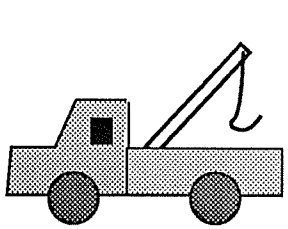
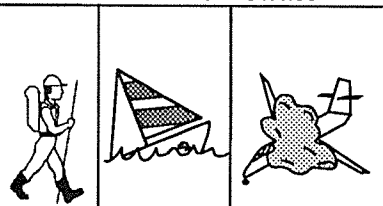
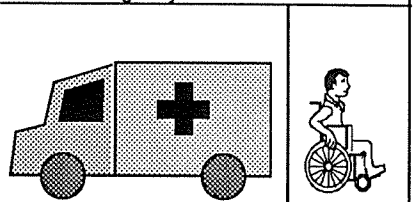
Figure III-1
Market Segmentation
SecurNet℠ Emergency Services

Service Applications / Characteristics	Emergency Road Service	Search & Rescue Service	Emergency Medical Service
			
Subscriber Usage/ Requirements Priorities	• High Reliable, Real-Time, Two-Way Communications ("911 Service) • Accurate Position Determination • Low Cost/Light Weight/Small Size/Low Power • Short But Accurate Messages • Occasional Usage/Event Triggered • Minimum System Non Availability		
Key Subscriber Benefits By Service Segment	• Universal Coverage • No Need To Get To Telephone • Very Low Cost • Driver Initiated Autonomous Operation (Air Bag or Other Trigger) • Shares Radio Antenna • Easily Packaged • Simultaneous Communications and Position Location • Confirmation of Receipt of Messages	• Universal Coverage • Serves Remote Area Where No Communications Exist • Very Low Cost • Subscriber or Automous Operation • Back-Pack Life Vest Portability • Long Battery Life • Rugged • Simultaneous Communications and Position Location • Confirmation of Receipt of Message	• Universal Coverage • Personal Portability (When A Phone Can't Be Reached) • Subscriber or Autonomous Operation • Capability To Poll For Status • Very Low Cost • Confirmation of Receipt of Message • Dependability
U.S. Addressable Markets	48 Million Automobile Club Members 120 Million Licensed Automobiles and Vans	22 Million Visitors Annually To National and U.S. Forest Service Parks 10 Million Pleasure Boats	12 Million Persons Over 65 With Serious Health Problems

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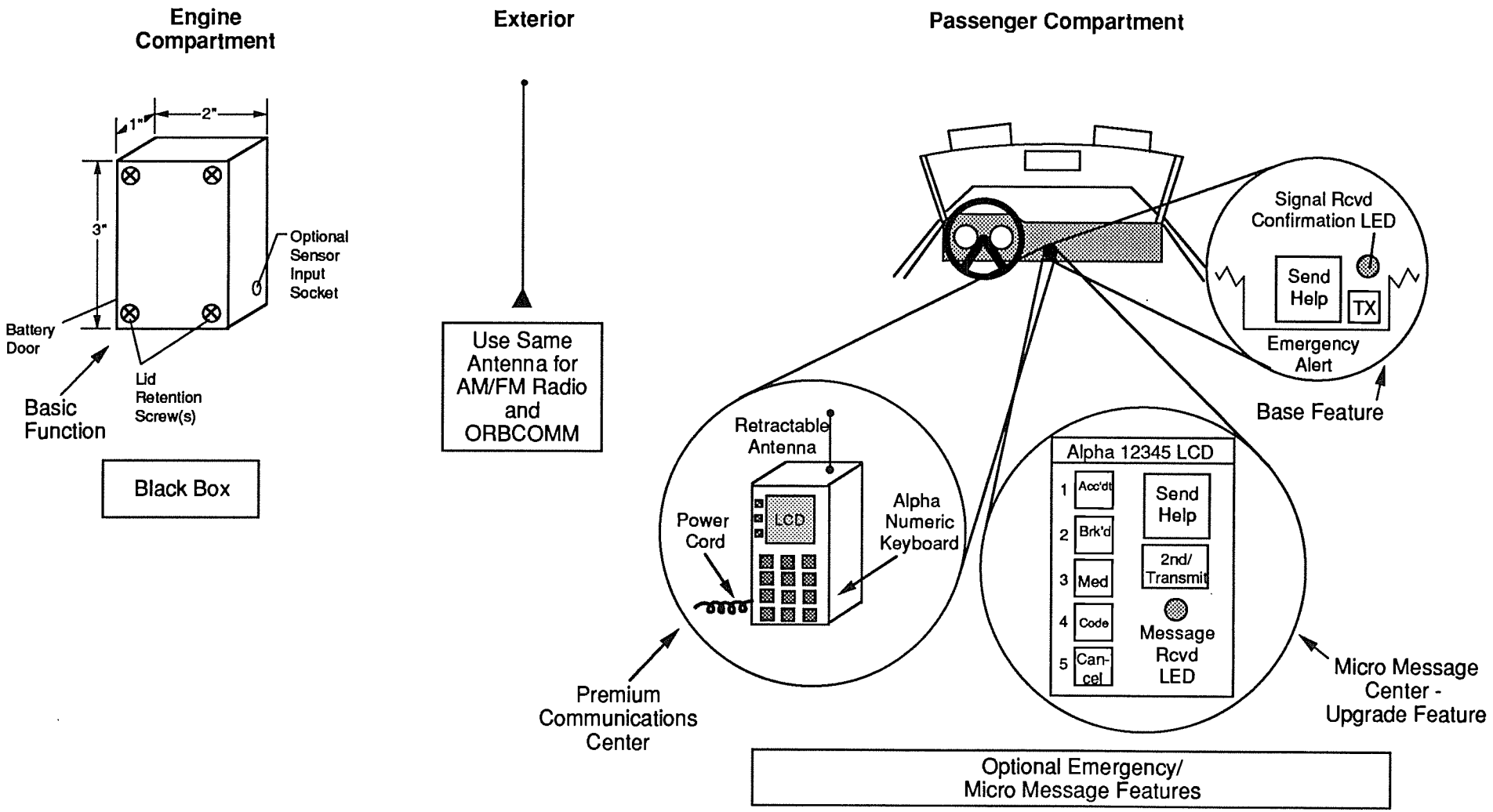
market, the subscriber terminals must be low cost, light weight, small size, rugged in construction, float, and use little power. Only very short messages are required such as "Send Help", a code describing the type of help needed, and the subscriber's identification number. It is essential that the person calling for help receive confirmation that the call has been heard. Reasonably accurate and timely position determination is required.[24/] Emergency service subscribers clearly hope not to have to use the service but require that near full-time system availability be maintained so that it is there when needed. Emergency service subscribers are projected to account for a substantial portion of all ORBCOMM subscribers.

The SecurNet service will also fill the geographic gaps in the existing Emergency Road Services ("ERS") network. SecurNet services will be designed to interface with the existing ERS delivery system. ORBCOMM will enter into contracts with road service insurance providers such as AAA, AMOCO and Allstate to offer SecurNet service as an added-cost feature of that auto club. Under this sort of arrangement, ORBCOMM will receive revenues from the ERS provider each time a SecurNet subscription is sold and each time the system is used.

[24/] The ORBCOMM system will provide an accuracy of 37 meters (120 feet) in seven minutes or less for terminals equipped with two-frequency band position determination, and an accuracy of 1,100 meters (3,600 feet) or 370 meters (1,200 feet) for single frequency determination terminals, depending on the frequency selected. This level of accuracy should satisfy the needs of SecurNet subscribers.

Figure III-2
Optional Automotive Installations



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SecurNet terminals will be easily integrated into automobiles, including where available, attachment to the air bag trigger. Presumably, any accident severe enough to trigger an air bag may result in injuries and extensive physical damage to the vehicle, and the ORBCOMM terminal will summon help automatically. Interest in this feature, among others, has been indicated by Ford Motor Company. Other functions will also be offered for automotive use. Figure III-2 depicts, in its base configuration, a small "black box" containing communications and position determination electronics, which would be installed in the engine compartment or under the dash. Power will be taken from the vehicle's 12 volt system, and the ORBCOMM antenna will be shared with the car radio. This system will provide autonomous accident and position determination reporting. Also, the same system could be used to locate stolen cars. By adding a passenger compartment keyboard, ranging from very simple to a full alphanumeric keyboard, use of the base system can be incrementally enhanced for two-way messaging. A premium feature, the personal communications terminal, will be usable in or away from the vehicle.

In addition to the automotive segment, ORBCOMM's SecurNet service will provide a low cost, lawful alternative to ELTs and EPIRBs and will help achieve the objectives of the proposed PELTS service. Hikers will carry a rugged, portable version of the ORBCOMM terminal with features ranging from a one-channel transmit and receive capability, to full message transmit

and receive functions with an alphanumeric keyboard. In either case the low, 2 watt transmit power, light weight, long battery life, and low prices for the equipment and the service will make SecurNet services highly attractive to the outdoors person, as well as for installation in small ships and pleasure boats.

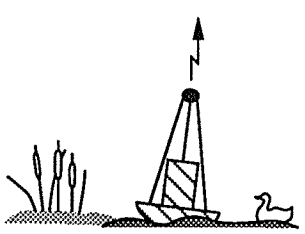
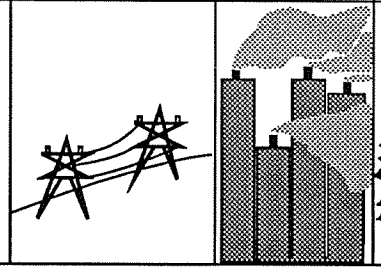
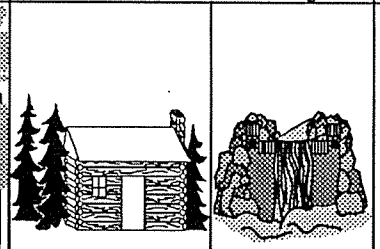
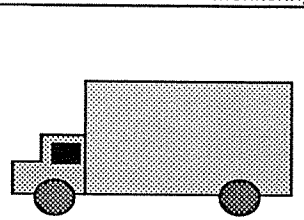
b. DataNet Data Acquisition Services

DataNet Data Acquisition Services will be oriented toward business, industrial, and environmental applications where data needs to be collected from multiple remote points and transmitted back to a central processing center. Subscribers to this category of service are interested primarily in the one-way, in-bound flow of data on a regular basis or, in the event of out-of-specification conditions, an alert of such conditions. Figure III-3 shows the major applications for DataNet services. These include Environmental/Ecology, Industrial and Utilities, Remote Asset Monitoring and Vehicle Performance Monitoring.

Subscribers for these services require only one-way in-bound capability; however, it is necessary to have an out-bound link to poll the remote terminals, for remote system checks, and for message receipt confirmation. The equipment in this service must be capable of long life and be able to operate unattended in harsh conditions with minimal maintenance. Typically, the time of transmission is not critical, thus permitting use of polling in off-peak hours.

The low cost of the subscriber terminals and low transmit power requirement (2 to 5 watts) opens the way for large

Figure III-3
Market Segmentation
DataNet[sm] Data Aquisition

Service Applications / Characteristics	Environmental/Ecology	Industrial and Utilities	Remote Asset Monitoring	Vehicle Performance Monitoring
				
Subscriber Usage/ Requirements Priorties	• Low Cost, Two-Way Communications • Remote, Unattended Operation • Non-Time Critical Information • Remote, Polled Control and System Check • Durability • Autonomous Operation • Long-Life Battery/Solar Power Operation • Minimal Maintenance			
Key Subscriber Benefits By Service Segment	• Low Cost Permits Wide Spread Deployment • Low Power Consumption Means Minimal Terminal Maintenance • Small Size and Low Weight For Easy Installation • Remote System Status Checking	• Makes Status Monitoring Cost Effect For New Functions • Operates In Areas Not Served by Telephone System • Reduces Maintenance Costs/ Break Downs • Provides Early Problem Alert • Remote System Status Checking	• Provides Automatic Status Check and Alerts From Remote Facilities • Low Cost, Stand Alone Operation • Serves Areas Without Telephone Service • Remote System Status Checking	• Improves Data Availability and Time Lines • Low Cost, Reliable, Durable • Autonomous Operation • Improves Management and Service Planning • Remote System Status Checking • Easy Installation
U.S. Addressable Markets	100,000 Data Stations Operated By The U.S. Government EPA Specifies Need For Millions of Remote Sensors	151 Million Utility Meters and Oil Wells	270,000 Remote Vacation Homes and Other Properties	1.3 Million Long Haul and Medium Trucks

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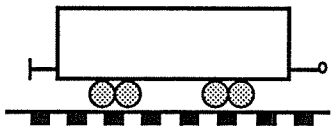
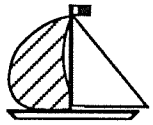
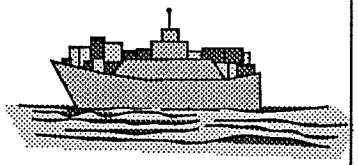
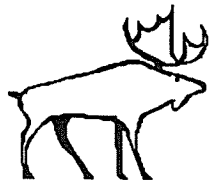
numbers to be installed over wide areas. ORBCOMM is well suited for environmental monitoring, industrial process monitoring, and "listening" for out-of-specification conditions at remote property including country houses or waterways. The terminals are expected to be fixed installations, where position determination is not required. In these cases, the position determination capability would not be installed in the equipment, thereby reducing the cost of the units.

c. MapNet Tracking Services

MapNet Tracking Services will be designed for applications where the basic requirement of the subscriber is to know where property or living creatures are located at any point in time, without any action being taken by the "searchee" to trigger the search. Figure III-4 shows the four major service applications in this segment and the characteristics of each: Boxcars and Containers, Anti-Theft/Property Recovery, Customs and Shipping, and Animal Tracking. The key benefits to the subscribers and the estimated size of the U.S. addressable markets are also shown.

ORBCOMM is targeting tracking service subscribers that require both low cost and accurate to moderately accurate position location capability. The low cost of the ORBCOMM terminals allows the subscriber to deploy the transceivers in the thousands to achieve system-wide control in the case of the shipping industry, or to appeal to the mass market in the case of anti-theft applications. The need for near real-time information

Figure III-4
Market Segmentation
MapNet[sm] Tracking Services

Service Applications / Characteristics	Boxcars & Containers	Anti-Theft/Property Recovery		Customs & International Shipping	Animal Tracking
					
Subscriber Usage/ Requirements Priorities	• Low Cost: Two-Way Communications • Durability • Accurate To Moderately Accurate Position Determination • Near Real -Time To Occasional Availability • Remote Polled Control and System Check				
Key Subscriber Benefits By Service Segment	• New Source of Vital System Control Information • Low Cost • Control of Usage • One Uniform System for U.S. and International Rugged • Short Antenna • Solar Power Option	• Deterrent to Theft • Reduced Insurance Premiums • More Certain and Rapid Property Recovery • Ease of Installation and Use • Continuous Tracking of Missing Property		• Assists In Identifying Tampering as It Occurs • Tracks Containers When in Customer Possession • Allows Use of "Hidden" Tags for Tracking/Tracing	• Low Cost and Weight • Long Battery Life • Rugged • Short Antenna • Transmit - Only Option • Improved Position Determination Accuracy (U.S. Areas)
U.S. Addressable Markets	13 Million Boxcar and Multimode Containers	120 Million Licensed Automobiles and Vans, Million Pleasure Boats		500,000 Containers In Service with U.S. Lines	Estimated 5,000 Tracking Units in Service

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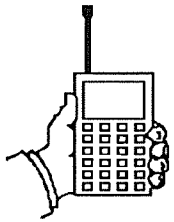
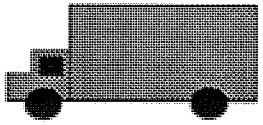
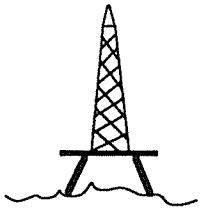
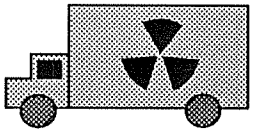
varies by application from high priority in the stolen property recovery to occasional use in animal tracking and shipping. To meet these varying needs, the position location and transmission process will be controlled from the Master Network Control Center in line with customer direction. In some limited applications, the process will be initiated by a pre-set clock in the subscriber terminal. Also, the ORBCOMM system will be able to check remotely the status of the terminals through the polling link to assure the units are operating properly. Of course, in these applications durability and low maintenance are required. ORBCOMM will offer MapNet services directly to end users and to resellers specializing in selected industries.

d. VitalNet Message Services

VitalNet Message Services will be designed to meet the needs of those who require the capability and convenience of two-way communications from any location, at any time, without having to be near a telephone or extensions thereof. Many of these subscribers also will require or value the position location capability of the ORBCOMM system. These subscribers need ever-present and ubiquitous communications to transact business, to overcome handicaps, to operate long-haul truck systems or manufacturing facilities efficiently, and to monitor closely movements of hazardous and high value cargos. Figure III-5 shows the five major service applications in this segment and the characteristics of each: Personal Business, Handicapped, Truck Operations, SCADA, and Hazardous Materials Transport. The key

Figure III-5
Market Segmentation
VitalNet[sm] Message Services

Service Applications / Characteristics	Personal/Business	Handicapped	Truck Operations	SCADA	Hazardous Materials
					
Subscriber Usage/ Requirements Priorities	• Highly Reliable Real-Time, Two-Way Communications • Personal, Portability and Mobile • 50-150 Character Messages With Low Error Rate • Moderately Accurate Position Determination • High System Availability • Long Battery Life/Rechargeability • Remote System Status Checking • Confirmation of Receipt of Message				
Key Subscriber Benefits by Service Segment	• Universal Two-Way Communications Fills PSTN and Cellular Gaps • Low Cost, Accurate Messages • Access To Data Bases For Critical Information • Interconnects With Packet Networks Ubiquitous Two-Way Paging at One-Way Paging Cost	• Frees User From Dependence on PSTN • Two-Way Communications Between Hearing Impaired • Message Waiting/Message Received Lights • Low Cost Light Weight Convenience • Provides Ubiquitous Life-Line Service	• Significant Cost Savings Versus Existing and Planned Geostationary Services • Rapid Pay Back of Low Investment Thru Productivity • Minimal Installation • Contact With Driver When Out of Vehicle • Superior Performance in City "Canyons" • Remote Control	• Flexible and Low Cost Deployment of Microvsat Network • Low Cost Permits Wide Application • Improved Data Flow and Control Over Processes • Stand "Alone" Operation • Low Power Requirements • Long Battery Life • Minimal Maintenance	• Significant Cost Savings Versus Existing and Planned Geostationary Services • Minimal Installation • Contact With Driver When Out of Vehicle • Superior Performance (Availability) Across All Types of Terrain • Remote Control
U.S. Addressable Markets	- 7.5 Million Pagers in Operation, 15 Million by 1995 - 2 Million Cellular Subscribers, 15 Million by 1995	2 Million Hearing Impaired Persons	1.3 Million Long and Medium Haul Trucks	15 Million Existing Terminals	18 Million Hazmat Shipments Per Year

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benefits to the subscribers and the estimated size of the U.S. addressable markets are also shown.

These subscribers require a highly reliable, real-time, two-way communications capability. Convenient personally portable and mobile terminals will include features such as displays, keyboards, warning lights and alarms, extended memory capacity, and office quality finish combined with robustness. Because communications will be the primary use of the equipment, the system and terminals will be designed to accommodate messages up to 150 characters, and it will be possible to connect the units to printers or transfer information to computers. In fact, ORBCOMM anticipates that computer manufacturers will build ORBCOMM capabilities into portable computer equipment to expand the utility of the computers to include "wireless" transmission and receipt of "telegram" type messages.[25/] VitalNet terminals also will be capable of operation for long periods without recharge, will acknowledge receipt of messages, can be checked for proper operations remotely, and will provide position determination capability.

VitalNet service will fill in gaps in the communications system that are unlikely to be filled by low cost communications alternatives in the foreseeable future. The services also have the potential, in some respects, to extend the reach of the PSN. For example, it is not likely that terrestrial cellular service will cover all of the Mid-West, western states and other

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[25/] The system is not suitable for large file transfer.

areas completely. In addition, it is likely that alternative geostationary satellite systems will be unable to reduce subscriber equipment costs to ORBCOMM unit costs.

Also, VitalNet terminals can be viewed as portable "E Mail" terminals, because they will have the capability through the Master Network Control Center to be interconnected via packet switched services to data bases and others on the "E Mail" system. This capability is of particular importance to the hearing impaired and other handicapped persons who need to be freed from physical dependence on the PSN. There do not appear to be any other low-cost alternatives.

Individuals and business persons will find VitalNet services to be helpful in keeping in touch and coordinating their affairs. A subscriber could be easily reached and asked to call home. The caller from home would receive confirmation that the message had been received. Likewise a subscriber could call another subscriber without knowing his or her location and receive confirmation that the message had been received, even if the called unit were unattended. Insurance adjusters and rescue workers at disaster sites, workers at remote job sites, and trucking companies will make use of this convenient, two-way communications capability to improve productivity.

The attractiveness of being able to communicate between trucks on the road and a dispatch center is now well-established, but not all fleets need the high capacity systems offered by geostationary satellite based systems. ORBCOMM's in-vehicle

equipment is targeted to be an order of magnitude less costly than these existing systems, albeit with lower system capabilities. Also, ORBCOMM simplifies vehicle installation by operating with a simple omnidirectional antenna, which allows the subscriber to share use with an AM/FM radio antenna.

2. Subscriber Terminal Features

ORBCOMM will license qualified companies, royalty free, to manufacture, distribute, and service subscriber terminals. Licensees will be required to meet exacting system design and quality standards and to demonstrate compliance on a regular basis. ORBCOMM intends to type-certify subscriber equipment.[26/]

[26/] Potential manufacturers include:

Electronics	Automotive	Communications
• Motorola	• Ford	• AT&T
• E.F. Johnson	• Chrysler	• GTE
• GE	• General Motors	

Ford Motor Company's Electronic Division has investigated with OSC the potential for ORBCOMM services in automotive applications, and is discussing with OSC research and development efforts and potential automotive OEM manufacturing arrangements. Ford Motor Company is an outstanding example of an U.S. company that has achieved world-class quality and cost performance across its product line. With its large overseas automotive manufacturing operations, Ford could provide over six million "platforms" in which ORBCOMM terminals might be installed as original equipment. Also, Ford's worldwide dealership network could provide a distribution system for after-market sales and service.

Ford's Electronics Division manufactures a wide range of automotive components in the U.S., including powertrain, audio, vehicle control and instrumentation electronics. In 1989, the Electronics Division manufactured in excess of ten million electronic devices that require design and manufacturing know-how similar to that required for the ORBCOMM terminals.

(continued...)

FCC Use Only Call Sign	File No.

FCC 401

FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

Approved by OMB
3060-0046
Expires 4/30/87

APPLICATION FOR NEW OR MODIFIED COMMON CARRIER RADIO STATION AUTHORIZATION UNDER PART 22

Schedule A – *(Complete One Schedule A Per Application)*

1. Does this application refer to an existing station?

☐ Yes ☒ No If "YES," give Call Sign:

2. Is this an amendment to a pending application?

☐ Yes ☒ No If "YES," give File No.:

3. Name of Applicant. Indicate the name, mailing address and telephone number of the applicant. *(For Subsidiary Communications Authorizations, see Instruction No.5(C).*

Legal Name of Applicant (If person, list last name first)

ORBITAL COMMUNICATIONS CORPORATION

Assumed Name Used for Doing Business (if any)

ORBCOMM

Mailing Street Address or P.O. Box, City, State and ZIP Code	Area Code – Telephone No.
12500 Fair Lakes Circle, Ste 350, Fairfax Virginia 22033	(703) 631-3600

4. Contact Representative. Indicate the name, mailing address, and telephone number of person to contact, if other than applicant.

Name (Last name first)

N/A

Firm or Company Name

Mailing Street Address or P.O. Box, City, State and ZIP Code	Area Code – Telephone No.

5. Indicate the number of separate sites requested in this application. 20

6. Type of Service (Mark "X" One)

A. ☐ One-Way (Except Subsidiary Communications Authorization)

B. ☒ Two-Way

C. ☐ Both One-Way and Two-Way

D. ☐ One-Way (Subsidiary Communications Authorization)

Will Broadcast facilities be leased?

☐ Yes ☐ No If "YES," submit as Exhibit ____, the name and address of the proposed lessee.

7. Nature of Service (Mark "X" One)

A. ☐ Public Land Mobile Service (Other than Air-Ground Radiotelephone Service)

B. ☐ Domestic Public Cellular Radio Telecommunications Service
Attach as Exhibit ____ a showing of financial qualifications as required by Section 22.917 of FCC Rules and Regulations

C. ☐ Offshore Radio Service

D. ☐ Rural Radio Service

E. ☐ Air-Ground Radiotelephone Service

Digital Land Mobile-Satellite Services

F. ☐ Developmental
Attach as Exhibit _____ a narrative statement in support of the request. (See Subpart F, Part 22 of FCC Rules and Regulations.

8. Carrier Type

A. ☐ Radio Common Carrier B. ☐ Wireline Common Carrier

Non-Dominant

9. Control Points – Table MOB-1A: to be completed for control points which are initial, additional or deleted. In Column (B) use the following symbols to specify status: I=Initial; A=Additional; D=Deleted.

(A) Location (Street Address, City or Town and State)	(B) I, A or D	FCC Use Only Control Point No.
1. 12500 Fair Lakes Circle, Fairfax VA 22033	I	
2. 3380 Mitchell Lane, Boulder CO 80301	I	
3.		

Table MOB-1B: to be completed for control points which are to be relocated. Give the present location first, followed by the proposed location.

Location (Street Address, City or Town and State)	FCC Use Only Location No.
1. Present Location: N/A	
Proposed Location:	
2. Present Location:	
Proposed Location:	

10. Applicant is: (Mark "X" One)	11. If applicant is a corporation (including joint stock companies) identify the state or country laws under which it is organized.
A. ☐ Individual B. ☐ Partnership C. ☐ Unincorporated Association D. ☒ Corporation	Delaware

	Place an "X" in the appropriate column.	YES	NO
12.	Does the applicant certify that it complies with Section 310(b) of the Communications Act of 1934, as amended, and Section 22.4 of the Commission's Rules regarding alien ownership and control? If "NO," attach as Exhibit _____ a statement describing applicant's ownership or control by aliens.	X	
13.	Is applicant directly or indirectly controlled by any other corporation? If "YES," give names and addresses of all such controlling corporations, including organization having ultimate control, in Exhibit _____. See FCC Form 430 Satellite System Filing Appendix C	X	
14.	Has applicant or any party to this application had any FCC station license or permit revoked or had any application for permit, license or renewal denied by this Commission? If "YES," attach as Exhibit _____ a showing giving call sign of license or permit revoked and relate circumstances.		X
15.	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? If "YES," attach as Exhibit _____ a statement relating the facts.		X
16.	Has the applicant, or any party to this application, or any person directly or indirectly controlling the applicant ever been convicted of a felony by any state or federal court? If "YES," attach as Exhibit _____ a statement relating the facts.		X
17.	Is applicant, or any person directly or indirectly controlling the applicant, presently a party in any pending matter referred to in Items 15 and 16? If "YES," show in Exhibit _____ a statement relating the facts.		X
18.	Is applicant directly or indirectly, through stock ownership, contract, or otherwise currently interested in the ownership or control of any other licensed radio stations or pending applications for radio stations under Part 22 within 40 miles of the station applied for here? (See Sections 22.13(a) of FCC Rules and Regulations.) If "YES," show, for each, call sign (if known), file no. (if pending), service, base station location (city and state), frequency and name of licensee in Exhibit _____.		X
19.	Has applicant been denied state certification for the facilities proposed in this application? If "YES," attach as Exhibit _____, a statement describing the state authority's action and any pending appeals, or whether the state appeal process has been exhausted and attach copies of any relevant decisions.		X
20.	Is this an application for one or more additional channels for which a loading study is required per Sections 22.16 and 22.516 of FCC Rules? If "YES," include required loading study as Exhibit _____. In the same Exhibit, show data on held orders or from a valid statistical survey or any other materials which demonstrate that the public interest would be served by grant of this application.		X
21.	Is this application for more than one channel on a new system? If "YES," show, in Exhibit _____, data on held orders or from a valid statistical survey or any other materials which demonstrate that the public interest would be served by grant of this application.		X

22. List below the Exhibits that are attached to this application.

Exhibit Number	Sec. and/or Item No. of Rule or Form	Exhibit Number	Sec. and/or Item No. of Rule or Form	Exhibit Number	Sec. and/or Item No. of Rule or Form

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. All statements made in the attached exhibits are a material part hereof and are incorporated herein as if set out in full in this application. The undersigned, individually and for the applicant, hereby certifies that the statements made in this application are true, complete and correct to the best of his (her) knowledge and belief, and are made in good faith.

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

23. Date	24. Typed Name of Person Signing	
25. Signature		26. Title (*Position Held by Person Signing Application*)

FCC
401

Approved by OMB
3060–0046
Expires 4/30/87

Schedule B

(Complete One Schedule B Per Antenna Location)

There are 1 Schedule B's with this application. This is Schedule B number 1.

27. Antenna Location Record. *(For Temporary Fixed Stations, see Instruction 5(B).*

a. Street Address, City, County and State *(If in area not designated by street, give distance and direction from, and name of, nearest town)*

Low earth orbit (970KM Circular)

b. North Latitude *(Deg-Min-Sec)*
N/A

c. West Longitude *(Deg-Min-Sec)*
N/A

FCC Use Only
Location No.

28. Application Type. *(Mark "X" as many as applicable.)*

A. [X] Radio Station Authorization

B. [ ] Amendment of Pending Application *(As indicated in Item 2 on Schedule A).*

C. [ ] Fill in

D. [ ] Modification of Authorization

E. [ ] Partial Assignment *(A separate FCC 401 is to be filed by assignee and assignor)*
(Mark "X" One)
File No. _____ [ ] Assignee [ ] Assignor

F. [ ] Subsidiary Communications Authorization

29. Does the applicant request waiver of any requirements of FCC Rules? [ ] Yes [XX] No
If "YES," attach Exhibit _____ specifying Rule(s) for which waiver is requested and demonstrating good cause for each waiver. *(See Instruction No. 9).*

30. Are there any other pending applications known to the applicant with which this application is believed to be mutually exclusive? [ ] Yes [XX] No
If "YES," provide the following:

a. File Number	b. Call Sign	c. Frequency (MHz)

31. Nature of Request. *(Mark "X" as many as applicable.)*

A. [ ] Change Frequency
B. [ ] Add Frequency
C. [ ] Delete Frequency
D. [ ] Increase Power
E. [ ] Increase Antenna Height
F. [ ] Change Antenna/Transmitter Location
G. [ ] Change Control Point Location
H. [ ] Additional Antenna Location
I. [ ] Change Antenna System
J. [X] Other *(specify):* Construct a LEO Satellite System

Attach as Exhibit _____ a showing of specific details of changes.

32. Would grant of this application be an environmental "major action" per Rule Section 1.1305? [ ] Yes [X] No

If "YES," attach Exhibit _____ as the required statement per Rule Section 1.1311.

FCC Use Only
Antenna No.

33. Table MOB-2 ANTENNAS, RADIATION AND POINTS OF COMMUNICATION.

1. One Table MOB-2 is to be completed for each new or modified antenna system at each site, including the addition or modification of transmitters which will change power output from a transmitter, or effective radiated power or emissions.
2. Attach separate Table MOB-2 if authorization of more than one antenna system is requested.
3. Supplementary Explanations of Certain Items:

d - Directions of Maximum Gain. The maximum number of directions to be shown is 4. Specify bearings of directions of maximum gain, in degrees from true north. If omnidirectional, specify "Omni."

e - Maximum Antenna Gain. Maximum power gain over reference half-wave dipole, in decibels.

h - Beam Width of Major Lobe of Antenna Pattern. Defined as the arc, in degrees, including only points on the polar diagram which are within 3 decibels (half power points) of the point of maximum gain. For omnidirectional antennas, the beam width is defined as 360 degrees.

j(2) - Class of Station. Use the following codes:

BS - Base Station	TS - Test	SB - Subscriber Station
CT - Control Station	DI - Dispatch	RX - Relay Station
RP - Repeater	SI - Signaling	IO - Inter-Office
ST - Standby	CO - Central Office	

Table MOB-2

There are 22 Table MOB-2's with this Schedule B. This is Table MOB-2 number 1 of Schedule B number 22.

a. Antenna Status	b. Make of Antenna		c. Type No. of Antenna
1. ☐ Existing 2. ☒ Proposed	See Satellite System Filing Part V		
d. Directions of Maximum Gain	**e. Maximum Antenna Gain**	**f. Maximum Effective Radiated Power**	**g. Height of Antenna Tip Above Ground Level**
See (b)	See (b) Decibels	See (b) Watts	Feet
h. Beam Width of Major Lobe of Antenna Pattern	**i. Polarization** *(Mark "X" One)*		
Degrees	1. ☐ Vertical 2. ☐ Horizontal 3. ☒ Circular 4. ☐ Elliptical		

j. Transmitters

(Same line numbers apply to same transmitters)

FCC Use Only Transmitter No.	*Line No.*	(1) Frequency XXXXXX (KHz)	(2) Class of Station (Enter Code)	(3) Emission Designators	(4) Transmitter Output Power (Watts)
	1	137.0-137.27	Space	27K00F9D	10 *
	2		Station		
	3				
	4	137.3-137.4	Space	90K00G9D	10
	5		Station		
	6				
	7	400.075-400.125	Space	40K00G9D	20
	8		Station		

Transmitters, continued * Per Channel

Line No.	(5) Points of Communication	(6) Azimuth of Radio Path (Degrees From True North)	(7) Length of Radio Path (Miles)
1	Contiguous United States		
2	Alaska		
3	Hawaii		
4	Puerto Rico		
5			
6			
7			
8			

FCC Use Only
Antenna No.

33. Table MOB-2 ANTENNAS, RADIATION AND POINTS OF COMMUNICATION.

1. One Table MOB-2 is to be completed for each new or modified antenna system at each site, including the addition or modification of transmitters which will change power output from a transmitter, or effective radiated power or emissions.
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e - Maximum Antenna Gain. Maximum power gain over reference half-wave dipole, in decibels.

h - Beam Width of Major Lobe of Antenna Pattern. Defined as the arc, in degrees, including only points on the polar diagram which are within 3 decibels (half power points) of the point of maximum gain. For omnidirectional antennas, the beam width is defined as 360 degrees.

j(2) - Class of Station. Use the following codes:

BS - Base Station	TS - Test	SB - Subscriber Station
CT - Control Station	DI - Dispatch	RX - Relay Station
RP - Repeater	SI - Signaling	IO - Inter-Office
ST - Standby	CO - Central Office	

Table MOB-2

There are 22 Table MOB-2's with this Schedule B. This is Table MOB-2 number 2 of Schedule B number 22.

a. Antenna Status	b. Make of Antenna	c. Type No. of Antenna
1. ☐ Existing 2. ☒ Proposed	See Satellite System Filing Part V	

d. Directions of Maximum Gain	e. Maximum Antenna Gain	f. Maximum Effective Radiated Power	g. Height of Antenna Tip Above Ground Level
See (b)	See (b) Decibels	See (b) Watts	Feet

h. Beam Width of Major Lobe of Antenna Pattern	i. Polarization *(Mark "X" One)*
Degrees	1. ☐ Vertical 2. ☐ Horizontal 3. ☒ Circular 4. ☐ Elliptical

j. Transmitters
(Same line numbers apply to same transmitters)

FCC Use Only Transmitter No.	*Line No.*	(1) Frequency ~~XXXXXX~~ (KHz)	(2) Class of Station (Enter Code)	(3) Emission Designators	(4) Transmitter Output Power (Watts)
	1	137.0-137.27	Space	27K00F9D	10 *
	2		Station		
	3				
	4	137.3-137.4	Space	90K00G9D	10
	5		Station		
	6				
	7	400.075-400.125	Space	40K00G9D	20
	8		Station		

Transmitters, continued * Per Channel

Line No.	(5) Points of Communication	(6) Azimuth of Radio Path (Degrees From True North)	(7) Length of Radio Path (Miles)
1	Contiguous United States		
2	Alaska		
3	Hawaii		
4	Puerto Rico		
5			
6			
7			
8			

Figure III-6
Subscriber Terminal Features by Service Application

Features / Service Application	Communications																			Position Determination		
	Basic Functions		Antennas		Power Sources		Msg. Mem.	Transmit Triggers				Displays/Signals					Channels[5]			RemoteTerm. Doppler		Hub[6] Doppler
	TX	RX	Built In	Host Shared	Internal Battery	External		Poll	Sensor	911 Buttons Only	Key Pad*	Msg. R'vd Confirm Light	Msg. LCD	Msg. Waiting Light	Msg. Waiting Light	RS232 Port	TX	RX	1 Ch.	2 Ch.	
SecurNet SM Emergency Services																					
Emer. Road Service/ - Mobile	S	S	N/A	S	S(B/U)	S	O	S	S	O	O	S	O	O	O	N/A	1-3	1-2	S	O	O
Accidents - Portable	S	S	S	N/A	S	O	O	S	N/A	S	O	S	O	O	O	O	1-3	1-2	S	O	O
Search & Rescue - Mobile	S	S	N/A	S	S(B/U)	S	O	S	S	O	O	S	O	O	O	N/A	1-3	1-2	S	O	O
- Portable	S	S	S	N/A	S	O	O	S	O	S	O	S	O	O	O	O	1-3	1-2	S	O	O
Emergency Medical - Portable	S	S	S	N/A	S	O	O	S	O[1]	S	O	S	O	O	O	N/A	1-3	1-2	O	O	O
DataNet SM Data Acquisition Services																					
Environment Monitoring	S	O	S	N/A	S	O	O	S	S	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	1	O	O	N/A
Industrial & Utilities	S	O	S	N/A	S	O	O	S	S	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	1	O	O	N/A
Remote Asset Monitoring	S	O	S	O	S	O	O	S	S	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	1	O	O	N/A
Vehicle Performance	S	O	N/A	N/A	S(B/U)	S	S	S	S	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	1	O	O	N/A
MapNet SM Tracking Services																					
Boxcars & Containers	S	S	S	N/A	S	O	N/A	S	N/A[2]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	1	S	O	N/A
Vehicle Security/Recovery	S	S	N/A	S	S(B/U)	S	N/A	S[3]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1-3	1-2	O	S	N/A
Customs & International Shipping	S	S	S	N/A	S	N/A	N/A	S	N/A[2]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	1	S	O	N/A
Animal Tracking	S	O	S	N/A	S	N/A	N/A	O	S[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	N/A	S	O	N/A
VitalNet SM Message Services																					
Personal and Business	S	S	S	N/A	S	O	S	S	O	N/A	S	S	S	S	S	S	3	1-2	O	O	O
Handicapped	S	S	S	N/A	S	O	S	S	O	N/A	S	S	S	S	S	S	3	1-2	O	O	O
Truck Tracking	S	S	N/A	S	S(B/U)	S	S	S	S	N/A	S	S	S	S	S	S	3	1-2	S	O	O
SCADA (Fixed)	S	S	S	N/A	S	O	S	S	S[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1-2	1	N/A	N/A	N/A
Hazardous Materials	S	S	N/A	S	S	S	S	S	O	N/A	S	S	S	S	S	S	3	1-2	O	S	O

S = Standard, Feature, B/U = Backup, O = Optional, N/A = Not Available/Not Applicable

*Ranges From Simple Multiple Function Keypad to Alpha/Numeric Keyboards, Memory Will Vary With Requirement

1) Water, Crash or Heat Sensors Only, Custom Sensors Tied To Other Events Such As Heart Monitors May Be Developed
2) Custom Sensors To Detect Tampering May Be Available
3) Owner Reports Loss
4) Preprogrammed
5) Number Channels Dependent on User Grade of Service Requirement, Additional TX Channels Available as Special Option
6) Fail-Safe Back-Up Only In Event Remote Unit Is Inoperable

Attachment 5B

91213.06

FCC Use Only
Antenna No.

33. Table MOB-2 ANTENNAS, RADIATION AND POINTS OF COMMUNICATION.

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e - Maximum Antenna Gain. Maximum power gain over reference half-wave dipole, in decibels.

h - Beam Width of Major Lobe of Antenna Pattern. Defined as the arc, in degrees, including only points on the polar diagram which are within 3 decibels (half power points) of the point of maximum gain. For omnidirectional antennas, the beam width is defined as 360 degrees.

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BS - Base Station	TS - Test	SB - Subscriber Station
CT - Control Station	DI - Dispatch	RX - Relay Station
RP - Repeater	SI - Signaling	IO - Inter-Office
ST - Standby	CO - Central Office	

Table MOB-2

There are 22 Table MOB-2's with this Schedule B. This is Table MOB-2 number 3 of Schedule B number 22.

a. Antenna Status	b. Make of Antenna	c. Type No. of Antenna
1. ☐ Existing 2. ☒ Proposed	See Satellite System Filing Part V	

d. Directions of Maximum Gain	e. Maximum Antenna Gain	f. Maximum Effective Radiated Power	g. Height of Antenna Tip Above Ground Level
See (b)	See (b) Decibels	See (b) Watts	Feet

h. Beam Width of Major Lobe of Antenna Pattern	i. Polarization *(Mark "X" One)*
Degrees	1. ☐ Vertical 2. ☐ Horizontal 3. ☒ Circular 4. ☐ Elliptical

j. Transmitters
(Same line numbers apply to same transmitters)

FCC Use Only Transmitter No.	*Line No.*	(1) Frequency ~~XXXXX~~ (KHz)	(2) Class of Station (Enter Code)	(3) Emission Designators	(4) Transmitter Output Power (Watts)
	1	137.0-137.27	Space	27K00F9D	10 *
	2		Station		
	3				
	4	137.3-137.4	Space	90K00G9D	10
	5		Station		
	6				
	7	400.075-400.125	Space	40K00G9D	20
	8		Station		

Transmitters, continued * Per Channel

Line No.	(5) Points of Communication	(6) Azimuth of Radio Path (Degrees From True North)	(7) Length of Radio Path (Miles)
1	Contiguous United States		
2	Alaska		
3	Hawaii		
4	Puerto Rico		
5			
6			
7			
8			

Figure III-7

SecurNet Pak Pal Emergency Terminal

Figure III-6 summarizes the features that will be offered in each of the ORBCOMM services and applications. Most services will include both transmit and receive capabilities. However, for animal tracking and some DataNet data acquisition services the receiver may be omitted and replaced with timed triggers. This would reduce costs but would limit utility as well. Other aspects of the terminals include antennas that can be built into the subscriber unit as standard equipment or that can share use of an existing radio antenna (e.g. automobiles). Similarly, power sources, message memory capacity, transmit triggers, displays, and input-output devices such as bar-code readers will vary by application.

The basic units will have one transmit and receive channel. This will reduce cost but subscribers may on occasion experience momentary communications delay during peak hours. For the more sophisticated units, multiple transmit channels with scanning capability will alleviate potential blockage and increase overall system efficiency, but will add to the cost.

Two planned models of the many different versions of ORBCOMM subscriber terminals are shown in the following photographs:

26/ (...continued)
A number of other U.S. manufacturers are fully qualified to design, develop and produce such equipment. For example, Motorola has a proven record as a supplier of reliable radio-based portable subscriber equipment competitive in both the U.S. and worldwide markets.

Figure III-7 shows the SecurNet PakPal™ subscriber terminal designed for use by hikers, campers, boaters, mountain climbers and others seeking lightweight, highly portable emergency communications and position determination capability. The rugged, waterproof unit will weight about 5 ounces and will measure 1 X 2 X 3 inches. It will have a suggested retail price under $150. A unit having only emergency communications capability will be priced under $50 at retail. Annual subscriber fees will range from $30 to $50, depending on the type of service, plus a fee for each use. Units could be rented at park stations, or even be mandatory equipment for hazardous hikes or climbs, due to the savings in search and rescue costs implied.

ORBCOMM's Securnet Service will require subscription at the time of purchase, which will allow ORBCOMM to "commission" the unit and acquire relevant information for the data bases. Usually, prior to the start of a trip, the subscriber will call ORBCOMM on an 800 number and ask for a system check. ORBCOMM will transmit a signal to the unit instructing it to activate the position determination and transmit functions and will confirm proper operation through the LEDs.

In the event of an emergency during his or her trip, the hiker will extend the antenna, turn the unit on, and hold both the "911" and "Send" buttons down for 3 to 5 seconds. The two button operation is used to minimize inadvertent false alarms. The unit, through its 9 inch antenna, will transmit the emergency call and its identification number to the satellite,

Figure III-8

VitalNet P^2C^2 Message Terminal

where receipt of the message will be recorded and a confirmation signal returned to the hiker's unit. The "message received" LED on the SecurNet PakPal would illuminate. Simultaneous with the activation of the emergency call, the unit will start the position determination calculation. The mutual "fix" will take about 7 minutes with location accuracy increasing with each satellite pass. As soon as the position is calculated, the unit will automatically transmit the unit's location to the satellite. The satellite will record receipt of the position transmission and return an acknowledgement signal which will trigger the "Confirm Position Transmitted" LED.[27/] The emergency call and position will be received by the ORBCOMM Master Network Control Center, where the computer system will identify the closest appropriate search and rescue authority and display the information to an ORBCOMM "action dispatcher" who will be responsible for notifying the proper authority and following the case to completion. The hiker will also have the capability to cancel the emergency message.

In the above scenario, the hiker had not turned on the unit (or extended the antenna) until an emergency occurred. Other users may wish to turn on the unit at the beginning of the trip and place it in their gear with the antenna extended (including the period while the unit is being handled by an airline should the gear be lost in transit). This mode will use

---

[27/] In order to conserve the batteries, the LEDs will turn off automatically after a predetermined interval.

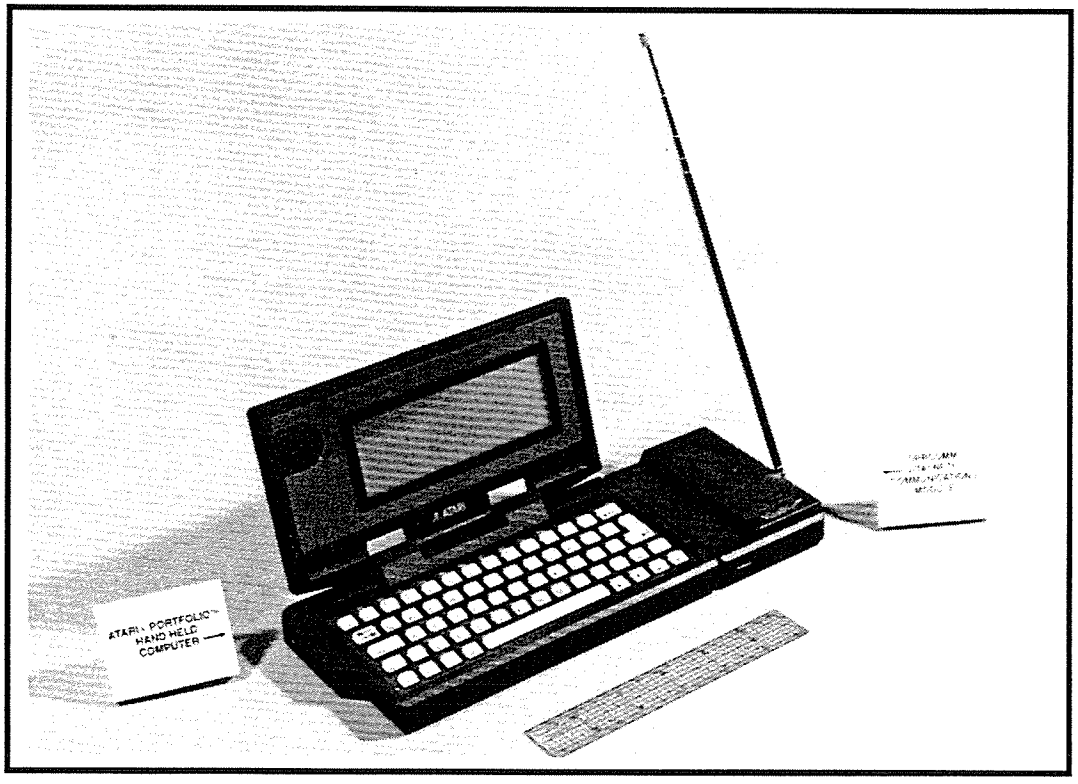
very little power, yet will enable the position determination circuit to be activated on command from the satellite. Thus, the SecurNet PakPal would be functional, even if the subscriber were unconscious. Also, during a search, the subscriber unit will be activated automatically or by the Service Operations Center as necessary to improve position resolution and to permit use as a signal direction finder by the search party.

Other versions of this terminal will be built into automotive products, will be used in tracking applications, will serve as private ELT and EPIRB equivalents, or will be fitted to sea survival suits and life boats. ORBCOMM may seek the endorsement of the International Maritime Organization (IMO) to integrate SecurNet services into the Global Maritime Distress and Safety System (GMDSS), particularly for small ships and pleasure boats. The same basic communications and position determination capabilities are suitable for many functions.

The VitalNet P^2C^2™ terminal shown in Figure III-9 (P^2C^2 stands for Personal Portable Communications Center) represents the premium or upper end of the product/service spectrum. The P^2C^2 represents the next generation of mobile personal communications. The capability embedded in P^2C^2 is not available from other service providers today, and it has the potential to meet the needs of thousands of persons for a convenient and low cost way of staying in touch at all times, no matter where they are located.

Figure III-9

Atari® Portfolio™ Hand-Held Computer with ORBCOMM VitalNet℠ Communications Module



P^2C^2 will weigh 10 to 12 ounces (depending on the battery selected), and will measure about 7 x 3 x ¾ inches. It will have a full alphanumeric keyboard, in alphabetic or QWERTY format, plus the capability to function as a calculator. P^2C^2 will have a 10 line LCD display, illuminated for night operation, which will permit a 150 character message to be composed prior to transmission or displayed after receipt. The unit will be able to receive and store up to twelve 100 character messages and will operate, depending on the duty cycle, between a week and a month without recharging or replacing the batteries. P^2C^2 also will have an RS232 interface port for connection to a personal computer or modem. LEDs will indicate when transmitted messages have been received at the satellite, when messages have been received by P^2C^2, and when the batteries are low. An optional speaker will provide tone alert when messages are received and synthesized voice message read-outs for "macro" messages such as "Call Home". The unit will have a telescopic 18" antenna.

The typical P^2C^2 subscriber terminal also will have three transmit and one or two receive channels. Synthesized multiple frequency channels with scanning capability will assure fast access to an open satellite channel. Two receive channels will provide greater position determination accuracy (37 meters (120 feet) in seven minutes) than can be obtained with a single frequency.

Subscribers will have in P^2C^2 the ultimate in portable communications capability. No matter where a person is, P^2C^2

will be able to silently send and receive messages. There will be no need to "get to a phone" if at a remote job site, or if tied up in traffic on the way to a key meeting, or if in need of fuel for logging operations. And if a subscriber desires the position determination feature, it will be available as an optional product/service feature. It is envisioned that P^2C^2 terminals will have a suggested retail price of $250 to $300, and that monthly subscription charges will be about $35 plus a flat charge per message. At these levels, P^2C^2 is projected to cost substantially less than cellular (average monthly user fees are reported to be about $150) and about equal to national paging. P^2C^2 will have the additional advantages over cellular of ubiquitous geographic coverage and built-in "answering machine" service, and advantages over paging of geographic coverage and two-way message capability. Moreover, neither cellular nor paging offer position determination services.

In operation, the P^2C^2 subscriber typically would leave the unit in the "on" mode. This mode permits messages to be received and remote system checks to be run. Drain on the battery is minor in this stand-by state. If the subscriber wishes to send a message, he or she would be prompted for the addressee's identification code and would then "type" in the message. When the message is ready, the subscriber would enter it in memory and push the "Send" key in combination with another key to transmit the message. Subscribers will be able to use macro key combinations to create, store, retrieve, and send

frequently used messages. The caller identification number will be automatically added to the end of the message. When received by the satellite, the "Message Received" LED will light. Likewise, when a message is received at the subscriber terminal, the "Message Waiting" LED will light and, if desired, a tone will be heard.

The capabilities incorporated into the P^2C^2 will be packaged differently to meet the requirements of specific subscriber applications. Personal and business users will be interested in all of the functions described above but with only moderate interest in position determination. Handicapped persons will be strongly interested in all of the capabilities. Truck tracking and other similar mobile applications will require more rugged versions of the same equipment and will use an external antenna.

The communications capabilities of the ORBCOMM P^2C^2 will also be built into other types of terminals. ORBCOMM envisions computer manufacturers offering VitalNet message capabilities integrated with their portable computer terminals. For instance, the Atari® Portfolio "palm top" computer pictured below in Figure III-9, which is the size of a paperback book and weighs one pound, might add ORBCOMM capabilities by plugging in a VitalNet communications module.[28/] This type of integration would make use of the computer's existing display, keyboard, memory and

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[28/] The names Atari and Portfolio are registered trademarks of Atari Corporation, and Portfolio is a product of Atari Corporation.

power source. The subscriber will then have a computer and telecommunications center in one convenient and ultra-compact unit.

3. Subscriber Terminal Costs

In the past six months, OSC has cooperated with Ford Motor Company's Electronics Division, a major manufacturer of high volume, high quality automotive electronics, to evaluate the performance requirements and operating characteristics of the ORBCOMM system as applied to automotive products. As a part of this effort, a design for the basic single channel transmit and single channel receive communications unit and a manufacturing cost study was completed, assuming very high volume manufacturing processing. In the study, circuitry required for position determination using one and two receive channels was analyzed on an incremental basis. Preliminary indications support ORBCOMM's conclusion that the subscriber equipment can be manufactured and distributed at the retail prices discussed above, and in so doing, may appeal to mass consumer markets.

4. ORBCOMM Will Interconnect With Present Terrestrial Networks

The ORBCOMM system is being designed to interconnect with and complement the PSN both domestically and internationally. Internally, the ORBCOMM network will use a specially adapted version of the X.25 protocol. Communications received from and transmitted over the PSN will be made compatible with packet switched network protocols. Major

customers may be linked with the Network Master Control Center with dedicated circuits. Smaller users may be connected via public packet switched networks. This interconnection will enable ready integration of the ORBCOMM services into existing public and private networks and thereby enhance the reach and efficiency of these networks.

ORBCOMM will interconnect with international networks in the same manner. All international traffic will be transmitted across borders using authorized public and private packet data and private circuit networks. Thus, a message sent from a mobile ORBCOMM subscriber in the U.S. to another subscriber traveling in another country will be sent through the least cost international facilities to the ORBCOMM foreign licensee for transmission to the foreign traveler. Service will be provided directly to ships at sea where international regulation permits such service, and any requisite coordinations have been completed. ORBCOMM satellites will have a store and forward capability permitting messages or data files to be uplinked in the U.S. or at sea and carried for later delivery when in view of the ship or a U.S. Regional Gateway.

ORBCOMM services also will complement those offered by the paging industry. ORBCOMM terminals may function as paging terminals, providing a new way to expand the size and scope of paging networks. ORBCOMM will pursue relationships with paging companies for interconnection with their voice mailbox systems. While ORBCOMM terminals will provide the capability to

communicate detailed information two-way, it may still be important to the subscriber to learn more about the background and subtleties of a particular matter than is permitted by the short ORBCOMM message. In this event, the subscriber could be provided a telephone voice mailbox number to call for additional details. An ORBCOMM subscriber could then make use of his or her cellular phone or other nearby phone to retrieve the voice message.[29/]

5. Nature and Principal Terms of Offerings to be Made to Other Parties

ORBCOMM will offer its services as a common carrier.[30/] ORBCOMM will also seek to enter into agreements with automobile and truck manufacturers, who will provide OEM platforms for the installation of ORBCOMM compatible terminals and who require services support to their subscriber/customers. ORBCOMM will seek to contract with emergency service providers, who will

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29/ Likewise, ORBCOMM terminals could provide "call waiting" and "answering machine" capabilities to cellular telephone users. Should a cellular phone owner be talking, an incoming call will encounter a busy signal. The caller could leave a message via ORBCOMM requesting a return call. In this manner, cellular phone users will then know that an attempt has been made to call them and will have the opportunity to return the call. Use of voice mailbox, call waiting, and answering machine functions are expected to increase cellular airtime.

30/ ORBCOMM lacks market power, and therefore should be treated as a non-dominant common carrier. See Competitive Common Carrier Services, 85 FCC 2d 1 (1980) (adopting dominant and non-dominant classifications) and 98 FCC 2d 1191 (1984) (forbearance regulation applied to non-dominant domestic satellite carriers). Cf., Land Mobile Satellite Service, 2 FCC Rcd 485, 490 (1987) (streamlined regulation applied to LMSS consortium).

"resell" ORBCOMM services in conjunction with existing services (emergency road service and insurance providers). ORBCOMM also will seek to enter into arrangements to supply ORBCOMM services to telecommunications companies that will market ORBCOMM services.

ORBCOMM will establish internal marketing and operations capability to provide some of its services directly to subscribers. The markets that are prime candidates for direct service include search and rescue, most tracking services and data acquisition services.

Foreign markets will be served through local licensees that will market and deliver through dedicated local ground facilities. ORBCOMM will retain ownership of the satellite system, and will receive license fees, royalties and technical assistance fees from the licensees.

Contracts for ORBCOMM services with OEM platform providers and resellers will recognize the unique systems requirements of each of these entities. Contracts with individual subscribers will be on a monthly or annual basis. New subscribers will be charged a modest one time sign-up fee to offset the costs associated with establishing new accounts. Individual subscribers will be able to discontinue service at any time with no further payment of fees. Although we have developed preliminary price levels and rate structures for financial analysis purposes, specific prices (and any necessary tariffs) will be determined later.

D. ORBCOMM Subscriber Demand Projections

The following table (Table III-2) shows projected subscriber demand by ORBCOMM service for the proposed system during the 1994 to 2001 period.

In total, the number of subscribers (defined as individual transmitters) is projected at 205,000 in the first year of operation, and at 5.2 million subscribers by the eighth year of operation. These projections are conservative, as will be explained below, but provide a solid planning base given the pioneering nature of the service. Small increases in market penetration rate assumptions make a significant difference in the projections, but the viability of the system was tested using the lower figures. ORBCOMM has sized the system (and the requisite spectrum) to balance the risks and uncertainties inherent with any new service against what appears to be a very real possibility that subscriber acceptance will be considerably higher than baseline projections.

Over the life of the system, SecurNet emergency service subscribers are projected to account for a substantial portion of total subscribers. This assumes that ORBCOMM terminals will be built into one percent of the 15 million new vehicles sold in the U.S. beginning in 1994, increasing annually by one percentage point to a five percent installation rate in 1998 and beyond. We also assume that any subscriber losses during the period are replaced with after-market installations. For the sake of conservatism, ORBCOMM has projected no subscribers in the search

Table III-2
ORBCOMM Subscriber Demand Projections
1994-2201
(000)

Subscriber Terminals	1994	1995	1996	1997	1998	1999	2000	2001	Period Avg
Emergency Services	150	450	900	1,500	2,250	3,000	3,750	4,500	2,060
Data Acquisition Services	20	55	90	125	160	195	230	265	140
Tracking Services	20	30	45	50	55	60	65	70	50
Messaging Services	15	50	100	150	200	250	300	350	175
Total Terminals	205	585	1,135	1,825	2,665	3,505	4,345	5,185	2,425

Subscriber % Total by Service									
Emergency Services	73%	77%	79%	82%	84%	86%	86%	87%	85%
Data Acquisition Services	10	9	8	7	6	5	5	5	6
Tracking Services	10	5	4	3	2	2	2	1	2
Messaging Services	7	9	9	8	8	7	7	7	7
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

and rescue and emergency medical applications.[31/] The installation rate in new vehicles could easily be three or four times higher, thereby increasing the total number of emergency road service subscribers to 15 to 20 million.

DataNet data acquisition service subscribers are projected at 20,000 in 1994 increasing to 265,000 in 2001. Existing potential applications exceed 150 million, and the advent of DataNet capability is projected to stimulate new applications, especially in the environmental market. The absolute number of DataNet subscribers is projected to increase ten-fold over the period; however, the percentage of DataNet to total system subscribers is expected to fall. This is explained by the very large growth in emergency service subscribers.

The demand for MapNet tracking services is projected at 20,000 subscribers in 1994 increasing to 70,000 in 2001. This represents substantially less than 1% of the 5 million boxcars and containers and a minuscule fraction of the 182 million registered vehicles and boats in the U.S. Even a modest increase in the assumed penetration rates will increase the number of subscribers dramatically. A high-side subscriber base exceeding 500,000 is believed to be easily within reach. The system will be able to accommodate large numbers of DataNet and MapNet

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31/ Although not factored into our baseline forecasts, ORBCOMM has the capacity and willingness to provide PELTS-type search and rescue services. Indeed, the ORBCOMM system meets these needs better than the terrestrial radio system proposed in the PELTS NPRM.

subscribers because many of the applications will operate in the polled service mode.

VitalNet message service subscribers are projected at 15,000 in 1994, increasing to 350,000 in 2001. The 50,000 subscribers projected for 1995 would represent about 1.5% of the 30 million cellular and paging subscribers expected in that year. Assuming the combined number of paging and cellular subscribers is 60 million in 2001 (one-half the growth rate projected between 1989 and 2001), VitalNet subscribers would be about 6% of the total number of paging and cellular subscribers. Long- and medium-haul trucking and handicapped subscribers are also included in the projected VitalNet subscriber base.

For the interest of conservatism, no sales to U.S. government military or civilian agencies or to state and local governments, other than for environment monitoring applications, are included. Government sales could increase the various projections by as much as 10 to 30%.

Traffic analyses show that the proposed ORBCOMM system will have capacity to meet these requirements and potential growth.

IV. ORBIT CONSIDERATIONS

A. Requested Constellation And Orbits

The ORBCOMM system will consist of a constellation of twenty satellites comprised of three planes inclined to 40 degrees with six satellite per plane (eighteen in total) for temperate zone and equatorial coverage, and two planes inclined

to 90 degrees with one satellite each (two in total) for polar coverage.

The reliability and capability of low-orbiting satellite systems is well established. The U.S. Government has operated several low-orbiting systems, including the U.S. Navy Transit, NOAA satellites, and Landsat. Of these, Transit may be considered, at least with respect to position determination, to be a precursor to the ORBCOMM system. Transit first became operational in 1963, to provide accurate position determination capability for surface vessels and submarines. Over the years, the Transit user base has grown to include land surveyors and commercial vessels: in total about 80,000 users. The system continues in operation and will remain active until 1996 at which time the GPS system will assume the position determination role for military missions. Currently, there are twelve Transit spacecraft in circular polar orbits at 600 nautical miles. One of the Transit spacecraft operated continuously for 21 years before being removed from service.

NOAA has operated low-orbiting weather satellites for many years, and NASA operated five Landsat and four Nimbus satellites for earth observation. Numerous military satellites also have operated successfully in low earth orbit.

1. Orbital Altitude and Inclination

Orbital parameters such as altitude and inclination are driven primarily by the degree and the type of ground coverage required by the system. In addition, considerations such as orbital life also have a significant impact on their choice. With low-earth orbit satellites, orbital altitudes below 800-900 km begin to suffer from the effects of air drag resulting in costly propulsion systems to maintain precise orbit position and shortened life. Above this altitude, the effects of drag are minimized, although the solar radiation pressure becomes more significant. To achieve an optimum balance between the two forces, and to obtain the maximum operating life, the primary eighteen satellite ORBCOMM system will be placed in a circular 970 km orbit, at an inclination of 40 degrees, thus achieving long life and maximum useful coverage. The supplementary two satellite polar system also will be placed in 970 km circular orbits but inclined to 90 degrees.

2. Orbital Planes and Satellite Spacing

The considerations which drive the satellite constellation configuration consist primarily of the ground coverage required and the launch/replacement philosophy. From a coverage viewpoint the number of planes, P, and likewise the product of planes and satellites (P x S) decreases as the orbital altitude increases.

To obtain the optimum tradeoff between single coverage and the minimum launch/replacement costs, the primary ORBCOMM

constellation will be comprised of three planes with six satellites in each plane. The planes will be separated by 120° and the satellites within a plane by 60°. Polar coverage is achieved with the two polar orbiting satellites. These planes will be orthogonal with the satellites 180° out of plane.

3. Deployment and Replenishment

Each of the 20 satellites will be deployed on an OSC Pegasus vehicle launched under license from the U.S. Department of Transportation. Pegasus can deliver 480 lb (217.5 kg) to the desired 970 kilometer orbit at 40 degrees inclination. A 330 lb (149.6 kg) satellite and a 30 lb adapter/separation system can be accommodated with a 120 lb (54.4 kg) or 25% margin. This is sufficient margin to consider a shared launch opportunity with a secondary satellite customer defraying some fraction of the launch cost, although this has not been assumed for the sake of conservatism. The Pegasus launch vehicles are expected to provide insertion accuracies of ± 56 km in altitude and ± 0.2° in inclination. Once deployed at the nominal operational altitude, the individual orbits of the coplanar satellites will be established using each satellite's integral propulsion, or stationkeeping, subsystem. Preliminary distinct orbit altitudes will be established for each satellite. This different orbit altitude will cause the satellite to drift to its proper in-plane location relative to the other five satellites in the plane. As each satellite reaches its assigned in-plane position, the orbit altitude is changed back to the nominal one, and the

stationkeeping subsystem will prevent further drift. This operation is identical in principle to the operation used to change the station location (or longitude) of a geosynchronous satellite. The same procedures will be used to maintain the orthogonal and phasing relationship of the polar orbit satellites.

Deployment of the full constellation will require 20 launches. Replenishment of failed satellites in the constellation will also be achieved by launching individual satellites on Pegasus. Integration of the satellites with the Pegasus launch vehicle will be conducted at the launch site. The Pegasus launches will be conducted at 13,100 meters (43,000 ft) over the open Atlantic Ocean.

4. Orbit Tracking and Management Plan

Satellites in low-earth orbit necessitate a more complex tracking and management scheme than those in geosynchronous orbit. Each of the satellites, at the proposed orbital altitude, will complete one orbit of the earth in approximately 104 minutes. As each orbit is complete, the earth will have rotated such that a longitudinal shift of the satellite ground track will have occurred. For a satellite in a 970 km orbit, this shift is approximately twenty-six degrees. As a result, each satellite track is shifted from the previous one by this longitudinal shift. Tracking of any particular satellite will subsequently be shifted from one regional gateway to the next.

The Satellite Control Center receives, via the regional gateways, a particular satellite's position based on the output of a GPS receiver located in the satellite. An ephemeris database of reported positions will be maintained and updated at the Satellite Control facility for each of the satellites in orbit. The Satellite Control Center will utilize the database for determining the orbit management plan. During the course of a twenty-four hour period, each satellite will complete between 13-14 orbits, and 400 or more over a period of a month. The orbit of each satellite will be constantly monitored, and on a periodic basis, the Satellite Control Center will direct the appropriate regional gateway to perform any orbit adjustments required. For the orbital altitude chosen for the ORBCOMM system, it is anticipated that only nominal corrections will be necessary over the seven-year operational life of the satellites.

B. Collision Probability Is Extremely Low

The probability of a collision of two satellites or a collision of a satellite with trackable man-made debris is extremely remote. Historically, there is no known past collision of two satellites in orbit.

C. No Safety Or Damage Risks On Satellite End-of-Life

At the end of functional life of each satellite, the satellite will pose no credible safety or damage risk to other satellites. The satellite will remain in a very slowly decaying orbit, with altitude decay that will preclude collision with

replenishment satellites placed into the operational orbit. It is estimated that natural orbital decay will result in atmospheric reentry. On reentry, the satellite is expected to burn up entirely in the atmosphere with no credible risk of any of the pieces reaching Earth's surface.

D. Use Of The Proposed Orbits Is In The Public Interest

There presently are no privately owned communications satellites in low-earth orbit, and no known satellites orbiting at the altitude proposed by ORBCOMM. Orbital locations for low-earth orbiting satellites are not directly regulated by the FCC, the ITU, or any other organization. While there is no existing process for obtaining low-earth orbit assignments, the procedures for granting radio and launch licenses will have the effect of establishing licensed orbital assignments. It is anticipated that any other applicant for a low-earth orbiting satellite system planning to use the altitude and adjacent spectrum proposed by ORBCOMM will be required to coordinate with ORBCOMM to preclude physical and frequency interference.

1. ORBCOMM Will Place New Orbit Capacity in Public Service

The desirable portions of the geostationary orbit serving the U.S. in the C-Band and Ku-Band are occupied. As the communications capacity on these satellites becomes fully utilized, users will be forced into higher frequency bands in order to reuse the prime orbit locations. User terminals that

operate at these higher frequencies will be more expensive than those operating at lower frequencies. ORBCOMM's objective is to provide an alternative to this trend with respect to selected types of communications services.

ORBCOMM's innovative system will make use of orbital space that is not in service today. Moreover, the low-earth orbit makes possible ORBCOMM's low subscriber terminal costs and the simultaneous use of the Doppler effect for position determination. By authorizing the proposed service, the Commission effectively will have added valuable and scarce orbit locations that can be used for provision of services in the public interest, without displacing any current licensees.

2. ORBCOMM Permits Frequency Use and Reuse that Otherwise Would Not Be Possible

The VHF frequencies proposed for use in the ORBCOMM system presently are not used in non-government satellite service. The 400.1 MHz UHF frequency is not used in any service, government or non-government. The government VHF frequencies assignments in the 137-138 MHz band are for Space-to-Earth Meteorological, Space Operation, and Space Research applications (NOAA satellites and NASA PegSat) and in the 148-149.9 MHz band for fixed and mobile radio (4,000 radios at military bases).

Use of the 137-138 MHz band from geostationary satellites is impractical for most applications, particularly those proposed by ORBCOMM, because these applications require very small antennas. ORBCOMM's low-earth orbit permits use of

low power subscriber equipment and antennas as short as 23 cm (9 inches). ORBCOMM plans to use a total of 370 KHz of bandwidth in this band for Space-to-Earth communications, potentially serving hundreds of thousands, and possibly millions of subscriber terminals (as well as the Regional Gateways). Thus, presently underutilized spectrum will be put to valuable and productive use, made possible by the employment of an unused low-earth orbit resource.

ORBCOMM's system also will increase the use of spectrum presently licensed only to mobile radio applications on U.S. military bases. Use of the 148-149.9 MHz band only for those 4,000 radios results in valuable spectrum (that ORBCOMM proposes to utilize across the entire country) only being used in a few highly localized areas. ORBCOMM proposes to use a total of 478 KHz of bandwidth for uplinks from the subscriber terminals and Regional Gateways to the satellites, which will provide national (and potentially global) coverage.

Moreover, ORBCOMM's use of that spectrum will be in addition to, not in lieu of, the current licensees. ORBCOMM expects that virtually all usage of the system will be out of range of military bases. In any case, interference, from such users to the military radios is not likely to occur (See Appendix A for Interference Considerations). In addition, the nine Regional Gateways will be located so as to preclude any harmful interference with the military radios, and the subscriber terminal antennas will be designed for maximum gain toward space

(whereas mobile radio equipment is designed to propagate signals along the surface of the earth). Through careful system design and coordination with military users, more efficient use of the proposed spectrum in the 148-149.9 MHz band will be obtained.[32/]

V. SATELLITE SYSTEM DESCRIPTION

A. Space Segment

The ORBCOMM System will consist of a constellation of low-earth orbit satellites launched on a phased basis. The primary constellation will be comprised of three orbital planes with six satellites per plane, inclined with respect to the equator at an angle of 40 degrees. The supplemental constellation will be two satellites in orthogonal polar orbits flying 180 degrees apart. This system design allows efficient, two-way data capabilities and position determination on a global basis.

The ORBCOMM satellites will operate simultaneously in two frequency bands: the VHF Band for the transmission and reception of all messaging traffic, and the UHF Band for the transmission of time signals, standard frequency, and satellite ephemeris information required for enhanced position determination. Each satellite will have twenty-one uplink messaging channels operating in the 148-149.9 MHz frequency range; nine down-link messaging channels operating in the 137-138 MHz frequency range; one downlink channel operating in the

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[32/] In the unlikely event that such coordination proves impractical, ORBCOMM will bear the costs of moving these licensees to another part of the spectrum.

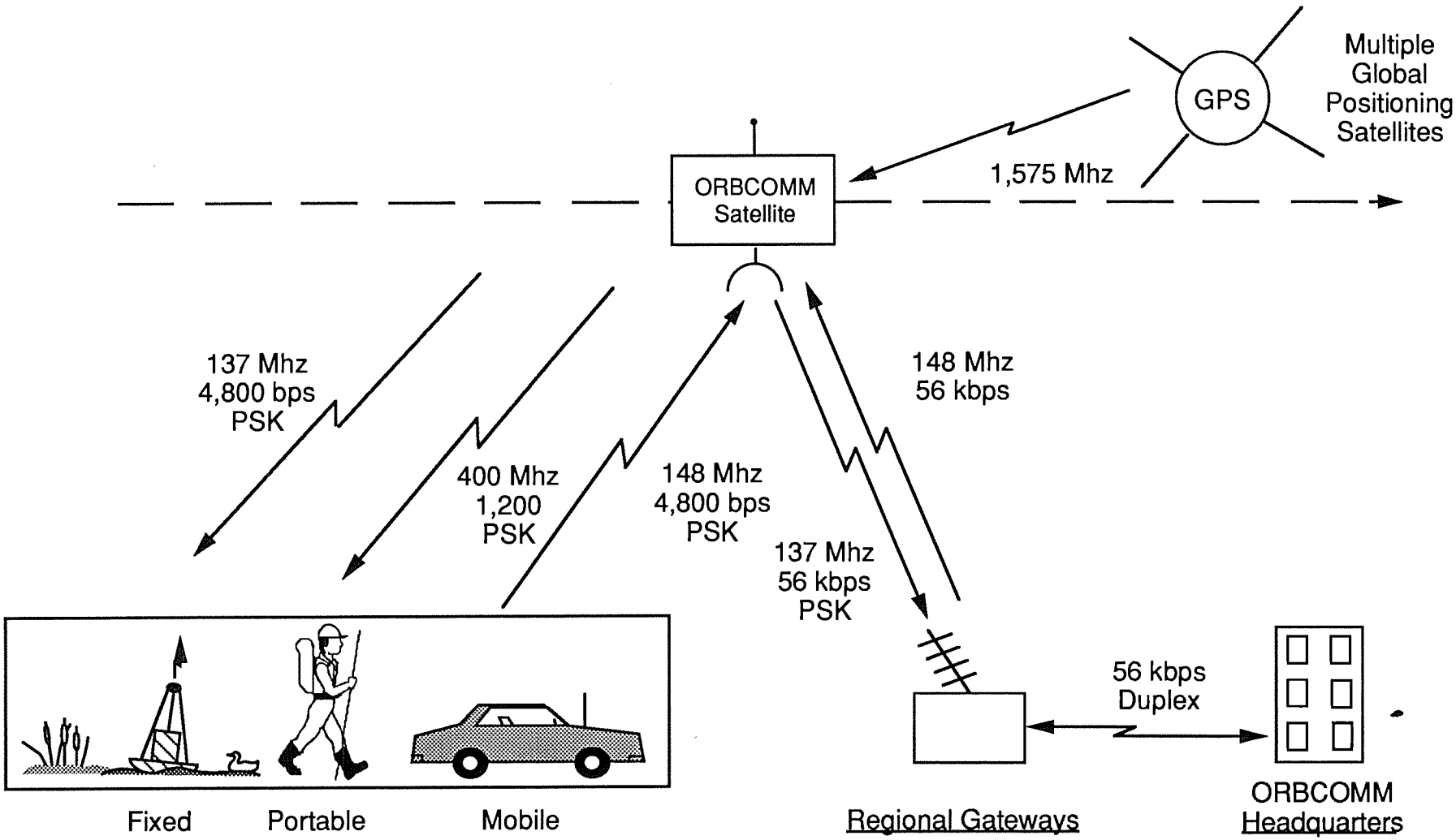
UHF Band at 400.1 MHz; and an inter-satellite receive link operating in the L-Band at 1575.42 MHz (to receive GPS time/positioning information).

The frequencies requested by ORBCOMM minimize subscriber communications terminal costs, while also providing position determination capability with the maximum accuracy possible within the context of the system design.

As set forth in greater detail below, the messaging channels between the subscriber terminal and the satellite are asymmetrical, incorporating twenty receive channels and eight transmit channels. Between the regional gateways and the satellite there will be a single receive and a single transmit channel. The system will also include single transmit channel between the satellite and the ground segment in the UHF band, and a single receive channel between the GPS satellite and the ORBCOMM satellite in the L-band.

Figure V-1 depicts the ORBCOMM system. The ORBCOMM satellites have been specified to meet technical standards that comply with the International Radio Regulations, and to be compatible with the electromagnetic environment in which it will operate. The major spacecraft characteristics are shown in Table V-1. The following sub-sections describe in greater detail all aspects of the ORBCOMM satellite system.

Figure V-1
ORBCOMM Frequencies and Data Rates



Note: Satellite-to-Subscriber and Subscriber-to-Satellite Links to be Monitored at Satellite Operations Center

00202.03a

TABLE V-1

MAJOR SPACECRAFT CHARACTERISTICS

Stabilization	Gravity Gradient/3-Axis
Mission Life	7 Years
Station Keeping	+/- 2 Degrees In-Plane +/- 1 Degree Out-of-Plane
Eclipse Capability	50 Percent
Frequency Bands	137-138 MHz 148-149 MHz 400 MHz 1,575 MHz
Earth Coverage	5,566 km[33/] [3,473 miles]
Number UpLink Channels	21 @ 148 MHz[34/]
Number DownLink Channels	9 @ 137 MHz[34/] 1 @ 400 MHz
Number Intersatellite RX Channels	1 @ 1,575 MHz
Total Occupied Bandwidth	370 KHz @ 137 MHz 478 KHz @ 148 MHz 50 KHz @ 400 MHz
Polarization	Circular
Transmit EIRP	10 dBw @ 137 MHz 13 dBw @ 400 MHz
Satellite G/T	-24.0 dB/K @ 148 MHz
In-Orbit Mass (BOL)	150 kg
Orbit	Inclined (40 and 90 Degrees)

33/ Circle of Coverage Diameter for 5 Degree Elevation Angle.

34/ Service allocation: Subscriber uplinks -- 3 polling, 17 random access, plus 1 gateway uplink; 8 subscriber downlinks, plus 1 gateway downlink

1. Two Frequency Band Operation

The ORBCOMM system will operate simultaneously in the VHF and UHF frequency bands between space and earth. To achieve maximum operation efficiency, all traffic from the ground segment (i.e. the subscriber terminals and the gateways) to the satellite will operate in the 148-149.9 MHz frequency range of the VHF Band, and all traffic from the satellite to the ground segment will operate in the 137-138 MHz frequency range of the VHF Band. The UHF Band will be used to transmit time signals, standard frequency, and satellite ephemeris information to Regional Gateways, the Satellite Control Center and subscriber terminals.

ORBCOMM is concurrently filing a petition for rulemaking to allocate the VHF frequencies to the proposed low-earth orbiting mobile communications. These aforementioned frequency bands already are allocated domestically and internationally for satellite services. These frequencies are also already allocated for shared government and non-government use. ORBCOMM also is requesting authorization to operate the proposed system on a "Modified Primary" basis in the U.S. Under the "Modified Primary" status, ORBCOMM will operate in a manner that will not cause harmful interference to currently licensed users but will be granted Primary status versus any new

services or new users in existing services proposed in these frequencies. Presently only NASA, NOAA and military mobile radio operate in the proposed VHF bands. The specific frequencies and channel bandwidth will be compatible with existing authorized users. Appendix A details ORBCOMM Interference Analysis for the proposed system.

ORBCOMM also proposes to make use of 50 KHz of the 100 KHz of bandwidth available at 400.075 to 400.125 MHz to provide GPS derived time signals. This proposed usage is in line with existing worldwide ITU allocation of this spectrum for Standard Frequency and Time Signals by satellite, including the +/- 25 KHz bandwidth usage restriction. ORBCOMM will provide the very precise GPS time as part of its service offerings and on an unrestricted basis to other users.

2. Frequency and Polarization Plan

The ORBCOMM satellite communications system will provide the following transmit and/or receive capability:

	Frequency(MHz)	Channels	Required Bandwidth Occupied KHz Per Channel	Total KHz
Downlink				
Subscrib Term	137.000-137.270	8	27	270
Regional Gtwy	137.300-137.400	1	90	100
Timer/Frequency	400.075-400.125	1	40	50
Uplink				
Subscrib Term	148.000-148.378	20	15	378
Reg Gateway	148.700-148.800	1	90	100
			TOTAL	898

Memo: Inter-Satellite Link

GPS Sat (Receive Only)	1,575.42

Within these frequencies, each satellite will provide useable bandwidths of 478 KHz in the 148-149.9 MHz frequency range, 370 KHz in the 137-138 MHz frequency range and 50 KHz in the 400 MHz frequency range (a total of 898 KHz, combining space and ground links). Table V-2 describes the composition of the three channel bandwidths specified, and Table V-3 provides the proposed frequency plan. Polarization for both the VHF Band and the UHF Band will be circular. Spurious emissions beyond the useable bandwidth of each frequency band will be attenuated by input and output filters as well as good RF design practices.

TABLE V-2

CHANNEL BANDWIDTH REQUIREMENTS

UPLINK CHANNELS (148 MHz)

Bit Rate	1,200 bps
Communications Spectrum	3,600 Hz
Position Determination Spectrum[35/]	7,276 Hz
Frequency Error	2,960 Hz
	13,836 Hz >>>>15 KHz

DOWNLINK CHANNELS (137 MHz)

Bit Rate	4,800 bps
Communications Spectrum	14,400 Hz
Position Determination Spectrum[35/]	6,736 Hz
Frequency Error	2,740 Hz
	23,876 Hz >>>>27 KHz

DOWNLINK CHANNEL (400 MHz)

Bit Rate	4,800 bps
Communications Spectrum	14,400 Hz
Position Determination Spectrum[35/]	19,674 Hz
Frequency Error	800 Hz
	39,674 Hz >>>>40 KHz

35/ Doppler Shift

TABLE V-3

SUBSCRIBER TERMINAL - SATELLITE FREQUENCY PLAN

CHANNEL NUMBER	DOWN-LINK CENTER FREQUENCY
1	137.030 MHz
2	137.060 MHz
3	137.090 MHz
4	137.120 MHz
5	137.150 MHz
6	137.180 MHz
7	137.210 MHz
8	137.240 MHz

CHANNEL NUMBER	UP-LINK CENTER FREQUENCY
1	148.018 MHz
2	148.036 MHz
3	148.054 MHz
4	148.072 MHz
5	148.090 MHz
6	148.108 MHz
7	148.126 MHz
8	148.144 MHz
9	148.162 MHz
10	148.180 MHz
11	148.198 MHz
12	148.216 MHz
13	148.234 MHz
14	148.252 MHz
15	148.270 MHz
16	148.288 MHz
17	148.306 MHz
18	148.324 MHz
19	148.342 MHz
20	148.360 MHz

TABLE V-3 (con't)

REGIONAL GATEWAY - SATELLITE FREQUENCY PLAN

CHANNEL NUMBER	DOWNLINK CENTER FREQUENCY
1	137.350 MHz

CHANNEL NUMBER	UPLINK FREQUENCY BAND
1	148.750 MHz

TIMING CHANNEL FREQUENCY PLAN

CHANNEL NUMBER	DOWNLINK CENTER FREQUENCY
1	400.100 MHz

GPS FREQUENCY PLAN

CHANNEL NUMBER	INTER-SATELLITE LINK CENTER FREQUENCY
1	1,575.42 MHz (Receive Only)

3. Spacecraft Coverage

ORBCOMM's satellite system will provide near-continuous high quality coverage to essentially all of the area of the globe bounded by the 70 degree latitude grids. Polar area coverage will be provided every one-half hour for fourteen minutes. This high degree of coverage flows from the deployment of a constellation consisting of 20 satellites. Figure V-2 depicts the ground track for one satellite plane at one point in time. Each of the satellite footprints provide the coverage outlined in the following table:

Elevation Angle	Coverage Area[36/]	Coverage Time
5 degrees	5,566 km	14 minutes
10 degrees	4,675 km	12 minutes
15 degrees	3,785 km	10 minutes

Figure V-3 depicts the coverage area obtained by the constellation of twenty satellites at one point in time. As that illustration demonstrates, within the boundaries of plus-and-minus seventy degrees latitude, near continuous coverage will be provided 95 percent of the time.

4. Communications Subsystem

The ORBCOMM communications subsystem is comprised of a combination of VHF, UHF and L-Band receive and/or transmit antenna assemblies, receivers, input and output multiplexers,

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36/ Circle of Coverage Diameter

Figure V-2.
Satellite Coverage for Single Plane[1]

[1] Zero and Five Degree Elevation Angles

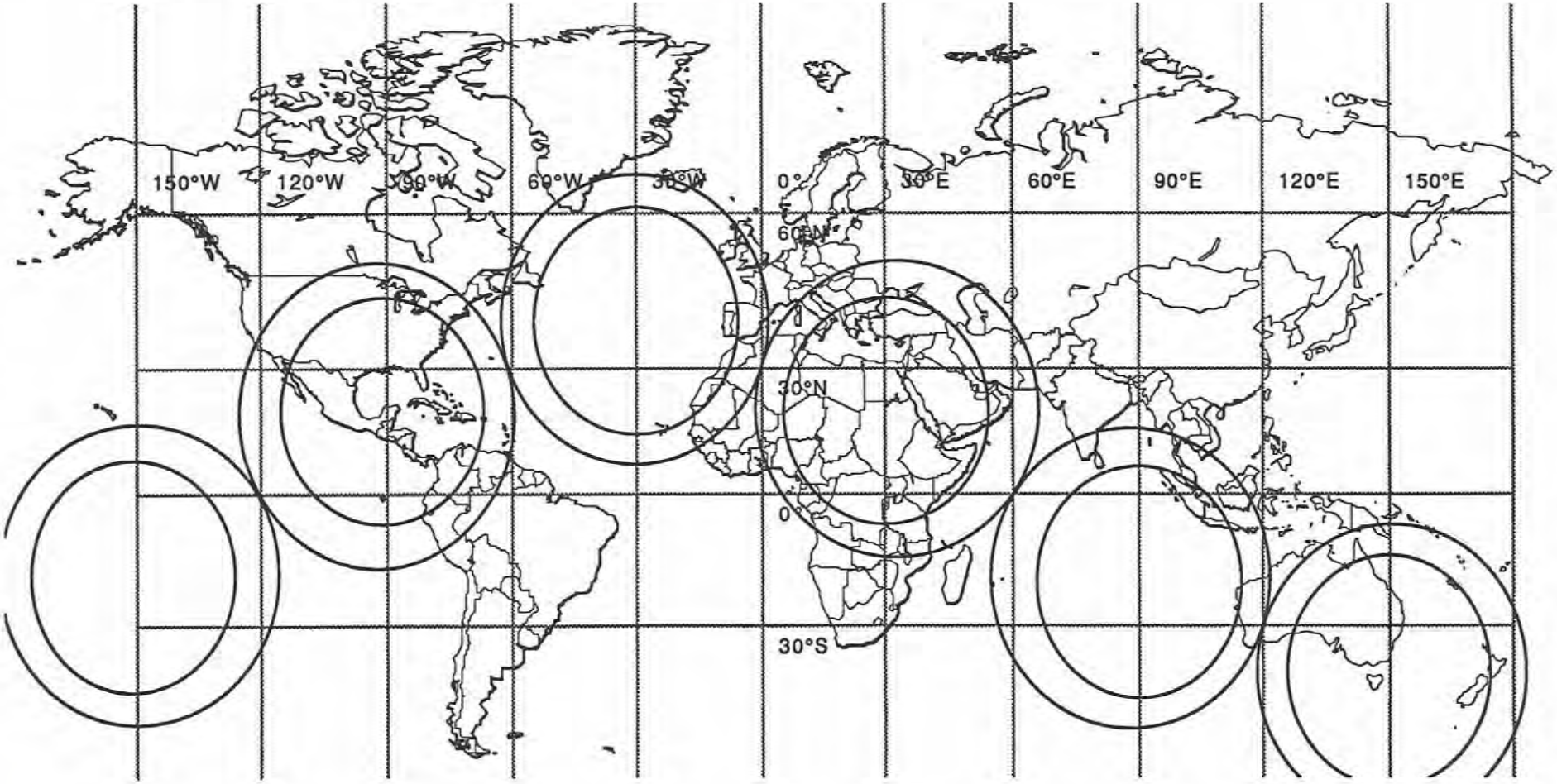
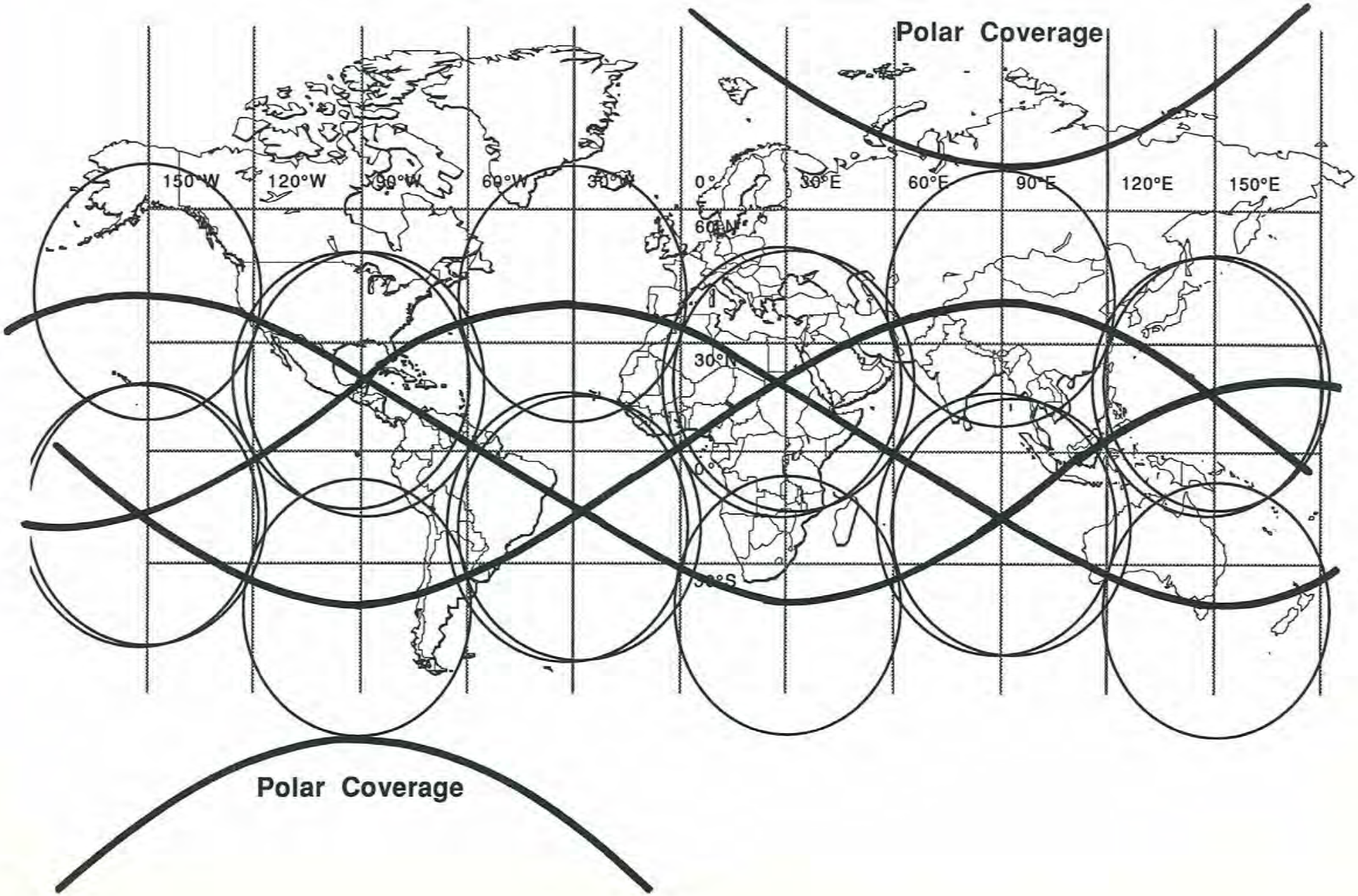


Figure V-3
Twenty Satellite System Coverage



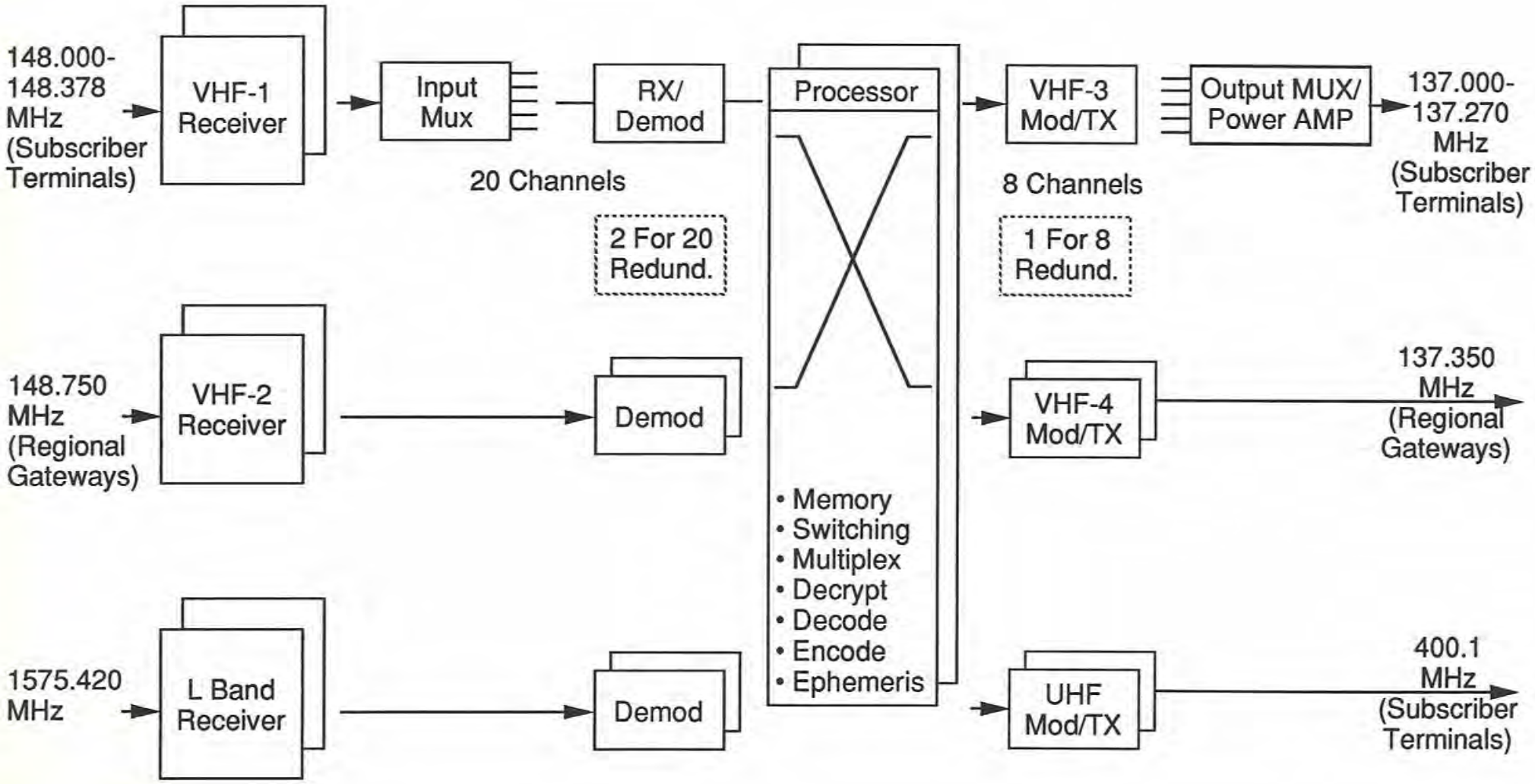
demodulators and modulators, switching matrices, channel combiners, power amplifiers, and a message processing system. Redundancy is provided throughout the communications subsystem to assure maximum reliability during the operational life of the satellite. A functional block diagram is depicted in Figure V-4.

Input signals from subscriber terminals and Regional Gateways at 148 MHz will be received and routed through two distinct paths, identified as VHF-1 and VHF-2, to the Message System Processor (MSP). VHF-1 is the 148 MHz in-bound path carrying traffic from subscriber terminals to the satellite. VHF-2 is the 148 MHz out-bound path carrying traffic from the Regional Gateways to the satellite. VHF-3 is the 137 MHz path carrying out-bound traffic to the subscriber terminals. VHF-4 is the 137 MHz path carrying in-bound traffic to the Regional Gateways. The input section of the satellite for each of these paths contains a test coupler, isolator, filter and RF switch. The filters provide the requisite response characteristics and protect against out-of-band interference. Isolators ensure proper match and reduce interaction between the antenna and pre-select filters. The RF switch enables two-for-one receiver redundancy.

The receivers have pre-amplifiers which will provide high gain and low noise over the derived frequency bands. For the "Subscriber Terminal to Regional Gateway" link, VHF-1 and VHF-4, the receiver downconverts the signal to an intermediate frequency and then filters and amplifies the signal before

Figure V-4

Satellite Block Diagram



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feeding it to the input multiplexers. Hybrid splitters separate and isolate the 20 receive channels which are then routed to a second bank of receivers for subsequent demodulation to reconstruct the subscriber message. The subscriber message is then routed to the MSP to be processed by, multiplexed with, and retransmitted to a Regional Gateway via the 137 MHz downlink (VHF-4). All subscriber messages are routed through the Regional Gateways and to the Network Master Control Center for posting and processing. Redundant modulators and power amplifiers provide the necessary power to transmit the gateway signal.

For the "Regional Gateway to Subscriber Terminal" link, VHF-2 and VHF-3, the receiver downconverts the signal to an intermediate frequency, demodulates the signal and routes it to the MPS. The MPS separates the signal into its appropriate addresses for specific processing and subsequent retransmission. The individual messages are combined into appropriate groups, and then routed to the modulators and power amplifiers for transmission to the subscriber terminals via the appropriate VHF-3 downlink. Redundant modulators and power amplifiers provide the necessary power to transmit the VHF signals.

The GPS signal is received via a redundant L-Band receiver, demodulated and routed to the Message Processor where the satellite ephemeris is developed. The ORBCOMM satellite position and GPS time information is subsequently routed to the VHF-3 and UHF down-links for transmission to the appropriate ground segment elements for use in position determination and

TT&C functions. Redundant modulators and power amplifiers provide the necessary power to transmit the UHF signal.

a. Technical Parameters

For the VHF-1 path, each of the twenty message receive channels will have a useable bandwidth of 15 KHz, and for the VHF-3 path each of the eight message transmit channels will have a useable bandwidth of 27 KHz. For the VHF-2 and VHF-4 paths, the receive channel and transmit channels will each have a useable bandwidth of 90 KHz. The UHF transmit channel will have a useable bandwidth of 40 KHz (50 KHz with guard bands). All specifications will be maintained over the respective individual frequency bands. Typical performance characteristics of the VHF, UHF and L-Band channels are shown in Table V-4.

TABLE V-4

RECEIVER PERFORMANCE

Parameter	VHF (Path)	L-Band
Input Frequency	(1) 148.000-148.378 MHz (2) 148.700-148.800 MHz	1,575.42 MHz
Minimum Input Power per Channel	(1) -151 dBw (2) -144 dBw	- 130 dBw

EIRP SUMMARY

Parameter	VHF (Path)	UHF
Per Channel Output Power	(3) 10 watts (4) 10 watts	20 watts
EIRP per Channel	(3) 10 dBw (4) 10 dBw	13 dBw
Pwr Flux Density[37/]	(3) -123.4 (4) -131.2	-131.2

b. Transmission Modes

The communications subsystem receives and transmits in two basic transmission modes. The particular transmission mode depends on the channelization within the communications subsystem, which is assigned in accordance with the classification of message service. To achieve maximum throughput in the communication subsystem, while maintaining overall minimum subscriber terminal cost, the transmission modes for the VHF-1 frequency band employ Frequency Shift Keying (FSK) at a data rate

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37/ dBw/m^2/4KHz at the ground. This is consistent with other low-earth orbit satellite utilization, e.g., PegSat (a NASA Goddard satellite) power flux density is -124 dBw/m^2/4KHz.