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

In the Matter of the Application of HUGHES COMMUNICATIONS GALAXY, INC. For Authority to Construct, Launch and Operate GALAXY/SPACEWAY™, a Global Interconnected System of Geostationary Ka band Fixed-Service and Ku band Broadcast Communications Satellites	File No.

SYSTEM AMENDMENT

Hughes Communications Galaxy, Inc. ("HCG") hereby requests authority to construct, launch and operate a hybrid FSS/BSS international geostationary satellite system. This system, known as "GALAXY/SPACEWAY™," will provide state-of-the-art Ka band fixed satellite and Ku band broadcast satellite services. This request amends HCG'S pending SPACEWAY™ application for an international Ka band system, filed on July 26, 1994.

EXECUTIVE SUMMARY

A. GALAXY/SPACEWAY™ Concept

When HCG initially proposed the SPACEWAY™ system in December 1993, the system was comprised of two stand-alone Ka band domestic communications satellites. Last year, in July 1994, HCG expanded the original SPACEWAY™ concept into a global

network consisting of interconnected regional satellite systems at six orbital locations around the world. The global SPACEWAY™ system was designed to be a platform that would provide low-cost telephony, narrow-band data, high-speed data, videoconferencing and video telephony communications services around the world, all seamlessly integrated into the public switched telephone network ("PSTN"). Those services would be provided to both individual and commercial users through ubiquitously deployed ultra-small (26" in diameter) antennas that can be mass merchandised and easily installed. The system's high-power spot beams and on-board processors would offer high data rate transmissions in an extremely efficient spectral range, and the ability to offer "bandwidth on demand."

By this amendment, HCG proposes to expand dramatically SPACEWAY's™ global service capabilities to meet emerging worldwide demand for cost-effective, efficient and comprehensive satellite-based communications services. In addition to the 26 inch antennas that will support high capacity, two-way communications services, the system now supports the delivery of direct-to-home ("DTH") service to satellite antennas as small as 18 inches in diameter. It also now provides the capacity needed to offer global distribution of video programming to cable systems, broadcasters and other video service providers around the world. In order to reflect the system's far more extensive capabilities, Hughes has renamed the system "GALAXY/SPACEWAY™."

The proposed enhancements are a direct response to the burgeoning international demand for digital services that currently is unmet. Both the tremendous popularity of the direct broadcast satellite ("DBS") services that are now offered in the United States by another Hughes company, DIRECTV™, and the anticipated demand for direct-to-home service in Latin America that Hughes' soon-to-be launched Galaxy III-H satellite will

provide, reflect an increasingly compelling need for the provision of an international video distribution capability.

Significantly, GALAXY/SPACEWAY™ also is true to its heritage. The system will continue to meet the two-way business and telecommunications needs of individual and commercial users throughout the world. Indeed, both the continued demand for high-speed INTERNET access and the lack of widely available, high-speed data connections highlight the growing global demand for the wide-band interactive services that have always been a centerpiece of the SPACEWAY™ system platform.

As was true with the original SPACEWAY™ application, GALAXY/SPACEWAY™ will use state-of-the-art technology. The system continues to offer narrow spot beam coverage at Ka band, which provides high capacity, two-way communications services to ultra-small antennas (66 centimeters or 26 inches in diameter) that can be ubiquitously deployed, mass produced and easily installed. On-board processors allow HCG to offer "bandwidth on demand," which avoids the need for dedicated channels and greatly reduces the cost of service. In addition, the system's direct-to-home service capabilities will support the provision of thousands of video channels around the world. Thus, GALAXY/SPACEWAY™ customers can use a single ultra-small satellite antenna for both high speed access to the information superhighway and for direct-to-home video reception. The system uses cutting edge technology to serve a wide range of markets with a comprehensive platform of innovative voice data and video applications. In sum, GALAXY/SPACEWAY™ responds to the imminent convergence of multiple services in today's telecommunications marketplace.

GALAXY/SPACEWAY™ represents a significant advance in system design since HCG's original SPACEWAY™ proposal. GALAXY/SPACEWAY™ continues to utilize the entire 2.5 GHz of spectrum now available in the Ka band for fixed satellite services, except for the United States, where HCG proposes to use 1 GHz at each of two orbital locations. Through the use of highly efficient spot beam technology, GALAXY/SPACEWAY™ satellites will be able to reuse this Ka band spectrum up to 12 times.

In addition to providing the high speed, high capacity telecommunications services that have always been the core of the SPACEWAY™ system, the modified GALAXY/SPACEWAY™ system contains a key and novel feature: use of Ku band BSS frequencies that otherwise would be unused. The existing International Telecommunications Union ("ITU") plans for those bands preassign orbital locations around the world to various countries. Under those plans, the United States is provided only a limited number of preassigned BSS orbital locations. The ITU plans, however, also permit "non-conforming" uses of the BSS bands (use in a manner that was not contemplated when the plans were adopted 15 years ago), provided that the proposed non-conforming uses do not interfere with the uses specified in the ITU plans.

HCG has added to SPACEWAY™ a 500-800 MHz Ku band BSS platform to create a global BSS system that does not in any way interfere with the planned uses of the BSS bands. This design allows HCG to integrate into the current SPACEWAY™ design an entirely new level of video distribution capabilities. In addition to using the BSS bands for direct-to-home service, GALAXY/SPACEWAY™ will use the Ka band in order to provide "backbone" distribution services for video service providers around the world.

As originally proposed, the GLOBAL/SPACEWAY™ system incorporated inter-satellite links ("ISLs") in order to provide the first truly interconnected worldwide wide-band communications system. These ISLs remain integral to the system proposal, and HCG has expanded their use to support the transmission of video programming around the globe. Among other things, these ISLs avoid the expense, time delay and inefficiencies of multiple "hops" that are required today to provide global connectivity.

The GALAXY/SPACEWAY™ hybrid platform of Ka band FSS frequencies, intersatellite links, and Ku band BSS frequencies enhances the spectral efficiencies that are already inherent in geostationary satellite systems, provides unparalleled signal quality, offers significant savings in ground infrastructure, and makes available additional satellite capacity for other uses.

HCG has chosen the following 15 orbital locations for the GALAXY/SPACEWAY™ system: 25° E.L., 36° E.L., 41° E.L., 48° E.L., 54° E.L., 101° E.L., 110° E.L., 125° E.L., 149° E.L., 164° E.L., 173° E.L., 101° W.L., 99° W.L., 67° W.L., and 49° W.L. The number and location of these positions is dictated by the existing International Telecommunications Union ("ITU") plan for the BSS frequencies that are an integral part of the GALAXY/SPACEWAY™ system. GALAXY/SPACEWAY™ has been carefully designed to avoid creating interference with other BSS systems that are protected from interference under the existing ITU BSS plans. These orbital locations have also been carefully chosen to provide Ku band BSS and Ka band FSS service at optimal elevation angles and to maximize global coverage of the system.

As a global telecommunications superhighway, GALAXY/SPACEWAY™ will provide a wide range of two-way voice and one-way and two-way video and data services at

both high and low transmission rates. Since the system will be compatible and interoperable with the terrestrial telecommunications infrastructure, it will complement and provide an alternative to many existing terrestrial services. In addition, the global nature of the system offers the unique ability to immediately serve many regions of the world where the normal extension of the terrestrial telecommunications infrastructure is not economically practical, or will not occur for decades.

The system's ability to provide "bandwidth on demand" makes GALAXY/SPACEWAY™ the first telecommunications system to truly offer affordable, high capacity, two-way service to virtually anyone at any location around the world. GALAXY/SPACEWAY's™ new video distribution capabilities also promise to serve untapped global markets for video services, as well as facilitate the development of other new satellite services. By providing a high quality, cost-effective means of global communications, GALAXY/SPACEWAY™ clearly meets the Administration's mandate to develop a Global Information Infrastructure and meet the needs of the underserved.

B. Summary of Changes to the Pending July 26, 1994 Amended Application

The July 1994 SPACEWAY™ amendment requested authority to operate a global interconnected network of 17 Ka band satellites at six orbital locations. GALAXY/SPACEWAY™ features the same basic functionalities and capabilities as the original SPACEWAY™ system, and also incorporates an entirely new, global video distribution dimension to the system. While these new service capabilities will expand dramatically the system's service possibilities, they do not require the deployment of significantly more spacecraft – HCG proposes to add only three more spacecraft to the system. HCG has redeployed this fleet to fifteen orbital locations in order to expand the system's service

capabilities but still retain current global coverage. This amendment makes the following primary changes and enhancements into the GALAXY/SPACEWAY™ system:

(1) Ku BSS - The most innovative change to GALAXY/SPACEWAY™ is the addition of a worldwide video distribution capability using Ku band BSS frequencies. There is tremendous current demand for global and regional direct-to-home services. GALAXY/SPACEWAY™ meets this demand by using the under-utilized "planned" ITU BSS frequency bands in a non-conforming manner that will not interfere with any BSS systems that are protected by current ITU plans. In order to take advantage of the Ka band as a backbone for the worldwide distribution of BSS services, it is essential that the Ku band BSS payloads be paired with Ka band FSS payloads on the same satellite. HCG proposes to use the traditional BSS bands for DTH service. GALAXY/SPACEWAY™ will use 11.7 - 12.5 GHz in Region 1, 12.2 - 12.7 GHz in Region 2, and 11.7 - 12.2 GHz in Region 3. For feeder links to these DTH bands, the system will use 17.8 - 18.1 GHz band for Regions 1 and 3, and the 17.3 - 17.8 GHz band in Region 2.

(2) Ka FSS - In order to respond to market demand, HCG has incorporated an even more flexible use of the Ka band into the GALAXY/SPACEWAY™ design. The originally proposed on-board processors on the satellites will continue to support the use of multiple narrow spot beams. HCG now also proposes to deploy Ka band payloads that can be configured to provide the wide area coverage needed to support the video backhaul capabilities required for Ku band BSS.

(3) Intersatellite Links - As noted above, HCG plans to use intersatellite links to connect this global system and to conserve the use of uplink and downlink spectrum. Each satellite will have intersatellite beams pointed in both the east and west directions, in two

polarities, to relay signals either on a transponder basis or channel basis. In order to meet the increased need for ISLs, HCG proposes to add intersatellite links at both 22.55 - 23.55 GHz and 32.0 - 33.0 GHz. In addition, HCG proposes to expand the use of V band for intersatellite services at 54.25 - 58.2 GHz and 59 - 64 GHz.

(4) Orbital Positions - In order to incorporate BSS video distribution capabilities, GALAXY/SPACEWAY™ must add orbital locations and modify slightly some of the originally requested SPACEWAY™ orbital locations. These changes are required to ensure compliance with the present ITU BSS plan and non-interference with existing and planned BSS systems. The SPACEWAY™ position over Central and South America has been changed from 50° W.L. to 49° W.L. and the position which covers Papua New Guinea, Australia and New Zealand has been changed from 175° E.L. to 173° E.L. (175° E.L. was previously referred to as "the Pacific Interconnect"). HCG's previous request for 99° W.L. and 101° W.L. over North America, 25° E.L. over Europe and Africa, and 110° E.L. over Asia-Pacific remains unchanged. To provide global BSS coverage with interconnected Ka band FSS, HCG proposes to add nine more orbital positions: 36° E.L. for service to Western Europe and Scandinavia; 41° E.L. serving Africa, Turkey, and the Arabian Peninsula; 48° E.L. serving Eastern Europe; 54° E.L. serving Western Russia; 101° E.L. serving Iran and the Indian subcontinent; 125° E.L. serving China; 149° E.L. serving Indonesia, the Philippines, and Southeast Asia; 164° E.L. serving Japan, Korea, and Taiwan; and 67° W.L. serving Central and South Americas. Figure 1 summarizes the service area and orbital locations proposed by the system.

antenna to both obtain high speed access to the Internet and receive hundreds of channels of video programming.

The key and novel feature to the modified system is its use of Ku band BSS frequencies that otherwise would be unused. The existing ITU plans for those bands preassign orbital locations around the world to various countries. Under those plans, the United States is provided only a limited number of preassigned BSS orbital locations. The ITU plans, however, also permit "non-conforming" uses of the BSS bands (use in a manner that was not contemplated when the plans were adopted fifteen years ago), provided that the proposed non-conforming uses do not interfere with the uses specified in the ITU plans.

Hughes has carefully designed a global BSS system that does not in any way interfere with the planned uses of the BSS bands. This design allows Hughes to integrate into the current SPACEWAY design an entirely new level of video distribution capabilities. In addition to using the BSS bands for direct-to-home service, GALAXY/SPACEWAY will use the Ka band and intersatellite links at the same orbital location in order to provide "backbone" distribution services for video service providers around the world.

In accordance with the letter from the Managing Director to counsel for Hughes dated September 28, 1995, enclosed is a check for $943,285, in payment of the additional filing fee for this request.

Pending resolution of Hughes's September 19, 1995 request for a clarification of the appropriate filing fee for this system, Hughes is submitting an additional filing fee for both the FSS and the BSS payloads in this system, in each case based on the total number of orbital locations requested. In connection with its prior Spaceway filings in December 1993 and July 1994, Hughes submitted filing fees of $144,060 and $413,475, which represented a total of seven (7) FSS "Space Stations" filing fees (2 paid in December 1993 and 5 paid in July 1994). Since Hughes now proposes a total of fifteen FSS orbital locations for this system (eleven of which also will be BSS orbital locations), it is submitting a filing fee for eight additional FSS orbital locations (at $82,690 each) and eleven BSS orbital locations (at $25,615 each), for a total of $943,285.

Although we believe that this fee represents the maximum filing fee payable for this system, Hughes understands that this filing fee is an interim payment and agrees to submit any further payment, if required by the Commission, within thirty

Figure 1 GALAXY/SPACEWAY™ Service Areas and Orbital Locations

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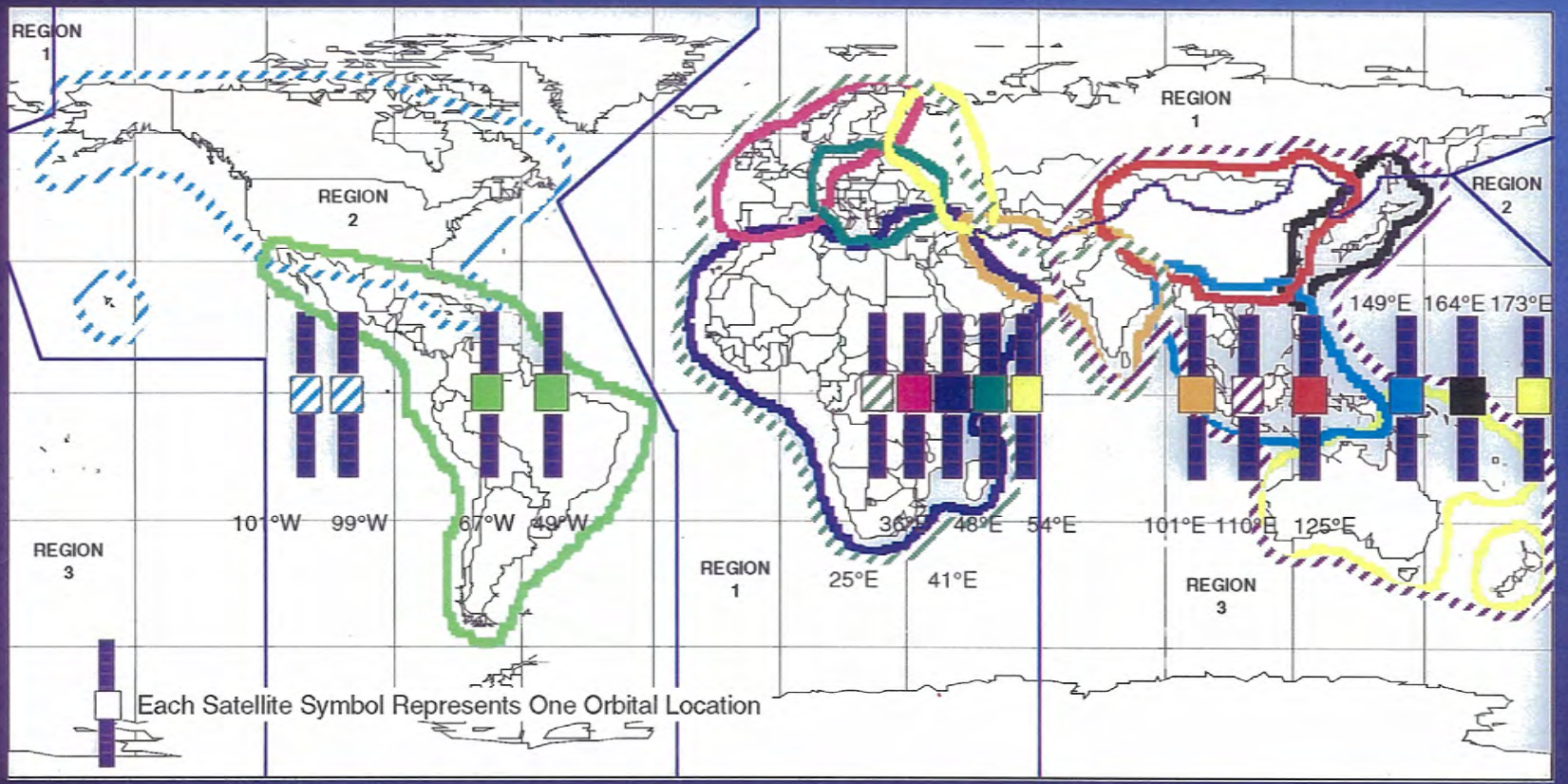

-180 -150 -120 -90 -60 -30 0 30 60 90 120 150 180

Ka-Band and Ku-Band Payloads (Ku-Band Coverage Shown Only)

Ka-Band Payload Only

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(5) Higher Capacity Uplinks - To make the GALAXY/SPACEWAY™ system even more flexible, HCG has added a high capacity (6 Mbps) uplink that supports the transmission of high quality compressed digital video.

(6) Other Changes - With the addition of a Ku band payload, as well as to minimize interference with existing systems, HCG has changed transfer orbit TT&C frequencies from C band to Ku band. In addition, HCG has added 3 satellites to the original proposed fleet.

C. Qualifications of HCG

HCG operates a fleet of domestic communications satellites that is comprised of the Galaxy I-R(S), V-W, and VI C band satellites, the SBS-4, SBS-5 and SBS-6 Ku band satellites, and the hybrid (combined C and Ku band) Galaxy IV(H) and VII(H) satellites. HCG also is authorized to operate the Galaxy III(H) hybrid (combined C and Ku band) communications satellite, which is scheduled for launch in December 1995. In addition, an HCG affiliate operates the fleet of Leasat satellites that provides essential communications services to the United States Navy.

Through this fleet of satellites, HCG has provided a wide variety of reliable satellite services for over a decade. HCG satellites provide the means for commercial television and radio distribution, teleconferencing, video backhaul, high speed image transmission (e.g., medical imaging), educational programming, and private data networks, among other services. Countless end users across the country rely on these services every day.

In addition, another Hughes company, DIRECTV™, has launched and now operates the first United States satellites to provide true DBS service. DIRECTV™ provides

direct-to-home video service in the United States to 18-inch antennas that are mass marketed and easily installed.

Hughes' international experience in satellite communications and telecommunications networks is also extensive. In the 1970s, Hughes designed and implemented Indonesia's first domestic satellite network, Palapa A, which established that country's first national telephone and television network. In 1985, Hughes formed a partnership with Itochu and Mitsui to implement Japan's first and most successful satellite operating company, JCSat. Hughes Network Systems, another Hughes company, is a world leader in VSAT networks and services.

The commitment of HCG and other Hughes companies to providing domestic and international satellite services is clearly demonstrated by the years of service that HCG has provided over its existing fleet of satellites and by the significant investments that it has made to continue operation of that fleet into the next century. GALAXY/SPACEWAY™ represents HCG's comprehensive effort to serve its customers' expanding needs for two-way digital telecommunication services on demand, both domestically and internationally, and to expand globally the success Hughes has had in direct-to-home distribution.

D. Summary of Benefits

Grant of the Application will serve the public interest in several important respects. GALAXY/SPACEWAY™ makes highly efficient use of the limited spectrum resource and offers innovative services in Ka band spectrum that has been underutilized for commercial service to date. GALAXY/SPACEWAY™ also advances the use of Ku band BSS spectrum for direct-to-home reception, and its on-board Ka band processors allow the

provision of spectrum efficient "bandwidth-on-demand" services. Thus, GALAXY/SPACEWAY™ will play a vital role in both providing affordable high-data rate telecommunications services in the rapidly expanding international marketplace and creating a Global Information Infrastructure.

In sum, GALAXY/SPACEWAY™ will enhance existing satellite communications, promote new and innovative two-way telecommunication services on-demand, and significantly contribute to the distribution of data and video programming worldwide. Grant of this Application will help maintain the United States' position as a global leader in space technology and also ensure that U.S.-based satellite providers will be able to compete effectively with other global telecommunications services well into the 21st century.

ITEM A. Name and Address of Applicant

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ITEM C. System Description

1. System Concept and Technology

The GALAXY/SPACEWAY™ global system supports a wide range of end-user applications through the use of a single, ultra-small, mass-produced terminal in major markets around the world. GALAXY/SPACEWAY™ is a highly flexible, efficient and cost-effective means of providing on a regional and global basis, both (1) ubiquitous voice, medium and high speed data, and video telephony services; and (2) entertainment, educational, informational and business video programming distribution services.

GALAXY/SPACEWAY™ will consist of 20 geostationary satellites at 15 orbital locations that will be interconnected by intersatellite links (ISLs). The constellation of satellites will consist of a mixture of payload platforms. One platform will provide the two-way interactive, bandwidth-on-demand, Ka band fixed satellite service (FSS) described in HCG's July 26, 1994 SPACEWAY™ filing. Another platform will provide direct-to-home delivery of video programming at the Ku band broadcast satellite service (BSS) frequencies, and will also utilize Ka band frequencies for "traditional" FSS services, such as video backhaul, satellite news gathering (SNG) and business data applications. The specific satellite configurations at each orbital location will be tailored to the market demand for the various services.

Key components of the GALAXY/SPACEWAY™ system include satellite interconnectivity; on-board switching/processing; narrow and wide spot beams; small, easily installed ground terminals; digital transmission at medium and high data rates; frequency cross-strapping, and steerable antennas.

The services provided by the GALAXY/SPACEWAY™ system will be extended globally through the use of ISLs, which allow any satellite in the constellation to relay the signals received from its particular uplink coverage area to the downlink coverage area of any number of other satellites in the constellation. GALAXY/SPACEWAY's™ innovative use of ISLs will help satellite programming distributors economize on ground infrastructure costs and will provide flexibility in meeting distribution needs. The use of ISLs also will eliminate the need for multiple earth-space hops, thereby freeing up additional satellite capacity and simplifying the distribution process.

In the narrow, high powered Ka band spot beam configuration, GALAXY/SPACEWAY™ satellites will make possible the use of extremely small end user antennas (approximately 66 cm), and will permit reuse of frequencies as much as 12 times. This configuration allows symmetric and asymmetric communications at data rates ranging from less than 16 Kbps to 1.5 Mbps, depending upon end user application and terminal size. Asymmetric connections may support data rates as high as 6 Mbps, which will facilitate digital video signals. State-of-the-art on-board processing will provide users with flexible routing between beams and will enable immediate access to transmission capacity at various data rates. Due to its efficient spectrum re-use, each satellite can support more than 11,500 simultaneous connections at 384 Kbps, for an aggregate throughput of 4.4 Gbps.

Digital compression technology allows transponders to be divided into multiple channels, increasing the number of potential transmissions per transponder. On-board switching in the wide area configuration will be available on a channel basis as well as on a transponder basis, permitting global connectivity for both SCPC (Single Channel Per Carrier) and MCPC (Multiple Channel Per Carrier) transmissions. This channel level switching

capability makes more efficient use of each transponder and decreases transmission costs while providing each channel with many different routing possibilities - both regionally and globally.

The GALAXY/SPACEWAY™ satellites will be capable of cross-strapping signals between FSS Ka band and BSS Ku band frequencies. Signals uplinked at Ka band will be capable of being downlinked Ku band, Ka band or both. As with the on-board switching, cross-strapping will be available on a channel basis as well as on a transponder basis. This approach offers customers maximum flexibility in meeting their distribution needs.

GALAXY/SPACEWAY™ will complement existing regional satellite systems by providing an alternate path for programming or data distribution. In some regions, HCG may establish partnerships with local entities to serve that region's particular needs. For areas without existing systems or those that are currently underserved, GALAXY/SPACEWAY™ could be used as a regional system.

2. Services Offered

a. Telephony, Data and High Resolution Video

One of the key features of GALAXY/SPACEWAY™ is the variety of applications offered to consumers and business customers. GALAXY/SPACEWAY's™ small, inexpensive user terminals will make it possible for many consumers and small businesses, for which satellite VSAT networks are currently unaffordable, to take advantage of a variety of new services. Consumer uses will include basic telephony and narrow-band data communications, personal video telephony, high-speed personal computer access to the Internet and on-line services (such as CompuServe and America On-Line), as well as access to the wide variety of interactive entertainment, information and education multimedia services currently being developed for the "information superhighway".

Business applications in the GALAXY/SPACEWAY™ global system will include: basic telephony, narrowband and high speed data communications between multiple office LAN sites, including Internet access and information services; video telephony and videoconferencing across multiple meeting sites; interactive training, medical and technical tele-imaging; and a variety of applications performed by commercial users of satellite VSAT networks today, including point-of-sale transaction validation and corporate data communications.

The GALAXY/SPACEWAY™ system represents a giant stride forward for the transmission of data. The incorporation of on-board switching/processing, multi-spot beam coverage, and advanced ground terminal semiconductor technology, will allow immediate and on-demand access to space segment and extremely fast data transmission. For many applications, such as sending medical images (X-rays) to and from remote clinics, short transmission time is critical. The GALAXY/SPACEWAY™ system can dramatically reduce the retransmission time of important data by increasing transmission rates more than 140 times. The following chart displays this relationship between time, information content and bandwidth.

IMAGE	INFORMATION CONTENT	ORDINARY PHONE LINE	GALAXY/ SPACEWAY™ 384 Kbps	GALAXY/ SPACEWAY™ 1.5 Mbps
Digitized Photo	1.0 megabits	1.7 min	2.6 sec	0.7 sec
CAD/CAM	2.0 megabits	3.4 min	5.2 sec	1.4 sec
CT Scan	5.2 megabits	9.0 min	13.5 sec	3.4 sec
X-ray	12.0 megabits	21.0 min	31.3 sec	7.8 sec

SOURCE: Ascend Communications, "ISDN Service May Catch On, "*Forbes*," 12 October 1992.

Other examples of GALAXY/SPACEWAY™ applications include the transmission of high resolution video signals for educational and informational program distribution. High resolution video and multimedia files can be exchanged via GALAXY/SPACEWAY,™ transferring important medical information which can be interactively analyzed by world experts, and used to teach doctors in rural areas. Educational programming can be distributed internationally in real time, with professors teaching students interactively from multiple remote sites. In particular, GALAXY/SPACEWAY™ is uniquely suited to serve the educational needs of areas that are otherwise underserved because of their remote locations.

b. Video and Direct-To-Home Distribution

The entertainment industry will be able to use GALAXY/SPACEWAY's™ expanded FSS and BSS video distribution capabilities to distribute programming to cable headends and to transmit direct-to-home. This interconnected global system will offer many significant advantages over today's video distribution methods. Currently, cable programmers must use several earth-to-ground hops and procure an equal number of transponders to

distribute their networks worldwide. One cable network currently uses 15 separate transponders provided by 12 separate satellite service providers to distribute its programming globally. GALAXY/SPACEWAY™ greatly enhances the spectral efficiency of that video distribution network. The GALAXY/SPACEWAY™ system will allow that same programmer to avoid multiple hops, maintain signal quality and simplify the transmission scheduling process, while also reducing the programmer's ground infrastructure costs.

Figures C-1 and C-2 graphically demonstrate the significant efficiencies that GALAXY/SPACEWAY™ offers for cable distribution. Figures C-3 and C-4 show how GALAXY/SPACEWAY™ offers similar efficiencies for the distribution of special events of global and regional interest, such as a World Cup soccer event. Similarly, broadcasters will find GALAXY/SPACEWAY™ invaluable. The system will provide the ability to backhaul video to network affiliates and support satellite news gathering ("SNG") with one simultaneous transmission. Breaking news stories can be distributed worldwide in real time, thereby greatly accelerating the news dissemination process.

Programmers who target ethnic or other niche markets around the world also will benefit from the cost effective method of distribution that GALAXY/SPACEWAY™ offers. Purchasing transponders on numerous satellites to transmit a channel to distinct audiences across the globe is very expensive and involves complicated coordination. GALAXY/SPACEWAY™ greatly reduces transmission costs for the required ground infrastructure. Figures C-5 and C-6 depict the savings that GALAXY/SPACEWAY™ provides. These are just a few examples of the video markets that GALAXY/SPACEWAY™ can serve.

The specific applications provided by each of the GALAXY/SPACEWAY™ satellites will be determined by market demands. As those markets change and new

applications are developed, GALAXY/SPACEWAY™ will provide a flexible, comprehensively designed service platform to adapt to these new demands.

Figure C-1

Global Cable Distribution – 1995

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- 15 satellites used for program distribution alone
- Even more complex if program acquisition routing shown
- Multiple uplinks and antennas required

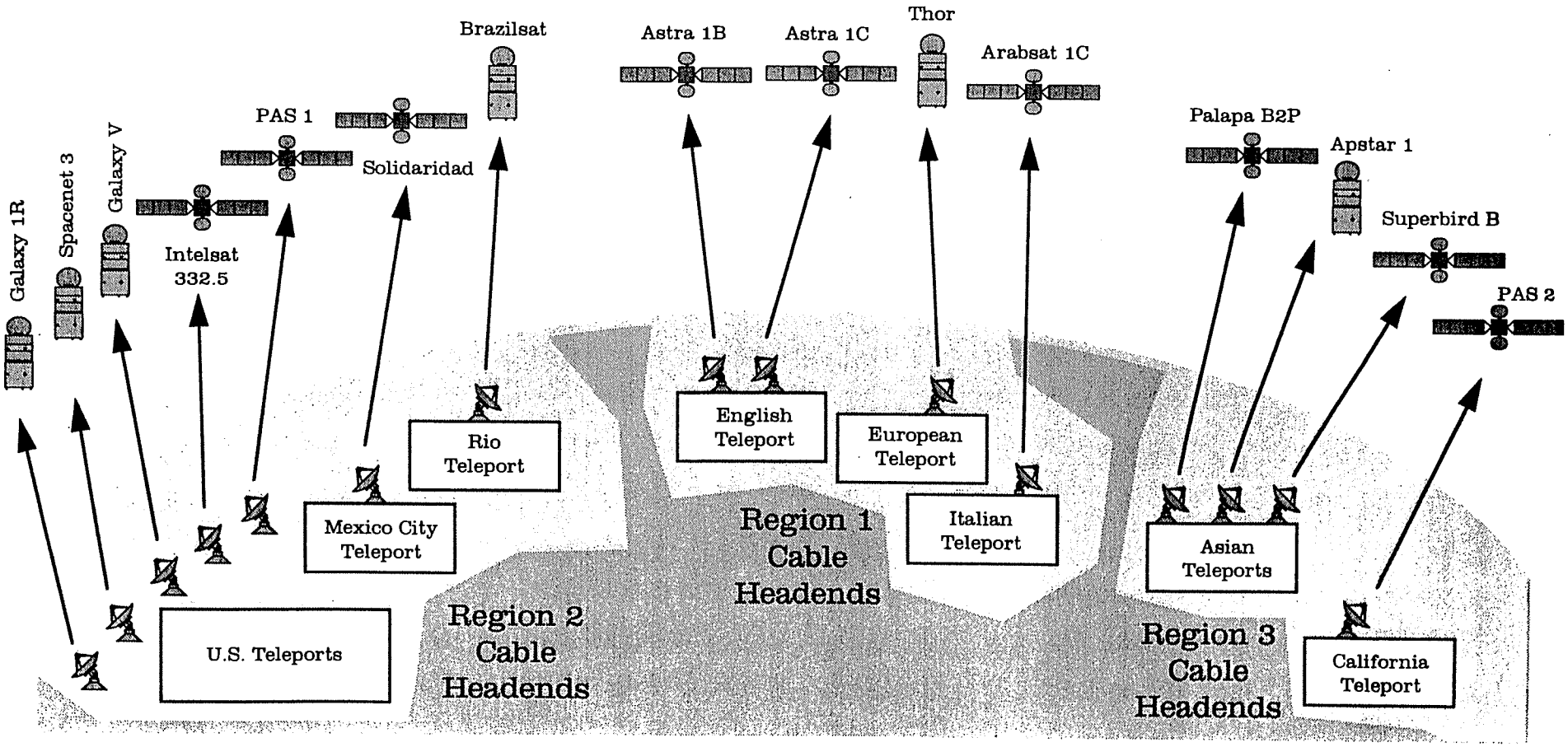

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Figure C-2

Global Cable Distribution via GALAXY/SPACEWAY™

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- Fewer satellites
- Easier coordination
- Regional interconnection

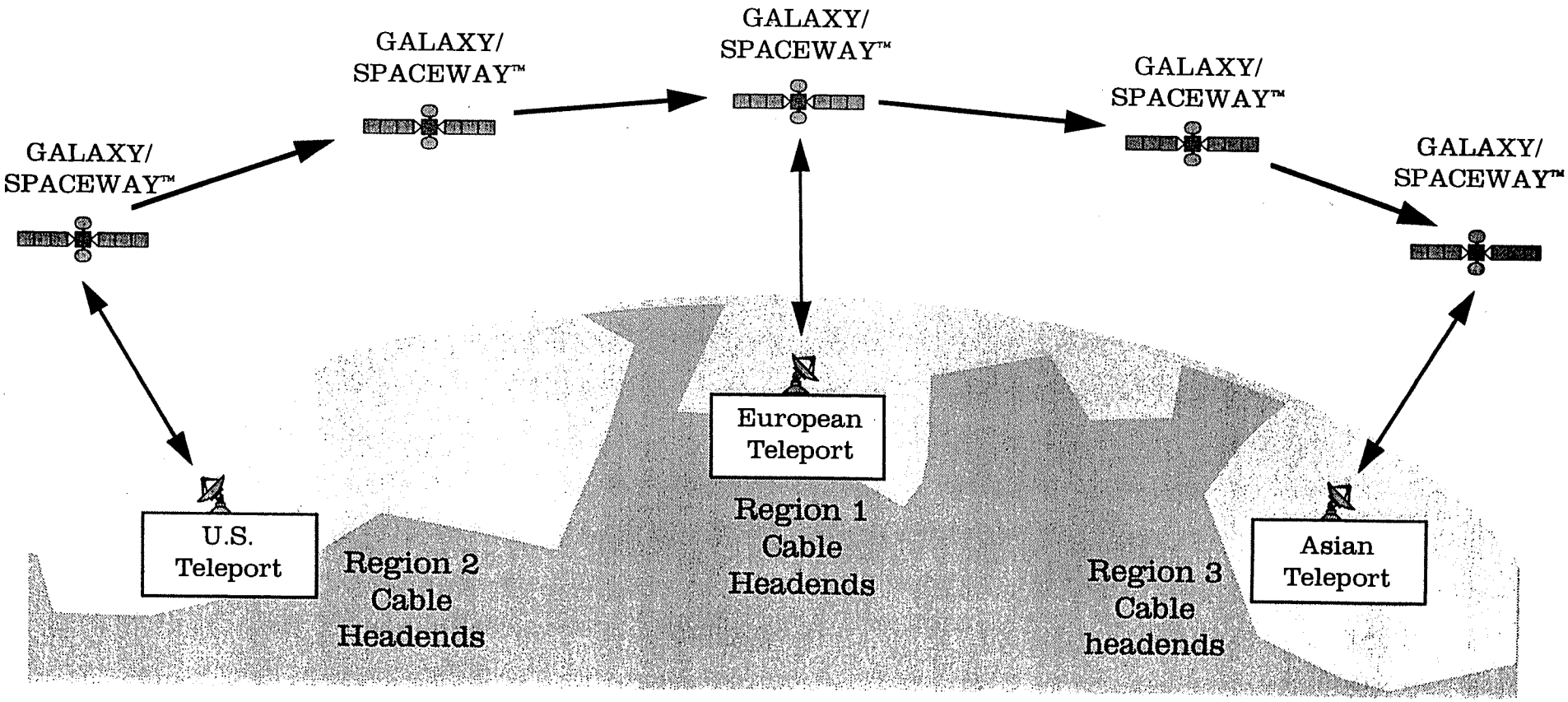

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Figure C-3

1994 World Cup Event

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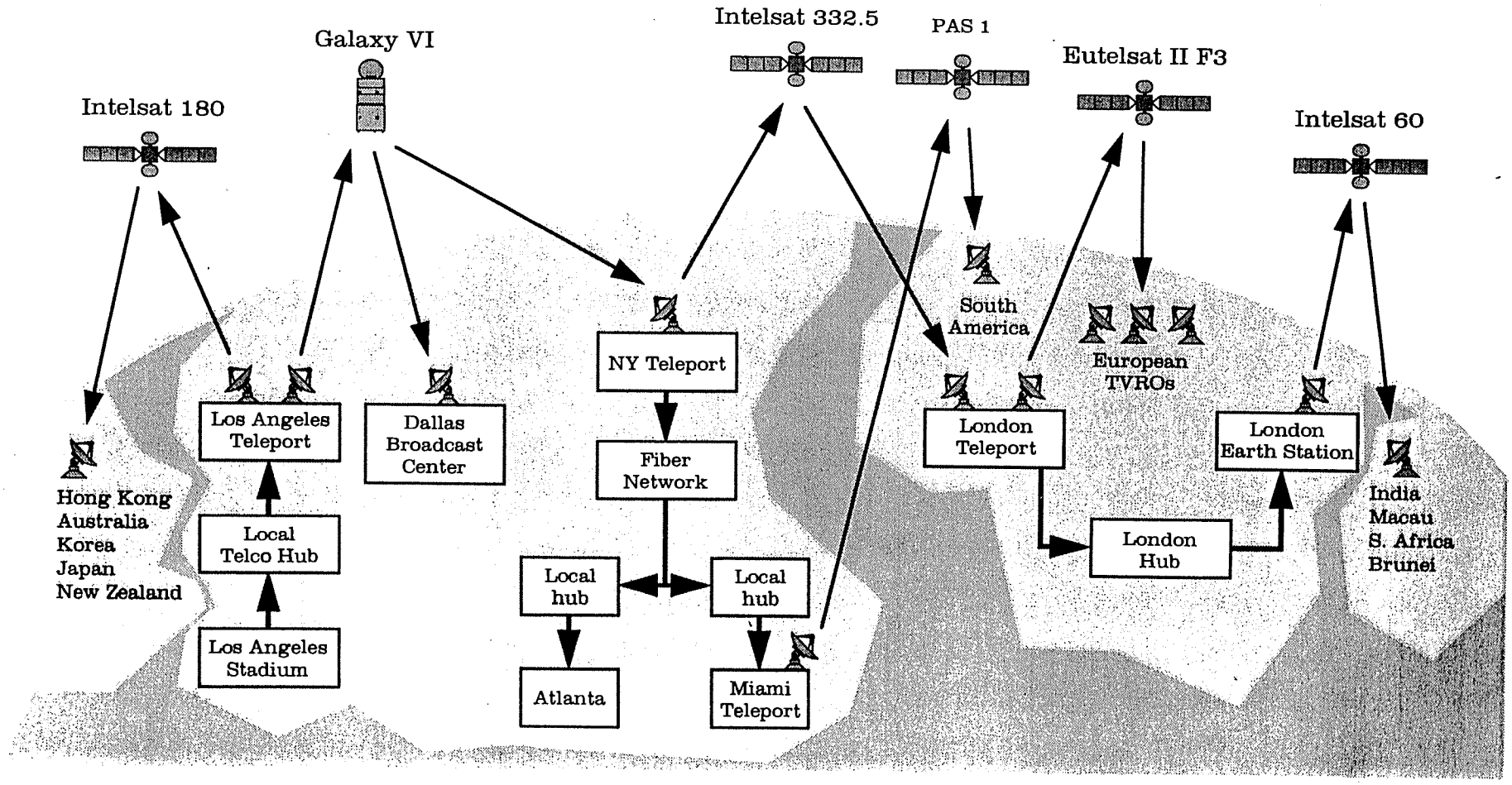

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Figure C-4

World Cup Event via GALAXY/SPACEWAY™

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- Each country could use distinct channel for national coverage
- Uplink to same satellite with one antenna

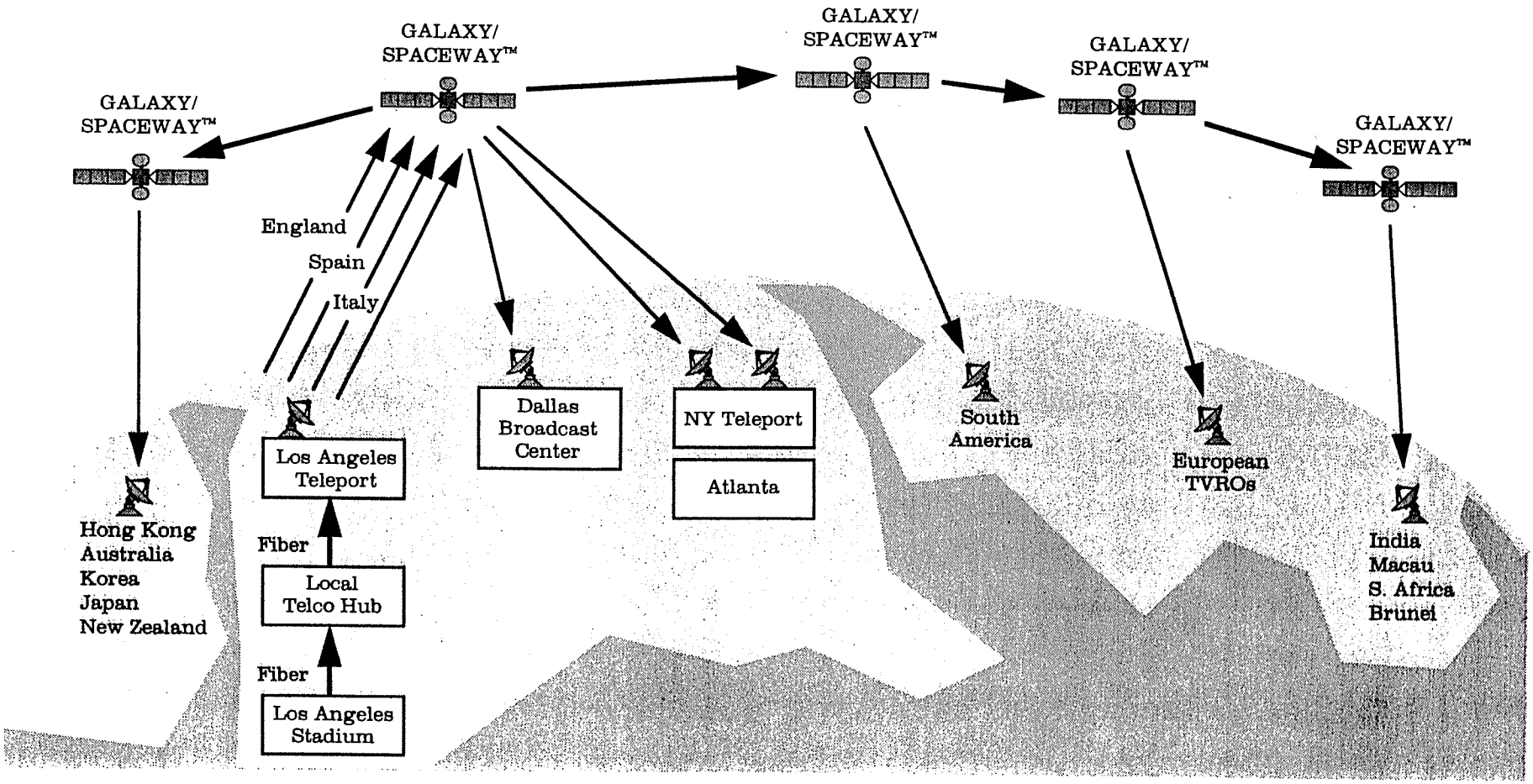

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Figure C-5

Worldwide DTH Distribution – 1995

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- Not affordable for many programmers (e.g., ethnic programmers)
- Multiple teleports and satellites used

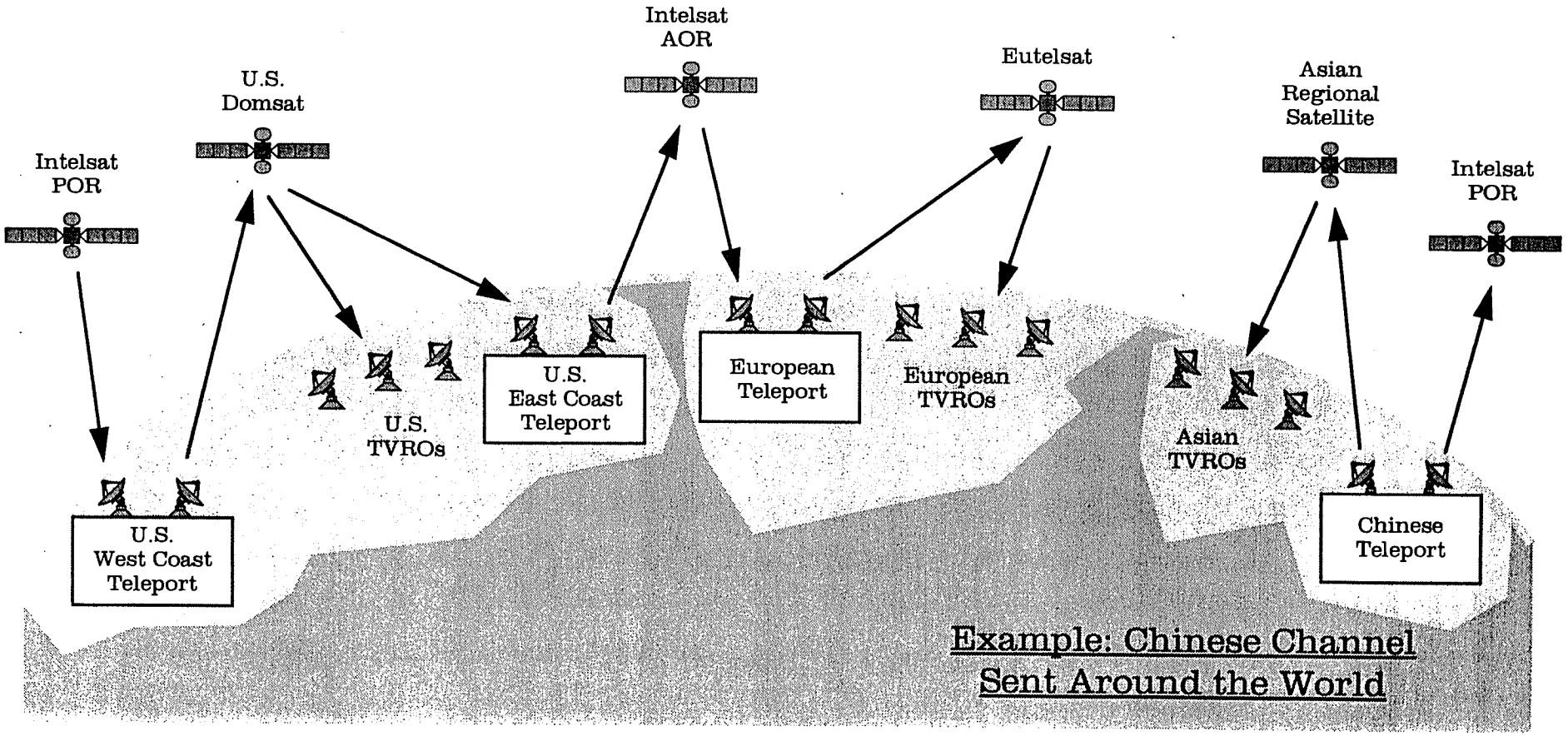

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Figure C-6

Worldwide DTH Distribution via GALAXY/SPACEWAY™

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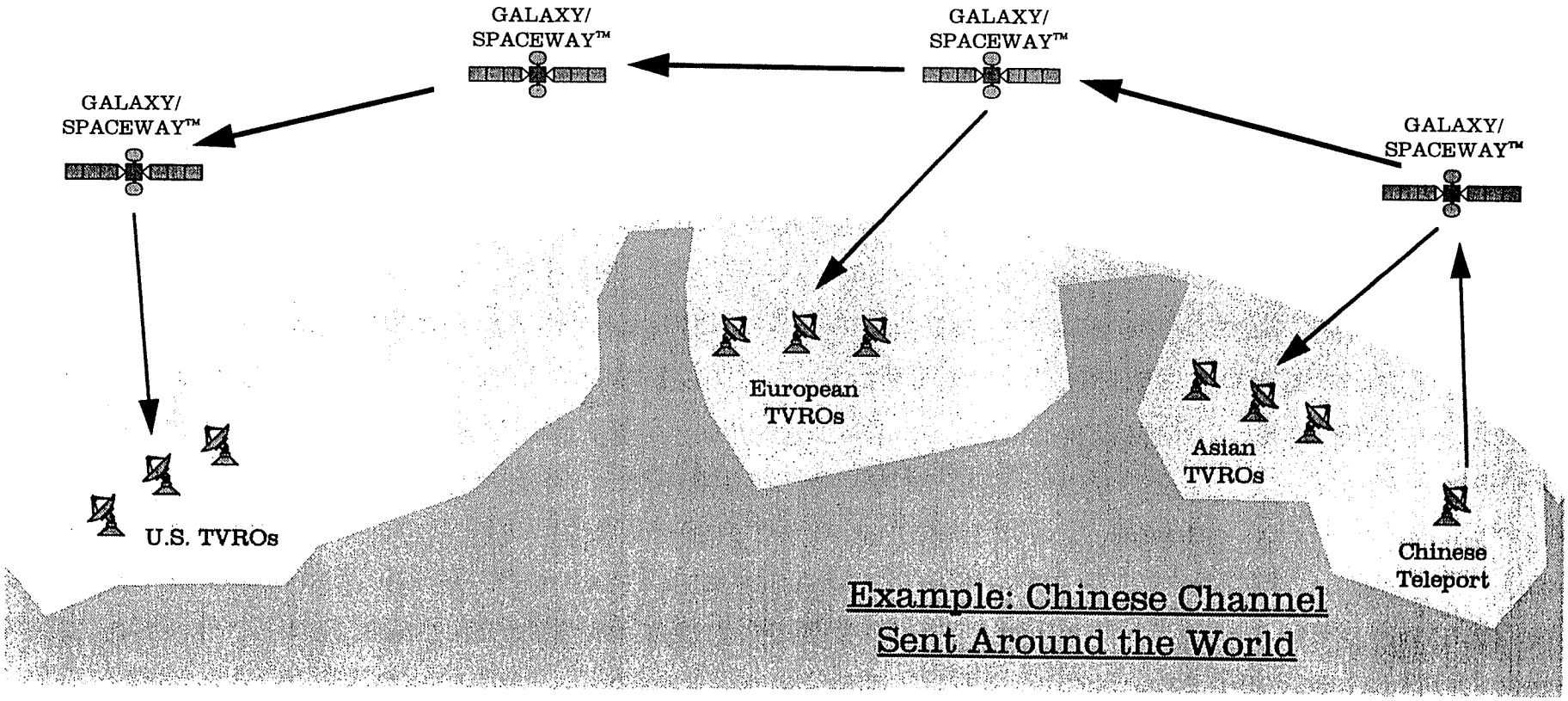
- Niche programming becomes viable on a global basis
- Necessary ground infrastructure and coordination greatly reduced
- Could use one SCPC channel



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3. Global Demand for GALAXY/SPACEWAY™ Services

a. The Market for Two-Way Telecommunication Services

Key technological advantages, such as mass-marketed low cost terminals and highly efficient use of frequency spectrum, make GALAXY/SPACEWAY™ well-suited for the provision of a full range of low and high-bandwidth communication services worldwide.

HCG's research and design efforts have confirmed that low data rate services, such as basic telephony, can be efficiently provided using GALAXY/SPACEWAY™. Thus, GALAXY/SPACEWAY™ will meet the substantial and growing demand for both improving the fundamental telecommunications infrastructure in countries worldwide, as well as the demand for high data-rate communications in more developed economies like the United States. Furthermore, as an interconnected global system, GALAXY/SPACEWAY™ is uniquely suited to meet the demand for international communication needs.

(1) Worldwide Demand for Telephony

Basic telephone service remains a scarce resource for most of the world's population. Whereas advanced telecommunications infrastructure in the U.S. and other highly developed countries provides 50-60 main telephone lines per 100 inhabitants, almost 80% (4 billion) of the world's population enjoys an average density less than 10 lines per 100 inhabitants. This unequal distribution of telephone capacity is illustrated in Figure C-7.

In many of these underserved areas, large portions of the population are waiting long periods for installation of customer premises equipment. Selected data on worldwide waiting times are shown in Figure C-8. Many countries have instituted aggressive plans to upgrade their infrastructures, including the use of modern technologies, such as digital cellular fixed wireless systems. Nevertheless, because these efforts are often subject to delay, a

satisfactory level of basic telephone service in many of the countries described will not be available for many years.

GALAXY/SPACEWAY™ will continue to offer an efficient and cost-efficient transmission system to facilitate the provision of telephony, facsimile and narrow-band data communications on a local, national or international level. Public telephone service can be delivered in any community through the use of existing pay phone technology and GALAXY/SPACEWAY's™ small terminals. Each GALAXY/SPACEWAY™ 1.5 Mbps earth terminal can support many public phones. Moreover, GALAXY/SPACEWAY™ can do this at costs that are competitive with conventional wireline and fixed wireless services in all but the highest subscriber density areas, and with even greater flexibility.

Figure C-7
Distribution of Telephone Capacity
Unequal Shares of Global Network
Telephone Main Lines per 100 Inhabitants, 1992

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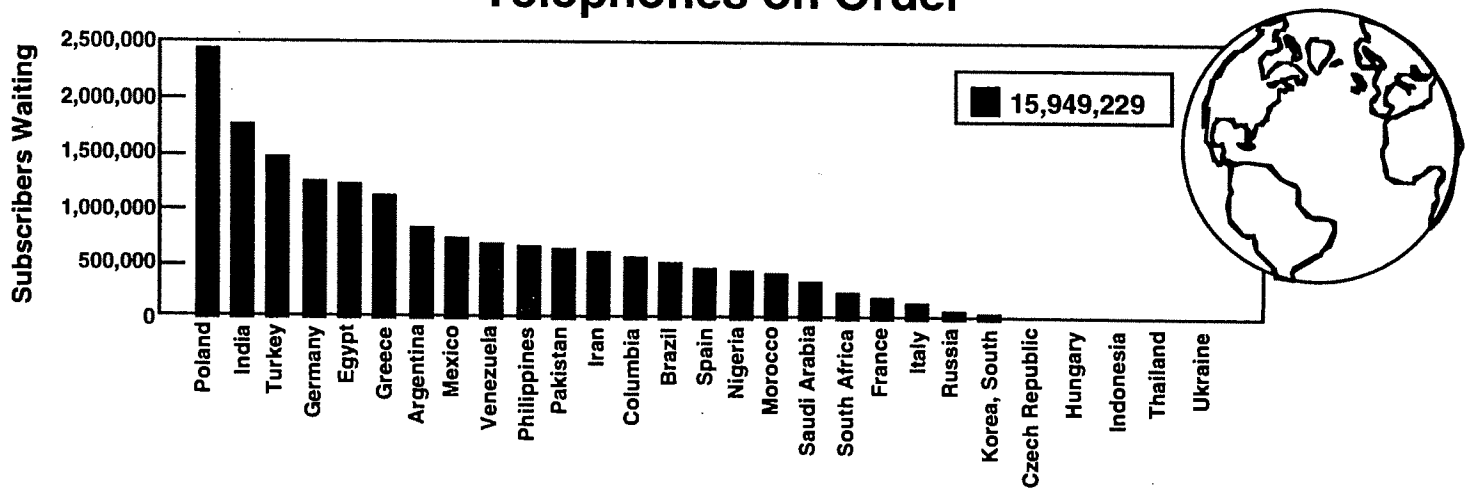
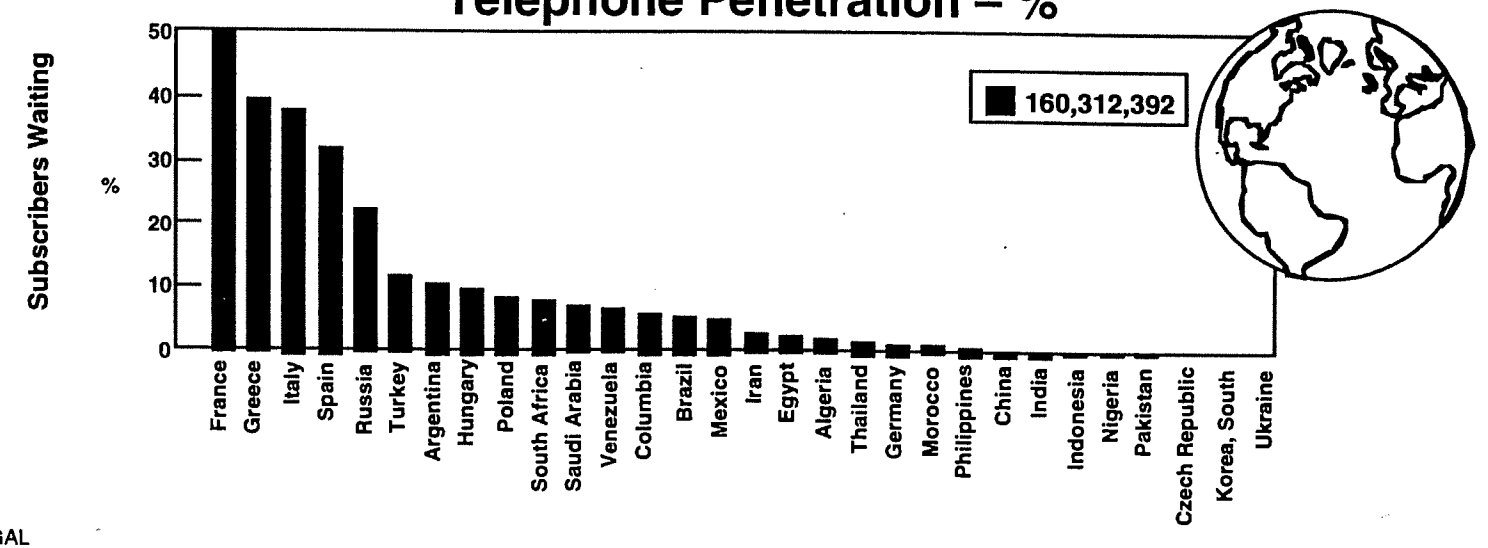
Figure C-8
Worldwide Waiting Times
International Telephone Penetration
Telephones on Order



Telephone Penetration – %



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(2) Demand for High Bandwidth Services and High Data-rate Communications

The GALAXY/SPACEWAY™ system will complement, as well as supplement, the services provided by terrestrial telecommunications networks worldwide. In the U.S., where local telephone companies, cable system operators and long distance carriers are engaged in the development of high capacity "full service networks," GALAXY/SPACEWAY™ will serve the needs of underserved areas, private network customers, and end-users in areas for whom the bandwidth-on-demand service will be economically attractive.

GALAXY/SPACEWAY™ will also serve a complementary role in many other countries that have well-developed telecommunications infrastructures, but where high bandwidth services are not uniformly available, such as those in Western Europe. However, in countries with underdeveloped telecommunications networks, GALAXY/SPACEWAY™ will make high bandwidth services available to millions of people in a time frame not otherwise achievable.

GALAXY/SPACEWAY™ will meet the communication needs of a wide variety of business and consumer end users. Many of these needs are evident today, and the market need for high data-rate communications will continue to grow significantly. Many factors are contributing to the strong growth in demand for high data-rate communications. For example, the deployment of high-speed communications facilities available to most home PC and many office PC users has not kept pace with the increase in speed and processing power of personal computers that has occurred in the past few years. As a result, limits within the existing telecommunications infrastructure restrict the ability of PC users to transfer and access large files in a timely fashion.

The proliferation of computers and video telephony equipment, and a concomitant trend toward distributed work habits in many businesses are in themselves increasing the demand for access to high data-rate communications services. For example, a significant proportion of the U.S. work force conducts its work activities from home. This "work-at-home" market of approximately 40 million homes includes self-employed individuals as well as "telecommuters." The telecommuting segment of the work-at-home market now represents approximately 7 million households and is estimated to grow at an annual rate of 10%. These users consist largely of business professionals, many of whom utilize a personal computer to access documents via office local area networks and to work collaboratively with other PC users at the office. The trend toward work-at-home, and telecommuting in particular, will increase demand for high data rate communications as home- and office-based workers engage in video-teleconferencing and work collaboratively through computers.

Indeed, HCG anticipates that many home PC users and on-line subscribers will seek higher speed communications links, such as GALAXY/SPACEWAY™, in order to enhance their productivity, and in order to effectively transmit and receive increasingly large multimedia files which could not otherwise be accommodated over the existing telephone network. The following Table C-1 illustrates the growing projected market for home computer and for on-line services:

Table C-1: Projected Market for Home Computers & On-Line Services

	1993	1995	1997
Home PCs	31 M	38M	45 M
Home PC/Modems	13 M	18M	21 M
On-Line Services Subscribers	4 M	14M	16 M

(Sources: "Surveys, Forecasts and other Data Bearing on Potential Demand for A Proposed Satellite Communication Service," *Link Resources,* 20 January 1994 and , "1995 SPACEWAY™ Services Demand Study," *Hughes Communications,* June 1995.)

Although terrestrial services, such as ISDN, are being deployed to meet high-speed data transmission requirements, these services will not be universally available. Moreover, both the cost and logistics of constructing a high-speed terrestrial data network to serve subscribers throughout the world are prohibitive. As a result, substantial numbers of prospective end users – especially those in suburban and rural residential areas – will be underserved by the terrestrial network. The GALAXY/SPACEWAY™ system is designed to meet the voice, video and data transmission requirements of these end users cost-effectively by providing necessary telecommunications services, where such capabilities are unavailable via terrestrial facilities.

Another source of consumer demand for GALAXY/SPACEWAY™ services will be personal video telephony. Until the development of the GALAXY/SPACEWAY™ system, a high quality video phone service has not been available for universal consumer use. The terminal equipment has been too expensive and the necessary high speed communications facilities have not been available to individual residential consumers. By offering low cost terminal equipment and ubiquitous high speed transmission via satellite, HCG anticipates

significant consumer demand for video telephony. Research conducted by Bellcore indicates that 2% of all respondents "would probably" purchase a video telephony service at a terminal cost of $1000 and monthly service charge of $50. Assuming 2% of the 96 million U.S. households purchased GALAXY/SPACEWAY,™ the system would have approximately 2 million customers. HCG believes that this estimate of demand is conservative, because, as mentioned, the proliferation of computer-based video conferencing equipment in the workplace will further stimulate consumer demand.

Additional sources of demand are private business VSAT networks, which are currently used to meet the internal data and video transmission requirements of corporations and other organizations. VSAT networks are now an accepted component of the telecommunications infrastructure, with an estimated 200 networks and over 80,000 terminals installed within the U.S. (Hughes Network Systems, a Hughes affiliate company, is the leading U.S. supplier of VSAT networks). These networks, which primarily use Ku band FSS satellite capacity, serve a variety of user industry segments, including financial services, insurance, auto manufacturing, retailing and petroleum. While traditional Ku band VSAT networks typically are economically justified for users with multiple locations (often hundreds and occasionally thousands of sites), HCG anticipates that the low cost Ka GALAXY/SPACEWAY™ terminals and on-demand access to channel capacity will allow a broader range of users to utilize Ka band VSAT technology, thereby greatly enlarging the market for satellite services.

In sum, HCG anticipates that the GALAXY/SPACEWAY™ system will meet communications needs of a wide variety of business and consumer users evident today, and will satisfy the market need for high data-rate communications that are expected to grow significantly tomorrow. Each GALAXY/SPACEWAY™ satellite has a capacity of

approximately 11,500 simultaneous full duplex 384 Kbps channels. Because most customer usage is likely to be occasional, frequent channel reuse will be possible. Thus, the system will be able to accommodate a very large customer base. Based on HCG projections of how many customers can be served adequately during peak periods, HCG estimates that GALAXY/SPACEWAY™ will be able serve more than 5 million high speed access users.

b. The Market for Video Distribution Services

The most innovative addition to GALAXY/SPACEWAY™ is its comprehensive video distribution capability. The tremendous popularity of the DBS services offered by another Hughes company, DIRECTV™, and other recent marketplace developments, reflect the enormous growth of domestic and international demand for digital direct-to-home services. In addition, distributing video programming through satellites is an integral part of HCG's current customer needs, and customer demand for increased capacity and distribution capability worldwide is growing at a staggering rate. HCG has expanded the GALAXY/SPACEWAY™ system to offer all of these services to business and residential consumers on a global basis.

With the advent of higher-powered satellites and video compression technology, small receive antennas can today be used to receive hundreds of channels of programming directly into the home via satellite. In the United States, perhaps the most dramatic success story in the multichannel video marketplace over the past year has been DIRECTV™, which has three DBS satellites co-located at the 101° W.L. orbital position. Using small 18-inch antennas, DIRECTV™ today delivers approximately 175 channels of digital entertainment, informational and pay-per-view programming directly to households located throughout the entire continental United States ("CONUS"). Although DIRECTV™ has been in service only

since early 1994, it presently has over 800,000 customers, and is expected to have 3,000,000 customers by the second half of 1996.

Given the enormous domestic success of DIRECTV™, HCG has already formed local partnerships in several countries to offer DIRECTV™ in Latin America, and is preparing to face potentially vigorous competition in this emerging DTH market. News Corp., Inkari and other providers have announced imminent plans to offer Latin American DTH service. NahuelSat S.A. of Argentina also has been selling DTH service in Argentina, Chile, Uruguay and southern Brazil since 1994.

The popularity of DTH services in Europe is well established. DTH transmission has been very successfully employed by the Societe Europeanne des Satellites (SES) over the Astra system of satellites. The first Astra satellite was launched in 1988 and SES has now ordered an eighth satellite to be delivered in 1998. Astra's penetration into the European market is now close to 20 million households.

All of these developments have led Hughes to develop advanced capabilities on GALAXY/SPACEWAY™ to expand and market the direct-to-home concept on a worldwide basis. Even as far back as 1982 when BSS Region 2 frequencies were allocated and licensed for United States DBS service, then-Chairman Mark Fowler observed that a worldwide system of DBS satellites "linking all people to all lands is not beyond the power of DBS." DBS Report and Order, 90 FCC 2d 676, 728 (concurring statement of Chairman Mark S. Fowler). GALAXY/SPACEWAY™'s innovative use of BSS frequencies to offer a variety of different constituencies across the world access to comprehensive video distribution capabilities and service offerings fulfills with that vision.

A unique feature of the GALAXY/SPACEWAY™ direct-to-home capability is the system's ability to meet demand for more localized program content. Like many other DTH systems, GALAXY/SPACEWAY is capable of providing wide-area BSS beam coverages that may be used to offer programming on a national or regional basis. In addition, however, the system's narrow Ka band spot beams permit more localized video service that can be tailored to the needs of populations in smaller countries or cities.

A variety of market forces are also spurring increased demand for satellite capacity to distribute video programming on a regional or global basis. One example is the rapidly growing but underserved market for ethnic programming. The global movement of people is a modern phenomenon. As people emigrate to work and live in other countries, many desire to keep abreast of what is happening in their homelands and to be informed and entertained in their native languages. Correspondingly, programmers need a way to reach these people in their relocated environments.

Three examples are the Filipino, Japanese and Chinese populations living abroad. The Filipino community currently has an estimated 3.5 million workers living abroad in some 140 nations[1]. 2.5 million Japanese emigrants and their descendants are estimated to be living abroad[2], while the number of overseas Chinese is between 30 and 40 million[3]. Presently, multiple satellite transmissions are required to serve these discrete populations and many people remain unserved or underserved. International programmers currently use HCG's domestic satellite fleet to provide foreign language programming in the United States,

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[1]Inter Press Service, March 9, 1995.

[2]Asahi News Service, Nov. 17, 1993.

[3]The Christian Science Monitor, March 23, 1994.

but must use multiple satellite resources and ground facilities for worldwide distribution. GALAXY/SPACEWAY™ provides a unique method to simplify this process and meet the needs of these specialized markets.

4. Operations and Ground Infrastructure

The GALAXY/SPACEWAY™ system will utilize several types of ground communications equipment. The end user terminals that are the heart of the system will accommodate one-way direct-to-home broadcast reception as well as bi-directional data and video transmissions up to 1.5 Mbps rates, using antennas ranging from 45 centimeters to 1.2 meters in diameter. Consumers desiring direct-to-home video services only can be served with 18 inch (45 cm) antennas similar to those used for the DIRECTV™ services in the United States. With a slightly larger antenna, just 26 inches (66 cm) in diameter, a more sophisticated receiver/decoder consumer unit can receive the same video entertainment services as well as perform high-data rate two-way communication functions.

The system will allow both "private" network and "open" network communications. Private networks could be created where GALAXY/SPACEWAY™ terminals in a predefined "community" communicate with each other directly via a GALAXY/SPACEWAY™ satellite, with or without connections to the PSTN. Open networks allow GALAXY/SPACEWAY™ subscribers to connect with any other subscriber or with any other person or entity served by the PSTN through a GALAXY/SPACEWAY™ "connection point." GALAXY/SPACEWAY™ terminal equipment and communications formats will be compatible with terrestrial standards to allow this connectivity to occur in an efficient manner.

HCG anticipates that regional broadcast centers will be constructed for packaging and transmission to GALAXY/SPACEWAY™ satellites for broadcast to customers via Ku band. Alternatively, pre-packaged programming may be sent via intersatellite link at Ka band and cross-strapped to Ku band for distribution directly to consumers.

HCG anticipates that projected demand for GALAXY/SPACEWAY™ DTH services will be large and that it will be necessary and desirable to mass-market the GALAXY/SPACEWAY™ terminals to end users worldwide. Hughes Network Systems, an affiliate of Hughes that manufactures VSAT terminals and DTH integrated receiver/decoders today, can produce GALAXY/SPACEWAY™ terminals for the commercial market, and other consumer and commercial communications electronics manufacturers will likely produce those terminals as well. GALAXY/SPACEWAY™ terminals will be widely available in consumer and industrial retail outlets. HCG anticipates that all of these transmit and receive earth stations/terminals will be owned by the end users for the service.

Installation procedures for commercial GALAXY/SPACEWAY™ terminals should be similar to those for VSAT or DIRECTV™ terminals today. Although consumer terminals, especially those utilizing a 45 cm or 66 cm antenna, may be easily installed by end users, many consumers may wish to use the services of professional installers.

HCG plans to make capacity on the GALAXY/SPACEWAY™ satellites available through sales and non-common carrier leases, pursuant to the Commission's decision in Domestic Fixed-Satellite Transponder Sales, 90 FCC 2d 1238 (1982), aff'd sub nom., World Communications v. FCC, 735 F.2d 1465 (DC Cir. 1984), and HCG may form partnerships or strategic alliances with other companies to offer GALAXY/SPACEWAY™ services. HCG anticipates that most end users will obtain GALAXY/SPACEWAY™ services through retail

telecommunications providers, such as interexchange carriers, local exchange carriers, competitive access providers, and PTT's, each of whom will acquire "bulk" GALAXY/SPACEWAY™ capacity from HCG and resell it in smaller units to individual users. These types of retail providers already have well-developed name recognition and local presence with consumer and commercial customers, and are well suited to provide retail marketing of the GALAXY/SPACEWAY™ services.

5. Satellite System Description

The GALAXY/SPACEWAY™ system will consist of a space segment and a ground segment. The space segment will consist of a system of 20 satellites in 15 orbital positions. These satellites will be capable of being launched by one of the currently available commercial launch vehicles. Each satellite will be maintained in geostationary orbit (to a tolerance of $\pm 0.05°$) and at zero orbital inclination (with a tolerance of $\pm 0.05°$). The satellite system will provide global coverage.

GALAXY/SPACEWAY™ will provide both "bandwidth on demand" high capacity two-way and the world-wide distribution of programming to cable networks and direct-to-home consumers. The "bandwidth on demand" two-way communication links will be provided at Ka band. Distribution of cable network programming will utilize Ka band uplinks and downlinks in the fixed satellite service frequencies, and Ka and/or V band intersatellite links. Direct-to-home services will be provided in the Ku band broadcast satellite service frequencies using regional programming uplinks. Each satellite will be able to communicate directly with other satellites through intersatellite links, thereby obviating the need for multiple satellite hops.

In addition to the end-user owned terminals described above, the GALAXY/SPACEWAY™ ground segment will consist of:

(i) Earth stations to perform the necessary telemetry, tracking, and command functions for the spacecraft,

(ii) An Operations Control Center (OCC) to command and control the satellites; and

(iii) A Network Control Center (NCC) to control signal routing and resource assignment on board the satellites.

HCG already employs a sophisticated network of earth stations to perform TT&C. HCG owns and operates the Operations Control Center (OCC) in El Segundo, California, where the complex coordination and integration of the space and terrestrial segments of the HCG C band and Ku band satellite network are focused. The Hughes Mission Control Center (HMCC) directs the launch through transfer orbit and on orbit activities of all Hughes spacecraft and performs subsystem testing once the satellites are in their respective geostationary positions. Once operational, the spacecraft are station-kept and controlled from the OCC.

In HCGs' current operation, telemetry data from the satellites are received by TT&C earth stations in Spring Creek, New York, Castle Rock, Colorado and Fillmore, California. This information is then transmitted to the OCC over leased lines where it is processed, archived, and analyzed. Commands to control the spacecraft are issued from the OCC and subsequently routed to the TT&C earth stations for processing and uplinking to the satellites. Although the earth stations are under the overall control of the OCC, each earth station may operate independently of the OCC, if necessary. A 24-hour backup OCC is also available at the Fillmore TT&C earth station.

HCG's existing TT&C stations and the OCC will be modified to provide the necessary services for the GALAXY/SPACEWAY™ satellites. Vital command and telemetry functions will be handled via earth stations located around the world or alternatively through the intersatellite link.

All GALAXY/SPACEWAY™ signal switching and routing will be controlled and monitored by the NCC in the United States, which will maintain and optimize the configuration of the network in order to ensure quality service and maximum availability. Among other functions, the NCC will: (a) allow end users to request and reserve link setups (b) provide authorization and access to the satellite.

ITEM D. General Technical Information

1. Satellite Operational Characteristics

a. Frequency Plan

The GALAXY/SPACEWAY™ global network will use the Ka band to provide fixed satellite services, such as bandwidth-on-demand communications and video distribution. The network will use the 17.7 - 20.2 GHz portion of the Ka band for space-to-earth (downlink) transmissions and the 27.5 - 30.0 GHz portion of the Ka band for earth-to-space (uplink) transmissions.[4] Maximum spectral efficiency is achieved by utilizing frequency reuse through orthogonal polarizations and spatial separation between beams. The entire 2.5 GHz of Ka band spectrum is allocated on a worldwide basis for the Fixed Satellite Service (FSS), but it will be under review for reallocation at the World Radio Conference in October 1995

[4]In North America 1 GHz of spectrum (29.0 - 30.0 GHz for the uplink, 19.2 - 20.2 GHz for the downlink) will be used. HCG adopted this configuration in July 1994 to plan for the likelihood that LMDS and the GSO FSS services could not share the same spectrum on a co-frequency basis.

(WRC-95). HCG plans to reconfigure GALAXY/SPACEWAY™ Ka band frequency plan, as necessary, to be consistent with the decisions of WRC-95 and the Commission's pending 28 GHz rulemaking. A summary of the GALAXY/SPACEWAY™ proposed frequencies is given in Table D-1.

The Ka band services are described using two different earth coverages: high powered narrow beams and wide area beams. An associated frequency and polarization plan is presented in Figure D-1.

High Powered Narrow Beams

For the high power narrow beams, each orbital location over each region will employ up to a total of forty-eight 125 MHz spot beams for uplink and downlink communications (twenty-four in each polarization) for each 500 MHz band. The narrow spot beams allow each satellite to effectively reuse the 500 MHz of spectrum assigned to it approximately 12 times.

Wide Area Beams

The system employs two types of wide area beams. First, for bandwidth-on-demand two-way services, the system can offer 125 MHz wide-area spot beams that will be well suited for coverage of sparsely populated areas. Second, for video distribution services the system can employ up to 24 transponders of 36 MHz each on wide area beams. Each wide area beam has dual polarization for frequency reuse to efficiently use the Ka band spectrum. Any portion of the Ka band spectrum can be allocated to either size beam according to market demand.[5]

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[5]The entire 2.5 GHz has been requested at Ka band for each orbital location. HCG acknowledges that other Ka band systems exist or have been filed for and coordination may require loss of some of the requested spectrum.

TABLE D-1 GALAXY/SPACEWAY™ Frequencies

Service	Uplink Frequency (GHz)	Downlink Frequency (GHz)
Ka band FSS	27.50-30.00	17.70-20.20*
Ka band FSS (N. America Only)	29.00-30.00	19.20-20.20
BSS - Region 1	17.30-18.10*	11.70-12.50
BSS - Region 2	17.30-17.80*	12.20-12.70
BSS - Region 3	17.30-18.1*	11.70-12.20
Ka band ISL 1	22.55-23.55	32.00-33.00
Ka band ISL 2	32.00-33.00	22.55-23.55
V band ISL 1	54.25-58.20	59.00-64.00
V band ISL 2	59.00-64.00	54.25-58.20

* A frequency overlap exists between Ka FSS receive and Ku BSS transmit. This overlap will be addressed on an individual orbital location basis as necessary.

The GALAXY/SPACEWAY™ global network also uses the Ku band spectrum in accordance with ITU Radio Regulation Articles 15 and 15A (BSS Plan). In particular, the 11.7 - 12.5 GHz (in Region 1), the 12.2 - 12.7 GHz (in Region 2) and the 11.7 - 12.2 GHz (in Region 3) portions of the Ku band will be used for direct-to-home broadcasts (space-to-earth direction). The 17.3 - 18.1 GHz portion of the Ku band will be used for the associated feeder links (earth-to-space direction) for Regions 1 & 3 and 17.3 - 17.8 GHz for Region 2. Frequency plans are included in Figures D-2, D-3 and D-4. Frequency reuse is also employed at Ku band by using both polarizations, making efficient use of the frequency spectrum. The Ku band BSS frequency plan uses transponder bandwidths of 24 MHz in Region 2 so that 32 transponders can be accommodated in 500 MHz. In Regions 1 and 3 the BSS plan requires transponder bandwidths of 27 MHz, allowing a total of 40 and 24 transponders within 800 MHz and 500 MHz respectively. For Region 3, the earth-to-space frequency band is 800 MHz wide (17.8 - 18.1 GHz), while space-to-earth has 500 MHz (12.2 - 12.7 GHz). HCG requested

the entire uplink band as specified in the Radio Regulations, Article 8, RR8-150 (Orb-85), footnote 869, in order to be consistent with the BSS Plan and to allow for frequency flexibility during coordination.