Electrical Power System. Electrical power for the spacecraft is derived from solar cells mounted on solar array panels and storage batteries located within the spacecraft. The orbit average power required for the satellite is shown in Table 4.7-1. When the spacecraft is in the sun the output from these arrays is used to power the spacecraft. Under some heavy-load conditions, power from the battery is also used while the spacecraft is in sunlight.

For eclipse operation, the spacecraft power comes only from the batteries. An electronic control system ensures efficient power use. There are periods of time over ocean areas where there is little or no traffic when the solar array power can be used to recharge the batteries quickly. The solar arrays are motor driven to track the sun for maximum energy generation.

4.7.5. Propulsion System. The propulsion system is a conventional blowdown hydrazine monopropellant design. The thrusters are used for orbit raising, orbit maintenance, repositioning, contingency attitude control, final deorbit, and as backup (to the magnetic torquers) for momentum wheel unloading.

4.7.6. Thermal Control System. The thermal control system of the spacecraft is maintained by both passive and active systems that have been used in Globalstar and other spacecraft. Radiators and heat pipes are used to transport heat from the electronic assemblies to surfaces where the heat can be rejected to

space. Some components require temperature control with heaters to maintain the thermal environment within their design constraints.

4.7.7. Reliability. The estimated mean operational satellite lifetime is 7.5 years. Because the operating orbit requires very little maintenance, the life of the spacecraft is limited not by fuel, but rather by random component failures and on-orbit degradation due to ambient environments (e.g., radiation).

The satellite reliability is designed for a probability of success at 7.5 years of 0.89. A major contributor to extending satellite life is the use of redundancy in all critical areas (e.g,. momentum wheels, TWTAs). Furthermore, the overall constellation operational life is greatly increased by appropriate sparing and replacement strategies for failed individual spacecraft.

4.7.8. Launch Segment. The launch segment consists of expendable launch vehicles (LVs) and ground facilities to place the satellites into their parking orbits. The satellites are designed to be launched on LVs with a minimum fairing diameter of 2.2 meters. Present candidates are the Delta, Zenit, Atlas, Ariane, and Proton, all of which offer the key cost advantage of multiple launches. Final selection of specific LVs will be done later in the program, based on constellation fill and sparing strategies, launch site suitability, cost, number of satellites per launch and program risk.

To place satellites in different orbit planes, it is necessary to launch the satellites into an intermediate altitude orbit, and then let asymmetric earth forces

slowly drift the orbit plane away from the original launch plane. This is a well-established technique, which will also be used to launch the Globalstar system.

4.8. **Services to be Provided and Areas to be Served.** As a global satellite system, GS-40 will offer a broad array of telecommunications services to fixed High Data Rate Terminals in all areas of the Earth. These services will augment the mobile voice, data, paging, and facsimile services to be provided by the Globalstar MSS Above 1 GHz system.

GS-40 will provide capacity to meet the constantly increasing demand for broadband data services and interactive connections to the Global and National Information Infrastructures for residential, business and government users. These services will include global Internet access and trunking services for connecting buildings, wireline and wireless telephone switching offices with each other and remote terrestrial cellular sites with the Public Switched Telephone Network and Public Land Mobile Network. For example, through the ubiquity of an NGSO satellite system, GS-40 would allow remote islands of terrestrial wireless networks to interconnect to the rest of the world. In addition, it would enable LAN-to-LAN communication by connecting routers at remote locations through satellite channels. GS-40 will also have the capability for multimedia, interactive applications for both commercial and residential consumers.

By providing these high data rate services, GS-40 will augment the mobile voice and data services to be provided by the first-generation Globalstar system. The Globalstar business plan is designed to provide worldwide coverage to extend

modern telecommunications services rapidly and economically to significant numbers of people who currently lack basic telephone services and to enhance wireless telecommunications in areas underserved or not served by existing or contemplated cellular systems. Globalstar expects to provide a communications solution in parts of the world where the build-out of terrestrial systems cannot be economically justified. Authorization of GS-40 would enable Globalstar to expand the services which it provides and also to provide a full array of competitive telecommunications services in underserved areas of the globe. Through GS-40, Globalstar will be able to offer subscribers in these areas "one-stop shopping" for satellite-delivered voice and broadband data services.

4.8.1. **Communication Link Analysis.** Appendix C contains the link budgets for the 38/49 GHz payloads.

4.8.2. **Antenna Gain Contours.** Figure 4.8-A shows the nadir-pointing gain contour for the scanning 38/49 GHz phased array antennas. Figure 4.8-B demonstrates the gain contour scanned off nadir by 48.5 degrees. These gain contours are angular and not projections onto the Earth. The X and Y coordinates are rectangular projections of the off-nadir angle.

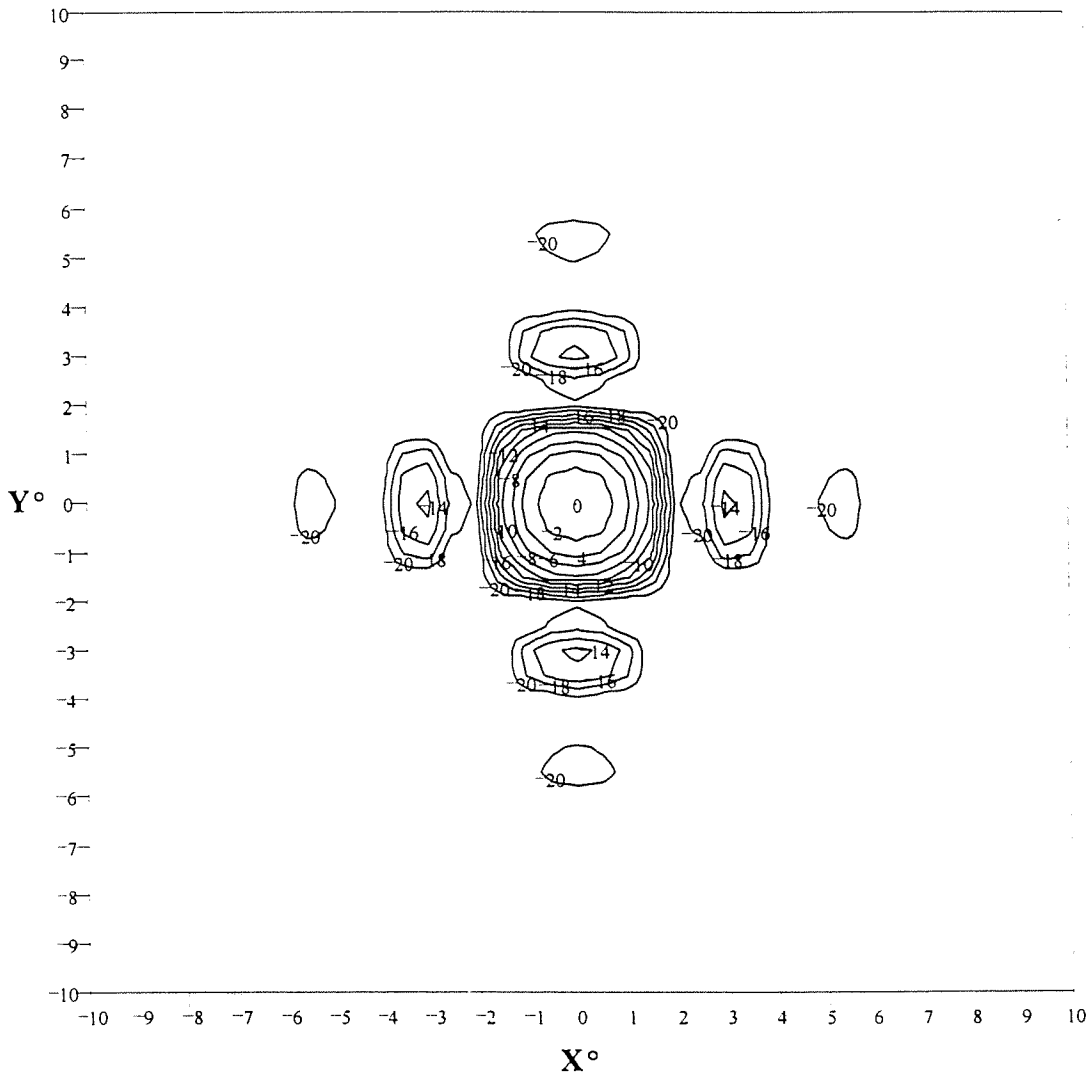

Figure 4.8-A. **38/49 GHz Antenna, Normalized Gain Contour at Nadir (Max gain = 37.3 dBi)**

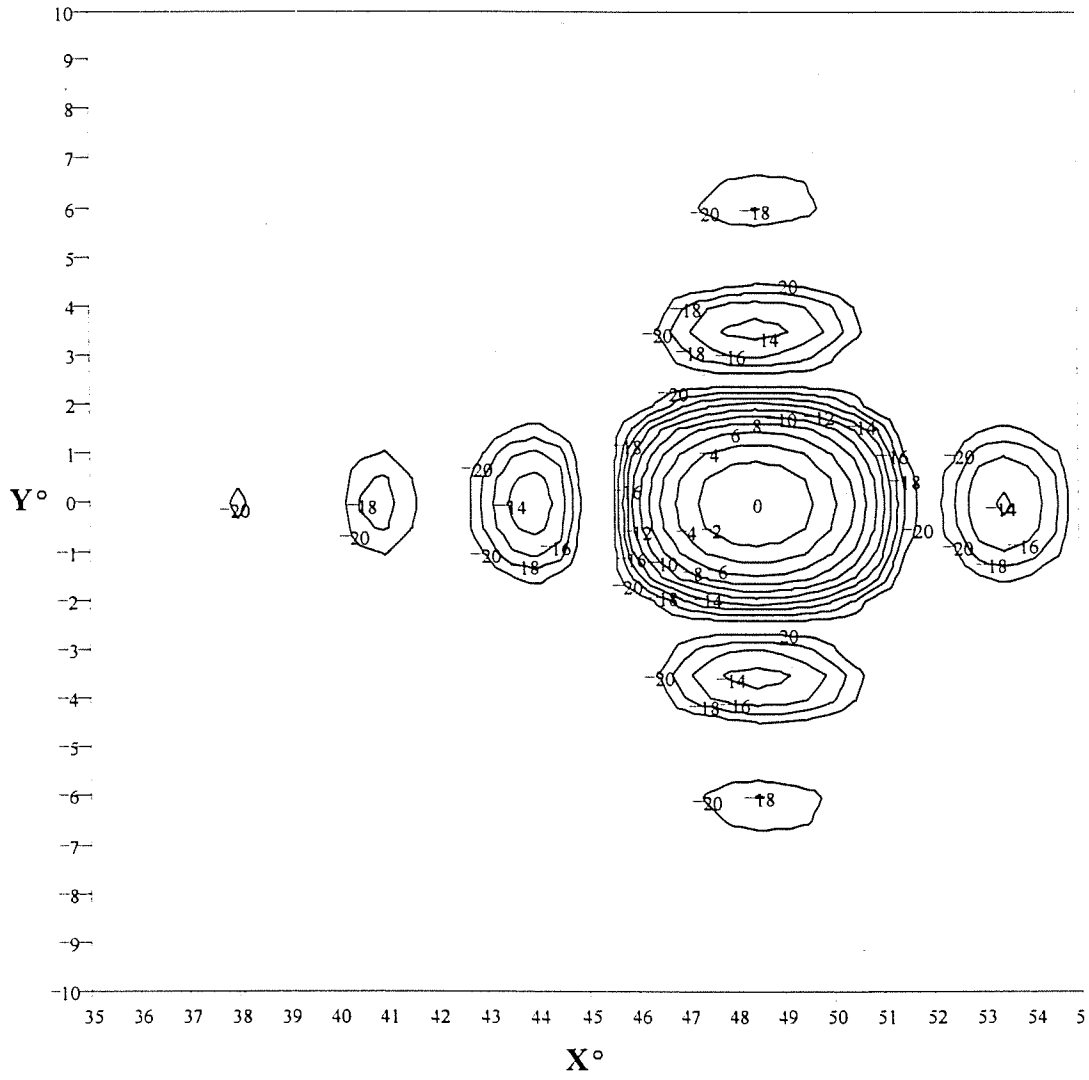

Figure 4.8-B. **38/49 GHz Antenna, Normalized Gain Contour at 48.5 Degrees Off Nadir (Max gain = 33.5 dBi)**

4.9. **Spectrum Sharing.** The proposed system is designed to be modified to accommodate sharing in the service links if such sharing is required for licensees at 38/49 GHz. Also, techniques exist which can be used to mitigate the interference between the multiple NGSO systems. Available interference mitigation techniques are polarization diversity, spread spectrum, power control and satellite diversity which allows the links between users and/or gateways to be established through one or more satellites.

V. AUGMENTATION OF THE 38/49 GHz SYSTEM

Contemporaneously with this application, Globalstar has submitted a proposal to launch and operate an MSS system in the 2 GHz frequency bands. In addition, as the Commission is aware, the first generation Globalstar system will be launched for operation in the 1.6/2.4 GHz MSS frequencies, for which L/Q Licensee, Inc., holds a license.[6] In the event that Globalstar is licensed to use the 38/49 GHz spectrum, it may ultimately decide to launch a system which has two or more communication payloads interconnected on the same satellite. The system will incorporate satellite antenna-to-antenna connectivity features, such as feeder link turn-around, to enable gateway-to-gateway links. In this section, Globalstar will illustrate the possible applications of interconnecting and describe how the

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[6] See Loral/Qualcomm Partnership, L.P., 10 FCC Rcd 2333 (Int'l Bur. 1995).

multi-payload configurations would differ from the 38/49 GHz system proposed in this application.[7]

5.1. Augmentation Option 1: 38/49 GHz + 1.6/2.4 GHz NGSO System[8]

5.1.1. Frequency Plan and Transmission Parameters. The augmented 38/49 GHz + 1.6/2.4 GHz system would use the same uplink (48,200 - 49,200 MHz) and downlink frequencies (37,500 - 38,500 MHz) as the proposed 38/49 GHz constellation. In addition, the system would be capable of providing Globalstar operation in the 1.6/2.4 GHz MSS bands: 1610 - 1626.5 MHz for uplink communications and 2483.5 - 2500 MHz for downlink communications to mobile User Terminals (UTs).[9]

For feeder links, Globalstar would request C-band spectrum at 5150 - 5250 MHz as well as 100 MHz of spectrum within the Ku-band allocation of 15.45 -

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[7] If Globalstar is authorized to use the 38/49 GHz frequencies, and LQL and Globalstar determine to launch a multi-payload satellite system, then they will submit the necessary applications for authorization at that time.

[8] Some of the features of the 38/49 GHz satellite system would remain unchanged even if augmented with one or more additional payloads, including: (1) the description and coverage of the constellation; (2) the technical parameters of the telemetry and command system; and (3) the characteristics and operation of the spacecraft's subsystems.

[9] Globalstar is authorized to be constructed over the entire 16.5 MHz of L-band uplinks; however, it is currently authorized to operate in the United States over the 1610-1621.35 MHz band. For convenience, the L-band spectrum is referenced throughout this section as 1610-1626.5 MHz.

15.65 GHz or the Ka-band allocation of 19.3 - 19.6 GHz.[10] Alternatively, the system could use 300 MHz of spectrum within the Ku-band allocation of 15.45 - 15.65 GHz and/or the Ka-band allocation of 19.3 - 19.6 GHz for feeder uplink communications and the C-band allocation of 6875 - 7055 MHz, or other available spectrum, for feeder downlink communications. Table 5.1-1 describes the frequency and polarization plan for the 1.6/2.4 GHz and 38/49 GHz service bands. In this table, and the tables that follow, UT refers to mobile or fixed Globalstar User Terminals.

Satellite Link	Proposed Frequency Band	Polarization
HRT to Satellite Gateway to Satellite	48,200 - 49,200 MHz	LHCP
Satellite to HRT Satellite to Gateway	37,500 - 38,500 MHz	RHCP
UT to Satellite	1610 - 1626.5 MHz	LHCP
Satellite to UT	2483.5 - 2500 MHz	LHCP
Gateway to Satellite	5150 - 5250 MHz and 100 MHz in Ku or Ka Band; and/or 300 MHz in Ku and/or Ka Band	LHCP and RHCP LHCP or RHCP LHCP or RHCP
Satellite to Gateway	6875 - 7055 MHz	LHCP and RHCP

Table 5.1-1. Frequency and Polarization Plan

Table 5.1-2 summarizes the transmission rates and modulation characteristics for the service and feeder link carriers as well as the command and telemetry carriers. The carriers with transmission rates of multiples of 1.23 Mbps

[10] As a result of the WRC-97 conference, these allocations might change to 15.43 - 15.63 GHz and 19.3 - 19.7 GHz respectively.

are capable of occupying common segments of the service and feeder link spectrum, thereby affording significant spectrum efficiency and system flexibility. The corresponding emission designators are shown in Table 5.1-3.

Satellite Link	Transmission Rate, Mbps	Modulation Format	Channel Bandwidth, MHz
UT to Satellite and Satellite to UT	1.23	QPSK	1.23
HRT to Satellite and Satellite to HRT	10.24 *	QPSK	18
Gateway to Satellite and Satellite to Gateway	10.24 * 51.84 *	QPSK QPSK	18 90
Telemetry Carrier	1 kbps	PCM/Bi-ϕ-L/BPSK	0.007
Command Carrier	2 kbps	PCM/NRZ/BPSK/FM	0.076

* Uncoded burst rate; coding is K=9; r=1/2 convolutional, concatenated with Reed-Solomon.

Table 5.1-2. Summary of Transmission Rates and Modulation Characteristics

Satellite Link	Emission Designators
User to Satellite and Satellite to User	1M23G7W
HRT to Satellite and Satellite to HRT	18M0G7W
Gateway to Satellite and Satellite to Gateway	1M23G7W 18M0G7W 90M0G7W
Telemetry Channel	7K00G1D
Command Channel	76K0F2D

Table 5.1-3. Emission Designators

5.1.2. Communications Subsystem. The communications payload for the 38/49 GHz + 1.6/2.4 GHz system would combine the payload for the 38/49 GHz stand-alone system described in Section 4.4.2. with the payload for the Globalstar system (1.6/2.4 GHz). The block diagram for this configuration would combine Figure 4.4-A with the payload diagrams relating to the Globalstar system already on file with the Commission. The antenna gain contours for this payload would consist of the Globalstar 1.6 and 2.4 GHz contours. The major communications payload parameters are summarized in Table 5.1-4.

Number of beams 49 GHz Uplink 38 GHz Downlink 1.6 GHz Uplink 2.4 GHz Downlink 5 GHz feeder downlink 15 or 30 GHz feeder uplink	 30 (electronically steered phased array) 30 (electronically steered phased array) 16 (phased array) 16 (phased array) 1 (global coverage) 1 (global coverage)
Bandwidth per 38/49 GHz beam	1 GHz
Bandwidth per 1.6/2.4 GHz beam	16.5 MHz
Polarization	Circular
Polarization Frequency Reuse	Yes: 5 GHz No: 15, 19, 38, 49 GHz
Satellite Receive G/T	4.5 dB/K (49 GHz) -19 dB/K (1.6 GHz) -24 to -28 dB/K (feeder link)
Maximum EIRP capability per beam	52 dBW (38 GHz) 30 dBW (2.4 GHz) 20 dBW (feeder link)

Table 5.1-4. Communications Payload Summary

5.1.3. Power Flux Density Compliance. Estimates of power flux density (pfd) have been determined for this possible augmentation of the proposed

38/49 GHz system. For the space-to-earth links in the band 37,500 - 38,500 MHz, the system operating levels will not exceed the pfd values in ITU Radio Regulation 2581. For the space-to-earth links in the band 6875 - 7055 MHz, the system operating levels will not exceed the pfd limits in the table of A2.2.1. of ITU Resolution 46 (WRC-95). For the space-to-earth links in the band 2483.5 - 2500 MHz, the system operating levels will not exceed the pfd limits in the table of A2.1.2.3.1 of ITU Resolution 46 (WRC-95).

5.1.4. Space Station Characteristics. Figure 5.1-A depicts the spacecraft configuration for the 38/49 GHz + 1.6/2.4 GHz system.

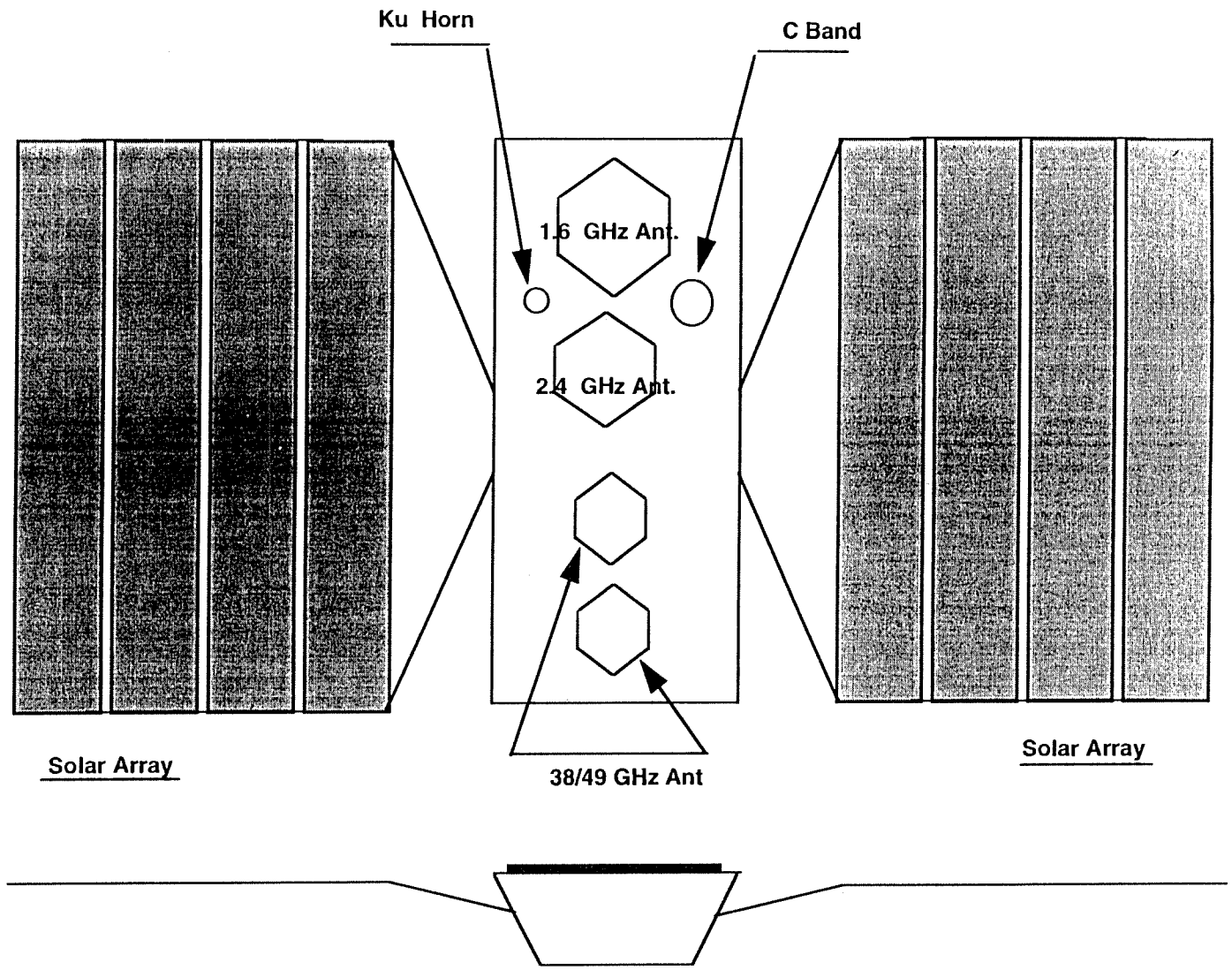

Figure 5.1-A. Spacecraft configuration for 38/49 GHz + 1.6/2.4 GHz

Table 5.1-4 compares parameters of the 38/49 GHz stand-alone with the 38/49 GHz + 1.6/2.4 GHz system.

PARAMETER	38/49 GHz	38/49 GHz + 1.6/2.4 GHz
Dry Mass (kg)	992	1372
EOL Ave. Power (kw)	2.28	3.04
Spacecraft Length (m)	3.5	4.2

Table 5.1-4. Spacecraft Mass and Power Budgets

5.1.5. Service to be Provided and Areas to be Served. A combined 38/49 GHz + 1.6/2.4 GHz system would be capable of providing the same array of services provided by the proposed 38/49 GHz (see Section 4.8) as well as the ability to offer mobile voice, data and facsimile services such as those provided by the Globalstar system.

5.2. Augmentation Option 2: 38/49 GHz + 2 GHz System

5.2.1. Frequency Plan and Transmission Parameters. The system design would use the same uplink (48,200 - 49,200 MHz) and downlink frequencies (37,500 - 38,500 MHz) as the 38/49 GHz stand-alone system proposed in this application. In addition, it would be capable of operating over the available service uplink MSS band of 1990 - 2025 MHz (within the U.S.) and 1980 - 2025

MHz (where available) and over the service downlink MSS band of 2165 - 2200 MHz (within the U.S.) and 2160 - 2200 MHz (where available).[11]

For feeder uplink communications, Globalstar would request 200 MHz of spectrum in the Ku-band allocation of 15.45 - 15.65 GHz or the Ka-band allocations of 19.3 - 19.6 GHz[12] and/or 49 GHz, and, for feeder downlinks, 100 MHz of spectrum in the C-band allocation of 6700 - 6875 MHz and/or 38 GHz, or other available spectrum. Table 5.2-1 describes the frequency and polarization plan for the 38/49 GHz + 2 GHz system. In this table and the tables that follow, HRT refers to a High-Rate Terminal (providing 2.048 Mbps service in the 38/49 GHz band), and MRT refers to a Medium-Rate Terminal (providing 128 kbps service in the 2 GHz band).

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[11] Globalstar's proposed 2 GHz system includes four geostationary satellites, which would be interconnected with each other and the NGSO satellites through 60 GHz intersatellite crosslinks. This configuration would also be used in Augmentation Option 2.

[12] As a result of the WRC-97 conference, these allocations might change to 15.43 - 15.63 GHz and 19.3 - 19.7 GHz respectively.

Satellite Link	Proposed Frequency Band	Polarization
HRT to Satellite Gateway to Satellite	48,200 - 49,200 MHz	LHCP
Satellite to HRT Satellite to Gateway	37,500 - 38,500 MHz	RHCP
UT to Satellite MRT to Satellite	US: 1990 - 2025 MHz and where available: 1980 - 2025 MHz	LHCP
Satellite to UT Satellite to MRT	US: 2165 - 2200 MHz and where available: 2160 - 2200 MHz	LHCP
Gateway to Satellite	200 MHz in Ku- or Ka-Band	LHCP or RHCP
Satellite to Gateway	6700 - 6875 MHz	LHCP and RHCP

Table 5.2-1. Frequency and Polarization Plan

Table 5.2-2 summarizes the transmission rates and modulation characteristics for both the 2 and 38/49 GHz service and feeder link carriers as well as the command and telemetry carriers. The carriers with transmission rates of multiples of 1.23 Mbps may occupy common segments of the service and feeder link spectrum, thereby affording significant spectrum efficiency and system flexibility. The corresponding emission designators are shown in Table 5.2-3.

Satellite Link	Transmission Rate, Mbps	Modulation Format	Channel Bandwidth, MHz
UT to Satellite and Satellite to UT	1.23	QPSK	1.23
MRT to Satellite and Satellite to MRT	2.048 *	QPSK	3.8
HRT to Satellite and Satellite to HRT	10.24 *	QPSK	18
Gateway to Satellite and Satellite to Gateway	1.23 2.048 * 10.24 * 51.84 *	QPSK QPSK QPSK QPSK	1.23 3.8 18 90
Telemetry Carrier	1 kbps	PCM/Bi-ϕ-L/BPSK	0.007
Command Carrier	2 kbps	PCM/NRZ/BPSK/FM	0.076

* Uncoded burst rate; coding is K=9, r=1/2 convolutional, concatenated with Reed-Solomon.

Table 5.2-2. Summary of Transmission Rates and Modulation Characteristics

Satellite Link	Emission Designators
UT to Satellite and Satellite to UT	1M23G7W
MRT to Satellite and Satellite to MRT	3M80G7W
HRT to Satellite and Satellite to HRT	18M0G7W
Gateway to Satellite and Satellite to Gateway	1M23G7W 3M80G7W 18M0G7W 90M0G7W
Telemetry Channel	7K00G1D
Command Channel	76K0F2D

Table 5.2-3. Emission Designators

5.2.2. Communications Subsystem. The communications payload block diagram for this option is shown in Figure 5.2-A. This system is capable of providing both fixed and mobile satellite services. One part of the satellite uses the 38/49 GHz band for feeder links to offer 2 GHz fixed MRTs at a burst rate of 2.048 Mbps. A second part could use either the 38/49 GHz frequencies or the 7 and 15 GHz frequencies as feederlinks to provide 2 GHz MSS. These two systems are explained below and illustrated in Figure 5.2-B.

5.2.2.1. Payload for Service to Fixed MRTs. This portion of the payload is composed of the 38/49 GHz system and the 2 GHz system. It provides connectivity to fixed MRTs at TDMA burst rates up to 2.048 Mbps (data rates up to 128 kbps in a 16-slot burst frame).

The satellite antenna forms 96 S-band uplink and 96 S-band downlink beams of approximately 10 degrees, which cover the visible area of the earth below each satellite. Using satellite switched TDMA (SS-TDMA), the 96 S-band beams are connected to all 30 of the 38 GHz downlink beams at 2.048 Mbps each. Approximately 30 MHz of the 38 GHz downlink bandwidth is used for 2/38 GHz interconnection. Similar connections are made between the thirty 49 GHz spot beams and the 96 S-band downlink beams.

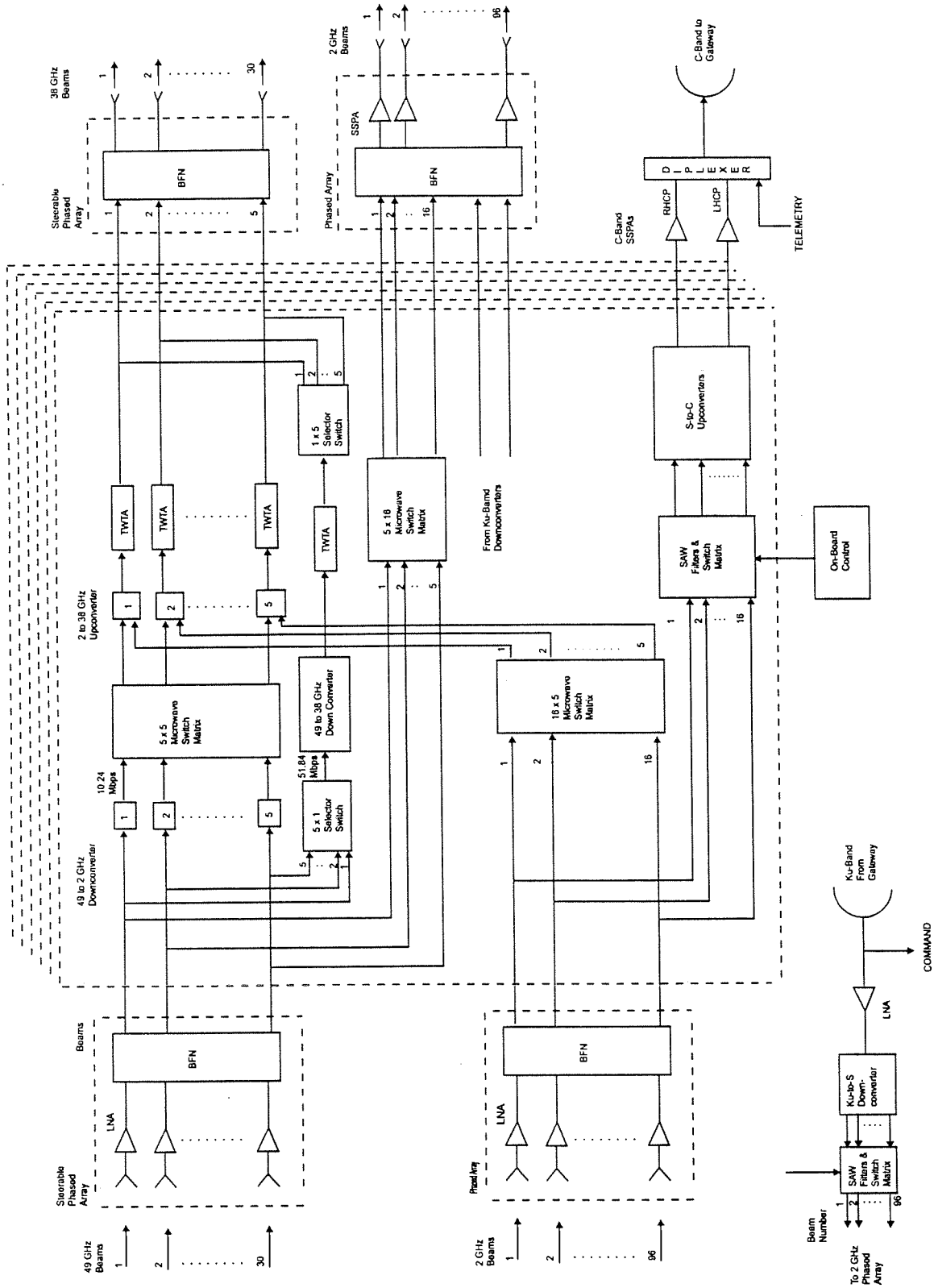


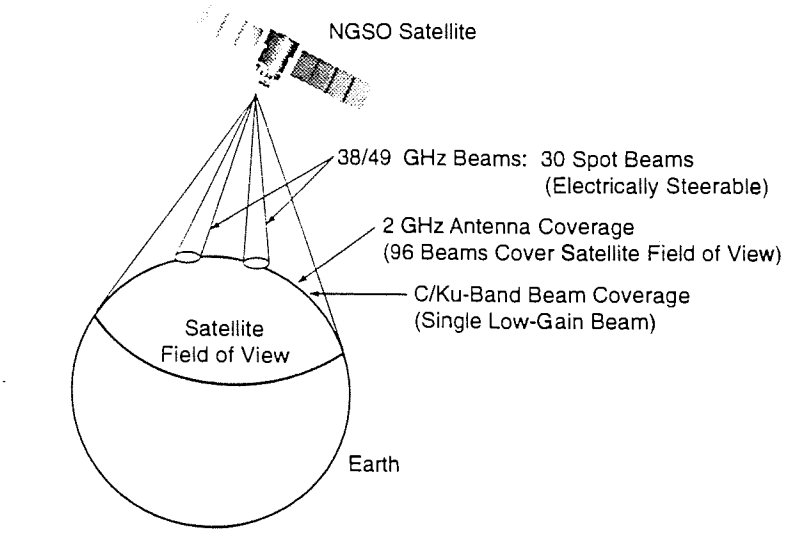
Figure 5.2-A. Combined 38/49 GHz and 2 GHz Communications Payloads

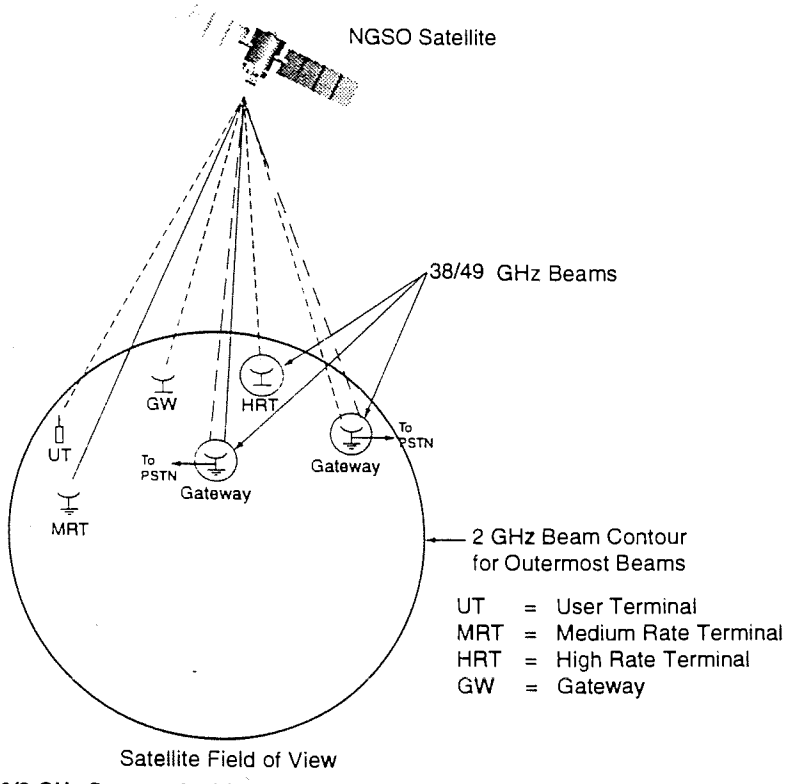
In addition, there are six 38/49 GHz transponders which serve the 30 uplink and 30 downlink beams. Each transponder serves one group of five uplink and five downlink beams. The payload block diagram for each of the six 38/49 GHz transponders consists of two parts, as described in (a) and (b) below.

(a) Each of 30 beams at 49 GHz is downconverted to a microwave intermediate frequency, microwave switched, upconverted to 38 GHz, amplified by 48 watt TWTAs and transmitted to the ground on 30 beams. The microwave switch matrix allows any of the five uplink beams in each group to be connected to any of the five downlink beams.

(b) There is a direct connection between any of the five uplink beams in a group to any of the five downlink beams at 51.84 Mbps via a 49 to 38 GHz downconverter. This allows high data rate links between two hubs or gateways at the OC-1 rate.

5.2.2.2. Payload for Mobile Terminals. This payload carries mobile voice, facsimile and data traffic up to 144 kbps via either the 38/49 GHz or the 7 and 15 GHz feeder links that are allocated for this purpose. The system uses the same transponders and 2 GHz antennas as that for MRTs.





40/2 GHz System Architecture

Types of Links:
a. MRT (2 GHz) to and from Gateway (38/49 GHz)
b. HRT (38/49 GHz) to and from Gateway (38/49 GHz)
c. Gateway to Gateway (38/49 GHz)
d. MSS UT (2 GHz) to and from Gateway (C, Ku, and/or 38/49 GHz)

Figure 5.2-B. 38/49/2 GHz System Architecture

The major communications payload parameters are summarized in Table 5.2-4.

Number of beams 49 GHz Uplink 38 GHz Downlink 2 GHz Uplink 2 GHz Downlink 5 GHz feeder downlink 15 or 30 GHz feeder uplink	 30 (electronically steered phased array) 30 (electronically steered phased array) 96 (phased array) 96 (phased array) 1 (global coverage) 1 (global coverage)
Bandwidth per 38/49 GHz beam	1 GHz
Bandwidth per 2 GHz beam	45 MHz
Polarization	Circular
Polarization Frequency Reuse	Yes: 5 GHz No: 2, 15, 19, 38, 49 GHz
Satellite Receive G/T	4.5 dB/K (49 GHz) -14 dB/K (2 GHz) -24 to -28 dB/K (feeder link)
Maximum EIRP capability per beam	52 dBW (38 GHz) 30 dBW (2.2 GHz) 20 dBW (feeder link)

Table 5.2-4. Communications Payload Summary

5.2.3. Power Flux Density Compliance. Estimates of power flux density (pfd) have been determined for this possible augmentation of the 38/49 GHz system. For the space-to-earth links in the band 37,500 - 38,500 MHz, the system operating levels will not exceed the pfd values in ITU Radio Regulation 2581. For the space-to-earth links in the band 2165 - 2200 MHz (within the U.S.) and 2160 - 2200 MHz (where available), the system operating levels will not exceed the pfd values in the table of A2.1.2.3.1 of ITU Resolution 46 (WRC-95). For the space-to-earth links in the band 6700 - 6875 MHz, the system operating

levels will not exceed the pfd limits in the table of A2.2.1 of ITU Resolution 46 (WRC-95).

5.2.4. Space Station Characteristics. Figure 5.2-C depicts the spacecraft configuration for the 38/49 GHz + 2 GHz system. The key weight and power parameters of this option are described in Table 5.2-5.

PARAMETER	38/49 GHz	38/49 GHz + 2 GHz
Dry Mass (kg)	992	1372
EOL Ave. Power (kW)	2.28	3.04
Spacecraft Length (m)	3.5	4.2

Table 5.2-5. Spacecraft Mass and Power Budgets