KaStarcom will also foster the development and successful marketing of the video–phone system, long a favorite of the science fiction stories but, until now, stymied by the complete lack of broadband communications links to every home and office. Granted there have been a few slow scan systems developed which would work over the copper phone line system, but their blatantly limited image performance and their high expense destroyed their public appeal. By providing a sufficiently broadband channel capability to every geographic point in the US and at an appealingly affordable market price, KaStarcom will eliminate the only real barrier to the video–phone's successful development and marketing. Although Bellcore's research has showed perhaps 2% of the public would probably pay $1000 for a video–phone terminal plus $50 per month for the service, their research results were very likely skewed by the high prices they were using for their model. The situation is analogous to the development of CD players: the first models were very expensive and only a small percentage of the population initially bought them despite their superior audio quality. But the costs quickly tumbled as the designs and production methods were improved, and then the market demand increased exponentially. We would expect the same thing to happen with video–phones, rendering the present market estimate of 2% of the 96 million US homes, or 2 million subscribers, merely an "entry estimate" and, therefore, very conservative. In fact, if the video–phone terminal price could be brought down to the $100 level — a factor of ten reduction from the Bellcore model — we would fully expect every household which now has a normal audio phone would install the video version.

II.A.3.b.5 Distance Learning

Distance learning can bring the best teachers in a nation to all students. Picture for a moment, the vision of schools and libraries throughout America linked to each other by a network of wired or wireless paths. What flows over the pipe is not just transmissions of data or voice, but moving video images that will capture a child's interest and imagination.

Instead of a high-school French class repeating taped phrases syllable-by-syllable before a teacher, American and French students could team up interactively through a real-time video link and build their French and English language skills together. What a great way to promote cultural understanding between our children!

Moreover, the Information Superhighway can connect every school and library in the world to create a Global Digital Library, so every child has the riches of a world's library at the click of a computer mouse.

II.A.3.b.6 Telemedicine

Telemedicine will allow a patient to be examined by a far-away medical specialist via video conference. X-rays and CAT scans can be delivered via high-speed data lines. This will lower health care costs and improve the quality of care.

II.A.4 THE MARKET AND DEMAND FOR KASTARCOM SERVICES

The previous section on the Potential Market for KaStarcom has provided many of the details on the market which shows there is a demand for the KaStarcom services. KaStarcom World Satellite LLC anticipates the KaStarcom system will meet the communications needs of a very broad spectrum of business and consumer end Users. As has already been shown, and is illustrated in Figures VIII.A.1.1 and VIII.A.1.2, many of the needs for a high rate communications service are evident today and will only continue to grow in the future. In many ways this is a circular process: the demand is fueled by the availability of broadband capacity and the broadband capacity is developed to meet the demand. But one of the real drivers is the American talent to invent innovative and immediately popular and useful applications to use the increased broadband capacity as it becomes available. So even if there were not already so many proven applications for the broadband capacity, this American talent would certainly conceive and produce innovative applications which require it.

So, for example, personal computers have increased in processing speed and memory capacity while the applications software has increased in sophistication and capability to use that processor power and memory. There is no such thing as too powerful a processor or too much memory. And one of the more important software and computer hardware developments is the field of networking and telecommunications. Unfortunately, the communications links available to most homes and to many businesses do not match these root communications capabilities, imposing an artificial bottleneck on the use of the available computing tools to their full capability. The effect of this is to decrease the efficiency of the business operations using these tools.

Similarly, video-conferencing equipment has rapidly evolved over the past ten years so that "desk top" versions are now readily available with superior performance to their large and expensive, dedicated room predecessors. Many of these new versions actually consist of plug-in expansion cards for PC's, thus presaging the integrated office of the ISDN standard. Clearly, the rapid and increasingly widespread adoption of this equipment for conducting business meetings without the previous travel expense or loss of time in traveling means there will be an increasing demand for communications links capable of carrying the associated high speed data. Thus the completely inadequate copper telephone lines will be completely replaced by fiber and other high rate data transmission services such as KaStarcom.

The spread of the video-conferencing equipment and services will also drive the development and spread of the video-phone discussed earlier. Both require the same broadband communications links and, to a large extent, can share the same equipment — a PC integrating the video-conference and video-phone equipment as plug-in cards is not a far fetched idea and is analogous to the integration of PC, phone, fax and data modem already current in many homes and most offices. And, of course, these developments will be tied to the economic availability of high rate communications links.

We have already alluded to the increasing acceptance of the "telecommuting" office worker working from home as an employee of a firm. The current estimate of 9 million telecommuting households is estimated to be growing at 38% per year, and the only real throttle on the growth of this sector is the limited availability of terrestrial high speed links to most homes. KaStarcom will effectively remove that brake for any household which can afford to purchase the necessary VSAT, and that equipment will be mass produced and sold through the major stores and other retail chains at very acceptable prices. Hence, we expect a very strong demand for the services from this domestic (and business) market.

Therefore, KaStarcom believes the size and scope of the market for high rate, broadband communications services both now and in the future more than justify the production of the KaStarcom system covered by this application for license. The capacity of the system in terms of numbers of subscribers will depend on the required user channel data rates (T1, T2, etc.). At the lowest rate of 384 kbps, the capacity will be in the range of 19,800 simultaneous duplex channels. The subscriber usage base will be much larger than this because of the infrequent usage of a channel by an individual subscriber, around one million users in peak periods — the actual number of KaStarcom service *subscribers,* as distinct from actual *users* at any instant, will be in the multiple millions. This *user* base (and, consequently, the subscriber base) can be easily increased by the launch and co-location of additional satellites in the requested orbital slots, to a total of five satellites per slot, which would completely use the 2,500 MHz of available Ka-band spectrum for each location. This would increase the possible user base by 500% to some four to five million users.

II.A.5 OPERATIONS AND MARKETING

The KaStarcom system design is very unique and distinct from the current C- and Ku-band FSS satellite systems:

- a baseband processor and a fast microwave switch matrix for traffic processing, switching and routing

- a system of overlaid and overlapping small spot beams for maximum coverage

- two separately located satellites inter-connected by a microwave inter-satellite link.

Therefore, the operations and marketing will be subtly different as well.

Because the system provides 100% complete coverage of the USA, any User of the system can directly access any other user without having to make a double hop and without having to go through the PSTN. That is, the system provides open network communications to all its users. Since the data packet header address is used for the routing decisions by the payload BBP on-board the satellite, then these communications are in every sense analogous to the Internet with each User being assigned a unique "name" which defines location and other communication parameters; in fact, there is no reason that this "name" could not be identical to the User's Internet name in a truly integrated and global communication system. KaStarcom would publish a directory of users to facilitate these direct connections.

Of course, KaStarcom users could also communicate with PSTN users in the same open network environment by including a PSTN hub in the net. In fact, this mode will probably be more frequent than the non–PSTN mode, at least in the early years of the system. The direct system users in this mode could be homes and businesses who are not adequately served by the terrestrial phone system in terms of high speed data communications, possibly because they are in a rural location. Thus, the space system will fill–in the holes in the terrestrial system. In this respect, the two systems will be complementary and synergistic. The only consequent requirement on the KaStarcom system is to make the terminal equipment and communications protocols compatible with the PSTN standards at the access trunk/channel level.

The success of the KaStarcom system will be enhanced by the availability of inexpensive User terminals. Hence, we will be working with established suppliers of ground terminal equipment and VSAT's to design and mass produce suitable terminals. The idea is these terminals will be mass marketed by the vendors through chain retail stores such as Radio Shack and Sears, and through mail order houses. The installation will be no more difficult than for a current VSAT and could be performed easily by any competent do–it–yourselfer or by any of the many VSAT installation professionals already in this business.

KaStarcom intends to market the KaStarcom system capacity through sales and non–common carrier leases. See Domestic Fixed Satellite Transponder Sales, 90 FCC 2d 1238 (1982), aff'd sub nom., World Communications vs. FCC, 735 F.2d 1465 (DC Cir. 1984)). KaStarcom expects retail telecommunications providers to acquire "bulk" capacity from KaStarcom and broker it in smaller units to the individual users. Indeed, if the user terminal equipment is made sufficiently inexpensive, a situation analogous to the cellular phone market could arise where the terminal equipment is provided to the user at or below cost by the capacity reseller when the user signs up for capacity usage. There are already a sufficient number of well established and reputable resellers in the communications market to ensure the KaStarcom capacity will be efficiently and honestly marketed and that the user will have adequate after–market support.

II.B PROPOSED SYSTEM

The KaStarcom satellite system has been uniquely designed by KaStarcom's engineers and proposed satellite vendor, Lockheed Martin. The KaStarcom satellite system will provide digital two way transmissions as authorized by the FCC. These transmissions will be directed to end users in all 50 states.

The preliminary satellite physical characteristics for the Ka- band direct digital order services satellite system are as follows:

Table VII.A-1: KaStarcom Key System Characteristics

Technical Summary

Orbital Location	Launch Vehicle	Design life
175 ° West	Ariane, Atlas, Long March	10 Years
52° East	Ariane, Atlas, Long March	10 Years

Transponder Configuration

Frequency Band (GHz)		Transmit		Receive	
Primary	S/C#1	19.2 - 19.7		29.0 - 29.5	
	S/C#2	19.7 - 20.0		29.5 - 30.0	
Number of Transponders:		48 per satellite			
Inter Satellite Link Frequency Band:		120 MHz @ 60 GHz			
HPA power:		Primary:	30W	ISL:	15W
HPA redundancy:		Primary:	54 for 48	ISL:	2 for 1
Receiver redundancy:			54 for 48	ISL:	2 for 1

Coverage

The KaStarcom System will provide global coverage.

Satellite Overview:

Satellite Manufacturer:	Lockheed Martin (proposed)
Launch Service Provider:	TBD
Design Life:	10 years
Structure Height:	11.7 ft (3.6m)
Structure (DxW):	6.7 ft x 6.7 ft (2.0m x 2.0m)
Overall Length (Solar arrays deployed):	78.7 ft (24.0m)

Table VII.A-1: KaStarcom Key System Characteristics

(continued)

Total weight at launch (Ariane 4):	**3217 kg**
Dry Weight:	**1692 kg**
Liquid propellant weight:	**1525 kg**
Power Available (end of life):	**6606W**
Batteries:	**Nickel Hydrogen**
Eclipse Capability:	**100% (79% DoD)**
Station keeping:	**+/- 0.050 degrees box**
Attitude Control:	**Three axis stabilization**
Command and Telemetry Frequency:	**C- and Ka-band**
Ka-Band Reflector Antennas:	**4 spotbeam transmit, 4 spotbeam receive, 1 CONUS transmit and receive**
ISL Antenna	**1 transmit and receive**
Omni Antennas:	**1 dual deployed**

PART III PUBLIC INTEREST CONSIDERATIONS

Section 7 of the Communications Act of 1934, as amended, states that it is the policy of the United States to "encourage the provision of new technologies and services to the public." In granting unique satellite system applications, the Commission has consistently acknowledged that policy and has encouraged applicants to submit innovative proposals to provide communications services to the public.

KaStarcom has responded to this challenge by developing a proposal that utilizes state-of-the-art ATM digital transmission technology to provide the public with a wide variety of communications services that are currently unavailable. In addition, KaStarcom's proposal will advance the statutory objective of providing equitable distribution of communications services throughout the United States. See 47 U.S.C. Section 307(b).

The Commission has examined the potential demand and interest for a digital communications service at 28 Ghz and has concluded that there is a large unfilled need for the services being performed by ACTS and proposed herein by KaStarcom, including those necessary to complement the new Personal Communication Services being authorized by the FCC.

In addition to the obvious benefits that KaStarcom's programming proposals will bring the American people, the establishment of America's Interactive Satellite System also will promote national economic objectives. First, establishment of a successful Ka-band interactive system will stimulate demand for new spectrum uses, as well as promote the development of the production of equipment required for the reception and transmission of the service, and the installation, maintenance, and repair of such equipment. Second, approval of the KaStarcom proposal will promote the national goal of maintaining the United States' lead in the area of satellite technology and communications.

As demonstrated in this Application, KaStarcom has examined the needs of potential system subscribers, as well as the technical requirements of satisfying those needs, and has designed a system that will provide spectral efficiency, and provide high quality service to all subscribers. KaStarcom's proposal incorporates the most advanced equipment available to insure that reliable, high quality service will be provided to subscribers throughout the United States at a reasonable cost. Consistent with the Commission's policy of providing service to the public as rapidly as possible, KaStarcom will comply with the Commission's due diligence procedures, and place the system in service within six years of a construction permit grant.

Significantly, the principals and corporate affiliates of KaStarcom have extensive experience in related communications businesses, and the provision of communications services to the public. KaStarcom intends to augment this existing expertise by hiring technical and managerial personnel experienced in satellite communications and radio programming. The successful ventures of KaStarcom's principals in the highly competitive communications field attest to the managerial and marketing skills of its organizers.

It is submitted that this application demonstrates that KaStarcom is legally, technically, financially, and otherwise qualified in all respects to become a Ka-band permittee. In addition, the foregoing demonstrates that grant of this application will serve the public interest, convenience and necessity.

PART IV FINANCIAL QUALIFICATIONS

IV.A SYSTEM COSTS

KaStarcom has examined in detail the cost of implementing its K-band proposal. Utilizing the latest pricing information available, KaStarcom has projected the construction cost of the satellite system, and all necessary operational components, as well as the first-year operating costs of the system. As set forth in more detail in Part V of this Application, the estimated costs of construction and first year operation of two satellite systems will be $625,000,000. The single satellite system proposed will be approximately $312,500,000.

The total capital requirements for the development, deployment and operation of KaStarcom space and ground segments will be approximately $625 million, which includes the construction costs of two more satellites and the respective launches, launch services, launch insurance, associated ground equipment, and pre-operating expenses. This cost does not include the user terminals and ground stations which are not part of this Application and are not considered in the estimated costs. The following is an itemization of the capital investment requirements:

• Two satellites, insurance, and launch vehicles ($275.00 M per)	$550.00 M
• Satellite operations center/TT&C	$ 15.00 M
• Network Control	$ 30.00 M
TOTAL	$605.00 M
• Pre-Operational Expenditures	$ 20.00 M
TOTAL COST:	$625.00 M
TOTAL COST (SINGLE SATELLITE)	$312.50 M

The projections of revenues, operating expenses and the resulting profit are shown for the first 10 years of operation in the following spreadsheet titled "KaStarcom PROJECTIONS". From this data it can be seen that the initial capital expenditures and pre-operational expenses will be recovered within the first four years of operation. This is well within the risk-reward tradeoff criteria required for this type of venture.

The business scenario shown assumes that one half of the transponders will be used to provide direct service for the general public while the other half will serve the wholesale market and will be available to programmers and resellers on a lease or purchase basis. Of course much of this is at this point a "best projection" and the business plan will be adjusted to meet the market needs.

In the projection shown, the number of direct subscribers planned for the first year of satellite operation is 100,000. This, along with an expected average monthly revenue of $30 per subscriber results in the subscriber revenue shown in the table below. Years 2 through 10 show a conservative ramp up of the number of subscribers. The other portion of the total revenue is shown in the row titled "Leasing Revenue" and is that portion of the satellite for leases and/or purchase. All figures are based on one satellite only.

KaStarcom PROJECTIONS

YEARS AFTER LAUNCH	1	2	3	4	5	6	7	8	9	10
# SUBSCRIBERS (000'S)	100	300	500	600	700	800	900	1000	1000	1000
SUBSCRIBER REVENUE ($M)	36	108	180	218	252	288	324	360	360	360
LEASING REVENUE ($M)	100	120	150	180	200	225	250	276	276	276
TOTAL REVENUE ($M)	136	228	330	396	452	513	574	636	636	636
OPERATING EXPENSES($M)	40	60	80	90	100	110	120	130	130	130
NET INCOME ($M)	96	168	250	306	352	403	454	506	506	506

IV.B FINANCIAL DEMONSTRATION

FCC Rules, as construed by the Commission, requires KaStarcom to demonstrate its ability to finance this total amount. While KaStarcom is not relying upon first year revenues to operate the proposed system, such revenues will be generated as well. If necessary, KaStarcom is prepared to obtain financing through other means including:

i. Leases of transponder capacity to prospective customers of the KaStarcom system;

ii. Project financing to be provided by, or raised by, an investment funding institution or public offering; and

iii. Cash flow from existing operations.

Attached as Exhibit D-1 is KaStarcom's Request For Waiver of Sections 25.140(b)-(d). It should be noted that KaStarcom has marketing and financial expertise that will assure the funds for this project will be available. Of course, should the Commission require additional information concerning KaStarcom's financial qualifications it will be provided upon request. However, KaStarcom believes it has sufficiently demonstrated its financial plans and capabilities herein, particularly in light of the Commission's general policy, in similar licensing circumstances, not to insist upon a stringent financial showing at the application stage. Indeed, this policy was applied to numerous applicants in the first Ka-band processing round.

Attached is KaStarcom's balance sheet current within 90 days of the filing of this application. A copy of a letter from Legg Mason Wood Walker, Incorporated also is attached. KaStarcom's Request for Waiver of Section 25.140 of the Commission's Rules is set forth in Exhibit D-1.

KaSTARCOM. WORLD SATELLITE LLC
UNAUDITED BALANCE SHEET
NOVEMBER 1997

ASSETS

CURRENT ASSETS	
Cash - Bank	$350,000.00
Total Current Assets	$350,000.00
Total Assets	$350,000.00

LIABILITIES AND STOCKHOLDERS' EQUITY

Current Liabilities	$ 0
Long Term Liabilities	$ 0
Total Liabilities	$350,000.00
Stockholder's Equity	
Contributed Capital	$350,000.00
Retained Earnings	$ 0
Earnings Year-to-date	$ 0
TOTAL LIABILITIES AND STOCKHOLDERS' EQUITY	$350,000.00

Declaration Of David M. Drucker

I, David M. Drucker, hereby declare under penalty of perjury that:

1. I am President of Televerde Communications, ~~L.P.~~ Corp, the managing member of KaStarcom World Satellite, LLC.

2. The foregoing is a true and correct copy of the consolidated financial statements of Kastarcom World Satellite, LLC as of November 1997.

David M. Drucker

December 19, 1997

LEGG MASON Corporate Finance

Legg Mason Wood Walker, Incorporated
Suite 1100, 1735 Market Street, Philadelphia, PA 19103
215•496•8300 Fax: 215•568•2031

October 20, 1997

Mr. David M. Drucker
President
KaStarcom. World Satellite Corp.
P.O. Box 1471
Evergreen, CO 80437

Re: KaStarcom. World Satellite Corp.

Dear Mr. Drucker:

Legg Mason has reviewed the business plan as set forth in the Federal Communications Commission (hereinafter "FCC"), application of KaStarcom. World Satellite Corp. (hereinafter "KaStar") for Authority to Construct, Launch and Operate a Ka Band Digital International Region B Fixed Communications Satellite System at 175° W.L. and 52° E.L. We understand that KaStar intends to file this application with the FCC in the near future to complement its authorized domestic fixed satellite system at 109.2° W.L. and 73° W.L.

Legg Mason is a leading international investment banking and securities firm. Since 1993 it has raised over $20.0 billion of financing for its clients. Legg Mason participates in the offering of equity and debt securities for a wide variety of companies including those in the telecommunications industry.

In light of the track record of the principals of KaStar we believe that if KaStar's satellite plans are effected as contemplated, the financing opportunities presented could be appealing to various financial and industrial corporations as well as individual investors.

While the precise terms of any specific financing will be subject to the grant by the FCC of KaStar's authorization and to market conditions at the time of any offering, we anticipate that there will be a number of potential investors who will seriously consider equity and/or debt investments. It is on this basis, we will be working with KaStar in its effort to raise the funds necessary for it to construct, launch and operate its international satellite system.

We understand that KaStar intends to file this letter with the FCC, and this letter has been provided solely for that purpose.

Sincerely,

Legg Mason Wood Walker, Incorporated

By: ______________________
Seth J. Lehr

PART V LEGAL QUALIFICATIONS OF APPLICANT

V.A. APPLICANT INFORMATION

KaStarcom is a Delaware Limited Liability Company organized to provide Ka-band service to the public. Its principal office is located at 2701 Alcott Denver, Colorado 80211. Its Certificate of Formation is attached hereto.

Manager	
Televerde Communications Corp.	1.0%
Other Members	
Robert Luly (non-voting)	1.5%
Segaloff and Sons Joint Venture	5.0%
WSS Misc Trust	2.5%
David S. Segaloff Family Trust	7.5%
Peter M. Segaloff Family Trust	7.5%
WSS/Boys Trust	12.5%
Segaloff Grandchildren's D&E Trust	5.0%
E.D. David	0.925%
Elizabeth B. David Trust	1.0%
J. William David Trust	1.0%
Joshua M. David Trust	1.0%
Gregory B. David Trust	1.0%
Walter S. Segaloff	3.825$
David M. Drucker	48.75%

The manager and members of KaStarcom are U.S. Citizens. The affairs of KaStarcom are conducted exclusively by Televerde Communications Corp. ("TCC"). The stock of TCC is owned by David M. Drucker (50%) and Walter S. Segaloff (50%).

V.B. EQUAL EMPLOYMENT OPPORTUNITY

In accordance with the FCC Rules, KaStarcom will afford equal opportunity in employment to all qualified persons, and no person shall be discriminated against in employment because of race, color, religion, national origin, sex or age. KaStarcom intends to implement a program consistent with the attached Model Program which satisfies the requirements of the FCC Rules. In addition, KaStarcom will, upon issuance by the commission of a Ka-band permit, annually file FCC Form 395, if required.

The discussion herein demonstrates that KaStarcom is legally qualified to become a KA BAND permittee/licensee, and that it has satisfied all legal requirements set forth in Part 25 of the FCC's Rules.

FCC 430

Federal Communications Commission
Washington, DC 20554

Approved by OMB
3060-0105

LICENSEE QUALIFICATION REPORT

See reverse for public burden estimate

INSTRUCTIONS:

A. The "Filer" of this report is defined to include: (1) An applicant, where this report is submitted in connection with applications for common carrier and satellite radio authority as required for such applications; or (2) A licensee or permittee, where this report is required by the Commission's Rules to be submitted on an annual basis.

B. Submit an original and one copy (sign original only) to the Federal Communications Commission, Washington, DC 20554. If more than one radio service is listed in Item 6, submit an additional copy for each such additional service. If this report is being submitted in connection with an application for radio authority, attach it to that application.

C. Do not submit a fee with this report.

1. Business Name and Address (Number, Street, State and ZIP Code) of Filer's Principal Office

KaStarcom. World Satellite, LLC
P.O. Box 1471
Evergreen, CO 80439

2. (Area Code) Telephone Number

(303) 526-1039

3. If this report supersedes a previously filed report, specify its date

N/A

4. Filer is (check one):

☐ Individual ☐ Partnership ☐ Corporation

☒ Other (Specify): Limited Liability Company

5. Under the laws of what State (or other jurisdiction) is the Filer organized?

DELAWARE

6. List the common carrier and satellite radio services in which Filer has applied or is a current licensee or permittee: Televerde Communications Corp., the manager of KaStarcom, is the sole general partner of Televerde Communications, L.P. Televerde Communications, L.P. is the majority shareholder of KaStar Satellite Communications Corp. KaStar holds authorizations for GSO FSS satellites in the Ka-band.

7(a) Has the Filer 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 I a statement giving call sign and file number of license or permit revoked and relating circumstances.* ☐ YES ☒ NO

(b) Has any court finally adjudged the Filer, or any person directly or indirectly controlling the Filer, 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 other means of unfair methods of competition? *If "YES", attach as Exhibit II a statement relating the facts.* ☐ YES ☒ NO

(c) Has the Filer, or any party to this application, or any person directly or indirectly controlling the Filer ever been convicted of a felony by any state or Federal court? *If "YES", attach as Exhibit III a statement relating the facts.* ☐ YES ☒ NO

(d) Is the Filer, or any person directly or indirectly controlling the Filer, presently a party in any matter referred to in Items 7(b) and 7(c)? *If "YES", attach as Exhibit IV a statement relating the facts.* ☐ YES ☒ NO

8. Is the Filer, directly or indirectly, through stock ownership, contract or otherwise, currently interested in the ownership or control of any other radio stations licensed by the Commission? *If "YES", submit as Exhibit V the name of each such licensee and the licensee's relation to the Filer.* See Exhibit V ☒ YES ☐ NO

If Filer is an individual (sole proprietorship) or partnership, answer the following and Item 11: N/A

9(a) Full Legal Name and Residential Address (Number, Street, State and ZIP Code) of Individual or Partners:

(b) Is Individual or each member of a partnership a citizen of the United States? ☐ YES ☐ NO

(c) Is Individual or any member of a partnership a representative of an alien or of a foreign government? ☐ YES ☐ NO

If Filer is a corporation, answer the following and Item 11:

10(a) Attach as Exhibit VI the names, addresses, and citizenship of those stockholders owning of record and/or voting 10 percent or more of the Filer's voting stock and the percentages so held. In the case of fiduciary control, indicate the beneficiary(ies) or class of beneficiaries.

See Exhibit VI

(b) List below, or attach as Exhibit VII the names and addresses of the officers and directors of the Filer.

See Exhibit VII

(c) Is the Filer directly or indirectly controlled by any other corporation? ☐ YES ☒ NO

If "YES", attach as Exhibit VIII a statement (including organizational diagrams where appropriate) which fully and completely identifies the nature and extent of control. Include the following: (1) the address and primary business of the controlling corporation and any intermediate subsidiaries; (2) the names, addresses, and citizenship of those stockholders holding 10 percent or more of the controlling corporation's voting stock; (3) the approximate percentage of total voting stock held by each such stockholder; and (4) the names and addresses of the president and directors of the controlling corporation.

(d) Is any officer or director of the Filer an alien? ☐ YES ☒ NO

(e) Is more than one-fifth of the capital stock of the Filer owned of record or voted by aliens or their representatives, or by a foreign government or representative(s) thereof, or by a corporation organized under the laws of a foreign country? ☐ YES ☒ NO

(f) Is the Filer directly or indirectly controlled: (1) by any other corporation of which any officer or more than one-fourth of the directors are aliens, or (2) by any foreign corporation or corporation of which more than one-fourth of the capital stock is owned or voted by aliens or their representatives, or by a foreign government or representatives thereof. ☐ YES ☒ NO

(g) If any answer to questions (d), (e) or (f) is "YES", attach as Exhibit IX a statement identifying the aliens or foreign entities, their nationality, their relationship to the Filer, and the percentage of stock they own or vote.

11. CERTIFICATION

This report constitutes a material part of any application which cross-references it, and all statements made in the attached exhibits are a material part thereof. The ownership information contained in this report does not constitute an application for, or Commission approval of, any transfer of control or assignment of radio facilities. The undersigned, individually and for the Filer, hereby certifies that the statements made herein are true, complete and correct to the best of the Filer's knowledge and belief, and are made in good faith. The undersigned, individually and for the Filer, certifies that neither the applicant nor any other party to the application is subject to a denial of Federal benefits, that includes FCC benefits, pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance.

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND/OR IMPRISONMENT (U.S. CODE, TITLE 18, SECTION 1001), AND/OR REVOCATION OF ANY STATION LICENSE OR CONSTRUCTION PERMIT (U.S. CODE, TITLE 47, SECTION 312(A)(1)), AND/OR FORFEITURE (U.S. CODE, TITLE 47, SECTION 503).

Filer (must correspond with that shown in Item 1)	Typed or Printed Name	
KaStarcom. World Satellite, LLC	David M. Drucker	
Signature	Title President of Televerde Communications Corp., Sole Manager	Date December 19, 1997

NOTICE TO INDIVIDUALS REQUIRED BY THE PRIVACY ACT OF 1974 AND THE PAPERWORK REDUCTION ACT OF 1995

The solicitation of personal information requested in this form is to determine if you are qualified to become or remain a licensee in common carrier or satellite radio service pursuant to the Communications Act of 1934, as amended. No authorization can be granted unless all information requested is provided. Your response is required to obtain the requested authorization or retain an authorization.

Public reporting burden for this collection of information is estimated to average 2 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate, or any other aspect of this collection of information, including suggestions for reducing the burden to Federal Communications Commission, Records Management Branch, Washington, DC 20554, Paperwork Reduction Project (3060-0105), or via the Internet to dconway@fcc.gov. DO NOT SEND COMPLETED FORMS TO THIS ADDRESS. Individuals are not required to respond to a collection of information unless it displays a currently valid OMB control number.

EXHIBIT V

I. David Drucker has the following broadcast interests:

1. 100% shareholder of GreenTV Corp. Green TV Corp. is the licensee of KSBS-TV, Steamboat Springs, Colorado; TV Translator Stations K63GB and K18ED, Denver, Colorado; KDMD-TV, Anchorage, Alaska; Station K41DP, Anchorage, Alaska; Station K22AG, Anchorage, Alaska; and Station K18ED, Fairbanks, Alaska.

2. 50% shareholder of Cayo Hueso Television Corp., licensee of LPTV Station, licensee of Stations W55BV, Homestead, Florida and W21BD, Pompano Beach, Florida.

3. 100% shareholder of Polarcomm Corp., licensee of KXRE(AM), Manitou Springs, Colorado; WKIZ(AM), Key West, Florida; and KRRU(AM), Pueblo, Colorado. Polarcomm has a pending application for the assignment of KNEB-TV, Ketchikan, Alaska.

4. 20% shareholder of Echonet-Longmont Corp., 50% shareholder of Longmont-Channel 25 Corp.

5. 50% shareholder in Televerde Communications Corp. ("TCC"), sole general partner of Televerde Communications, L.P., which in turn is the majority shareholder in KaStar Satellite Communications Corp. ("KaStar"). KaStar holds authorizations for two GSO FSS satellites in the Ka-band.

6. 49.99% shareholder of Ladybug Mountain PCS Corp. Ladybug holds a 7% interest in KaStar Satellite Communications Corp.

EXHIBIT VI

1. David M. Drucker
   P.O. Box 255
   Evergreen, CO 80437

   David Drucker owns 48.75% of the stock of KaStarcom.

2. Walter Segaloff/Boys Trust
   P.O. Box 255
   Evergreen, CO 80437

   Walter Segaloff/Boys Trust owns 12.5% of the stock of KaStarcom. Walter Segaloff is the trustee.

EXHIBIT VII

1. Televerde Communications Corp.
   P.O. Box 1471
   Evergreen, CO 80439

   Manager

State of Delaware

Office of the Secretary of State

I, EDWARD J. FREEL, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY THE ATTACHED IS A TRUE AND CORRECT COPY OF THE CERTIFICATE OF LIMITED LIABILITY COMPANY OF "KASTARCOM. WORLD SATELLITE, LLC", FILED IN THIS OFFICE ON THE TWENTY-FIFTH DAY OF AUGUST, A.D. 1997, AT 1:30 O'CLOCK P.M.

Edward J. Freel, Secretary of State

2788736 8100

971283843

AUTHENTICATION: 8621796

DATE: 08-25-97

State of Delaware

Office of the Secretary of State

I, EDWARD J. FREEL, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY "KASTARCOM. WORLD SATELLITE, LLC" IS DULY FORMED UNDER THE LAWS OF THE STATE OF DELAWARE AND IS IN GOOD STANDING AND HAS A LEGAL EXISTENCE SO FAR AS THE RECORDS OF THIS OFFICE SHOW, AS OF THE TWENTY-FIFTH DAY OF AUGUST, A.D. 1997.

AND I DO HEREBY FURTHER CERTIFY THAT THE ANNUAL TAXES HAVE NOT BEEN ASSESSED TO DATE.

Edward J. Freel, Secretary of State

2788736 8300

971284061

AUTHENTICATION: 8621806

DATE: 08-25-97

CERTIFICATE OF FORMATION
OF
KaSTARCOM. WORLD SATELLITE, LLC

The undersigned, intending to form a Delaware Limited Liability Company under the Delaware Limited Liability Company Act, executes the following Certificate of Formation.

FIRST: The name of the limited liability company (the "Company") is: **KaSTARCOM. WORLD SATELLITE, LLC.**

SECOND: The address in Delaware of the registered office of the Company is 1209 Orange Street, Wilmington, Delaware 19801, and the name of the registered agent for service of process at such address is **THE CORPORATION TRUST COMPANY.**

By executing this Certificate of Formation, I hereby declare and certify that this is my act and deed and the facts stated in this Certificate of Formation are true.

DATED: AUGUST 25, 1997

CHRISTY T. O'CONNOR, Authorized Signatory

Approved by OMB
3060-0120
Expires 11/30/96

BROADCAST EQUAL EMPLOYMENT OPPORTUNITY

MODEL PROGRAM REPORT

1. APPLICANT

Name of Applicant	Address
KaStarcom. World Satellite, LLC	P.O. Box 1471 Evergreen, CO 80439
Telephone Number (include area code) (303) 526-1039	

2. This form is being submitted in conjunction with:

[X] Application for Construction Permit for New Station

[ ] Application for Assignment of License

[ ] Application for Transfer of Control

(a) Call letters (or channel number of frequency) ____________

(b) Community of License (city and state) ____________

(C) Service:

[ ] AM [ ] FM [ ] TV [ ] Other (Specify) ____________

INSTRUCTIONS

Applicants seeking authority to construct a new commercial, noncommercial or international broadcast station, applicants seeking authority to obtain assignment of the construction permit or license of such a station, and applicants seeking authority to acquire control of an entity holding such construction permit or license are required to afford equal employment opportunity to all qualified persons and to refrain from discrimination in employment and related benefits on the basis of race, color, religion, national origin or sex. See Section 73.2080 of the Commission's Rules. Pursuant to these requirements, an applicant who proposes to employ five or more full-time employees must establish a program designed to assure equal employment opportunity for women and minority groups (that is, Blacks not of Hispanic origin, Asians or Pacific Islanders, American Indians or Alaskan Natives and Hispanics). This is submitted to the Commission as the Model EEO Program. If minority group representation in the available labor force is less than five percent (in the aggregate), a program for minority group members is not required. In such cases, a statement so indicating must be set forth in the EEO model program. However, a program must be filed for women since they comprise a significant percentage of virtually all area labor forces. If an applicant proposes to employ fewer than five full-time employees, no EEO program for women or minorities need be filed.

Guidelines for a Model EEO Program and a Model EEO Program are attached.

NOTE: Check appropriate box, sign the certification below and return to FCC:

[X] Station will employ fewer than 5 full-time employees; therefore no written program is being submitted.

[ ] Station will employ 5 or more full-time employees. Our Model EEO Program is attached. (You must complete **all** sections of this form.)

I certify that the statements made herein are true, complete, and correct to the best of my knowledge and belief, and are made in good faith.

Signed and dated this 19 day of December, 19 97

Signed [signature]

Title President of Televerde Communications Corp., Manager

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND/OR IMPRISONMENT (U.S. CODE, TITLE 18, SECTION 1001), AND/OR REVOCATION OF ANY STATION LICENSE OR CONSTRUCTION PERMIT (U.S. CODE, TITLE 47, SECTION 312(a)(1), AND/OR FORFEITURE (U.S. CODE, TITLE 47, SECTION 503).

PART VI TECHNICAL DESCRIPTION

VI.A SYSTEM DESCRIPTION

VI.A.1 SYSTEM CONCEPT

VI.A.1.a Overview

The **KaSTARCOM.** system is designed to be a Global broadband ATM data communications network. It will merge most elements of the proposed "National Information Highway" with current DBS and DHS video distribution practices to produce a low cost, ubiquitous, high rate digital data, video, telephony service. In this regard it will drive the development and widespread adoption of both the integrated office and the integrated home communications systems,, merging computers, phones, video, and television into one interactive and seamless whole. The **KaSTARCOM.** service communications capacity has been specifically designed to be provided "on demand" to the user. For the United States, it is also deliberately made synergistic with existing Ku-band DBS ventures such as EchoStar, DirecTV, USSB, etc., thus providing a natural extension and enhancement of these services while avoiding any duplication of their business.

The **KaSTARCOM.** system will consist of four separately located satellites generating a multi-spot beam pattern (up to 60 spot beams) to cover the service areas and provide a high degree of spectrum reutilization. The proposed orbital locations are: 73° West Longitude, 109.2° West Longitude, 52° East Longitude and 175° West Longitude. The antenna coverages for both the Transmit and Receive beams are depicted in Figures VI.A.1-1, VI.A.1-2, VI.A.1-3 and VI.A.1-4 respectively.

The FCC authorized satellites located at 73° WL and 109.2° WL provide service to North America, Central America and South America including all 50 states and Puerto Rico. In addition, spot beams to Southwest Europe and Northwest Africa are also provided from the satellite located at 73° WL. The end result for the user is that every location within CONUS will have continuous coverage by four to six beams, locations in Mexico, Southwest Europe, and on the coast of South America by 2 beams each, along with locations in Alaska, Hawaii, Puerto Rico, Central America and Northwest Africa by 1 beam each. This will provide an effective bandwidth

Figure VI.A.1-1: 73° WL Ka-Band Antenna Coverage:

EIRP Beam Contour Level 56 dBW, G/T Beams Contour Level 12 dB/K

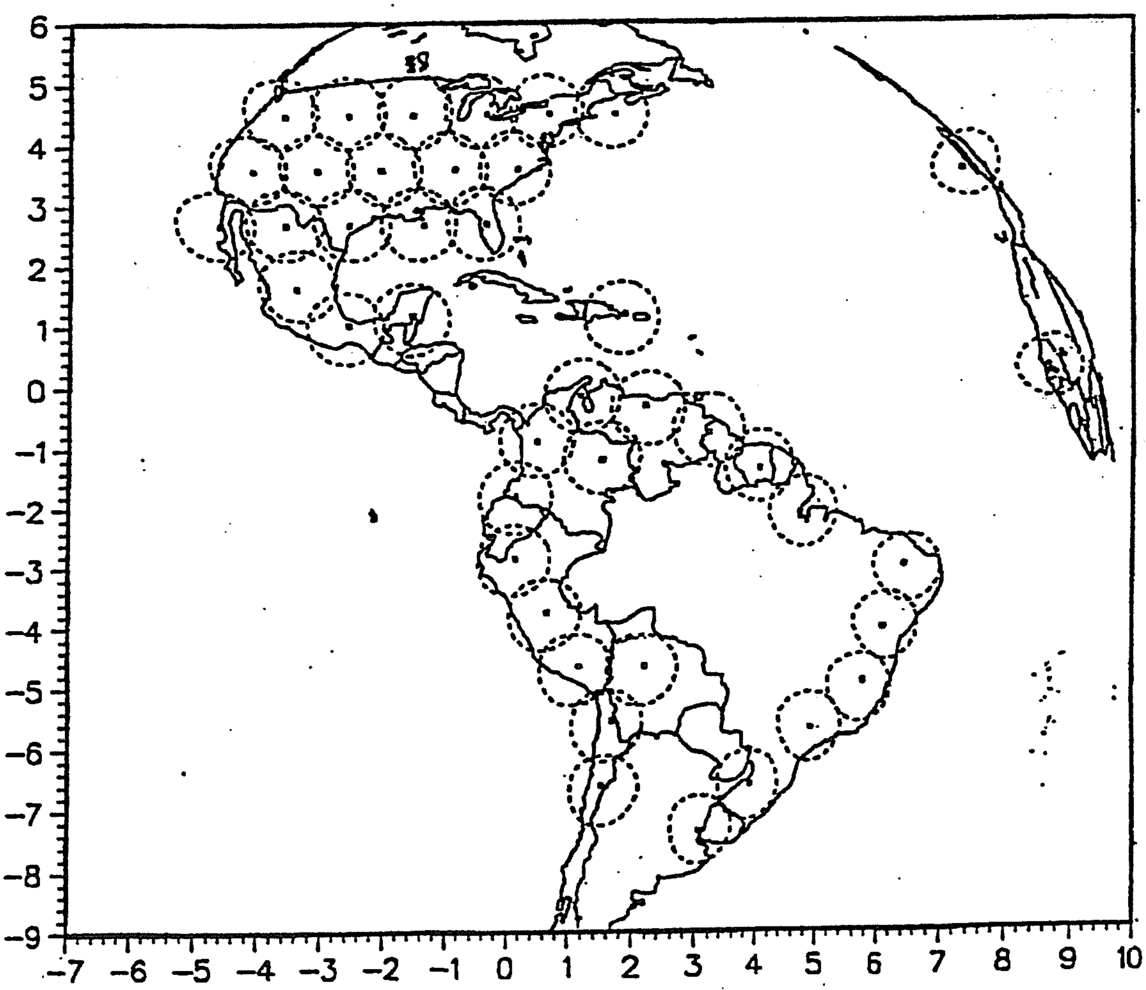


Figure VI.A.1-2: 109.2° WL Ka-Band Antenna Coverage:

EIRP Beam Contour Level 56 dBW, G/T Beam Contour Level 12 dB/K

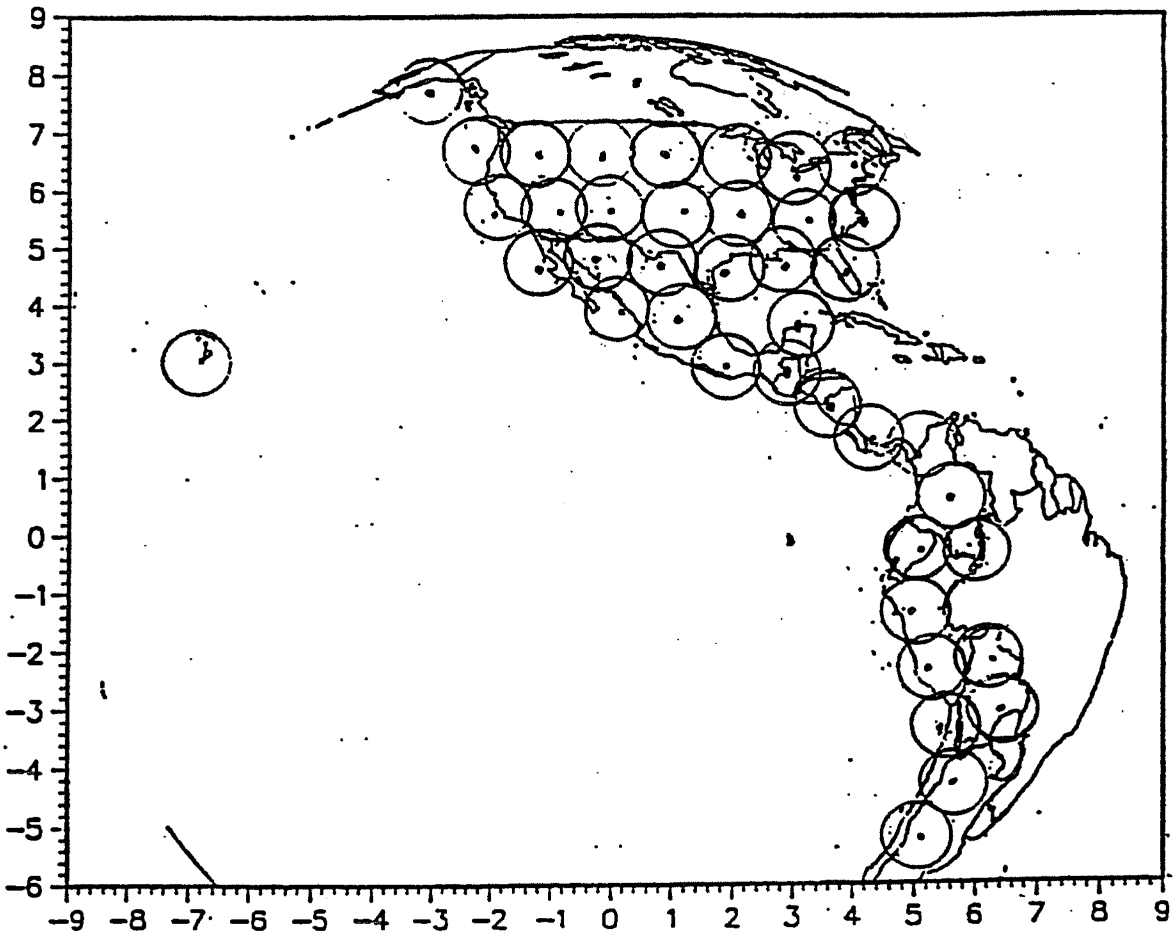


Figure VI.A.1-3: 52° EL Ka-Band Antenna Coverage:

EIRP Beam Contour Level 56 dBW, G/T Beam Contour Level 12 dB/K

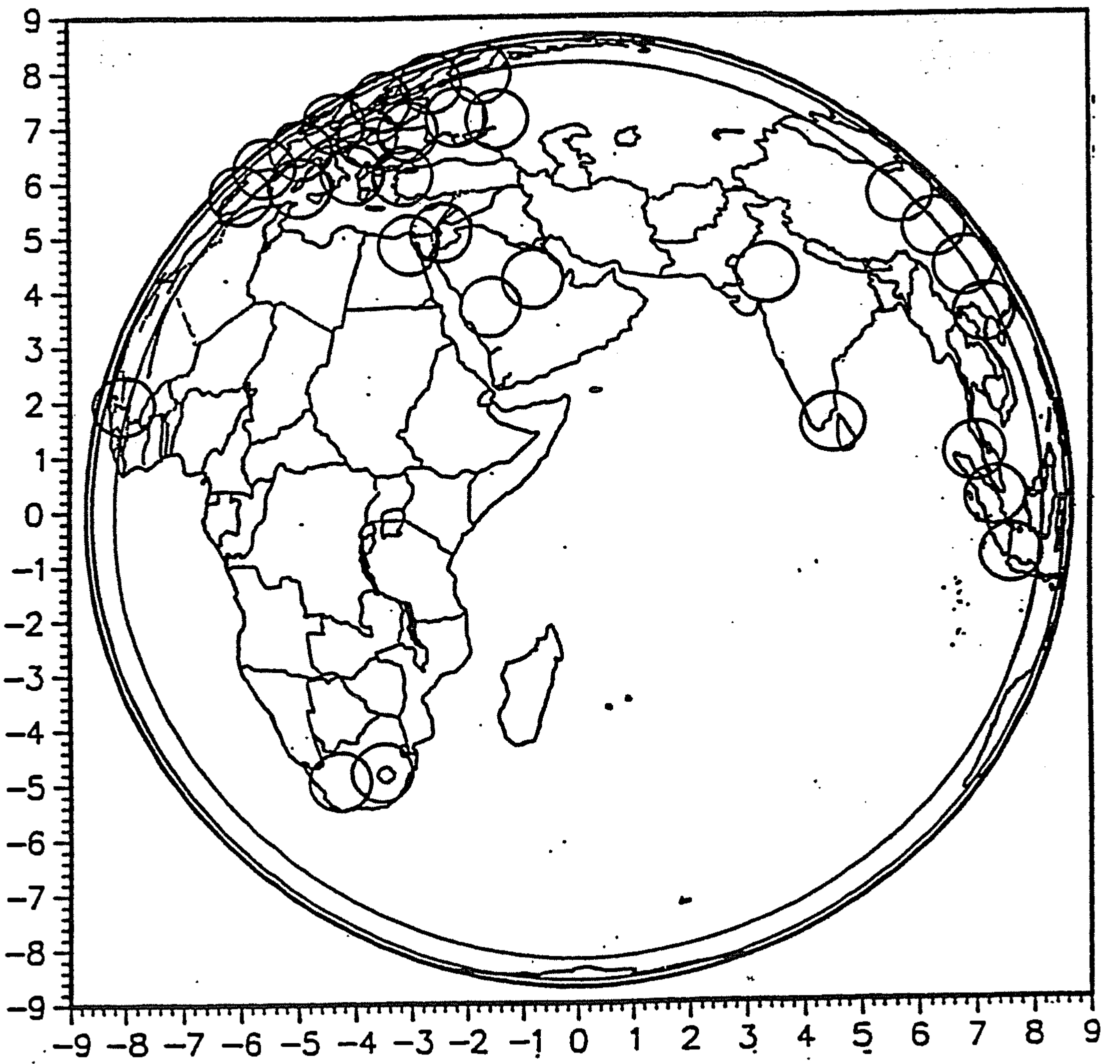
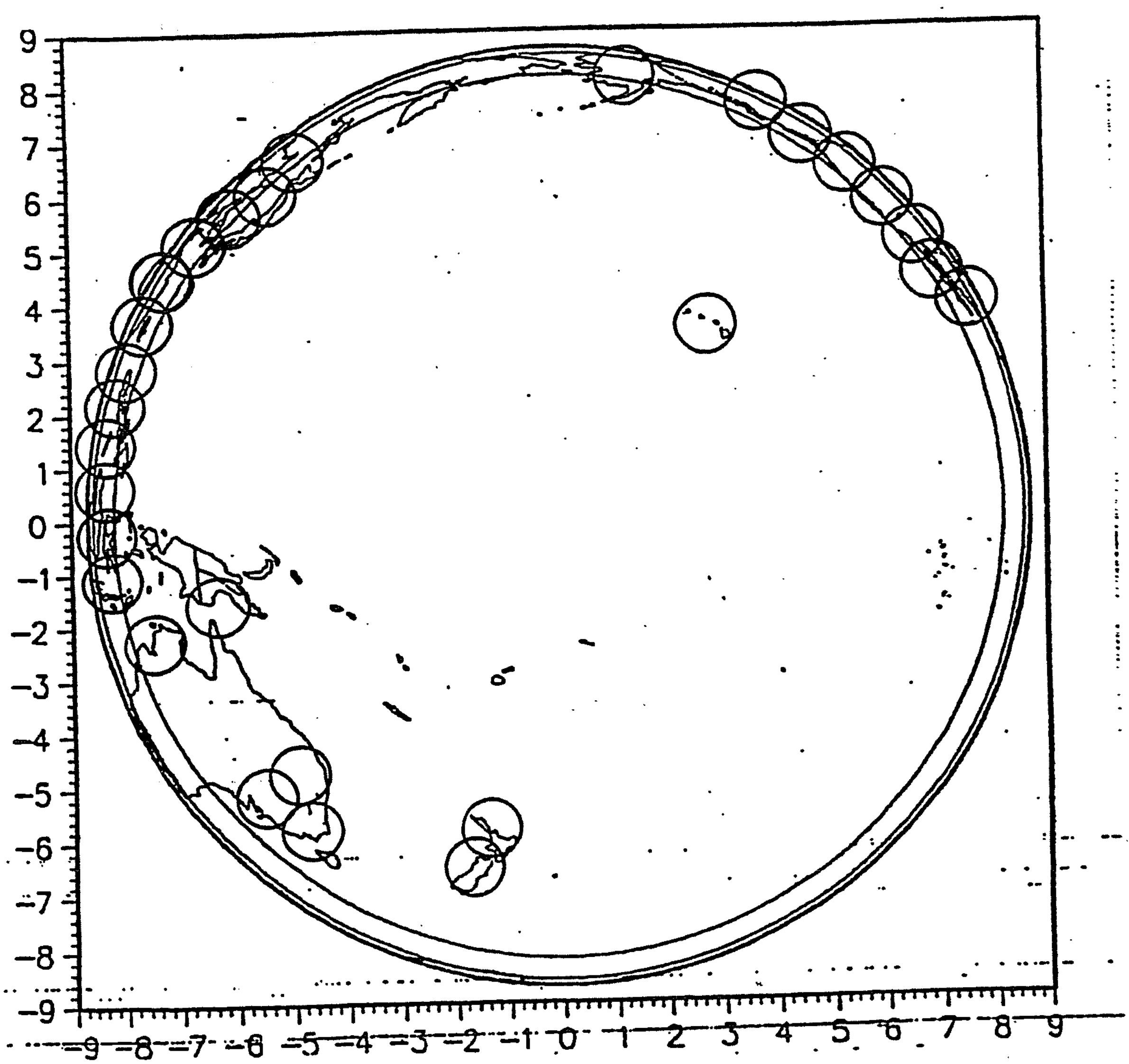


Figure VI.A.1-4: 175° WL Ka-Band Antenna Coverage:

EIRP Beam Contour Level 56 dBW, G/T Beam Contour Level 12 dB/K



of 480 to 720 MHZ to service the communications needs of each user in the CONUS.

The proposed satellite located at 52° EL provides coverage for Europe, Western Russia, and selected areas of China, Southeast Asia, India and Africa.

The proposed satellite located at 175° WL provides an interconnection with the Pacific Rim Nations including Japan, Korea, China, the Philippines, Indonesia, Australia and New Zealand. The selection of 175° WL orbit location permits direct connection between the Western Hemisphere and the Pacific Rim nations. **KaSTARCOM.** is prepared to submit the necessary documentation to the ITU for this location.

Communications traffic will be dynamically processed and routed between beams onboard the satellites in response to user-generated routing requests, the processing and routing being handled by an advanced and high performance communications digital data baseband processor (BBP) and microwave switch matrix (MSM).

Eventually the four satellites in their separate orbital locations will be directly interlinked by a state-of-the-art microwave intersatellite link (ISL). Thus, traffic can be uplinked to one satellite and downlinked from the other when the transmitter and receiver user terminals are serviced by separate satellites, but without the need for a double hop through an intermediate ground station linking the two satellites. This will both keep the transmission round trip delay within the standard GEO-satellite quarter second and avoid double usage charges to the users. The initial deployment of the **KaSTARCOM.** satellite will be at 73° WL and 109.2°WL. Additional satellites will be added at 52° EL and 175° WL to complete the Global System.

All of these satellites will be connected to each other by microwave ISLs, leading to the development of a global space-based network complementing and extending, but not replacing, the terrestrial networks. The space and terrestrial networks will be interconnected by the **KaSTARCOM.** gateway stations, allowing the user to rapidly and easily access any other user on either network. Thus, in many ways the overall effect will be to provide a vastly increased capability Internet system: one able to carry video, phone, and data traffic at very high communication data rates.

For marketing, economic, and technical reasons, the **KaSTARCOM.** system will be compatible with broadband ATM and similar high rate digital packetized data communications applications: SONET fiber network, B-ISDN, interactive video, phone trunking, cellular- and PCN-switch linking, video-conferencing, computer networking, and similar advanced communications traffics on the "National Information Highway." It will not be used for the current digital DBS home video distribution applications (DirecTV, USSB, etc.) until that market migrates to the Ka-band and broadband ATM technology at some time in the not too distant future. This migration is expected to coincide with the development of interactive video and "local town hall meeting" communication concepts since broadband ATM technology will be required for these domestic applications. It will be remembered during the last Presidential election campaign, certain politicians advanced the concept of political meetings at the local community level - and ultimately even at the federal government level - being conducted by interactive video techniques from the individual citizen's home. This was likened to the local town hall meetings of pre-television days since it would bring the local, state and federal government elected representatives into a closer interactive relationship with their constituents.

Figure VI.A.1-5[4] illustrates the bandwidth needs for a range of current and developing communications applications, and Figure VI.A.1-6 shows how the development of new communications applications follows the growth of bandwidth availability.

Traffic type	End-system bandwidth
Remote query	1 Mbps
CD digital audio	1.5 Mbps
Compressed video (JPEG)	2-10 Mbps
Document reprographics	20-100 Mpbs
Compressed high-definition TV	20-100 Mbps
UNIX NFS file I/O	100-200 Mbps
CCIR digital video	216 Mbps
High-definition full motion video	1-2 Gbps
Parallel server I/O	1-10 Gpbs

Figure VI.A.1-5 Sample of Traffic Type and Bandwidth for SONET/ATM Networks.

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[4] Taken from: *High Data Rate* SATCOM; Dr. Marcos Bergamo, Division Scientist with BBN Systems and Technologies and a Principal Investigator on the ARPA/NASA Gigabit Satellite Network over ACTS; 1994 AIAA 15th International Communications Satellite Systems Conference Colloquium.

Figure VI.A.1-7 emphasizes the use of fiber-optic links and the SONET protocol because of the speed with which this technology is taking over in the landline market. However, this also means the **KaSTARCOM.** system must provide an equivalent OC-3, for example, capability since it must inevitably interconnect fiber links if it is to make any penetration of the evolving high rate data communications market. But, in order to be economically viable by servicing the largest possible percentage of the available user market, it must also handle the emerging ATM applications at STS-3 rates as well as the traditional and lower rate VSAT, telephone, and similar T1 rate applications. As will be seen, the **KaSTARCOM.** system design takes the demonstrated Advanced Communications Technology Satellite (ACTS) technology a significant step further in meeting these diverse needs.

VI.A.2 Communication System Architecture

The **KaSTARCOM.** system advances the state of the art in satellite-based ommunications technology. It builds on the demonstrated NASA ACTS communications system designs and protocols, using multibeam Ka-band antennas to generate a family of small spot beams, and a sophisticated baseband processor (BBP) and microwave switch matrix (MSM) to dynamically route the communications traffic data packets and among the antenna beams in real time according to the user's requirements.

Each spot beam antenna design will be similar to the ACTS antenna design: a parabolic reflector plus feed horn array. Each satellite antenna farm (4 transmit and 4 receive) will generate up to 60 small spotbeams, covering the local service areas with 2 beams at each location (one on each polarization).

Each spot will cover an area approximately 600-km diameter on the ground and will provide a minimum peak effective isotropic radiated power (EIRP) of 60 dBW for each beam. The latter will be achieved by selecting the satellite transponders amplifier output powers to provide an adequately high margin to compensate for most rain fade effects in the beam; but extremely heavy rain fall will possibly cause some degradation of the link quality for the users. Additional rain fade

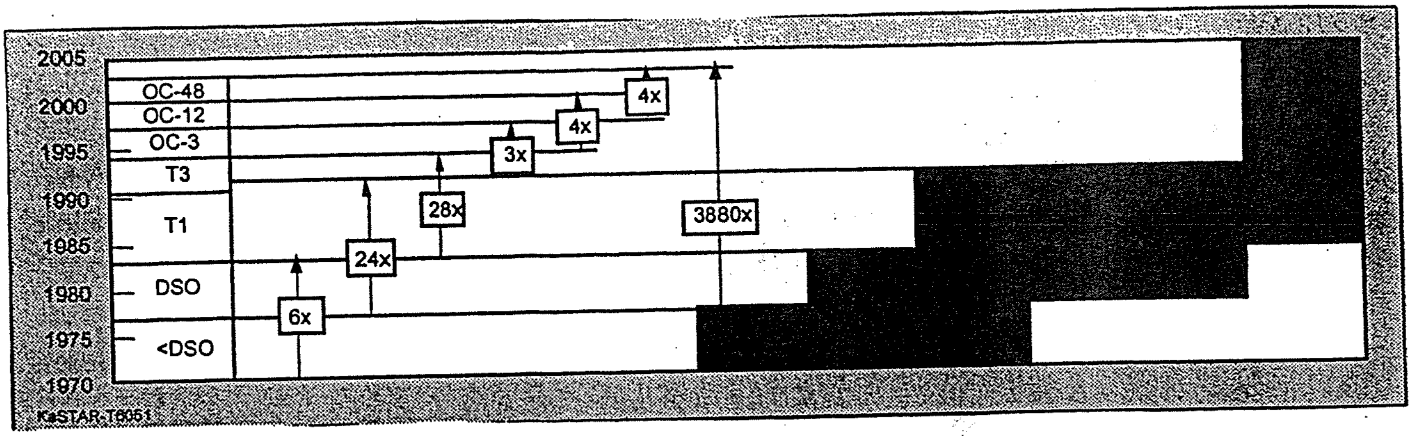

Figure VI.A.1-6[5] shows how the development of new communications applications follows the growth of bandwidth availability.

Optical Level	Equivalent electrical rate USA	Europe	(Mb/s)
OC-1	STS-1	—	51.84
OC-3	STS-3	STM-1	155.52
OC-9	STS-9	STM-3	933.12
OC-12	STS-12	STM-4	622.06
OC-24	STS-24	STM-8	1244.16
OC-36	STS-36	STM-12	1866.24
OC-48	STS-48	STM-16	2488.32

Why 51.84 Mbps?
- DS-3 (44.736 Mbps)
- Plus SONET overhead, called STS-1

Why 155.52 Mbps?
- E4 (~140 Mbps)
- Plus SDH overhead, called STM-1
- Equivalent to SONET STS-3c
- Base for all STM-N signals

STS-N signal, N = 1, 3, 9, 12, 24, 36, and 48
- STS-N = N times 51.84 Mbps, byte interleaving

KaSTAR-T6000

Figure VI.A.1-7[6] defines the SONET hierarchy and line rates

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5 ibid., Dr. Marcos Bergamo.

6 ibid., Dr. Marcos Bergamo.

compensation will be obtained by the use of robust codes for encoding the data. These two measures will allow the use of extremely small user terminals: 66-cm to 2-m diameter (depending on traffic data rates), and the small spot beams will ensure high spectrum usage efficiency.

Each of the spot beams will have a bandwidth of 120 MHZ and there will be four primary beam frequencies per satellite. Ten high traffic beams are assigned a second 120-MHZ band to double the traffic capacity in these beams.

Each satellite's communications payload comprises a BBP subsystem for low-rate data, T2 (6.312 Mbps) rates or less, and an MSM subsystem for high-rate data (from 24 Mbps to ATM/STS-3/OC-3 rates) in parallel. The BBP subsystem is a packet processor and router, taking in packets from an FDM uplink and regrouping the packets into TDM streams for the downlinks, whereas the MSM subsystem is effectively a crossbar switch plus bent-pipe transmission system for wideband data rates--this is shown schematically in Figure VI.A.2-1[7], and is functionally similar to the ACTS payload design. This distinction is driven by the component technology presently available for the BBP: packet processing and switching into a 120 Mbps TDM data stream. Subchannel rates much greater than T2 is not yet feasible for a satellite-borne processor. However, the **KaSTARCOM.** high-rate MSM subsystem will still differ from the traditional FSS bent-pipe transmission subsystem design so that it provides the crossbar switch function between the uplink and downlink beams.

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[7] Taken from *Acts Multibeam Communications Package: Description and Performance Characterization;* W. Cashman, GE Astro-Space; AIAA-92-1963-CP.

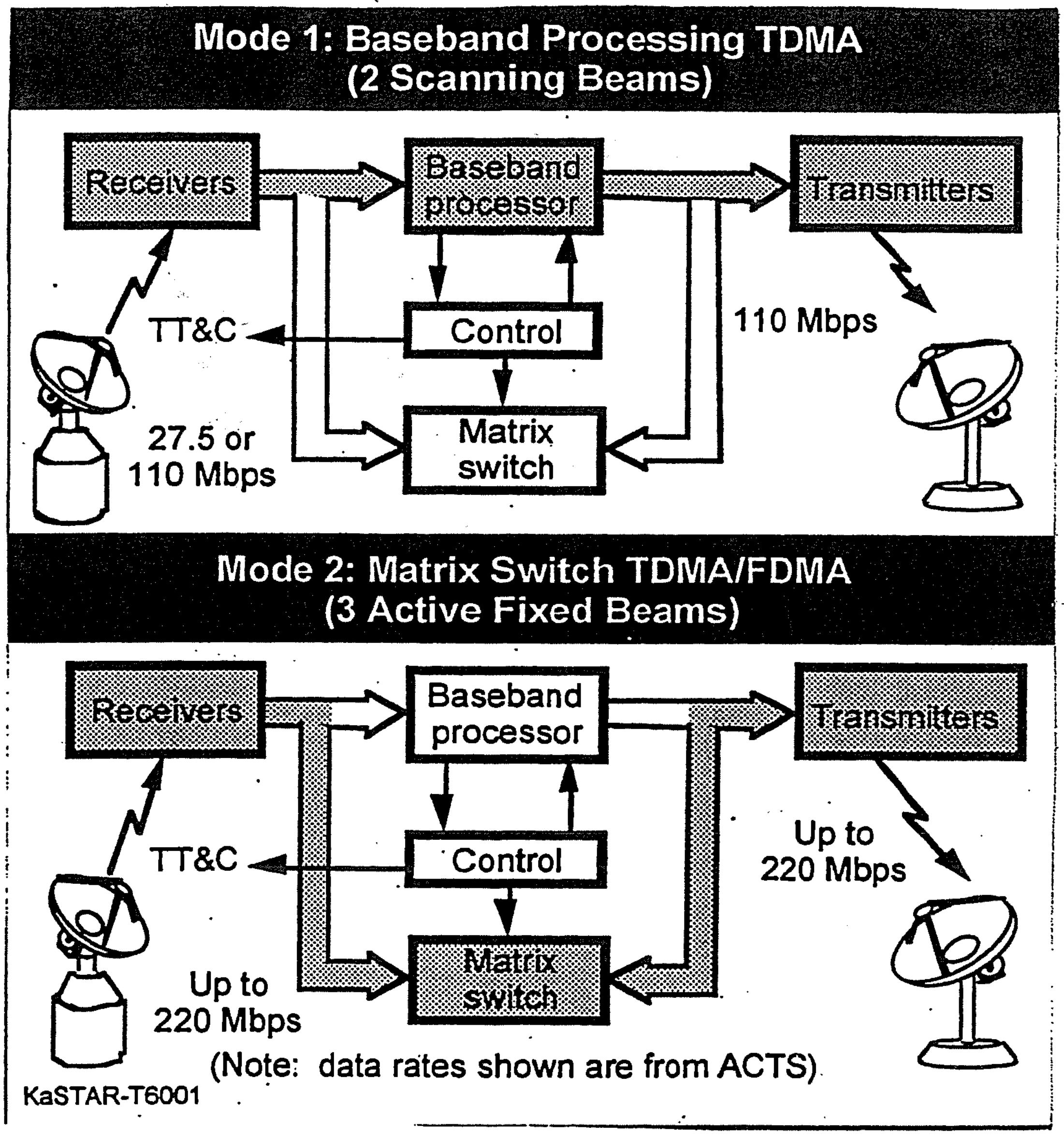

Figure VI.A.2-1

KaSTARCOM./ACTS Low-Rate BBP and High-Rate MSM Traffic Flow

The difference in the communications system designs between **KaSTARCOM.** and ACTS comes in the capacity of each subsystem: on **KaSTARCOM.**, the BBP processes 42 uplink/downlink 120 Mbps channels and the MSM routes 31 channels, but at different data rates.

The Gateway to Gateway links are primarily wideband trunking services with OC-1 to OC-3 capacity and will use the MSM "bent pipe" mode of transmission.

The CPE uplinks will utilize the basis T-1 rate as a building block with time multiplexing on a sub-frame basis to achieve lower CPE requirements (ie. 384 kbps and 768 kbps). Higher bit rates may be achieved by multiples up to 4 times T-1 rates.

Each uplink and downlink beam is allocated 120 MHZ bandwidth for each polarization providing a total throughput rate in excess of 240 Mbps per beam. A maximum EIRP of 60 dBW (on axis) will be provided for each beam.

The **KaSTARCOM.** MSM subsystem will accommodate transmission rates up to 155.52 Mbps (ATM/STA-3/OC-3) in each beam. This can be accommodated in a bandwidth of 120-MHZ per beam with QPSK modulation. These rates will be organized in the uplinks by the Network Control Center (NCC) assigning appropriate bandwidth to the FDM signals on request from the users.

Baseband Processor Preliminary Requirements

The baseband processor is to consist of modules to provide a total throughput of up to 5 Gbps. Each module will provide a 120 Mbps output signal and receive multiple 2 and 8 Mbps streams. Data will be routed from the multiple input ports on a packet basis within and between processor modules to the multiple output ports. A message packet will support 1/16 of a T1 circuit. Frame time will be between 1 and 10 milliseconds. Each input and output stream will contain synchronization signals and orderwire information in addition to the message packets. The basic characteristics of the BBP are:

1. Uplink

   1.1 Modulation: QPSK.
   1.2 Transmission rate: 2 Mbps; 8 Mbps
   1.3 Number of ports: up to 40-2 Mbps ports; up to 8-8 Mbps ports
   1.4 TDM: each input signal stream may consist of up to 4 independent bursts
   1.5 Packet: each burst may be further divided into packets that require independent routing. A full 2 Mbps stream will contain 16 message packets; an 8 Mbps stream will contain 64 message packets.

2. Downlink
   2.1 Modulation: QPSK
   2.2 Transmission rate: 120 Mbps
   2.3 Number of ports: 1
   2.4 TDM: each output signal stream may consist of up to 960 independent message packets.

In the satellite communications payload, subchannel data rates at T2 and below (384 kbps, 768 kbps, 1.544 Mbps, 6.312 Mbps) will be handled by the BBP; rates above T2 will be handled by the MSM. The latter will include T3 (44.736 Mbps), OC-1/STS-1 (51.84 Mbps), and ATM/OC-3/STS-3 (155.52 Mbps). The decision as to which subsystem is operational for the beam traffic is made by the NCC in response to user requests for capacity. In reality, this means the NCC will dedicate particular beams to be either low-rate or high-rate beams and connect them to the BBP or MSM accordingly. Once made, this allocation remains set until the NCC commands a change; that is, the allocations of beams to low-rate and high-rate traffic is not performed dynamically by the satellite communications payload. Since the majority of high-rate traffic is foreseen to be between businesses using ATM communication systems and fiber-optic cable nodes using OC-3 (and above) transmissions, it is to be expected these users will require continuous, uninterrupted links. This arises because (a) these data rates require the full 120-MHZ bandwidth of the beam, and (b) their traffic has already been multiplexed from a variety of sources and does not require further multiplexing.

Rates above OC-3 will be accommodated using the "SONET Stripes" approach over multiple beams--users in CONUS may be served by up to eight beams from the two satellites at different frequencies and polarizations. This principal is illustrated in Figure VI.A.2-2[8], showing the HIPPI/SONET communications link over ACTS. As can be seen, data rates above OC-3 (155.52 Mbps) are accommodated by subdividing into OC-3 channels, or "SONET Stripes." But note that the HIPPI/SONET Gateway in this diagram would be a user terminal and is not part of the **KaSTARCOM.** system provided by **KaSTARCOM.** World Satellite Corp.

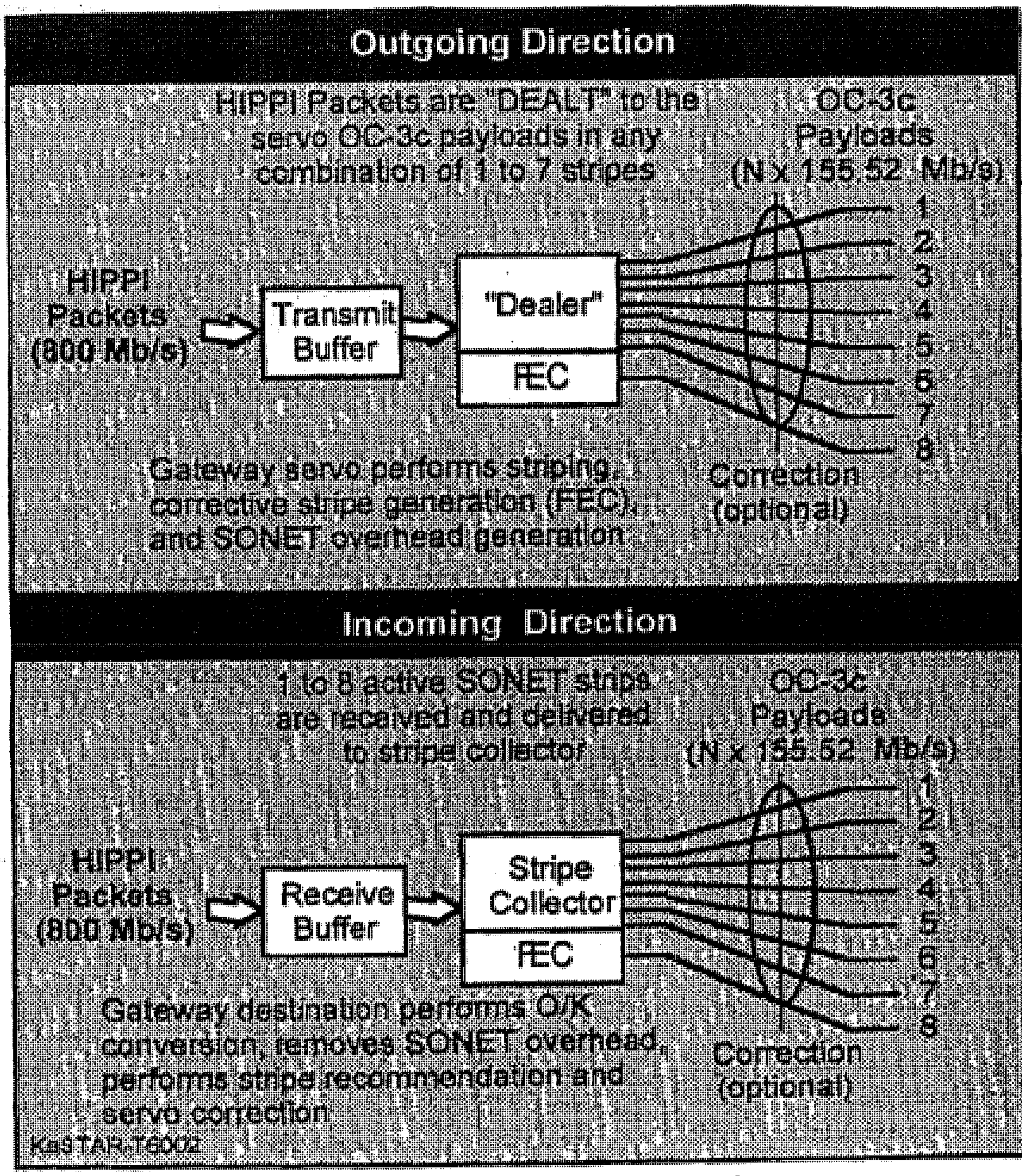

Figure VI.A.2-2 HIPPI/SONET Gateway

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[8] ibid., Dr. Marcos Bergamo.

Figure VI.A.2-3[9] shows how rates up to STS-12/OC-12 (622.08 Mbps) can be accommodated by different number of OC-3 Stripes. In all cases, actual achieved data rates will be a function of user terminal size and traffic type.

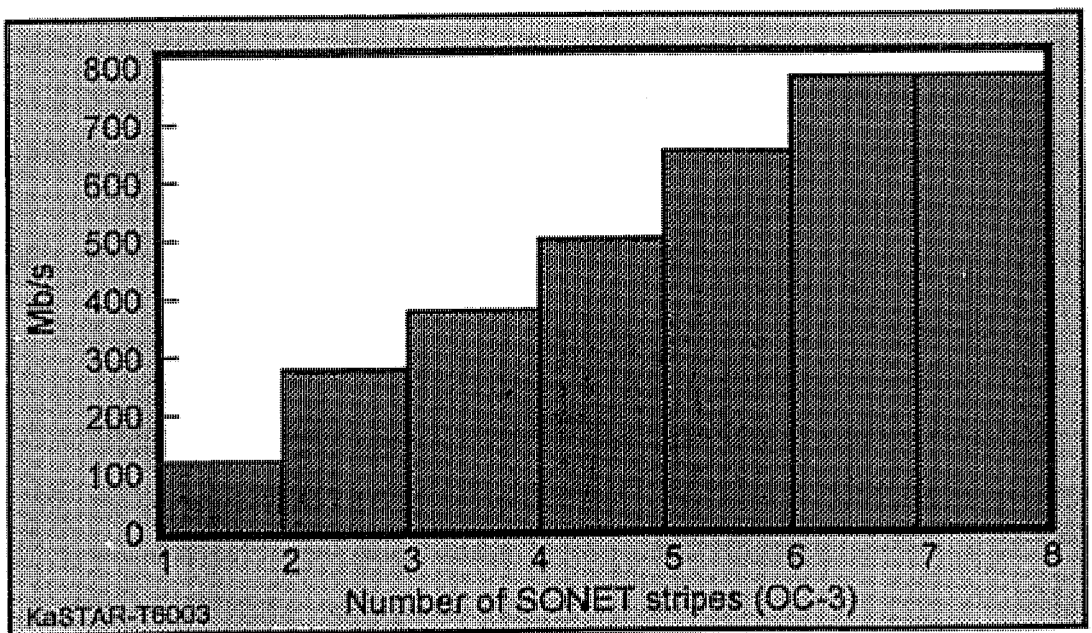

Figure VI.A.2-3 HIPPI performance vs SONET OC-3s

[9] ibid., Dr. Marcos Bergamo.

The ACTS BBP and MSM provide the design heritage for the traffic routing baseband processor and microwave switch matrix forming the heart of each satellite's communication payload. Using this BBP and MSM technology moves satellite-based communications out of the age of simple and static "bent pipe" links between ground terminals which were expensive to re-route and limited in communications capability. Instead, the **KaSTARCOM.** system will offer the traffic distributor and user the unparalleled opportunity to dynamically re-route traffic in real-time, allowing both the targeting of specific users for the reception of specific traffic and real-time re-routing of traffic as a function of the user needs. As will be seen, this unique feature opens wide the possible applications market for this system, allowing the one system to address the needs of a range of users previously requiring diverse and separate satellite systems. Because the BBP and MSM technology has been demonstrated on ACTS, the implementation of the **KaSTARCOM.** BBP and MSM is viewed as a low-risk item. This view is also supported by the application and use of the same basic design and technology on IRIDIUM® and its proposal (in a derivative form) for Teledesic and Spaceway.

As mentioned, the BBP and MSM route traffic within and between beams. How this re-routing is implemented depends on whether the traffic is low rate (T2 and below) or high rate (above T3 up to OC-3). The routing, in terms of the beam assignments (ie. connections) to the BBP for low-rate data or MSM for high-rate data, is determined by the NCC from routing requests sent to it by the traffic distributors and users via an Orderwire bent-pipe channel on each satellite. The NCC sends the beam assignment instructions via the Satellite Operations Control Center (SOCC) and the satellite TT&C to the BBP which then sets the connection of the beams to the BBP or the MSM according to these instructions.

VI.A.2.a Low-Rate Data

All traffic at T1 rates (1.544 Mbps) and below is processed and routed by the BBP. The low-rate traffic will typically be VSAT and similar traffic of 1.544 Mbps (T1) data rate and below. These channels will be frequency division multiplexed into the appropriate satellite uplink antenna beam covering each uplink ground transmitter. Whatever the base data rate, the data will be packetized to the ATM standard, and each packet header will contain the definition of the routing required. In the BBP, the uplink stream is demodulated and the data packet headers are decoded to determine the required downlink routing of each separate packet. In this way, the uplink FDM channels are demultiplexed and then the data packets TDM remultiplexed into new downlink beams such that all packets requiring to be routed to the same downlink beam coverage area are in the same downlink beam.

This approach of dynamically determining the routing in real-time from an examination of the data packet headers by the payload BBP is very much suited to the ATM/SONET-type communications protocols **KaSTARCOM.** will use.

In order to provide an "open system" access for uplinking to the satellites by the users while also assuring the bandwidth utilization efficiency, the system will use FDM uplinks and TDM downlinks. In this way, the need for time synchronization of the uplink terminals is avoided and the downlink user terminals will use essentially the same technology as the current DirecTV DBS digital video terminals to extract the required data packets from the TDM digital data stream.

Additionally, because the satellite payload transponders are operating as an FDM to TDM converter, their high power amplifiers (HPAs) are run in a saturated SCPC mode. Figure VI.A.2a-1[10] illustrates the basic link concept, making the point that both the transmit earth station TWTA (because it is handling one frequency channel of the multichannel FDM uplink) and the satellite TWTA are run in their most linear modes. This maximizes their conversion efficiency and minimizes the generation of wasteful spurious harmonic and intermodulation interference.

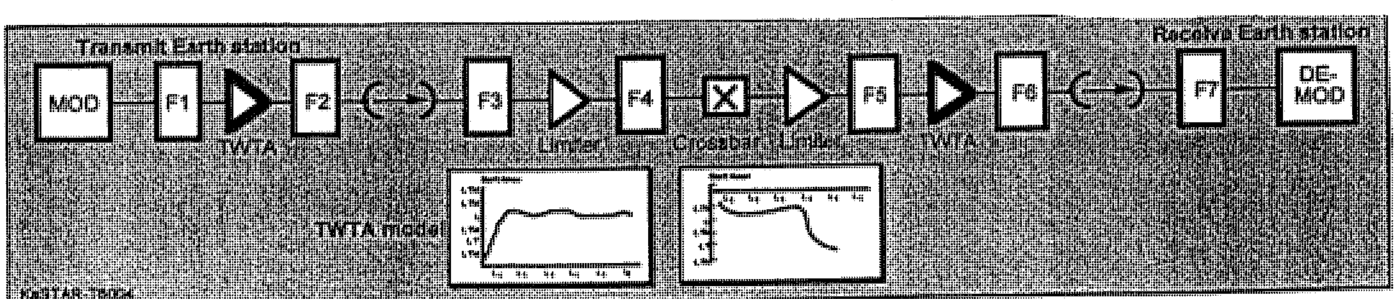

Figure VI.A.2.a-1 HDR SATCOM with on-board crossbar channel switching

[10] ibid., Dr. Marcos Bergamo.

VI.A.2.b High-Rate Data

All traffic above the T2 rates and up to the ATM/STS-3/OC-3 rates (155.52 Mbps) are processed and routed by the MSM and not by the BBP. The beams assigned to the MSM chain will have been connected by switching commands from the BBP following instructions transmitted to the BBP by the NCC over the satellite TT&C channels. Once the assigned beams have been connected, the BBP plays no further role in the traffic data processing until the NCC sends new beam assignment instructions. The MSM now acts as a "bent pipe" transponder, taking in the uplink broadband signal from a beam and sending it down the beam or beams defined by the MSM switch state. Because there is no signal processing in the MSM function, there can be no FDM to TDM conversion in the MSM chain. That is, the full beam bandwidth must always be used for any transmission, so there can only be one carrier per beam. In essence the transponder is acting as a trunking system and this means this high data-rate mode of the satellite communications payload will only be used by traffic hub stations, fiber-optic cable nodes, and the like. The hub stations will package traffic at the lower data rates into an ATM/OC-3 standard transmission to avoid wasting bandwidth. Users and subscriber groups will see **KaSTARCOM.** as a transparent service based on defined interface specifications.

In both modes (low and high rate), the packets will comply with the ATM standard irrespective of the actual base data rate. The traffic type will determine the ATM Type--for example, 1 (for voice traffic) and 5 (for data traffic)--and this will be reflected in the ATM Adaptation Layer (AAL) of the cell header. The cells (or packets) transmitted to the satellite from the user ground terminal will include FEC, Reed-Solomon, and other robust codes to provide a high degree of data security and rain fade protection. In the low data-rate mode, the BBP will use the same codes for the transmission of the packets to the user terminals. Unlike on ACTS, the **KaSTARCOM.** BBP will not perform any form of additional FEC coding on the downlinked signals; instead, all coding will be performed at the uplink ground terminals and the satellite transponders will have sufficiently powerful amplifiers to provide an adequate link margin under most climatic conditions in the USA. It is important to note that these link codes are intended to supply the user with an acceptable grade of service; however, these codes are transparent to the user.

In all cases, the user ground reception terminals must be capable of operating over the entire 155.51-Mbps range at the front end, since the terminal has to receive a TDM broadband transmission and extract the data packets addressed to that specific terminal. On the transmission side, each terminal must cover the entire 500-MHZ band at the RF front end since it has to send an appropriate FDM signal to the satellite with frequency agile transmitters. None of this presents great technical problems nor will it have a significant user terminal price impact.

As has been noted, the number of "subchannels" per beam is dependent on the channel traffic data rates. The beams are grouped into four frequency sets and the four sets are overlaid on each other. This approach ensures the high capacity, narrow beams are used in the most efficient manner to cover a large geographic area, while only placing reasonable demands on the satellite power, mass and thermal resources. That is, the satellite is more realistic to produce with current technology and does not require the development of new solar array, battery or thermal control technologies, an important consideration for a commercial venture like this. Unlike the current DBS video satellites, it avoids the need for the very high power (120/240W) amplifiers associated with large area spots at the same high data rates, using instead multiple high gain spot beams and 50W amplifiers (Fig. VII.B.2-1).

The microwave ISL's will utilize 60-GHz technology developed under the SDIO/BMDO program and adapted for commercial use. Each satellite will carry an ISL with up to four 120 MHZ channels, and the antenna beam will be wide enough to avoid acquisition and tracking problems with the other targeted satellite. The BBP and MSM will both route traffic through the downlink beams of the host satellite as well as through the ISL for downlinking through the neighboring satellite's beams, depending on the data packet routing requirements. However, the same data packets would not normally be both downlinked from the host and sent through the ISL for downlinking from the neighboring satellite unless some form of broadcast mode was required by a user.

Because **KaSTARCOM.** is answering some of the same market needs as IRIDIUM® and Teledesic, it will inevitably at first sight have an apparent degree of similarity to these two designs. However, as should be evident from the detail provided in this Application, there are significant and important differences between the three approaches:

- First, the **KaSTARCOM.** will use GEO-satellites and not LEO-satellites (like IRIDIUM® and Teledesic). The reasons are simple:
  - GEO-satellites can lay down a permanent, uninterrupted, fixed coverage pattern on the ground.
  - A GEO-satellite can have a ground coverage antenna pattern that is shaped for optimum coverage of the landmass it is illuminating. The shaping and beam traffic density can also take account of population density and traffic demands, thus increasing the system effectiveness and efficiency of the communications resource usage.
- Second, for marketing, economic, and technical reasons, the **KaSTARCOM.** will make use of broadband ATM and ATM-compatible high rate digital packetized data communications applications: SONET fiber network, B-ISDN, interactive video, phone trunking, cellular- and PCN-switch linking, video-conferencing, computer networking, and similar-advanced communications traffics on the "National Information Infrastructure." The reasons for compatibility with the ATM standard have been best described by Ellen M. Hancock (IBM Networking Systems)[12]:

"ATM's impact will be profound. It will be the springboard to the next great leap forward in communications. Why? Because ATM is not just another networking technology. It offers four key advantages and advances:

1. ATM increases the amount of information a network can carry--multiplying capacity not by tens, not by hundreds, but by thousands
2. ATM is an outstanding technology for mixing data, voice, text, image, and video--and delivering them all simultaneously over a single network
3. ATM offers a base for integrating networks of all types and sizes: local-area networks, wide-area networks, and later, nationwide and worldwide "information superhighways,"

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[12] *Asynchronous Transfer Mode--The Coming Revolution;* Ellen M. Hancock, IBM Networking Systems; World Communications and Technology 1994, Sterling Publications Limited.

and

4. ATM promises to be a rare thing in our industry: a true standard, embraced by all the major suppliers--and not in just one country, but worldwide.

IBM and many others--networking and computer suppliers, telephone carriers, cable television operators and more--have identified ATM as the definitive high-speed networking technology for the next 15 years. All these information providers will play in tomorrow's global information system, providing information-rich communications tools in the office, in the home, and on the road. In short, anywhere we can plug in, dial in, or raise an antenna."

As Hancock notes, ATM is rapidly becoming--and may, indeed, have even already become--the defacto worldwide standard for high-speed digital communications. And the major networking companies--for example: Hughes LAN Systems[13] and IBM Networking Systems[14]--have already adopted ATM as the standard for their systems and are producing the corresponding equipment.

This is because being cell-based rather than packet-based, ATM has proved to be capable of carrying any type of information and of being simpler and faster than the competing packet-based systems (Ethernet, FDDI, etc.). In a packet system, each packet is of variable length and the location of its headers and addresses is dependent on the network protocol (IP, IPX, DECNET, Appletalk, etc.), making packets inherently more difficult to forward than cells. Whereas the ATM cell is a fixed length (53 bytes) and the header is always the first five bytes and has a standard, defined format.

Additionally, ATM is a connection-oriented technology. In contrast, most LAN-based protocols (IP, IPX, Appletalk, etc.) are connectionless which means nodes simply transmit data packets as and when they need to without first establishing any communication with the destination node. In the ATM network, a connection is established between the two end points--the "virtual circuit"--

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13 *Asynchronous Transfer Mode--The Future of Global Networking;* Bobby Murphy and Anthony Alles, Hughes LAN Systems; World Communications and Technology 1994, Sterling Publications Limited.

14 ibid., Ellen M. Hancock.

before the data transfer can take place. Once the virtual circuit is set up, the ATM cells are self-routed by the fields in the cell header that define the connections to which the cell belongs.

Finally, ATM is a scaleable technology, ranging in speeds from less than 12 Mbps up to 48 Gbps per user. In contrast, FDDI and Faster Ethernet, for example, provide data rates of 100 Mbps but that is shared among all users on the network.

VI.B SYSTEM DESIGN DESCRIPTION

The **KaSTARCOM.** system will consist of a space segment and a ground segment.

The space segment will eventually consist of four satellites, currently proposed to be based on the Lockheed Martin Astro-Space Series A2100 satellite bus, and four launch vehicles--selected from an Ariane, Proton, or Sea Launch. The four satellites will be located at 109.2° WL, 73° WL, 52° EL and 175° WL and maintained at a geosynchronous position to within ±0.05° and at zero inclination to within ±0.05°.

The ground segment will be comprised of:

- Two TT&C Earth stations for the tracking, telemetry, and command of the satellites;
- A satellite operations control center (SOCC) that performs the functions of satellite control from the Mission Control Station (MCS) and of the communications payload and traffic management from NCC--that is, the MCS and NCC are part of the SOCC complex. These centers communicate with the satellite through the TT&C stations;
- The traffic hub stations and user terminals providing the communications services.

KaSTARCOM. World Satellite Corp. will construct, own, and operate the SOCC (which includes the MCS and NCC) and TT&C stations; the traffic hub stations will be part of the traffic suppliers' systems, e.g., a radio broadcaster or a business's VSAT hub. The actual manning, operation, and maintenance of the SOCC/MCS/NCC and TT&C stations may be subcontracted to one of the number of companies already providing such services.

KaSTARCOM. World Satellite Corp. currently plans to arrange the construction of the SOCC and TT&C station at Douglas County, Colorado.

The TT&C stations will each include two 4-meter, Ka-band antennas interfaced to a 20-GHz receiver and a 30-GHz transmitter; there will also be a single, steerable 10-meter, C-band antenna with a 6-GHz transmitter and 4-GHz receiver. For economic and practical reasons, the satellites will use C-band for the TT&C during the launch and early operations phase of the missions. During this phase, it is important to have adequate coverage of the satellite from the ground, normally requiring several stations in the northern and southern hemispheres around the world. Once on station, the satellites will communicate with the TT&C stations at Ka-band directly through the main satellite antennas. Then the C-band TT&C transponder will serve as a backup to the Ka-band system, communicating through the satellite omni-antenna.

The SOCC will be linked to the TT&C stations by dedicated leased lines. The MCS in the SOCC is responsible for all monitoring and control of the satellite, including the communications payload, via the TT&C channels. The TT&C stations route the received telemetry data to the SOCC for archiving, processing, analysis, and display. Acting on both the satellite status as indicated by this telemetry, and the communications payload configuration requests from the NCC, the MCS staff then issue commands to the satellites by routing these commands to the TT&C stations for transmission. For redundancy and safety purposes, the TT&C stations can also be operated independently of the SOCC/MCS if necessary in an emergency.

The **KaSTARCOM.** system users will interface to the system through the NCC. The NCC is responsible for the monitoring and management of the complete **KaSTARCOM.** user-communications system, including ground stations where appropriate. The key function of the NCC is to optimize the configuration of the satellite communication payloads such that maximum capacity availability is ensured at all times and especially during peak hours of usage. The associated functions are to serve as the authority to whom users send their requests for capacity assignments, to authorize access to the satellites by the users, and to monitor and analyze the **KaSTARCOM.** system communications performance over time. NCC will initiate the necessary corrective measures for any observed performance degradation such as outages, excess blocking time, and excess queuing time, etc.

All of the user terminals communicating with the system will be owned by the relevant end-users, be they private individuals, companies, or traffic hub operators. However, it is not ruled out that at some future date during the system operation, traffic hubs could be installed and operated by the **KaSTARCOM.** system. The decision on this would depend on the market developments at that time.