Assessing the Technical and Financial Viability of Broadband Satellite Systems Using a Cost per T1 Minute Metric

by
Andjelka Kelic

B.S.E. Aerospace Engineering, University of Michigan, 1995
B.S. Political Science, University of Michigan, 1995

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Signature of Author______________________________________
Department of Aeronautics and Astronautics
August 13, 1999

Certified by______________________________________
Professor Daniel Hastings
Professor of Aeronautics and Astronautics
Thesis Supervisor

Accepted by______________________________________
Professor Jaime Peraire
Department of Aeronautics and Astronautics Graduate Committee

Accepted by______________________________________
Professor Richard de Neufville
Chairman, Technology and Policy Program
Professor of Civil Engineering

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Abstract

A cost per 1.544 Mbps (T1) link per minute metric is developed for systems evaluation of satellite based broadband communications systems. Global market models based on Internet growth and computer penetration are developed. Initially systems are limited by the available market, however as the market increases, the design of the system becomes the limiting factor. These limits include satellite power resources, achievable link margins, and rain attenuation. A computer simulation is developed to model the complex interactions between the capacity limits and distributed market models.

The most effective designs should be able to satisfy the expected market model for the lowest cost per T1 minute. To calculate the metric, life cycle costs are estimated for satellite design and construction, launch, insurance, gateways, gateway and control center operations, and terrestrial Internet connections. The cost per T1 minute for a 30% internal rate of return is then calculated from the achievable capacity. The metric is evaluated for five modeled systems in geosynchronous and low Earth orbits to demonstrate the applicability of the metric to the system engineering and design process.

The results indicate that there is room for multiple systems in the market because the initially deployed systems cannot satisfy the full market demand. The cost per T1 minute indicates that all of the systems are economically viable and able to compete with terrestrial services. The metric shows the sensitivity of the systems to market variations and illustrates the criticality of beam placement and deployment strategies to minimize risk. Using the metric, several strategies are explored to tailor systems to the market as it develops and also to cope with market uncertainties.

Thesis Supervisor: Daniel E. Hastings
Title: Professor of Aeronautics and Astronautics

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Finally thank you most of all to my parents, Svetislav and Diane Kelic, for always supporting me in everything that I chose to do.

Any sufficiently advanced technology is indistinguishable from magic.

Clark's Third Law

Listen – you'll never learn anything by talking. The measure of an intelligent person is the ability to change his mind.

Kelly Johnson

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Chapter 1: Introduction

1.1 Satellite Telecommunications

Commercial satellite ventures in telecommunications and remote sensing are experiencing a period of rapid growth. Telecommunications is by far the largest commercial use of satellites today with many of the satellite manufacturers attempting to not only provide satellite busses to third parties for telecommunications payloads, but to put forth their own commercial telecommunications ventures. Though satellite manufacturers are just beginning to get into the business of commercial telecommunications, the use of satellites in such systems has a much longer history. Space-based communications had its roots in the market demands for reliable telephone service from the United States to Europe.

The first radio links for overseas calls were established between Europe and the United States in 1915. Despite many improvements, communication by radio was typically unreliable, noisy, and expensive. Service was so poor that people refrained from making overseas calls unless absolutely necessary. The problem with reliability was eliminated in 1956 with the laying of the first transatlantic telephone cable, TAT-1. The major drawback to the cable was its extremely limited capacity. It could only handle 36 telephone calls at any one time. As traffic grew, the decision of how to handle the increasing volume quickly came to the fore. AT&T had already placed microwave towers on hilltops to establish large capacity radio links for transcontinental telephone traffic. The leap to the idea of satellites was simply waiting for the appropriate time.

Thus the scene was set for the launching of satellites as part of the International Geophysical Year (IGY) which was from July 1, 1957 to December 31, 1958. Both the United States and the Soviet Union set rocket and satellite programs in motion to meet this goal. On October 4, 1957, the Soviets launched their first satellite. In late January of 1958, the United States followed suit with the launch of the Explorer satellite. While the IGY satellites did little to solve the communications problems, they did prove to the world that launching something into orbit was possible.

The first entity to capitalize on this ability and make use of it in the realm of communications was the United States military. The SCORE (Satellite Communications Repeater) satellite was launched into a low Earth orbit (LEO) in December, 1958. Technologically, the satellite was simple; a receiver and tape recorder stored a message transmitted from the ground during one part of its orbit, which could later be relayed via a transmitter to a ground station below another part of the orbit. The military application was to carry orders from the Pentagon to a commander in some remote region and carry intelligence in the opposite direction.

On the civilian side, AT&T's Bell Telephone Laboratories had been working on traveling wave tubes, which would make satellite transmitters very efficient. Studies by the director, Dr. John Pierce, concluded that satellites for communications should not be higher than two or three thousand miles, because if they were, transmission time delay would cause an echo in conversations. In simulations where a delay was inserted, Pierce found that the delay in combination with the poor quality of the echo suppression techniques in use lowered voice quality far below what the public was willing to accept.

The Echo satellite was launched into a medium altitude orbit (MEO) of about a thousand miles high in August 1960. The purpose of the satellite was to study atmospheric density, the pressure of the sun on a large balloon in orbit, and several communications questions posed by Bell Labs. Echo was a limited success. Ground stations on opposite sides of the country and even across the ocean were able to communicate with one another by reflecting signals off of Echo's surface. However, since Echo was merely a mirror, only a tiny fraction of the energy striking it was reflected back to Earth.

Bell Labs and RCA quickly began work on two satellites that would not be nearly as power limited as Echo. At around the same time, NASA decided to solicit bids for an active satellite. In addition to awarding the contract to RCA for a satellite called Relay, NASA agreed to launch Bell Labs' Telstar satellite. Both satellites successfully transmitted two-way telephone conversations and live television signals. The dawn of a new era in the commercial telecommunications industry had begun.

The government added its endorsement of satellite telecommunications with the passage of the Communications Satellite Act of 1962. The act called for the creation of a private company, which later came to be called the Communications Satellite Corporation (Comsat) that would be closely regulated as to technical, economic, and foreign matters by the government. Half of Comsat's stock would be sold to the public, the other half was reserved for purchase by communications companies. Its charter called for creating a global system of satellite communications [McLucas, p. 31]. Comsat still exists today, and the communications satellite industry has grown to be the largest and most successful commercial space application.

1.2 Modern Systems

The quest still continues for a global system of communications in the present day. Now, instead of the simple desire of making an overseas call, the trend is toward mobile systems, more ubiquitous information accessibility, and personal information services. A large step forward occurred in this arena when the Federal Communications Commission (FCC) awarded licenses to three companies to build, launch, and operate low earth orbiting satellite systems to provide worldwide mobile voice services with transceivers about the size of today's cellular telephones. The three systems awarded licenses at that time were Iridium, Globalstar, and Odyssey[1]. These systems plan to begin providing service in 1998.

With the increased emphasis on a National and Global Information Infrastructure (NII and GII), the Internet has become the newest manifestation of the power of information. As a disseminator of information, it has no parallel. The overarching vision for the GII is that it will allow ready access to information at a reasonable cost by anyone at any time. Yet many countries are attempting to regulate, if not block access to the Internet. The feeling is that whoever controls the flow of information, has the ability to control the parts of the world depending on that information.

In light of this, it was not surprising that when the FCC deadline for filing an application to construct and launch broadband satellite communications systems passed on September 29, 1995, fourteen companies had filed applications. These companies were categorized based on coverage and market focus as shown in Figure 1.1.

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[1] For a technical and cost analysis of these systems see MIT S.M. Thesis, *Assessing the Future Growth Potential of Mobile Satellite Systems Using a Cost per Billable Minute* by Cary Gumbert, August 1995, and MIT S.M. Thesis, *The Development and Application of a Cost per Minute Metric for the Evaluation of Mobile Satellite Systems in a Limited-Growth Voice Communications Market* by Michael Violet, August 1995.

CONUS
Millennium (Motorola)
Echostar
Netsat
Ka-Star
Vision Star

Extensions
GE Americom
PanAmSat
Orion Atlantic

Worldwide Systems
Spaceway (Hughes)
Astrolink (Lock/Martin)
Teledesic (Gates/McCaw)
VoiceSpan (AT&T)
CyberStar (SS/L)
Morning Star

Figure 1.1: Fourteen companies filing with FCC

Of the fourteen systems, five provide regional coverage over the continental United States (CONUS) with similar services for Alaska and Hawaii, three are extensions of existing systems, and six provide global coverage. The extensions are applications to add additional satellites to Direct Broadcast Service (DBS) systems with the ability to transmit data at Ka band. Data transmission was listed as a secondary service for these systems, with their main focus being DBS.

The six truly global broadband systems propose to expand the NII and the GII by providing a wide range of broadband services to small fixed or transportable terminals. Through the wide range of coverage that is proposed, the systems plan to bring the following services to the global marketplace:

- Videoconferencing: By providing bandwidth on demand, the systems will be able to carry audio and video signals from desktop to desktop throughout the world. This service will have the flexibility to be tailored to end users' geographic needs thus offering lower rates and global accessibility.
- Telemedicine: Telemedicine will allow health care to be brought to regions of the world that have very limited provisions for health care. Through videoconferencing for diagnosis and treatment, and the ability to rapidly transmit large amounts of data, such as X-ray images, to remote specialists for analysis, the systems will provide information to nurses and medical workers in remote locations.
- Intranets: Divisions of corporations are becoming more globally diverse as the work force is becoming more widely distributed. The systems will link regional offices together and link telecommuters with their home offices.

- Distance Learning: Just as with medical professionals, educators will be able to use the systems to provide educational services to students who are in remote locations. The high bandwidth of the systems will allow these services to be provided on an interactive basis and in real time.
- Global Internet and Telephony Access: The systems also propose to reach the "last mile", or the individual users that cannot obtain service through other means. In many of the industrialized areas of the world, this means broadband Internet services for individual computer users. In the less developed areas of the world, the systems can provide access to basic communications services like telephony.

Flexibility is a key element of the broadband satellite systems that make all of these services possible. Large coverage areas allow access to small user terminals almost anywhere in the world. The user terminals are fixed, but their size of approximately 60 cm makes them extremely portable. Bandwidth on demand gives the users of the system the data rates they need when they need them without requiring large changes in infrastructure or equipment.

The existence of so many different proposed systems to provide global broadband communications raised the issue of whether a metric could be constructed to assist in determining an optimal technical design and path for corporate deployment strategies. Gumbert [Gumbert, 1995] and Violet [Violet, 1995] demonstrated that a cost per function metric could be developed to successfully compare satellite based mobile telecommunications services. The following methodology, employed to develop the cost per billable minute metric, was also used to develop the comparative metric for the broadband systems:

1. Construct a market model
2. Develop a simulation to determine system capacity using the technical characteristics of the system and the market model
3. Construct a cost model for the systems
4. Combine the cost model and the simulation results to obtain a cost per function

This thesis follows that methodology and carries it forward, employing the metric to examine design decisions and develop corporate strategies for implementation.

In order to focus the analysis, five of the worldwide systems were chosen as models for construction of the metric. These systems are Spaceway [Hughes Communications Galaxy, Inc., 1994], Astrolink [Lockheed Martin Corporation], CyberStar [LAHI], VoiceSpan [AT&T Corporation], and Teledesic [Teledesic Corporation]. A summary of their characteristics from the respective FCC filings is shown in Table 1.1.

Table 1.1: System Summary

System	Altitude (km)	Operational Satellites	Locations (Planes)	Access Scheme	Spot Beams
Astrolink	35785 (GEO)	9	5	TDMA/FDMA	192
CyberStar	35785 (GEO)	3	3	FDM/TDMA	27
Spaceway	35785 (GEO)	8	4	TDMA	48
Teledesic	700 (LEO)	840	21	TDMA/FDMA	64
VoiceSpan	35785 (GEO)	12	7	CDMA	32-64

1.2 Cost per T1 Minute

The cost per T1 minute is the metric used to compare the broadband satellite systems. The cost per T1 minute is what the company needs to recover from customers through monthly service fees, ground equipment sales, and other services, in order to achieve a specific internal rate of return.

The concept of cost per function as a metric was developed in order to compare systems that are technologically very different, yet perform a similar function. The comparison that allows the systems to be evaluated on an equal basis is the cost incurred in order to achieve a particular function. In the case of global cellular communication it was cost per billable minute [Gumbert, Violet]. For launch vehicles the metric is cost per kg to a given orbit. For broadband communications systems it is the cost to provide high speed information transfer.

In the current market, the majority of home users of the Internet are typically billed a flat monthly fee for unlimited connect time. Since these users are limited by the data rate of current modem technology, data transfer rates can be neglected in the billing scheme. A flat fee is a convenient billing method since it eliminates the overhead necessary to monitor a customer's connection time. Most service providers that provide dial-in connections are moving away from a per minute charge towards a flat monthly fee [Boardwatch, July/August 1997]. Business customers, who connect to the Internet at widely varying data rates, purchase a connection for a maximum data rate. They then have the option to be billed monthly for an unlimited connect time at that rate or a monthly charge determined by the usage level under which 95 percent of statistically measured data flow falls. The statistically measured billing allows users to periodically obtain a burst data rate of the maximum without having to pay for the maximum data rate at all times. A monthly cost based on a specific data rate lends itself to the formulation of a metric for comparing broadband satellite communications systems. The broadband systems have varying connection rates and capacity differences, thus the metric for equitable comparison is a cost per minute based on a specific data rate. A cost per minute rather than a cost per month eliminates the necessity to estimate "typical" monthly usage. The broadband systems being compared are marketed as high speed data connections ideal for multimedia communication, thus a T1 (1.544 Mbps) data rate was selected as the rate for comparative analysis.

Once the achievable capacity and system costs are known, the cost per T1 minute can be estimated. The achievable capacity depends on the available market and the satellite system design. System costs include recurring and non-recurring estimates for satellite design and construction, launch, insurance, gateways, gateway and control center operations, and terrestrial Internet connections.

1.3 Report Overview

The following is a brief summary of the material contained in each chapter:

Chapter 2: Market Analysis

This chapter describes the three different market models developed for use in the simulation. From the market projections a geographical distribution was produced for the years 1999 to 2010. These traffic models are used in the capacity simulation.

Chapter 3: Capacity Simulations

The capacity model is described in detail. A computer simulation was used to determine the achievable capacity for each year of system operation. Some of the major limiting capacity constraints include market demographics, market capture, rain attenuation, inter-channel interference and overlap, and limited payload power resources.

Chapter 4: System Costs

This chapter describes the development of the $77K rule-of-thumb satellite cost model along with the corresponding models for launch and ground segment costs. The model is compared to the claimed costs for the systems listed in the FCC filings.

Chapter 5: Cost Per T1 Minute

The development of the cost per T1 minute metric is described in detail and is calculated for the modeled systems under the market scenarios described in Chapter 2. The effect of market capture and program delays on the cost per T1 minute is also explored.

Chapter 6: Corporate Strategies

Various strategies for implementation of a broadband satellite communications system exist. This chapter explores the effects of deployment strategies and beam placement on the cost per T1 minute. The competitiveness of the broadband satellite systems with current terrestrial technologies is examined.

Chapter 7: Conclusions

The study is concluded and a summary of the key issues that were raised through the analysis is provided.

Chapter 2: Market Analysis

2.1 Introduction

An understanding of the target market is crucial to any business venture. Attempts to accurately model the market are the focus of much activity in the corporate world. The Internet presents an excellent example of that phenomenon. Currently a flurry of studies are being conducted in order to quantify user behavior and purchasing habits on the Internet. Many corporations are interested in tapping into the sales potential that the Internet represents. Studied topics range from Internet usage to user demographics and purchasing patterns. Drawing from these studies and through independent research, market models for the broadband communications systems were constructed and are described in this chapter.

2.2 Internet Growth

By any estimate, the Internet is currently experiencing rapid growth. The inception of the World Wide Web (WWW) has caused a virtual explosion in Internet traffic. Recent surveys estimate that approximately 35-37 million people in the United States age 16 and over have access to the Internet [CommerceNet]. Local Internet service providers are springing up all over the United States and URLs (Universal Resource Locator) have become common sights on printed advertising. Corporate America has caught on to the Internet trend and spent $12.4 million in the fourth quarter of 1995 to purchase space on Web sites [Resnick]. Clearly the Internet is growing. The real challenge lies in quantifying that growth. Most sources say that the current growth is exponential, however, those estimates are based on sparse data. The data that is available comes from the old National Science Foundation (NSF) backbone that was administered by Merit, Inc. from its inception in the fall of 1987 to its decommission in April 1995. Merit gathered data on traffic traversing the NSFNET from January 1988 to April 1995 [NSFNET]. Depending on the method of examining the data, two very different Internet growth trends can be derived.

2.2.1 Exponential Growth Model

First, the Merit data in terms of the number of bytes traversing the NSF backbone from January 1991 to April 1995 is examined. As shown in Figure 2.1, the growth trend falls off abruptly after November of 1994. At that time, traffic began moving from the NSF backbone to the new Network Access Point (NAP) architecture [NSFNET]. The new NAP architecture was a realization that the growing role of commercial service providers needed to be accommodated and would allow the National Science Foundation (NSF) to step back from actually operating a network [Harris]. The NAP architecture allows regional networks and network service providers to connect and exchange traffic, with no content or usage restriction [Chicago NAP].

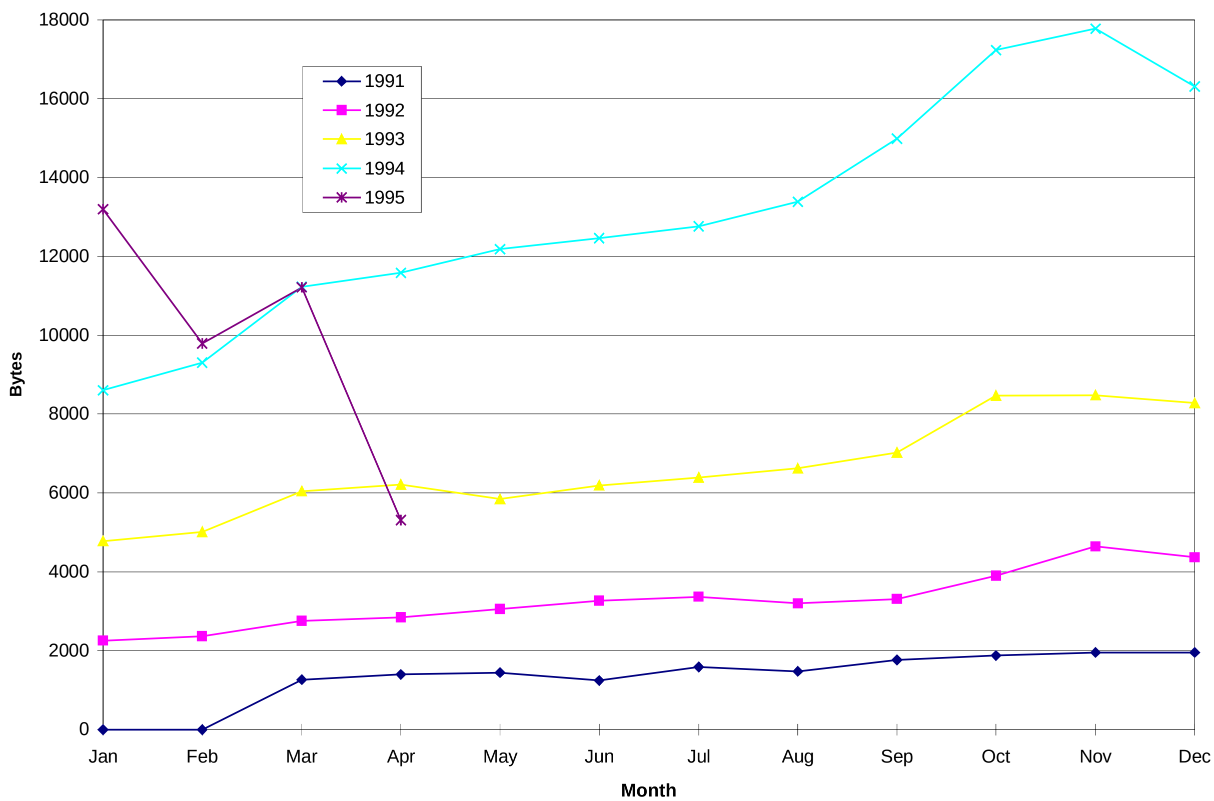

Figure 2.1: Bytes Traversing the NSF Backbone

The NSF backbone consisted of computers in the United States. Though data entering the NSF backbone could potentially come from networks in other countries, it is assumed that the majority of the data traversing the network at the time the data was taken is primarily from the

United States, since over half of all Internet hosts were located there [Lottor]. In order to obtain a projection of the world market, the amount of data traversing the NSF backbone is doubled. Neglecting the data obtained after the transition to the new architecture began, the data is projected forward to the year 2010. An exponential curve that most Internet users expect is obtained. Due to the new architecture, comprehensive data on bytes traversing the network after April 1995 is not available.

2.2.2 Third Order Growth Model

Looking at the Merit data in terms of the number of packets traversing the NSF backbone from January 1988 to April 1995 yields a very different growth curve, shown in Figure 2.2.

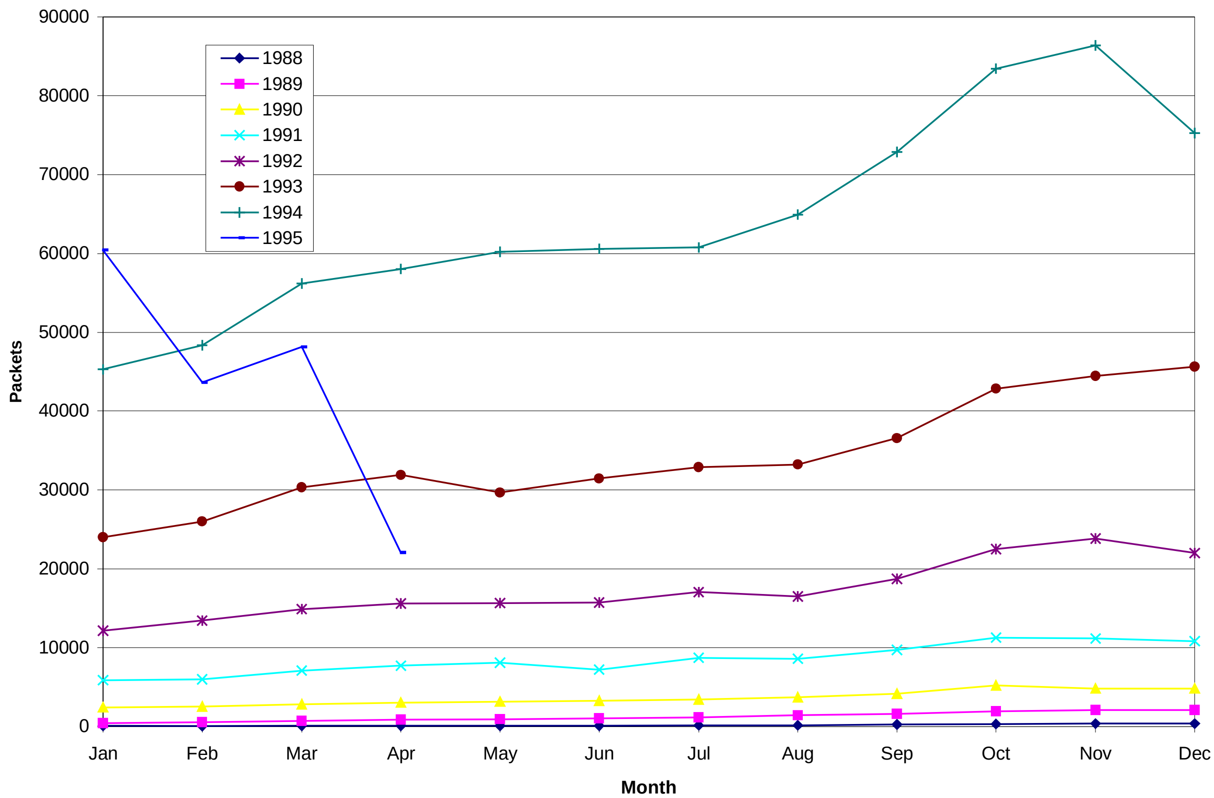

Figure 2.2: Packets Traversing the NSF Backbone

Again, data from December 1994 to April 1995 is neglected due to the transition to the new architecture. During the period prior to the transition, the average packet size was approximately 200 bytes, thus to transform the packet data into bytes, it is assumed that a packet is on average 200 bytes. As with the exponential model, the data is doubled to go from NSF backbone bytes to world bytes. When this data is projected forward, a third order curve is obtained.

2.2.3 Summary

The exponential and third order models are depicted in Figure 2.3. As shown, the projections come from only a small sampling of data. Unfortunately, due to the new NAP architecture, comprehensive network traffic data is no longer available.

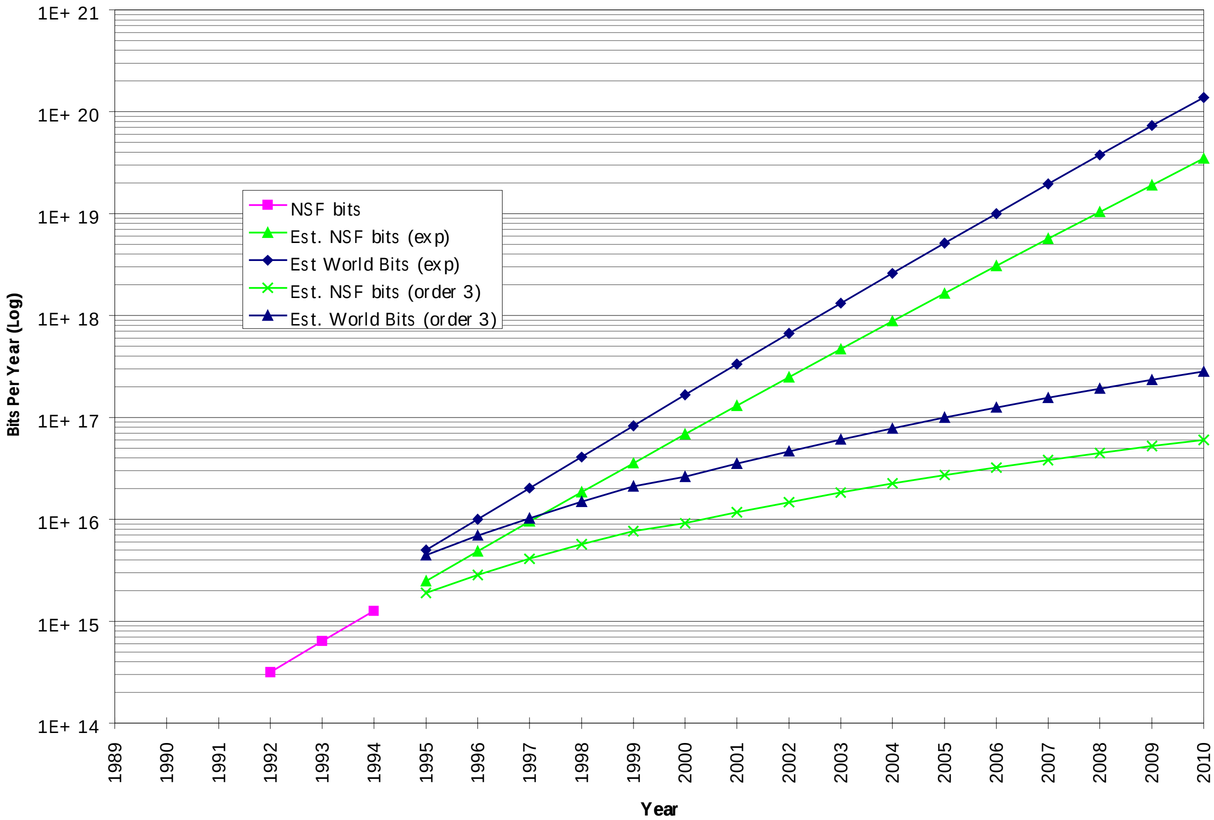

Figure 2.3: Exponential and Third Order Markets

These market models are assumed to be upper and lower bounds to the growth of Internet traffic. The third order model is a very conservative estimate due to the assumption of a 200 byte packet. Packets are not a constant size; thus assuming a constant size packet underestimates growth of high bandwidth services such as the World Wide Web, which did not become the largest source of network traffic until April of 1995. With the growth of Internet commerce and the beginnings of Internet telephony, it appears that the third order market is not a likely scenario. The model is kept to assist in examining the broadband satellite systems when they do not reach capacity saturation. The exponential model is considered an upper bound since the Internet is still in its infancy and growth rates of technology are typically exponential in the early years and then begin to level off. Both of these models discuss the growth of the entire Internet. It is anticipated that the increase in traffic will come from the extension of terrestrial land lines and new access technologies such as the broadband satellite systems.

2.3 The Last Mile

As another estimate of market growth, a model based on computer growth trends was developed. A graph of the world installed base of personal computers is shown in Figure 2.4 [Auerbach].

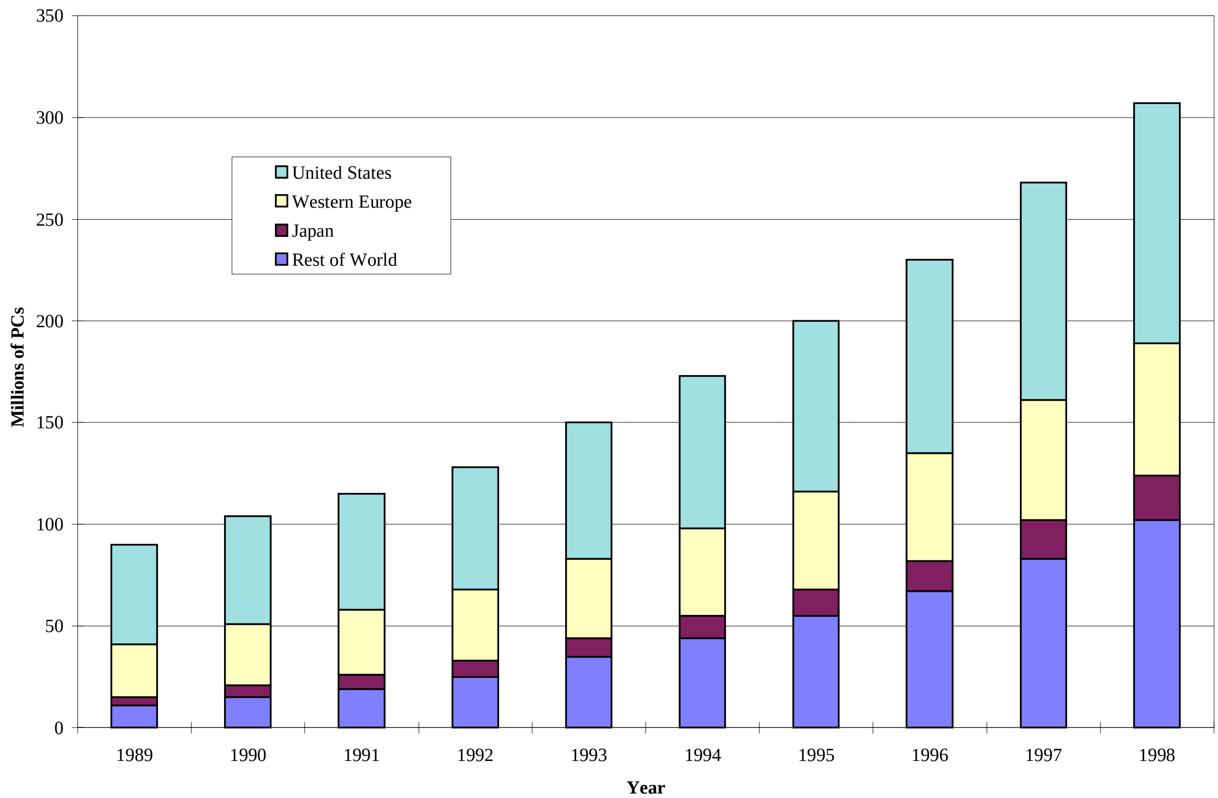

Figure 2.4: Personal Computer Installed Base

As seen in the figure, the United States is currently home to nearly half of the world's computers. However, as the United States market saturates, the rest of the world still has room to grow and will quickly begin to catch up. Early saturation of the market in the United States is a typical scenario with many high technology items. Rather than project forward current trends in the computer market, gross domestic product (GDP) is examined as an indicator.

2.3.1 GDP as an Indicator

It has long been theorized that GDP is an excellent indicator for market growth of high technology items. Since the majority of such items are expensive, many of the consumers come from wealthier nations. To explore this theory, the relationship of the number of telephones and automobiles in a country to the country's GDP was examined.

Figure 2.5 shows the percentage of world telephones that a country has versus its percentage of world GDP. Each point on the plot represents a different country [CIA]. The variation appears to be linear, resulting in the linear log scale graph shown in the figure. The higher a country's percentage of world GDP, the more of the world's telephones that it has.

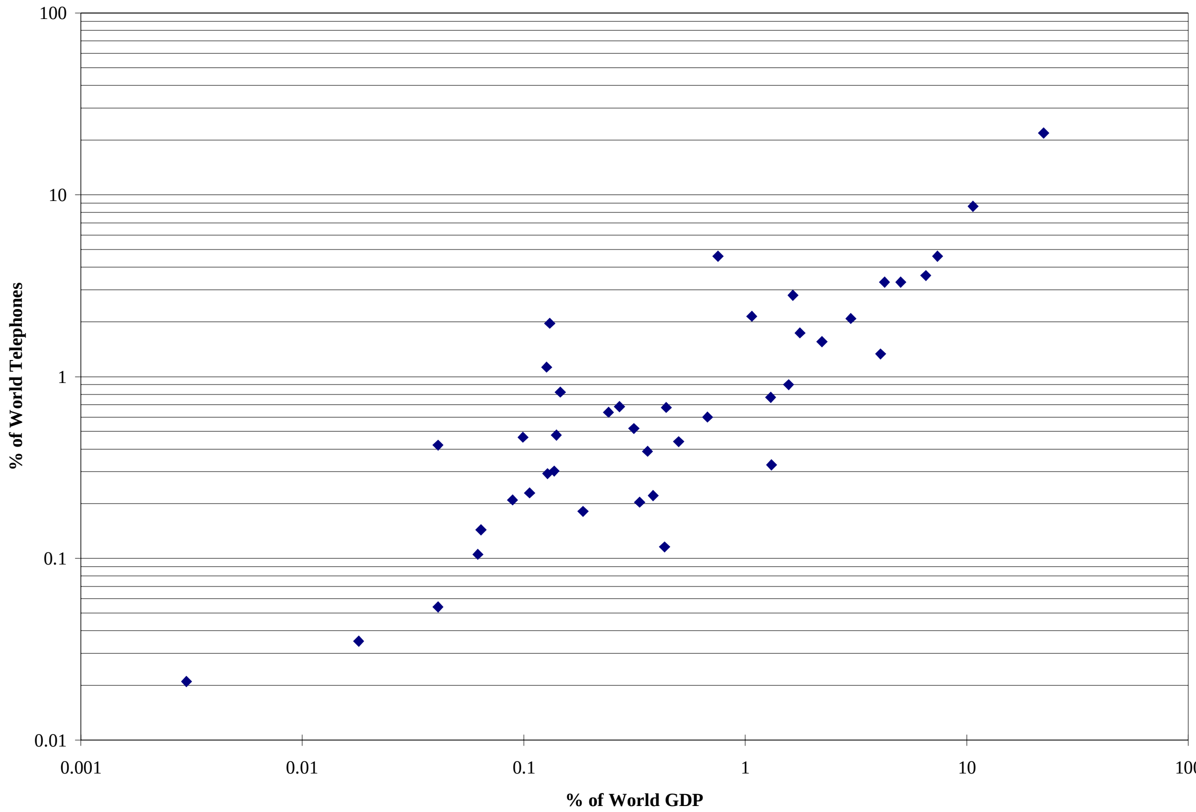

Figure 2.5: World Telephones vs. GDP

It can be argued that telephones are no longer considered high technology items since they are mass produced. The barrier to acquiring a telephone may no longer be the cost of the telephone itself, but the lack of infrastructure in the country. For example, it is estimated that it will take upwards of 20 years to install copper wiring into the majority of the interior parts of Africa. Thus in these areas, a telephone dependent on copper wire is useless. There is also a fairly large amount of spread in the data in Figure 2.5.

For a second example, percentage of world automobiles versus percentage of world GDP is examined in Figure 2.6 [CIA]. Again, each point on the graph represents a country. Automobiles are a much higher priced item than telephones, and are considered a luxury commodity. As seen in the figure, the spread in this data is much smaller than it is for telephones. This suggests that the governing factor for the purchase of an automobile is monetary. Whereas, for a telephone, regardless of the amount of capital an individual is willing to invest, the item is useless without the necessary infrastructure of wiring.

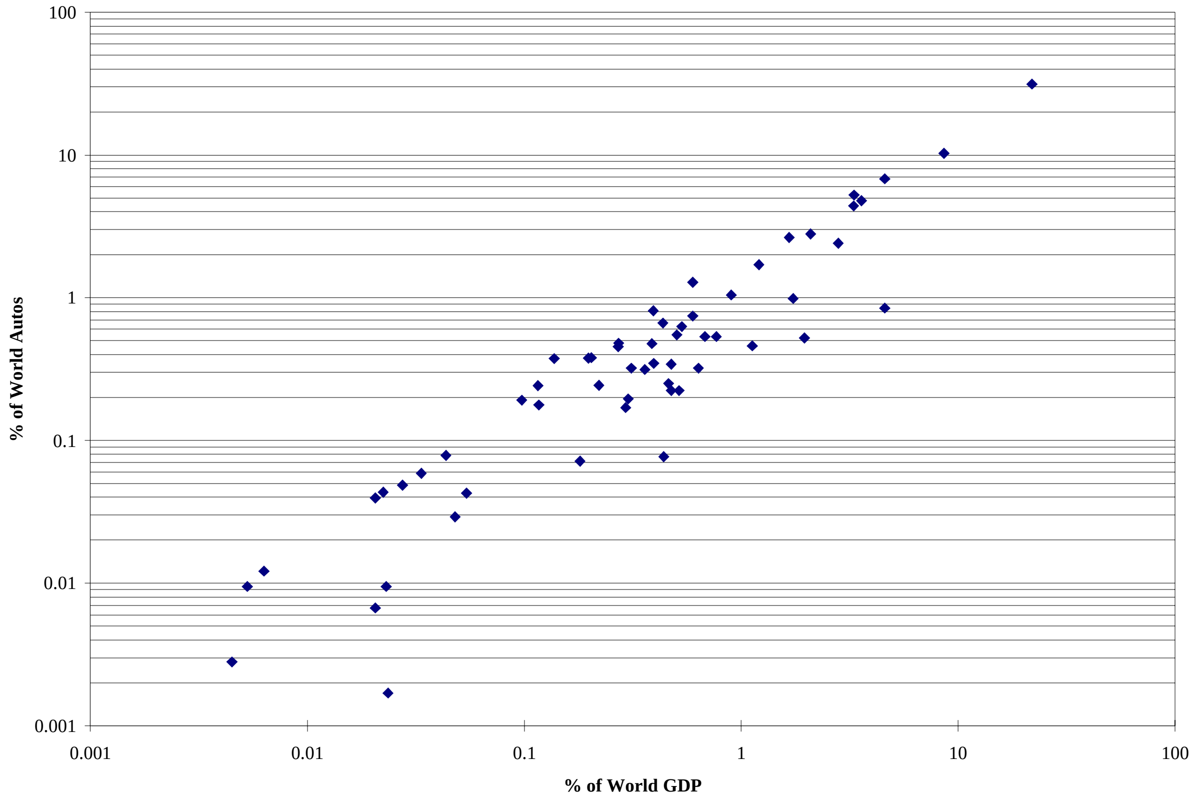

Figure 2.6: Worldwide Automobiles vs. GDP

It is anticipated that computer growth trends will behave more like automobile growth trends. A computer does not necessarily rely on a great deal of infrastructure, and while the price of a computer is not nearly as high as that of an automobile, members of the industry concede that even in the U.S. market, there is a great deal of difficulty in reaching the lower economic classes [Auerbach]. Computer penetration in various countries is thus projected to begin to equalize at the country's respective percentage of world GDP. The results of the projection are shown in Figure 2.7. The pictured trends correspond to current statements that markets such as the United States are beginning to reach saturation and the growth rate is rapidly tapering off [Auerbach]. Many products experience high growth rates at their inception which begin to slow as the markets that can afford the product reach saturation. As computers are introduced in foreign markets, growth rates are expected to increase rapidly.

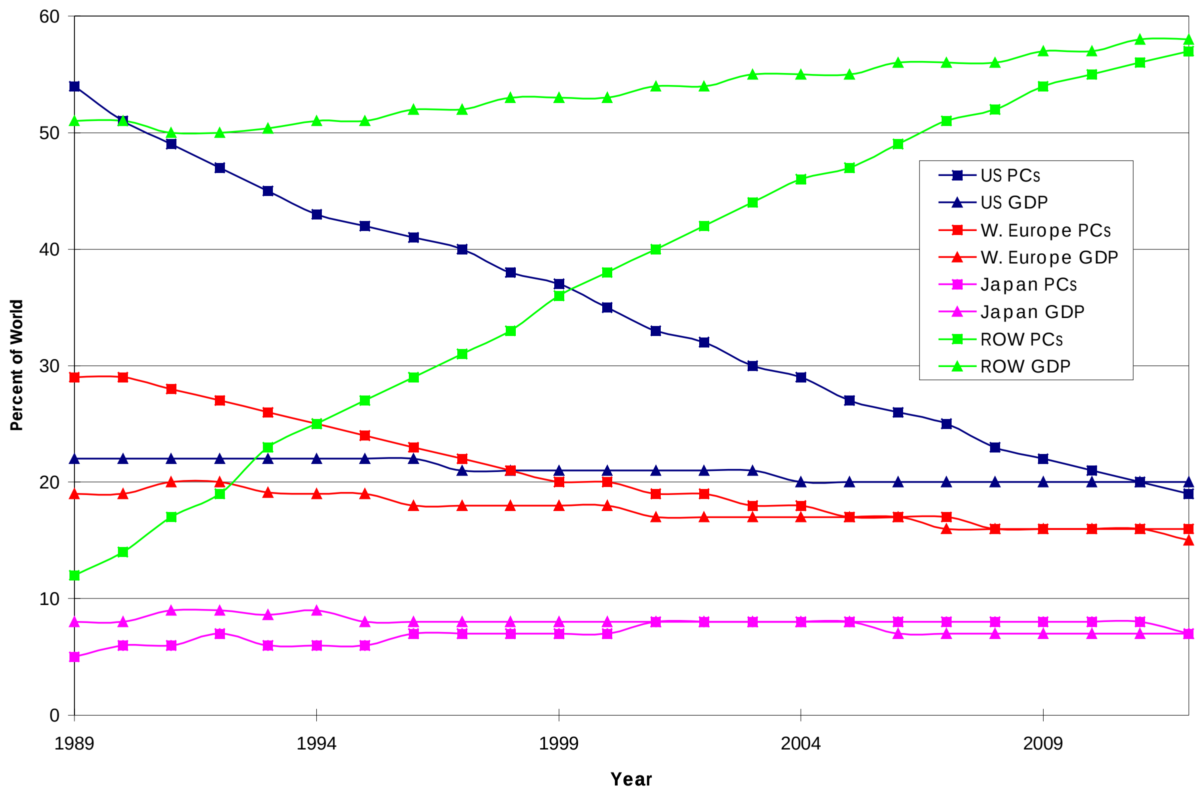

Figure 2.7: Projected Personal Computer Growth

2.3.2 Hosts

Included in the estimate of the growth of personal computers are those computers that are connected to the Internet as hosts. Hosts on the Internet are those computers that have a permanent connection to the Internet. A computer that dials in and is dynamically assigned an IP address for the duration of its connection is not considered a host computer. Mark Lottor of Network Wizards conducts a survey of the number of hosts on the Internet. This survey is conducted every six months and results are available from the Network Wizards web site at http://www.nw.com. The last mile market consists of those computers that are not already connected to the Internet because the current infrastructure does not reach them. This market is shown as the difference between the two curves in Figure 2.8.

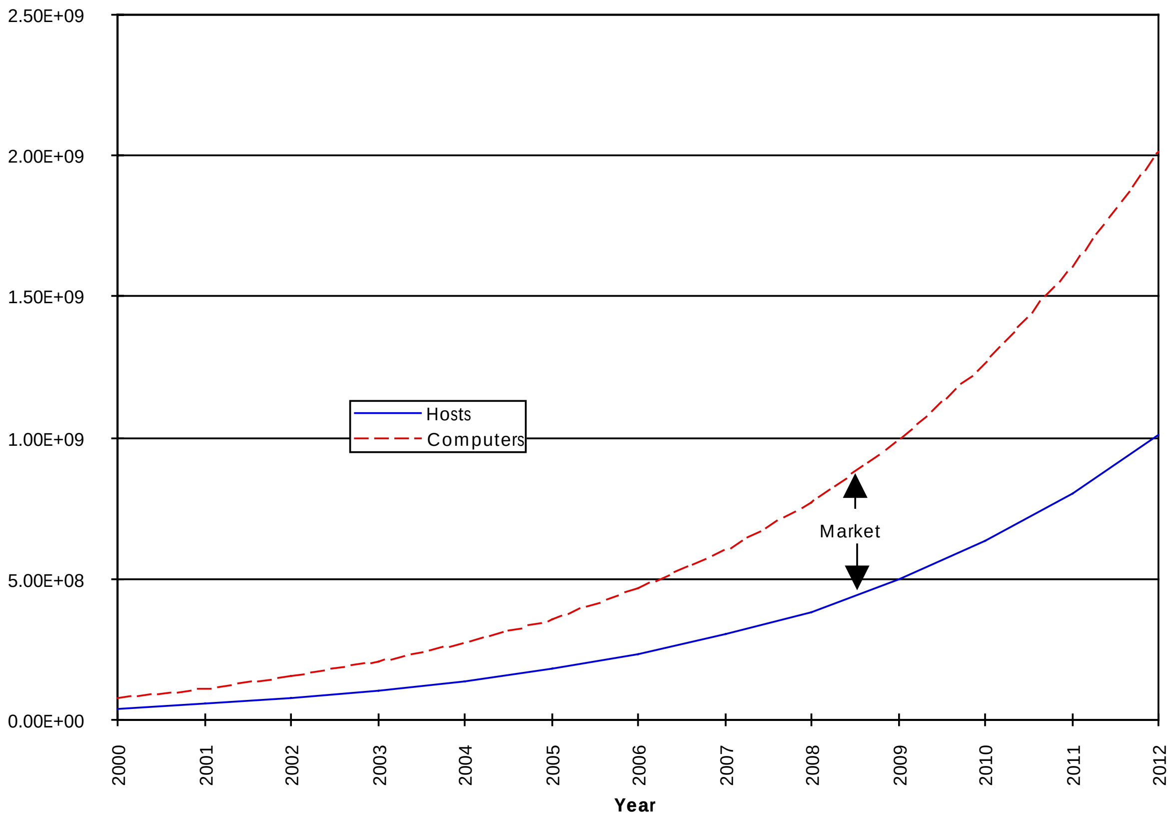

Figure 2.8: The Last Mile Market

2.3.3 From Computers to Bits

For the last mile market to be useful in the simulation, the number of computers must be converted to bits per year. This task requires an insight into the behavior of current Internet users. To explore user behavior, data from Algonet, a commercial service provider located in Sweden, was obtained and analyzed. Algonet offers its users several different types of services. These range from dialing in to a Unix shell and running processes from the shell to running a point-to-point protocol (PPP) connection which allows the user to run software on a home computer (such as a DOS/Windows machine or a Macintosh). Some commands that are available to users are telnet, FTP, mail, lynx, and all standard Unix commands. Netscape is not available as a shell command due to its graphical interface, so it is only usable with a PPP connection. Approximately 78% of Algonet's users connect via PPP and run software resident on their home computers. Since PPP connections demand fairly high data transfer rates to operate effectively, it is expected that the majority of dial-in users are connecting with a 14.4 or 28.8 kbps connection. Data on these users was gathered for two different time periods, the first in November of 1995 and the second in April of 1996. The data was obtained by tracking users on Algonet's machines. Each machine was queried every five minutes to obtain a list of users and their corresponding idle times. The data was compiled using a program that tracked complete login sessions and determined how long the user was idle during an individual login session. This idle time was then divided by the total number of minutes the user was logged in to obtain a percentage of login time that the user was idle. Each session was weighted equally regardless of the length of time logged in and an average idle time per login session was obtained. For the November data, the average idle time was 17.4% with a total of 17,912 tracked sessions. The April data yielded an average idle time of 20.5% with a total of 36,912 tracked sessions. Thus users are active for approximately 80% of the time that they are connected.

The other piece of the puzzle necessary to construct a picture of the data potential that the unconnected computers represent is the average connect speed and usage time of a user. The most common form of Internet connection is via modem. The predicted growth in modem speeds, shown in Figure 2.9, was examined.

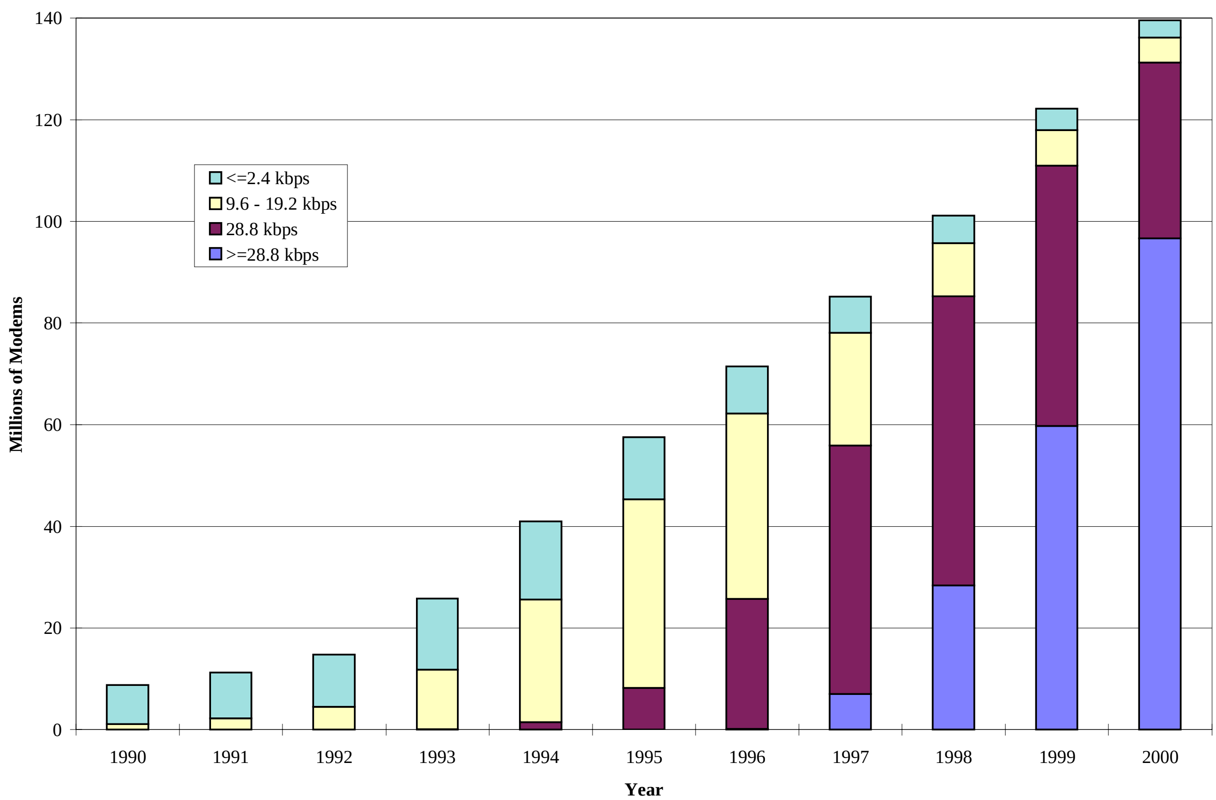

Figure 2.9: Modem Speeds

The average modem speed for 1996 is 18.1 kbps, which coincides with Algonet's estimates that the majority of their users connect via either a 14.4 kbps or 28.8 kbps connection. Taking the average time that a user spends active during a login session as 80% from the Algonet data, yields a transmission rate of about 14.5 kbps which is on the order of 1% of a T1 connection. It can be reasonably assumed that Internet application software will develop to utilize the excess available capacity as modem speed increases, so usage rates can be taken as a constant 80% of average modem speed. The curve represents projections that require fundamental changes in technology. Modems are rapidly approaching the transmission limits of copper wire. For speeds to continue to increase beyond 56 kbps or 64 kbps, a fundamental shift in connection technologies is required. The beginnings of these shifts are visible today with the increase in usage of ISDN and the introduction of xDSL and cable modems with speeds up to 10 Mbps that run over coaxial cabling. Technologies such as these and the increased proliferation of fiber optic cabling provide the increase in Internet hosts seen in the projections of Internet host growth in Figure 2.8. If the projections are carried forward based on current trends, average modem speed can be expected to reach 180 kbps by the year 2005 with improvements in technology and compression algorithms. This is approximately 10% of a T1 connection at mid life of the satellite systems.

According to the CommerceNet/Nielsen Internet Demographics Survey conducted in mid 1995, the average Internet user spends on average about one hour per day logged in [CommerceNet/Nielsen]. Combining this information with average activity rates and modem speeds yields a projected market for the data potential that computers not connected to the Internet represent.

2.4 Worldwide Distributions

Once estimates on the growth of the worldwide market are obtained, these markets must be globally distributed so they can become input to the capacity simulation code. To facilitate this distribution the world was divided up into five degree latitude and longitude cells.

The common measures for purchasing power are based on the wealth of countries as a whole, or on the wealth of individuals, thus the world market was distributed to countries in two different ways: GDP and GDP per capita. Examples of a distribution based on GDP and a distribution based on GDP per capita are shown in Figure 2.10 and 2.11 respectively. Percentage of the market for each five degree square are shown in the figures.

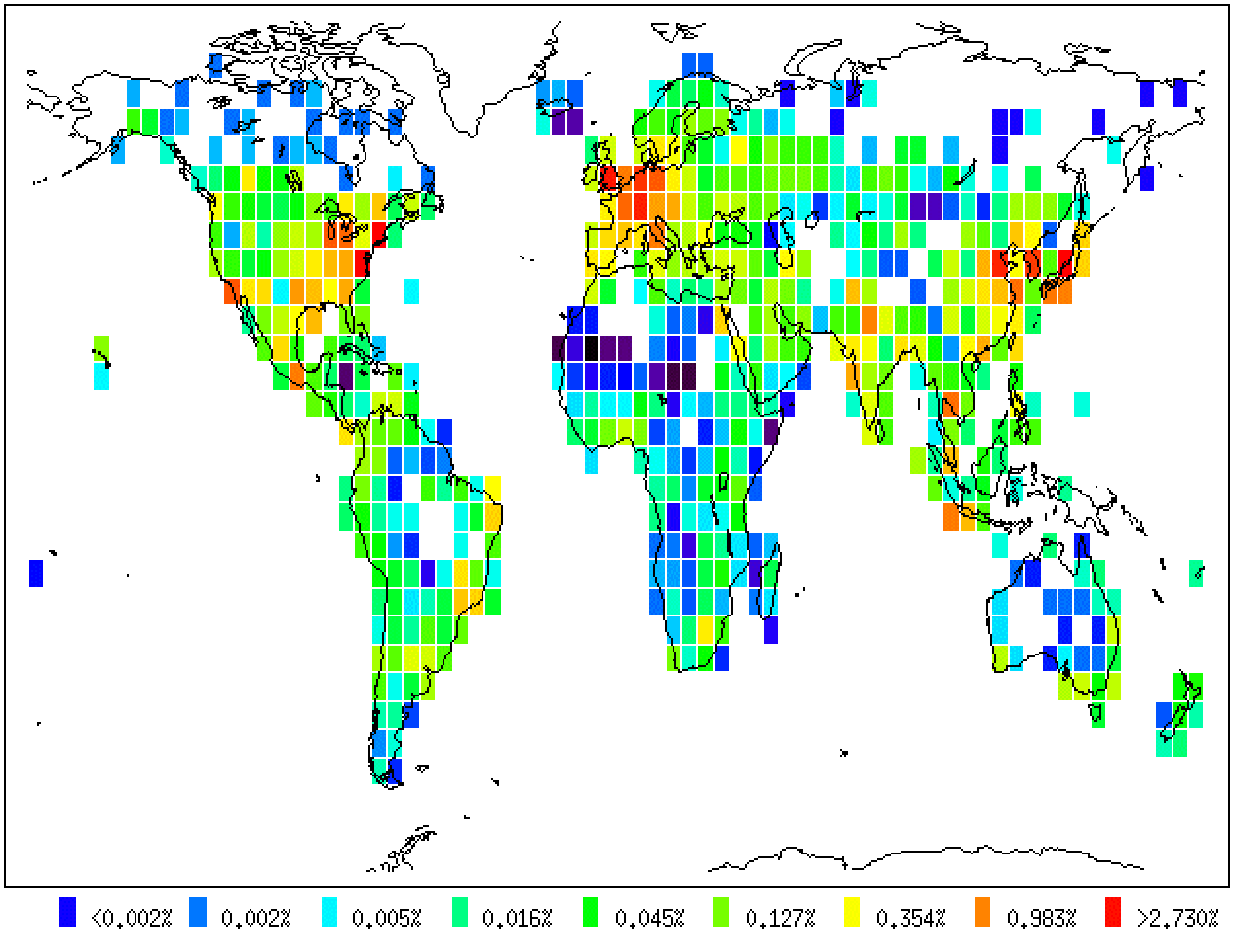

Figure 2.10: World Market, Last Mile, 2010, GDP Distribution

Distributing the world traffic from country to country according to a country's percentage of the world GDP accounts for the country's purchasing power as a whole, regardless of population. On the other hand, distributing the world traffic according to GDP per capita accounts for the purchasing power of an individual within a country when the country's wealth is evenly distributed among the population. In a GDP per capita distribution, countries with large populations are penalized. Even if the country as a whole appears wealthy with respect to other nations, distributed on a per individual basis, the amount of wealth per person is small. For example, in a scenario where a simplified country consists of three individuals, one with enough money to buy a computer and two with barely enough money to sustain themselves, the distribution used to determine the number of computers in the country plays an important role. In a GDP distribution, the country would be allocated one computer, since the total wealth of the country is enough to afford one. However, in a GDP per capita distribution, the country would be allocated nothing, since the one individual's wealth distributed among three people is not enough to afford a computer.

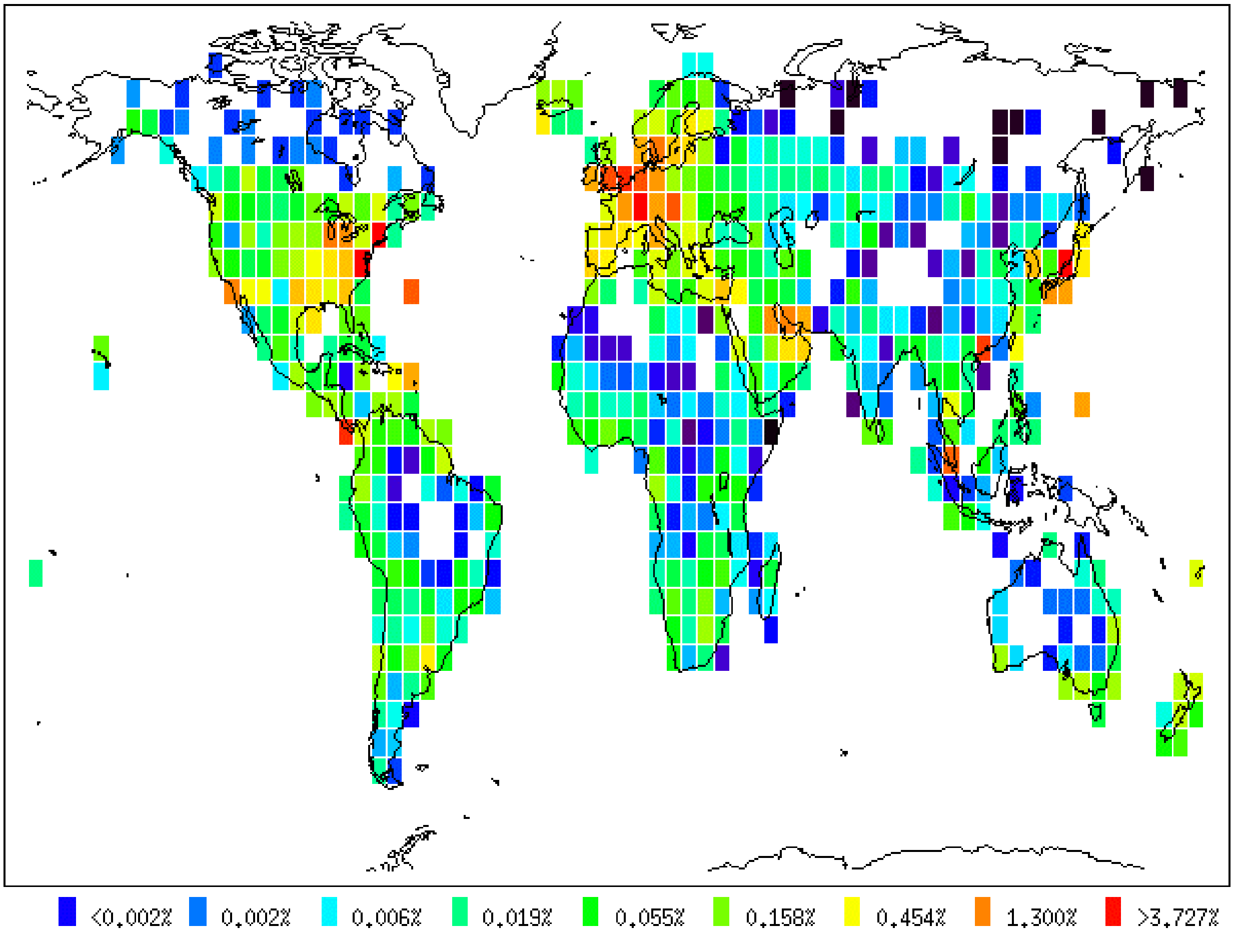

Figure 2.11: World Market, Last Mile, 2010, GDP Per Capita Distribution

Once various percentages of the market are allocated to a country, the data is further distributed according to the population distribution within the country. A more densely populated area of a country is expected to contribute a larger portion of that country's Internet traffic than a lower density population area. In this manner each of the three markets are distributed according to GDP and GDP per capita, giving a total of six market scenarios to be examined.

2.5 User Profiles

In order to determine whether a time of day distribution needs to be taken into account for the market data, the behavior of the potential users of the systems is examined. The users can be divided into three different categories: home users, business users, and backbone users. Home users of the service are individuals who desire Internet access for things like e-mail and entertainment, similar to users found on America On-Line, Netcom, or Algonet. Business users are those users that either use the service to telecommute or connect from a place of work. Backbone users would be similar to corporate intranets or actual national and regional backbones that need to be able to communicate at high data rates. Each of these groups exhibits very different behavior patterns as shown in Figure 2.12.

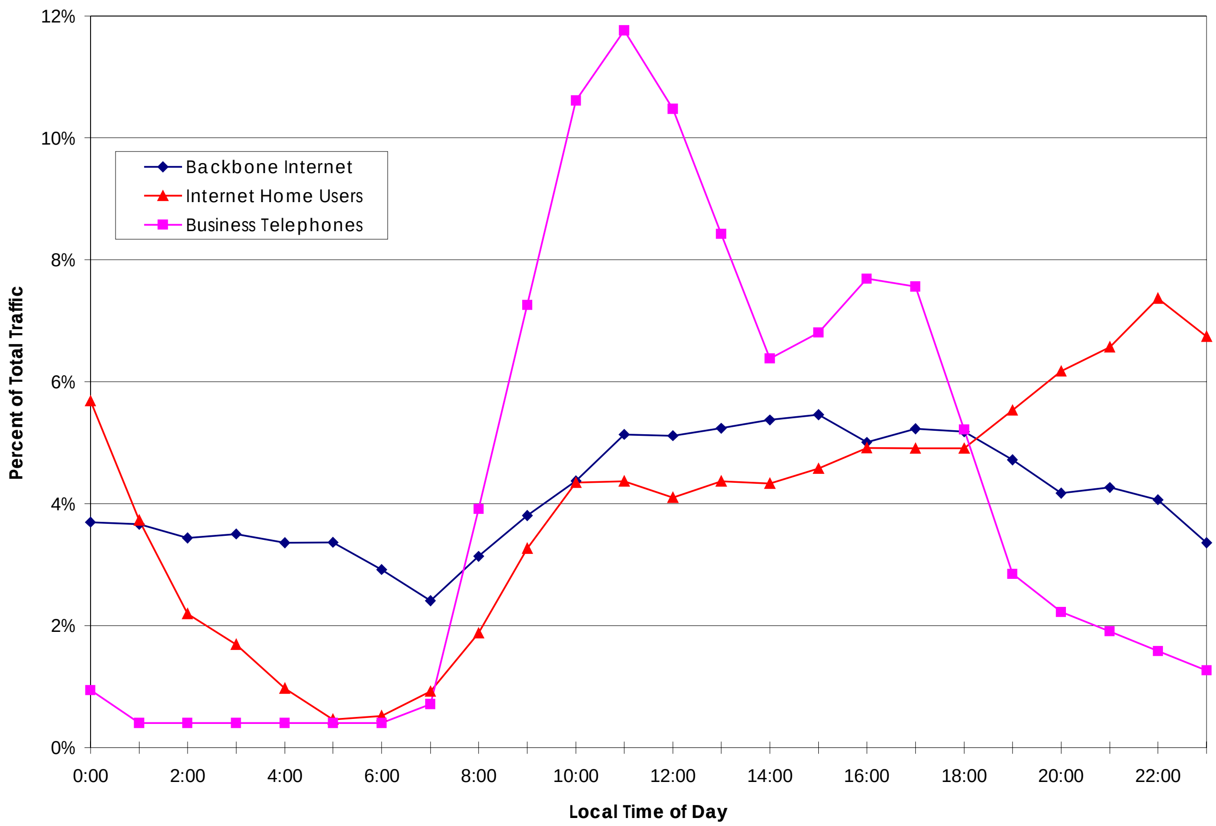

Figure 2.12: Time of Day Distributions

Again examining the data from Algonet for home users [Lonn], the highest usage periods, with a peak of around 7% of daily users logged in, occur between the hours of 8pm and 11pm local time with a large decline at midnight. The number of users reaches a low at around 6am local time and local minimums occur at noon and 6pm. This behavior pattern is not surprising since people use the system after they get home from work or school and then log out when they eat and sleep.

For telecommuters and other business users of the Internet, traffic patterns are expected to be similar to that of phone calls for a business. Activity reaches a peak of about 12% at 10am and is highest from the hours of 8am to 4pm local time. After 4pm, usage tapers off until midnight when it reaches nearly zero. The peak usage period for a business occurs 12 hours prior to the peak for the home user and is slightly greater in magnitude [Gumbert, p. 61].

Data on backbone Internet traffic was downloaded from NORDUnet, a backbone network based in Denmark [NORDUnet]. Traffic for data on all of NORDUnet's links has a very different time of day distribution from that of home and business users. The traffic on a backbone has much smaller fluctuations than business and home user traffic examined individually. Fewer fluctuations exist in a backbone time of day distribution because a backbone sends and receives data from computers worldwide and requests from different time zones average out into a nearly constant flow of traffic.

Since different types of users have very different behavior patterns, the actual time of day distribution for any of the satellite systems would depend heavily on marketing strategies. By varying what kind of user the services are marketed to, the systems have the ability to construct almost any time of day distribution they desire. Time of day distribution is therefore neglected in the capacity simulations.

2.6 Summary

Three different market scenarios were developed to attempt to simulate the potential growth of Internet traffic. As shown in Figure 2.13, the third order and exponential models represent upper and lower bounds to the market development. The last mile model is larger than the exponential initially, but the growth of the exponential model quickly overcomes it and surpasses it by the year 2005. This results from the two different quantities that the models are presenting. The last mile model represents the growth of computers not connected to the Internet. The exponential model is a measure of the growth of the Internet itself. These two quantities are intertwined. The Internet is growing and as the Internet grows the amount of traffic traversing the network and the number of hosts attached to it also increases. Since the Internet is growing faster than the computer market, the increase in number of hosts means a corresponding decrease in the number of computers that are not yet connected to the Internet. Despite the fact that the exponential and last mile market were constructed from different data, their estimates of growth are fairly similar. On the other hand, the third order model lies far below the other two, substantiating the idea that it is an unlikely scenario.

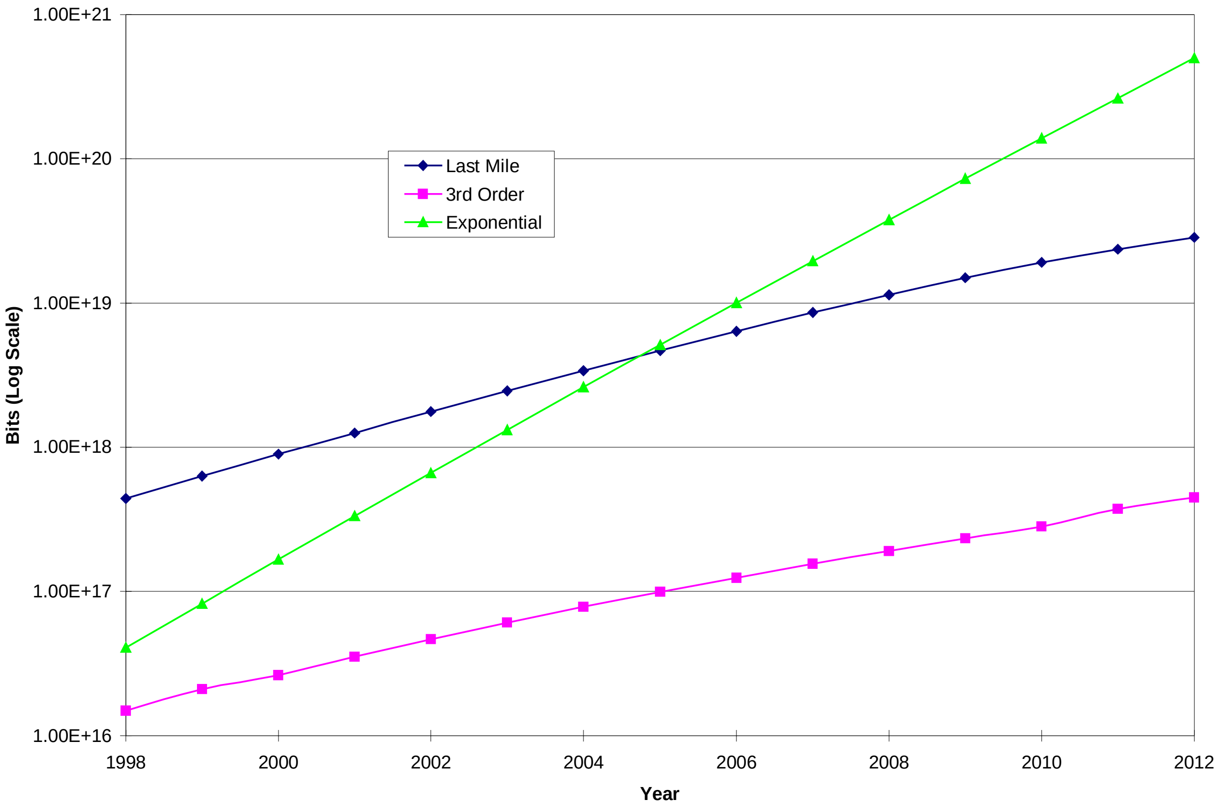

Figure 2.13: Market Scenarios

The three markets were distributed worldwide by GDP and GDP per capita. The simulation discussed in the next chapter was run by employing the six market models distributed world wide over five degree longitude and latitude cells.

Chapter 3: Capacity Simulations

3.1 Introduction

In order to comparatively evaluate the broadband satellite systems, an estimate of the total achievable capacity of each one is required. The achievable capacity is the total number of bits that the system can realistically transfer at a given point in time. In actual operational conditions, the achievable capacity will vary with time. However, since this time variation can be affected by such factors as the type of customer and the billing pattern imposed, a time of day distribution is not included in the market models. Achievable capacity differs from the sum of all transponder capacities, or theoretical capacity, in that it accounts for market availability, rain attenuation, satellite power resources, beam overlap, inter-channel interference, and achievable link margins.

A computer simulation was used to estimate the effects of these factors and model the operation of broadband satellite communications systems in a distributed market scenario. VoiceSpan, Astrolink, Spaceway, CyberStar, and Teledesic were used as models for the GEO(12), GEO(9), GEO(8), GEO(3), and LEO constellations used in the simulation. Basic system parameters and with theoretical capacities are listed in Table 3.1.

Table 3.1: System Parameters

System	Operational Satellites	Locations (Planes)	Access Scheme	Altitude (km)	Satellite Capacity (Gbps)
GEO (9)	9	5	TDMA/FDMA	GEO	7.7
GEO (3)	3	3	FDM/TDMA	GEO	4.9
GEO (8)	8	4	TDMA	GEO	4.6
LEO	840	21	TDMA/FDMA	LEO	13.3
GEO (12)	12	7	CDMA	GEO	5.9

3.2 Logic Flow

The simulation calculates the number of bits that can be transferred through a given system under the limiting factors of satellite power resources, achievable link margins, rain attenuation, and distributed market models. Flexibility within the simulation allows the modeling of both geosynchronous and low Earth orbit systems without any modifications. Inter-satellite links can also be modeled if required.

The program begins by projecting spot beams onto the Earth from the satellite ephemeris data given in an input file. Examples of the input files used for the simulation of each system can be found in the appendices. The simulation then calculates a link budget for each channel in each beam and estimates rain attenuation based on the globally distributed Crane rain model. Availability is calculated based on rain attenuation and the resulting link margin. It is then multiplied by the transponder capacity to give the maximum data rate available on that channel. Whether or not the channel will carry that maximum data rate at all times depends on the accessible market for the beam. The accessible market is governed by the coverage area and the magnitude of the market within the beam. The achievable capacity is the minimum of the supportable data rate and the available market to which it has access. A flow chart depicting this process can be found in Figure 3.1.

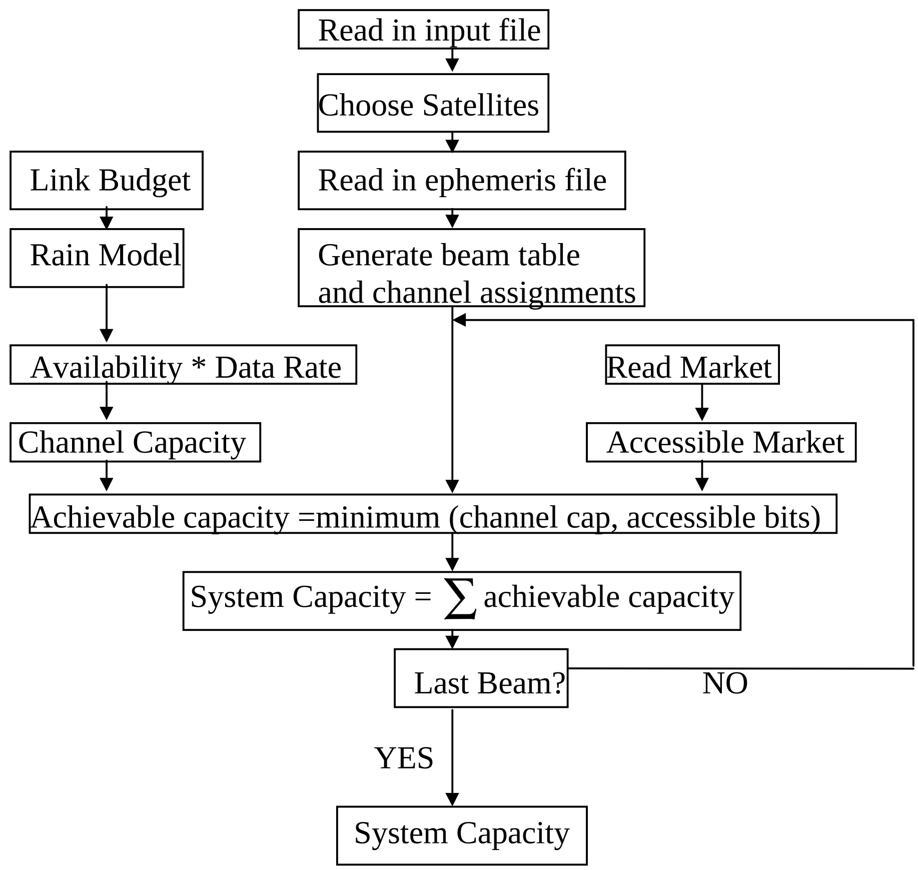

Figure 3.1: System Capacity Flow Chart

3.3 Program Components

3.3.1 Input File

The input file contains the necessary satellite and market information for the program to perform the simulation. This section contains a brief description of the input files. Sample input files for the systems used in the simulations can be found in Appendices A.1-A.5.

The top of the input file contains the name of the system to be simulated and is used by the program to reference the corresponding ephemeris data. The next section of the input file specifies the market model and the years for which the simulation will run. Multiple years can be run from the same input file, allowing the user to simply specify the number of years for simulation and requiring no additional input from the user during the course of the simulations. The total size of the market for each year must also be entered into the input file.

The system characteristics section of the input file contains the following information: number of satellites, number of beams per satellite, number of scannable positions per beam if beam-hopping is utilized by the system, the number of polarizations, the number of transponder channels per beam, the bandwidth and capacity of each channel, and the total RF power available to the payload. Inter-satellite links, if desired, can also be specified. Link parameters for both the uplink and the downlink are required. This information includes nominal power per channel, transmission burst rates, E_b/N_o, terminal gains, system temperature, and link losses.

The beam section contains detailed information on individual beams. On a per-beam basis, the following parameters are entered: gain, boresight location in either longitude/latitude or azimuth/elevation, uplink and downlink center frequencies, polarization, and position in the scan cycle, if required. The individual beam information must be entered for each satellite if a custom beam pattern exists as it does for the GEO systems in the simulation. For the LEO system, the beam locations are given in azimuth/elevation relative to the satellite, thus only one beam table is required for the entire system.

3.3.2 Beam Generation

In an attempt to support the largest total capacity for each satellite, the beams are first ordered to give those supporting the largest link margin priority. This ordering is to account for the systems that have insufficient payload power to operate all beams simultaneously. By calculating a simple link budget for each beam based on its link parameters and assuming no rain attenuation, the beams that should be able to support a higher data rate are placed at the top of the list. In an evenly distributed large market, the beams with the higher data rates are those with the highest link margin and the largest link availabilities. While the assumption of a perfect market and the omission of rain attenuation in the calculation could result in a smaller than optimal system capacity, this capacity reduction is small in comparison to that which would result if no ordering took place.

The primary output of this portion of the simulation program is the beam file which contains the coverage regions for each powered beam to a resolution of one-half degree longitude and latitude. Employing the ordered list of beams, the following steps are performed:

1. Power per Channel Calculation

Several different constraints determine the transmit power of communications channels in each beam. The transmit power used in the simulation is determined for each beam by taking the minimum value of the available payload power, the power flux density limits, and the nominal power per channel. If the calculated transmit power is greater than zero, the beam is considered active and the calculated value is used for all link calculations involving the beam. If the calculated transmit power is less than zero, then the satellite does not have sufficient power resources for any more beams and the program moves on to the next satellite in the constellation. The constraints are described in further detail below.

Available Payload Power: Some of the proposed systems do not have sufficient power resources aboard the satellite to operate all of the transponders at saturation simultaneously. To prevent over estimation of the satellite capacity, as the transmit power for each beam is determined a comparison to the remaining available power on the satellite is performed. The total available RF power is reduced by the transmit power of the beam as each beam calculation is performed. If there is no power available, the beam is not used in the simulation.

Power Flux Density Limits: The International Telecommunications Union (ITU) and the FCC have placed limits on the amount of RF power that may be received at the surface of the Earth based on the amount of power in a given area in a 1 MHz bandwidth. For the Ka-band downlinks of the proposed fixed services, the limits imposed by the ITU at the World Radio Conference of 1995 are [ITU, 1995]:

- -115 dB (W/m^2) in any 1 MHz band for $0° \le \varepsilon < 5°$
- $-115 + 0.5 (\varepsilon - 5)$ dB (W/m^2) in any 1 MHz band for $5° \le \varepsilon < 25°$
- -105 dB (W/m^2) in any 1 MHz band for $\varepsilon > 25°$

where ε is the elevation angle of the incident radiation in degrees above the horizontal plane.

These regulations limit the power per channel of the beam, which is given by:

$$P_{ch} = \frac{4S^2 PFD\pi}{G_t L_c}\left(\frac{B}{1000}\right)$$

where S is the slant range in meters, PFD is the regulated limit, L_c is the downlink antenna loss in Watts, B is the channel bandwidth in Hz and G_t is the antenna gain for the corresponding beam. The calculation is performed for both the toe and the heel of the beam and the one which places the greatest constraint on power is used.

Nominal Power per Channel: The transmit power per channel cannot exceed the saturation power of the transponders.

2. Rain Attenuation and Link Availability Calculation

Once the power for each channel in the beam is derived, an estimation of the likely attenuation due to rain is calculated. Calculations are performed using the Crane rain model [Crane, 1980] to determine the average probability of successfully completing the communication link. The Crane model divides the world into eight different climactic regions (A-H) according to the average amount of rainfall experienced within that region. The model was discretized and digitized at MIT and is shown in Figure 3.2. The model is used by the simulation to determine the climactic region in the boresight of each beam. Through a series of calculations that are described in detail in Crane's paper, *Prediction of Attenuation by Rain* [Crane, 1980], the attenuation in dB due to rain is obtained. The attenuation decreases the link margin calculated from the power derived in the previous step. The link availability is then the percentage of the link that is available to support transmission after the losses have been accounted for. It is utilized later to determine the billable data rate that can be supported by each channel.

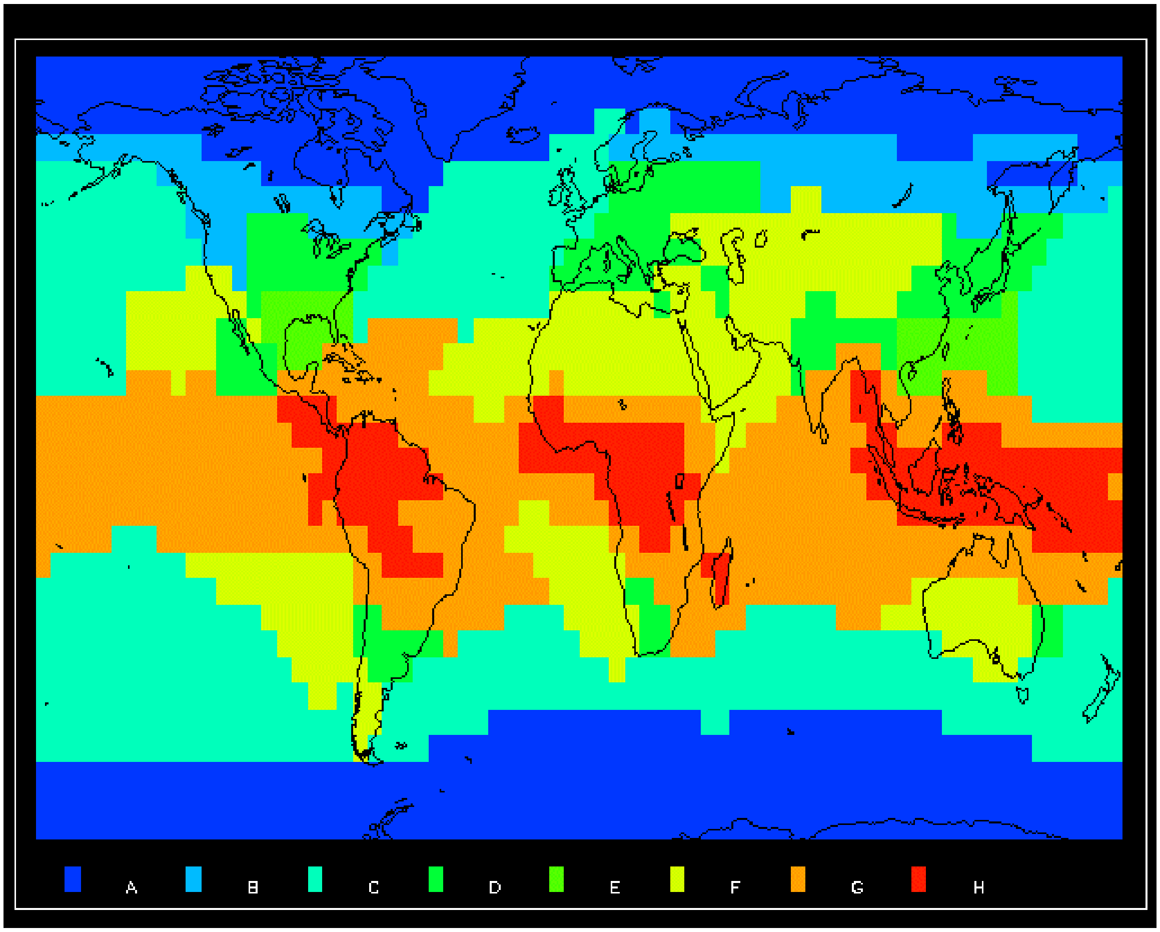

Figure 3.2: The Crane Rain Regions

<u>3. Projection and Discretization of Spot Beams</u>

Once the link availability is determined, the active spot beam is projected onto the surface of the Earth. For simplification, the method assumes a spherical Earth and circular beams. A detailed description of the methodology can be found in Gumbert [Gumbert].

To allow a correspondence between the discretized market model and the beam coverage area, the coverage area is also discretized into half-degree cells. The longitude and latitude of the lower left corner of each cell is used to identify it and is written to a file for each beam.

3.3.3 Channel Assignment and Interference

While GEO systems are typically designed so that beams from different satellites cannot interfere with one another, this is nearly impossible for a LEO system. Spot beams from different satellites with similar frequencies and polarizations can overlap in ground coverage area as the satellites propagate through their orbits. Overlap most commonly occurs at high latitudes where the satellites pass close to one another, but can occur anywhere in the coverage area. The overlapping communications channels cannot be operated simultaneously due to interference. The simulation searches the spot beam coverage areas to determine where overlap in polarization, frequency, and space occurs. Available communications channels are then distributed amongst the overlapping beams. Overlap between satellites of a system is the only interference check performed by the simulation. It assumes the interference between systems is within the operational limits required by the FCC.

3.3.4 Accessible Market and Achievable Capacity

The accessible market is the number of bits of traffic on the ground that a given beam has access to due to its coverage region. It is not a function of the capacity of the transponders. To perform the calculation, bits are allocated to all the one-half degree cells that make up a beam. Each ½ degree beam cell lies within one of the five degree market cells of the distributed market model described in Section 2.4. The market within each of the five degree cells is assumed to be evenly distributed and is divided by the simulation into one hundred subcells that are approximately the same size as the beam cells. Each subcell is one hundredth of the number of bits contained in the corresponding five degree market cell. A beam cell that overlays a market subcell has access to the market within that subcell. Thus the accessible capacity of a beam is the sum of all the bits that are allocated to each of the beam's component cells. To prevent double counting of market bits, after a beam has accessed a particular subcell of the market, the market remaining in that subcell must be reduced by the amount that the first beam can uplink. Transponder capacity and link availability of the channels in the beam determine the number of bits that the beam can upload. The algorithm used to determine the number of bits for uplink is described below.

The simulation first cycles through the spot beams to determine whether or not they are active. The accessible market of each beam is the sum of the market in each component cell that makes up the beam. The uplink capacity of the beam is the product of the transponder data rate, the link availability, and the number of channels allocated to the beam. The calculated uplink capacity is then compared to the accessible market. The smaller of these is the maximum number of bits that can be uplinked by the beam. Before this calculation is repeated for the other beams, the market is reduced accordingly.

If intersatellite links are specified, traffic is allocated to them before the downlink capacity is computed. The amount of traffic going over the intersatellite link is specified in the input file as either a percentage of the total uplink bits for the satellite or the data rate of the intersatellite link channel. The destination satellite for each link is also specified in the input file. Since traffic patterns are dependent on market demographics and not on satellite hardware, the outgoing traffic is assumed to originate from each beam in proportion to the relative size of that beam's accessible market. The satellite sends outgoing traffic and then receives incoming traffic and sums the total number of arriving bits. The incoming traffic is allocated to the beams also in proportion to the size of the accessible market. Through a conservation of bits argument, the number of downlinked bits is equal to the number of uplink bits minus those leaving via intersatellite links plus those arriving via the intersatellite links. The maximum number of bits that can be downlinked is limited by the downlink capacity of the beam which is defined as the product of the link availability, the maximum data rate, and the number of channels in the beam. True achievable capacity is the minimum of the downlink capacity of the beam and the number of bits to be downlinked. The sum of this quantity over all the beams on the satellite gives the achievable satellite capacity and the sum of the satellite capacity over the satellites in the constellation gives the achievable system capacity.

3.4 Assumptions

The simulation makes several simplifying assumptions in order to perform its task in a reasonable time period. Some of the assumptions and errors embedded into the simulation that may affect the results are as follows:

- Rain attenuation and link availability are calculated only at the boresight of each beam. This simplification reduces run time, but may over or under estimate the achievable capacity of the beam. The errors in estimation are most likely to occur in areas where the beams have broad coverage regions such as the tropics where the climate has a finer spatial resolution.
- The link budget assumes a clear sky system temperature. The resulting effect is very small and is insignificant when comparing between systems.
- Beams that are allocated power may be disabled by the overlap calculation. This is an inefficient use of power resources, since some of the disabled beams may be high priority beams satisfying the maximum market. The logic sequence of the program could cause this to occur since the beams are assigned power with a prioritization based on satisfying the maximum market. Calculations are done in this order to minimize the number of beam cells that much be searched for overlap and minimize computational time. The systems that this may have an adverse effect on are those with insufficient power to operate all channels simultaneously.
- The simulation neglects time of day distribution. As shown in Section 2.5, the usage behavior of the market is affected by both the time of day distribution and the type of service provided. The market is assumed constant with time of day, allowing the GEO systems to have constant system capacities that only require calculation once. The LEO

systems also have no variation in the system capacity with time of day, since with a very large satellite constellation, the pattern of the orbits repeats rapidly enough to assume a constant capacity.

3.5 Simulation Results

The achievable capacity results obtained from the simulation are presented and discussed in this section. The operation of each system was simulated under the three different market scenarios each with two different distributions discussed in Chapter 2 for the expected system lifetime. This section also highlights some of the graphical outputs available from the simulation. The deployment strategies assumed for the various systems are shown in Figure 3.3.

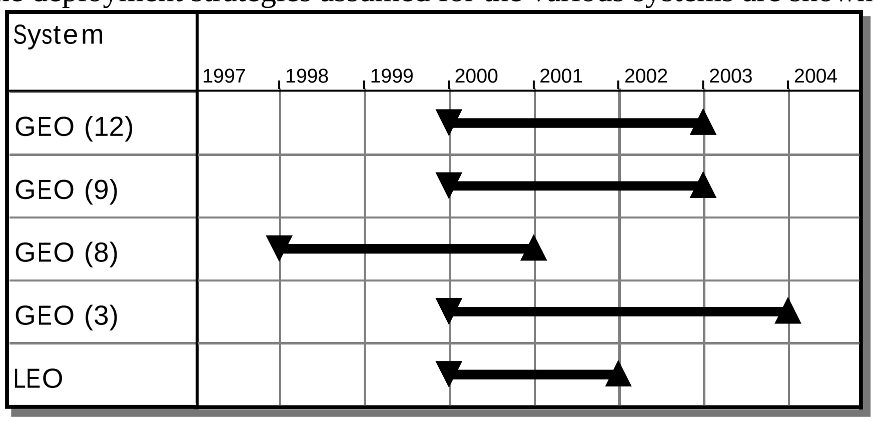

Figure 3.3: Deployment Schedule

3.5.1 The Effects of Intersatellite Links on the Achievable Capacity

In order to determine the effects of intersatellite links on the achievable capacity, a simulation was run using GEO(3) with varying amounts of outgoing intersatellite link traffic. The simulation incorporated two inter-regional crosslinks per satellite with a varying percentage of the uplink bits being routed to these crosslinks. The capacity of the inter-satellite link was set at 1 Gbps. The achievable capacities for the exponential market model over the lifetime of the system is shown in Figure 3.4. The plot is of achievable capacity in Gbps by year of simulation with the percentage of uplink bits going to the crosslinks varying from zero to twenty.

As shown in the figure, the intersatellite links have no noticeable effect on the achievable system capacity. The crosslinks will only serve to reduce achievable capacity slightly if the data throughput capability is not sufficient to carry the inter-regional demand. The intersatellite links cannot increase the achievable capacity with the assumed market models since all of the bits must be eventually downlinked. The limits are then the locally supportable market or the downlink capacity.

Arguments for the inclusion of intersatellite links are primarily marketing oriented. By not requiring the bits uplinked by the satellite to be immediately downlinked for inter-regional transport, the system can claim to provide more rapid data service and also attempt to circumvent any possible tariffs for building ground stations to downlink bits in the region. For an intranet market, inter-satellite links are desirable from a data security standpoint. The satellite provides a dedicated link for data so that it does not have to pass through the terrestrial Internet, making the data less susceptible to eavesdropping by unauthorized third parties. However, since the presence of inter-satellite links makes little or no difference in the achievable system capacity, for ease of calculation, they will be omitted in future simulations.

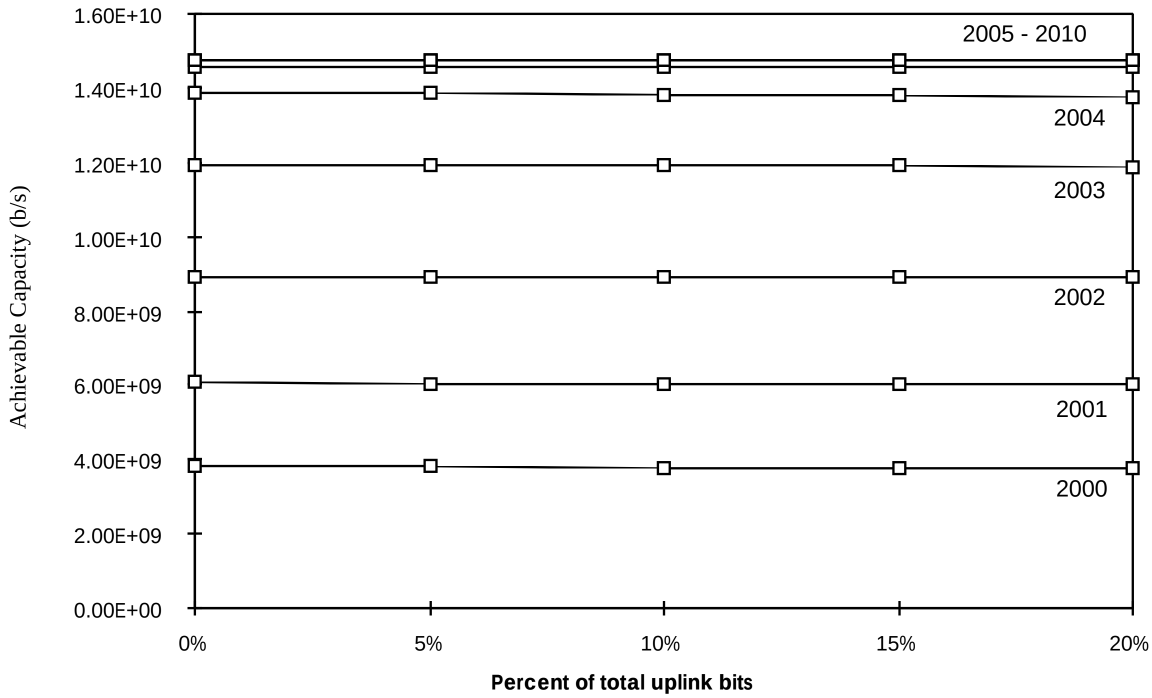

Figure 3.4: Inter-regional Traffic and Achievable System Capacity

3.5.2 GEO(3) Simulations

The GEO(3) system consists of three geostationary satellites, one each servicing North America, Europe, and Asia. The system will have a 12 year lifetime, with the first launch planned for 1999 and initial operating capability in 2000. Simulations for this system were run both with and without intersatellite links in order to ascertain the effects of their inclusion as discussed in the previous section. The graphical results shown here are for the simulation without intersatellite links. A sample input file for the GEO(3) system can be found in Appendix A1.

The beam placements for the system are shown in Figures 3.5 to 3.7. From the coverage areas it can be seen that this is truly a regional system covering the well developed market regions of the world.

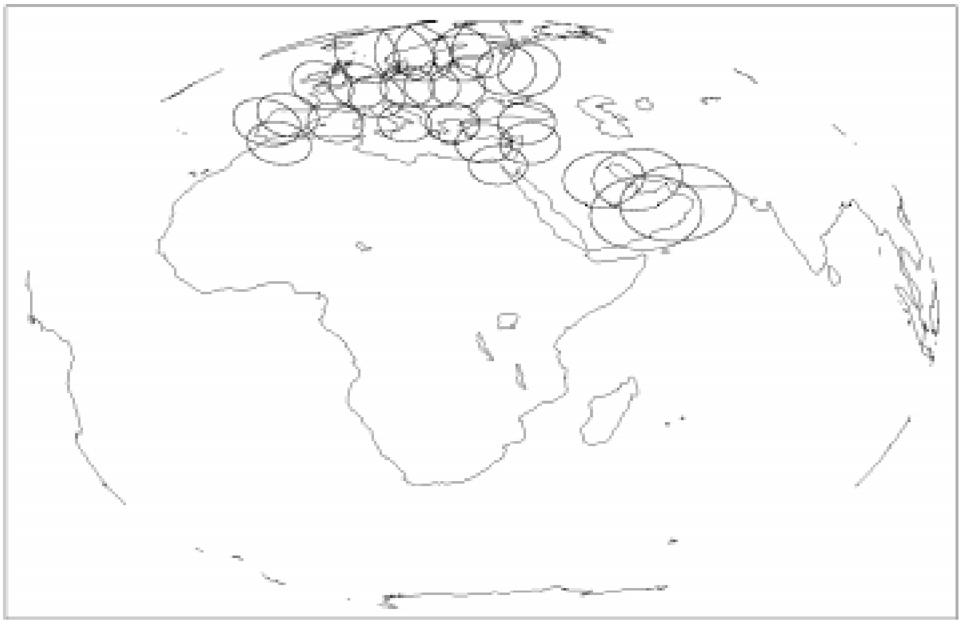

Figure 3.5: Europe Region GEO(3) Beam Pattern

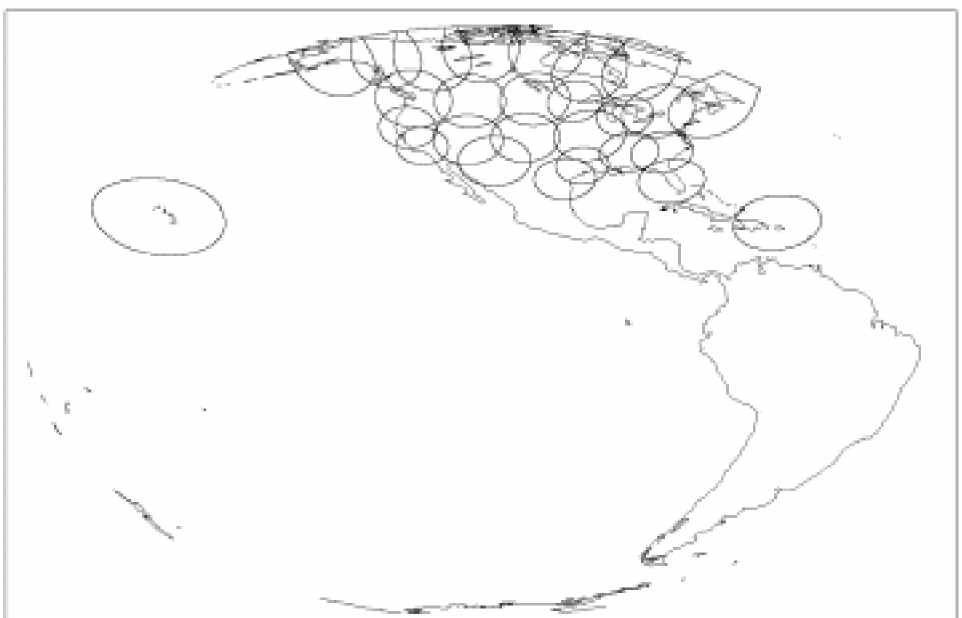

Figure 3.6: North American Region GEO(3) Beam Pattern

Figure 3.7: Asian Region GEO(3) Beam Pattern

The satellites are deployed over a period of four years with the North American satellite deployed in 2000, the Europe satellite in 2002, and the Asian satellite launched in 2003. The achievable capacity as a function of years of operation is shown in Figure 3.8. The exponential and last mile market models result in similar achievable capacities, while the third order market models result in significantly lower capacities.

Early in the operational lifetime of the system, with only the North American satellite operational, the achievable capacities for all market models are similar. Since North America already has a well-developed Internet community, growth under any of the market models is small in this region compared to growth in less developed regions. With the introduction of the European satellite, the differences between the exponential and last mile market and the third order market become much more pronounced. This is because Europe is comprised of both areas that have well developed Internet communities and other areas in which Internet usage is still fairly limited. The last mile and exponential models have higher growth rates for less developed regions. With the launch of the Asia satellite in 2003, differences between the GDP and GDP per capita distributions in the last mile and exponential markets are observable. This is due largely to the demographic differences between Asia and North America and Europe. In North America and Europe, the countries with the largest GDP also have the largest GDP per capita. However, in Asia there are both large, poor countries (China) with high GDPs but very low GDPs per capita, and small, wealthy countries (Hong Kong, Singapore) that have both a high GDP and a high GDP per capita. Therefore, satellite beam patterns that focus on the large population areas in Asia will have markedly lower achievable capacities under a GDP per capita market distribution.

During the initial years of system deployment and operation, the last mile markets give the largest achievable capacity. For both the last mile and exponential market scenarios, the achievable capacity increases rapidly as the market matures and additional satellites are deployed. The large increases in achievable capacity are due to the launch of additional satellites and performance plateaus between launches can be seen in the figure. For the last mile markets, the system approaches saturated design capacity in the year 2003, while taking slightly longer in the exponential markets and approaching saturation in 2005. In the third order market scenarios, the system never reaches saturation.

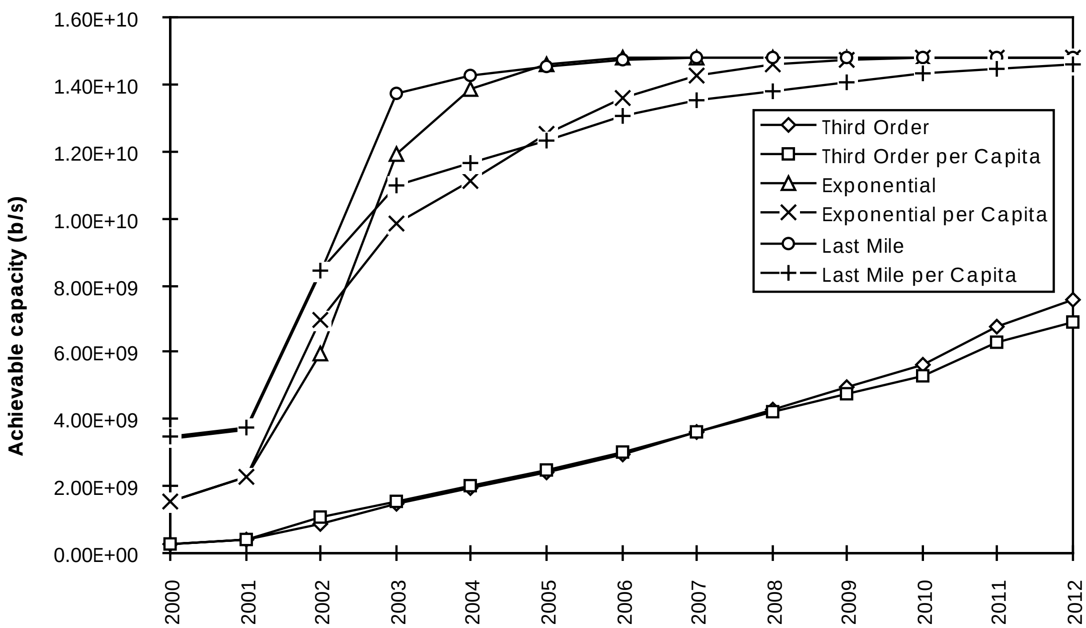

Figure 3.8: GEO(3) Achievable Capacity Profile

The shapes of the capacity curves are due to the beam utilization rates during the system lifetime. For all markets at the start of system lifetime in 2001, the system is market limited. While the market is still developing, only the large commercial centers of North America, Europe, and Asia have more traffic available on the ground than the capacity of the satellite is able to support. As the exponential and last mile markets grow and additional satellites are launched to service that market, a sharp increase in achievable capacity is observed. At around 2005, the last mile and exponential markets have matured enough that the system approaches its design capacity. The third order markets never mature enough to approach the design capacity of the system, thus the achievable capacity simply tracks market growth.

3.5.3 GEO(8) Simulations

The GEO(8) constellation is a network of eight geostationary satellites operating in four orbital slots. This is a truly global system servicing North America, Europe, Africa, South

America, Asia, and the Pacific. For simulation purposes, the first launch is assumed to occur in 1998 with initial operating capability in 1999 and a system lifetime through 2012.

The spot beam patterns shown in Figures 3.9 to 3.16 were derived from estimates of likely market growth regions. The beam patterns for the first satellites in each region allow the system to achieve global coverage while the second satellites concentrate coverage regions on areas of large projected market growth.

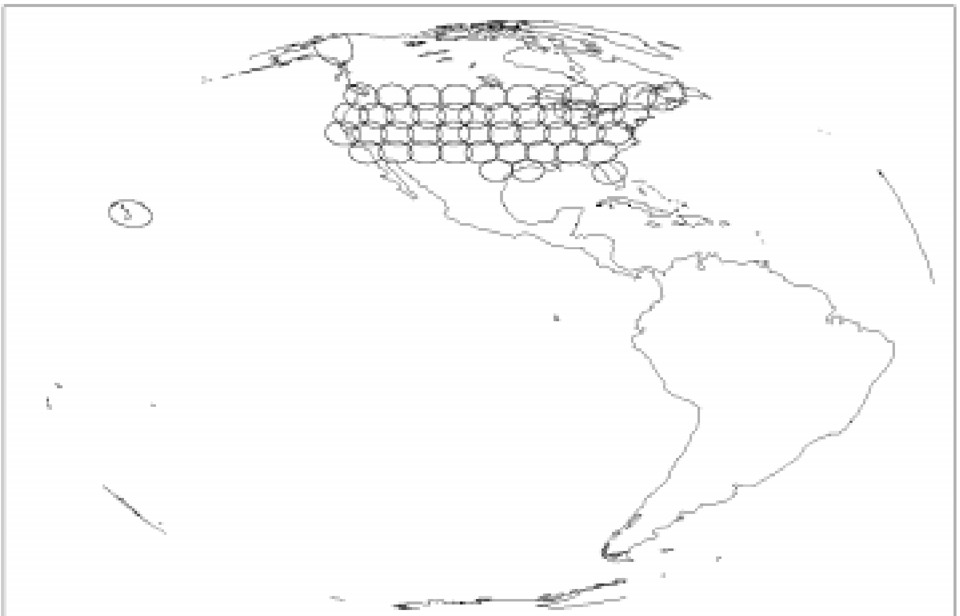

Figure 3.9: North America 1 GEO(8) Beam Pattern

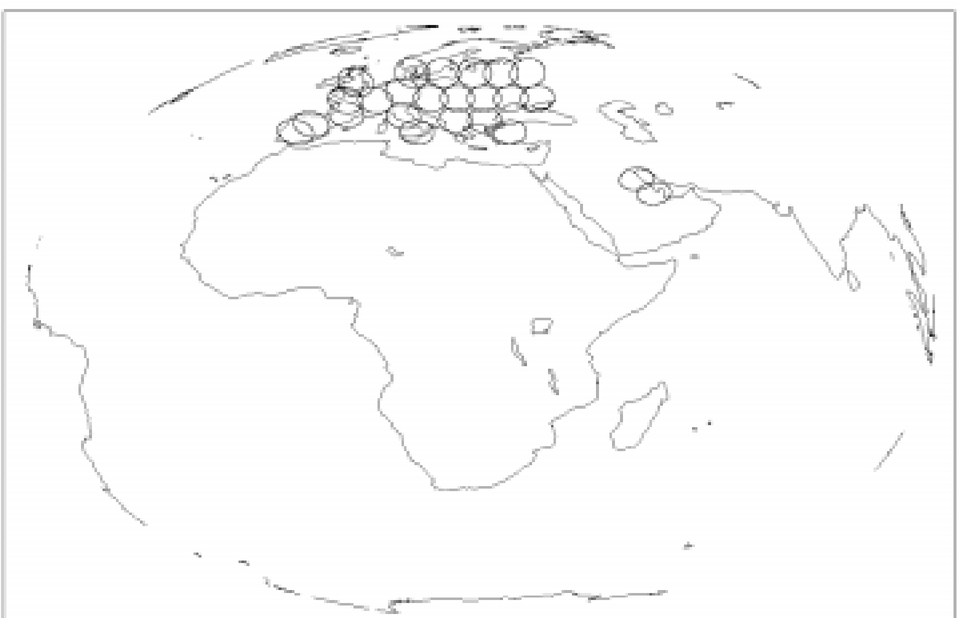

Figure 3.10: Europe/Africa 1 GEO(8) Beam Pattern

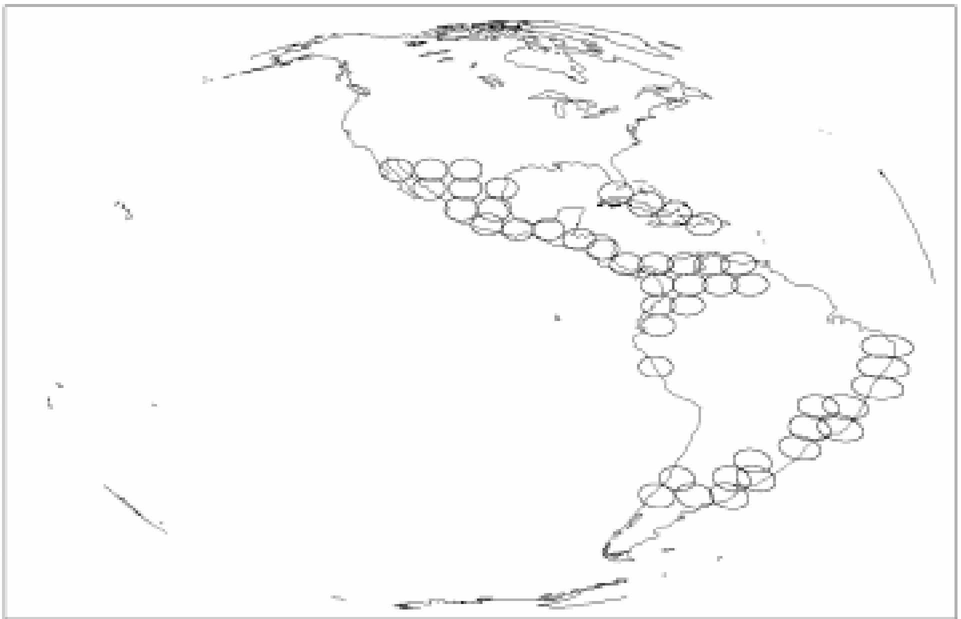

Figure 3.11: South America 1 GEO(8) Beam Pattern

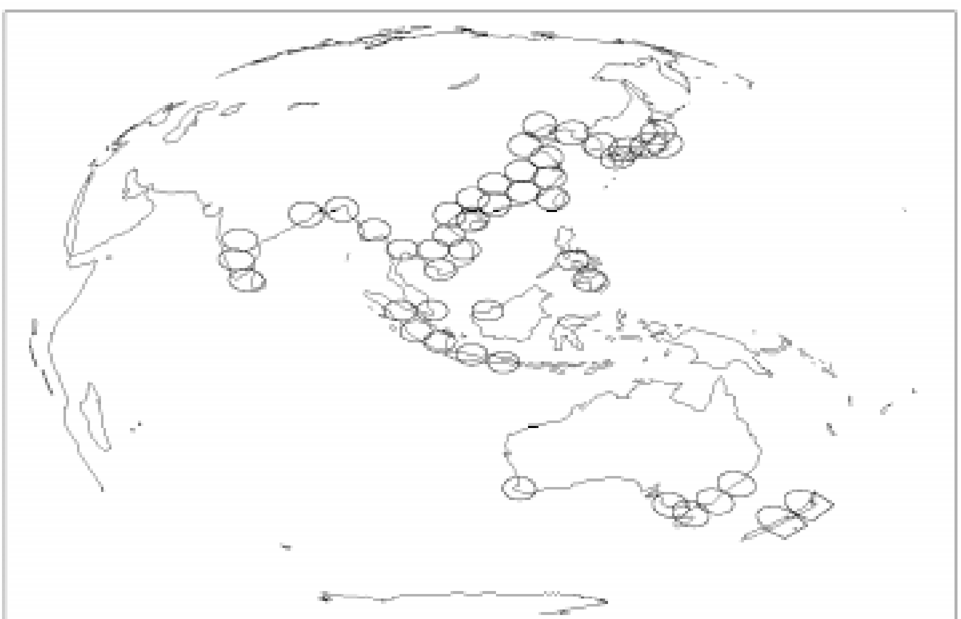

Figure 3.12: Pacific Rim 1 GEO(8) Beam Pattern

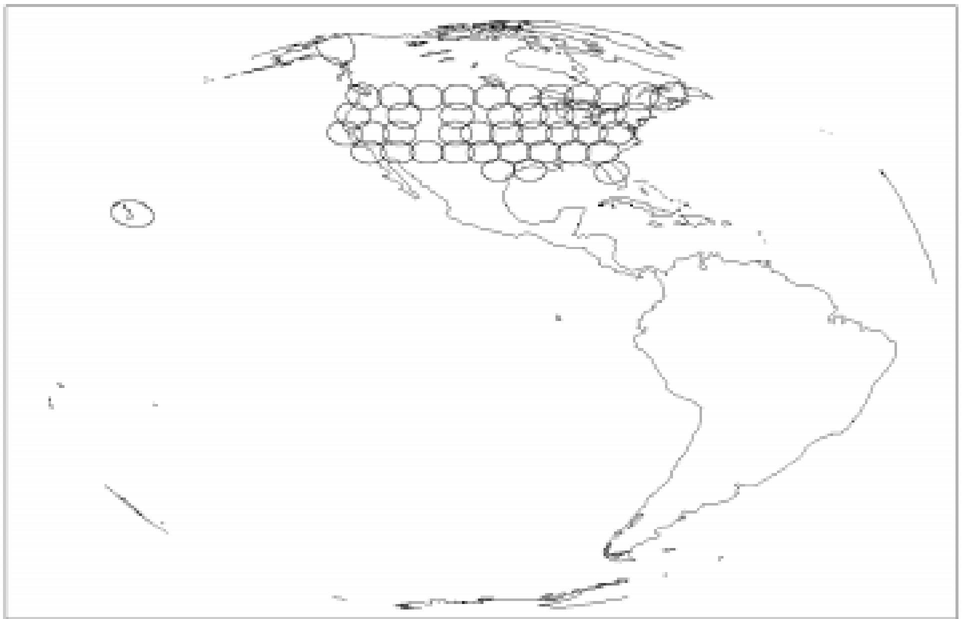

Figure 3.13: North America 2 GEO(8) Beam Pattern

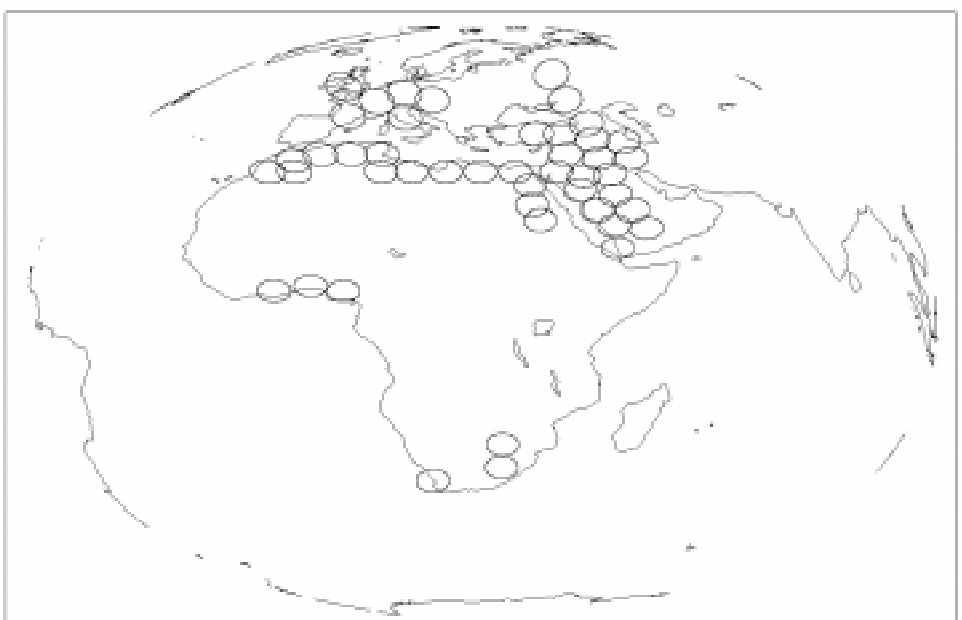

Figure 3.14: Europe/Africa 2 GEO(8) Beam Pattern

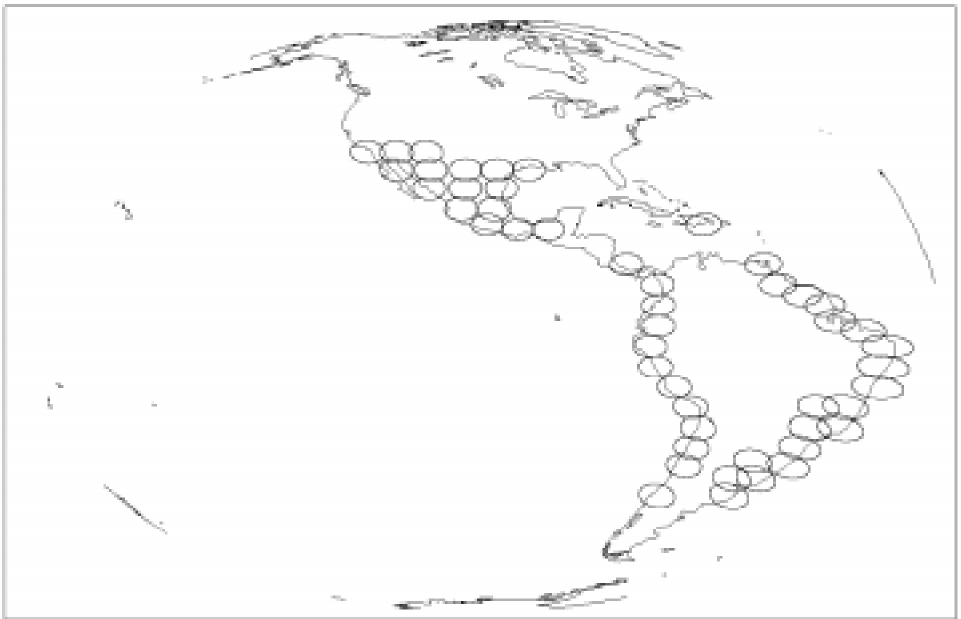

Figure 3.15: South America 2 GEO(8) Beam Pattern

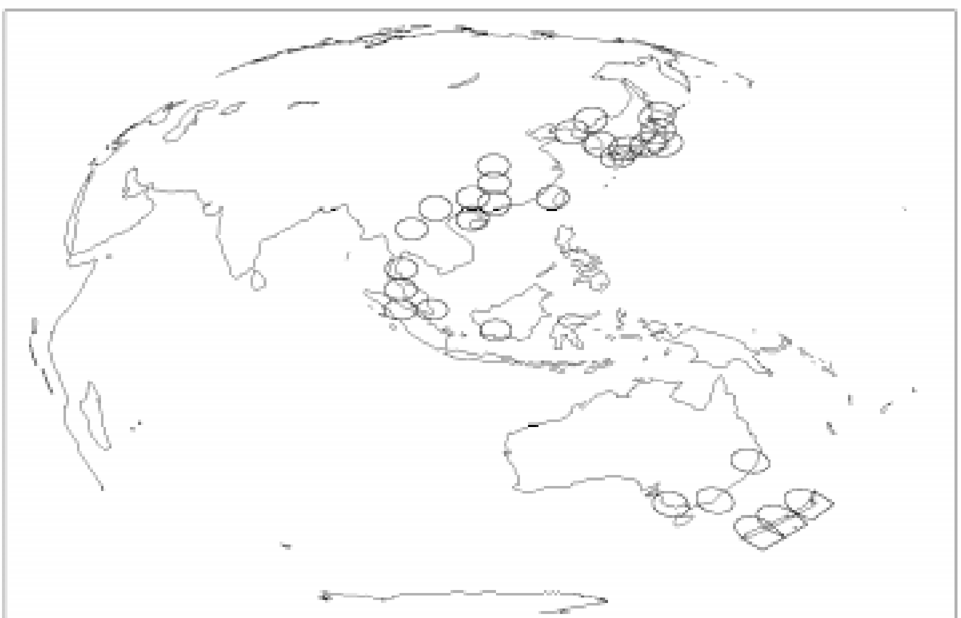

Figure 3.16: Pacific Rim 2 GEO(8) Beam Pattern

The GEO(8) system was simulated for the various market scenarios from the years 1999 to 2012. A sample input file for the simulation of GEO(8) can be found in Appendix A2. The initial year of operation assumed for each of the satellites is as follows:

- 1999 - North America 1 and 2, Europe/Africa 1, Asia 1, South America 1
- 2000 - Europe 2, Asia 2, South America 2

The achievable system capacity for the constellation lifetime is shown in Figure 3.17. Very little variation exists between the GDP and GDP per capita distributions for any of the three market growth models. Unlike GEO(3), GEO(8) is insensitive to the market distribution due to its larger and more comprehensive coverage regions. Also unlike GEO(3), each of the market models result in a smooth achievable capacity curve with no distinct plateaus. Since all of the satellite resources are on orbit and operational by the year 2000, the achievable capacity follows the maturation of the markets.

The last mile market results in the largest achievable capacity from 2000 to 2003 and increases until saturation is reached in 2008. The achievable capacity for the exponential market shows a rapid increase from 2002 to 2005 and reaches saturation in 2007. Capacity for the third order market models increases at the rate of market growth and never reaches saturation.

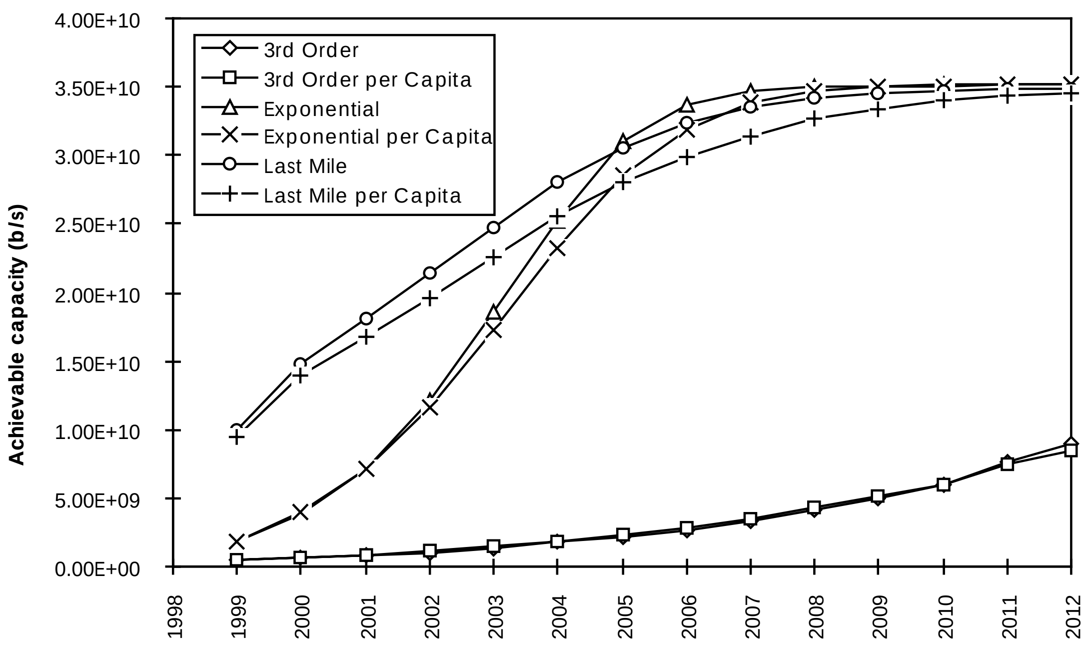

Figure 3.17: GEO(8) Achievable Capacity Profile

The early deployment of all the system resources results in the satellite spot beams being under-utilized through the early years of system lifetime. Shortly after full operational capability in 2001, only large commercial centers on the northeastern coast of the United States and in the United Kingdom have sufficiently large markets to support the full link capacity of the spot beams. In the other regions, the achievable capacity is limited by the market available. As the exponential and last mile markets develop, more of the beams become link limited as opposed to market limited until the full system approaches saturation.

3.5.4 LEO Simulations

The LEO system consists of a constellation of 840 interlinked satellites with 40 operational satellites in each of 21 orbital planes. Since the system cannot attain complete global coverage until the full complement of satellites are deployed, initial and final operating capability will occur simultaneously in 2001. For purposes of the simulation, the expected lifetime of the satellites is assumed to be ten years.

As mentioned previously, the Ka band is prone to high rain attenuation. To prevent attenuation and terrain blocking for links at low elevation angles, an elevation mask is employed that only allows satellites that are 40º above the horizon to be employed for communication links. This constraint limits the size of the satellite footprint and drives the constellation size required to achieve global coverage.

Rather than utilize tracking user equipment, the LEO constellation maps the Earth's surface into a fixed grid of approximately 20,000 "supercells", each consisting of nine smaller cells. Each satellite footprint covers a maximum of 64 supercells or 576 cells. As the satellites pass over the supercells, the beams are steered to fixed cell locations within the footprint. Each spot beam scans through nine different positions that correspond to the nine cells within each supercell as shown in Figure 3.18. This is the functional equivalent of time division multiple access (TDMA) with steerable ground antennas.

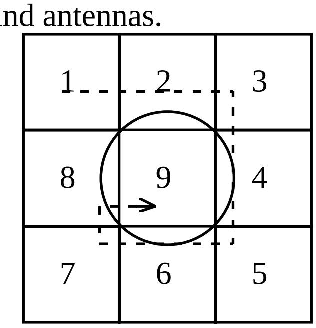

Figure 3.18: Scannable beam positions within supercells

The implementation of a LEO system required several assumptions to simplify the simulation. The key system assumptions are summarized below and a sample input file can be found in Appendix A3.

- **Walker constellation**: The satellite ephemeris files were obtained from the output of Satellite Toolkit [STK, 1995]. The constellation assumed is a Walker delta pattern [Walker, 1984] with twenty one planes, forty satellites per plane, and no phasing between planes.

- **Intersatellite links**: Section 3.5.1 discusses the negligible effects that the inclusion of intersatellite links have on a geostationary system. For a globally interconnected LEO constellation to perform as a packet switched network, intersatellite links are required. However, from the perspective of the achievable capacity simulation, provided that the crosslinks are capable of supporting the theoretical uplink/downlink capacity of the satellite, they will not act as a limiting factor. Since the Teledesic constellation is designed in a manner such that the cumulative capacity of the intersatellite links per satellite is sufficient to support the theoretical uplink/downlink capacity [Teledesic, 1995], this assumption is used for the LEO system and intersatellite links are neglected in the simulation.
- **Beam pattern**: To simulate the Earth fixed grid discussed previously, a beam pattern based on a symmetrical construction of the 64 supercells to be accessed by the spot beam is employed. The nine beam footprints contained in each square represent the nine scannable positions for that spot beam. A projection of the entire spot beam pattern for all 576 footprints which includes the 40º elevation mask is shown in Figure 3.19.

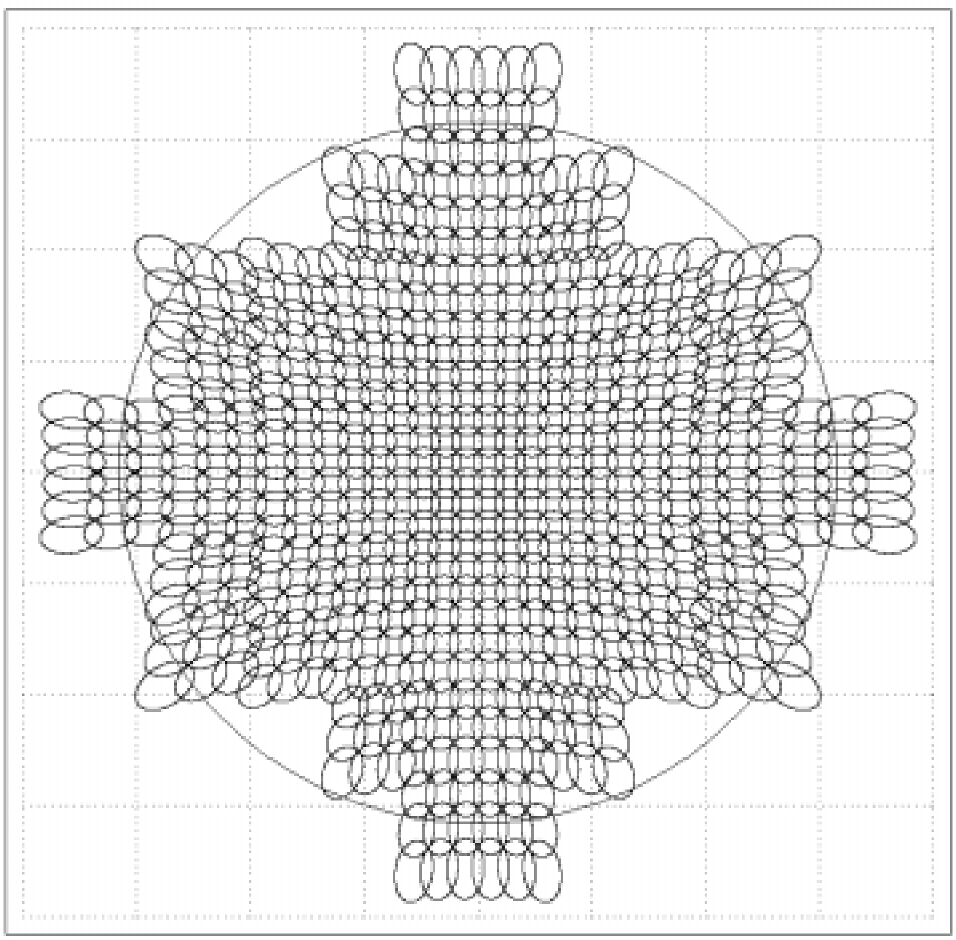

Figure 3.19: LEO Beam Pattern with 9 Scan Positions per Beam

In addition to these assumptions, the simulation of the LEO constellation was performed in a piecewise fashion. The simulation was divided up into three regional sections: North America, Europe/Africa, and Asia/South America. Since the market models do not provide estimates for traffic over the oceans, only those satellites that were over populated land masses were selected. Propagation of the satellites is not required due to the ubiquitous coverage provided by such a large constellation. Care was taken not to select any of the same satellites for inclusion in two different regional simulations and the regional splits were made along low traffic areas to minimize error.

The capacity simulation for the LEO system was performed over the expected system lifetime from 2000 to 2010. The achievable capacity results for that period are shown graphically in Figure 3.20. Note that the graph has a logarithmic y-axis.

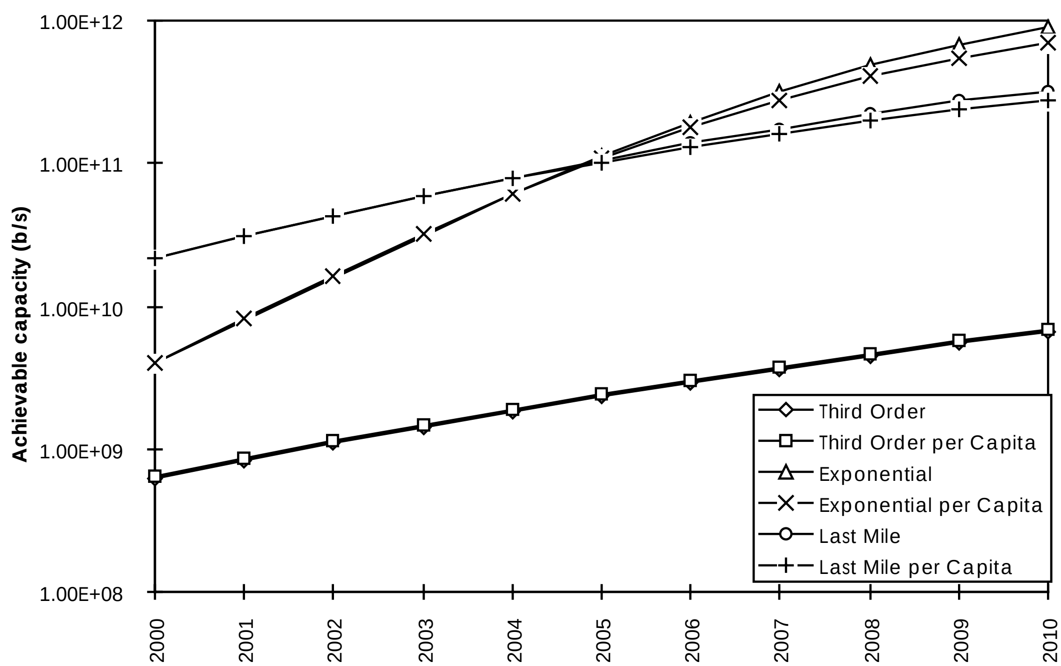

Figure 3.20: LEO Achievable Capacity Profile

The nearly uniform coverage of the LEO constellation results in a minimal difference in achievable capacity for the two market distributions for any of the market growth models. The coverage pattern allows access to all of the market, regardless of its location. None of the capacity profiles show the characteristic plateaus observed at system saturation. The link capacity of the LEO constellation is greater than the global market can support.

As shown, the last mile model gives the largest achievable capacity until 2005. After 2005, the exponential model has the largest achievable capacity. The third order growth models have a much lower achievable capacity than the other two, being nearly two orders of magnitude smaller by the year 2010. Comparing Figure 3.20 to the total market bits for the three growth models shown in Figure 2.13 provides some insight into the results shown. The shape and magnitude of the profiles in the two figures are nearly identical. The LEO constellation accesses all of the achievable market around the world. Thus, for the projected market models, the system is overdesigned.

Throughout the system lifetime, only the spot beams over the large industrial regions in northern Europe, North America, and Asia saturate. Over the rest of the world, the system has capacity to spare. A system that is overdesigned for the broadband market has the additional ability of capturing portions of the telephony market in the developing regions of the world. The accessibility of the telephony market in those regions and the implications of its inclusion are further explored in Chapter 6.

3.5.5 GEO(9) Simulations

The GEO (9) constellation consists of nine geostationary satellites in five orbital positions. The service regions for the satellites are the Americas, Europe/Africa, Asia/Australasia, Atlantic, and Oceania. The sample input file in Appendix A4 summarizes the input parameters used for the simulation of this system. The GEO(9) system uses a ubiquitous beam placement strategy similar to that shown in the LEO system. Each satellite has 192 spot beams which were spread across the coverage regions. The years of the simulation ran from 2000 to 2010. The deployment strategy assumed for the constellation is as follows:

- 2000 - USA 1 and Europe 1
- 2001 - Asia 1, Atlantic 1, and Oceania
- 2002 - USA 2, Europe 2, and Asia 2
- 2003 - Atlantic 2

The achievable system capacity assuming this deployment strategy is shown in Figure 3.21. Unlike the GEO(8) constellation, GEO(9) shows marked differences in the capacity attainable for the different market distributions. The difference between the achievable capacity for the GDP and GDP per capita distributions is due to the beam patterns that were employed for the GEO(9) simulation. Rather than concentrating the beams on the most heavily populated and industrialized areas, the beams were spread evenly over the land masses. This gives a coverage region similar in scope to that of the LEO system, although the capacity of the entire constellation is not as high. In the GDP per capita market models where traffic is more concentrated in specific regions, this beam placement strategy causes the beams over the industrialized areas to quickly saturate while those in the lesser developed regions are under-utilized.

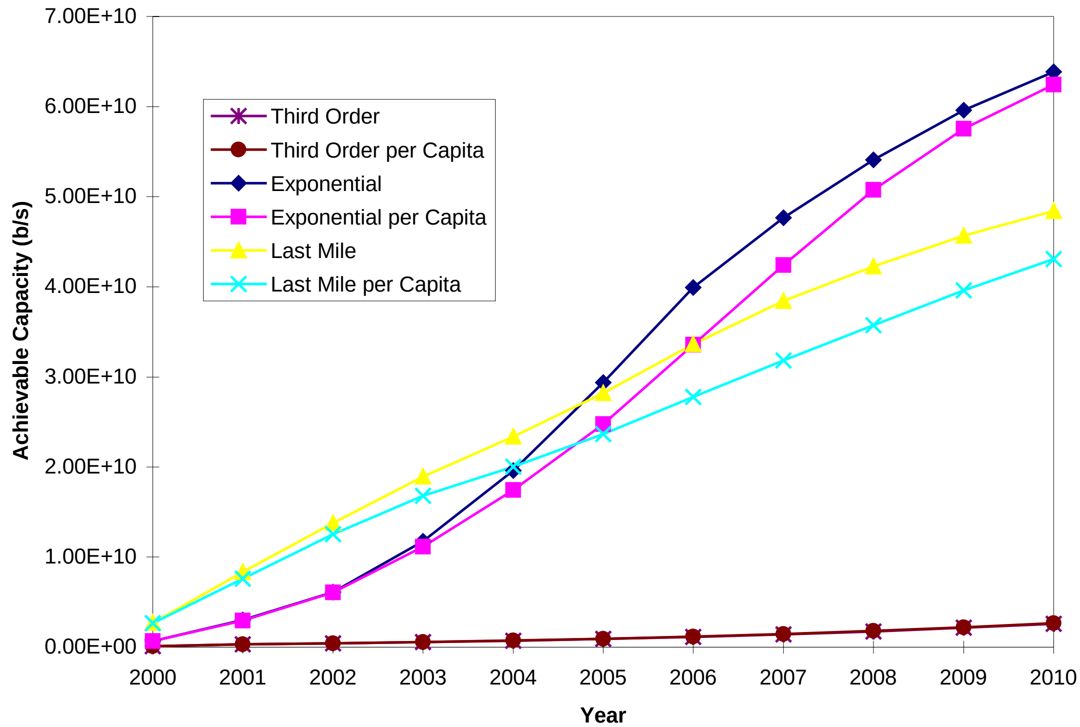

Figure 3.21: GEO(9) Achievable Capacity Profile

Unlike GEO(3) which showed achievable capacity plateaus between satellite launches, each of the market models results in a relatively smooth performance curve for GEO(9). This is a direct result of the early deployment of the constellation and of the widely distributed spot beams. Since a majority of GEO(9)'s spot beams are under-utilized, especially during the early years of the system's lifetime, the capacity curves follow the market maturation. In the exponential models, the system reaches saturation in the year 2010. The last mile and third order market growth models never reach saturation due to the more concentrated nature of the traffic in those models.

Despite its drawbacks, such a beam placement strategy puts GEO(9) into an excellent position to compete in areas where there is not a large terrestrial infrastructure and also includes the possibility of capturing the telephony market in under-developed regions. The possibility of capturing market in under-developed and developing regions puts GEO(9) in true direct competition with the LEO constellation.

3.5.6 GEO(12) Simulations

The GEO(12) system consists of twelve geostationary satellites in seven different orbital locations. For the purposes of the simulation, the first launch was set to occur in 2000 with full operating capability by 2002. The input parameters used in the simulation are summarized in the sample input file shown in Appendix A5. The input file includes the beam patterns for the constellation which are displayed graphically in Figures 3.22 to 3.28. The coverage regions tend to concentrate capacity in the larger developed regions of the world. These are the coverage regions that are used to calculate the achievable capacity.

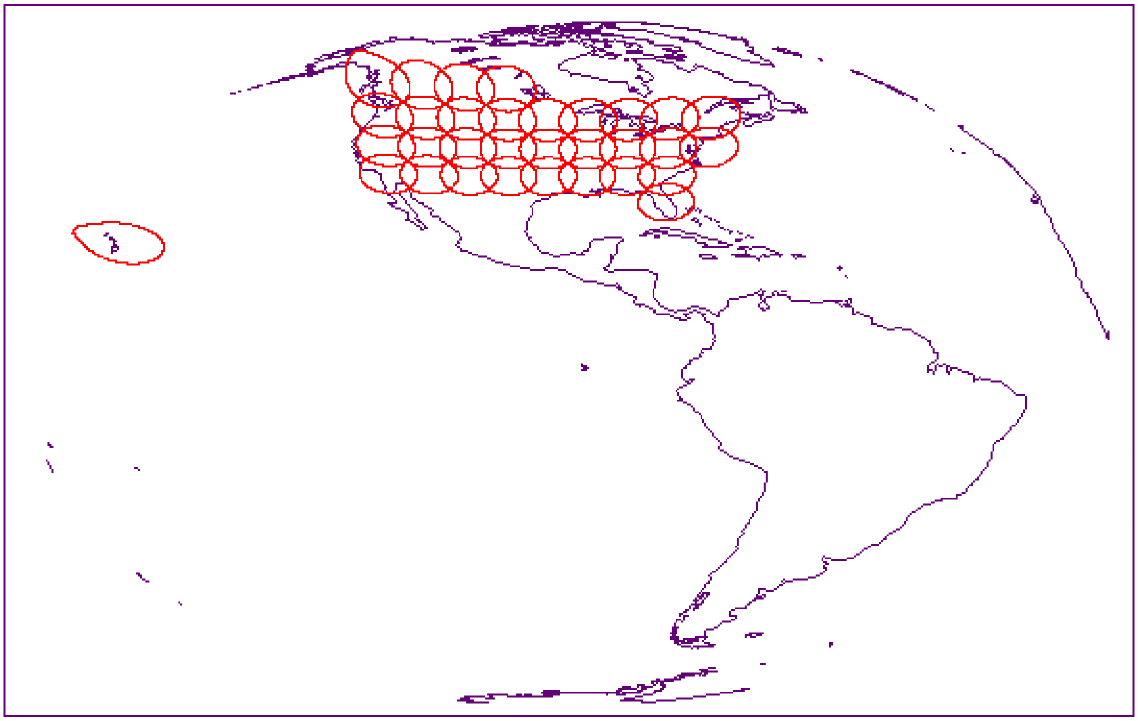

Figure 3.22: GEO(12) Satellites 1 and 5 Beam Pattern

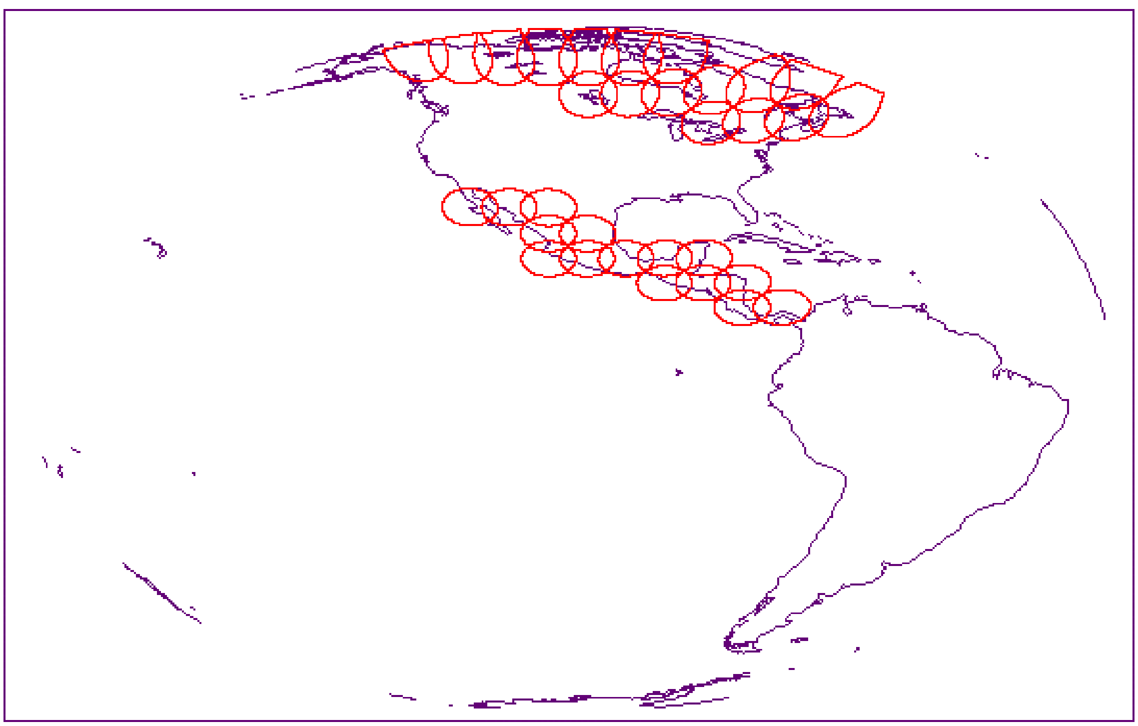

Figure 3.23: GEO(12) Satellite 2 Beam Pattern

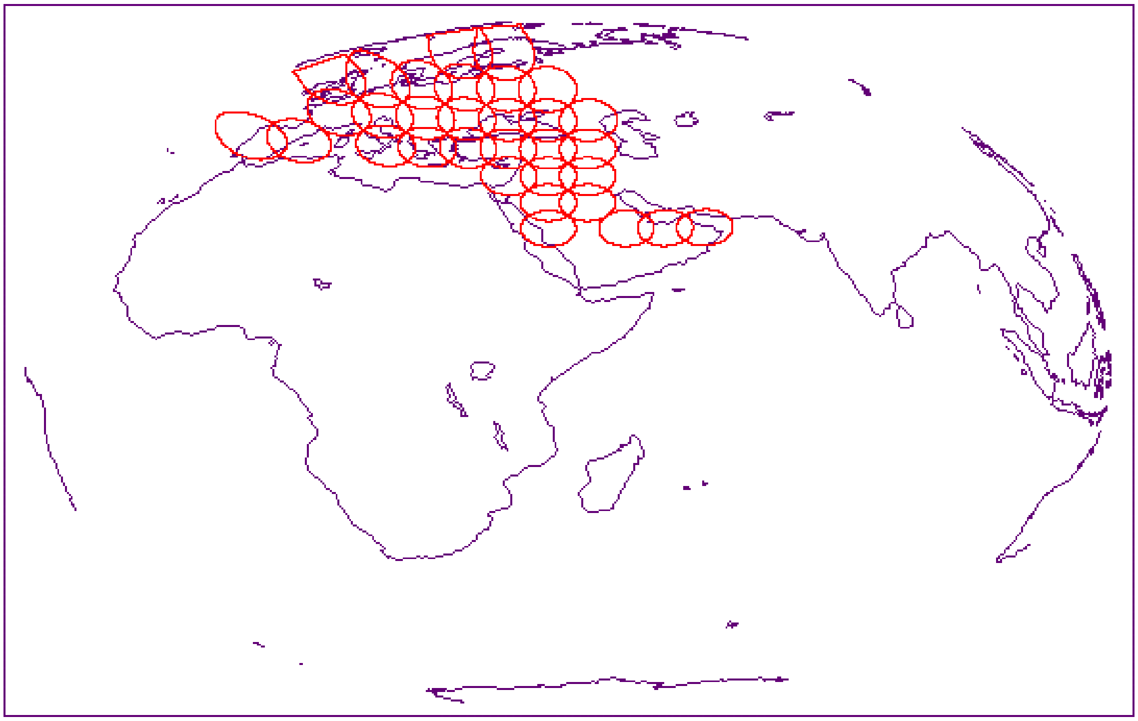

Figure 3.24: GEO(12) Satellites 3 and 9 Beam Pattern

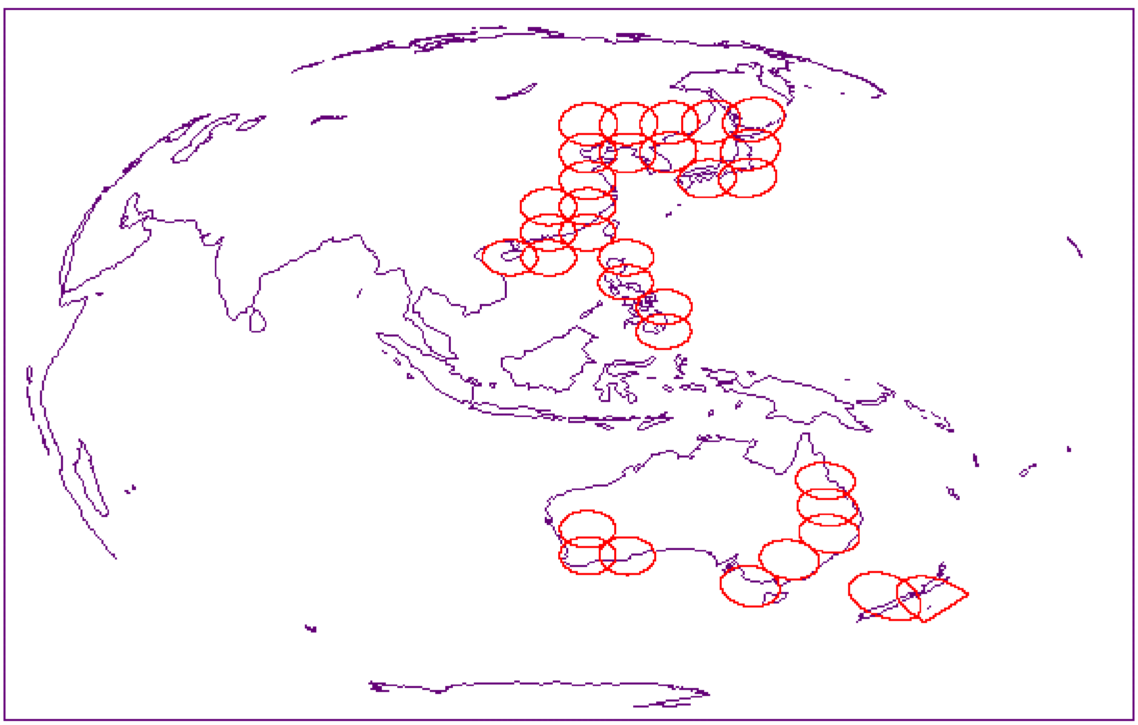

Figure 3.25: GEO(12) Satellite 4 and 10 Beam Pattern

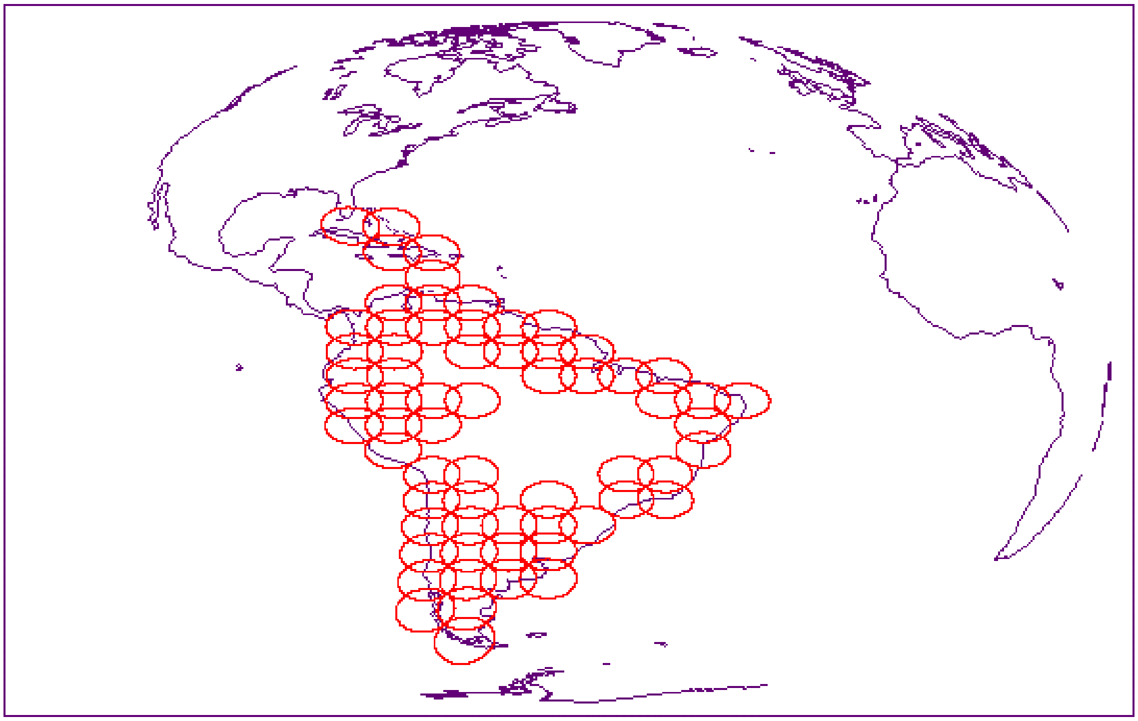

Figure 3.26: GEO(12) Satellite 6 Beam Pattern

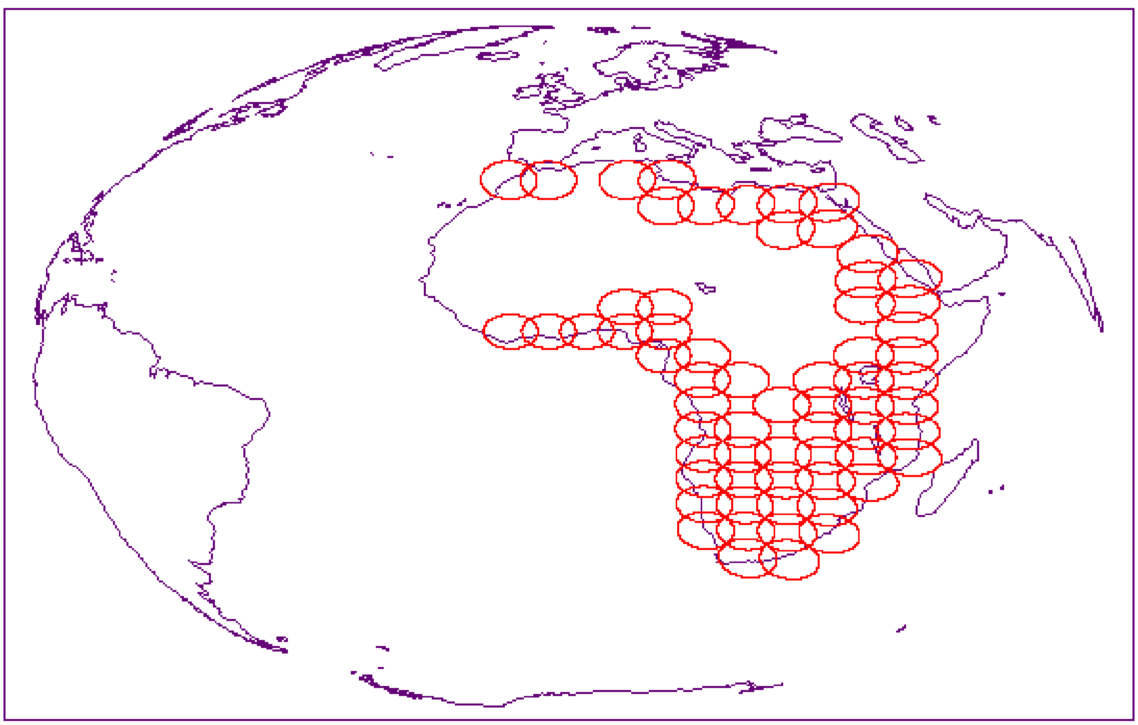

Figure 3.27: GEO(12) Satellites 7 and 11 Beam Pattern

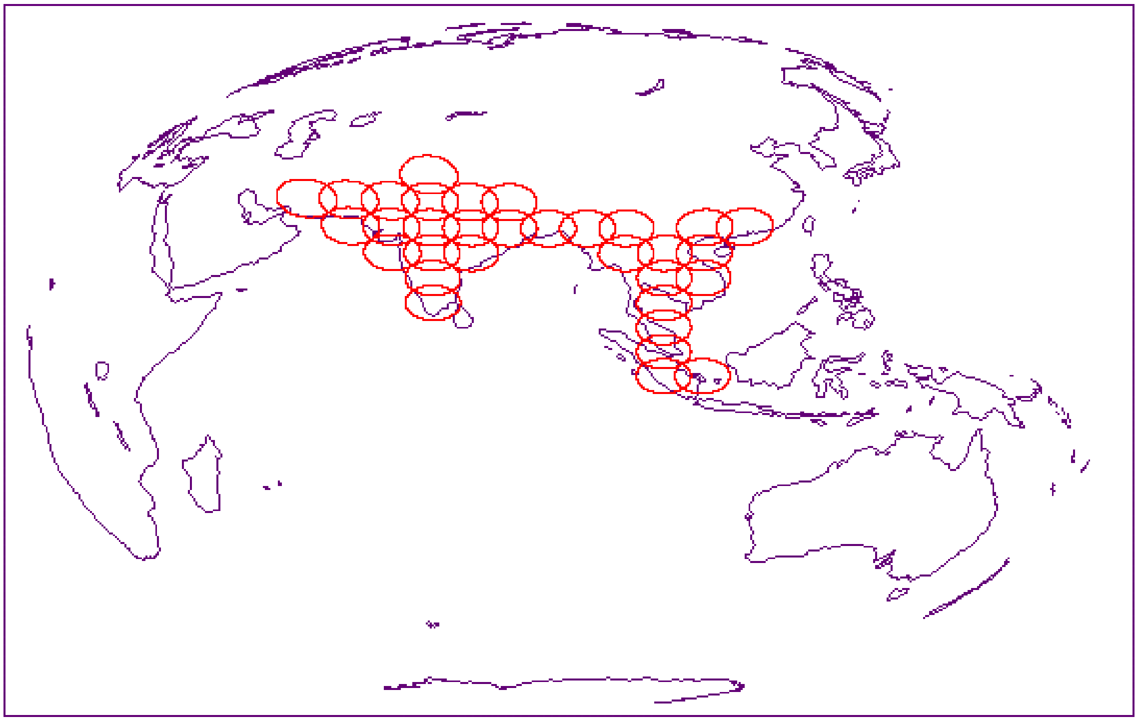

Figure 3.28: GEO(12) Satellite 12 Beam Pattern

The system was simulated for the different market scenarios over its lifetime. The years of the simulation ran from 2000 to 2010. The assumed deployment strategy is shown below:

- 2000 - USA 1, North America, Europe 1, and Asia/Australia 1
- 2001 - USA 2, Caribbean/South America, Africa 1, and Asia/India 1
- 2002 - Europe 2, Asia/Australia 2, Africa 2, and Asia/India 2

The achievable capacity for this twelve satellite constellation is shown in Figure 3.29. Like the GEO(8) and GEO(3) constellations, GEO(12)'s beam patterns are highly concentrated in developed areas with large populations. Of note is that GEO(12) has a nearly identical total system capacity to that of GEO(9), yet due to the difference in beam patterns, there is far less of a difference in achievable capacity between market distributions during the early years. Initially, the majority of market growth is seen in the developed regions where GEO(12) concentrates its spot beams. However as lesser developed regions begin to grow more rapidly around 2005, the difference in achievable capacity for the GDP and GDP per capita market distributions becomes larger for the GEO(12) constellation but smaller for GEO(9). This is a direct result of the more universal coverage of GEO(9)'s spot beams. Since the beam patterns for GEO(12) concentrate capacity on areas that are the higher traffic regions, the result is a higher overall capacity than GEO(9), but a greater dependence on market distribution.

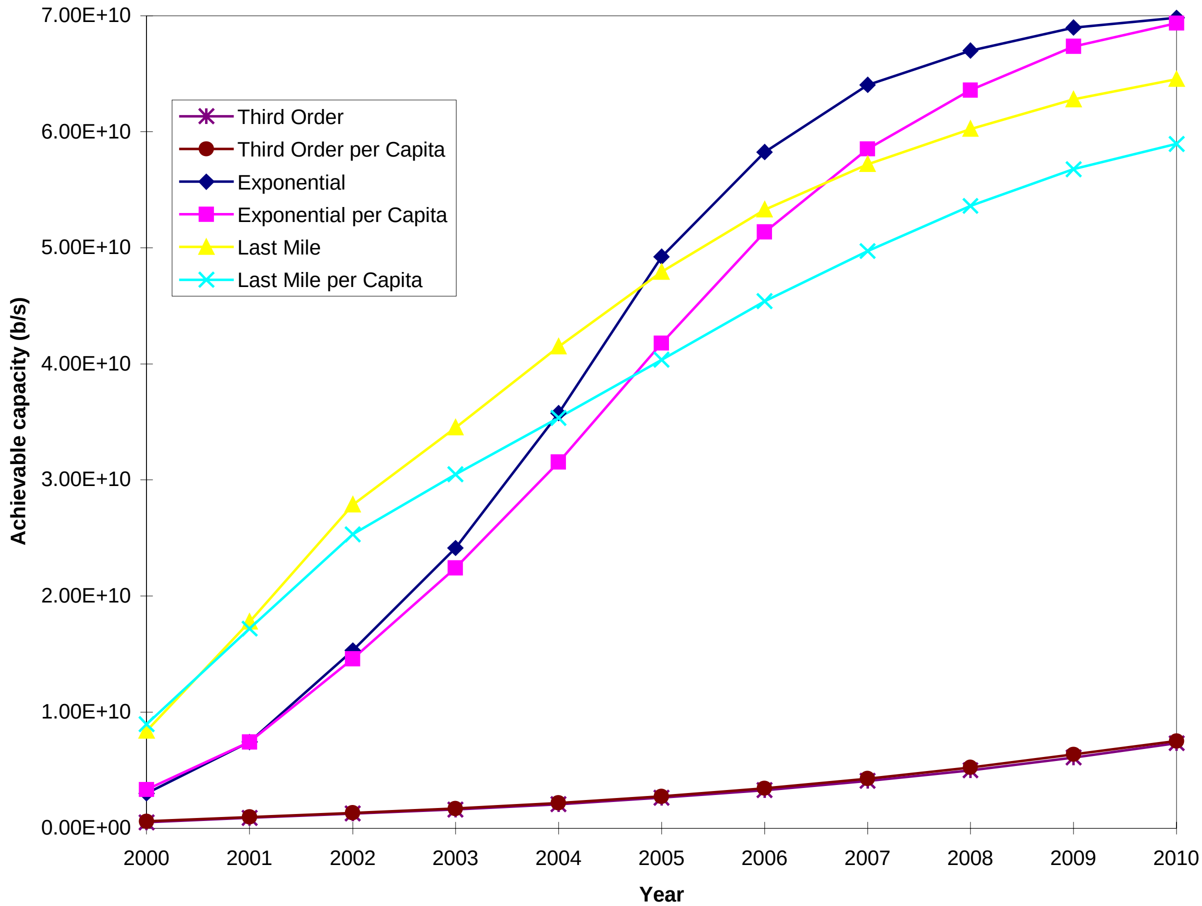

Figure 3.29: GEO(12) Achievable Capacity Profile

As seen with the achievable capacity results for the GEO(9) system, GEO(12) saturates in the exponential market in the year 2010. Though its yearly capacities in all models are larger than GEO(9)'s and the beam pattern allows for fewer under-utilized spot beams, GEO(12) is still over-designed for the market that it can reach and the remaining market curves contain no plateaus and simply track market growth.

3.6 Summary

The simulations performed in this chapter show some of the effects of design choices on the achievable capacity of a system. Systems that concentrate coverage on the industrialized regions of the world have far fewer under-utilized resources than those that attempt to provide larger coverage regions. However, larger systems that concentrate solely on industrialized areas are more sensitive to market distributions than those that provide truly global coverage. While the achievable capacity results provide insight into the technical viability of the systems, the economic viability is also dependent on the effects that design decisions have had on the cost of the system.

Chapter 4: System Costs

4.1 Introduction

Estimating the cost of the system is critical to the calculation of the cost per T1 minute. For the proposed systems, cost estimates are included in the FCC filings. Close examination shows that each system includes a slightly different list of costs in its estimate. Some include costs such as marketing and even inflation, while others just give the cost of the satellites themselves. To provide a comparison, the costs for the modeled systems are estimated and compared to the claimed costs for actual systems listed in the respective FCC filings. The total cost of the system (C_T) includes recurring (R) and non-recurring (NR) estimates for satellite design and construction, launch, insurance, gateways, gateway and control center operations, and terrestrial Internet connections. These are given by

$$C_T = NR_{satellite} + R_{satellite} + R_{launch} + R_{insurance} + NR_{gateway} + R_{gateway} + R_{operations} + NR_{internet} + R_{internet} \quad (1)$$

All satellites are assumed to have a lifetime through the year 2010, giving a satellite lifetime of ten years for the GEO systems and seven years for the LEO model.

4.2 Claimed Cost Summary

The FCC requires each proposal to prove financial viability. In order to do this, each of the systems provides a listing of anticipated costs and revenues. A summary of the claimed costs can be found in Table 4.1. VoiceSpan's costs are not included here. Due to their request for confidential treatment from the FCC, the costs are not part of the public filing. The table lists the claimed cost for the design, development and manufacture of the satellites as satellite cost. The life cycle cost includes the satellite cost plus ground stations, operations and personnel, launch, and insurance costs. In the case of Spaceway, the costs also include marketing and nominal annual inflation. Astrolink includes the cost of launching the satellites along with the development costs and Teledesic's estimates account for their plan to mass manufacture satellites. Since the methods used to estimate costs, and even the costs included in the estimates, are very different, a direct comparison of the costs listed in the FCC filings is not necessarily insightful.

Table 4.1: FCC Claimed Costs

System	Satellite Cost (FY 96 $B)	Life Cycle Cost (FY 96 $B)
Astrolink	3.8	9.1
CyberStar	.45	10.1
Spaceway	2.6	10.7
Teledesic	6.3	17.8

CyberStar and Teledesic also included a calendarized expense schedule for the design and development of their satellites. From the schedule shown in Figure 4.1, CyberStar and Teledesic incur 50% and 66% respectively of their total costs by the mid point of the development cycle.

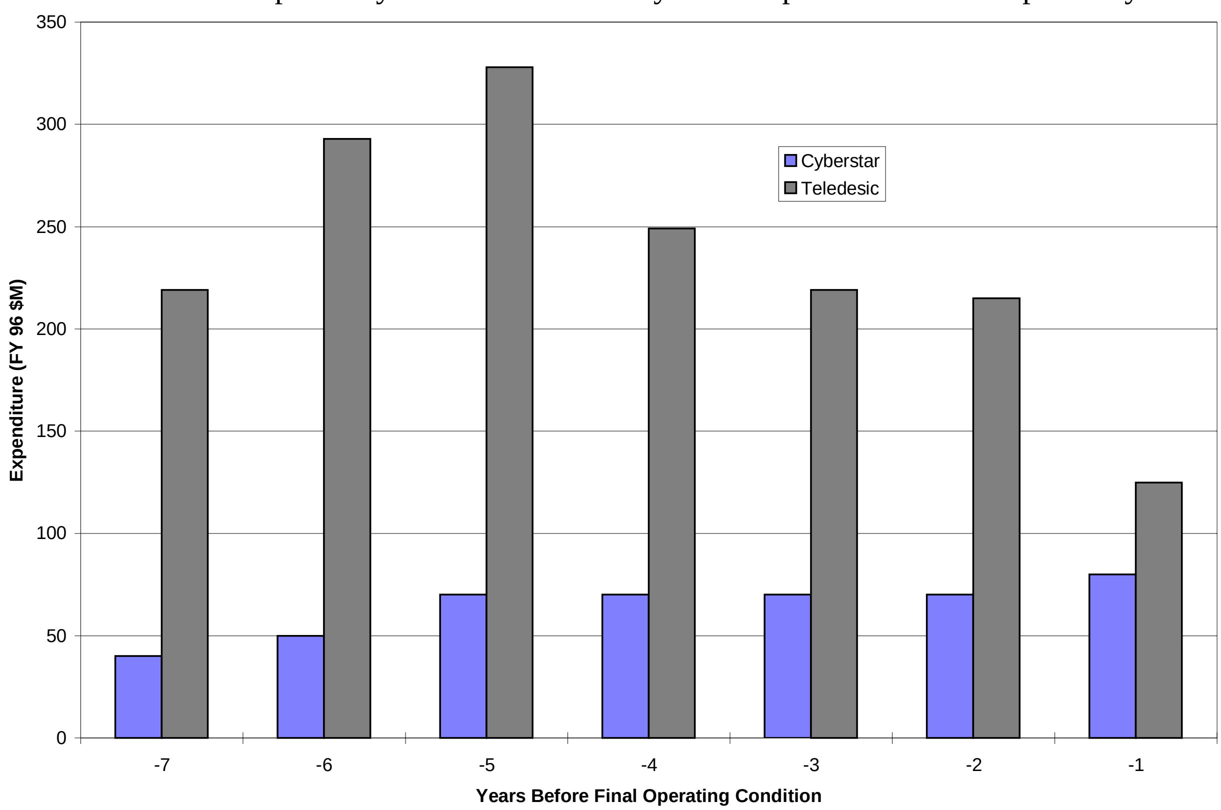

Figure 4.1: Claimed Development Expense Schedule

The claimed costs and schedules are used as a comparison to the cost estimates developed in this chapter which include the operational life cycle costs.

4.3 Cost Estimation Tools

Several cost estimation techniques are common throughout the cost model. The model works in constant fiscal year 1996 dollars (FY 96 $), thus all costs are adjusted using the Office of the Secretary of Defense estimates [Larson, p. 721]. Cost estimates in constant year dollars are useful for comparing alternatives and simplify computations since interest is assumed to be zero for the period of the estimates.

Also important to the cost model is the spreading of costs over the development period. As seen in Figure 4.1, the systems estimate spending of about 50% of the total by mid life of the development. Thus for the cost model, a 50% development cycle is assumed for all systems. To spread the cost over time, a spreading method that approximates the experience of actual programs was developed by Wynholds and Skratt [1977]. For a 50% expenditure at development midpoint, the function becomes

$$F(T) = [10 + T(6T - 15)]T^3 \tag{2}$$

where F(T) is the fraction of cost consumed in time, T, and T is the fraction of the total time elapsed [Larson, p. 733].

The final technique employed is the use of a learning curve for development. A learning curve describes the relationship between a firm's cumulative output and the amount of inputs needed to produce a unit of output [Pindyck, p. 224]. It accounts for productivity improvements as a larger number of units are produced. The total production costs, C_{prod}, for N units is given by

$$C_{prod} = TFU \times L \tag{3}$$

where

$$L \equiv N^B$$

$$B \equiv 1 - \frac{\ln\left((100\%)/S\right)}{\ln 2}$$

TFU is the theoretical first unit cost, L is the learning curve factor, and S is the learning curve slope in percent. The learning curve slope, S, represents the percentage reduction in total cost when the number of production units is doubled. In the cost model, the slopes assumed were 95% for less than 10 units, 90% for between 10 and 50 units, and 85% for over 50 units [Larson, p. 735]. A large LEO system would likely try to achieve mass manufacture of its satellites to take advantage of the reduction in cost from the learning curve, so an even lower slope than 85% is expected, however, the standard 85% is employed. The GEO (3) model, on the other hand, includes the manufacture of only four satellites (three operational, one spare) which would likely be crafted more individually.

All satellites are expected to have an operational lifetime of 10 years. This is a common lifetime for GEO satellites, but usually not for LEO satellites. Teledesic claims a 10 year lifespan in its filing with the FCC, so a 10 year life span is assumed for the LEO satellites as well.

Costs for the satellite system are broken down into recurring and non-recurring costs. Non-recurring costs are associated with design, development, manufacture, and testing of the qualification model. Recurring costs include all manufacturing, integration with the launch vehicle, and the launch cost.

4.4 Space Segment

To estimate the cost of the satellites, a dry mass model of 77 thousand dollars per kilogram of spacecraft dry mass for the recurring costs is assumed. The cost per kilogram of dry mass is based on industry experience from communications satellites [Lovell, 1995]. A non-recurring cost of seven times the first unit is assumed for the LEO system because the system is based on new satellite designs. Mass manufacturing techniques, if employed, also require a larger initial investment. Non-recurring costs for the GEO systems is assumed to be three times the first unit cost since they are similar to previous satellite designs and will employ traditional satellite manufacturing methods.

$$\begin{aligned} TFU &= \$77{,}000 \times DryMass \\ NR_{GEO} &= 3TFU \\ NR_{LEO} &= 7TFU \end{aligned} \tag{4}$$

Table 4.2 shows a comparison between the recurring and non-recurring cost estimates of satellite development and manufacture obtained from the $77K model. Comparison between the cost estimates in the FCC filings shown in Table 4.1 and the cost estimates from the $77K model shown in Table 4.2 shows that the model gives a fairly reasonable estimate for satellite development and manufacturing costs.

Table 4.2: Satellite Costs (FY 96 B$)

System	77K
GEO(12)	2.7
GEO(9)	1.8
GEO(3)	.96
GEO(8)	1.3
LEO	10.7

Along with the cost of the satellite construction, there is the cost of launching the satellites to their respective orbits. A cost per kg of wet mass to an orbit was calculated to use as an estimate in the cost model. Cost per kg to geosynchronous orbit is approximately $30,530 (FY

96 \$). The cost per kg to low earth orbit for a near polar inclination is approximately \$15,480 [Isakowitz]. To obtain a total launch cost, the wet mass of each satellite was multiplied by its respective cost per kg to orbit.

Insurance is a significant portion of launch costs. The insurance on a launch was calculated using a 20% rate on the sum of the recurring satellite and launch cost. This would cover replacement costs for the satellites and the launch vehicle in the event of a launch failure.

$$C_{ins} = 0.2(R_{satellite} + R_{launch}) \tag{5}$$

4.5 Ground Segment

The ground segment costs include the costs of gateways to communicate to the satellites, the terrestrial Internet connection hardware and services, a control center to control the satellites, and personnel to operate them.

For the model, two communications gateways per region of coverage were assumed. It is assumed that each gateway was capable of communication with the terrestrial network and telemetry, tracking, and control (TT&C). Each gateway requires two Ka-band stationary antennas. Even in the case of Teledesic, the ground antennas will not be tracking the satellite since the satellite tracks specific areas on the ground [Kohn]. The estimated cost for a gateway with antennas and related hardware is \$15M (FY 96 \$) [Groenaas]. The learning curve described in Section 4.3 is applied to the production of the gateways. A non-recurring factor of five times the cost of the first ground station is assumed [Lovell].

Operations costs are estimated by assuming four, five person shifts for each gateway site and four, twelve person shifts for the control center. The estimated cost to support one person is \$150,000 per year [Yamron].

To determine the number of OC-3 (155 Mbps) circuits necessary per satellite, it was assumed that all the bits uplinked by the satellite would have to be downlinked to the same region. This would be the case if the satellite system had no intersatellite links to transport traffic. The number of OC-3 circuits is allowed to increase as the number of bits uplinked by the satellite increases with the growth of the market, thus the total cost of hardware to connect to the terrestrial Internet varies from year to year. The current cost of an OC-3 connection involves both an installation charge, the cost of the hardware, and a recurring cost for maintenance of the connection and agreements required to transport Internet traffic. The installation cost of an OC-3 circuit is estimated at \$8500 and the recurring cost at \$94,800 per year, all in fiscal year 1996 dollars [Quintana].

The cost of control centers was not estimated due to the large number of options available. Some systems will need to construct new control centers, while others will be in a position to simply modify existing control centers.

4.6 Summary

A cost model of \$77K per kilogram of satellite dry mass was used to obtain estimates for satellite development and manufacture. The satellite cost estimates appear reasonable when compared to the projected costs of similar systems given in FCC filings. The \$77K satellite cost model was combined with cost models for launch and the ground segment to obtain a projected yearly expenditure breakdown of cost. This yearly breakdown of estimated cost is used to calculate the cost per T1 minute.

Chapter 5: Cost per T1 Minute

5.1 Introduction

The concept of functional metrics to compare systems that are technologically different has existed for quite some time. The difficulty of developing a functional metric lies in choosing the appropriate performance criteria for evaluation. For example, with automobiles the performance criteria that consumers use range from vehicle handling to personal comfort and safety, yet the primary purpose of an automobile is transportation. The primary recurring cost of the automobile to the consumer is fuel. Thus, for an automobile, a reasonable comparative metric is number of miles travelled per gallon of fuel consumed.

Applying similar scrutiny to the broadband satellite systems reveals that their primary purpose is information transfer. From a business perspective, the appropriate functional metric is the cost to provide information transfer. Incorporating the Internet as a model leads to the use of a monthly cost based on a specific data rate. Since the broadband satellite systems have varying connection rates and capacity differences, a cost per minute based on a specific data rate can provide an equitable comparison. A cost per minute rather than a cost per month eliminates the complexity of estimating “typical” monthly usage. The broadband systems being proposed and modeled are marketed as high speed data connections ideal for multimedia communication, thus a T1 (1.544 Mbps) data rate was selected as the rate for comparative analysis. T1 connections are considered well suited to high traffic systems, company-wide systems, WANs, and Web Server applications, representing the wave of the future for Internet communications [SelectNet].

5.2 Internal Rate of Return

The internal rate of return of a project is a measure of profitability that takes into account the variation in value of money with time. For a project with the time span and risks similar to those associated with the broadband communications systems, a potential investor would typically require a 30% rate of return [Yamron].

Associated with the internal rate of return is the concept of time value of money. A dollar today is worth more than a dollar a year from now, since investing that dollar today would earn interest. In order to account for the depreciation, a discount rate, i, is applied to convert all future moneys to constant year dollars, in this case, fiscal year 1996 dollars (FY 96 $). Thus the present discounted value of an amount, F, that is received N periods in the future is

$$P = \frac{F}{(1+i)^N} \tag{1}$$

For example, $1000 received five years from now at a yearly discount rate of 10% would only be worth $620. Reversing the calculation, if $620 were invested today at an interest rate of 10% and compounded annually, it would be worth $1000 five years from now.

The present worth of a series of investments is given by

$$P = \sum_{j=1}^{n} \frac{F}{(1+i)^j} \tag{2}$$

The notion of net present value (NPV) comes from Equation (2). Net present value is defined as the net discounted benefits less the net discounted costs. For a project to be considered worthwhile, the net present value of benefits must be greater than the net present value of costs. This is given mathematically by

$$NPV = \sum_{j=1}^{n} \frac{(B_j - C_j)}{(1+i)^j} \geq 0 \tag{3}$$

where B_j is the benefit at the end of period j, and C_j is the cost at the end of period j.

The internal rate of return, i^*, is the discount rate for which the net present value equals zero, or net costs are equal to net benefits [Steiner, p. 153]. In the case of the broadband communications systems, the desired i^* is 30%, so Equation (3) becomes

$$\sum_{j=1}^{n} \frac{(B_j - C_j)}{(1+.3)^j} = 0 \tag{4}$$

The benefits for each year, given in Equation 5, are the costs to the user to maintain a T1 link for one minute, C_{T1}, times the number of T1 connections available, N_{T1}. The user cost per T1 minute includes system costs as described in Chapter 4 and a 30% internal rate of return, but does not include items such as sales and advertising costs.

$$B_j = C_{T1}(N_{T1})_j \tag{5}$$

Substituting Equation (5) into (4) and solving for C_{T1} gives

$$C_{T1} = \frac{\sum_{j=1}^{n} \frac{C_j}{(1+.3)^j}}{\sum_{j=1}^{n} \frac{\left(N_{T1}\right)_j}{(1+.3)^j}} = \frac{NPV\left(C_j\right)}{NPV\left[\left(N_{T1}\right)_j\right]} \tag{6}$$

which is essentially the net present value of the system costs divided by the equivalent of the net present value of the number of T1 links available.

5.3 Zero Order Comparison

As a test of the viability of the cost and capacity models, an estimate of the cost per T1 minute was obtained using the stated satellite capacities and costs from the FCC filings for the five proposed systems that were used as models in the simulation. These capacities are shown in Table 5.1.

Table 5.1: Satellite Capacities

System	Satellite Capacity (Gbps)
Astrolink	7.7
CyberStar	4.9
Spaceway	4.6
Teledesic	13.3
Teledesic (2 million connections)	0.13
VoiceSpan	5.9

Two different capacities were employed for Teledesic since the FCC filings gave both a satellite capacity and a number of connections that the system could support. The stated system capacity for Teledesic was multiplied by a factor of 0.3 to account for only 30% of the capacity being usable at any given time since the rest is over ocean. The two different capacities given in the Teledesic filing account for the two different costs shown in Figure 5.1.

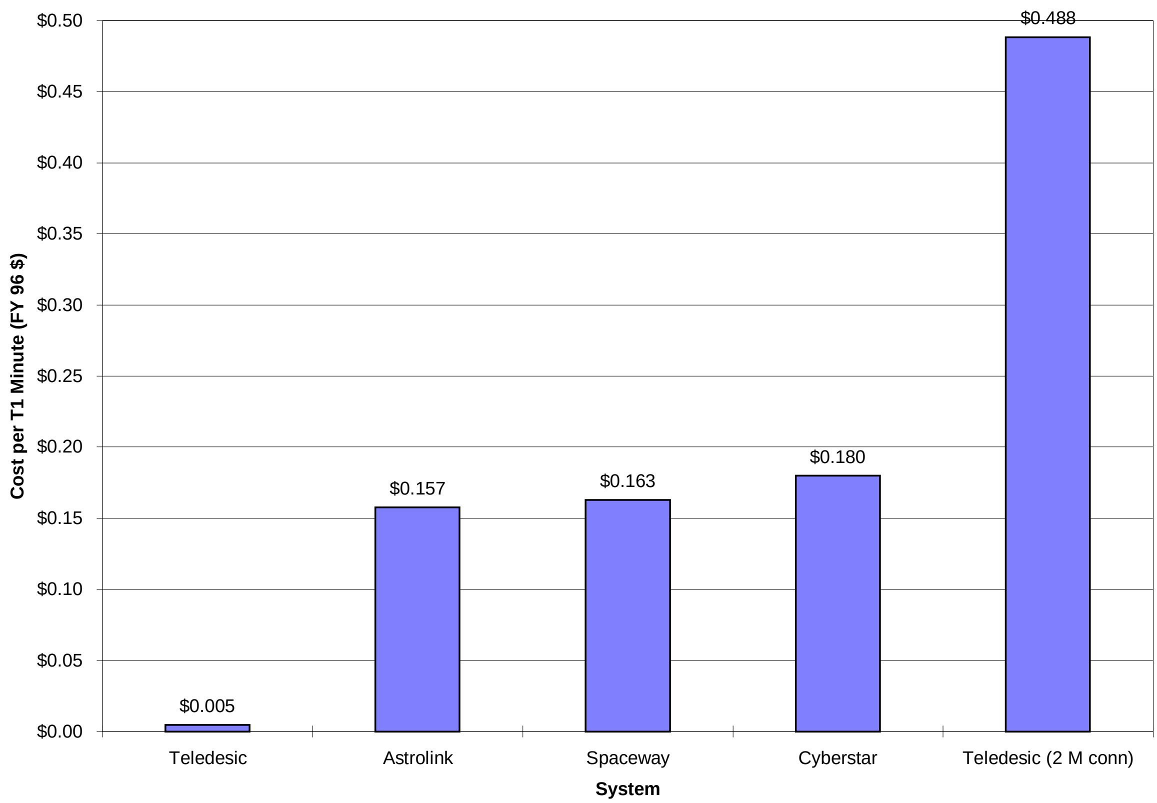

Figure 5.1: Zero Order Cost Per T1 Minute

The yearly breakdown of costs from the FCC filings includes the cost of the spacecraft, respective launch, insurance, and associated ground equipment and pre-operating expenses. For Spaceway the costs of marketing and nominal annual inflation are also included. The Teledesic system only includes the first year of operations' costs in the FCC filing, so it was assumed that the operations' costs for later years were identical to those of the first year. According to the CyberStar and Astrolink filings, the costs given are those for the development, maintenance, and deployment of the satellite system and associated ground segment.

This basic estimate for cost per T1 minute does not account for market development or distribution and all systems are expected to be operating at full capacity throughout their lifetime. After market and capacity limitations are accounted for and the dry mass model is incorporated, the cost per T1 minute of the systems is expected to fluctuate around this zero order. It is anticipated that the two Teledesic estimates represent upper and lower bounds for the cost per T1 minute.

A more detailed discussion of terrestrial competition can be found in Section 6.5, however, as a baseline for comparison, consider current connection technology for the home user. By far, the most common method of connection to the Internet for the home user is dialing in to an Internet service provider via a modem. Current costs for Internet service is about $20 a month for unlimited connect time, which the provider estimates at 400 hours of connect time. The average user connects at a speed of 14.4 kbps or 28.8 kbps [Lonn]. Considering the $20 charge to be at a speed of 28.8 kbps leads to a cost per T1 minute of 4.5 cents. This cost is misleading as a direct comparison, since home users cannot obtain T1 level service through a modem and an Internet service provider.

For dedicated T1 class service, a user must install a fiber optic line to the home. The installation of the fiber optic connection costs $2000 per household for a high quality voice line and up to $6000 per household for a data line. Though these costs are expected to drop as installation of fiber optic cabling becomes more common, due to the skilled techniques required to install such cabling, the cost is not expected to drop below $2000. The current cost per month for T1 level service ranges from $500 to $1000 [Kraushaar, 1995].

Satellite broadband communications systems fall between these two extremes. They encompass the capability of the fiber optic connection at a cost on the order of current dial-in Internet service. Cable modems are also attempting to tap into this segment of the market. However, the information transfer associated with cable is highly asymmetric. The architecture is designed to convey high speed data to the user, but does not have the ability to receive high speed data back on the same line. Before launching into a detailed comparison with terrestrial technologies, the five model systems are explored to assess their competitiveness with one another.

5.4 Dry Mass Model Cost Per T1 Minute

Cost per T1 minute estimates for the modeled systems were obtained using the satellite dry mass cost model of $77K (FY 96 $) discussed in Chapter 4. The capacity code discussed in detail in Chapter 3 was run for the full deployment of all systems, shown in Figure 5.2.

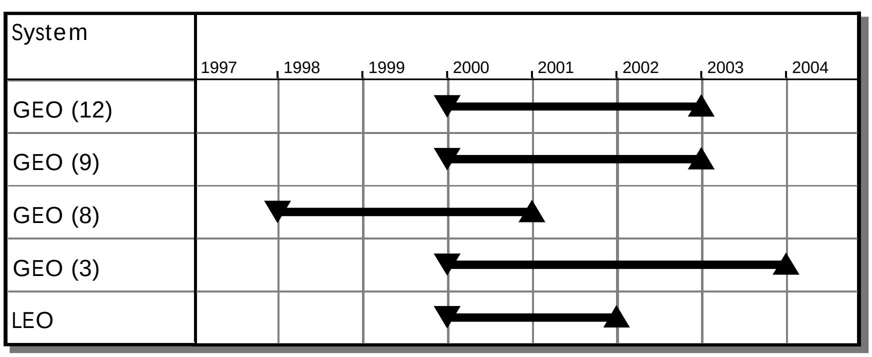

Figure 5.2: Nominal Deployment Schedule

5.4.1 100% Market Availability

The systems were each given access to 100% of the available market on the ground, thus the results shown in Figure 5.3 assume that only one system exists at any given time. As shown, for all of the market models except the third order growth model, the cost per T1 minute is similar. In the third order model, the cost per T1 minute is significantly larger since there is not enough market available to allow the systems to reach saturation. The systems are over designed for the available market and thus the total system cost must be amortized over a smaller number of bits, resulting in the higher cost per T1 minute. Since the third order market model is a low estimate of Internet growth as discussed in Section 2.2.3, it will be neglected in favor of closer examination of the remaining market models.

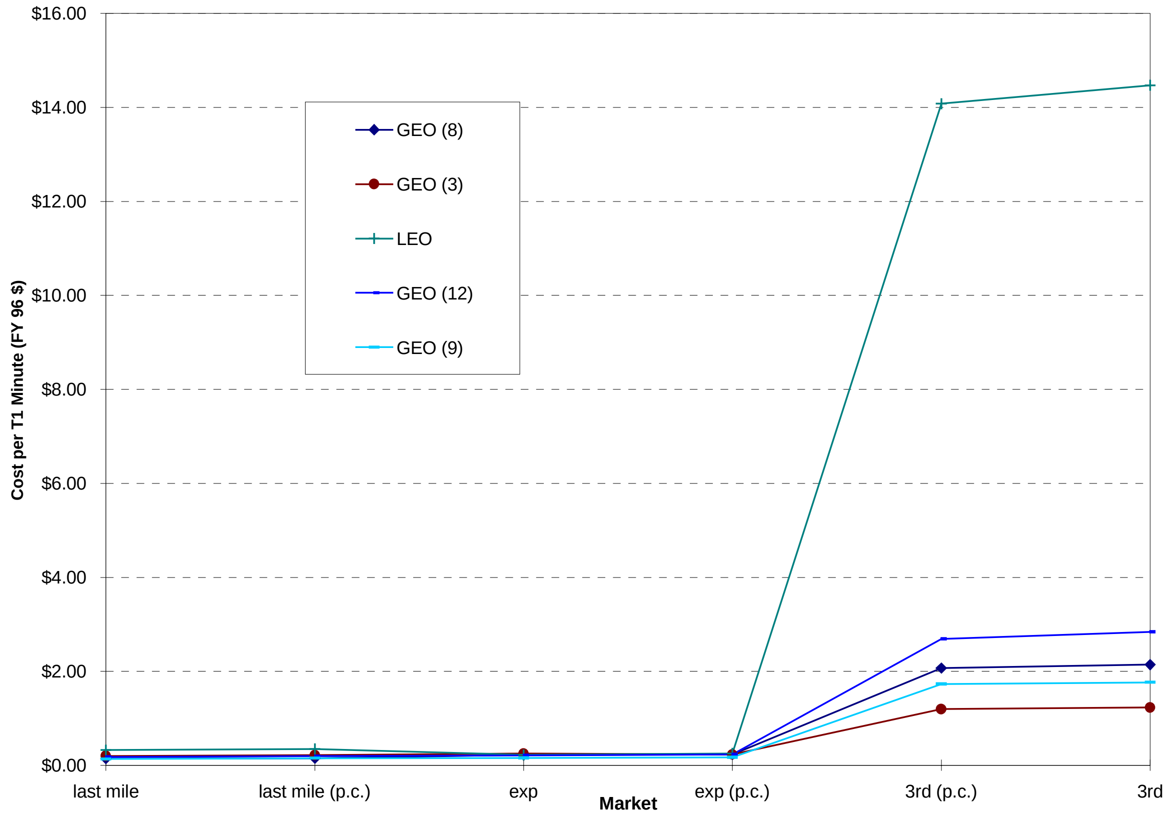

Figure 5.3: Cost Per T1 Minute, All Markets, 100% Market Availability

Closer examination of the remaining market models, shown in Figure 5.4, reveals that there is very little difference in the cost per T1 minute among the systems. There is also only a marginal difference caused by the distribution of the market by GDP or by GDP per capita. In the last mile model, the LEO system is still over designed for the market that is available, resulting in a higher cost per T1 minute. The metric thus allows a baseline comparison of different systems designed to provide a similar service and also a preliminary determination of the type of market growth that is necessary for a system to be viable. Also of note is that the LEO model is competitive under the standard satellite cost assumptions as discussed in Section 4.4 in well developed market scenarios. If a large LEO system is able to take advantage of mass manufacturing techniques and economies of scale, the cost of the constellation will decrease significantly with a corresponding decrease in the cost per T1 minute.

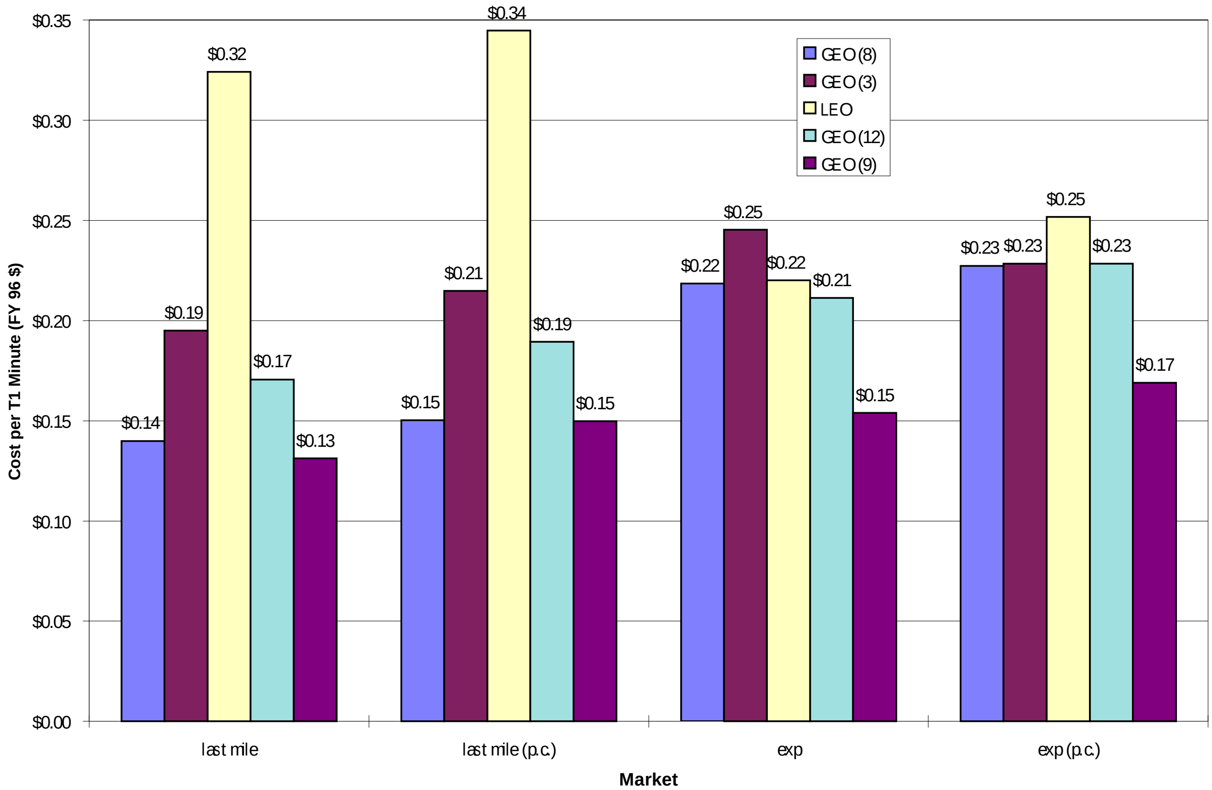

Figure 5.4: Cost Per T1 Minute, 100% Market Capture

5.4.2 30% Market Availability

To simulate the scenario of three systems competing equally for customers, each system was allowed to access only 30% of the available market. The reduction in market accessibility was achieved by taking the global number of bits per year obtained by the market projections shown in Figure 2.13 and reducing them by 70% before globally distributing the market. The cost per T1 minute results for this scenario are shown in Figure 5.5.

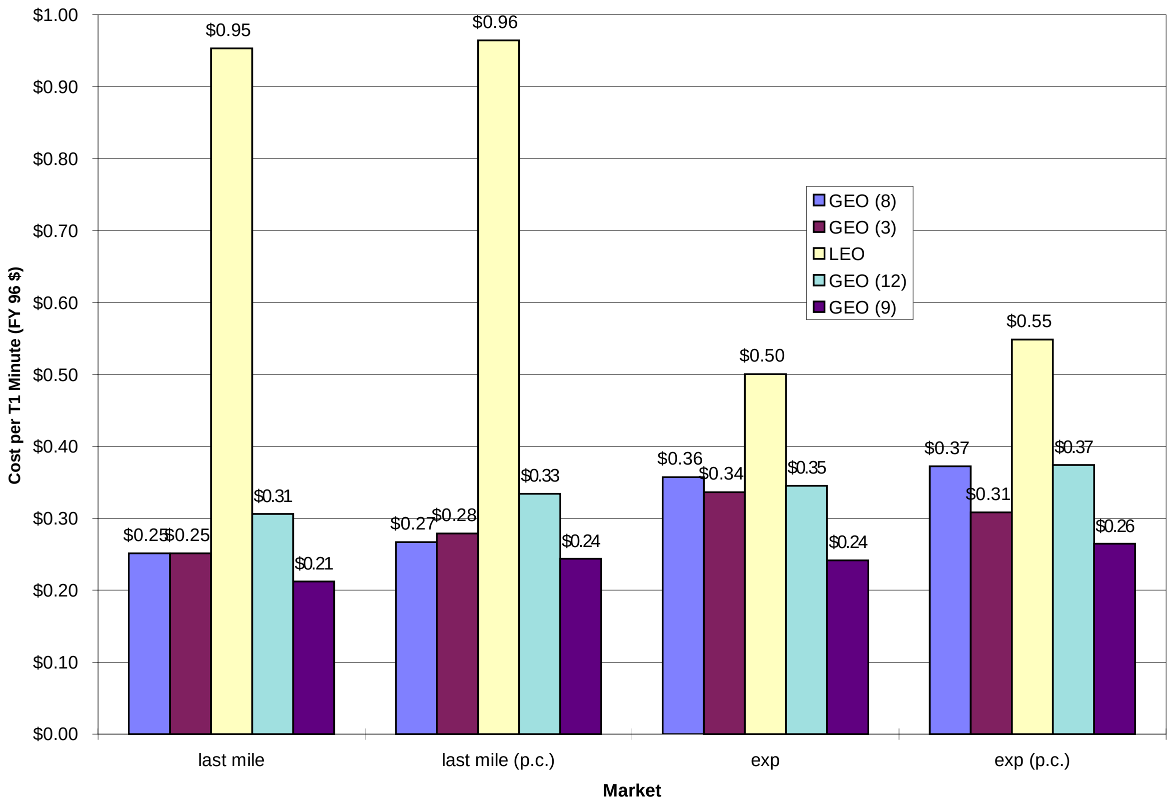

Figure 5.5: Cost Per T1 Minute, 30% Market Availability

As expected, the LEO model's cost per T1 minute increases dramatically in the last mile market. The system was overdesigned for 100% market capture in that market, thus the decrease in market availability only exacerbates that condition.

5.4.3 Competitive Market

While allowing the systems to have access to only 30% of the total market is illustrative in showing sensitivity to market capture, it does not represent a true competitive environment. Restricting each system to 30% of the market gives smaller systems an advantage since the larger systems are not able to access the market remaining when a smaller system reaches saturation. In reality, the systems will be competing with one another for customers. Smaller systems such as GEO(3) will reach a capacity limit even when only being allowed 30% of the market. Any market remaining will be available to the other systems and contribute to a larger customer base and thus a decrease in cost per T1 minute. For example, examining this situation for the last mile per capita market for GEO(8), GEO(3), and the LEO system for the years in which the LEO system would be operational, yields the results shown in Table 5.2.

Table 5.2: Market Availability

Year	GEO (3) Capture	GEO (8) Capture	Available to LEO
2002	11.31%	17.86%	70.83%
2003	10.86%	16.02%	73.12%
2004	8.68%	14.02%	77.30%
2005	6.90%	12.11%	81.12%
2006	5.23%	10.24%	84.53%
2007	4.12%	8.64%	87.24%
2008	3.27%	7.17%	89.57%
2009	2.61%	5.89%	91.50%
2010	2.14%	4.87%	92.99%

As shown in the table, even in the market in which the LEO system's cost per T1 minute sees its largest increase, the actual market that will be available to the system is greater than 60%. GEO(8) and GEO(3) are able to capture less than the 30% of the market allocated to them due to the location of their spot beams. Due to a combination of the market distribution and spot beam locations, there are portions of the world market that the GEO(3) and GEO(8) systems cannot access. The LEO system, with complete global coverage, has the technological capability of capturing the left over market regardless of where globally that market is distributed. This will significantly decrease its cost per T1 minute. Figure 5.6 shows the cost per T1 minute obtained when the LEO system is given access to 60% of the market and GEO(3) and GEO(8) are held to 30%.

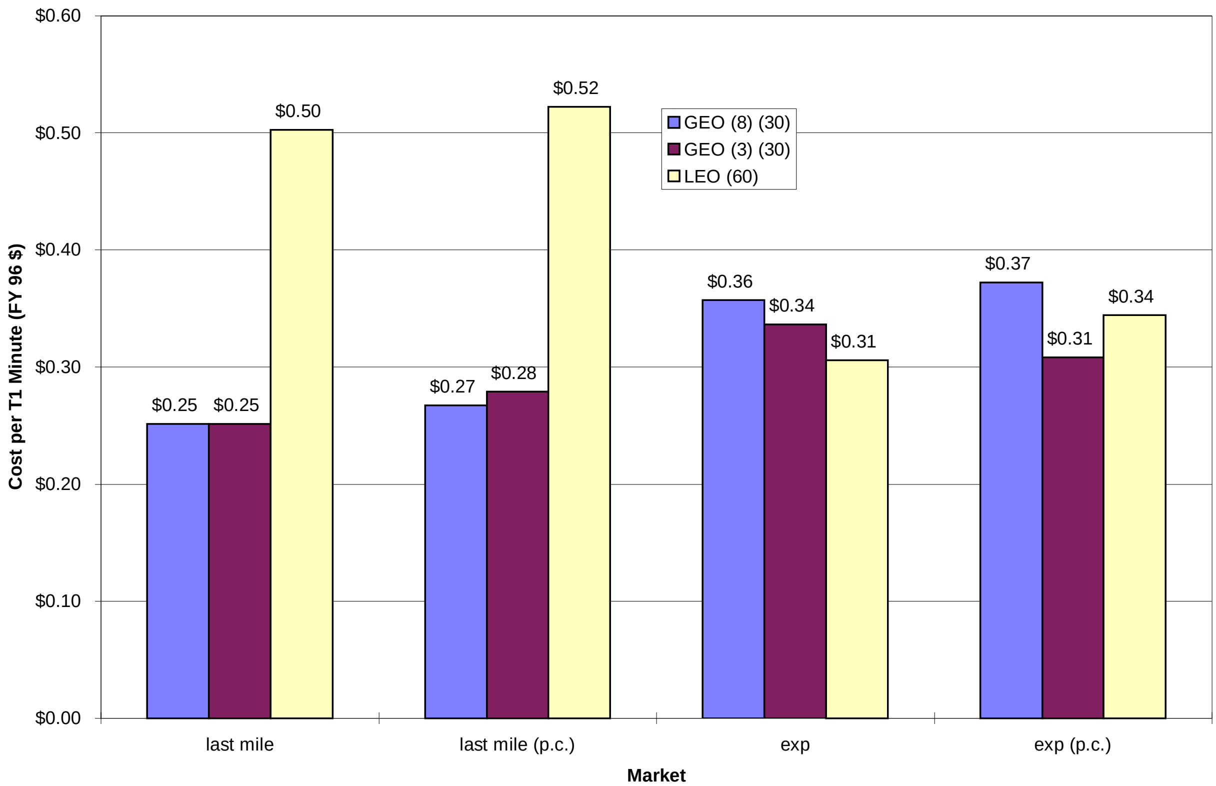

Figure 5.6: Cost Per T1 Minute, LEO 60% Market Availability

Since the LEO system's capacity is large, increasing the amount of market it has access to results in a direct reduction of the cost per T1 minute. As shown in Figure 5.6, the cost per T1 minute drops significantly if the LEO system is allowed access to the majority of the market remaining after the GEO(8) and GEO(3) constellations reach saturation. The LEO system is the only one with complete global coverage, thus a combination of any other two systems with it will lead to similar reductions in its cost per T1 minute.

5.4.4 Market Capture

For GEO(8), GEO(3), GEO(9), and GEO(12), changes in market capture have a minimal effect on the cost per T1 minute. Being the first system to market is therefore not critical to their success. Since the LEO system is affected by market capture and, due to longer development time, will likely begin operation later than the other systems, the ability to successfully market services and capture a significantly larger market share than the other systems would appear to be critical to its success. However, as shown, the other four systems can not support enough of the market to have a significant effect on the LEO system's cost per T1 minute. Thus any combination of two systems have the ability to co-exist comfortably with a large LEO system in the studied market scenarios.

Figure 5.7 is a more detailed examination of the effects of market capture on the GEO(8) constellation. The scenarios depicted are 100%, 50%, and 30% market capture.

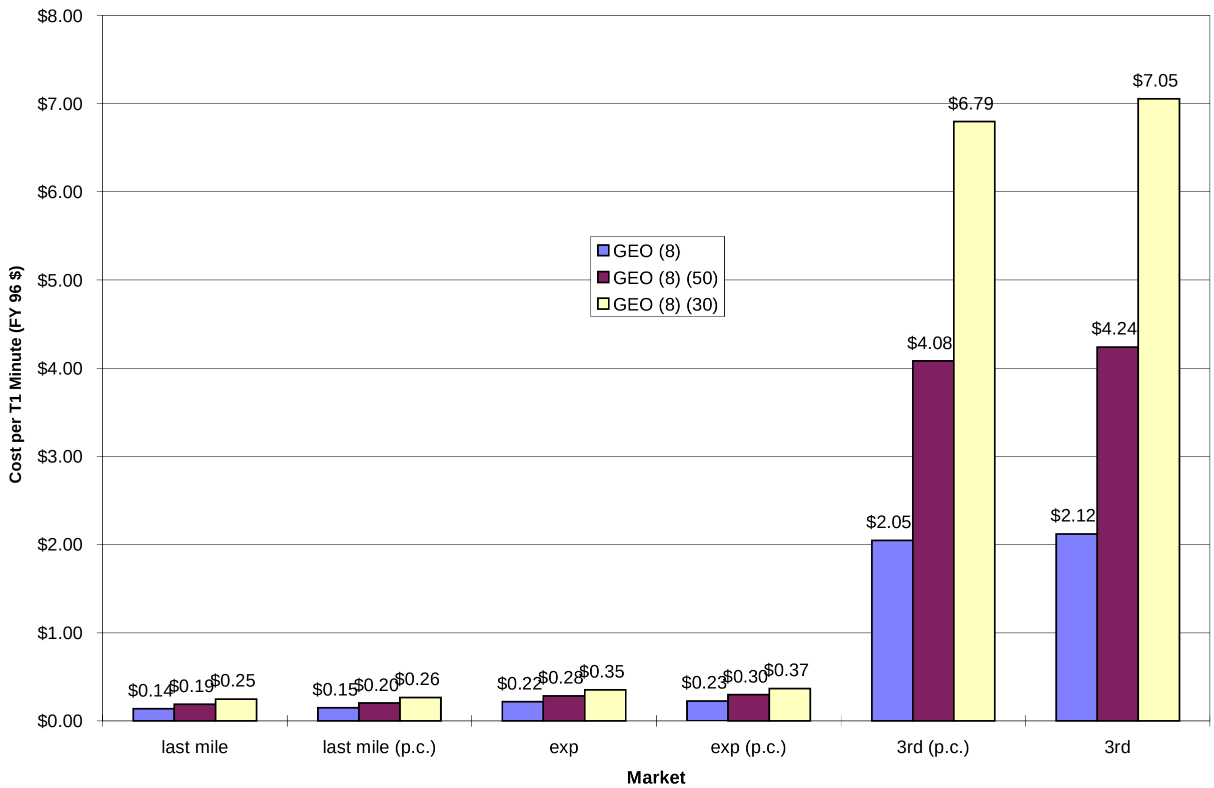

Figure 5.7: Effect of Market Capture on GEO(8)

In the larger market scenarios where the GEO(8) system approaches saturation, the difference in the cost per T1 minute for different levels of market capture is reasonably small. In regions where the system has underutilized resources due to smaller market capture, the cost per T1 minute could be decreased by focusing these resources on providing basic telephony service. This option is further explored in Chapter 6.

5.4.5 Uncertainties

Any large LEO system would be pushing the frontiers of current aerospace technology. The modeled system faces several technology hurdles along with a potentially difficult deployment schedule. In order to simulate the response of such a system to deviations from its configuration and timeline, several changes were made to the cost model. To simulate the inability to overcome a technology hurdle, the mass of each satellite was increased by 25%. For simulation of an inability to meet the launch schedule, another cost model was developed that allowed three years for deployment of the constellation, moving the date of final operating capability from the year 2002 to 2003. The results of these adjustments are shown in Figure 5.8.

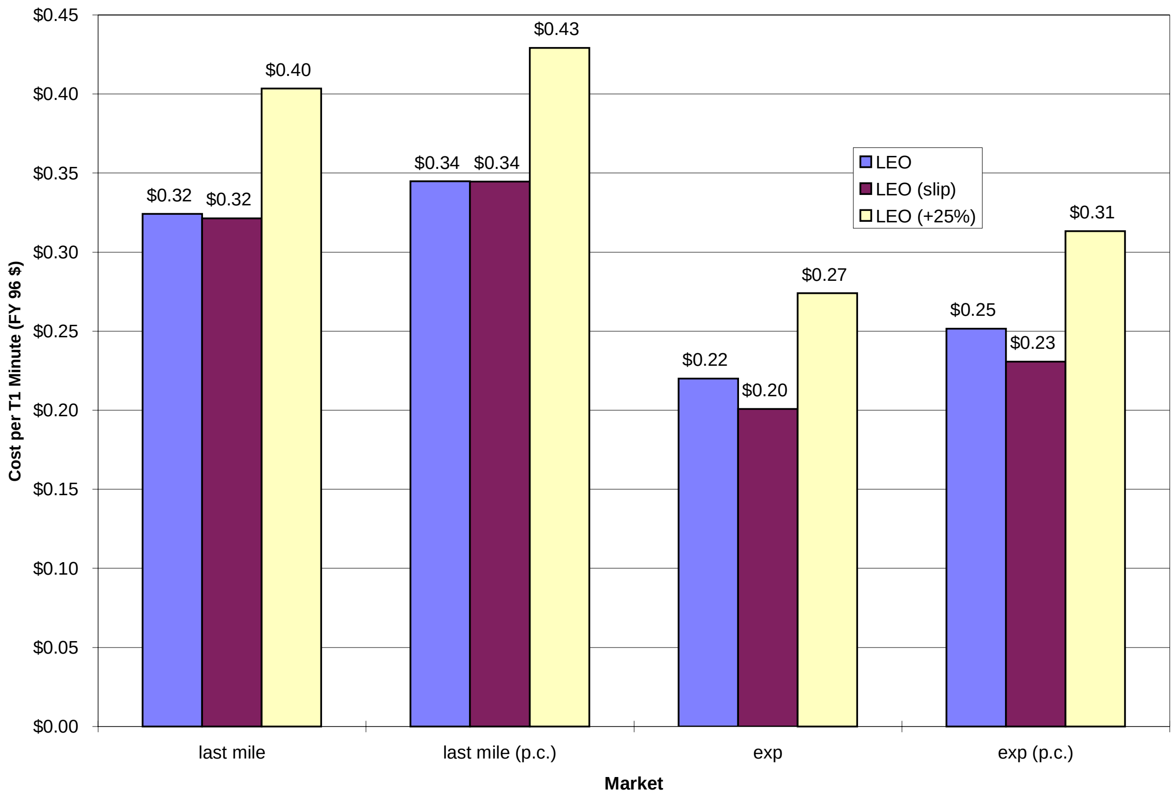

Figure 5.8: Variations on the LEO Constellation

The increase in mass in the LEO constellation translates directly into an increase in the cost per T1 minute. The increase is not very large and could potentially be recovered from a decrease in cost due to mass manufacture of the system's 900 satellites.

Allowing the LEO system to launch its satellites over a three year period and slip its final operating capability date by a year results in a decrease in the cost per T1 minute. This slip allows the system to take advantage of the decrease in net present value of the money spent and to wait for the market to further develop to a point where the system is not as over designed for the existing market. Again, the analysis shows that a large LEO system has the potential to be competitive under standard cost models even under adverse circumstances.

5.5 Summary

Figure 5.9 shows a summary of all of the systems examined across the more likely last mile and exponential market scenarios. From this figure, it can be seen that systems that are designed to focus on the heaviest market regions have the least variation in cost per T1 minute across markets. Thus a carefully designed deployment strategy can have a significant effect on a system's adaptability to variations in the market.

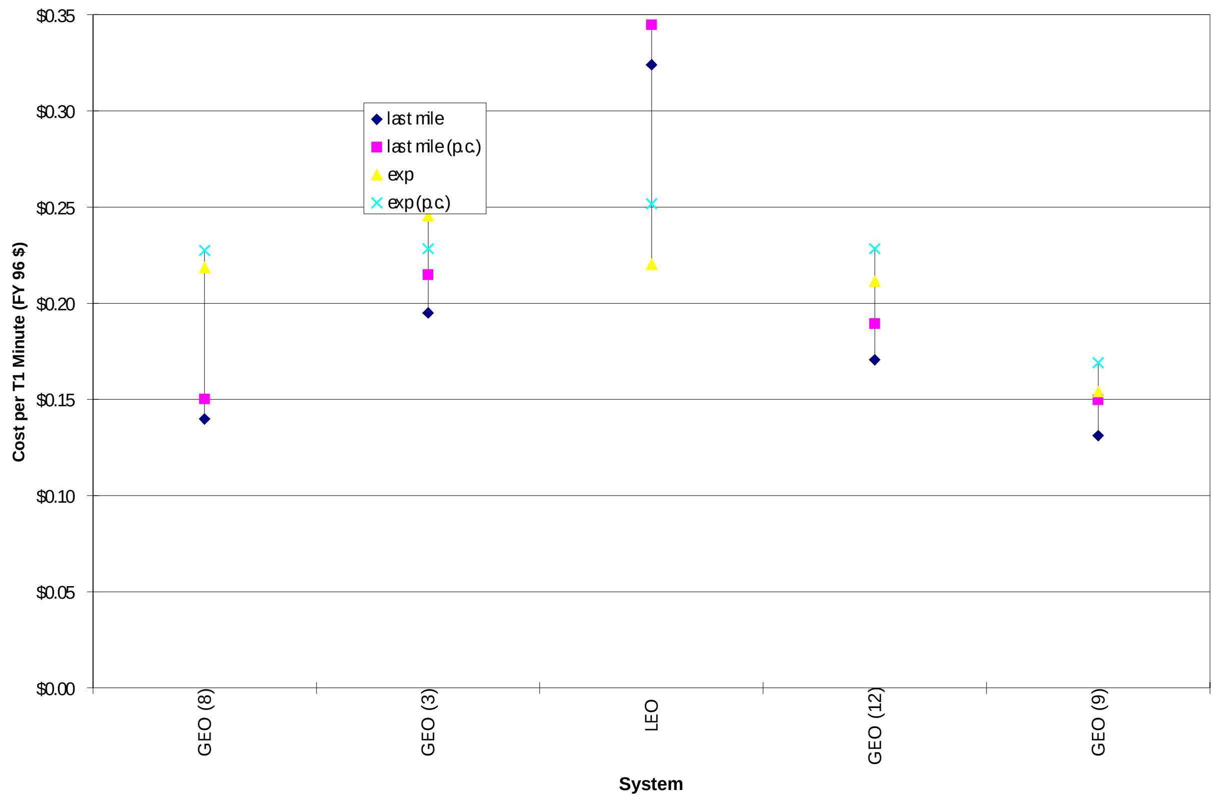

Figure 5.9: Cost Per T1 Minute Summary

Under a cost per T1 minute metric, all of the systems studied have the ability to be competitive. A large LEO system, even when examined under standard industry cost models, is competitive in the studied market scenarios. As shown, any two systems in combination with even a LEO system have the potential to co-exist and still obtain a 30% internal rate of return while achieving similar costs per T1 minute.

Chapter 6: Corporate Strategies and Competition

6.1 Introduction

Many different implementation strategies are available for the broadband satellite systems. Aspects of these strategies range from beam placement and satellite deployment timelines to operating agreements with telecommunications companies and Internet service providers. This chapter will attempt to explore and quantify some of the various strategies available to the broadband systems.

6.2 Deployment Strategies

6.2.1 Delayed Deployment

As discussed in Section 5.4.5, delaying the deployment of the LEO system by a year causes a large portion of the costs to be delayed as well. Examining a smaller constellation such as GEO(8) allows the effect of net present value on the cost per T1 minute across markets to be observed. Since even an eight satellite constellation has a large number of possibilities for deployment, a few restrictions are placed on the deployment schedule for this example. Global operating capability is assumed to occur by the year 2000. The final satellites are assumed to be launched and become operational by 2003. These restrictions allow the deployment schedule of six of the satellites to be fixed and two to vary as shown in Table 6.1.

Table 6.1: GEO(8), Delayed Deployments

	Year					
Strategy	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Nominal	USA 1/Eur 1	S Amer 1/Asia 1 USA 2/Eur 2	S Amer 2/Asia 2			
1	USA 1/Eur 1	S Amer 1/Asia 1	USA 2/Asia 2			S Amer 2/Eur 2
2	USA 1/Eur 1	S Amer 1/Asia 1		USA 2/Asia 2		S Amer 2/Eur 2
3	USA 1/Eur 1	S Amer 1/Asia 1			USA 2/Asia 2	S Amer 2/Eur 2

For this example, it is assumed that those two satellites will be launched in the same year and that year is allowed to vary. The nominal deployment strategy corresponds to the eight satellite constellation deployment utilized in the original model. When the deployment schedules are used to calculate the cost per T1 minute, Figure 6.1 results.

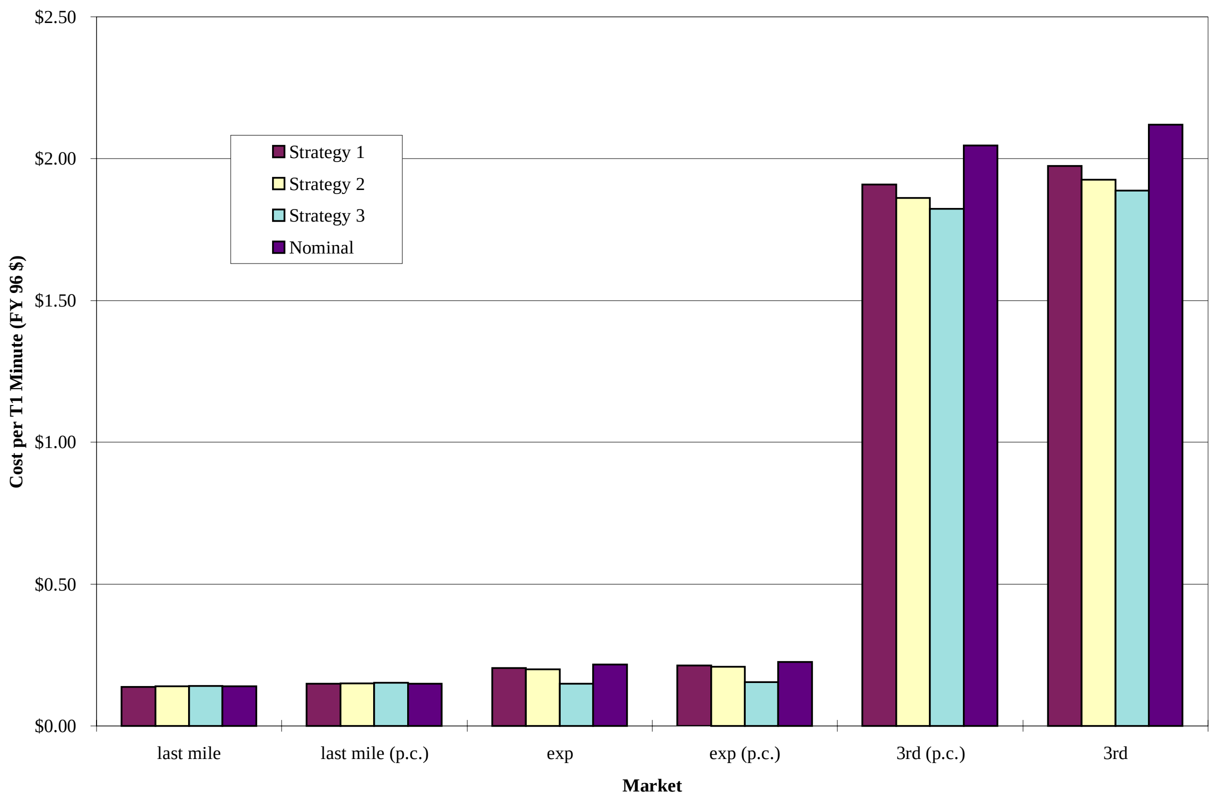

Figure 6.1: Variations in Time of Launch, All Markets, GEO(8)

From Figure 6.1, it appears that delaying the launch of the two satellites has very little effect in markets where the satellite system has reached capacity saturation. However, in under developed markets such as the third order scenario, the decrease in cost due to the drop in net present value obtained by delaying the launch of the satellites has a significant effect on the cost per T1 minute. Figure 6.2 provides a closer examination of the cost per T1 minute differences between the strategies in the third order market. Thus if the Internet market does not develop as rapidly as expected, delaying the launch of additional satellites is beneficial. Since delayed launch does not have a significant effect on markets that develop more rapidly and GEO(8) is not significantly effected by market capture, delaying the launch of additional satellites until the market has had a chance to mature is an option to be considered.

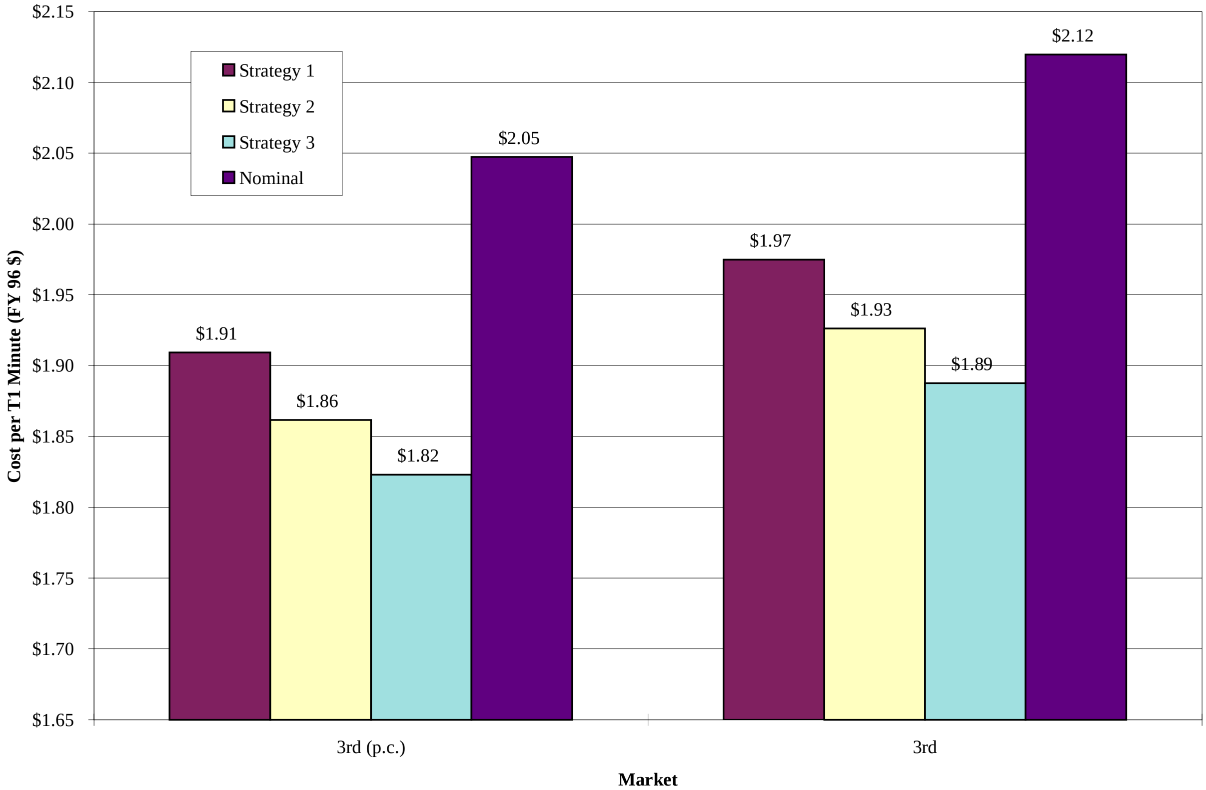

Figure 6.2: Variation in Time of Launch, 3rd Order Market, GEO(8)

6.2.2 Improved Deployment Strategies

As was illustrated by the last section, deployment strategy can have a marked effect on the cost per T1 minute. The efficiency of utilization of system resources plays a large role in the cost per T1 minute. If resources are used to saturation, the cost can be amortized over a larger number of bits, thus decreasing the cost per T1 minute. Conversely, if resources are under utilized early in the system lifetime, costs become more difficult to recover due to net present value of investment. Thus expenditure should be made at a time when it can bring significant returns. Ideally, satellites should be deployed to mirror market growth and use resources to their full potential. Doing so results in much lower risk and predictable returns on investment. Since there is no clear market capture advantage as discussed in Section 5.4.4, there is no advantage to launching satellites that will not be used for several years. It is in the best interest of the investor to delay the launch of a regional satellite until the market to be serviced has matured.

The nominal deployment strategy for the GEO(8) system assumes an eight satellite constellation. As was seen in the previous section, delaying the launch of the satellites that serve underdeveloped regions results in significant reductions in the cost per T1 minute. While this is a minimal strategy for tailoring the system to the desired market, another primary method is simply to reduce the size of the constellation. This section employs the capacity results to adjust the size of the constellation along with designing a launch time scale. These achievable capacities are then used to calculate the resulting cost per T1 minute.

For GEO(8), the nominal deployment strategy places many of the satellite resources in orbit long before the market on the ground exists to support them. The reduced system sizes employed for the simulation and the timeline for satellite operation is shown in Table 6.2. To simplify the analysis, the two, four, and six satellite constellations are simply truncated versions of the full system deployment. The last mile market is used as the simulated market for this analysis. The capacity simulation results for the truncated systems represent achievable capacity in the event that corporate decisions are made to halt system development at various stages of the deployment period. The seven satellite constellation is an example of a system that is truly tailored to the last mile market.

Table 6.2: Deployment Strategies for GEO(8)

	F.O.C	**Year of Satellite Operation by Region**							
		N. America		**Europe**		**Asia**		**S. America**	
		1	**2**	**1**	**2**	**1**	**2**	**1**	**2**
8 Satellite	2000	1999	1999	1999	2000	1999	2000	1999	2000
2 Satellite	1999	1999	-	1999	-	-	-	-	-
4 Satellite	1999	1999	-	1999	-	1999	-	1999	-
6 Satellite	2000	1999	1999	1999	2000	1999	-	1999	-
7 Satellite	2003	1999	1999	1999	2003	2002	2002	2003	-

The achievable capacity results for the deployments are shown in Figure 6.3. Of interest in this figure are the time at which system saturation occurs and the overall achievable capacity at that time. The two satellite system with one satellite over North America and the other over Europe reaches saturation quickly and thus represents a low risk investment. The total return on investment is small due to the limited overall system capacity. The full eight satellite deployment on the other hand has the potential of generating large amounts of revenue, however the system does not reach saturation until late in its lifetime so these revenues are never achieved. This suggests that a more tailored deployment strategy has the potential of obtaining a better return on investment.

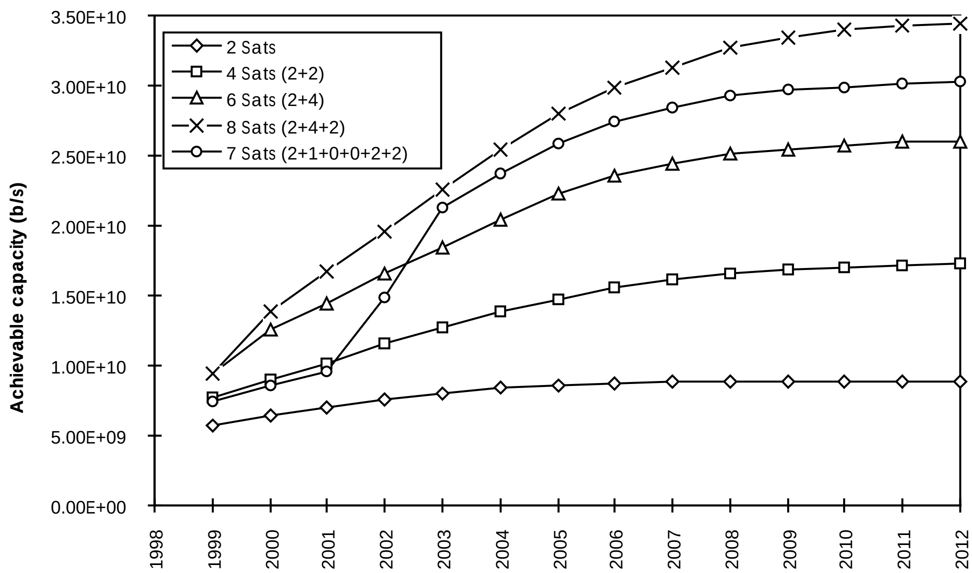

Figure 6.3: GEO(8) Capacity Profiles for Deployment Strategies for the Last Mile Market

An attempt was made to design a strategy by examining the capacity profiles for each of the eight satellites shown in Figure 6.4. The theoretical capacity for each of the GEO(8) satellites is 4.6 Gbps. To design the seven satellite strategy, it is assumed that a satellite that achieved at least a 2 Gbps capacity, or slightly less than half of the theoretical capacity, would be deployed. The second South America satellite is not deployed since it does not achieve a 2 Gbps capacity until more than halfway through the system lifetime. The selection of satellites in this manner could be iterated until an optimum configuration is reached. The seven satellite configuration discussed serves as an example of the methodology.

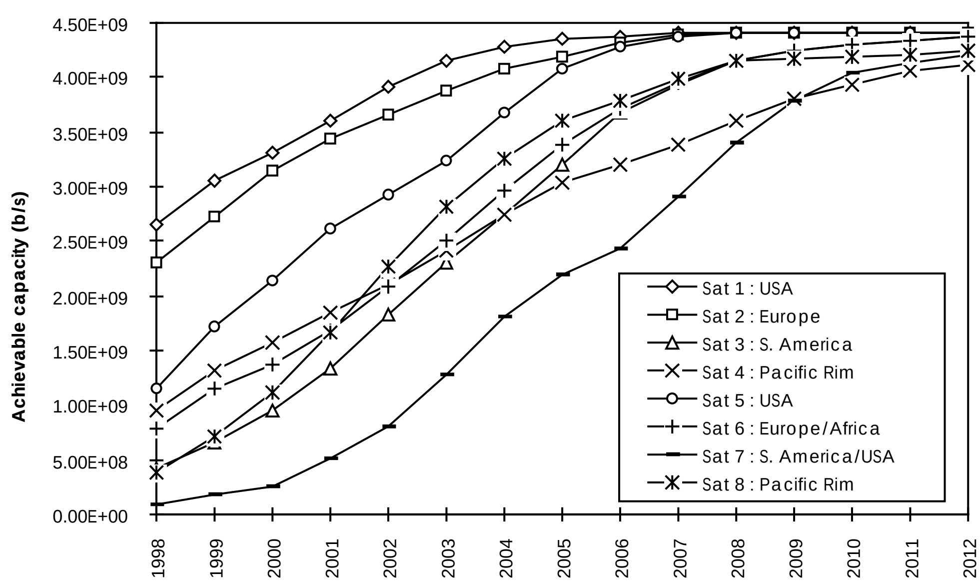

Figure 6.4: GEO(8) Satellite Capacity Profiles for the Last Mile Market

The capacity profile for the seven satellite configuration is illustrated in Figure 6.3. The achievable capacity of the strategy compares favorably to the other deployment options over the time period of the simulation.

- Until 2001, the system has a similar achievable capacity to the four satellite constellation, but with the cost of only three satellites.
- In 2002, with only five operational satellites, the GEO(8) "7" configuration achieves a capacity that is nearly equivalent to that of the six satellite constellation.
- After 2003, with only seven operational satellites, the system has nearly the capacity of the full eight satellite constellation.

By matching the trends in market development, the seven satellite configuration provides similar achievable capacities to the other deployment strategies with fewer satellites deployed. This is a much more efficient use of system resources.

One of the true tests of the effects of truncated system deployment and tailoring of deployment to match market growth is the cost per T1 minute. When the capacity results are incorporated into a cost per T1 minute calculation, the results obtained are shown in Figure 6.5.

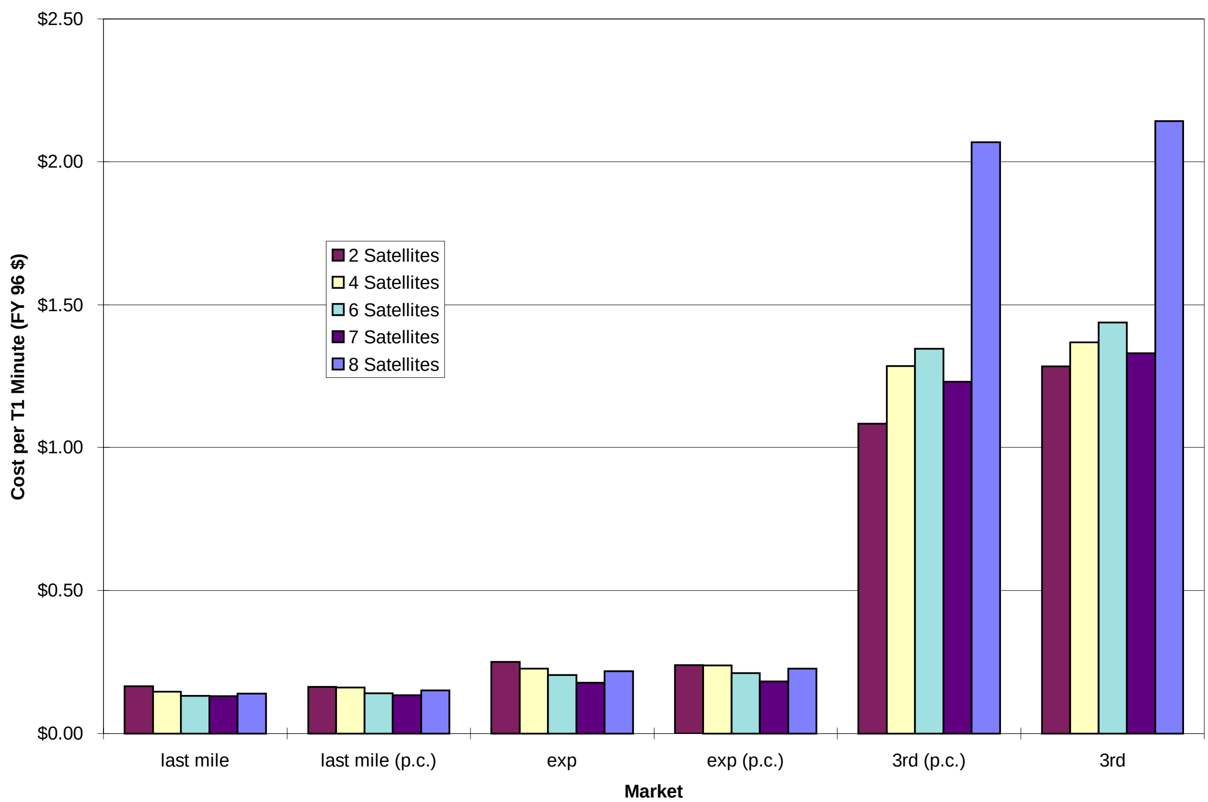

Figure 6.5: Variation in Number of Satellites, GEO (8)

As can be seen in Figure 6.5, the number of satellites deployed has a nominal effect in the markets where the systems saturate. The largest difference in cost per T1 minute is again observed in the under developed third order market. In this case, the lower costs are due to the variation in size of the systems. Fewer satellites than global capacity result in fewer TT&C stations and consequently lower system costs. Smaller systems also have less capacity, resulting in fewer circuits necessary to connect to the terrestrial Internet, again resulting in lower system costs and a corresponding lower cost per T1 minute in the third order market. The two and four satellite systems have a slightly larger cost per T1 minute than the other systems in developed markets, as seen in Figure 6.5. Thus, if the system is already saturated, it is advantageous to launch additional satellites over high traffic regions to amortize non-recurring costs over a larger number of bits.

The seven satellite configuration, as discussed previously, shows some interesting characteristics. In the third order market, the cost per T1 minute is lower than all systems except for the two satellite configuration. In that market, the two satellite configuration has the advantage of being nearer to saturation than the other configurations and the two satellites are also positioned over the densest market areas so any increase in market capture from the addition of satellites in the four and six satellite configuration only results in a nominal increase in capacity since the additional satellites are over lower traffic regions. The seven satellite configuration is designed to capture as much of the market as possible at the lowest overall system cost. Since it focuses on obtaining capacity from the highest traffic regions, every increase in cost also has a corresponding fairly large increase in overall system throughput. The seven satellite constellation does not launch the satellite that captures the least amount of traffic, thereby obtaining a nearly identical system throughput to the eight satellite constellation, but for the cost of only seven satellites. In the more advanced markets, a lower cost per T1 minute results. Thus a thorough analysis of the market and a satellite deployment strategy that focuses on the heaviest traffic areas could be advantageous.

6.3 Meeting Market Uncertainties

While tailoring system deployment to the market as it develops is the ideal way to ensure that resources are used to their full potential and that the system generates as large a return on investment as possible, it cannot be done to high degrees of accuracy. Uncertainty will always exist in the market projections, since most business planners do not have the luxury of having a market that is known in advance and will develop precisely as predicted. A primary way to cope with this uncertainty is to use the additional capacity of the satellites to provide telephony services to remote locations. A detailed discussion of the telephony market is beyond the scope of this thesis but several points warrant some exploration.

From the market distribution graphs in Figures 2.10 and 2.11, the regions in which the market is least developed include areas of South America, Africa, and the Middle East. For a system to have truly global service, it needs to provide coverage in these regions for the multinational and larger national corporations that do exist in those areas. This results in unused capacity over the less developed parts of those regions.

In order to supplement the Internet traffic in those regions, the systems have the ability to offer basic telephony services that truly can reach the last mile. A satellite system does not require the fiber optic or copper infrastructure on the ground, simply a small terminal, so service can be provided quickly, circumventing the long wait times for the placement of terrestrial infrastructure. Examining the data in Figure 6.6 shows that the regions in which the systems have underused capacity are also those that have the fewest phones per 1000 people [CIA]. In many of these regions, installing terrestrial infrastructure will take upwards of twenty years, so a satellite system is ideal to meet the latent demand for basic telephony services.

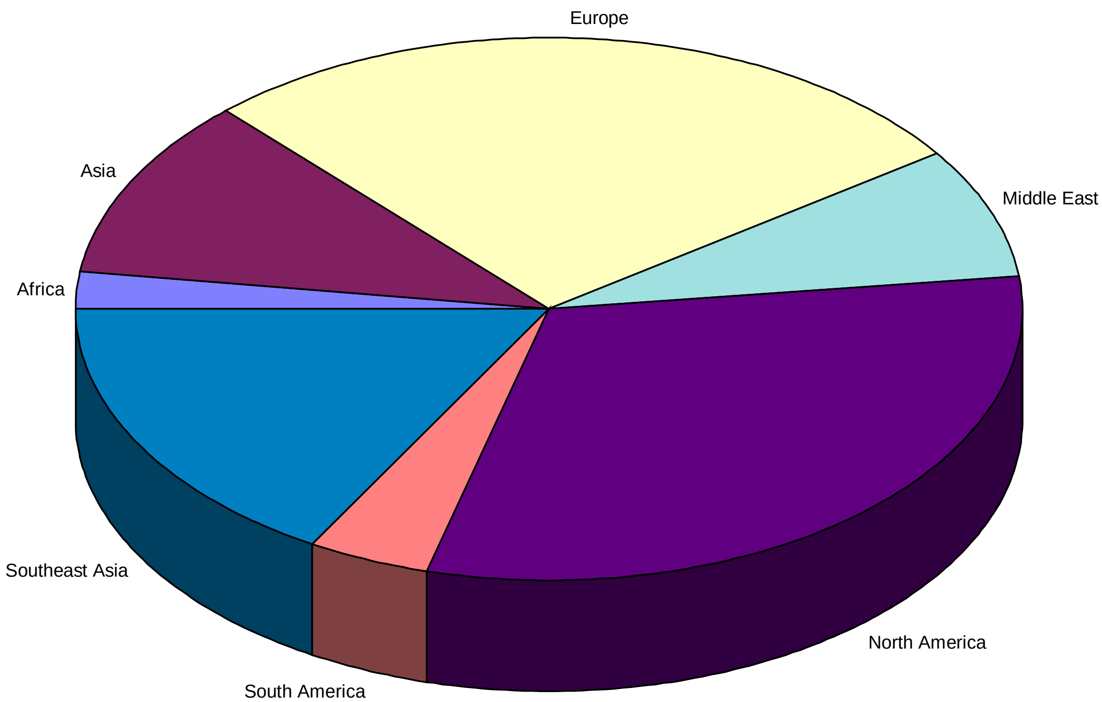

Figure 6.6: Average Phone Lines per 1000 People by Region

The voice quality circuits that the systems plan to offer are at a data rate of 16 kbps [LAHI]. Thus for every T1 link the system can support approximately 96 voice circuits. Using the cost per T1 minute estimate obtained for modems of 4.5 cents from Section 5.3 as a reasonable per minute cost for a phone call results in a T1 minute revenue of $4.32. Compared to the average costs per T1 minute of around $0.21 obtained in Chapter 5, it can be seen that the telephony market is an excellent way to supplement revenue or to allow the systems to offer a lower flat rate service to Internet users. By offering telephony service, a system can offset some of the uncertainty that is inherent in any market model and greatly increase chances of the financial success of the program.

6.4 Latency

For telephony service, a key issue is that of signal latency. Though studies have shown that echo is one of the primary discriminators in voice systems, latency is also cited as an important issue [Gumbert]. The time delay of a LEO system is from 170 to 300 ms and from 400 to 600 ms for a GEO system [Kiesling]. In voice services, there is a noticeable difference to the user in the delay associated with a LEO versus a GEO system. However, in areas of the world where satellite based telephone service would be used to reach the last mile, there are few alternatives available. According to FCC data shown in Table 6.3, many of these regions are dependent on satellite links to support their long distance phone service.

Table 6.3: Percentage Long Distance Satellite Circuits by Region

Region	Satellite Circuits	Total Circuits	Percentage
Africa	1992	2276	88%
Middle East	2421	3071	79%
South America	4036	7684	53%
Eastern Europe	1534	3272	47%
Caribbean	2771	9119	30%
Asia	5621	19690	29%
Oceania	1026	4817	21%
Western Europe	3496	35096	10%
North and Central America	3008	79333	4%
Antarctica & Maritime	0	60	0%

As seen in the table, underdeveloped and developing regions of the world are already highly dependent on satellite systems to provide for their telecommunications needs. For these regions, latency is not as much of an issue because having phone service that goes through a satellite with some delay is better than not having any phone service at all. While the market for phone service in these regions may not be as high as in the developed world, they are easier for satellite systems to acquire due to much higher penetration rates than in the developed world. The latency argument from the perspective of phone service does not apply in developed regions, since the primary market in those regions is broadband and there is very little unused capacity.

In the developed world, latency is an issue depending on the type of broadband service being provided. For applications such as large file transfers, web browsing, and even e-mail and telemedicine the additional latency seen in a GEO system is not an issue. These applications are not time dependent down to millisecond levels. A user web browsing, for example, will only notice that the page takes a half second longer to begin downloading. Once the data begins transferring, the latency is no longer observable. Where latency becomes important is for truly interactive broadband applications, such as videoconferencing, where the additional delay for a

GEO system becomes noticeable. The latency difference for a LEO versus a GEO system will be noticeable provided that the entire data path is via dedicated satellite or high speed lines. If the packets are traversing the terrestrial Internet, the difference between LEO and GEO latencies will be lost in the delays inherent in the routing of Internet packets over the terrestrial network.

6.5 Terrestrial Infrastructure

The terrestrial infrastructure that currently provides Internet service is a source of competition for the broadband satellite systems. Terrestrial technologies employed in this area range from copper wire to fiber optic cabling and wireless connections. Since terrestrial networks are primarily a source of competition in developed areas of the world such as North America and Europe, the status of the technology in the United States is used as a comparative example.

6.5.1 Copper

Internet connections provided over voice grade copper lines such as basic dial-up Internet service are limited to the speeds of modem technologies and the transmission limits of the wire itself. Currently, 33.6 kbps and 56 kbps modems are beginning to gain wider spread usage, but as seen from the service provider listings in the July/August 1997 *Boardwatch Internet Service Provider Listings*, very few service providers are supporting dial-up connections at that speed. The predominant connection speed is 28.8 kbps at an average cost of $19.95 per month for unlimited access [Rickard]. Since standard dial-up Internet connections via copper lines are not capable of providing T1 level service, they are not a true competitor to the broadband systems. ISDN, using both B-channels and operating at 128 kbps, is fast enough for applications such as low quality real-time video. However the telephone companies have been very slow to market this technology and it is still not fast enough for even VCR-quality video.

xDSL technologies are the only ones capable of providing T1 and faster connections over existing twisted pair copper wire. The technology comes in several different variants from asymmetric digital subscriber lines (ADSL), which can provide bi-directional traffic at 384 kbps, to very-high-bit-rate digital subscriber lines (VDSL), which is designed to reach 50 Mbps. The basic premise of the technology is to create a dynamic mathematical model of the copper wire transmission paths which allows the xDSL modem to actively compensate for distortion introduced by the transmission path. Essentially the copper wire capacity is divided into 255 bins with each one treated as an analog modem channel.

The drawbacks to this technology are that currently only limited trials have been conducted in selected areas and there is no wide scale deployment. Due to the limitations of twisted pair copper wire, the technology is limited to a distance of about 4000 meters from the telephone plant. It is estimated that about 50% of all households in the United States lie within this distance [Internet Access]. Quality of the copper infrastructure is also an issue. If the telephone companies are quicker to market and deploy xDSL technologies faster than they have been deploying ISDN to date, these technologies could become a serious competitor to the broadband satellite systems in developed areas. The need to build new telephone plants to accommodate all subscribers due to the distance limitation casts some doubt on the widespread deployment of this technology. Clearly however, xDSL is not a solution for the last mile and underdeveloped regions which only have limited copper wire infrastructure.

6.5.2 Coaxial Cable

Cable modems are the cable industry's response to the "cheaper, better, faster" call of Internet users. The service is designed to provide about 30 Mbps to the neighborhood on the downlink and a 256 kbps uplink. The slower uplink to the cable head-end is due to the physical design of the cable plant[2]. Trials are underway in several different areas across the country, including Alexandria, Virginia and Boston, Massachusetts. In these areas, the cost of service ranges from $40 to $60 per month with a $100 installation charge [Ryu], [Hutchinson]. The cable industry appears to be taking a cautious route to deploying the service, similar to the route the telephone companies took with ISDN. The industry has taken a beating in recent years on customer service issues and is approaching its new role as Internet service provider by attempting to design the network so that problems are apparent before users begin calling in to report them [Ryu]. While such a cautious approach is understandable, several factors necessitate getting to market early.

Cable was originally designed as a broadcast medium to provide video to the home, the only expected upstream traffic was billing information for pay per view services. The upstream channels are therefore not capable of carrying large quantities of high speed data and are typically noisy. Broadcast style Internet service is appropriate for the home user in the current market where the majority of activity by the home user is Web browsing. Once users start demanding symmetric connections for interactive multimedia or videoconferencing, the cable industry will be forced to spend a lot of capital to upgrade the infrastructure or risk losing subscribers to services such as xDSL or to the broadband satellite systems.

Another primary difficulty with the technology is bandwidth sharing. The 30 Mbps is truly shared. The system provides 30 Mbps to the neighborhood and all subscribers in that neighborhood must share the bandwidth. Thus in its current trial state with only a few users, subscribers are seeing virtually unlimited bandwidth whenever they require it. However as more

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[2] A detailed discussion of the cable plant and use of the facilities to provide Internet service can be found in, *Connecting Homes to the Internet: an Engineering Cost Model*, MIT Master's Thesis (MBA), 1995, by Sharon Gillett.

users attempt to request large amounts of bandwidth simultaneously, performance will degrade. Estimates as to how many subscribers can be supported before drops in capacity are noticeable range from 25 to 100 [Internet Access]. Current cable infrastructure has about 300 subscribers per neighborhood hub, which would have to be reduced to continue to provide quality service.

The infrastructure and bandwidth difficulties coupled with a lack of standardization of cable modem hardware will make cable modems a good interim solution if the cable industry is able to deploy the system in time. However, once there is a need for symmetric data rates, the cable industry will require a costly upgrade in infrastructure to support it. The inability to support symmetric high speed connections also makes cable modems a poor choice for corporate intranets which require the ability to serve web pages and transfer large amounts of data that require upstream bandwidth. Thus for the corporate intranet market and individual users requiring symmetric high speed connections, cable modems are a poor competitor to the broadband satellite systems.

6.5.3 Wireless Technologies

Wireless technologies come in a variety of forms. Some architectures are very similar to cellular and only provide data rates of 28.8 kbps. Others are designed to provide high speed access point to point within line of sight. A broadcast style connection is also available via satellite. While these technologies are similar to the broadband satellite systems in that they require little terrestrial infrastructure from the user perspective, they do not represent true broadband competition for some of the same reasons that pertain to simple voice-grade copper wire and cable modem technologies.

The point to point technologies include multichannel multipoint distribution services (MMDS) and microwave point-to-point line-of sight. The MMDS service that is two way provides a speed of 1.5 Mbps and is expected to cost on the order of $30 to $50 flat rate per month for individual users and $450 per month for small businesses with 20 users on a LAN [Blackwell]. The transmitters have a range of up to 35 miles, so this technology is not capable of reaching the last mile. Deployment of this technology has been limited due to the FCC’s failure to grant two-way licenses to all but one provider.

Another wireless technology that is in use by ISPs for local loops to corporate customers is point-to-point line-of-sight microwave operating at 38 GHz. Available bandwidth ranges from 1.5 Mbps to 45 Mbps. The microwave services have a range of five miles but do provide bi-directional data transfer. The technology allows ISPs and corporate customers to bypass phone company switches.

The service that is functionally a cross between cable modems and satellite based broadband is the DirecPC system being marketed by Hughes Network Systems [Kirkpatrick].

DirecPC broadcasts from the Hughes Galaxy satellite constellation that provides direct broadcast television services. The system provides a 400 kbps downlink via a 21 inch roof-mounted satellite dish. However this system is not bi-directional, it requires a standard modem and phone line connection to provide the uplink path. The system plans to offer uplink capability by 1998, but it will only be on the order of 2400 or 4800 bps. The best rate offered by the system is $130 per month for unlimited access. Since the system is satellite based, it does have the potential to be global. However, until a return path is available on the uplink the last mile in underdeveloped regions of the world will not be able to use the system. DirecPC is also not a viable option for intranet customers that require a higher speed uplink.

The wireless technologies thus have the ability to compete with the broadband systems in areas of the developed world where two way access is available[3]. DirecPC and other one-way broadcast style systems are a good interim solution until true interactive multimedia is desired by the consumer. In the area of intranets for multi-national corporations conducting video-conferencing and high speed data transfer, the wireless systems are not in direct competition with the broadband satellite systems.

6.5.4 Fiber

Fiber optic lines represent the true broadband competition to the proposed satellite systems in the developed and developing regions of the world. Fiber optic technology is capable of supporting bi-directional data transfer at upwards of 2 Gbps. It is this technology that lies at the heart of today's Internet backbone. In the United States, a large portion of the Internet backbone was recently upgraded to OC-3 (155 Mbps) and plans for OC-12 (622 Mbps) backbone connectivity are being explored. The proliferation of fiber optic cabling is slowed only by the cost of buried cable and fiber interconnection equipment. The new TAT-12 and TAT-13 transatlantic cables doubled the capacity of the transatlantic cable system as can be seen in Table 6.4 [Lande, p. 25]. The table also lists cable capacity in T1 equivalent circuits. This is a slight over estimate of the number of circuits available since it does not allow for redundancy and restoration. The cost per T1 minute assumes that average activated circuits are used for 8 hours per day for 365 days per year and that 50% of the circuits are not active. These assumptions are consistent with the current utilization rates reported by the interexchange carriers shown in Table 6.5 for lit[4] fiber optic cable [Kraushaar, 1996]. Portions of the table that are marked "NA" represent years for which data was not provided by the interexchange carriers.

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[3] Currently, only one system is licensed to provide this service, CAI in Boston, MA.

[4] Lit fiber is the number of fiber strand miles that are activated or equipped with optoelectronic equipment at terminal and repeater sites and are capable of providing at least one voice-grade circuit.

Table 6.4: Transatlantic Cable System

System	Year	Technology	Cost ($M)	T1 Equiv. Circuits	Cost per T1 Equiv. Circuit	Cost per T1 Minute
TAT-1	1956	Coax Cable	$50	1.84	$26,889,888	$306.96
TAT-2	1959	Coax Cable	$43	2.03	$21,023,214	$239.99
TAT-3	1963	Coax Cable	$51	3.63	$13,951,143	$159.26
TAT-4	1965	Coax Cable	$50	2.86	$17,621,739	$201.16
TAT-5	1970	Coax Cable	$70	29.84	$2,358,889	$26.93
TAT-6	1976	Coax Cable	$197	165.80	$1,188,156	$13.56
TAT-7	1983	Coax Cable	$180	176.00	$1,022,727	$11.67
TAT-8	1988	Fiber Optic	$360	313.37	$1,148,810	$13.11
TAT-9	1992	Fiber Optic	$406	626.74	$647,801	$7.39
TAT-10	1992	Fiber Optic	$300	940.10	$319,114	$3.64
TAT-11	1993	Fiber Optic	$280	940.10	$297,840	$3.40
TAT-12	1996	Fiber Optic	$378	2506.94	$150,781	$1.72
TAT-13	1996	Fiber Optic	$378	2506.94	$150,781	$1.72

Table 6.5: Percent Fiber Miles Lit

Year	1990	1991	1992	1993	1994	1995
AT&T	49.6	44.6	49.5	50.9	49.6	47.3
Consolidated	53.4	53.4	53.4	57.8	53.7	NA
Frontier (RCI)	56.7	56.1	57.0	57.0	57.1	46.0
IXC Commun.	56.3	58.3	65.9	55.8	NA	NA
LCI	60.6	60.1	60.1	60.1	68.8	71.1
LDDS Worldcom	90.0	90.0	90.0	NA	NA	69.0
MCI	64.3	NA	NA	NA	NA	NA
MRC	65.0	NA	NA	NA	NA	NA
Sprint	53.9	55.1	55.1	NA	55.8	77.2
TCG	NA	NA	80.0	80.0	NA	NA
Valley Net	50.7	40.0	40.0	NA	NA	NA

The original intent of the majority of these fiber systems was to provide telephony rather than Internet service, however efforts are being made to construct new fiber optic cables by entities other than the interexchange carriers. In October 1996, the FCC granted MFS Communications Company, Inc. a license to construct a non-common carrier fiber optic cable system between the United States and the United Kingdom This will be the first cable to provide end to end facilities and services between the two countries. The system will be capable of providing 10 Gbps at an estimated total cost of construction of $500 million. A project is also underway to build the first undersea cable between the United States and China at a capacity of 10 Gbps and an estimated program cost of $1.4 billion [Lande, p. 24].

The installation of fiber optic cable is expensive and not affordable in many regions of the world. The FCC's rough cost estimates for buried cable is approximately $65,000 per mile which includes the purchase of the right of way. The cost for the buried cable is not the extent of the cost of running fiber to a home or a business. There is also the cost of the connection itself. For the trials that have been conducted for distribution fiber, or fiber to the home or business, the costs have ranged from around $2,000 to in excess of $6,000 [Kraushaar, 1996]. The more recent trials have fallen in the lower range, however costs are not expected to drop below the lower figure due to the labor costs for installing fiber optic equipment. Monthly costs for fiber optic links tend to be high due to the need to amortize costs over a short period of time. Once a fiber connection to the home is installed, the bandwidth is in place and cannot be distributed to another user if the original user no longer desires the service, thus the costs need to be recovered quickly.

6.5.5 Competitive Summary

While dial-up access is still the most prevalent method for the consumer to connect to the Internet, fiber optic cabling and xDSL represent the true competition to the broadband satellite systems. Both of these technologies are able to conduct high speed bi-directional information transfer. However, they are both dependent on fixed infrastructure and are not capable of reaching the last mile at a reasonable cost. Even in areas where fiber is accessible, the cost for a connection may be prohibitive to the home and business user. Wireless access also suffers from the inability to reach the last mile without a significant installation of infrastructure.

Cable modems and broadcast satellites are well positioned to provide an interim solution to the demands for bandwidth. The broadcast satellites have the ability to reach the last mile and provide service with a small investment in infrastructure, the current cost of a satellite dish is $700 and the monthly cost of the service ranges from $40 to $130 per month. Cable modems along with the broadcast satellites provide a high speed downlink to the user and a very low speed uplink. In the current market where Web browsing is one of the most common uses of the Internet, a high speed bi-directional link is not required. A small packet is sent out to request large amounts of data from a site. However, as technology develops and the demand for interactive applications grows, the upstream link will become a critical bottleneck for both of these technologies.

Thus for true symmetric data transfer, the options currently available to the consumer are shown in Table 6.6 [Vaughan-Nichols]. The table does not include some of the installation and equipment fees that were discussed previously. Taking the average cost per T1 minute for the last mile and exponential markets at 100% capture shown in Figure 5.4 as $0.21 per T1 minute, a baseline comparison to the T1 costs shown in the table can be made. Assuming that the flat monthly fee includes an average of 60 hours of connect time [Rickard], gives an average monthly rate for the satellite systems of $756. Even a 35% mark up of this monthly rate to include costs such as advertising places the monthly fee in the low end of the listed range for T1 connections. The satellite systems clearly have the ability to compete with broadband terrestrial technology.

Table 6.6: Connection Options

Link Type	Speed Range	Monthly Rate (FY 96 $)
Modem	14.4 - 33.6 kbps	20
Switched 56	56 kbps	500
ISDN	54 - 128 kbps	50 - 750
T-1	1.544 Mbps	1,000 - 3,000+
T-3	44.736 Mbps	5,000 - 30,000+

6.6 Additional Considerations

From studies conducted by Boardwatch magazine [Rickard, p. 23], the average backbone data transfer rate of the terrestrial Internet is 40 kbps. Unless a drastic change in the infrastructure of the Internet occurs, there will be bottlenecks in the system preventing users from achieving high data transfer rates, regardless of the speed of their connection to their local Internet service provider (ISP). In this context, broadband satellites become an excellent contestant for providing dedicated high speed access for corporate intranets that is capable of bypassing the terrestrial Internet. This may also open the doorway to alliances with ISPs. The broadband satellite systems are able to provide connections over large distances without the high costs of laying fiber optic cable, a veritable bargain for backups to terrestrial fiber lines that are already in place. The ISP, on the other hand, has the marketing and technical knowledge of setting up corporate intranets and user accounts. Many larger ISPs are experienced in forming alliances with foreign local providers that will be necessary for the satellite systems to gain landing rights in foreign markets.

Initial concerns of foreign governments attempting to prevent Internet access to their populations have been swept away by the speed in which Internet commerce and access has grown. In 1996 alone, the amount of commerce conducted on the Web was $2.6 billion and this number is expected to grow to more than $220 billion in 2001 [IDC]. Governments have been forced to come to the realization that the Web is a vital place of business for local firms, thus blocking access to the Internet is a detriment to the local economy. As of June 1997, 171 countries were connected to the Internet. A total of 195 out of a world total of 207 are able to send or receive e-mail [Toh-Pantin]. Some countries require providers and Internet users to have permits and be licensed and still others block access to some sites to filter content. However, in all cases governments have gradually been loosening their original restrictionist stances and projections indicate that all nations could be connected by the year 2000. The lessening of these restrictions will allow the broadband satellite systems to begin to enter into foreign markets to provide access either on a competitive level or through an operating agreement with a local provider.

6.7 Summary

A much better return on investment can be achieved by attempting to tailor the deployment of the broadband satellite systems to the market as it develops. Even a minimally tailored system that delays the launch of satellites can achieve a much lower cost per T1 minute. A better tailored system such as the seven satellite GEO(8) system can achieve an even lower cost per T1 minute. The metric provides the ability to tailor the deployment strategy of the system until an optimum is reached. Since the estimates of market development can never be perfect, corporations should explore providing telephony services to underdeveloped regions of the world as a method to minimize risk.

Despite the uncertainties inherent in the market models and the costs associated with deploying a satellite system, the broadband satellites are competitive with terrestrial technologies. Fiber optic cabling and xDSL represent true broadband competition to the systems in the developed world but cannot reach the last mile markets. Due to the cost of fiber connections and the distance limitations of xDSL, the broadband satellite systems have the ability to compete in even the industrialized regions and are the only systems that are able to provide true broadband service to the last mile. As demand for Internet connectivity extends around the globe, the possibility of strategic alliances between international service providers and the broadband satellite systems becomes a possibility. The satellite systems offer the providers the ability to reach the last mile with little investment in ground infrastructure. Due to the investment cost and long lead times necessary to deploy any kind of terrestrial wire infrastructure, but especially fiber optic technology, the ability to connect remote regions of the world quickly makes the broadband satellite systems an attractive partner. The satellite systems also would allow multinational corporations seeking to set up dedicated corporate intranets to obtain a dedicated link while bypassing the bottlenecks of the terrestrial Internet. An international ISP has the marketing and technical knowledge necessary to provide consumer accounts and corporate intranet solutions to clients. Such an alliance would help secure the financial viability of the broadband satellite programs.

Chapter 7: Conclusions

The popularity of the Internet is one of the newest manifestations of the Information Age. By all estimates, the Internet is growing and many different industries are attempting to tap into the sales potential envisioned in that growth. The broadband satellite systems represent commercial space's entry into the race to capture a market share of the Internet.

Five of these systems were selected as examples to develop and test the use of a cost per T1 minute metric to explore the technical and financial viability of satellite systems to provide broadband service. The specifications for each system used in the model are shown in Table 7.1

Table 7.1: System Specifications

System	Operational Satellites	Locations (Planes)	Access Scheme	Altitude (km)	Satellite Capacity (Gbps)
GEO (9)	9	5	TDMA/FDMA	GEO	7.7
GEO (3)	3	3	FDM/TDMA	GEO	4.9
GEO (8)	8	4	TDMA	GEO	4.6
LEO	840	21	TDMA/FDMA	LEO	13.3
GEO (12)	12	7	CDMA	GEO	5.9

Three key components were developed to formulate the metric. The market models, capacity simulation, and cost model are summarized below.

Market Model. The growth models for the Internet developed for use in the capacity simulation are shown in Figure 7.1.

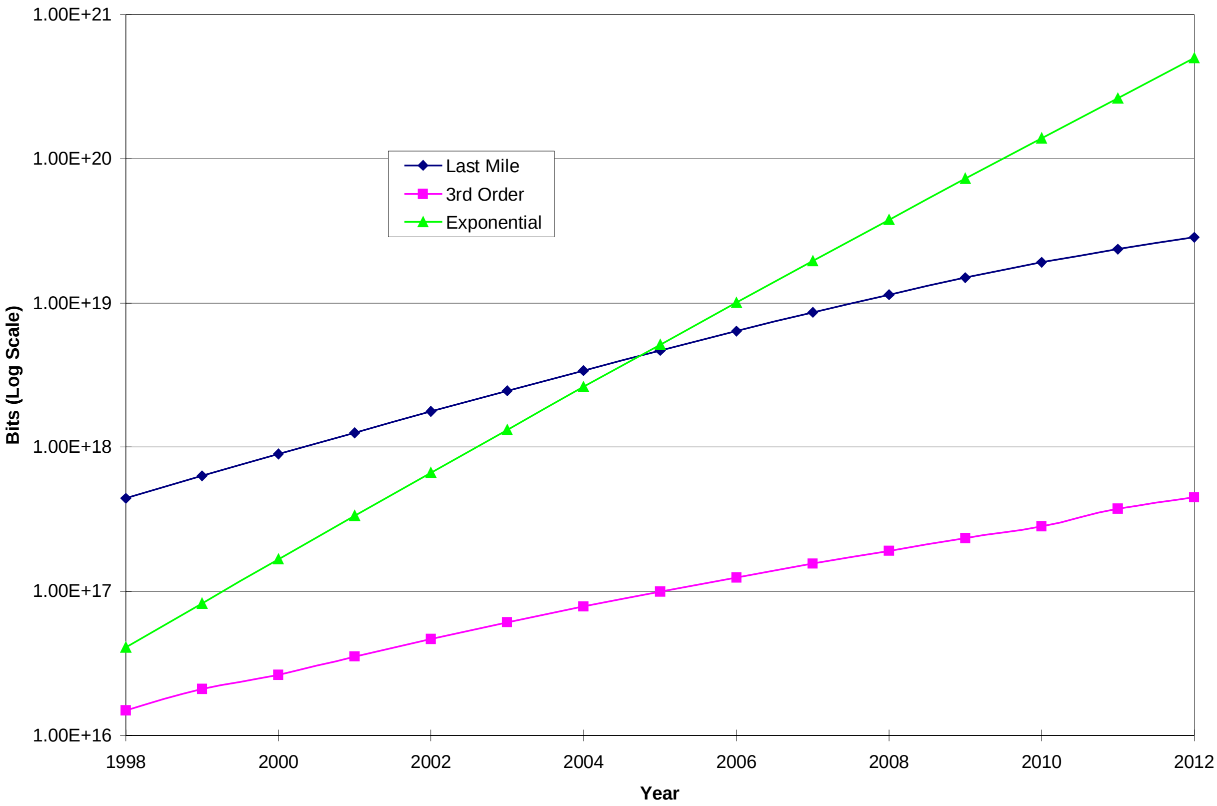

Figure 7.1: Market Growth Models

The exponential and third order models are projections of NSF backbone bit and packet data respectively. The last mile model was developed through a rigorous exploration of computer sales worldwide, increase in modem speeds, Internet host growth, and Internet user behavior. The last mile model represents the potential traffic available from computers not yet connected to the Internet. The exponential and third order models are used as upper and lower bounds to Internet growth for the purposes of the simulation. To produce a global market model, each of the growth models were distributed into five degree latitude and longitude cells based on GDP and GDP per capita. The result was six different worldwide markets for each year from 1999 to 2012.

Capacity Simulation. To explore the technical feasibility of the modeled systems, a capacity simulation was developed. The capacity simulation calculated achievable capacity for each system under the desired market models. The achievable capacity results demonstrate the effect of beam placement strategies on overall system capacity. Smaller systems such as GEO(3), which concentrate coverage on the industrialized regions of the world have very few under-utilized resources. Larger systems such as GEO(8) and GEO(12) that concentrate coverage on industrialized regions are more sensitive to market distribution than systems that provide truly global coverage. Due to their beam placements, these systems are unable to capture the market in under-developed regions thus are dependent on large market growth in industrialized areas. Systems, such as GEO(9) and the LEO system, that provide truly global coverage have more under-utilized system resources. However, these systems are able to capture market wherever it develops so are not dependent on market distribution.

From the capacity results, all of these systems appear to be technologically feasible in their basic configurations. Intersatellite links were shown to have no noticeable effects on achievable system capacity.

Cost Model. The final piece necessary to assemble the cost per T1 minute metric is an estimate of the costs of each system. The cost estimate includes the life cycle costs through the year 2010. Life cycle costs estimated are recurring and non-recurring costs for satellite design and construction, launch, insurance, gateways, gateway and control center operations, and terrestrial Internet connections at the gateways. The cost estimate does not include items such as marketing and control center construction. To provide an equitable comparison, satellite costs were based on a $77K per kg of spacecraft dry mass estimates. This estimate is based on recent industry experience of the costs of communications satellites. The recurring and non-recurring cost estimates for satellite development and manufacture obtained from this model are shown in Table 7.2.

Table 7.2: Space Segment Cost Estimate (FY 96 B$)

System	77K
GEO(12)	2.7
GEO(9)	1.8
GEO(3)	.96
GEO(8)	1.3
LEO	10.7

Costs for ground operations vary with achievable system capacity and therefore with the market model employed in the simulation.

When the market models, achievable capacity results, and cost model are assembled and a 30% internal rate of return included, the cost per T1 minute is obtained. The cost per T1 minute is the amount that the company must recover from customers through monthly service fees, ground equipment sales, and other services in order to obtain a 30% internal rate of return. The cost per T1 minute for the five modeled systems under the exponential and last mile markets is shown in Figure 7.2

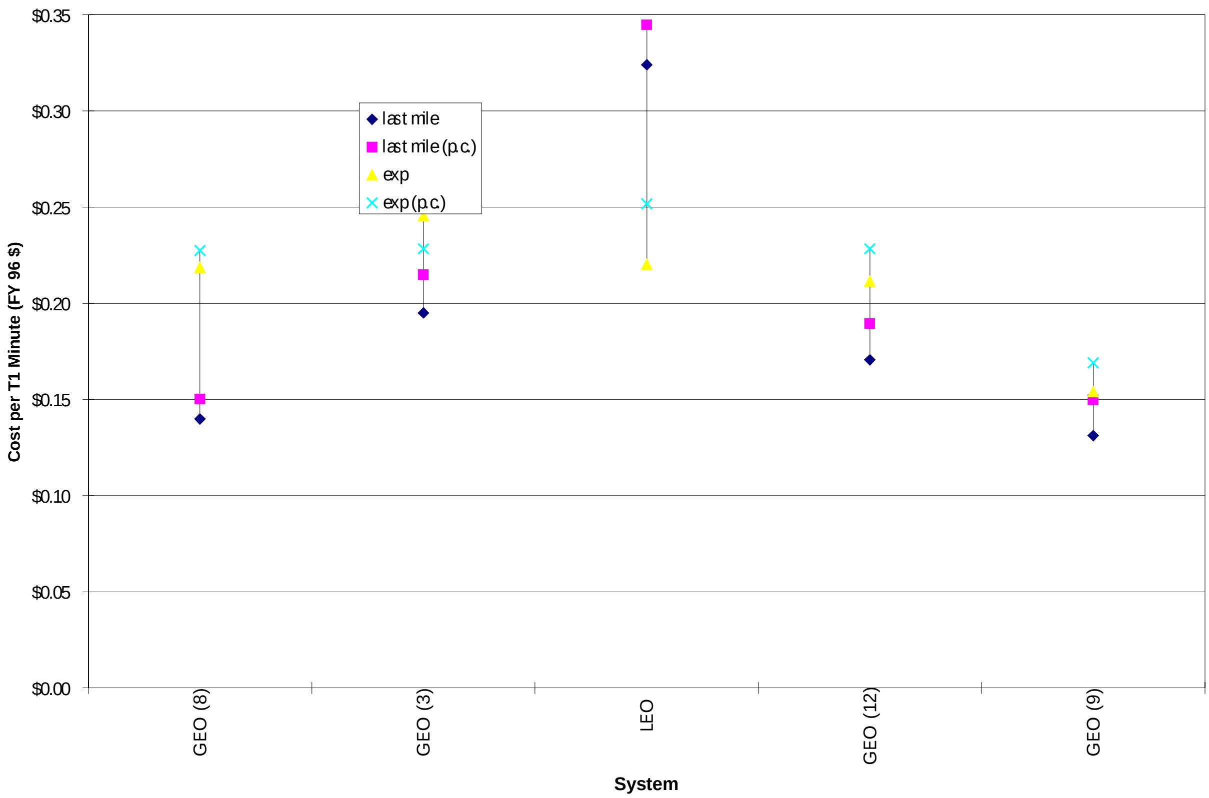

Figure 7.2: Cost per T1 Minute Summary

All systems have the ability to be competitive with one another. Small systems with well designed deployment strategies, such as GEO(3), show the less sensitivity to market variation. By designing the system so it operates near saturation for most of its lifetime, the system has few under-utilized resources and small variations in cost per T1 minute across markets. Larger capacity systems that are truly global, yet are not grossly overdesigned for the market, also see small fluctuations in cost per T1 minute across market models. A system that has a deployment strategy that is well tailored toward market development is able to achieve lower costs per T1 minute. Since market growth is difficult to predict, capture of the telephony market in under developed regions of the world will assist in mitigating market uncertainties.

The broadband satellite systems have the ability to compete with terrestrial alternatives. In comparison to the terrestrial connection options shown in Table 7.3, the average monthly cost of flat rate T1 service via the satellite systems assuming an average of 60 hours of connect time is $756. The only true broadband competition is fiber optic cabling which provides connection rates of T1 and higher. Even including a 35% mark-up of the satellite monthly rate to include costs such as advertising places the monthly fee in the low end of the listed range for terrestrial T1 connections.

Table 7.3: Terrestrial Connection Options

Link Type	Speed Range	Monthly Rate (FY 96 $)
Modem	14.4 - 33.6 kbps	20
Switched 56	56 kbps	500
ISDN	54 - 128 kbps	50 - 750
T-1	1.544 Mbps	1,000 - 3,000+
T-3	44.736 Mbps	5,000 - 30,000+

In addition, broadband terrestrial technologies are not capable of reaching the last mile. Broadband satellite systems are not only able to compete in industrialized regions, but are the only option available in many areas of the world due to a lack of terrestrial infrastructure.

These considerations raise the possibility of strategic alliances between the broadband satellite systems and international Internet service providers (ISP). The satellite systems offer the ability to reach the last mile and allow multinational corporations to obtain dedicated broadband intranets while bypassing the bottlenecks of the terrestrial Internet. An international ISP has the marketing and technical knowledge necessary to provide consumer accounts and corporate intranet solutions to clients. Such abilities make an international ISP an excellent partner to help secure the financial viability of the broadband satellite systems and provide a truly global system solution. The broadband satellite systems in such a partnership have the unique ability to lead the world forward into a new era of worldwide broadband communications.

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Appendices

Appendix A1: GEO(3) Sample Input File

```
**********************************************************
GEO(3)
**********************************************************
x
15                              Number of Years
1998    1999    2000    2001    2002    2003    2004
2005    2006    2007    2008    2009    2010    2011    2012
1.29e9  2.62e9  5.28e9  1.06e10 2.11e10 4.19e10 8.27e10
1.62e11 3.17e11 6.19e11 1.20e12 2.31e12 4.39e12 8.34e12 1.58e13
__________________________________________________________
3       number of sats
27      number of beams per sat
1       number of scan positions per beam
0       beam coordinate system [0=lon/lat, 1=relative Az/El]
2       channels per beam
1       number of polarizations
125.e6  bandwidth per channel (Hz)
92.e6   channel capacity (bits/sec)
5000.   comms power (greater than necessary)
_________________________________________________________
Inter-Satellite Links
2       Number of ISL per satellite
1.0e9   ISL Rate
0.1     Outgoing percentage (inter-regional demand)
Destination array (where the links go by satellite number):
2       3
1       3
1       2
___________________________________________________________
Misc - where to store beam data
beam.dat
____________________________________________________
Downlink
60.     power per channel (W)
79.6    Data Rate (dBHz)
5.4     Eb/No required (dB)
41.0    Gain Receiver (dB)
24.4    System Temperature (dBK)
-0.5    Circuit Losses (dB)
-1.0    Atmospheric Losses (dB)
___________________________________________________________
Uplink
1.0     Power per user (W)
55.8    Data Rate (dBHz)
8.6     Eb/No required (dB)
44.5    Gain Transmitter (dB)
27.8    System Temperature (dBK)
___________________________________________________________
Satellite Number 1
sat     beam     beam coords   gain    up freq        down freq      polar   scan cycle
1       1       0.0     60.0    41.7    28.350e9       18.950e9       1       1
1       2       10.0    60.0    42.2    28.475e9       19.075e9       1       1
1       3       15.0    60.0    42.2    29.750e9       19.950e9       1       1
1       4       25.0    60.0    42.0    29.875e9       20.075e9       1       1
1       5       30.0    62.0    41.7    29.500e9       19.700e9       1       1
1       6       -3.0    50.0    42.0    29.625e9       19.825e9       1       1
1       7       5.0     50.0    42.3    29.875e9       20.075e9       1       1
1       8       10.0    47.0    42.4    29.500e9       19.700e9       1       1
1       9       15.0    50.0    42.5    29.625e9       19.825e9       1       1
1       10      20.0    50.0    42.4    28.350e9       18.950e9       1       1
1       11      25.0    50.0    42.3    28.475e9       19.075e9       1       1
1       12      35.0    55.0    41.8    29.625e9       19.825e9       1       1
1       13      40.0    55.0    41.5    29.750e9       19.950e9       1       1
1       14      -8.0    40.0    41.3    29.500e9       19.700e9       1       1
1       15      -5.0    42.0    42.0    28.475e9       19.075e9       1       1
1       16      5.0     40.0    42.4    28.350e9       18.950e9       1       1
1       17      17.0    40.0    42.6    29.750e9       19.950e9       1       1
1       18      25.0    40.0    42.4    29.500e9       19.700e9       1       1
1       19      37.0    40.0    41.7    29.875e9       20.075e9       1       1
1       20      -3.0    35.0    41.5    29.875e9       20.075e9       1       1
1       21      30.0    35.0    41.8    29.625e9       19.825e9       1       1
1       22      37.0    35.0    41.3    28.350e9       18.950e9       1       1
1       23      32.0    30.0    41.5    29.750e9       19.950e9       1       1
1       24      47.0    27.0    38.8    29.500e9       19.700e9       1       1
1       25      52.0    27.0    38.1    28.475e9       19.075e9       1       1
1       26      57.0    22.0    36.1    29.875e9       20.075e9       1       1
```

1	27	52.0	20.0	36.1	29.625e9	19.825e9	1	1
Satellite Number 2								
sat	beam	beam coords		gain	up freq	down freq	polar	scan cycle
2	1	-82.0	27.5	40.8	28.350e9	18.950e9	1	1
2	2	-81.5	34.0	41.6	29.625e9	19.825e9	1	1
2	3	-65.0	45.0	39.8	29.875e9	20.075e9	1	1
2	4	-87.0	34.0	41.8	29.500e9	19.700e9	1	1
2	5	-77.5	44.0	40.5	29.750e9	19.950e9	1	1
2	6	-72.0	56.0	40.5	29.625e9	19.825e9	1	1
2	7	-95.0	31.0	42.4	29.750e9	19.950e9	1	1
2	8	-92.5	38.0	40.0	29.875e9	20.075e9	1	1
2	9	-85.0	56.0	40.1	29.500e9	19.700e9	1	1
2	10	-84.5	43.0	42.4	28.475e9	19.075e9	1	1
2	11	-103.0	37.5	40.2	29.750e9	19.950e9	1	1
2	12	-119.0	35.5	42.5	29.500e9	19.700e9	1	1
2	13	-92.5	47.0	42.5	28.350e9	18.950e9	1	1
2	14	-122.0	40.0	41.8	28.350e9	18.950e9	1	1
2	15	-112.0	37.0	40.0	28.475e9	19.075e9	1	1
2	16	-100.0	47.5	40.2	29.625e9	19.825e9	1	1
2	17	-90.0	65.0	40.0	29.875e9	20.075e9	1	1
2	18	-108.0	32.0	39.6	29.875e9	20.075e9	1	1
2	19	-112.0	47.0	40.1	29.500e9	19.700e9	1	1
2	20	-110.0	65.0	39.9	29.750e9	19.950e9	1	1
2	21	-122.5	47.5	39.5	29.875e9	20.075e9	1	1
2	22	-122.5	61.0	39.6	28.475e9	19.075e9	1	1
2	23	-135.0	61.0	40.8	28.350e9	18.950e9	1	1
2	24	-150.0	60.0	39.5	29.625e9	19.825e9	1	1
2	25	-67.0	19.0	39.3	28.475e9	19.075e9	1	1
2	26	-157.5	20.0	36.3	29.500e9	19.700e9	1	1
2	27	-98.0	28.0	41.1	29.625e9	19.825e9	1	1
Satellite Number 3								
sat	beam	beam coords		gain	up freq	down freq	polar	scan cycle
3	1	140.0	40.0	38.8	29.625e9	19.825e9	1	1
3	2	137.0	36.0	40.2	29.750e9	19.950e9	1	1
3	3	125.0	10.0	38.5	29.625e9	19.825e9	1	1
3	4	120.0	39.0	38.3	29.875e9	20.075e9	1	1
3	5	125.5	39.0	41.4	28.350e9	18.950e9	1	1
3	6	114.5	39.0	41.3	28.350e9	18.950e9	1	1
3	7	115.0	30.0	39.4	29.500e9	19.700e9	1	1
3	8	120.0	27.0	41.8	29.625e9	19.825e9	1	1
3	9	115.0	28.0	40.0	28.475e9	19.075e9	1	1
3	10	115.0	22.0	42.4	29.750e9	19.950e9	1	1
3	11	105.0	24.0	40.2	29.875e9	20.075e9	1	1
3	12	105.0	21.0	40.2	28.475e9	19.075e9	1	1
3	13	109.0	12.0	39.7	29.500e9	19.700e9	1	1
3	14	105.0	-6.0	39.6	29.500e9	19.700e9	1	1
3	15	102.0	5.0	41.3	29.875e9	20.075e9	1	1
3	16	100.0	12.0	39.7	29.750e9	19.950e9	1	1
3	17	100.0	18.0	40.1	29.625e9	19.825e9	1	1
3	18	95.0	25.0	40.1	29.500e9	19.700e9	1	1
3	19	90.0	27.0	39.9	29.750e9	19.950e9	1	1
3	20	86.0	23.0	41.3	28.350e9	18.950e9	1	1
3	21	82.0	21.0	40.5	29.625e9	19.825e9	1	1
3	22	82.0	15.0	40.2	28.475e9	19.075e9	1	1
3	23	77.0	12.0	38.8	28.350e9	18.950e9	1	1
3	24	77.0	19.0	38.1	29.875e9	20.075e9	1	1
3	25	75.0	23.0	38.1	29.500e9	19.700e9	1	1
3	26	80.0	28.0	40.2	28.475e9	19.075e9	1	1
3	27	75.0	32.0	38.0	29.875e9	20.075e9	1	1

Appendix A2: GEO(8) Sample Input File

```
**********************************************************
GEO(8)
**********************************************************
x
1                              Number of Years
2010
4.39e12
__________________________________________________________
8       number of sats
48      number of beams per sat
1       number of scan positions per beam
0       beam coordinate system [0=lon/lat, 1=relative Az/El]
1       channels per beam
2       number of polarizations used
125.e6  bandwidth per channel (Hz)
92.e6   channel capacity (bits/sec)
5000.   communication power (W)
__________________________________________________________
Inter-Satellite Links
0       Number of ISL per satellite
__________________________________________________________
Misc - where to store beam data
beam.dat
__________________________________________________________
Downlink
20.0    power per channel (W)
79.6    Data Rate (dBHz)
5.0     Eb/No required (dB)
43.0    Gain Receiver (dB)
24.4    System Temperature (dBK)
-0.5    Circuit Losses (dB)
-1.0    Atmospheric Losses (dB)
__________________________________________________________
Uplink
1.0     Power per user (W)
55.8    Data Rate (dBHz)
8.0     Eb/No required (dB)
44.5    Gain Transmitter (dB)
27.6    System Temperature (dBK)
__________________________________________________________
Satellite Number 1
sat     beam     beam coords  gain    up freq        down freq      polar   scan cycle
1       1       -123.0 47.1   46.5    29.500e9       19.700e9       1       1
1       2       -117   47.1   46.5    29.625e9       19.825e9       1       1
1       3       -123.0 42.    46.5    29.750e9       19.950e9       1       1
1       4       -118.5 42.    46.5    29.875e9       20.075e9       1       1
1       5       -111   47.1   46.5    29.500e9       19.700e9       1       1
1       6       -105   47.1   46.5    29.625e9       19.825e9       1       1
1       7       -114.0 42.    46.5    29.750e9       19.950e9       1       1
1       8       -109.5 42.    46.5    29.875e9       20.075e9       1       1
1       9       -99.0  47.1   46.5    29.500e9       19.700e9       1       1
1       10      -98.5  29.0   46.5    29.500e9       19.700e9       1       1
1       11      -105.0 42.    46.5    29.750e9       19.950e9       1       1
1       12      -101.5 42.    46.5    29.875e9       20.075e9       1       1
1       13      -123.0 37.5   46.5    29.500e9       19.700e9       1       1
1       14      -118.5 37.5   46.5    29.625e9       19.825e9       1       1
1       15      -118.0 33.    46.5    29.750e9       19.950e9       1       1
1       16      -114.0 37.5   46.5    29.500e9       19.700e9       1       1
1       17      -109.5 37.5   46.5    29.625e9       19.825e9       1       1
1       18      -113.5 33.    46.5    29.875e9       20.075e9       1       1
1       19      -109.  33.    46.5    29.750e9       19.950e9       1       1
1       20      -105.0 37.5   46.5    29.500e9       19.700e9       1       1
1       21      -101.5 37.5   46.5    29.625e9       19.825e9       1       1
1       22      -104.5 33.    46.5    29.875e9       20.075e9       1       1
1       23      -150.0 65.0   46.5    29.625e9       19.825e9       1       1
1       24      -155.0 20.0   46.5    29.875e9       20.075e9       1       1
1       25      -93.0  47.1   46.5    29.625e9       19.825e9       2       1
1       26      -87.0  47.1   46.5    29.500e9       19.700e9       2       1
1       27      -97.0  42.    46.5    29.750e9       19.950e9       2       1
1       28      -92.5  42.    46.5    29.875e9       20.075e9       2       1
1       29      -82.0  47.1   46.5    29.625e9       19.825e9       2       1
1       30      -76.0  47.1   46.5    29.500e9       19.700e9       2       1
1       31      -88.0  42.    46.5    29.750e9       19.950e9       2       1
1       32      -83.5  42.    46.5    29.875e9       20.075e9       2       1
1       33      -70.0  47.1   46.5    29.625e9       19.825e9       2       1
1       34      -64.0  47.1   46.5    29.500e9       19.700e9       2       1
```

```
1       35      -79.0   42.     46.5    29.750e9        19.950e9        2       1
1       36      -74.5   42.     46.5    29.875e9        20.075e9        2       1
1       37      -94.    29.0    46.5    29.625e9        19.825e9        2       1
1       38      -100.5  33.     46.5    29.750e9        19.950e9        2       1
1       39      -82.    28.5    46.5    29.625e9        19.825e9        2       1
1       40      -79.0   37.5    46.5    29.500e9        19.700e9        2       1
1       41      -97.0   37.5    46.5    29.500e9        19.700e9        2       1
1       42      -92.5   37.5    46.5    29.625e9        19.825e9        2       1
1       43      -96.0   33.     46.5    29.875e9        20.075e9        2       1
1       44      -91.5   33.     46.5    29.750e9        19.950e9        2       1
1       45      -88.0   37.5    46.5    29.500e9        19.700e9        2       1
1       46      -83.5   37.5    46.5    29.625e9        19.825e9        2       1
1       47      -87.0   33.     46.5    29.875e9        20.075e9        2       1
1       48      -82.5   33.     46.5    29.750e9        19.950e9        2       1
Satellite Number 2
sat     beam      beam coords   gain    up freq         down freq       polar   scan cycle
2       1       -1.5    53      46.5    29.500e9        19.700e9        1       1
2       2       -6      39      46.5    29.625e9        19.825e9        1       1
2       3       -4      41      46.5    29.750e9        19.950e9        1       1
2       4       -0.5    47.5    46.5    29.750e9        19.950e9        1       1
2       5       1.5     43.5    46.5    29.875e9        20.075e9        1       1
2       6       36      48      46.5    29.625e9        19.825e9        1       1
2       7       5.5     47.5    46.5    29.625e9        19.825e9        1       1
2       8       15      39      46.5    29.625e9        19.825e9        1       1
2       9       10      50      46.5    29.750e9        19.950e9        1       1
2       10      16      48      46.5    29.625e9        19.825e9        1       1
2       11      21      48      46.5    29.750e9        19.950e9        1       1
2       12      26      48      46.5    29.625e9        19.825e9        1       1
2       13      31      48      46.5    29.750e9        19.950e9        1       1
2       14      10      56      46.5    29.875e9        20.075e9        1       1
2       15      17      56      46.5    29.500e9        19.700e9        1       1
2       16      24      56      46.5    29.875e9        20.075e9        1       1
2       17      30      56      46.5    29.500e9        19.700e9        1       1
2       18      36      56      46.5    29.875e9        20.075e9        1       1
2       19      12      43      46.5    29.500e9        19.700e9        1       1
2       20      21      42      46.5    29.875e9        20.075e9        1       1
2       21      26      42      46.5    29.500e9        19.700e9        1       1
2       22      30      39      46.5    29.750e9        19.950e9        1       1
2       23      48      28      46.5    29.875e9        20.075e9        1       1
2       24      50      25      46.5    29.500e9        19.700e9        1       1
2       25      -1.5    53      46.5    29.501e9        19.700e9        2       1
2       26      -6      39      46.5    29.626e9        19.825e9        2       1
2       27      -4      41      46.5    29.751e9        19.950e9        2       1
2       28      -0.5    47.5    46.5    29.751e9        19.950e9        2       1
2       29      1.5     43.5    46.5    29.876e9        20.075e9        2       1
2       30      36      48      46.5    29.626e9        19.825e9        2       1
2       31      5.5     47.5    46.5    29.626e9        19.825e9        2       1
2       32      15      39      46.5    29.626e9        19.825e9        2       1
2       33      10      50      46.5    29.751e9        19.950e9        2       1
2       34      16      48      46.5    29.626e9        19.825e9        2       1
2       35      21      48      46.5    29.751e9        19.950e9        2       1
2       36      26      48      46.5    29.626e9        19.825e9        2       1
2       37      31      48      46.5    29.751e9        19.950e9        2       1
2       38      10      56      46.5    29.876e9        20.075e9        2       1
2       39      17      56      46.5    29.501e9        19.700e9        2       1
2       40      24      56      46.5    29.876e9        20.075e9        2       1
2       41      30      56      46.5    29.501e9        19.700e9        2       1
2       42      36      56      46.5    29.876e9        20.075e9        2       1
2       43      12      43      46.5    29.501e9        19.700e9        2       1
2       44      21      42      46.5    29.876e9        20.075e9        2       1
2       45      26      42      46.5    29.501e9        19.700e9        2       1
2       46      30      39      46.5    29.751e9        19.950e9        2       1
2       47      48      28      46.5    29.876e9        20.075e9        2       1
2       48      50      25      46.5    29.501e9        19.700e9        2       1
Satellite Number 3
sat     beam      beam coords   gain    up freq         down freq       polar   scan cycle
3       1       -113    29      46.5    29.625e9        19.825e9        1       1
3       2       -108    29      46.5    29.500e9        19.700e9        1       1
3       3       -103    29      46.5    29.625e9        19.825e9        1       1
3       4       -82     10      46.5    29.500e9        19.700e9        1       1
3       5       -88     15      46.5    29.750e9        19.950e9        1       1
3       6       -108    25      46.5    29.875e9        20.075e9        1       1
3       7       -103    25      46.5    29.750e9        19.950e9        1       1
3       8       -98     25      46.5    29.875e9        20.075e9        1       1
3       9       -64.5   6       46.5    29.500e9        19.700e9        1       1
3       10      -103.5  21      46.5    29.625e9        19.825e9        1       1
3       11      -99     21      46.5    29.500e9        19.700e9        1       1
3       12      -100    18      46.5    29.875e9        20.075e9        1       1
3       13      -96     17      46.5    29.750e9        19.950e9        1       1
3       14      -92     17      46.5    29.875e9        20.075e9        1       1
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3	15	-65	-37	46.5	29.500e9	19.700e9	1	1
3	16	-96	17	46.5	29.875e9	20.075e9	2	1
3	17	-92	17	46.5	29.750e9	19.950e9	2	1
3	18	-82	24	46.5	29.500e9	19.700e9	1	1
3	19	-78	22	46.5	29.625e9	19.825e9	1	1
3	20	-74	20	46.5	29.500e9	19.700e9	1	1
3	21	-70	18	46.5	29.625e9	19.825e9	1	1
3	22	-82	10	46.5	29.875e9	20.075e9	1	1
3	23	-78	10	46.5	29.750e9	19.950e9	1	1
3	24	-74	10	46.5	29.875e9	20.075e9	1	1
3	25	-70	10	46.5	29.750e9	19.950e9	1	1
3	26	-66	10	46.5	29.875e9	20.075e9	1	1
3	27	-78	6	46.5	29.500e9	19.700e9	2	1
3	28	-73.5	6	46.5	29.625e9	19.825e9	2	1
3	29	-69	6	46.5	29.500e9	19.700e9	2	1
3	30	-78	2	46.5	29.875e9	20.075e9	2	1
3	31	-74	2	46.5	29.750e9	19.950e9	2	1
3	32	-78	-2	46.5	29.500e9	19.700e9	2	1
3	33	-38	-6	46.5	29.625e9	19.825e9	2	1
3	34	-78	-10	46.5	29.875e9	20.075e9	2	1
3	35	-38	-10	46.5	29.750e9	19.950e9	2	1
3	36	-38	-14	46.5	29.625e9	19.825e9	2	1
3	37	-50	-18	46.5	29.875e9	20.075e9	2	1
3	38	-44	-18	46.5	29.750e9	19.950e9	2	1
3	39	-50	-22	46.5	29.625e9	19.825e9	2	1
3	40	-43	-22	46.5	29.500e9	19.700e9	2	1
3	41	-85	13	46.5	29.625e9	19.825e9	2	1
3	42	-50	-26	46.5	29.750e9	19.950e9	2	1
3	43	-58	-29	46.5	29.500e9	19.700e9	2	1
3	44	-70	-33	46.5	29.750e9	19.950e9	2	1
3	45	-60	-33	46.5	29.875e9	20.075e9	2	1
3	46	-55	-33	46.5	29.750e9	19.950e9	2	1
3	47	-72	-37	46.5	29.625e9	19.825e9	2	1
3	48	-58	-37	46.5	29.625e9	19.825e9	2	1

Satellite Number 4

sat	beam	beam coords		gain	up freq	down freq	polar	scan cycle
4	1	176	-38	46.5	29.125e9	19.325e9	1	1
4	2	172	-42	46.5	29.000e9	19.200e9	1	1
4	3	142	-38	46.5	29.250e9	19.450e9	1	1
4	4	147	-40	46.5	29.375e9	19.575e9	1	1
4	5	150	-37	46.5	29.250e9	19.450e9	1	1
4	6	152	-33	46.5	29.375e9	19.575e9	1	1
4	7	116	-34	46.5	29.000e9	19.200e9	1	1
4	8	113	-8	46.5	29.250e9	19.450e9	1	1
4	9	109	-6.5	46.5	29.000e9	19.200e9	1	1
4	10	102	-2	46.5	29.375e9	19.575e9	1	1
4	11	112	23	46.5	29.250e9	19.450e9	1	1
4	12	100	2	46.5	29.125e9	19.325e9	1	1
4	13	104	2	46.5	29.000e9	19.200e9	1	1
4	14	111	2	46.5	29.125e9	19.325e9	1	1
4	15	124	8	46.5	29.375e9	19.575e9	1	1
4	16	122	12	46.5	29.250e9	19.450e9	1	1
4	17	105	-4	46.5	29.125e9	19.325e9	1	1
4	18	140	39	46.5	29.000e9	19.200e9	1	1
4	19	137	36	46.5	29.125e9	19.325e9	1	1
4	20	133	35	46.5	29.000e9	19.200e9	1	1
4	21	129	36	46.5	29.125e9	19.325e9	1	1
4	22	125	39	46.5	29.000e9	19.200e9	1	1
4	23	117	36	46.5	29.250e9	19.450e9	1	1
4	24	120	33	46.5	29.375e9	19.575e9	1	1
4	25	120	28.5	46.5	29.000e9	19.200e9	2	1
4	26	116	30	46.5	29.125e9	19.325e9	2	1
4	27	120	24	46.5	29.250e9	19.450e9	2	1
4	28	116	25.5	46.5	29.375e9	19.575e9	2	1
4	29	112	23	46.5	29.250e9	19.450e9	2	1
4	30	109	20	46.5	29.375e9	19.575e9	2	1
4	31	106	17	46.5	29.250e9	19.450e9	2	1
4	32	108	14	46.5	29.000e9	19.200e9	2	1
4	33	104	14	46.5	29.125e9	19.325e9	2	1
4	34	100	14	46.5	29.000e9	19.200e9	2	1
4	35	105	10	46.5	29.250e9	19.450e9	2	1
4	36	96	18	46.5	29.250e9	10.450e9	2	1
4	37	91	22	46.5	29.000e9	19.200e9	2	1
4	38	86	21	46.5	29.125e9	19.325e9	2	1
4	39	106	21	46.5	29.000e9	19.200e9	2	1
4	40	109	24	46.5	29.125e9	19.325e9	2	1
4	41	120	24	46.5	29.125e9	19.325e9	2	1
4	42	140	36	46.5	29.375e9	19.575e9	2	1
4	43	77	16	46.5	29.250e9	19.450e9	2	1
4	44	131	33	46.5	29.375e9	19.575e9	2	1

4	45	77	12	46.5	29.125e9	19.325e9	2	1
4	46	79	8	46.5	29.000e9	19.200e9	2	1
4	47	120	41	46.5	29.125e9	19.325e9	2	1
4	48	112	27	46.5	29.000e9	19.200e9	2	1
Satellite Number 5								
sat	beam	beam coords		gain	up freq	down freq	polar	scan cycle
5	1	-123.0	47.1	46.5	29.000e9	19.200e9	1	1
5	2	-117	47.1	46.5	29.125e9	19.325e9	1	1
5	3	-123.0	42.	46.5	29.250e9	19.450e9	1	1
5	4	-74.5	42.	46.5	29.375e9	19.575e9	1	1
5	5	-111	47.1	46.5	29.000e9	19.200e9	1	1
5	6	-105	47.1	46.5	29.125e9	19.325e9	1	1
5	7	-114.0	42.	46.5	29.250e9	19.450e9	1	1
5	8	-83.5	37.5	46.5	29.250e9	19.450e9	1	1
5	9	-99.0	47.1	46.5	29.000e9	19.200e9	1	1
5	10	-98.5	29.0	46.5	29.000e9	19.200e9	1	1
5	11	-105.0	42.	46.5	29.250e9	19.450e9	1	1
5	12	-88.0	42.	46.5	29.000e9	19.200e9	1	1
5	13	-123.0	37.5	46.5	29.000e9	19.200e9	1	1
5	14	-118.5	37.5	46.5	29.125e9	19.325e9	1	1
5	15	-118.0	33.	46.5	29.250e9	19.450e9	1	1
5	16	-114.0	37.5	46.5	29.000e9	19.200e9	1	1
5	17	-79.0	37.5	46.5	29.125e9	19.325e9	1	1
5	18	-113.5	33.	46.5	29.375e9	19.575e9	1	1
5	19	-109.	33.	46.5	29.250e9	19.450e9	1	1
5	20	-105.0	37.5	46.5	29.000e9	19.200e9	1	1
5	21	-101.5	37.5	46.5	29.125e9	19.325e9	1	1
5	22	-104.5	33.	46.5	29.375e9	19.575e9	1	1
5	23	-150.0	65.0	46.5	29.125e9	19.325e9	1	1
5	24	-155.0	20.0	46.5	29.375e9	19.575e9	1	1
5	25	-93.0	47.1	46.5	29.125e9	19.325e9	2	1
5	26	-87.0	47.1	46.5	29.000e9	19.200e9	2	1
5	27	-97.0	42.	46.5	29.250e9	19.450e9	2	1
5	28	-92.5	42.	46.5	29.375e9	19.575e9	2	1
5	29	-82.0	47.1	46.5	29.125e9	19.325e9	2	1
5	30	-76.0	47.1	46.5	29.000e9	19.200e9	2	1
5	31	-88.0	42.	46.5	29.250e9	19.450e9	2	1
5	32	-83.5	42.	46.5	29.375e9	19.575e9	2	1
5	33	-70.0	47.1	46.5	29.125e9	19.325e9	2	1
5	34	-64.0	47.1	46.5	29.000e9	19.200e9	2	1
5	35	-79.0	42.	46.5	29.250e9	19.450e9	2	1
5	36	-74.5	42.	46.5	29.375e9	19.575e9	2	1
5	37	-94.	29.0	46.5	29.125e9	19.325e9	2	1
5	38	-100.5	33.	46.5	29.250e9	19.450e9	2	1
5	39	-82.	28.5	46.5	29.125e9	19.325e9	2	1
5	40	-79.0	37.5	46.5	29.000e9	19.200e9	2	1
5	41	-97.0	37.5	46.5	29.000e9	19.200e9	2	1
5	42	-92.5	37.5	46.5	29.125e9	19.325e9	2	1
5	43	-96.0	33.	46.5	29.375e9	19.575e9	2	1
5	44	-91.5	33.	46.5	29.250e9	19.450e9	2	1
5	45	-88.0	37.5	46.5	29.000e9	19.200e9	2	1
5	46	-83.5	37.5	46.5	29.125e9	19.325e9	2	1
5	47	-87.0	33.	46.5	29.375e9	19.575e9	2	1
5	48	-82.5	33.	46.5	29.250e9	19.450e9	2	1
Satellite Number 6								
sat	beam	beam coords		gain	up freq	down freq	polar	scan cycle
6	1	5.5	47.5	46.5	29.000e9	19.200e9	2	1
6	2	10	50	46.5	29.125e9	19.325e9	2	1
6	3	16	48	46.5	29.250e9	19.450e9	2	1
6	4	12	43	46.5	29.375e9	19.575e9	2	1
6	5	10.5	30	46.5	29.000e9	19.200e9	2	1
6	6	10	50	46.5	29.135e9	19.325e9	1	1
6	7	-4	52	46.5	29.250e9	19.450e9	2	1
6	8	-3	30	46.5	29.375e9	19.575e9	2	1
6	9	-7.5	30	46.5	29.250e9	19.450e9	2	1
6	10	41	22	46.5	29.125e9	19.325e9	2	1
6	11	43	19	46.5	29.250e9	19.450e9	2	1
6	12	44	29.5	46.5	29.000e9	19.200e9	2	1
6	13	43	14.5	46.5	29.000e9	19.200e9	2	1
6	14	1.5	43.5	46.5	29.125e9	19.325e9	2	1
6	15	47.5	18.5	46.5	29.375e9	19.575e9	2	1
6	16	39	26	46.5	29.375e9	19.575e9	2	1
6	17	43	37.5	46.5	29.000e9	19.200e9	2	1
6	18	43	41.5	46.5	29.125e9	19.325e9	2	1
6	19	48	37	46.5	29.250e9	19.450e9	2	1
6	20	41	48	46.5	29.375e9	19.575e9	2	1
6	21	41	56	46.5	29.000e9	19.200e9	2	1
6	22	32	23	46.5	29.125e9	19.325e9	2	1
6	23	33	20	46.5	29.250e9	19.450e9	2	1
6	24	5.5	47.5	46.5	29.000e9	19.200e9	1	1

6	25	34	39	46.5	29.000e9	19.200e9	2	1
6	26	38	39	46.5	29.125e9	19.325e9	1	1
6	27	38	34	46.5	29.250e9	19.450e9	1	1
6	28	36	30	46.5	29.000e9	19.200e9	1	1
6	29	30	30	46.5	29.125e9	19.325e9	1	1
6	30	25	30	46.5	29.000e9	19.200e9	1	1
6	31	20	30	46.5	29.125e9	19.325e9	1	1
6	32	15	30	46.5	29.000e9	19.200e9	1	1
6	33	10	34	46.5	29.250e9	19.450e9	1	1
6	34	5	34	46.5	29.375e9	19.575e9	1	1
6	35	0	34	46.5	29.250e9	19.450e9	1	1
6	36	-4	32.5	46.5	29.375e9	19.575e9	1	1
6	37	32	27	46.5	29.250e9	19.450e9	1	1
6	38	43	33	46.5	29.375e9	19.575e9	1	1
6	39	40	29	46.5	29.125e9	19.325e9	1	1
6	40	7.5	6	46.5	29.000e9	19.200e9	1	1
6	41	3	7	46.5	29.125e9	19.325e9	1	1
6	42	-2	6	46.5	29.000e9	19.200e9	1	1
6	43	18	-32	46.5	29.375e9	19.575e9	1	1
6	44	28	-24	46.5	29.250e9	19.450e9	1	1
6	45	28	-29	46.5	29.375e9	19.575e9	1	1
6	46	44	25	46.5	29.375e9	19.575e9	1	1
6	47	46	22	46.5	29.125e9	19.325e9	1	1
6	48	48	33	46.5	29.250e9	19.450e9	1	1

Satellite Number 7

sat	beam	beam coords		gain	up freq	down freq	polar	scan cycle
7	1	-113	29	46.5	29.125e9	19.325e9	1	1
7	2	-108	29	46.5	29.000e9	19.200e9	1	1
7	3	-103	29	46.5	29.125e9	19.325e9	1	1
7	4	-98.5	29	46.5	29.000e9	19.200e9	2	1
7	5	-94	29	46.5	29.125e9	19.325e9	1	1
7	6	-118	33	46.5	29.250e9	19.450e9	2	1
7	7	-113.5	33	46.5	29.375e9	19.575e9	2	1
7	8	-109	33	46.5	29.250e9	19.450e9	2	1
7	9	-82	10	46.5	29.000e9	19.200e9	1	1
7	10	-108	25	46.5	29.375e9	19.575e9	1	1
7	11	-103	25	46.5	29.250e9	19.450e9	1	1
7	12	-98	25	46.5	29.375e9	19.575e9	1	1
7	13	-60	6	46.5	29.000e9	19.200e9	1	1
7	14	-99	21	46.5	29.000e9	19.200e9	1	1
7	15	-100	18	46.5	29.375e9	19.575e9	1	1
7	16	-96	17	46.5	29.250e9	19.450e9	1	1
7	17	-92	17	46.5	29.375e9	19.575e9	1	1
7	18	-62	10	46.5	29.250e9	19.450e9	1	1
7	19	-70	18	46.5	29.125e9	19.325e9	1	1
7	20	-78	6	46.5	29.000e9	19.200e9	2	1
7	21	-78	2	46.5	29.375e9	19.575e9	2	1
7	22	-78	-2	46.5	29.000e9	19.200e9	2	1
7	23	-79	-6	46.5	29.125e9	19.325e9	1	1
7	24	-78	-10	46.5	29.375e9	19.575e9	2	1
7	25	-75	-14	46.5	29.250e9	19.450e9	2	1
7	26	-72	-18	46.5	29.375e9	19.575e9	1	1
7	27	-70	-22	46.5	29.000e9	19.200e9	1	1
7	28	-70	-26	46.5	29.125e9	19.325e9	1	1
7	29	-70	-30	46.5	29.000e9	19.200e9	1	1
7	30	-56	4	46.5	29.250e9	19.450e9	2	1
7	31	-72	-37	46.5	29.125e9	19.325e9	2	1
7	32	-58	-37	46.5	29.000e9	19.200e9	2	1
7	33	-60	-33	46.5	29.375e9	19.575e9	2	1
7	34	-55	-33	46.5	29.250e9	19.450e9	2	1
7	35	-58	-29	46.5	29.125e9	19.325e9	2	1
7	36	-50	-30	46.5	29.000e9	10.200e9	1	1
7	37	-50	-26	46.5	29.250e9	19.450e9	2	1
7	38	-50	-22	46.5	29.125e9	19.325e9	2	1
7	39	-43	-22	46.5	29.000e9	19.200e9	2	1
7	40	-50	-18	46.5	29.375e9	19.575e9	2	1
7	41	-44	-18	46.5	29.250e9	19.450e9	2	1
7	42	-44	-3	46.5	29.375e9	19.575e9	1	1
7	43	-50	-1	46.5	29.125e9	19.325e9	1	1
7	44	-52	2	46.5	29.375e9	19.575e9	1	1
7	45	-103.5	21	46.5	29.125e9	19.325e9	1	1
7	46	-38	-14	46.5	29.125e9	19.325e9	2	1
7	47	-38	-10	46.5	29.250e9	19.450e9	2	1
7	48	-38	-6	46.5	29.125e9	19.325e9	2	1

Satellite Number 8

sat	beam	beam coords		gain	up freq	down freq	polar	scan cycle
8	1	176	-38	46.5	29.625e9	19.825e9	1	1
8	2	172	-42	46.5	29.500e9	19.700e9	1	1
8	3	142	-38	46.5	29.750e9	19.950e9	1	1
8	4	176	-38	46.5	29.625e9	19.825e9	2	1

8	5	172	-42	46.5	29.500e9	19.700e9	2	1
8	6	142	-38	46.5	29.750e9	19.950e9	2	1
8	7	150	-37	46.5	29.750e9	19.950e9	1	1
8	8	150	-37	46.5	29.750e9	19.950e9	2	1
8	9	112	23	46.5	29.750e9	19.950e9	1	1
8	10	100	2	46.5	29.625e9	19.825e9	1	1
8	11	104	2	46.5	29.500e9	19.700e9	1	1
8	12	112	23	46.5	29.750e9	19.950e9	2	1
8	13	100	2	46.5	29.625e9	19.825e9	2	1
8	14	104	2	46.5	29.500e9	19.700e9	2	1
8	15	140	39	46.5	29.500e9	19.700e9	1	1
8	16	137	36	46.5	29.625e9	19.825e9	1	1
8	17	133	35	46.5	29.500e9	19.700e9	1	1
8	18	129	36	46.5	29.625e9	19.825e9	1	1
8	19	125	39	46.5	29.500e9	19.700e9	1	1
8	20	140	39	46.5	29.500e9	19.700e9	2	1
8	21	137	36	46.5	29.625e9	19.825e9	2	1
8	22	133	35	46.5	29.500e9	19.700e9	2	1
8	23	129	36	46.5	29.625e9	19.825e9	2	1
8	24	125	39	46.5	29.500e9	19.700e9	2	1
8	25	120	24	46.5	29.750e9	19.950e9	1	1
8	26	120	24	46.5	29.750e9	19.950e9	2	1
8	27	112	31	46.5	29.750e9	19.950e9	1	1
8	28	109	20	46.5	29.875e9	20.075e9	1	1
8	29	112	27	46.5	29.500e9	19.700e9	2	1
8	30	109	20	46.5	29.875e9	20.075e9	2	1
8	31	109	24	46.5	29.625e9	19.825e9	1	1
8	32	120	24	46.5	29.625e9	19.825e9	1	1
8	33	140	36	46.5	29.875e9	20.075e9	1	1
8	34	109	24	46.5	29.625e9	19.825e9	2	1
8	35	120	24	46.5	29.625e9	19.825e9	2	1
8	36	140	36	46.5	29.875e9	20.075e9	2	1
8	37	131	33	46.5	29.875e9	20.075e9	1	1
8	38	131	33	46.5	29.875e9	20.075e9	2	1
8	39	169	-45	46.5	29.625e9	19.825e9	1	1
8	40	152	-28	46.5	29.750e9	19.950e9	2	1
8	41	142	43	46.5	29.625e9	19.825e9	1	1
8	42	142	43	46.5	29.625e9	19.825e9	2	1
8	43	129	42	46.5	29.750e9	19.950e9	1	1
8	44	104	22	46.5	29.500e9	19.700e9	2	1
8	45	101	18	46.5	29.500e9	19.700e9	1	1
8	46	100	6	46.5	29.750e9	19.950e9	2	1
8	47	112	-2	46.5	29.875e9	20.075e9	1	1
8	48	100	10	46.5	29.500e9	19.700e9	2	1

Appendix A3: LEO Input File

```
*********************************************************
LEO
*********************************************************
comp
15                              Number of Years
1998    1999    2000    2001    2002    2003    2004
2005    2006    2007    2008    2009    2010    2011    2012
1.40e10 2.10e10 2.84e10 3.99e10 5.59e10 7.81e10 1.08e11
1.48e11 2.03e11 2.72e11 3.62e11 4.76e11 6.06e11 7.51e11 9.0e11

840     total number of sats
64      number of beams per sat
9       number of scan positions per beam
1       beam coordinate system [0=lon/lat, 1=relative Az/El]
1       channels per beam
2       number of polarizations used
400.e6  bandwidth per channel (Hz)
324.e6  channel capacity (bits/sec)
3000.   communication power (W)

Inter-Satellite Links
0       Number of ISL per satellite

Misc
beam.dat

Downlink
75.0    power per channel (W)
85.1    Data Rate (dBHz)
4.5     Eb/No required (dB)
33.0    Gain Receiver (dB)
26.5    System Temperature (dBK)
-0.5    Circuit Losses (dB)
-1.0    Atmospheric Losses (dB)

Uplink
0.5     Power per user (W)
53.5    Data Rate (dBHz)
4.5     Eb/No required (dB)
36.0    Gain Transmitter (dB)
30.0    System Temperature (dBK)

Typical Satellite
sat     beam     beam coords     gain       up freq   down freq      polar    scan
1     0.785406    0.0424050      29.8000  2.88000e+10  1.90000e+10      1       1
2     0.321272    0.0948151      29.8000  2.88000e+10  1.90000e+10      1       2
3     0.196681     0.152891      29.8000  2.88000e+10  1.90000e+10      1       3
4     0.541607     0.174724      29.8000  2.88000e+10  1.90000e+10      1       4
5     0.787808     0.127114      29.8000  2.88000e+10  1.90000e+10      1       5
6      1.25314    0.0948158      29.8000  2.88000e+10  1.90000e+10      1       6
7      1.37633     0.152934      29.8000  2.88000e+10  1.90000e+10      1       7
8      1.03110     0.174650      29.8000  2.88000e+10  1.90000e+10      1       8
9     0.783951     0.211746      29.8000  2.88000e+10  1.90000e+10      1       9
10     0.142945     0.212004     29.8000  2.88000e+10  1.90000e+10      2       1
11     0.111102     0.271495      29.8000  2.88000e+10  1.90000e+10      2       2
12    0.0906625     0.331160      29.8000  2.88000e+10  1.90000e+10      2       3
13     0.269767     0.341655      29.8000  2.88000e+10  1.90000e+10      2       4
14     0.326748     0.284286      29.8000  2.88000e+10  1.90000e+10      2       5
15     0.411855     0.228280      29.8000  2.88000e+10  1.90000e+10      2       6
16     0.628728     0.258100      29.8000  2.88000e+10  1.90000e+10      2       7
17     0.512405     0.308580      29.8000  2.88000e+10  1.90000e+10      2       8
18     0.429338     0.362005      29.8000  2.88000e+10  1.90000e+10      2       9
19    0.0787531     0.390908      29.8000  2.88000e+10  1.90000e+10      1       1
20    0.0679287     0.450715      29.8000  2.88000e+10  1.90000e+10      1       2
21    0.0596037     0.510562      29.8000  2.88000e+10  1.90000e+10      1       3
22     0.180878     0.517302      29.8000  2.88000e+10  1.90000e+10      1       4
23     0.205244     0.458425      29.8000  2.88000e+10  1.90000e+10      1       5
24     0.236625     0.399888      29.8000  2.88000e+10  1.90000e+10      1       6
25     0.380715     0.417812      29.8000  2.88000e+10  1.90000e+10      1       7
26     0.331903     0.473981      29.8000  2.88000e+10  1.90000e+10      1       8
27     0.293329     0.531010      29.8000  2.88000e+10  1.90000e+10      1       9
28    0.0492179     0.566705      30.9000  2.88000e+10  1.90000e+10      2       1
29    0.0447429     0.619483      30.9000  2.88000e+10  1.90000e+10      2       2
30    0.0409498     0.672270      30.9000  2.88000e+10  1.90000e+10      2       3
31     0.125369     0.676176      30.9000  2.88000e+10  1.90000e+10      2       4
32     0.136674     0.623783      30.9000  2.88000e+10  1.90000e+10      2       5
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33	0.149978	0.571479	30.9000	2.88000e+10	1.90000e+10	2	6
34	0.245197	0.581463	30.9000	2.88000e+10	1.90000e+10	2	7
35	0.223519	0.632834	30.9000	2.88000e+10	1.90000e+10	2	8
36	0.205002	0.684442	30.9000	2.88000e+10	1.90000e+10	2	9
37	0.0352268	0.721830	32.0000	2.88000e+10	1.90000e+10	1	1
38	0.0328685	0.768354	32.0000	2.88000e+10	1.90000e+10	1	2
39	0.0307668	0.814882	32.0000	2.88000e+10	1.90000e+10	1	3
40	0.0945856	0.817332	32.0000	2.88000e+10	1.90000e+10	1	4
41	0.100893	0.770998	32.0000	2.88000e+10	1.90000e+10	1	5
42	0.107963	0.724695	32.0000	2.88000e+10	1.90000e+10	1	6
43	0.177323	0.730911	32.0000	2.88000e+10	1.90000e+10	1	7
44	0.165613	0.776768	32.0000	2.88000e+10	1.90000e+10	1	8
45	0.155146	0.822711	32.0000	2.88000e+10	1.90000e+10	1	9
46	1.42785	0.212004	29.8000	2.88000e+10	1.90000e+10	2	1
47	1.16261	0.228279	29.8000	2.88000e+10	1.90000e+10	2	2
48	0.945236	0.257921	29.8000	2.88000e+10	1.90000e+10	2	3
49	1.06108	0.308495	29.8000	2.88000e+10	1.90000e+10	2	4
50	1.24893	0.283945	29.8000	2.88000e+10	1.90000e+10	2	5
51	1.46307	0.270851	29.8000	2.88000e+10	1.90000e+10	2	6
52	1.48292	0.330535	29.8000	2.88000e+10	1.90000e+10	2	7
53	1.30338	0.340878	29.8000	2.88000e+10	1.90000e+10	2	8
54	1.13907	0.361202	29.8000	2.88000e+10	1.90000e+10	2	9
55	1.49204	0.390908	29.8000	2.88000e+10	1.90000e+10	1	1
56	1.33796	0.399887	29.8000	2.88000e+10	1.90000e+10	1	2
57	1.19367	0.417599	29.8000	2.88000e+10	1.90000e+10	1	3
58	1.24206	0.473840	29.8000	2.88000e+10	1.90000e+10	1	4
59	1.37077	0.457742	29.8000	2.88000e+10	1.90000e+10	1	5
60	1.50640	0.449412	29.8000	2.88000e+10	1.90000e+10	1	6
61	1.51431	0.509272	29.8000	2.88000e+10	1.90000e+10	1	7
62	1.39270	0.515836	29.8000	2.88000e+10	1.90000e+10	1	8
63	1.27564	0.529461	29.8000	2.88000e+10	1.90000e+10	1	9
64	1.52158	0.566705	30.9000	2.88000e+10	1.90000e+10	2	1
65	1.42390	0.571479	30.9000	2.88000e+10	1.90000e+10	2	2
66	1.32861	0.581304	30.9000	2.88000e+10	1.90000e+10	2	3
67	1.35003	0.632711	30.9000	2.88000e+10	1.90000e+10	2	4
68	1.43847	0.622985	30.9000	2.88000e+10	1.90000e+10	2	5
69	1.52895	0.617941	30.9000	2.88000e+10	1.90000e+10	2	6
70	1.53251	0.670735	30.9000	2.88000e+10	1.90000e+10	2	7
71	1.44790	0.674507	30.9000	2.88000e+10	1.90000e+10	2	8
72	1.36472	0.682684	30.9000	2.88000e+10	1.90000e+10	2	9
73	1.53557	0.721830	32.0000	2.88000e+10	1.90000e+10	1	1
74	1.46536	0.724695	32.0000	2.88000e+10	1.90000e+10	1	2
75	1.39597	0.730795	32.0000	2.88000e+10	1.90000e+10	1	3
76	1.40752	0.776671	32.0000	2.88000e+10	1.90000e+10	1	4
77	1.47351	0.770188	32.0000	2.88000e+10	1.90000e+10	1	5
78	1.54031	0.766779	32.0000	2.88000e+10	1.90000e+10	1	6
79	1.54227	0.813310	32.0000	2.88000e+10	1.90000e+10	1	7
80	1.47834	0.815659	32.0000	2.88000e+10	1.90000e+10	1	8
81	1.41498	0.820961	32.0000	2.88000e+10	1.90000e+10	1	9
82	0.785398	0.296837	29.8000	2.88000e+10	1.90000e+10	1	1
83	0.658623	0.341805	29.8000	2.88000e+10	1.90000e+10	1	2
84	0.562199	0.390890	29.8000	2.88000e+10	1.90000e+10	1	3
85	0.685296	0.425734	29.8000	2.88000e+10	1.90000e+10	1	4
86	0.787463	0.381083	29.8000	2.88000e+10	1.90000e+10	1	5
87	0.914687	0.341291	29.8000	2.88000e+10	1.90000e+10	1	6
88	1.01090	0.390460	29.8000	2.88000e+10	1.90000e+10	1	7
89	0.887474	0.425199	29.8000	2.88000e+10	1.90000e+10	1	8
90	0.783692	0.465250	29.8000	2.88000e+10	1.90000e+10	1	9
91	0.494946	0.442714	29.8000	2.88000e+10	1.90000e+10	2	1
92	0.435120	0.496251	29.8000	2.88000e+10	1.90000e+10	2	2
93	0.386859	0.551164	29.8000	2.88000e+10	1.90000e+10	2	3
94	0.488911	0.576194	29.8000	2.88000e+10	1.90000e+10	2	4
95	0.545207	0.523922	29.8000	2.88000e+10	1.90000e+10	2	5
96	0.613411	0.473574	29.8000	2.88000e+10	1.90000e+10	2	6
97	0.713920	0.510277	29.8000	2.88000e+10	1.90000e+10	2	7
98	0.639598	0.556866	29.8000	2.88000e+10	1.90000e+10	2	8
99	0.576744	0.605928	29.8000	2.88000e+10	1.90000e+10	2	9
100	0.317565	0.595559	30.9000	2.88000e+10	1.90000e+10	1	1
101	0.290166	0.645938	30.9000	2.88000e+10	1.90000e+10	1	2
102	0.266616	0.696707	30.9000	2.88000e+10	1.90000e+10	1	3
103	0.344659	0.712147	30.9000	2.88000e+10	1.90000e+10	1	4
104	0.373669	0.662616	30.9000	2.88000e+10	1.90000e+10	1	5
105	0.407151	0.613684	30.9000	2.88000e+10	1.90000e+10	1	6
106	0.488861	0.636219	30.9000	2.88000e+10	1.90000e+10	1	7
107	0.449566	0.683255	30.9000	2.88000e+10	1.90000e+10	1	8
108	0.415187	0.731144	30.9000	2.88000e+10	1.90000e+10	1	9
109	1.07585	0.442714	29.8000	2.88000e+10	1.90000e+10	2	1
110	0.960032	0.473949	29.8000	2.88000e+10	1.90000e+10	2	2
111	0.859382	0.510530	29.8000	2.88000e+10	1.90000e+10	2	3
112	0.933447	0.557208	29.8000	2.88000e+10	1.90000e+10	2	4

113	1.02995	0.523511	29.8000	2.88000e+10	1.90000e+10	2	5
114	1.13831	0.495063	29.8000	2.88000e+10	1.90000e+10	2	6
115	1.18638	0.550038	29.8000	2.88000e+10	1.90000e+10	2	7
116	1.08403	0.574942	29.8000	2.88000e+10	1.90000e+10	2	8
117	0.990767	0.605057	29.8000	2.88000e+10	1.90000e+10	2	9
118	0.785398	0.546225	30.9000	2.88000e+10	1.90000e+10	1	1
119	0.717684	0.584659	30.9000	2.88000e+10	1.90000e+10	1	2
120	0.658315	0.625316	30.9000	2.88000e+10	1.90000e+10	1	3
121	0.726611	0.658789	30.9000	2.88000e+10	1.90000e+10	1	4
122	0.787020	0.620144	30.9000	2.88000e+10	1.90000e+10	1	5
123	0.854923	0.583886	30.9000	2.88000e+10	1.90000e+10	1	6
124	0.914227	0.624603	30.9000	2.88000e+10	1.90000e+10	1	7
125	0.845770	0.658008	30.9000	2.88000e+10	1.90000e+10	1	8
126	0.783930	0.694006	30.9000	2.88000e+10	1.90000e+10	1	9
127	1.25323	0.595559	30.9000	2.88000e+10	1.90000e+10	1	1
128	1.16602	0.613863	30.9000	2.88000e+10	1.90000e+10	1	2
129	1.08424	0.636286	30.9000	2.88000e+10	1.90000e+10	1	3
130	1.12336	0.683375	30.9000	2.88000e+10	1.90000e+10	1	4
131	1.20090	0.661956	30.9000	2.88000e+10	1.90000e+10	1	5
132	1.28295	0.644457	30.9000	2.88000e+10	1.90000e+10	1	6
133	1.30636	0.695258	30.9000	2.88000e+10	1.90000e+10	1	7
134	1.22813	0.710594	30.9000	2.88000e+10	1.90000e+10	1	8
135	1.15345	0.729749	30.9000	2.88000e+10	1.90000e+10	1	9
136	1.00730	0.643966	30.9000	2.88000e+10	1.90000e+10	2	1
137	0.935656	0.673459	30.9000	2.88000e+10	1.90000e+10	2	2
138	0.870074	0.705888	30.9000	2.88000e+10	1.90000e+10	2	3
139	0.920217	0.746918	30.9000	2.88000e+10	1.90000e+10	2	4
140	0.984292	0.715916	30.9000	2.88000e+10	1.90000e+10	2	5
141	1.05363	0.687834	30.9000	2.88000e+10	1.90000e+10	2	6
142	1.09262	0.734149	30.9000	2.88000e+10	1.90000e+10	2	7
143	1.02448	0.759641	30.9000	2.88000e+10	1.90000e+10	2	8
144	0.960791	0.788125	30.9000	2.88000e+10	1.90000e+10	2	9
145	2.35619	0.0424050	29.8000	2.88000e+10	1.90000e+10	2	3
146	2.82032	0.0948151	29.8000	2.88000e+10	1.90000e+10	2	2
147	2.94491	0.152891	29.8000	2.88000e+10	1.90000e+10	2	1
148	2.59999	0.174724	29.8000	2.88000e+10	1.90000e+10	2	6
149	2.35379	0.127114	29.8000	2.88000e+10	1.90000e+10	2	5
150	1.88845	0.0948158	29.8000	2.88000e+10	1.90000e+10	2	4
151	1.76526	0.152934	29.8000	2.88000e+10	1.90000e+10	2	9
152	2.11049	0.174650	29.8000	2.88000e+10	1.90000e+10	2	8
153	2.35764	0.211746	29.8000	2.88000e+10	1.90000e+10	2	7
154	2.99865	0.212004	29.8000	2.88000e+10	1.90000e+10	1	3
155	3.03049	0.271495	29.8000	2.88000e+10	1.90000e+10	1	2
156	3.05093	0.331160	29.8000	2.88000e+10	1.90000e+10	1	1
157	2.87183	0.341655	29.8000	2.88000e+10	1.90000e+10	1	6
158	2.81484	0.284286	29.8000	2.88000e+10	1.90000e+10	1	5
159	2.72974	0.228280	29.8000	2.88000e+10	1.90000e+10	1	4
160	2.51286	0.258100	29.8000	2.88000e+10	1.90000e+10	1	9
161	2.62919	0.308580	29.8000	2.88000e+10	1.90000e+10	1	8
162	2.71225	0.362005	29.8000	2.88000e+10	1.90000e+10	1	7
163	3.06284	0.390908	29.8000	2.88000e+10	1.90000e+10	2	3
164	3.07366	0.450715	29.8000	2.88000e+10	1.90000e+10	2	2
165	3.08199	0.510562	29.8000	2.88000e+10	1.90000e+10	2	1
166	2.96071	0.517302	29.8000	2.88000e+10	1.90000e+10	2	6
167	2.93635	0.458425	29.8000	2.88000e+10	1.90000e+10	2	5
168	2.90497	0.399888	29.8000	2.88000e+10	1.90000e+10	2	4
169	2.76088	0.417812	29.8000	2.88000e+10	1.90000e+10	2	9
170	2.80969	0.473981	29.8000	2.88000e+10	1.90000e+10	2	8
171	2.84826	0.531010	29.8000	2.88000e+10	1.90000e+10	2	7
172	3.09237	0.566705	30.9000	2.88000e+10	1.90000e+10	1	3
173	3.09685	0.619483	30.9000	2.88000e+10	1.90000e+10	1	2
174	3.10064	0.672270	30.9000	2.88000e+10	1.90000e+10	1	1
175	3.01622	0.676176	30.9000	2.88000e+10	1.90000e+10	1	6
176	3.00492	0.623783	30.9000	2.88000e+10	1.90000e+10	1	5
177	2.99161	0.571479	30.9000	2.88000e+10	1.90000e+10	1	4
178	2.89640	0.581463	30.9000	2.88000e+10	1.90000e+10	1	9
179	2.91807	0.632834	30.9000	2.88000e+10	1.90000e+10	1	8
180	2.93659	0.684442	30.9000	2.88000e+10	1.90000e+10	1	7
181	3.10637	0.721830	32.0000	2.88000e+10	1.90000e+10	2	3
182	3.10872	0.768354	32.0000	2.88000e+10	1.90000e+10	2	2
183	3.11083	0.814882	32.0000	2.88000e+10	1.90000e+10	2	1
184	3.04701	0.817332	32.0000	2.88000e+10	1.90000e+10	2	6
185	3.04070	0.770998	32.0000	2.88000e+10	1.90000e+10	2	5
186	3.03363	0.724695	32.0000	2.88000e+10	1.90000e+10	2	4
187	2.96427	0.730911	32.0000	2.88000e+10	1.90000e+10	2	9
188	2.97598	0.776768	32.0000	2.88000e+10	1.90000e+10	2	8
189	2.98645	0.822711	32.0000	2.88000e+10	1.90000e+10	2	7
190	1.71374	0.212004	29.8000	2.88000e+10	1.90000e+10	1	3
191	1.97898	0.228279	29.8000	2.88000e+10	1.90000e+10	1	2
192	2.19636	0.257921	29.8000	2.88000e+10	1.90000e+10	1	1

193	2.08051	0.308495	29.8000	2.88000e+10	1.90000e+10	1	6
194	1.89266	0.283945	29.8000	2.88000e+10	1.90000e+10	1	5
195	1.67852	0.270851	29.8000	2.88000e+10	1.90000e+10	1	4
196	1.65867	0.330535	29.8000	2.88000e+10	1.90000e+10	1	9
197	1.83821	0.340878	29.8000	2.88000e+10	1.90000e+10	1	8
198	2.00252	0.361202	29.8000	2.88000e+10	1.90000e+10	1	7
199	1.64955	0.390908	29.8000	2.88000e+10	1.90000e+10	2	3
200	1.80363	0.399887	29.8000	2.88000e+10	1.90000e+10	2	2
201	1.94792	0.417599	29.8000	2.88000e+10	1.90000e+10	2	1
202	1.89953	0.473840	29.8000	2.88000e+10	1.90000e+10	2	6
203	1.77082	0.457742	29.8000	2.88000e+10	1.90000e+10	2	5
204	1.63520	0.449412	29.8000	2.88000e+10	1.90000e+10	2	4
205	1.62728	0.509272	29.8000	2.88000e+10	1.90000e+10	2	9
206	1.74890	0.515836	29.8000	2.88000e+10	1.90000e+10	2	8
207	1.86595	0.529461	29.8000	2.88000e+10	1.90000e+10	2	7
208	1.62001	0.566705	30.9000	2.88000e+10	1.90000e+10	1	3
209	1.71769	0.571479	30.9000	2.88000e+10	1.90000e+10	1	2
210	1.81298	0.581304	30.9000	2.88000e+10	1.90000e+10	1	1
211	1.79156	0.632711	30.9000	2.88000e+10	1.90000e+10	1	6
212	1.70312	0.622985	30.9000	2.88000e+10	1.90000e+10	1	5
213	1.61264	0.617941	30.9000	2.88000e+10	1.90000e+10	1	4
214	1.60909	0.670735	30.9000	2.88000e+10	1.90000e+10	1	9
215	1.69369	0.674507	30.9000	2.88000e+10	1.90000e+10	1	8
216	1.77687	0.682684	30.9000	2.88000e+10	1.90000e+10	1	7
217	1.60602	0.721830	32.0000	2.88000e+10	1.90000e+10	2	3
218	1.67624	0.724695	32.0000	2.88000e+10	1.90000e+10	2	2
219	1.74562	0.730795	32.0000	2.88000e+10	1.90000e+10	2	1
220	1.73407	0.776671	32.0000	2.88000e+10	1.90000e+10	2	6
221	1.66808	0.770188	32.0000	2.88000e+10	1.90000e+10	2	5
222	1.60128	0.766779	32.0000	2.88000e+10	1.90000e+10	2	4
223	1.59933	0.813310	32.0000	2.88000e+10	1.90000e+10	2	9
224	1.66325	0.815659	32.0000	2.88000e+10	1.90000e+10	2	8
225	1.72661	0.820961	32.0000	2.88000e+10	1.90000e+10	2	7
226	2.35619	0.296837	29.8000	2.88000e+10	1.90000e+10	2	3
227	2.48297	0.341805	29.8000	2.88000e+10	1.90000e+10	2	2
228	2.57939	0.390890	29.8000	2.88000e+10	1.90000e+10	2	1
229	2.45630	0.425734	29.8000	2.88000e+10	1.90000e+10	2	6
230	2.35413	0.381083	29.8000	2.88000e+10	1.90000e+10	2	5
231	2.22691	0.341291	29.8000	2.88000e+10	1.90000e+10	2	4
232	2.13070	0.390460	29.8000	2.88000e+10	1.90000e+10	2	9
233	2.25412	0.425199	29.8000	2.88000e+10	1.90000e+10	2	8
234	2.35790	0.465250	29.8000	2.88000e+10	1.90000e+10	2	7
235	2.64665	0.442714	29.8000	2.88000e+10	1.90000e+10	1	3
236	2.70647	0.496251	29.8000	2.88000e+10	1.90000e+10	1	2
237	2.75473	0.551164	29.8000	2.88000e+10	1.90000e+10	1	1
238	2.65268	0.576194	29.8000	2.88000e+10	1.90000e+10	1	6
239	2.59639	0.523922	29.8000	2.88000e+10	1.90000e+10	1	5
240	2.52818	0.473574	29.8000	2.88000e+10	1.90000e+10	1	4
241	2.42767	0.510277	29.8000	2.88000e+10	1.90000e+10	1	9
242	2.50199	0.556866	29.8000	2.88000e+10	1.90000e+10	1	8
243	2.56485	0.605928	29.8000	2.88000e+10	1.90000e+10	1	7
244	2.82403	0.595559	30.9000	2.88000e+10	1.90000e+10	2	3
245	2.85143	0.645938	30.9000	2.88000e+10	1.90000e+10	2	2
246	2.87498	0.696707	30.9000	2.88000e+10	1.90000e+10	2	1
247	2.79693	0.712147	30.9000	2.88000e+10	1.90000e+10	2	6
248	2.76792	0.662616	30.9000	2.88000e+10	1.90000e+10	2	5
249	2.73444	0.613684	30.9000	2.88000e+10	1.90000e+10	2	4
250	2.65273	0.636219	30.9000	2.88000e+10	1.90000e+10	2	9
251	2.69203	0.683255	30.9000	2.88000e+10	1.90000e+10	2	8
252	2.72641	0.731144	30.9000	2.88000e+10	1.90000e+10	2	7
253	2.06574	0.442714	29.8000	2.88000e+10	1.90000e+10	1	3
254	2.18156	0.473949	29.8000	2.88000e+10	1.90000e+10	1	2
255	2.28221	0.510530	29.8000	2.88000e+10	1.90000e+10	1	1
256	2.20815	0.557208	29.8000	2.88000e+10	1.90000e+10	1	6
257	2.11165	0.523511	29.8000	2.88000e+10	1.90000e+10	1	5
258	2.00328	0.495063	29.8000	2.88000e+10	1.90000e+10	1	4
259	1.95521	0.550038	29.8000	2.88000e+10	1.90000e+10	1	9
260	2.05756	0.574942	29.8000	2.88000e+10	1.90000e+10	1	8
261	2.15083	0.605057	29.8000	2.88000e+10	1.90000e+10	1	7
262	2.35619	0.546225	30.9000	2.88000e+10	1.90000e+10	2	3
263	2.42391	0.584659	30.9000	2.88000e+10	1.90000e+10	2	2
264	2.48328	0.625316	30.9000	2.88000e+10	1.90000e+10	2	1
265	2.41498	0.658789	30.9000	2.88000e+10	1.90000e+10	2	6
266	2.35457	0.620144	30.9000	2.88000e+10	1.90000e+10	2	5
267	2.28667	0.583886	30.9000	2.88000e+10	1.90000e+10	2	4
268	2.22737	0.624603	30.9000	2.88000e+10	1.90000e+10	2	9
269	2.29582	0.658008	30.9000	2.88000e+10	1.90000e+10	2	8
270	2.35766	0.694006	30.9000	2.88000e+10	1.90000e+10	2	7
271	1.88836	0.595559	30.9000	2.88000e+10	1.90000e+10	2	3
272	1.97557	0.613863	30.9000	2.88000e+10	1.90000e+10	2	2

273	2.05736	0.636286	30.9000	2.88000e+10	1.90000e+10	2	1
274	2.01824	0.683375	30.9000	2.88000e+10	1.90000e+10	2	6
275	1.94070	0.661956	30.9000	2.88000e+10	1.90000e+10	2	5
276	1.85864	0.644457	30.9000	2.88000e+10	1.90000e+10	2	4
277	1.83524	0.695258	30.9000	2.88000e+10	1.90000e+10	2	9
278	1.91347	0.710594	30.9000	2.88000e+10	1.90000e+10	2	8
279	1.98815	0.729749	30.9000	2.88000e+10	1.90000e+10	2	7
280	2.13429	0.643966	30.9000	2.88000e+10	1.90000e+10	1	3
281	2.20594	0.673459	30.9000	2.88000e+10	1.90000e+10	1	2
282	2.27152	0.705888	30.9000	2.88000e+10	1.90000e+10	1	1
283	2.22138	0.746918	30.9000	2.88000e+10	1.90000e+10	1	6
284	2.15730	0.715916	30.9000	2.88000e+10	1.90000e+10	1	5
285	2.08796	0.687834	30.9000	2.88000e+10	1.90000e+10	1	4
286	2.04898	0.734149	30.9000	2.88000e+10	1.90000e+10	1	9
287	2.11712	0.759641	30.9000	2.88000e+10	1.90000e+10	1	8
288	2.18080	0.788125	30.9000	2.88000e+10	1.90000e+10	1	7
289	-0.785406	0.0424050	29.8000	2.88000e+10	1.90000e+10	2	7
290	-0.321272	0.0948151	29.8000	2.88000e+10	1.90000e+10	2	8
291	-0.196681	0.152891	29.8000	2.88000e+10	1.90000e+10	2	9
292	-0.541607	0.174724	29.8000	2.88000e+10	1.90000e+10	2	4
293	-0.787808	0.127114	29.8000	2.88000e+10	1.90000e+10	2	5
294	-1.25314	0.0948158	29.8000	2.88000e+10	1.90000e+10	2	6
295	-1.37633	0.152934	29.8000	2.88000e+10	1.90000e+10	2	1
296	-1.03110	0.174650	29.8000	2.88000e+10	1.90000e+10	2	2
297	-0.783951	0.211746	29.8000	2.88000e+10	1.90000e+10	2	3
298	-0.142945	0.212004	29.8000	2.88000e+10	1.90000e+10	1	7
299	-0.111102	0.271495	29.8000	2.88000e+10	1.90000e+10	1	8
300	-0.0906625	0.331160	29.8000	2.88000e+10	1.90000e+10	1	9
301	-0.269767	0.341655	29.8000	2.88000e+10	1.90000e+10	1	4
302	-0.326748	0.284286	29.8000	2.88000e+10	1.90000e+10	1	5
303	-0.411855	0.228280	29.8000	2.88000e+10	1.90000e+10	1	6
304	-0.628728	0.258100	29.8000	2.88000e+10	1.90000e+10	1	1
305	-0.512405	0.308580	29.8000	2.88000e+10	1.90000e+10	1	2
306	-0.429338	0.362005	29.8000	2.88000e+10	1.90000e+10	1	3
307	-0.0787531	0.390908	29.8000	2.88000e+10	1.90000e+10	2	7
308	-0.0679287	0.450715	29.8000	2.88000e+10	1.90000e+10	2	8
309	-0.0596037	0.510562	29.8000	2.88000e+10	1.90000e+10	2	9
310	-0.180878	0.517302	29.8000	2.88000e+10	1.90000e+10	2	4
311	-0.205244	0.458425	29.8000	2.88000e+10	1.90000e+10	2	5
312	-0.236625	0.399888	29.8000	2.88000e+10	1.90000e+10	2	6
313	-0.380715	0.417812	29.8000	2.88000e+10	1.90000e+10	2	1
314	-0.331903	0.473981	29.8000	2.88000e+10	1.90000e+10	2	2
315	-0.293329	0.531010	29.8000	2.88000e+10	1.90000e+10	2	3
316	-0.0492179	0.566705	30.9000	2.88000e+10	1.90000e+10	1	7
317	-0.0447429	0.619483	30.9000	2.88000e+10	1.90000e+10	1	8
318	-0.0409498	0.672270	30.9000	2.88000e+10	1.90000e+10	1	9
319	-0.125369	0.676176	30.9000	2.88000e+10	1.90000e+10	1	4
320	-0.136674	0.623783	30.9000	2.88000e+10	1.90000e+10	1	5
321	-0.149978	0.571479	30.9000	2.88000e+10	1.90000e+10	1	6
322	-0.245197	0.581463	30.9000	2.88000e+10	1.90000e+10	1	1
323	-0.223519	0.632834	30.9000	2.88000e+10	1.90000e+10	1	2
324	-0.205002	0.684442	30.9000	2.88000e+10	1.90000e+10	1	3
325	-0.0352268	0.721830	32.0000	2.88000e+10	1.90000e+10	2	7
326	-0.0328685	0.768354	32.0000	2.88000e+10	1.90000e+10	2	8
327	-0.0307668	0.814882	32.0000	2.88000e+10	1.90000e+10	2	9
328	-0.0945856	0.817332	32.0000	2.88000e+10	1.90000e+10	2	4
329	-0.100893	0.770998	32.0000	2.88000e+10	1.90000e+10	2	5
330	-0.107963	0.724695	32.0000	2.88000e+10	1.90000e+10	2	6
331	-0.177323	0.730911	32.0000	2.88000e+10	1.90000e+10	2	1
332	-0.165613	0.776768	32.0000	2.88000e+10	1.90000e+10	2	2
333	-0.155146	0.822711	32.0000	2.88000e+10	1.90000e+10	2	3
334	-1.42785	0.212004	29.8000	2.88000e+10	1.90000e+10	1	7
335	-1.16261	0.228279	29.8000	2.88000e+10	1.90000e+10	1	8
336	-0.945236	0.257921	29.8000	2.88000e+10	1.90000e+10	1	9
337	-1.06108	0.308495	29.8000	2.88000e+10	1.90000e+10	1	4
338	-1.24893	0.283945	29.8000	2.88000e+10	1.90000e+10	1	5
339	-1.46307	0.270851	29.8000	2.88000e+10	1.90000e+10	1	6
340	-1.48292	0.330535	29.8000	2.88000e+10	1.90000e+10	1	1
341	-1.30338	0.340878	29.8000	2.88000e+10	1.90000e+10	1	2
342	-1.13907	0.361202	29.8000	2.88000e+10	1.90000e+10	1	3
343	-1.49204	0.390908	29.8000	2.88000e+10	1.90000e+10	2	7
344	-1.33796	0.399887	29.8000	2.88000e+10	1.90000e+10	2	8
345	-1.19367	0.417599	29.8000	2.88000e+10	1.90000e+10	2	9
346	-1.24206	0.473840	29.8000	2.88000e+10	1.90000e+10	2	4
347	-1.37077	0.457742	29.8000	2.88000e+10	1.90000e+10	2	5
348	-1.50640	0.449412	29.8000	2.88000e+10	1.90000e+10	2	6
349	-1.51431	0.509272	29.8000	2.88000e+10	1.90000e+10	2	1
350	-1.39270	0.515836	29.8000	2.88000e+10	1.90000e+10	2	2
351	-1.27564	0.529461	29.8000	2.88000e+10	1.90000e+10	2	3
352	-1.52158	0.566705	30.9000	2.88000e+10	1.90000e+10	1	7

353	-1.42390	0.571479	30.9000	2.88000e+10	1.90000e+10	1	8
354	-1.32861	0.581304	30.9000	2.88000e+10	1.90000e+10	1	9
355	-1.35003	0.632711	30.9000	2.88000e+10	1.90000e+10	1	4
356	-1.43847	0.622985	30.9000	2.88000e+10	1.90000e+10	1	5
357	-1.52895	0.617941	30.9000	2.88000e+10	1.90000e+10	1	6
358	-1.53251	0.670735	30.9000	2.88000e+10	1.90000e+10	1	1
359	-1.44790	0.674507	30.9000	2.88000e+10	1.90000e+10	1	2
360	-1.36472	0.682684	30.9000	2.88000e+10	1.90000e+10	1	3
361	-1.53557	0.721830	32.0000	2.88000e+10	1.90000e+10	2	7
362	-1.46536	0.724695	32.0000	2.88000e+10	1.90000e+10	2	8
363	-1.39597	0.730795	32.0000	2.88000e+10	1.90000e+10	2	9
364	-1.40752	0.776671	32.0000	2.88000e+10	1.90000e+10	2	4
365	-1.47351	0.770188	32.0000	2.88000e+10	1.90000e+10	2	5
366	-1.54031	0.766779	32.0000	2.88000e+10	1.90000e+10	2	6
367	-1.54227	0.813310	32.0000	2.88000e+10	1.90000e+10	2	1
368	-1.47834	0.815659	32.0000	2.88000e+10	1.90000e+10	2	2
369	-1.41498	0.820961	32.0000	2.88000e+10	1.90000e+10	2	3
370	-0.785398	0.296837	29.8000	2.88000e+10	1.90000e+10	2	7
371	-0.658623	0.341805	29.8000	2.88000e+10	1.90000e+10	2	8
372	-0.562199	0.390890	29.8000	2.88000e+10	1.90000e+10	2	9
373	-0.685296	0.425734	29.8000	2.88000e+10	1.90000e+10	2	4
374	-0.787463	0.381083	29.8000	2.88000e+10	1.90000e+10	2	5
375	-0.914687	0.341291	29.8000	2.88000e+10	1.90000e+10	2	6
376	-1.01090	0.390460	29.8000	2.88000e+10	1.90000e+10	2	1
377	-0.887474	0.425199	29.8000	2.88000e+10	1.90000e+10	2	2
378	-0.783692	0.465250	29.8000	2.88000e+10	1.90000e+10	2	3
379	-0.494946	0.442714	29.8000	2.88000e+10	1.90000e+10	1	7
380	-0.435120	0.496251	29.8000	2.88000e+10	1.90000e+10	1	8
381	-0.386859	0.551164	29.8000	2.88000e+10	1.90000e+10	1	9
382	-0.488911	0.576194	29.8000	2.88000e+10	1.90000e+10	1	4
383	-0.545207	0.523922	29.8000	2.88000e+10	1.90000e+10	1	5
384	-0.613411	0.473574	29.8000	2.88000e+10	1.90000e+10	1	6
385	-0.713920	0.510277	29.8000	2.88000e+10	1.90000e+10	1	1
386	-0.639598	0.556866	29.8000	2.88000e+10	1.90000e+10	1	2
387	-0.576744	0.605928	29.8000	2.88000e+10	1.90000e+10	1	3
388	-0.317565	0.595559	30.9000	2.88000e+10	1.90000e+10	2	7
389	-0.290166	0.645938	30.9000	2.88000e+10	1.90000e+10	2	8
390	-0.266616	0.696707	30.9000	2.88000e+10	1.90000e+10	2	9
391	-0.344659	0.712147	30.9000	2.88000e+10	1.90000e+10	2	4
392	-0.373669	0.662616	30.9000	2.88000e+10	1.90000e+10	2	5
393	-0.407151	0.613684	30.9000	2.88000e+10	1.90000e+10	2	6
394	-0.488861	0.636219	30.9000	2.88000e+10	1.90000e+10	2	1
395	-0.449566	0.683255	30.9000	2.88000e+10	1.90000e+10	2	2
396	-0.415187	0.731144	30.9000	2.88000e+10	1.90000e+10	2	3
397	-1.07585	0.442714	29.8000	2.88000e+10	1.90000e+10	1	7
398	-0.960032	0.473949	29.8000	2.88000e+10	1.90000e+10	1	8
399	-0.859382	0.510530	29.8000	2.88000e+10	1.90000e+10	1	9
400	-0.933447	0.557208	29.8000	2.88000e+10	1.90000e+10	1	4
401	-1.02995	0.523511	29.8000	2.88000e+10	1.90000e+10	1	5
402	-1.13831	0.495063	29.8000	2.88000e+10	1.90000e+10	1	6
403	-1.18638	0.550038	29.8000	2.88000e+10	1.90000e+10	1	1
404	-1.08403	0.574942	29.8000	2.88000e+10	1.90000e+10	1	2
405	-0.990767	0.605057	29.8000	2.88000e+10	1.90000e+10	1	3
406	-0.785398	0.546225	30.9000	2.88000e+10	1.90000e+10	2	7
407	-0.717684	0.584659	30.9000	2.88000e+10	1.90000e+10	2	8
408	-0.658315	0.625316	30.9000	2.88000e+10	1.90000e+10	2	9
409	-0.726611	0.658789	30.9000	2.88000e+10	1.90000e+10	2	4
410	-0.787020	0.620144	30.9000	2.88000e+10	1.90000e+10	2	5
411	-0.854923	0.583886	30.9000	2.88000e+10	1.90000e+10	2	6
412	-0.914227	0.624603	30.9000	2.88000e+10	1.90000e+10	2	1
413	-0.845770	0.658008	30.9000	2.88000e+10	1.90000e+10	2	2
414	-0.783930	0.694006	30.9000	2.88000e+10	1.90000e+10	2	3
415	-1.25323	0.595559	30.9000	2.88000e+10	1.90000e+10	2	7
416	-1.16602	0.613863	30.9000	2.88000e+10	1.90000e+10	2	8
417	-1.08424	0.636286	30.9000	2.88000e+10	1.90000e+10	2	9
418	-1.12336	0.683375	30.9000	2.88000e+10	1.90000e+10	2	4
419	-1.20090	0.661956	30.9000	2.88000e+10	1.90000e+10	2	5
420	-1.28295	0.644457	30.9000	2.88000e+10	1.90000e+10	2	6
421	-1.30636	0.695258	30.9000	2.88000e+10	1.90000e+10	2	1
422	-1.22813	0.710594	30.9000	2.88000e+10	1.90000e+10	2	2
423	-1.15345	0.729749	30.9000	2.88000e+10	1.90000e+10	2	3
424	-1.00730	0.643966	30.9000	2.88000e+10	1.90000e+10	1	7
425	-0.935656	0.673459	30.9000	2.88000e+10	1.90000e+10	1	8
426	-0.870074	0.705888	30.9000	2.88000e+10	1.90000e+10	1	9
427	-0.920217	0.746918	30.9000	2.88000e+10	1.90000e+10	1	4
428	-0.984292	0.715916	30.9000	2.88000e+10	1.90000e+10	1	5
429	-1.05363	0.687834	30.9000	2.88000e+10	1.90000e+10	1	6
430	-1.09262	0.734149	30.9000	2.88000e+10	1.90000e+10	1	1
431	-1.02448	0.759641	30.9000	2.88000e+10	1.90000e+10	1	2
432	-0.960791	0.788125	30.9000	2.88000e+10	1.90000e+10	1	3

433	-2.35619	0.0424050	29.8000	2.88000e+10	1.90000e+10	1	9
434	-2.82032	0.0948151	29.8000	2.88000e+10	1.90000e+10	1	8
435	-2.94491	0.152891	29.8000	2.88000e+10	1.90000e+10	1	7
436	-2.59999	0.174724	29.8000	2.88000e+10	1.90000e+10	1	6
437	-2.35379	0.127114	29.8000	2.88000e+10	1.90000e+10	1	5
438	-1.88845	0.0948158	29.8000	2.88000e+10	1.90000e+10	1	4
439	-1.76526	0.152934	29.8000	2.88000e+10	1.90000e+10	1	3
440	-2.11049	0.174650	29.8000	2.88000e+10	1.90000e+10	1	2
441	-2.35764	0.211746	29.8000	2.88000e+10	1.90000e+10	1	1
442	-2.99865	0.212004	29.8000	2.88000e+10	1.90000e+10	2	9
443	-3.03049	0.271495	29.8000	2.88000e+10	1.90000e+10	2	8
444	-3.05093	0.331160	29.8000	2.88000e+10	1.90000e+10	2	7
445	-2.87183	0.341655	29.8000	2.88000e+10	1.90000e+10	2	6
446	-2.81484	0.284286	29.8000	2.88000e+10	1.90000e+10	2	5
447	-2.72974	0.228280	29.8000	2.88000e+10	1.90000e+10	2	4
448	-2.51286	0.258100	29.8000	2.88000e+10	1.90000e+10	2	3
449	-2.62919	0.308580	29.8000	2.88000e+10	1.90000e+10	2	2
450	-2.71225	0.362005	29.8000	2.88000e+10	1.90000e+10	2	1
451	-3.06284	0.390908	29.8000	2.88000e+10	1.90000e+10	1	9
452	-3.07366	0.450715	29.8000	2.88000e+10	1.90000e+10	1	8
453	-3.08199	0.510562	29.8000	2.88000e+10	1.90000e+10	1	7
454	-2.96071	0.517302	29.8000	2.88000e+10	1.90000e+10	1	6
455	-2.93635	0.458425	29.8000	2.88000e+10	1.90000e+10	1	5
456	-2.90497	0.399888	29.8000	2.88000e+10	1.90000e+10	1	4
457	-2.76088	0.417812	29.8000	2.88000e+10	1.90000e+10	1	3
458	-2.80969	0.473981	29.8000	2.88000e+10	1.90000e+10	1	2
459	-2.84826	0.531010	29.8000	2.88000e+10	1.90000e+10	1	1
460	-3.09237	0.566705	30.9000	2.88000e+10	1.90000e+10	2	9
461	-3.09685	0.619483	30.9000	2.88000e+10	1.90000e+10	2	8
462	-3.10064	0.672270	30.9000	2.88000e+10	1.90000e+10	2	7
463	-3.01622	0.676176	30.9000	2.88000e+10	1.90000e+10	2	6
464	-3.00492	0.623783	30.9000	2.88000e+10	1.90000e+10	2	5
465	-2.99161	0.571479	30.9000	2.88000e+10	1.90000e+10	2	4
466	-2.89640	0.581463	30.9000	2.88000e+10	1.90000e+10	2	3
467	-2.91807	0.632834	30.9000	2.88000e+10	1.90000e+10	2	2
468	-2.93659	0.684442	30.9000	2.88000e+10	1.90000e+10	2	1
469	-3.10637	0.721830	32.0000	2.88000e+10	1.90000e+10	1	9
470	-3.10872	0.768354	32.0000	2.88000e+10	1.90000e+10	1	8
471	-3.11083	0.814882	32.0000	2.88000e+10	1.90000e+10	1	7
472	-3.04701	0.817332	32.0000	2.88000e+10	1.90000e+10	1	6
473	-3.04070	0.770998	32.0000	2.88000e+10	1.90000e+10	1	5
474	-3.03363	0.724695	32.0000	2.88000e+10	1.90000e+10	1	4
475	-2.96427	0.730911	32.0000	2.88000e+10	1.90000e+10	1	3
476	-2.97598	0.776768	32.0000	2.88000e+10	1.90000e+10	1	2
477	-2.98645	0.822711	32.0000	2.88000e+10	1.90000e+10	1	1
478	-1.71374	0.212004	29.8000	2.88000e+10	1.90000e+10	2	9
479	-1.97898	0.228279	29.8000	2.88000e+10	1.90000e+10	2	8
480	-2.19636	0.257921	29.8000	2.88000e+10	1.90000e+10	2	7
481	-2.08051	0.308495	29.8000	2.88000e+10	1.90000e+10	2	6
482	-1.89266	0.283945	29.8000	2.88000e+10	1.90000e+10	2	5
483	-1.67852	0.270851	29.8000	2.88000e+10	1.90000e+10	2	4
484	-1.65867	0.330535	29.8000	2.88000e+10	1.90000e+10	2	3
485	-1.83821	0.340878	29.8000	2.88000e+10	1.90000e+10	2	2
486	-2.00252	0.361202	29.8000	2.88000e+10	1.90000e+10	2	1
487	-1.64955	0.390908	29.8000	2.88000e+10	1.90000e+10	1	9
488	-1.80363	0.399887	29.8000	2.88000e+10	1.90000e+10	1	8
489	-1.94792	0.417599	29.8000	2.88000e+10	1.90000e+10	1	7
490	-1.89953	0.473840	29.8000	2.88000e+10	1.90000e+10	1	6
491	-1.77082	0.457742	29.8000	2.88000e+10	1.90000e+10	1	5
492	-1.63520	0.449412	29.8000	2.88000e+10	1.90000e+10	1	4
493	-1.62728	0.509272	29.8000	2.88000e+10	1.90000e+10	1	3
494	-1.74890	0.515836	29.8000	2.88000e+10	1.90000e+10	1	2
495	-1.86595	0.529461	29.8000	2.88000e+10	1.90000e+10	1	1
496	-1.62001	0.566705	30.9000	2.88000e+10	1.90000e+10	2	9
497	-1.71769	0.571479	30.9000	2.88000e+10	1.90000e+10	2	8
498	-1.81298	0.581304	30.9000	2.88000e+10	1.90000e+10	2	7
499	-1.79156	0.632711	30.9000	2.88000e+10	1.90000e+10	2	6
500	-1.70312	0.622985	30.9000	2.88000e+10	1.90000e+10	2	5
501	-1.61264	0.617941	30.9000	2.88000e+10	1.90000e+10	2	4
502	-1.60909	0.670735	30.9000	2.88000e+10	1.90000e+10	2	3
503	-1.69369	0.674507	30.9000	2.88000e+10	1.90000e+10	2	2
504	-1.77687	0.682684	30.9000	2.88000e+10	1.90000e+10	2	1
505	-1.60602	0.721830	32.0000	2.88000e+10	1.90000e+10	1	9
506	-1.67624	0.724695	32.0000	2.88000e+10	1.90000e+10	1	8
507	-1.74562	0.730795	32.0000	2.88000e+10	1.90000e+10	1	7
508	-1.73407	0.776671	32.0000	2.88000e+10	1.90000e+10	1	6
509	-1.66808	0.770188	32.0000	2.88000e+10	1.90000e+10	1	5
510	-1.60128	0.766779	32.0000	2.88000e+10	1.90000e+10	1	4
511	-1.59933	0.813310	32.0000	2.88000e+10	1.90000e+10	1	3
512	-1.66325	0.815659	32.0000	2.88000e+10	1.90000e+10	1	2

513	-1.72661	0.820961	32.0000	2.88000e+10	1.90000e+10	1	1
514	-2.35619	0.296837	29.8000	2.88000e+10	1.90000e+10	1	9
515	-2.48297	0.341805	29.8000	2.88000e+10	1.90000e+10	1	8
516	-2.57939	0.390890	29.8000	2.88000e+10	1.90000e+10	1	7
517	-2.45630	0.425734	29.8000	2.88000e+10	1.90000e+10	1	6
518	-2.35413	0.381083	29.8000	2.88000e+10	1.90000e+10	1	5
519	-2.22691	0.341291	29.8000	2.88000e+10	1.90000e+10	1	4
520	-2.13070	0.390460	29.8000	2.88000e+10	1.90000e+10	1	3
521	-2.25412	0.425199	29.8000	2.88000e+10	1.90000e+10	1	2
522	-2.35790	0.465250	29.8000	2.88000e+10	1.90000e+10	1	1
523	-2.64665	0.442714	29.8000	2.88000e+10	1.90000e+10	2	9
524	-2.70647	0.496251	29.8000	2.88000e+10	1.90000e+10	2	8
525	-2.75473	0.551164	29.8000	2.88000e+10	1.90000e+10	2	7
526	-2.65268	0.576194	29.8000	2.88000e+10	1.90000e+10	2	6
527	-2.59639	0.523922	29.8000	2.88000e+10	1.90000e+10	2	5
528	-2.52818	0.473574	29.8000	2.88000e+10	1.90000e+10	2	4
529	-2.42767	0.510277	29.8000	2.88000e+10	1.90000e+10	2	3
530	-2.50199	0.556866	29.8000	2.88000e+10	1.90000e+10	2	2
531	-2.56485	0.605928	29.8000	2.88000e+10	1.90000e+10	2	1
532	-2.82403	0.595559	30.9000	2.88000e+10	1.90000e+10	1	9
533	-2.85143	0.645938	30.9000	2.88000e+10	1.90000e+10	1	8
534	-2.87498	0.696707	30.9000	2.88000e+10	1.90000e+10	1	7
535	-2.79693	0.712147	30.9000	2.88000e+10	1.90000e+10	1	6
536	-2.76792	0.662616	30.9000	2.88000e+10	1.90000e+10	1	5
537	-2.73444	0.613684	30.9000	2.88000e+10	1.90000e+10	1	4
538	-2.65273	0.636219	30.9000	2.88000e+10	1.90000e+10	1	3
539	-2.69203	0.683255	30.9000	2.88000e+10	1.90000e+10	1	2
540	-2.72641	0.731144	30.9000	2.88000e+10	1.90000e+10	1	1
541	-2.06574	0.442714	29.8000	2.88000e+10	1.90000e+10	2	9
542	-2.18156	0.473949	29.8000	2.88000e+10	1.90000e+10	2	8
543	-2.28221	0.510530	29.8000	2.88000e+10	1.90000e+10	2	7
544	-2.20815	0.557208	29.8000	2.88000e+10	1.90000e+10	2	6
545	-2.11165	0.523511	29.8000	2.88000e+10	1.90000e+10	2	5
546	-2.00328	0.495063	29.8000	2.88000e+10	1.90000e+10	2	4
547	-1.95521	0.550038	29.8000	2.88000e+10	1.90000e+10	2	3
548	-2.05756	0.574942	29.8000	2.88000e+10	1.90000e+10	2	2
549	-2.15083	0.605057	29.8000	2.88000e+10	1.90000e+10	2	1
550	-2.35619	0.546225	30.9000	2.88000e+10	1.90000e+10	1	9
551	-2.42391	0.584659	30.9000	2.88000e+10	1.90000e+10	1	8
552	-2.48328	0.625316	30.9000	2.88000e+10	1.90000e+10	1	7
553	-2.41498	0.658789	30.9000	2.88000e+10	1.90000e+10	1	6
554	-2.35457	0.620144	30.9000	2.88000e+10	1.90000e+10	1	5
555	-2.28667	0.583886	30.9000	2.88000e+10	1.90000e+10	1	4
556	-2.22737	0.624603	30.9000	2.88000e+10	1.90000e+10	1	3
557	-2.29582	0.658008	30.9000	2.88000e+10	1.90000e+10	1	2
558	-2.35766	0.694006	30.9000	2.88000e+10	1.90000e+10	1	1
559	-1.88836	0.595559	30.9000	2.88000e+10	1.90000e+10	1	9
560	-1.97557	0.613863	30.9000	2.88000e+10	1.90000e+10	1	8
561	-2.05736	0.636286	30.9000	2.88000e+10	1.90000e+10	1	7
562	-2.01824	0.683375	30.9000	2.88000e+10	1.90000e+10	1	6
563	-1.94070	0.661956	30.9000	2.88000e+10	1.90000e+10	1	5
564	-1.85864	0.644457	30.9000	2.88000e+10	1.90000e+10	1	4
565	-1.83524	0.695258	30.9000	2.88000e+10	1.90000e+10	1	3
566	-1.91347	0.710594	30.9000	2.88000e+10	1.90000e+10	1	2
567	-1.98815	0.729749	30.9000	2.88000e+10	1.90000e+10	1	1
568	-2.13429	0.643966	30.9000	2.88000e+10	1.90000e+10	2	9
569	-2.20594	0.673459	30.9000	2.88000e+10	1.90000e+10	2	8
570	-2.27152	0.705888	30.9000	2.88000e+10	1.90000e+10	2	7
571	-2.22138	0.746918	30.9000	2.88000e+10	1.90000e+10	2	6
572	-2.15730	0.715916	30.9000	2.88000e+10	1.90000e+10	2	5
573	-2.08796	0.687834	30.9000	2.88000e+10	1.90000e+10	2	4
574	-2.04898	0.734149	30.9000	2.88000e+10	1.90000e+10	2	3
575	-2.11712	0.759641	30.9000	2.88000e+10	1.90000e+10	2	2
576	-2.18080	0.788125	30.9000	2.88000e+10	1.90000e+10	2	1

Appendix A4: GEO(9) Sample Input File

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**********************************************************
GEO(9)
**********************************************************
9       number of sats
64      number of beams per sat
3       number of scan positions per beam
0       beam coordinate system [0=lon/lat, 1=relative Az/El]
1       channels per beam
2       number of polarizations
125.e6  bandwidth per channel (Hz)
130.e6  channel capacity (bits/sec)
5000.   comms power
_________________________________________________________
Inter-Satellite Links
0       Number of ISL per satellite
___________________________________________________________
Misc
beam.dat
____________________________________________________
Downlink
56.     power per channel (W)
81.1    Data Rate (dBHz)
6.0     Eb/No required (dB)
44.6    Gain Receiver (dB)
27.3    System Temperature (dBK) (clear sky)
-0.5    Circuit Losses (dB)
-1.0    Atmospheric Losses (dB)
___________________________________________________________
Uplink
2.0     Power per user (W)
58.9    Data Rate (dBHz)
5.5     Eb/No required (dB)
44.6    Gain Transmitter (dB)
27.8    System Temperature (dBK)
___________________________________________________________
Satellite Number        1 -USA1
Sat    Beam    Longitude     Latitude    Gain         Up Freq    Down Freq   Polar    Scan
1       1     -93.9077      14.3359     43.4000  2.97500e+10  1.99500e+10      1       1
1       2     -93.8516      18.6441     43.4000  2.95000e+10  1.97000e+10      1       1
1       3     -93.6685      27.8719     43.4000  2.95000e+10  1.97000e+10      1       1
1       4     -93.5224      32.9603     43.4000  2.97500e+10  1.99500e+10      1       1
1       5     -93.5224      32.9603     43.4000  2.97500e+10  1.99500e+10      1       2
1       6     -93.3132      38.5516     43.4000  2.95000e+10  1.97000e+10      1       1
1       7     -93.3132      38.5516     43.4000  2.95000e+10  1.97000e+10      1       2
1       8     -92.9921      44.9144     43.4000  2.97500e+10  1.99500e+10      1       1
1       9     -92.9921      44.9144     43.4000  2.97500e+10  1.99500e+10      1       2
1      10     -92.4270      52.6163     43.4000  2.95000e+10  1.97000e+10      1       1
1      11     -91.0064      63.4581     43.4000  2.97500e+10  1.99500e+10      1       1
1      12     -77.3437      2.03563     43.4000  2.95000e+10  1.97000e+10      1       1
1      13     -72.8515      2.04676     43.4000  2.96250e+10  1.98250e+10      1       1
1      14     -68.1085      2.06088     43.4000  2.95000e+10  1.97000e+10      1       1
1      15     -63.0153      2.07860     43.4000  2.96250e+10  1.98250e+10      1       1
1      16     -57.4177      2.10093     43.4000  2.95000e+10  1.97000e+10      1       1
1      17     -51.0461      2.12963     43.4000  2.96250e+10  1.98250e+10      1       1
1      18     -89.7050      14.3511     43.4000  2.98750e+10  2.00750e+10      1       1
1      19     -89.5348      18.6648     43.4000  2.96250e+10  1.98250e+10      1       1
1      20     -89.3002      23.1603     43.4000  2.98750e+10  2.00750e+10      1       1
1      21     -88.5350      33.0078     43.4000  2.98750e+10  2.00750e+10      1       1
1      22     -88.5350      33.0078     43.4000  2.98750e+10  2.00750e+10      1       2
1      23     -88.5350      33.0078     43.4000  2.98750e+10  2.00750e+10      1       3
1      24     -87.8968      38.6163     43.4000  2.96250e+10  1.98250e+10      1       1
1      25     -87.8968      38.6163     43.4000  2.96250e+10  1.98250e+10      1       2
1      26     -86.9127      45.0081     43.4000  2.98750e+10  2.00750e+10      1       1
1      27     -86.9127      45.0081     43.4000  2.98750e+10  2.00750e+10      1       2
1      28     -85.1632      52.7714     43.4000  2.96250e+10  1.98250e+10      1       1
1      29     -80.5936      63.8501     43.4000  2.98750e+10  2.00750e+10      1       1
1      30     -85.6481      10.1870     43.4000  2.95000e+10  1.97000e+10      1       1
1      31     -85.4464      14.3818     43.4000  2.97500e+10  1.99500e+10      1       1
1      32     -85.1569      18.7069     43.4000  2.95000e+10  1.97000e+10      1       1
1      33     -84.7571      23.2160     43.4000  2.97500e+10  1.99500e+10      1       1
1      34     -84.2091      27.9810     43.4000  2.95000e+10  1.97000e+10      1       1
1      35     -84.2091      27.9810     43.4000  2.95000e+10  1.97000e+10      1       2
1      36     -83.4473      33.1048     43.4000  2.97500e+10  1.99500e+10      1       1
1      37     -83.4473      33.1048     43.4000  2.97500e+10  1.99500e+10      1       2
1      38     -83.4473      33.1048     43.4000  2.97500e+10  1.99500e+10      1       3
1      39     -82.3467      38.7491     43.4000  2.95000e+10  1.97000e+10      1       1
```

1	40	-82.3467	38.7491	43.4000	2.95000e+10	1.97000e+10	1	2
1	41	-82.3467	38.7491	43.4000	2.95000e+10	1.97000e+10	1	3
1	42	-80.6319	45.2020	43.4000	2.97500e+10	1.99500e+10	1	1
1	43	-80.6319	45.2020	43.4000	2.97500e+10	1.99500e+10	1	2
1	44	-77.5123	53.0989	43.4000	2.95000e+10	1.97000e+10	1	1
1	45	-68.5231	64.7719	43.4000	2.97500e+10	1.99500e+10	1	1
1	46	-81.3812	10.2193	43.4000	2.96250e+10	1.98250e+10	1	1
1	47	-81.0902	14.4291	43.4000	2.98750e+10	2.00750e+10	1	1
1	48	-80.6719	18.7715	43.4000	2.96250e+10	1.98250e+10	1	1
1	49	-80.0925	23.3018	43.4000	2.98750e+10	2.00750e+10	1	1
1	50	-79.2952	28.0941	43.4000	2.96250e+10	1.98250e+10	1	1
1	51	-79.2952	28.0941	43.4000	2.96250e+10	1.98250e+10	1	2
1	52	-78.1801	33.2557	43.4000	2.98750e+10	2.00750e+10	1	1
1	53	-78.1801	33.2557	43.4000	2.98750e+10	2.00750e+10	1	2
1	54	-76.5531	38.9573	43.4000	2.96250e+10	1.98250e+10	1	1
1	55	-76.5531	38.9573	43.4000	2.96250e+10	1.98250e+10	1	2
1	56	-76.5531	38.9573	43.4000	2.96250e+10	1.98250e+10	1	3
1	57	-73.9724	45.5111	43.4000	2.98750e+10	2.00750e+10	1	1
1	58	-73.9724	45.5111	43.4000	2.98750e+10	2.00750e+10	1	2
1	59	-73.9724	45.5111	43.4000	2.98750e+10	2.00750e+10	1	3
1	60	-69.0740	53.6434	43.4000	2.96250e+10	1.98250e+10	1	1
1	61	-50.4097	66.9238	43.4000	2.98750e+10	2.00750e+10	1	1
1	62	-77.2241	6.12380	43.4000	2.97500e+10	1.99500e+10	1	1
1	63	-76.9773	10.2638	43.4000	2.95000e+10	1.97000e+10	1	1
1	64	-76.5871	14.4944	43.4000	2.97500e+10	1.99500e+10	1	1
1	65	-76.0247	18.8609	43.4000	2.95000e+10	1.97000e+10	1	1
1	66	-75.2425	23.4209	43.4000	2.97500e+10	1.99500e+10	1	1
1	67	-66.6653	45.9648	43.4000	2.97500e+10	1.99500e+10	1	1
1	68	-66.6653	45.9648	43.4000	2.97500e+10	1.99500e+10	1	2
1	69	-59.0505	54.5124	43.4000	2.95000e+10	1.97000e+10	1	1
1	70	-72.6974	6.15768	43.4000	2.98750e+10	2.00750e+10	1	1
1	71	-72.3791	10.3221	43.4000	2.96250e+10	1.98250e+10	1	1
1	72	-71.8745	14.5799	43.4000	2.98750e+10	2.00750e+10	1	1
1	73	-71.1445	18.9785	43.4000	2.96250e+10	1.98250e+10	1	1
1	74	-70.1231	23.5783	43.4000	2.98750e+10	2.00750e+10	1	1
1	75	-58.2123	46.6242	43.4000	2.98750e+10	2.00750e+10	1	1
1	76	-58.2123	46.6242	43.4000	2.98750e+10	2.00750e+10	1	2
1	77	-67.9134	6.20072	43.4000	2.97500e+10	1.99500e+10	1	1
1	78	-67.5097	10.3962	43.4000	2.95000e+10	1.97000e+10	1	1
1	79	-66.8674	14.6890	43.4000	2.97500e+10	1.99500e+10	1	1
1	80	-65.9328	19.1294	43.4000	2.95000e+10	1.97000e+10	1	1
1	81	-60.0127	34.1375	43.4000	2.97500e+10	1.99500e+10	1	1
1	82	-62.7690	6.25483	43.4000	2.98750e+10	2.00750e+10	1	1
1	83	-62.2579	10.4896	43.4000	2.96250e+10	1.98250e+10	1	1
1	84	-61.4403	14.8274	43.4000	2.98750e+10	2.00750e+10	1	1
1	85	-57.1030	6.32314	43.4000	2.97500e+10	1.99500e+10	1	1
1	86	-81.6550	-2.02710	43.4000	2.98750e+10	2.00750e+10	1	1
1	87	-77.3437	-2.03563	43.4000	2.97500e+10	1.99500e+10	1	1
1	88	-72.8515	-2.04676	43.4000	2.98750e+10	2.00750e+10	1	1
1	89	-68.1085	-2.06087	43.4000	2.97500e+10	1.99500e+10	1	1
1	90	-63.0153	-2.07860	43.4000	2.98750e+10	2.00750e+10	1	1
1	91	-57.4177	-2.10093	43.4000	2.97500e+10	1.99500e+10	1	1
1	92	-51.0461	-2.12963	43.4000	2.98750e+10	2.00750e+10	1	1
1	93	-43.3299	-2.16844	43.4000	2.97500e+10	1.99500e+10	1	1
1	94	-73.9724	-45.5111	43.4000	2.96250e+10	1.98250e+10	1	1
1	95	-69.0740	-53.6434	43.4000	2.98750e+10	2.00750e+10	1	1
1	96	-77.2241	-6.12380	43.4000	2.95000e+10	1.97000e+10	1	1
1	97	-76.9773	-10.2639	43.4000	2.97500e+10	1.99500e+10	1	1
1	98	-76.5871	-14.4944	43.4000	2.95000e+10	1.97000e+10	1	1
1	99	-72.6312	-33.4679	43.4000	2.95000e+10	1.97000e+10	1	1
1	100	-70.3664	-39.2543	43.4000	2.97500e+10	1.99500e+10	1	1
1	101	-66.6653	-45.9648	43.4000	2.95000e+10	1.97000e+10	1	1
1	102	-72.6974	-6.15768	43.4000	2.96250e+10	1.98250e+10	1	1
1	103	-72.3791	-10.3221	43.4000	2.98750e+10	2.00750e+10	1	1
1	104	-71.8745	-14.5799	43.4000	2.96250e+10	1.98250e+10	1	1
1	105	-71.1445	-18.9785	43.4000	2.98750e+10	2.00750e+10	1	1
1	106	-70.1231	-23.5783	43.4000	2.96250e+10	1.98250e+10	1	1
1	107	-68.6966	-28.4622	43.4000	2.98750e+10	2.00750e+10	1	1
1	108	-66.6543	-33.7544	43.4000	2.96250e+10	1.98250e+10	1	1
1	109	-63.5527	-39.6646	43.4000	2.98750e+10	2.00750e+10	1	1
1	110	-67.9134	-6.20071	43.4000	2.95000e+10	1.97000e+10	1	1
1	111	-67.5097	-10.3962	43.4000	2.97500e+10	1.99500e+10	1	1
1	112	-66.8674	-14.6890	43.4000	2.95000e+10	1.97000e+10	1	1
1	113	-65.9328	-19.1294	43.4000	2.97500e+10	1.99500e+10	1	1
1	114	-64.6139	-23.7821	43.4000	2.95000e+10	1.97000e+10	1	1
1	115	-62.7467	-28.7378	43.4000	2.97500e+10	1.99500e+10	1	1
1	116	-60.0127	-34.1375	43.4000	2.95000e+10	1.97000e+10	1	1
1	117	-62.7690	-6.25483	43.4000	2.96250e+10	1.98250e+10	1	1
1	118	-62.2579	-10.4896	43.4000	2.98750e+10	2.00750e+10	1	1
1	119	-61.4403	-14.8274	43.4000	2.96250e+10	1.98250e+10	1	1

1	120	-60.2403	-19.3223	43.4000	2.98750e+10	2.00750e+10	1	1
1	121	-58.5237	-24.0457	43.4000	2.96250e+10	1.98250e+10	1	1
1	122	-56.0395	-29.1014	43.4000	2.98750e+10	2.00750e+10	1	1
1	123	-57.1030	-6.32314	43.4000	2.95000e+10	1.97000e+10	1	1
1	124	-56.4468	-10.6082	43.4000	2.97500e+10	1.99500e+10	1	1
1	125	-55.3880	-15.0044	43.4000	2.95000e+10	1.97000e+10	1	1
1	126	-53.8119	-19.5721	43.4000	2.97500e+10	1.99500e+10	1	1
1	127	-51.5038	-24.3942	43.4000	2.95000e+10	1.97000e+10	1	1
1	128	-48.0217	-29.6006	43.4000	2.97500e+10	1.99500e+10	1	1
1	129	-50.6300	-6.41126	43.4000	2.96250e+10	1.98250e+10	1	1
1	130	-49.7552	-10.7623	43.4000	2.98750e+10	2.00750e+10	1	1
1	131	-48.3214	-15.2378	43.4000	2.96250e+10	1.98250e+10	1	1
1	132	-46.1274	-19.9096	43.4000	2.98750e+10	2.00750e+10	1	1
1	133	-42.7489	-24.8861	43.4000	2.96250e+10	1.98250e+10	1	1
1	134	-42.7332	-6.53135	43.4000	2.95000e+10	1.97000e+10	1	1
1	135	-41.4547	-10.9760	43.4000	2.97500e+10	1.99500e+10	1	1
1	136	-39.2767	-15.5719	43.4000	2.95000e+10	1.97000e+10	1	1
1	137	-98.1484	18.6441	43.4000	2.96250e+10	1.98250e+10	1	1
1	138	-98.2258	23.1329	43.4000	2.98750e+10	2.00750e+10	1	1
1	139	-98.3315	27.8719	43.4000	2.96250e+10	1.98250e+10	1	1
1	140	-98.3315	27.8719	43.4000	2.96250e+10	1.98250e+10	1	2
1	141	-98.3315	27.8719	43.4000	2.96250e+10	1.98250e+10	1	3
1	142	-98.4776	32.9603	43.4000	2.98750e+10	2.00750e+10	1	1
1	143	-98.4776	32.9603	43.4000	2.98750e+10	2.00750e+10	1	2
1	144	-98.4776	32.9603	43.4000	2.98750e+10	2.00750e+10	1	3
1	145	-98.6868	38.5516	43.4000	2.96250e+10	1.98250e+10	1	1
1	146	-98.6868	38.5516	43.4000	2.96250e+10	1.98250e+10	1	2
1	147	-99.0079	44.9144	43.4000	2.98750e+10	2.00750e+10	1	1
1	148	-99.0079	44.9144	43.4000	2.98750e+10	2.00750e+10	1	2
1	149	-99.5730	52.6163	43.4000	2.96250e+10	1.98250e+10	1	1
1	150	-100.994	63.4581	43.4000	2.98750e+10	2.00750e+10	1	1
1	151	-102.465	18.6648	43.4000	2.95000e+10	1.97000e+10	1	1
1	152	-102.700	23.1603	43.4000	2.97500e+10	1.99500e+10	1	1
1	153	-103.021	27.9079	43.4000	2.95000e+10	1.97000e+10	1	1
1	154	-103.021	27.9079	43.4000	2.95000e+10	1.97000e+10	1	2
1	155	-103.465	33.0078	43.4000	2.97500e+10	1.99500e+10	1	1
1	156	-103.465	33.0078	43.4000	2.97500e+10	1.99500e+10	1	2
1	157	-104.103	38.6163	43.4000	2.95000e+10	1.97000e+10	1	1
1	158	-104.103	38.6163	43.4000	2.95000e+10	1.97000e+10	1	2
1	159	-105.087	45.0081	43.4000	2.97500e+10	1.99500e+10	1	1
1	160	-105.087	45.0081	43.4000	2.97500e+10	1.99500e+10	1	2
1	161	-106.837	52.7714	43.4000	2.95000e+10	1.97000e+10	1	1
1	162	-111.406	63.8501	43.4000	2.97500e+10	1.99500e+10	1	1
1	163	-107.243	23.2160	43.4000	2.98750e+10	2.00750e+10	1	1
1	164	-107.791	27.9810	43.4000	2.96250e+10	1.98250e+10	1	1
1	165	-108.553	33.1048	43.4000	2.98750e+10	2.00750e+10	1	1
1	166	-108.553	33.1048	43.4000	2.98750e+10	2.00750e+10	1	2
1	167	-108.553	33.1048	43.4000	2.98750e+10	2.00750e+10	1	3
1	168	-109.653	38.7491	43.4000	2.96250e+10	1.98250e+10	1	1
1	169	-109.653	38.7491	43.4000	2.96250e+10	1.98250e+10	1	2
1	170	-111.368	45.2020	43.4000	2.98750e+10	2.00750e+10	1	1
1	171	-111.368	45.2020	43.4000	2.98750e+10	2.00750e+10	1	2
1	172	-114.488	53.0989	43.4000	2.96250e+10	1.98250e+10	1	1
1	173	-123.477	64.7719	43.4000	2.98750e+10	2.00750e+10	1	1
1	174	-112.705	28.0941	43.4000	2.95000e+10	1.97000e+10	1	1
1	175	-113.820	33.2557	43.4000	2.97500e+10	1.99500e+10	1	1
1	176	-113.820	33.2557	43.4000	2.97500e+10	1.99500e+10	1	2
1	177	-113.820	33.2557	43.4000	2.97500e+10	1.99500e+10	1	3
1	178	-115.447	38.9573	43.4000	2.95000e+10	1.97000e+10	1	1
1	179	-115.447	38.9573	43.4000	2.95000e+10	1.97000e+10	1	2
1	180	-118.028	45.5111	43.4000	2.97500e+10	1.99500e+10	1	1
1	181	-118.028	45.5111	43.4000	2.97500e+10	1.99500e+10	1	2
1	182	-122.926	53.6434	43.4000	2.95000e+10	1.97000e+10	1	1
1	183	-141.590	66.9238	43.4000	2.97500e+10	1.99500e+10	1	1
1	184	-119.369	33.4679	43.4000	2.98750e+10	2.00750e+10	1	1
1	185	-119.369	33.4679	43.4000	2.98750e+10	2.00750e+10	1	2
1	186	-119.369	33.4679	43.4000	2.98750e+10	2.00750e+10	1	3
1	187	-121.634	39.2544	43.4000	2.96250e+10	1.98250e+10	1	1
1	188	-121.634	39.2544	43.4000	2.96250e+10	1.98250e+10	1	2
1	189	-125.335	45.9648	43.4000	2.98750e+10	2.00750e+10	1	1
1	190	-125.335	45.9648	43.4000	2.98750e+10	2.00750e+10	1	2
1	191	-132.950	54.5124	43.4000	2.96250e+10	1.98250e+10	1	1
1	192	-156.326	20.4238	43.4000	2.96250e+10	1.98250e+10	1	1

Satellite Number 2 -EUROPE1

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
2	1	39.0161	2.01486	43.4000	2.95000e+10	1.97000e+10	1	1
2	2	39.0282	6.06061	43.4000	2.97500e+10	1.99500e+10	1	1
2	3	39.0531	10.1555	43.4000	2.95000e+10	1.97000e+10	1	1
2	4	39.0923	14.3359	43.4000	2.97500e+10	1.99500e+10	1	1
2	5	39.1484	18.6441	43.4000	2.95000e+10	1.97000e+10	1	1

2	6	39.2258	23.1329	43.4000	2.97500e+10	1.99500e+10	1	1
2	7	39.3315	27.8719	43.4000	2.95000e+10	1.97000e+10	1	1
2	8	39.4776	32.9603	43.4000	2.97500e+10	1.99500e+10	1	1
2	9	39.6868	38.5516	43.4000	2.95000e+10	1.97000e+10	1	1
2	10	40.0080	44.9144	43.4000	2.97500e+10	1.99500e+10	1	1
2	11	40.5730	52.6163	43.4000	2.95000e+10	1.97000e+10	1	1
2	12	41.9936	63.4581	43.4000	2.97500e+10	1.99500e+10	1	1
2	13	43.0644	2.01685	43.4000	2.96250e+10	1.98250e+10	1	1
2	14	43.1010	6.06668	43.4000	2.98750e+10	2.00750e+10	1	1
2	15	43.1763	10.1659	43.4000	2.96250e+10	1.98250e+10	1	1
2	16	43.1763	10.1659	43.4000	2.96250e+10	1.98250e+10	1	2
2	17	43.2950	14.3511	43.4000	2.98750e+10	2.00750e+10	1	1
2	18	43.4652	18.6648	43.4000	2.96250e+10	1.98250e+10	1	1
2	19	43.6998	23.1603	43.4000	2.98750e+10	2.00750e+10	1	1
2	20	44.0206	27.9079	43.4000	2.96250e+10	1.98250e+10	1	1
2	21	44.4650	33.0078	43.4000	2.98750e+10	2.00750e+10	1	1
2	22	45.1032	38.6163	43.4000	2.96250e+10	1.98250e+10	1	1
2	23	46.0873	45.0081	43.4000	2.98750e+10	2.00750e+10	1	1
2	24	47.8368	52.7714	43.4000	2.96250e+10	1.98250e+10	1	1
2	25	52.4064	63.8501	43.4000	2.98750e+10	2.00750e+10	1	1
2	26	47.2240	6.07899	43.4000	2.97500e+10	1.99500e+10	1	1
2	27	47.3519	10.1870	43.4000	2.95000e+10	1.97000e+10	1	1
2	28	47.5537	14.3818	43.4000	2.97500e+10	1.99500e+10	1	1
2	29	47.8431	18.7069	43.4000	2.95000e+10	1.97000e+10	1	1
2	30	48.2429	23.2160	43.4000	2.97500e+10	1.99500e+10	1	1
2	31	48.7909	27.9810	43.4000	2.95000e+10	1.97000e+10	1	1
2	32	49.5527	33.1048	43.4000	2.97500e+10	1.99500e+10	1	1
2	33	50.6533	38.7491	43.4000	2.95000e+10	1.97000e+10	1	1
2	34	52.3681	45.2020	43.4000	2.97500e+10	1.99500e+10	1	1
2	35	55.4877	53.0989	43.4000	2.95000e+10	1.97000e+10	1	1
2	36	64.4769	64.7719	43.4000	2.97500e+10	1.99500e+10	1	1
2	37	52.3281	18.7715	43.4000	2.96250e+10	1.98250e+10	1	1
2	38	52.9075	23.3018	43.4000	2.98750e+10	2.00750e+10	1	1
2	39	53.7048	28.0941	43.4000	2.96250e+10	1.98250e+10	1	1
2	40	54.8199	33.2557	43.4000	2.98750e+10	2.00750e+10	1	1
2	41	56.4469	38.9573	43.4000	2.96250e+10	1.98250e+10	1	1
2	42	59.0276	45.5111	43.4000	2.98750e+10	2.00750e+10	1	1
2	43	63.9260	53.6434	43.4000	2.96250e+10	1.98250e+10	1	1
2	44	82.5903	66.9238	43.4000	2.98750e+10	2.00750e+10	1	1
2	45	56.9753	18.8609	43.4000	2.95000e+10	1.97000e+10	1	1
2	46	57.7575	23.4209	43.4000	2.97500e+10	1.99500e+10	1	1
2	47	39.0161	-2.01486	43.4000	2.97500e+10	1.99500e+10	1	1
2	48	39.0282	-6.06061	43.4000	2.95000e+10	1.97000e+10	1	1
2	49	39.0531	-10.1555	43.4000	2.97500e+10	1.99500e+10	1	1
2	50	39.0923	-14.3359	43.4000	2.95000e+10	1.97000e+10	1	1
2	51	39.1484	-18.6441	43.4000	2.97500e+10	1.99500e+10	1	1
2	52	43.6998	-23.1603	43.4000	2.96250e+10	1.98250e+10	1	1
2	53	47.5537	-14.3818	43.4000	2.95000e+10	1.97000e+10	1	1
2	54	47.8431	-18.7069	43.4000	2.97500e+10	1.99500e+10	1	1
2	55	34.9839	2.01486	43.4000	2.96250e+10	1.98250e+10	1	1
2	56	34.9718	6.06061	43.4000	2.98750e+10	2.00750e+10	1	1
2	57	34.9469	10.1555	43.4000	2.96250e+10	1.98250e+10	1	1
2	58	34.9077	14.3359	43.4000	2.98750e+10	2.00750e+10	1	1
2	59	34.8516	18.6441	43.4000	2.96250e+10	1.98250e+10	1	1
2	60	34.7742	23.1329	43.4000	2.98750e+10	2.00750e+10	1	1
2	61	34.6685	27.8719	43.4000	2.96250e+10	1.98250e+10	1	1
2	62	34.5224	32.9603	43.4000	2.98750e+10	2.00750e+10	1	1
2	63	34.3132	38.5516	43.4000	2.96250e+10	1.98250e+10	1	1
2	64	33.9920	44.9144	43.4000	2.98750e+10	2.00750e+10	1	1
2	65	33.4270	52.6163	43.4000	2.96250e+10	1.98250e+10	1	1
2	66	32.0064	63.4581	43.4000	2.98750e+10	2.00750e+10	1	1
2	67	30.9356	2.01685	43.4000	2.95000e+10	1.97000e+10	1	1
2	68	26.8381	2.02090	43.4000	2.96250e+10	1.98250e+10	1	1
2	69	22.6550	2.02710	43.4000	2.95000e+10	1.97000e+10	1	1
2	70	18.3437	2.03563	43.4000	2.96250e+10	1.98250e+10	1	1
2	71	13.8515	2.04676	43.4000	2.95000e+10	1.97000e+10	1	1
2	72	9.10846	2.06088	43.4000	2.96250e+10	1.98250e+10	1	1
2	73	30.8990	6.06668	43.4000	2.97500e+10	1.99500e+10	1	1
2	74	30.8237	10.1659	43.4000	2.95000e+10	1.97000e+10	1	1
2	75	30.7050	14.3511	43.4000	2.97500e+10	1.99500e+10	1	1
2	76	30.5348	18.6648	43.4000	2.95000e+10	1.97000e+10	1	1
2	77	30.3002	23.1603	43.4000	2.97500e+10	1.99500e+10	1	1
2	78	29.9794	27.9079	43.4000	2.95000e+10	1.97000e+10	1	1
2	79	29.5350	33.0078	43.4000	2.97500e+10	1.99500e+10	1	1
2	80	28.8968	38.6163	43.4000	2.95000e+10	1.97000e+10	1	1
2	81	27.9127	45.0081	43.4000	2.97500e+10	1.99500e+10	1	1
2	82	26.1632	52.7714	43.4000	2.95000e+10	1.97000e+10	1	1
2	83	21.5936	63.8501	43.4000	2.97500e+10	1.99500e+10	1	1
2	84	26.7760	6.07899	43.4000	2.98750e+10	2.00750e+10	1	1
2	85	26.6481	10.1870	43.4000	2.96250e+10	1.98250e+10	1	1

2	86	26.4463	14.3818	43.4000	2.98750e+10	2.00750e+10	1	1
2	87	26.1569	18.7069	43.4000	2.96250e+10	1.98250e+10	1	1
2	88	25.7571	23.2160	43.4000	2.98750e+10	2.00750e+10	1	1
2	89	25.2091	27.9810	43.4000	2.96250e+10	1.98250e+10	1	1
2	90	24.4473	33.1048	43.4000	2.98750e+10	2.00750e+10	1	1
2	91	23.3467	38.7491	43.4000	2.96250e+10	1.98250e+10	1	1
2	92	21.6319	45.2020	43.4000	2.98750e+10	2.00750e+10	1	1
2	93	18.5123	53.0989	43.4000	2.96250e+10	1.98250e+10	1	1
2	94	9.52306	64.7719	43.4000	2.98750e+10	2.00750e+10	1	1
2	95	22.5655	6.09785	43.4000	2.97500e+10	1.99500e+10	1	1
2	96	22.3812	10.2193	43.4000	2.95000e+10	1.97000e+10	1	1
2	97	22.0902	14.4291	43.4000	2.97500e+10	1.99500e+10	1	1
2	98	21.6719	18.7715	43.4000	2.95000e+10	1.97000e+10	1	1
2	99	21.0925	23.3018	43.4000	2.97500e+10	1.99500e+10	1	1
2	100	20.2952	28.0941	43.4000	2.95000e+10	1.97000e+10	1	1
2	101	19.1801	33.2557	43.4000	2.97500e+10	1.99500e+10	1	1
2	102	17.5531	38.9573	43.4000	2.95000e+10	1.97000e+10	1	1
2	103	14.9724	45.5111	43.4000	2.97500e+10	1.99500e+10	1	1
2	104	10.0740	53.6434	43.4000	2.95000e+10	1.97000e+10	1	1
2	105	-8.59031	66.9238	43.4000	2.97500e+10	1.99500e+10	1	1
2	106	18.2241	6.12380	43.4000	2.98750e+10	2.00750e+10	1	1
2	107	17.9773	10.2638	43.4000	2.96250e+10	1.98250e+10	1	1
2	108	17.5871	14.4944	43.4000	2.98750e+10	2.00750e+10	1	1
2	109	17.0247	18.8609	43.4000	2.96250e+10	1.98250e+10	1	1
2	110	16.2425	23.4209	43.4000	2.98750e+10	2.00750e+10	1	1
2	111	15.1597	28.2519	43.4000	2.96250e+10	1.98250e+10	1	1
2	112	13.6312	33.4679	43.4000	2.98750e+10	2.00750e+10	1	1
2	113	11.3664	39.2544	43.4000	2.96250e+10	1.98250e+10	1	1
2	114	7.66525	45.9648	43.4000	2.98750e+10	2.00750e+10	1	1
2	115	0.0504837	54.5124	43.4000	2.96250e+10	1.98250e+10	1	1
2	116	13.6974	6.15768	43.4000	2.97500e+10	1.99500e+10	1	1
2	117	13.3791	10.3221	43.4000	2.95000e+10	1.97000e+10	1	1
2	118	12.8745	14.5799	43.4000	2.97500e+10	1.99500e+10	1	1
2	119	12.1445	18.9785	43.4000	2.95000e+10	1.97000e+10	1	1
2	120	11.1231	23.5783	43.4000	2.97500e+10	1.99500e+10	1	1
2	121	9.69661	28.4622	43.4000	2.95000e+10	1.97000e+10	1	1
2	122	7.65427	33.7544	43.4000	2.97500e+10	1.99500e+10	1	1
2	123	4.55267	39.6646	43.4000	2.95000e+10	1.97000e+10	1	1
2	124	-0.787701	46.6242	43.4000	2.97500e+10	1.99500e+10	1	1
2	125	-14.1444	56.0734	43.4000	2.95000e+10	1.97000e+10	1	1
2	126	8.91341	6.20072	43.4000	2.98750e+10	2.00750e+10	1	1
2	127	8.50974	10.3962	43.4000	2.96250e+10	1.98250e+10	1	1
2	128	7.86740	14.6890	43.4000	2.98750e+10	2.00750e+10	1	1
2	129	6.93281	19.1294	43.4000	2.96250e+10	1.98250e+10	1	1
2	130	5.61387	23.7821	43.4000	2.98750e+10	2.00750e+10	1	1
2	131	3.74671	28.7378	43.4000	2.96250e+10	1.98250e+10	1	1
2	132	1.01273	34.1375	43.4000	2.98750e+10	2.00750e+10	1	1
2	133	-3.31949	40.2359	43.4000	2.96250e+10	1.98250e+10	1	1
2	134	3.76903	6.25483	43.4000	2.97500e+10	1.99500e+10	1	1
2	135	3.25792	10.4896	43.4000	2.95000e+10	1.97000e+10	1	1
2	136	2.44025	14.8274	43.4000	2.97500e+10	1.99500e+10	1	1
2	137	1.24029	19.3223	43.4000	2.95000e+10	1.97000e+10	1	1
2	138	-0.476261	24.0457	43.4000	2.97500e+10	1.99500e+10	1	1
2	139	-2.96055	29.1014	43.4000	2.95000e+10	1.97000e+10	1	1
2	140	-6.74520	34.6620	43.4000	2.97500e+10	1.99500e+10	1	1
2	141	-1.89698	6.32314	43.4000	2.98750e+10	2.00750e+10	1	1
2	142	-2.55319	10.6082	43.4000	2.96250e+10	1.98250e+10	1	1
2	143	-3.61203	15.0044	43.4000	2.98750e+10	2.00750e+10	1	1
2	144	-5.18811	19.5721	43.4000	2.96250e+10	1.98250e+10	1	1
2	145	-7.49621	24.3942	43.4000	2.98750e+10	2.00750e+10	1	1
2	146	-10.9783	29.6006	43.4000	2.96250e+10	1.98250e+10	1	1
2	147	-8.36995	6.41126	43.4000	2.97500e+10	1.99500e+10	1	1
2	148	-9.24475	10.7623	43.4000	2.95000e+10	1.97000e+10	1	1
2	149	-10.6786	15.2378	43.4000	2.97500e+10	1.99500e+10	1	1
2	150	-12.8726	19.9096	43.4000	2.95000e+10	1.97000e+10	1	1
2	151	-16.2511	24.8861	43.4000	2.97500e+10	1.99500e+10	1	1
2	152	34.9839	-2.01486	43.4000	2.98750e+10	2.00750e+10	1	1
2	153	34.9718	-6.06061	43.4000	2.96250e+10	1.98250e+10	1	1
2	154	34.9469	-10.1555	43.4000	2.98750e+10	2.00750e+10	1	1
2	155	34.9077	-14.3359	43.4000	2.96250e+10	1.98250e+10	1	1
2	156	34.8516	-18.6441	43.4000	2.98750e+10	2.00750e+10	1	1
2	157	34.7742	-23.1329	43.4000	2.96250e+10	1.98250e+10	1	1
2	158	30.9356	-2.01685	43.4000	2.97500e+10	1.99500e+10	1	1
2	159	26.8381	-2.02090	43.4000	2.98750e+10	2.00750e+10	1	1
2	160	22.6550	-2.02710	43.4000	2.97500e+10	1.99500e+10	1	1
2	161	18.3437	-2.03563	43.4000	2.98750e+10	2.00750e+10	1	1
2	162	13.8515	-2.04676	43.4000	2.97500e+10	1.99500e+10	1	1
2	163	30.8990	-6.06668	43.4000	2.95000e+10	1.97000e+10	1	1
2	164	30.8237	-10.1659	43.4000	2.97500e+10	1.99500e+10	1	1
2	165	30.7050	-14.3511	43.4000	2.95000e+10	1.97000e+10	1	1

2	166	30.5348	-18.6648	43.4000	2.97500e+10	1.99500e+10	1	1
2	167	30.3002	-23.1603	43.4000	2.95000e+10	1.97000e+10	1	1
2	168	29.9794	-27.9079	43.4000	2.97500e+10	1.99500e+10	1	1
2	169	29.5350	-33.0078	43.4000	2.95000e+10	1.97000e+10	1	1
2	170	26.7760	-6.07899	43.4000	2.96250e+10	1.98250e+10	1	1
2	171	26.6481	-10.1870	43.4000	2.98750e+10	2.00750e+10	1	1
2	172	26.4463	-14.3818	43.4000	2.96250e+10	1.98250e+10	1	1
2	173	26.1569	-18.7069	43.4000	2.98750e+10	2.00750e+10	1	1
2	174	25.7571	-23.2160	43.4000	2.96250e+10	1.98250e+10	1	1
2	175	25.2091	-27.9810	43.4000	2.98750e+10	2.00750e+10	1	1
2	176	24.4473	-33.1048	43.4000	2.96250e+10	1.98250e+10	1	1
2	177	22.5655	-6.09785	43.4000	2.95000e+10	1.97000e+10	1	1
2	178	22.3812	-10.2193	43.4000	2.97500e+10	1.99500e+10	1	1
2	179	22.0902	-14.4291	43.4000	2.95000e+10	1.97000e+10	1	1
2	180	21.6719	-18.7715	43.4000	2.97500e+10	1.99500e+10	1	1
2	181	21.0925	-23.3018	43.4000	2.95000e+10	1.97000e+10	1	1
2	182	20.2952	-28.0941	43.4000	2.97500e+10	1.99500e+10	1	1
2	183	19.1801	-33.2557	43.4000	2.95000e+10	1.97000e+10	1	1
2	184	18.2241	-6.12380	43.4000	2.96250e+10	1.98250e+10	1	1
2	185	17.9773	-10.2639	43.4000	2.98750e+10	2.00750e+10	1	1
2	186	17.5871	-14.4944	43.4000	2.96250e+10	1.98250e+10	1	1
2	187	17.0247	-18.8609	43.4000	2.98750e+10	2.00750e+10	1	1
2	188	16.2425	-23.4209	43.4000	2.96250e+10	1.98250e+10	1	1
2	189	13.6974	-6.15768	43.4000	2.95000e+10	1.97000e+10	1	1
2	190	13.3791	-10.3221	43.4000	2.97500e+10	1.99500e+10	1	1
2	191	12.8745	-14.5799	43.4000	2.95000e+10	1.97000e+10	1	1
2	192	12.1445	-18.9785	43.4000	2.97500e+10	1.99500e+10	1	1

Satellite Number 3 -ASIA1

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
3	1	117.016	2.01486	43.4000	2.95000e+10	1.97000e+10	1	1
3	2	117.028	6.06061	43.4000	2.97500e+10	1.99500e+10	1	1
3	3	117.226	23.1329	43.4000	2.97500e+10	1.99500e+10	1	1
3	4	117.331	27.8719	43.4000	2.95000e+10	1.97000e+10	1	1
3	5	117.331	27.8719	43.4000	2.95000e+10	1.97000e+10	1	2
3	6	117.478	32.9603	43.4000	2.97500e+10	1.99500e+10	1	1
3	7	117.478	32.9603	43.4000	2.97500e+10	1.99500e+10	1	2
3	8	117.687	38.5516	43.4000	2.95000e+10	1.97000e+10	1	1
3	9	118.008	44.9144	43.4000	2.97500e+10	1.99500e+10	1	1
3	10	118.573	52.6163	43.4000	2.95000e+10	1.97000e+10	1	1
3	11	119.994	63.4581	43.4000	2.97500e+10	1.99500e+10	1	1
3	12	121.064	2.01685	43.4000	2.96250e+10	1.98250e+10	1	1
3	13	121.101	6.06668	43.4000	2.98750e+10	2.00750e+10	1	1
3	14	121.176	10.1659	43.4000	2.96250e+10	1.98250e+10	1	1
3	15	121.295	14.3511	43.4000	2.98750e+10	2.00750e+10	1	1
3	16	121.465	18.6648	43.4000	2.96250e+10	1.98250e+10	1	1
3	17	121.700	23.1603	43.4000	2.98750e+10	2.00750e+10	1	1
3	18	122.021	27.9079	43.4000	2.96250e+10	1.98250e+10	1	1
3	19	122.465	33.0078	43.4000	2.98750e+10	2.00750e+10	1	1
3	20	123.103	38.6163	43.4000	2.96250e+10	1.98250e+10	1	1
3	21	124.087	45.0081	43.4000	2.98750e+10	2.00750e+10	1	1
3	22	125.837	52.7714	43.4000	2.96250e+10	1.98250e+10	1	1
3	23	125.224	6.07899	43.4000	2.97500e+10	1.99500e+10	1	1
3	24	125.352	10.1870	43.4000	2.95000e+10	1.97000e+10	1	1
3	25	128.653	38.7491	43.4000	2.95000e+10	1.97000e+10	1	1
3	26	130.368	45.2020	43.4000	2.97500e+10	1.99500e+10	1	1
3	27	133.488	53.0989	43.4000	2.95000e+10	1.97000e+10	1	1
3	28	132.820	33.2557	43.4000	2.98750e+10	2.00750e+10	1	1
3	29	132.820	33.2557	43.4000	2.98750e+10	2.00750e+10	1	2
3	30	132.820	33.2557	43.4000	2.98750e+10	2.00750e+10	1	3
3	31	134.447	38.9573	43.4000	2.96250e+10	1.98250e+10	1	1
3	32	137.028	45.5111	43.4000	2.98750e+10	2.00750e+10	1	1
3	33	141.926	53.6434	43.4000	2.96250e+10	1.98250e+10	1	1
3	34	160.590	66.9238	43.4000	2.98750e+10	2.00750e+10	1	1
3	35	138.369	33.4679	43.4000	2.97500e+10	1.99500e+10	1	1
3	36	138.369	33.4679	43.4000	2.97500e+10	1.99500e+10	1	2
3	37	138.369	33.4679	43.4000	2.97500e+10	1.99500e+10	1	3
3	38	140.634	39.2544	43.4000	2.95000e+10	1.97000e+10	1	1
3	39	140.634	39.2544	43.4000	2.95000e+10	1.97000e+10	1	2
3	40	140.634	39.2544	43.4000	2.95000e+10	1.97000e+10	1	3
3	41	144.335	45.9648	43.4000	2.97500e+10	1.99500e+10	1	1
3	42	151.950	54.5124	43.4000	2.95000e+10	1.97000e+10	1	1
3	43	166.144	56.0734	43.4000	2.96250e+10	1.98250e+10	1	1
3	44	143.490	10.3962	43.4000	2.95000e+10	1.97000e+10	1	1
3	45	117.016	-2.01486	43.4000	2.97500e+10	1.99500e+10	1	1
3	46	117.028	-6.06061	43.4000	2.95000e+10	1.97000e+10	1	1
3	47	117.226	-23.1329	43.4000	2.95000e+10	1.97000e+10	1	1
3	48	117.331	-27.8719	43.4000	2.97500e+10	1.99500e+10	1	1
3	49	117.478	-32.9603	43.4000	2.95000e+10	1.97000e+10	1	1
3	50	121.064	-2.01685	43.4000	2.98750e+10	2.00750e+10	1	1
3	51	125.162	-2.02090	43.4000	2.97500e+10	1.99500e+10	1	1

3	52	129.345	-2.02710	43.4000	2.98750e+10	2.00750e+10	1	1
3	53	133.656	-2.03563	43.4000	2.97500e+10	1.99500e+10	1	1
3	54	138.149	-2.04676	43.4000	2.98750e+10	2.00750e+10	1	1
3	55	142.892	-2.06087	43.4000	2.97500e+10	1.99500e+10	1	1
3	56	121.176	-10.1659	43.4000	2.98750e+10	2.00750e+10	1	1
3	57	121.465	-18.6648	43.4000	2.98750e+10	2.00750e+10	1	1
3	58	121.700	-23.1603	43.4000	2.96250e+10	1.98250e+10	1	1
3	59	122.021	-27.9079	43.4000	2.98750e+10	2.00750e+10	1	1
3	60	122.465	-33.0078	43.4000	2.96250e+10	1.98250e+10	1	1
3	61	125.352	-10.1870	43.4000	2.97500e+10	1.99500e+10	1	1
3	62	125.554	-14.3818	43.4000	2.95000e+10	1.97000e+10	1	1
3	63	125.843	-18.7069	43.4000	2.97500e+10	1.99500e+10	1	1
3	64	126.243	-23.2160	43.4000	2.95000e+10	1.97000e+10	1	1
3	65	126.791	-27.9810	43.4000	2.97500e+10	1.99500e+10	1	1
3	66	127.553	-33.1048	43.4000	2.95000e+10	1.97000e+10	1	1
3	67	129.910	-14.4291	43.4000	2.96250e+10	1.98250e+10	1	1
3	68	130.328	-18.7715	43.4000	2.98750e+10	2.00750e+10	1	1
3	69	130.908	-23.3018	43.4000	2.96250e+10	1.98250e+10	1	1
3	70	131.705	-28.0941	43.4000	2.98750e+10	2.00750e+10	1	1
3	71	132.820	-33.2557	43.4000	2.96250e+10	1.98250e+10	1	1
3	72	133.776	-6.12380	43.4000	2.95000e+10	1.97000e+10	1	1
3	73	134.413	-14.4944	43.4000	2.95000e+10	1.97000e+10	1	1
3	74	134.975	-18.8609	43.4000	2.97500e+10	1.99500e+10	1	1
3	75	135.757	-23.4209	43.4000	2.95000e+10	1.97000e+10	1	1
3	76	136.840	-28.2519	43.4000	2.97500e+10	1.99500e+10	1	1
3	77	138.369	-33.4679	43.4000	2.95000e+10	1.97000e+10	1	1
3	78	138.303	-6.15768	43.4000	2.96250e+10	1.98250e+10	1	1
3	79	139.125	-14.5799	43.4000	2.96250e+10	1.98250e+10	1	1
3	80	139.856	-18.9785	43.4000	2.98750e+10	2.00750e+10	1	1
3	81	140.877	-23.5783	43.4000	2.96250e+10	1.98250e+10	1	1
3	82	142.303	-28.4622	43.4000	2.98750e+10	2.00750e+10	1	1
3	83	144.346	-33.7544	43.4000	2.96250e+10	1.98250e+10	1	1
3	84	143.087	-6.20071	43.4000	2.95000e+10	1.97000e+10	1	1
3	85	144.133	-14.6890	43.4000	2.95000e+10	1.97000e+10	1	1
3	86	145.067	-19.1294	43.4000	2.97500e+10	1.99500e+10	1	1
3	87	146.386	-23.7821	43.4000	2.95000e+10	1.97000e+10	1	1
3	88	148.253	-28.7378	43.4000	2.97500e+10	1.99500e+10	1	1
3	89	150.987	-34.1375	43.4000	2.95000e+10	1.97000e+10	1	1
3	90	150.987	-34.1375	43.4000	2.95000e+10	1.97000e+10	1	2
3	91	148.231	-6.25483	43.4000	2.96250e+10	1.98250e+10	1	1
3	92	152.476	-24.0457	43.4000	2.96250e+10	1.98250e+10	1	1
3	93	154.961	-29.1014	43.4000	2.98750e+10	2.00750e+10	1	1
3	94	154.961	-29.1014	43.4000	2.98750e+10	2.00750e+10	1	2
3	95	165.296	-41.0864	43.4000	2.98750e+10	2.00750e+10	1	1
3	96	186.664	-50.2498	43.4000	2.96250e+10	1.98250e+10	1	1
3	97	153.897	-6.32314	43.4000	2.95000e+10	1.97000e+10	1	1
3	98	168.772	-35.4420	43.4000	2.95000e+10	1.97000e+10	1	1
3	99	183.033	-42.8427	43.4000	2.97500e+10	1.99500e+10	1	1
3	100	161.245	-10.7623	43.4000	2.98750e+10	2.00750e+10	1	1
3	101	164.873	-19.9096	43.4000	2.98750e+10	2.00750e+10	1	1
3	102	190.338	-37.3713	43.4000	2.96250e+10	1.98250e+10	1	1
3	103	171.723	-15.5719	43.4000	2.95000e+10	1.97000e+10	1	1
3	104	112.984	2.01486	43.4000	2.96250e+10	1.98250e+10	1	1
3	105	112.852	18.6441	43.4000	2.96250e+10	1.98250e+10	1	1
3	106	112.774	23.1329	43.4000	2.98750e+10	2.00750e+10	1	1
3	107	112.774	23.1329	43.4000	2.98750e+10	2.00750e+10	1	2
3	108	112.669	27.8719	43.4000	2.96250e+10	1.98250e+10	1	1
3	109	112.669	27.8719	43.4000	2.96250e+10	1.98250e+10	1	2
3	110	112.522	32.9603	43.4000	2.98750e+10	2.00750e+10	1	1
3	111	112.313	38.5516	43.4000	2.96250e+10	1.98250e+10	1	1
3	112	111.992	44.9144	43.4000	2.98750e+10	2.00750e+10	1	1
3	113	111.427	52.6163	43.4000	2.96250e+10	1.98250e+10	1	1
3	114	108.936	2.01685	43.4000	2.95000e+10	1.97000e+10	1	1
3	115	104.838	2.02090	43.4000	2.96250e+10	1.98250e+10	1	1
3	116	100.655	2.02710	43.4000	2.95000e+10	1.97000e+10	1	1
3	117	96.3437	2.03563	43.4000	2.96250e+10	1.98250e+10	1	1
3	118	91.8515	2.04676	43.4000	2.95000e+10	1.97000e+10	1	1
3	119	108.824	10.1659	43.4000	2.95000e+10	1.97000e+10	1	1
3	120	108.705	14.3511	43.4000	2.97500e+10	1.99500e+10	1	1
3	121	108.535	18.6648	43.4000	2.95000e+10	1.97000e+10	1	1
3	122	108.300	23.1603	43.4000	2.97500e+10	1.99500e+10	1	1
3	123	108.300	23.1603	43.4000	2.97500e+10	1.99500e+10	1	2
3	124	107.979	27.9079	43.4000	2.95000e+10	1.97000e+10	1	1
3	125	107.535	33.0078	43.4000	2.97500e+10	1.99500e+10	1	1
3	126	106.897	38.6163	43.4000	2.95000e+10	1.97000e+10	1	1
3	127	105.913	45.0081	43.4000	2.97500e+10	1.99500e+10	1	1
3	128	104.776	6.07899	43.4000	2.98750e+10	2.00750e+10	1	1
3	129	104.648	10.1870	43.4000	2.96250e+10	1.98250e+10	1	1
3	130	104.446	14.3818	43.4000	2.98750e+10	2.00750e+10	1	1
3	131	104.157	18.7069	43.4000	2.96250e+10	1.98250e+10	1	1

3	132	103.757	23.2160	43.4000	2.98750e+10	2.00750e+10	1	1
3	133	103.209	27.9810	43.4000	2.96250e+10	1.98250e+10	1	1
3	134	102.447	33.1048	43.4000	2.98750e+10	2.00750e+10	1	1
3	135	101.347	38.7491	43.4000	2.96250e+10	1.98250e+10	1	1
3	136	99.6319	45.2020	43.4000	2.98750e+10	2.00750e+10	1	1
3	137	96.5123	53.0989	43.4000	2.96250e+10	1.98250e+10	1	1
3	138	100.566	6.09785	43.4000	2.97500e+10	1.99500e+10	1	1
3	139	100.381	10.2193	43.4000	2.95000e+10	1.97000e+10	1	1
3	140	100.090	14.4291	43.4000	2.97500e+10	1.99500e+10	1	1
3	141	99.6719	18.7715	43.4000	2.95000e+10	1.97000e+10	1	1
3	142	99.0925	23.3018	43.4000	2.97500e+10	1.99500e+10	1	1
3	143	98.2952	28.0941	43.4000	2.95000e+10	1.97000e+10	1	1
3	144	97.1801	33.2557	43.4000	2.97500e+10	1.99500e+10	1	1
3	145	95.5531	38.9573	43.4000	2.95000e+10	1.97000e+10	1	1
3	146	92.9724	45.5111	43.4000	2.97500e+10	1.99500e+10	1	1
3	147	88.0740	53.6434	43.4000	2.95000e+10	1.97000e+10	1	1
3	148	96.2241	6.12380	43.4000	2.98750e+10	2.00750e+10	1	1
3	149	95.9773	10.2638	43.4000	2.96250e+10	1.98250e+10	1	1
3	150	95.5871	14.4944	43.4000	2.98750e+10	2.00750e+10	1	1
3	151	95.0247	18.8609	43.4000	2.96250e+10	1.98250e+10	1	1
3	152	94.2425	23.4209	43.4000	2.98750e+10	2.00750e+10	1	1
3	153	93.1597	28.2519	43.4000	2.96250e+10	1.98250e+10	1	1
3	154	91.6312	33.4679	43.4000	2.98750e+10	2.00750e+10	1	1
3	155	89.3664	39.2544	43.4000	2.96250e+10	1.98250e+10	1	1
3	156	85.6653	45.9648	43.4000	2.98750e+10	2.00750e+10	1	1
3	157	91.6974	6.15768	43.4000	2.97500e+10	1.99500e+10	1	1
3	158	89.1231	23.5783	43.4000	2.97500e+10	1.99500e+10	1	1
3	159	87.6966	28.4622	43.4000	2.95000e+10	1.97000e+10	1	1
3	160	85.6543	33.7544	43.4000	2.97500e+10	1.99500e+10	1	1
3	161	82.5527	39.6646	43.4000	2.95000e+10	1.97000e+10	1	1
3	162	77.2123	46.6242	43.4000	2.97500e+10	1.99500e+10	1	1
3	163	84.9328	19.1294	43.4000	2.96250e+10	1.98250e+10	1	1
3	164	83.6139	23.7821	43.4000	2.98750e+10	2.00750e+10	1	1
3	165	81.7467	28.7378	43.4000	2.96250e+10	1.98250e+10	1	1
3	166	79.0127	34.1375	43.4000	2.98750e+10	2.00750e+10	1	1
3	167	74.6805	40.2359	43.4000	2.96250e+10	1.98250e+10	1	1
3	168	81.2579	10.4896	43.4000	2.95000e+10	1.97000e+10	1	1
3	169	80.4402	14.8274	43.4000	2.97500e+10	1.99500e+10	1	1
3	170	79.2403	19.3223	43.4000	2.95000e+10	1.97000e+10	1	1
3	171	77.5237	24.0457	43.4000	2.97500e+10	1.99500e+10	1	1
3	172	75.0395	29.1014	43.4000	2.95000e+10	1.97000e+10	1	1
3	173	71.2548	34.6620	43.4000	2.97500e+10	1.99500e+10	1	1
3	174	64.7039	41.0864	43.4000	2.95000e+10	1.97000e+10	1	1
3	175	75.4468	10.6082	43.4000	2.96250e+10	1.98250e+10	1	1
3	176	74.3880	15.0044	43.4000	2.98750e+10	2.00750e+10	1	1
3	177	72.8119	19.5721	43.4000	2.96250e+10	1.98250e+10	1	1
3	178	70.5038	24.3942	43.4000	2.98750e+10	2.00750e+10	1	1
3	179	67.0217	29.6006	43.4000	2.96250e+10	1.98250e+10	1	1
3	180	61.2282	35.4420	43.4000	2.98750e+10	2.00750e+10	1	1
3	181	61.7489	24.8861	43.4000	2.97500e+10	1.99500e+10	1	1
3	182	112.984	-2.01486	43.4000	2.98750e+10	2.00750e+10	1	1
3	183	112.972	-6.06061	43.4000	2.96250e+10	1.98250e+10	1	1
3	184	112.947	-10.1555	43.4000	2.98750e+10	2.00750e+10	1	1
3	185	108.936	-2.01685	43.4000	2.97500e+10	1.99500e+10	1	1
3	186	104.838	-2.02090	43.4000	2.98750e+10	2.00750e+10	1	1
3	187	100.655	-2.02710	43.4000	2.97500e+10	1.99500e+10	1	1
3	188	96.3437	-2.03563	43.4000	2.98750e+10	2.00750e+10	1	1
3	189	108.899	-6.06668	43.4000	2.95000e+10	1.97000e+10	1	1
3	190	104.776	-6.07899	43.4000	2.96250e+10	1.98250e+10	1	1
3	191	100.566	-6.09785	43.4000	2.95000e+10	1.97000e+10	1	1
3	192	100.566	-6.09785	43.4000	2.95000e+10	1.97000e+10	1	2

Satellite Number 4 -ATLANTIC1

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
4	1	-26.3132	38.5516	43.4000	2.95000e+10	1.97000e+10	1	1
4	2	9.58232	2.10093	43.4000	2.95000e+10	1.97000e+10	1	1
4	3	15.9539	2.12963	43.4000	2.96250e+10	1.98250e+10	1	1
4	4	23.6701	2.16845	43.4000	2.95000e+10	1.97000e+10	1	1
4	5	34.5451	2.22914	43.4000	2.96250e+10	1.98250e+10	1	1
4	6	-13.5936	63.8501	43.4000	2.98750e+10	2.00750e+10	1	1
4	7	-18.1569	18.7069	43.4000	2.95000e+10	1.97000e+10	1	1
4	8	-17.7571	23.2160	43.4000	2.97500e+10	1.99500e+10	1	1
4	9	-10.5123	53.0989	43.4000	2.95000e+10	1.97000e+10	1	1
4	10	-14.3812	10.2193	43.4000	2.96250e+10	1.98250e+10	1	1
4	11	-14.0902	14.4291	43.4000	2.98750e+10	2.00750e+10	1	1
4	12	-13.6719	18.7715	43.4000	2.96250e+10	1.98250e+10	1	1
4	13	-13.0925	23.3018	43.4000	2.98750e+10	2.00750e+10	1	1
4	14	-12.2952	28.0941	43.4000	2.96250e+10	1.98250e+10	1	1
4	15	-6.97241	45.5111	43.4000	2.98750e+10	2.00750e+10	1	1
4	16	-2.07396	53.6434	43.4000	2.96250e+10	1.98250e+10	1	1
4	17	16.5903	66.9238	43.4000	2.98750e+10	2.00750e+10	1	1

4	18	-10.2241	6.12380	43.4000	2.97500e+10	1.99500e+10	1	1
4	19	-9.97732	10.2638	43.4000	2.95000e+10	1.97000e+10	1	1
4	20	-9.58708	14.4944	43.4000	2.97500e+10	1.99500e+10	1	1
4	21	-9.02471	18.8609	43.4000	2.95000e+10	1.97000e+10	1	1
4	22	-8.24250	23.4209	43.4000	2.97500e+10	1.99500e+10	1	1
4	23	-7.15972	28.2519	43.4000	2.95000e+10	1.97000e+10	1	1
4	24	-5.63118	33.4679	43.4000	2.97500e+10	1.99500e+10	1	1
4	25	-3.36640	39.2544	43.4000	2.95000e+10	1.97000e+10	1	1
4	26	0.334751	45.9648	43.4000	2.97500e+10	1.99500e+10	1	1
4	27	7.94952	54.5124	43.4000	2.95000e+10	1.97000e+10	1	1
4	28	-5.69739	6.15768	43.4000	2.98750e+10	2.00750e+10	1	1
4	29	-5.37913	10.3221	43.4000	2.96250e+10	1.98250e+10	1	1
4	30	-4.87452	14.5799	43.4000	2.98750e+10	2.00750e+10	1	1
4	31	-4.14447	18.9785	43.4000	2.96250e+10	1.98250e+10	1	1
4	32	-3.12309	23.5783	43.4000	2.98750e+10	2.00750e+10	1	1
4	33	-1.69661	28.4622	43.4000	2.96250e+10	1.98250e+10	1	1
4	34	0.345734	33.7544	43.4000	2.98750e+10	2.00750e+10	1	1
4	35	3.44733	39.6646	43.4000	2.96250e+10	1.98250e+10	1	1
4	36	8.78770	46.6242	43.4000	2.98750e+10	2.00750e+10	1	1
4	37	22.1444	56.0734	43.4000	2.96250e+10	1.98250e+10	1	1
4	38	-0.913412	6.20072	43.4000	2.97500e+10	1.99500e+10	1	1
4	39	-0.509737	10.3962	43.4000	2.95000e+10	1.97000e+10	1	1
4	40	0.132605	14.6890	43.4000	2.97500e+10	1.99500e+10	1	1
4	41	1.06719	19.1294	43.4000	2.95000e+10	1.97000e+10	1	1
4	42	2.38613	23.7821	43.4000	2.97500e+10	1.99500e+10	1	1
4	43	4.25329	28.7378	43.4000	2.95000e+10	1.97000e+10	1	1
4	44	6.98727	34.1375	43.4000	2.97500e+10	1.99500e+10	1	1
4	45	11.3195	40.2359	43.4000	2.95000e+10	1.97000e+10	1	1
4	46	19.6403	47.6483	43.4000	2.97500e+10	1.99500e+10	1	1
4	47	4.23097	6.25483	43.4000	2.98750e+10	2.00750e+10	1	1
4	48	4.74208	10.4896	43.4000	2.96250e+10	1.98250e+10	1	1
4	49	5.55975	14.8274	43.4000	2.98750e+10	2.00750e+10	1	1
4	50	6.75971	19.3223	43.4000	2.96250e+10	1.98250e+10	1	1
4	51	8.47626	24.0457	43.4000	2.98750e+10	2.00750e+10	1	1
4	52	10.9605	29.1014	43.4000	2.96250e+10	1.98250e+10	1	1
4	53	14.7452	34.6620	43.4000	2.98750e+10	2.00750e+10	1	1
4	54	21.2961	41.0864	43.4000	2.96250e+10	1.98250e+10	1	1
4	55	9.89698	6.32314	43.4000	2.97500e+10	1.99500e+10	1	1
4	56	10.5532	10.6082	43.4000	2.95000e+10	1.97000e+10	1	1
4	57	11.6120	15.0044	43.4000	2.97500e+10	1.99500e+10	1	1
4	58	13.1881	19.5721	43.4000	2.95000e+10	1.97000e+10	1	1
4	59	15.4962	24.3942	43.4000	2.97500e+10	1.99500e+10	1	1
4	60	18.9783	29.6006	43.4000	2.95000e+10	1.97000e+10	1	1
4	61	24.7718	35.4420	43.4000	2.97500e+10	1.99500e+10	1	1
4	62	16.3700	6.41126	43.4000	2.98750e+10	2.00750e+10	1	1
4	63	17.2448	10.7623	43.4000	2.96250e+10	1.98250e+10	1	1
4	64	18.6786	15.2378	43.4000	2.98750e+10	2.00750e+10	1	1
4	65	20.8726	19.9096	43.4000	2.96250e+10	1.98250e+10	1	1
4	66	24.2511	24.8861	43.4000	2.98750e+10	2.00750e+10	1	1
4	67	29.9370	30.3744	43.4000	2.96250e+10	1.98250e+10	1	1
4	68	24.2668	6.53135	43.4000	2.97500e+10	1.99500e+10	1	1
4	69	25.5453	10.9760	43.4000	2.95000e+10	1.97000e+10	1	1
4	70	27.7233	15.5719	43.4000	2.97500e+10	1.99500e+10	1	1
4	71	31.3265	20.4238	43.4000	2.95000e+10	1.97000e+10	1	1
4	72	38.1207	25.7619	43.4000	2.97500e+10	1.99500e+10	1	1
4	73	35.6703	6.72384	43.4000	2.98750e+10	2.00750e+10	1	1
4	74	38.3143	11.3415	43.4000	2.96250e+10	1.98250e+10	1	1
4	75	44.3986	16.2599	43.4000	2.98750e+10	2.00750e+10	1	1
4	76	9.58232	-2.10093	43.4000	2.97500e+10	1.99500e+10	1	1
4	77	15.9539	-2.12963	43.4000	2.98750e+10	2.00750e+10	1	1
4	78	23.6701	-2.16844	43.4000	2.97500e+10	1.99500e+10	1	1
4	79	34.5451	-2.22914	43.4000	2.98750e+10	2.00750e+10	1	1
4	80	11.6120	-15.0044	43.4000	2.95000e+10	1.97000e+10	1	1
4	81	13.1881	-19.5721	43.4000	2.97500e+10	1.99500e+10	1	1
4	82	15.4962	-24.3942	43.4000	2.95000e+10	1.97000e+10	1	1
4	83	18.9783	-29.6006	43.4000	2.97500e+10	1.99500e+10	1	1
4	84	24.7718	-35.4420	43.4000	2.95000e+10	1.97000e+10	1	1
4	85	16.3700	-6.41126	43.4000	2.96250e+10	1.98250e+10	1	1
4	86	17.2448	-10.7623	43.4000	2.98750e+10	2.00750e+10	1	1
4	87	18.6786	-15.2378	43.4000	2.96250e+10	1.98250e+10	1	1
4	88	20.8726	-19.9096	43.4000	2.98750e+10	2.00750e+10	1	1
4	89	24.2511	-24.8861	43.4000	2.96250e+10	1.98250e+10	1	1
4	90	29.9370	-30.3744	43.4000	2.98750e+10	2.00750e+10	1	1
4	91	24.2668	-6.53135	43.4000	2.95000e+10	1.97000e+10	1	1
4	92	25.5453	-10.9760	43.4000	2.97500e+10	1.99500e+10	1	1
4	93	27.7233	-15.5719	43.4000	2.95000e+10	1.97000e+10	1	1
4	94	31.3265	-20.4238	43.4000	2.97500e+10	1.99500e+10	1	1
4	95	38.1207	-25.7619	43.4000	2.95000e+10	1.97000e+10	1	1
4	96	35.6703	-6.72384	43.4000	2.96250e+10	1.98250e+10	1	1
4	97	38.3143	-11.3415	43.4000	2.98750e+10	2.00750e+10	1	1

4	98	44.3986	-16.2599	43.4000	2.96250e+10	1.98250e+10	1	1
4	99	-33.9936	63.4581	43.4000	2.98750e+10	2.00750e+10	1	1
4	100	-52.1485	2.04676	43.4000	2.95000e+10	1.97000e+10	1	1
4	101	-56.8915	2.06088	43.4000	2.96250e+10	1.98250e+10	1	1
4	102	-61.9847	2.07860	43.4000	2.95000e+10	1.97000e+10	1	1
4	103	-67.5823	2.10093	43.4000	2.96250e+10	1.98250e+10	1	1
4	104	-73.9539	2.12963	43.4000	2.95000e+10	1.97000e+10	1	1
4	105	-44.4064	63.8501	43.4000	2.97500e+10	1.99500e+10	1	1
4	106	-55.9260	53.6434	43.4000	2.95000e+10	1.97000e+10	1	1
4	107	-74.5903	66.9238	43.4000	2.97500e+10	1.99500e+10	1	1
4	108	-58.3348	45.9648	43.4000	2.98750e+10	2.00750e+10	1	1
4	109	-52.3026	6.15768	43.4000	2.97500e+10	1.99500e+10	1	1
4	110	-66.7877	46.6242	43.4000	2.97500e+10	1.99500e+10	1	1
4	111	-80.1444	56.0734	43.4000	2.95000e+10	1.97000e+10	1	1
4	112	-57.0866	6.20072	43.4000	2.98750e+10	2.00750e+10	1	1
4	113	-69.3195	40.2359	43.4000	2.96250e+10	1.98250e+10	1	1
4	114	-77.6403	47.6483	43.4000	2.98750e+10	2.00750e+10	1	1
4	115	-62.2310	6.25483	43.4000	2.97500e+10	1.99500e+10	1	1
4	116	-62.7421	10.4896	43.4000	2.95000e+10	1.97000e+10	1	1
4	117	-72.7452	34.6620	43.4000	2.97500e+10	1.99500e+10	1	1
4	118	-79.2961	41.0864	43.4000	2.95000e+10	1.97000e+10	1	1
4	119	-79.2961	41.0864	43.4000	2.95000e+10	1.97000e+10	1	2
4	120	-100.664	50.2498	43.4000	2.97500e+10	1.99500e+10	1	1
4	121	-67.8970	6.32314	43.4000	2.98750e+10	2.00750e+10	1	1
4	122	-68.5532	10.6082	43.4000	2.96250e+10	1.98250e+10	1	1
4	123	-76.9783	29.6006	43.4000	2.96250e+10	1.98250e+10	1	1
4	124	-82.7718	35.4420	43.4000	2.98750e+10	2.00750e+10	1	1
4	125	-82.7718	35.4420	43.4000	2.98750e+10	2.00750e+10	1	2
4	126	-97.0325	42.8427	43.4000	2.96250e+10	1.98250e+10	1	1
4	127	-74.3699	6.41126	43.4000	2.97500e+10	1.99500e+10	1	1
4	128	-75.2448	10.7623	43.4000	2.95000e+10	1.97000e+10	1	1
4	129	-78.8726	19.9096	43.4000	2.95000e+10	1.97000e+10	1	1
4	130	-82.2511	24.8861	43.4000	2.97500e+10	1.99500e+10	1	1
4	131	-87.9370	30.3744	43.4000	2.95000e+10	1.97000e+10	1	1
4	132	-104.338	37.3713	43.4000	2.97500e+10	1.99500e+10	1	1
4	133	-83.5453	10.9760	43.4000	2.96250e+10	1.98250e+10	1	1
4	134	-85.7233	15.5719	43.4000	2.98750e+10	2.00750e+10	1	1
4	135	-89.3265	20.4238	43.4000	2.96250e+10	1.98250e+10	1	1
4	136	-96.1207	25.7619	43.4000	2.98750e+10	2.00750e+10	1	1
4	137	-43.3450	-2.02710	43.4000	2.97500e+10	1.99500e+10	1	1
4	138	-47.6563	-2.03563	43.4000	2.98750e+10	2.00750e+10	1	1
4	139	-52.1485	-2.04676	43.4000	2.97500e+10	1.99500e+10	1	1
4	140	-56.8915	-2.06087	43.4000	2.98750e+10	2.00750e+10	1	1
4	141	-61.9847	-2.07860	43.4000	2.97500e+10	1.99500e+10	1	1
4	142	-67.5823	-2.10093	43.4000	2.98750e+10	2.00750e+10	1	1
4	143	-73.9539	-2.12963	43.4000	2.97500e+10	1.99500e+10	1	1
4	144	-81.6701	-2.16844	43.4000	2.98750e+10	2.00750e+10	1	1
4	145	-35.1010	-6.06668	43.4000	2.95000e+10	1.97000e+10	1	1
4	146	-39.2240	-6.07899	43.4000	2.96250e+10	1.98250e+10	1	1
4	147	-39.3519	-10.1870	43.4000	2.98750e+10	2.00750e+10	1	1
4	148	-39.5537	-14.3818	43.4000	2.96250e+10	1.98250e+10	1	1
4	149	-39.8431	-18.7069	43.4000	2.98750e+10	2.00750e+10	1	1
4	150	-43.4345	-6.09785	43.4000	2.95000e+10	1.97000e+10	1	1
4	151	-43.6188	-10.2193	43.4000	2.97500e+10	1.99500e+10	1	1
4	152	-43.9098	-14.4291	43.4000	2.95000e+10	1.97000e+10	1	1
4	153	-44.3281	-18.7715	43.4000	2.97500e+10	1.99500e+10	1	1
4	154	-44.9075	-23.3018	43.4000	2.95000e+10	1.97000e+10	1	1
4	155	-47.7759	-6.12380	43.4000	2.96250e+10	1.98250e+10	1	1
4	156	-48.0227	-10.2639	43.4000	2.98750e+10	2.00750e+10	1	1
4	157	-48.4129	-14.4944	43.4000	2.96250e+10	1.98250e+10	1	1
4	158	-48.9753	-18.8609	43.4000	2.98750e+10	2.00750e+10	1	1
4	159	-49.7575	-23.4209	43.4000	2.96250e+10	1.98250e+10	1	1
4	160	-50.8403	-28.2519	43.4000	2.98750e+10	2.00750e+10	1	1
4	161	-52.3688	-33.4679	43.4000	2.96250e+10	1.98250e+10	1	1
4	162	-52.3026	-6.15768	43.4000	2.95000e+10	1.97000e+10	1	1
4	163	-52.6209	-10.3221	43.4000	2.97500e+10	1.99500e+10	1	1
4	164	-53.1255	-14.5799	43.4000	2.95000e+10	1.97000e+10	1	1
4	165	-53.8555	-18.9785	43.4000	2.97500e+10	1.99500e+10	1	1
4	166	-54.8769	-23.5783	43.4000	2.95000e+10	1.97000e+10	1	1
4	167	-56.3034	-28.4622	43.4000	2.97500e+10	1.99500e+10	1	1
4	168	-58.3457	-33.7544	43.4000	2.95000e+10	1.97000e+10	1	1
4	169	-61.4473	-39.6646	43.4000	2.97500e+10	1.99500e+10	1	1
4	170	-66.7877	-46.6242	43.4000	2.95000e+10	1.97000e+10	1	1
4	171	-57.0866	-6.20071	43.4000	2.96250e+10	1.98250e+10	1	1
4	172	-57.4903	-10.3962	43.4000	2.98750e+10	2.00750e+10	1	1
4	173	-58.1326	-14.6890	43.4000	2.96250e+10	1.98250e+10	1	1
4	174	-59.0672	-19.1294	43.4000	2.98750e+10	2.00750e+10	1	1
4	175	-60.3861	-23.7821	43.4000	2.96250e+10	1.98250e+10	1	1
4	176	-62.2533	-28.7378	43.4000	2.98750e+10	2.00750e+10	1	1
4	177	-64.9873	-34.1375	43.4000	2.96250e+10	1.98250e+10	1	1

4	178	-69.3195	-40.2359	43.4000	2.98750e+10	2.00750e+10	1	1
4	179	-62.2310	-6.25483	43.4000	2.95000e+10	1.97000e+10	1	1
4	180	-62.7421	-10.4896	43.4000	2.97500e+10	1.99500e+10	1	1
4	181	-63.5597	-14.8274	43.4000	2.95000e+10	1.97000e+10	1	1
4	182	-64.7597	-19.3223	43.4000	2.97500e+10	1.99500e+10	1	1
4	183	-66.4763	-24.0457	43.4000	2.95000e+10	1.97000e+10	1	1
4	184	-68.9605	-29.1014	43.4000	2.97500e+10	1.99500e+10	1	1
4	185	-72.7452	-34.6620	43.4000	2.95000e+10	1.97000e+10	1	1
4	186	-67.8970	-6.32314	43.4000	2.96250e+10	1.98250e+10	1	1
4	187	-68.5532	-10.6082	43.4000	2.98750e+10	2.00750e+10	1	1
4	188	-69.6120	-15.0044	43.4000	2.96250e+10	1.98250e+10	1	1
4	189	-71.1881	-19.5721	43.4000	2.98750e+10	2.00750e+10	1	1
4	190	-74.3699	-6.41126	43.4000	2.95000e+10	1.97000e+10	1	1
4	191	-75.2448	-10.7623	43.4000	2.97500e+10	1.99500e+10	1	1
4	192	-82.2668	-6.53135	43.4000	2.96250e+10	1.98250e+10	1	1
Satellite Number		5 -OCENIA						
Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
5	1	171.573	52.6163	43.4000	2.95000e+10	1.97000e+10	1	1
5	2	172.994	63.4581	43.4000	2.97500e+10	1.99500e+10	1	1
5	3	170.687	-38.5516	43.4000	2.97500e+10	1.99500e+10	1	1
5	4	171.008	-44.9144	43.4000	2.95000e+10	1.97000e+10	1	1
5	5	174.295	-14.3511	43.4000	2.96250e+10	1.98250e+10	1	1
5	6	174.465	-18.6648	43.4000	2.98750e+10	2.00750e+10	1	1
5	7	175.465	-33.0078	43.4000	2.96250e+10	1.98250e+10	1	1
5	8	176.103	-38.6163	43.4000	2.98750e+10	2.00750e+10	1	1
5	9	176.103	-38.6163	43.4000	2.98750e+10	2.00750e+10	1	2
5	10	178.554	-14.3818	43.4000	2.95000e+10	1.97000e+10	1	1
5	11	178.843	-18.7069	43.4000	2.97500e+10	1.99500e+10	1	1
5	12	178.843	-18.7069	43.4000	2.97500e+10	1.99500e+10	1	2
5	13	164.427	52.6163	43.4000	2.96250e+10	1.98250e+10	1	1
5	14	163.006	63.4581	43.4000	2.98750e+10	2.00750e+10	1	1
5	15	129.418	2.10093	43.4000	2.96250e+10	1.98250e+10	1	1
5	16	123.046	2.12963	43.4000	2.95000e+10	1.97000e+10	1	1
5	17	115.330	2.16845	43.4000	2.96250e+10	1.98250e+10	1	1
5	18	104.455	2.22914	43.4000	2.95000e+10	1.97000e+10	1	1
5	19	104.455	2.22914	43.4000	2.95000e+10	1.97000e+10	1	2
5	20	104.455	2.22914	43.4000	2.95000e+10	1.97000e+10	1	3
5	21	157.163	52.7714	43.4000	2.95000e+10	1.97000e+10	1	1
5	22	152.594	63.8501	43.4000	2.97500e+10	1.99500e+10	1	1
5	23	149.512	53.0989	43.4000	2.96250e+10	1.98250e+10	1	1
5	24	140.523	64.7719	43.4000	2.98750e+10	2.00750e+10	1	1
5	25	145.972	45.5111	43.4000	2.97500e+10	1.99500e+10	1	1
5	26	145.972	45.5111	43.4000	2.97500e+10	1.99500e+10	1	2
5	27	145.972	45.5111	43.4000	2.97500e+10	1.99500e+10	1	3
5	28	141.074	53.6434	43.4000	2.95000e+10	1.97000e+10	1	1
5	29	122.410	66.9238	43.4000	2.97500e+10	1.99500e+10	1	1
5	30	142.366	39.2544	43.4000	2.96250e+10	1.98250e+10	1	1
5	31	142.366	39.2544	43.4000	2.96250e+10	1.98250e+10	1	2
5	32	142.366	39.2544	43.4000	2.96250e+10	1.98250e+10	1	3
5	33	138.665	45.9648	43.4000	2.98750e+10	2.00750e+10	1	1
5	34	138.665	45.9648	43.4000	2.98750e+10	2.00750e+10	1	2
5	35	131.050	54.5124	43.4000	2.96250e+10	1.98250e+10	1	1
5	36	144.379	10.3221	43.4000	2.95000e+10	1.97000e+10	1	1
5	37	143.875	14.5799	43.4000	2.97500e+10	1.99500e+10	1	1
5	38	138.654	33.7544	43.4000	2.97500e+10	1.99500e+10	1	1
5	39	138.654	33.7544	43.4000	2.97500e+10	1.99500e+10	1	2
5	40	138.654	33.7544	43.4000	2.97500e+10	1.99500e+10	1	3
5	41	135.553	39.6646	43.4000	2.95000e+10	1.97000e+10	1	1
5	42	135.553	39.6646	43.4000	2.95000e+10	1.97000e+10	1	2
5	43	130.212	46.6242	43.4000	2.97500e+10	1.99500e+10	1	1
5	44	130.212	46.6242	43.4000	2.97500e+10	1.99500e+10	1	2
5	45	130.212	46.6242	43.4000	2.97500e+10	1.99500e+10	1	3
5	46	116.856	56.0734	43.4000	2.95000e+10	1.97000e+10	1	1
5	47	116.856	56.0734	43.4000	2.95000e+10	1.97000e+10	1	2
5	48	139.510	10.3962	43.4000	2.96250e+10	1.98250e+10	1	1
5	49	138.867	14.6890	43.4000	2.98750e+10	2.00750e+10	1	1
5	50	134.747	28.7378	43.4000	2.96250e+10	1.98250e+10	1	1
5	51	134.747	28.7378	43.4000	2.96250e+10	1.98250e+10	1	2
5	52	134.747	28.7378	43.4000	2.96250e+10	1.98250e+10	1	3
5	53	132.013	34.1375	43.4000	2.98750e+10	2.00750e+10	1	1
5	54	132.013	34.1375	43.4000	2.98750e+10	2.00750e+10	1	2
5	55	132.013	34.1375	43.4000	2.98750e+10	2.00750e+10	1	3
5	56	127.681	40.2359	43.4000	2.96250e+10	1.98250e+10	1	1
5	57	127.681	40.2359	43.4000	2.96250e+10	1.98250e+10	1	2
5	58	127.681	40.2359	43.4000	2.96250e+10	1.98250e+10	1	3
5	59	119.360	47.6483	43.4000	2.98750e+10	2.00750e+10	1	1
5	60	119.360	47.6483	43.4000	2.98750e+10	2.00750e+10	1	2
5	61	130.524	24.0457	43.4000	2.97500e+10	1.99500e+10	1	1
5	62	128.039	29.1014	43.4000	2.95000e+10	1.97000e+10	1	1
5	63	128.039	29.1014	43.4000	2.95000e+10	1.97000e+10	1	2

5	64	128.039	29.1014	43.4000	2.95000e+10	1.97000e+10	1	3
5	65	124.255	34.6620	43.4000	2.97500e+10	1.99500e+10	1	1
5	66	124.255	34.6620	43.4000	2.97500e+10	1.99500e+10	1	2
5	67	124.255	34.6620	43.4000	2.97500e+10	1.99500e+10	1	3
5	68	117.704	41.0864	43.4000	2.95000e+10	1.97000e+10	1	1
5	69	117.704	41.0864	43.4000	2.95000e+10	1.97000e+10	1	2
5	70	117.704	41.0864	43.4000	2.95000e+10	1.97000e+10	1	3
5	71	96.3355	50.2498	43.4000	2.97500e+10	1.99500e+10	1	1
5	72	96.3355	50.2498	43.4000	2.97500e+10	1.99500e+10	1	2
5	73	129.103	6.32314	43.4000	2.98750e+10	2.00750e+10	1	1
5	74	128.447	10.6082	43.4000	2.96250e+10	1.98250e+10	1	1
5	75	127.388	15.0044	43.4000	2.98750e+10	2.00750e+10	1	1
5	76	125.812	19.5721	43.4000	2.96250e+10	1.98250e+10	1	1
5	77	123.504	24.3942	43.4000	2.98750e+10	2.00750e+10	1	1
5	78	123.504	24.3942	43.4000	2.98750e+10	2.00750e+10	1	2
5	79	123.504	24.3942	43.4000	2.98750e+10	2.00750e+10	1	3
5	80	120.022	29.6006	43.4000	2.96250e+10	1.98250e+10	1	1
5	81	120.022	29.6006	43.4000	2.96250e+10	1.98250e+10	1	2
5	82	120.022	29.6006	43.4000	2.96250e+10	1.98250e+10	1	3
5	83	114.228	35.4420	43.4000	2.98750e+10	2.00750e+10	1	1
5	84	114.228	35.4420	43.4000	2.98750e+10	2.00750e+10	1	2
5	85	114.228	35.4420	43.4000	2.98750e+10	2.00750e+10	1	3
5	86	99.9675	42.8427	43.4000	2.96250e+10	1.98250e+10	1	1
5	87	99.9675	42.8427	43.4000	2.96250e+10	1.98250e+10	1	2
5	88	122.630	6.41126	43.4000	2.97500e+10	1.99500e+10	1	1
5	89	121.755	10.7623	43.4000	2.95000e+10	1.97000e+10	1	1
5	90	121.755	10.7623	43.4000	2.95000e+10	1.97000e+10	1	2
5	91	120.321	15.2378	43.4000	2.97500e+10	1.99500e+10	1	1
5	92	120.321	15.2378	43.4000	2.97500e+10	1.99500e+10	1	2
5	93	118.127	19.9096	43.4000	2.95000e+10	1.97000e+10	1	1
5	94	118.127	19.9096	43.4000	2.95000e+10	1.97000e+10	1	2
5	95	114.749	24.8861	43.4000	2.97500e+10	1.99500e+10	1	1
5	96	114.749	24.8861	43.4000	2.97500e+10	1.99500e+10	1	2
5	97	114.749	24.8861	43.4000	2.97500e+10	1.99500e+10	1	3
5	98	109.063	30.3744	43.4000	2.95000e+10	1.97000e+10	1	1
5	99	109.063	30.3744	43.4000	2.95000e+10	1.97000e+10	1	2
5	100	109.063	30.3744	43.4000	2.95000e+10	1.97000e+10	1	3
5	101	92.6620	37.3713	43.4000	2.97500e+10	1.99500e+10	1	1
5	102	92.6620	37.3713	43.4000	2.97500e+10	1.99500e+10	1	2
5	103	114.733	6.53135	43.4000	2.98750e+10	2.00750e+10	1	1
5	104	113.455	10.9760	43.4000	2.96250e+10	1.98250e+10	1	1
5	105	111.277	15.5719	43.4000	2.98750e+10	2.00750e+10	1	1
5	106	111.277	15.5719	43.4000	2.98750e+10	2.00750e+10	1	2
5	107	107.674	20.4238	43.4000	2.96250e+10	1.98250e+10	1	1
5	108	107.674	20.4238	43.4000	2.96250e+10	1.98250e+10	1	2
5	109	107.674	20.4238	43.4000	2.96250e+10	1.98250e+10	1	3
5	110	100.879	25.7619	43.4000	2.98750e+10	2.00750e+10	1	1
5	111	100.879	25.7619	43.4000	2.98750e+10	2.00750e+10	1	2
5	112	103.330	6.72384	43.4000	2.97500e+10	1.99500e+10	1	1
5	113	103.330	6.72384	43.4000	2.97500e+10	1.99500e+10	1	2
5	114	100.686	11.3415	43.4000	2.95000e+10	1.97000e+10	1	1
5	115	100.686	11.3415	43.4000	2.95000e+10	1.97000e+10	1	2
5	116	100.686	11.3415	43.4000	2.95000e+10	1.97000e+10	1	3
5	117	94.6014	16.2599	43.4000	2.97500e+10	1.99500e+10	1	1
5	118	94.6014	16.2599	43.4000	2.97500e+10	1.99500e+10	1	2
5	119	165.908	-14.3359	43.4000	2.96250e+10	1.98250e+10	1	1
5	120	165.852	-18.6441	43.4000	2.98750e+10	2.00750e+10	1	1
5	121	165.774	-23.1329	43.4000	2.96250e+10	1.98250e+10	1	1
5	122	140.108	-2.06087	43.4000	2.98750e+10	2.00750e+10	1	1
5	123	135.015	-2.07860	43.4000	2.97500e+10	1.99500e+10	1	1
5	124	129.418	-2.10093	43.4000	2.98750e+10	2.00750e+10	1	1
5	125	123.046	-2.12963	43.4000	2.97500e+10	1.99500e+10	1	1
5	126	115.330	-2.16844	43.4000	2.98750e+10	2.00750e+10	1	1
5	127	115.330	-2.16844	43.4000	2.98750e+10	2.00750e+10	1	2
5	128	104.455	-2.22914	43.4000	2.97500e+10	1.99500e+10	1	1
5	129	161.824	-10.1659	43.4000	2.97500e+10	1.99500e+10	1	1
5	130	157.776	-6.07899	43.4000	2.96250e+10	1.98250e+10	1	1
5	131	155.447	-33.1048	43.4000	2.96250e+10	1.98250e+10	1	1
5	132	155.447	-33.1048	43.4000	2.96250e+10	1.98250e+10	1	2
5	133	154.347	-38.7491	43.4000	2.98750e+10	2.00750e+10	1	1
5	134	154.347	-38.7491	43.4000	2.98750e+10	2.00750e+10	1	2
5	135	153.566	-6.09785	43.4000	2.95000e+10	1.97000e+10	1	1
5	136	153.381	-10.2193	43.4000	2.97500e+10	1.99500e+10	1	1
5	137	152.092	-23.3018	43.4000	2.95000e+10	1.97000e+10	1	1
5	138	152.092	-23.3018	43.4000	2.95000e+10	1.97000e+10	1	2
5	139	151.295	-28.0941	43.4000	2.97500e+10	1.99500e+10	1	1
5	140	151.295	-28.0941	43.4000	2.97500e+10	1.99500e+10	1	2
5	141	150.180	-33.2557	43.4000	2.95000e+10	1.97000e+10	1	1
5	142	150.180	-33.2557	43.4000	2.95000e+10	1.97000e+10	1	2
5	143	148.553	-38.9573	43.4000	2.97500e+10	1.99500e+10	1	1

5	144	148.553	-38.9573	43.4000	2.97500e+10	1.99500e+10	1	2
5	145	149.224	-6.12380	43.4000	2.96250e+10	1.98250e+10	1	1
5	146	148.977	-10.2639	43.4000	2.98750e+10	2.00750e+10	1	1
5	147	148.025	-18.8609	43.4000	2.98750e+10	2.00750e+10	1	1
5	148	147.243	-23.4209	43.4000	2.96250e+10	1.98250e+10	1	1
5	149	146.160	-28.2519	43.4000	2.98750e+10	2.00750e+10	1	1
5	150	144.631	-33.4679	43.4000	2.96250e+10	1.98250e+10	1	1
5	151	142.366	-39.2543	43.4000	2.98750e+10	2.00750e+10	1	1
5	152	142.366	-39.2543	43.4000	2.98750e+10	2.00750e+10	1	2
5	153	144.697	-6.15768	43.4000	2.95000e+10	1.97000e+10	1	1
5	154	144.379	-10.3221	43.4000	2.97500e+10	1.99500e+10	1	1
5	155	143.875	-14.5799	43.4000	2.95000e+10	1.97000e+10	1	1
5	156	143.144	-18.9785	43.4000	2.97500e+10	1.99500e+10	1	1
5	157	142.123	-23.5783	43.4000	2.95000e+10	1.97000e+10	1	1
5	158	140.697	-28.4622	43.4000	2.97500e+10	1.99500e+10	1	1
5	159	138.654	-33.7544	43.4000	2.95000e+10	1.97000e+10	1	1
5	160	138.654	-33.7544	43.4000	2.95000e+10	1.97000e+10	1	2
5	161	138.654	-33.7544	43.4000	2.95000e+10	1.97000e+10	1	3
5	162	139.913	-6.20071	43.4000	2.96250e+10	1.98250e+10	1	1
5	163	139.510	-10.3962	43.4000	2.98750e+10	2.00750e+10	1	1
5	164	138.867	-14.6890	43.4000	2.96250e+10	1.98250e+10	1	1
5	165	137.933	-19.1294	43.4000	2.98750e+10	2.00750e+10	1	1
5	166	136.614	-23.7821	43.4000	2.96250e+10	1.98250e+10	1	1
5	167	134.747	-28.7378	43.4000	2.98750e+10	2.00750e+10	1	1
5	168	134.769	-6.25483	43.4000	2.95000e+10	1.97000e+10	1	1
5	169	134.258	-10.4896	43.4000	2.97500e+10	1.99500e+10	1	1
5	170	133.440	-14.8274	43.4000	2.95000e+10	1.97000e+10	1	1
5	171	133.440	-14.8274	43.4000	2.95000e+10	1.97000e+10	1	2
5	172	132.240	-19.3223	43.4000	2.97500e+10	1.99500e+10	1	1
5	173	130.524	-24.0457	43.4000	2.95000e+10	1.97000e+10	1	1
5	174	128.039	-29.1014	43.4000	2.97500e+10	1.99500e+10	1	1
5	175	129.103	-6.32314	43.4000	2.96250e+10	1.98250e+10	1	1
5	176	128.447	-10.6082	43.4000	2.98750e+10	2.00750e+10	1	1
5	177	127.388	-15.0044	43.4000	2.96250e+10	1.98250e+10	1	1
5	178	127.388	-15.0044	43.4000	2.96250e+10	1.98250e+10	1	2
5	179	125.812	-19.5721	43.4000	2.98750e+10	2.00750e+10	1	1
5	180	123.504	-24.3942	43.4000	2.96250e+10	1.98250e+10	1	1
5	181	120.022	-29.6006	43.4000	2.98750e+10	2.00750e+10	1	1
5	182	120.022	-29.6006	43.4000	2.98750e+10	2.00750e+10	1	2
5	183	122.630	-6.41126	43.4000	2.95000e+10	1.97000e+10	1	1
5	184	121.755	-10.7623	43.4000	2.97500e+10	1.99500e+10	1	1
5	185	118.127	-19.9096	43.4000	2.97500e+10	1.99500e+10	1	1
5	186	118.127	-19.9096	43.4000	2.97500e+10	1.99500e+10	1	2
5	187	114.749	-24.8861	43.4000	2.95000e+10	1.97000e+10	1	1
5	188	114.733	-6.53135	43.4000	2.96250e+10	1.98250e+10	1	1
5	189	114.733	-6.53135	43.4000	2.96250e+10	1.98250e+10	1	2
5	190	103.330	-6.72384	43.4000	2.95000e+10	1.97000e+10	1	1
5	191	103.330	-6.72384	43.4000	2.95000e+10	1.97000e+10	1	2
5	192	103.330	-6.72384	43.4000	2.95000e+10	1.97000e+10	1	3

Satellite Number 6 -USA2

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
6	1	-93.9077	14.3359	43.4000	2.96250e+10	1.98250e+10	2	1
6	2	-93.8516	18.6441	43.4000	2.98750e+10	2.00750e+10	2	1
6	3	-93.6685	27.8719	43.4000	2.98750e+10	2.00750e+10	2	1
6	4	-93.5224	32.9603	43.4000	2.96250e+10	1.98250e+10	2	1
6	5	-93.5224	32.9603	43.4000	2.96250e+10	1.98250e+10	2	2
6	6	-93.3132	38.5516	43.4000	2.98750e+10	2.00750e+10	2	1
6	7	-93.3132	38.5516	43.4000	2.98750e+10	2.00750e+10	2	2
6	8	-92.9921	44.9144	43.4000	2.96250e+10	1.98250e+10	2	1
6	9	-92.9921	44.9144	43.4000	2.96250e+10	1.98250e+10	2	2
6	10	-92.4270	52.6163	43.4000	2.98750e+10	2.00750e+10	2	1
6	11	-91.0064	63.4581	43.4000	2.96250e+10	1.98250e+10	2	1
6	12	-77.3437	2.03563	43.4000	2.98750e+10	2.00750e+10	2	1
6	13	-72.8515	2.04676	43.4000	2.95000e+10	1.97000e+10	2	1
6	14	-68.1085	2.06088	43.4000	2.98750e+10	2.00750e+10	2	1
6	15	-63.0153	2.07860	43.4000	2.95000e+10	1.97000e+10	2	1
6	16	-57.4177	2.10093	43.4000	2.98750e+10	2.00750e+10	2	1
6	17	-51.0461	2.12963	43.4000	2.95000e+10	1.97000e+10	2	1
6	18	-89.7050	14.3511	43.4000	2.97500e+10	1.99500e+10	2	1
6	19	-89.5348	18.6648	43.4000	2.95000e+10	1.97000e+10	2	1
6	20	-89.3002	23.1603	43.4000	2.97500e+10	1.99500e+10	2	1
6	21	-88.5350	33.0078	43.4000	2.97500e+10	1.99500e+10	2	1
6	22	-88.5350	33.0078	43.4000	2.97500e+10	1.99500e+10	2	2
6	23	-88.5350	33.0078	43.4000	2.97500e+10	1.99500e+10	2	3
6	24	-87.8968	38.6163	43.4000	2.95000e+10	1.97000e+10	2	1
6	25	-87.8968	38.6163	43.4000	2.95000e+10	1.97000e+10	2	2
6	26	-86.9127	45.0081	43.4000	2.97500e+10	1.99500e+10	2	1
6	27	-86.9127	45.0081	43.4000	2.97500e+10	1.99500e+10	2	2
6	28	-85.1632	52.7714	43.4000	2.95000e+10	1.97000e+10	2	1
6	29	-80.5936	63.8501	43.4000	2.97500e+10	1.99500e+10	2	1

6	30	-85.6481	10.1870	43.4000	2.98750e+10	2.00750e+10	2	1
6	31	-85.4464	14.3818	43.4000	2.96250e+10	1.98250e+10	2	1
6	32	-85.1569	18.7069	43.4000	2.98750e+10	2.00750e+10	2	1
6	33	-84.7571	23.2160	43.4000	2.96250e+10	1.98250e+10	2	1
6	34	-84.2091	27.9810	43.4000	2.98750e+10	2.00750e+10	2	1
6	35	-84.2091	27.9810	43.4000	2.98750e+10	2.00750e+10	2	2
6	36	-83.4473	33.1048	43.4000	2.96250e+10	1.98250e+10	2	1
6	37	-83.4473	33.1048	43.4000	2.96250e+10	1.98250e+10	2	2
6	38	-83.4473	33.1048	43.4000	2.96250e+10	1.98250e+10	2	3
6	39	-82.3467	38.7491	43.4000	2.98750e+10	2.00750e+10	2	1
6	40	-82.3467	38.7491	43.4000	2.98750e+10	2.00750e+10	2	2
6	41	-82.3467	38.7491	43.4000	2.98750e+10	2.00750e+10	2	3
6	42	-80.6319	45.2020	43.4000	2.96250e+10	1.98250e+10	2	1
6	43	-80.6319	45.2020	43.4000	2.96250e+10	1.98250e+10	2	2
6	44	-77.5123	53.0989	43.4000	2.98750e+10	2.00750e+10	2	1
6	45	-68.5231	64.7719	43.4000	2.96250e+10	1.98250e+10	2	1
6	46	-81.3812	10.2193	43.4000	2.95000e+10	1.97000e+10	2	1
6	47	-81.0902	14.4291	43.4000	2.97500e+10	1.99500e+10	2	1
6	48	-80.6719	18.7715	43.4000	2.95000e+10	1.97000e+10	2	1
6	49	-80.0925	23.3018	43.4000	2.97500e+10	1.99500e+10	2	1
6	50	-79.2952	28.0941	43.4000	2.95000e+10	1.97000e+10	2	1
6	51	-79.2952	28.0941	43.4000	2.95000e+10	1.97000e+10	2	2
6	52	-78.1801	33.2557	43.4000	2.97500e+10	1.99500e+10	2	1
6	53	-78.1801	33.2557	43.4000	2.97500e+10	1.99500e+10	2	2
6	54	-76.5531	38.9573	43.4000	2.95000e+10	1.97000e+10	2	1
6	55	-76.5531	38.9573	43.4000	2.95000e+10	1.97000e+10	2	2
6	56	-76.5531	38.9573	43.4000	2.95000e+10	1.97000e+10	2	3
6	57	-73.9724	45.5111	43.4000	2.97500e+10	1.99500e+10	2	1
6	58	-73.9724	45.5111	43.4000	2.97500e+10	1.99500e+10	2	2
6	59	-73.9724	45.5111	43.4000	2.97500e+10	1.99500e+10	2	3
6	60	-69.0740	53.6434	43.4000	2.95000e+10	1.97000e+10	2	1
6	61	-50.4097	66.9238	43.4000	2.97500e+10	1.99500e+10	2	1
6	62	-77.2241	6.12380	43.4000	2.96250e+10	1.98250e+10	2	1
6	63	-76.9773	10.2638	43.4000	2.98750e+10	2.00750e+10	2	1
6	64	-76.5871	14.4944	43.4000	2.96250e+10	1.98250e+10	2	1
6	65	-76.0247	18.8609	43.4000	2.98750e+10	2.00750e+10	2	1
6	66	-75.2425	23.4209	43.4000	2.96250e+10	1.98250e+10	2	1
6	67	-66.6653	45.9648	43.4000	2.96250e+10	1.98250e+10	2	1
6	68	-66.6653	45.9648	43.4000	2.96250e+10	1.98250e+10	2	2
6	69	-59.0505	54.5124	43.4000	2.98750e+10	2.00750e+10	2	1
6	70	-72.6974	6.15768	43.4000	2.97500e+10	1.99500e+10	2	1
6	71	-72.3791	10.3221	43.4000	2.95000e+10	1.97000e+10	2	1
6	72	-71.8745	14.5799	43.4000	2.97500e+10	1.99500e+10	2	1
6	73	-71.1445	18.9785	43.4000	2.95000e+10	1.97000e+10	2	1
6	74	-70.1231	23.5783	43.4000	2.98625e+10	1.99500e+10	2	1
6	75	-58.2123	46.6242	43.4000	2.98625e+10	1.99500e+10	2	1
6	76	-58.2123	46.6242	43.4000	2.98625e+10	1.99500e+10	2	2
6	77	-67.9134	6.20072	43.4000	2.97875e+10	1.98250e+10	2	1
6	78	-67.5097	10.3962	43.4000	2.98750e+10	2.00750e+10	2	1
6	79	-66.8674	14.6890	43.4000	2.96250e+10	1.98250e+10	2	1
6	80	-65.9328	19.1294	43.4000	2.98750e+10	2.00750e+10	2	1
6	81	-60.0127	34.1375	43.4000	2.96250e+10	1.98250e+10	2	1
6	82	-62.7690	6.25483	43.4000	2.97500e+10	1.99500e+10	2	1
6	83	-62.2579	10.4896	43.4000	2.95000e+10	1.97000e+10	2	1
6	84	-61.4403	14.8274	43.4000	2.97500e+10	1.99500e+10	2	1
6	85	-57.1030	6.32314	43.4000	2.96250e+10	1.98250e+10	2	1
6	86	-81.6550	-2.02710	43.4000	2.97500e+10	1.99500e+10	2	1
6	87	-77.3437	-2.03563	43.4000	2.96250e+10	1.98250e+10	2	1
6	88	-72.8515	-2.04676	43.4000	2.97500e+10	1.99500e+10	2	1
6	89	-68.1085	-2.06087	43.4000	2.96250e+10	1.98250e+10	2	1
6	90	-63.0153	-2.07860	43.4000	2.97500e+10	1.99500e+10	2	1
6	91	-57.4177	-2.10093	43.4000	2.96250e+10	1.98250e+10	2	1
6	92	-51.0461	-2.12963	43.4000	2.97500e+10	1.99500e+10	2	1
6	93	-43.3299	-2.16844	43.4000	2.96250e+10	1.98250e+10	2	1
6	94	-73.9724	-45.5111	43.4000	2.95000e+10	1.97000e+10	2	1
6	95	-69.0740	-53.6434	43.4000	2.97500e+10	1.99500e+10	2	1
6	96	-77.2241	-6.12380	43.4000	2.98750e+10	2.00750e+10	2	1
6	97	-76.9773	-10.2639	43.4000	2.96250e+10	1.98250e+10	2	1
6	98	-76.5871	-14.4944	43.4000	2.98750e+10	2.00750e+10	2	1
6	99	-72.6312	-33.4679	43.4000	2.98750e+10	2.00750e+10	2	1
6	100	-70.3664	-39.2543	43.4000	2.96250e+10	1.98250e+10	2	1
6	101	-66.6653	-45.9648	43.4000	2.98750e+10	2.00750e+10	2	1
6	102	-72.6974	-6.15768	43.4000	2.95000e+10	1.97000e+10	2	1
6	103	-72.3791	-10.3221	43.4000	2.97500e+10	1.99500e+10	2	1
6	104	-71.8745	-14.5799	43.4000	2.95000e+10	1.97000e+10	2	1
6	105	-71.1445	-18.9785	43.4000	2.97500e+10	1.99500e+10	2	1
6	106	-70.1231	-23.5783	43.4000	2.95000e+10	1.97000e+10	2	1
6	107	-68.6966	-28.4622	43.4000	2.97500e+10	1.99500e+10	2	1
6	108	-66.6543	-33.7544	43.4000	2.95000e+10	1.97000e+10	2	1
6	109	-63.5527	-39.6646	43.4000	2.97500e+10	1.99500e+10	2	1

6	110	-67.9134	-6.20071	43.4000	2.98750e+10	2.00750e+10	2	1
6	111	-67.5097	-10.3962	43.4000	2.96250e+10	1.98250e+10	2	1
6	112	-66.8674	-14.6890	43.4000	2.98750e+10	2.00750e+10	2	1
6	113	-65.9328	-19.1294	43.4000	2.96250e+10	1.98250e+10	2	1
6	114	-64.6139	-23.7821	43.4000	2.98750e+10	2.00750e+10	2	1
6	115	-62.7467	-28.7378	43.4000	2.96250e+10	1.98250e+10	2	1
6	116	-60.0127	-34.1375	43.4000	2.98750e+10	2.00750e+10	2	1
6	117	-62.7690	-6.25483	43.4000	2.95000e+10	1.97000e+10	2	1
6	118	-62.2579	-10.4896	43.4000	2.97500e+10	1.99500e+10	2	1
6	119	-61.4403	-14.8274	43.4000	2.95000e+10	1.97000e+10	2	1
6	120	-60.2403	-19.3223	43.4000	2.97500e+10	1.99500e+10	2	1
6	121	-58.5237	-24.0457	43.4000	2.95000e+10	1.97000e+10	2	1
6	122	-56.0395	-29.1014	43.4000	2.97500e+10	1.99500e+10	2	1
6	123	-57.1030	-6.32314	43.4000	2.98750e+10	2.00750e+10	2	1
6	124	-56.4468	-10.6082	43.4000	2.96250e+10	1.98250e+10	2	1
6	125	-55.3880	-15.0044	43.4000	2.98750e+10	2.00750e+10	2	1
6	126	-53.8119	-19.5721	43.4000	2.96250e+10	1.98250e+10	2	1
6	127	-51.5038	-24.3942	43.4000	2.98750e+10	2.00750e+10	2	1
6	128	-48.0217	-29.6006	43.4000	2.96250e+10	1.98250e+10	2	1
6	129	-50.6300	-6.41126	43.4000	2.95000e+10	1.97000e+10	2	1
6	130	-49.7552	-10.7623	43.4000	2.97500e+10	1.99500e+10	2	1
6	131	-48.3214	-15.2378	43.4000	2.95000e+10	1.97000e+10	2	1
6	132	-46.1274	-19.9096	43.4000	2.97500e+10	1.99500e+10	2	1
6	133	-42.7489	-24.8861	43.4000	2.95000e+10	1.97000e+10	2	1
6	134	-42.7332	-6.53135	43.4000	2.98750e+10	2.00750e+10	2	1
6	135	-41.4547	-10.9760	43.4000	2.96250e+10	1.98250e+10	2	1
6	136	-39.2767	-15.5719	43.4000	2.98750e+10	2.00750e+10	2	1
6	137	-98.1484	18.6441	43.4000	2.95000e+10	1.97000e+10	2	1
6	138	-98.2258	23.1329	43.4000	2.97500e+10	1.99500e+10	2	1
6	139	-98.3315	27.8719	43.4000	2.95000e+10	1.97000e+10	2	1
6	140	-98.3315	27.8719	43.4000	2.95000e+10	1.97000e+10	2	2
6	141	-98.3315	27.8719	43.4000	2.95000e+10	1.97000e+10	2	3
6	142	-98.4776	32.9603	43.4000	2.97500e+10	1.99500e+10	2	1
6	143	-98.4776	32.9603	43.4000	2.97500e+10	1.99500e+10	2	2
6	144	-98.4776	32.9603	43.4000	2.97500e+10	1.99500e+10	2	3
6	145	-98.6868	38.5516	43.4000	2.95000e+10	1.97000e+10	2	1
6	146	-98.6868	38.5516	43.4000	2.95000e+10	1.97000e+10	2	2
6	147	-99.0079	44.9144	43.4000	2.97500e+10	1.99500e+10	2	1
6	148	-99.0079	44.9144	43.4000	2.97500e+10	1.99500e+10	2	2
6	149	-99.5730	52.6163	43.4000	2.95000e+10	1.97000e+10	2	1
6	150	-100.994	63.4581	43.4000	2.97500e+10	1.99500e+10	2	1
6	151	-102.465	18.6648	43.4000	2.87500e+10	2.00750e+10	2	1
6	152	-102.700	23.1603	43.4000	2.96250e+10	1.98250e+10	2	1
6	153	-103.021	27.9079	43.4000	2.98750e+10	2.00750e+10	2	1
6	154	-103.021	27.9079	43.4000	2.98750e+10	2.00750e+10	2	2
6	155	-103.465	33.0078	43.4000	2.96250e+10	1.98250e+10	2	1
6	156	-103.465	33.0078	43.4000	2.96250e+10	1.98250e+10	2	2
6	157	-104.103	38.6163	43.4000	2.98750e+10	2.00750e+10	2	1
6	158	-104.103	38.6163	43.4000	2.98750e+10	2.00750e+10	2	2
6	159	-105.087	45.0081	43.4000	2.96250e+10	1.98250e+10	2	1
6	160	-105.087	45.0081	43.4000	2.96250e+10	1.98250e+10	2	2
6	161	-106.837	52.7714	43.4000	2.98750e+10	2.00750e+10	2	1
6	162	-111.406	63.8501	43.4000	2.96250e+10	1.98250e+10	2	1
6	163	-107.243	23.2160	43.4000	2.97500e+10	1.99500e+10	2	1
6	164	-107.791	27.9810	43.4000	2.95000e+10	1.97000e+10	2	1
6	165	-108.553	33.1048	43.4000	2.97500e+10	1.99500e+10	2	1
6	166	-108.553	33.1048	43.4000	2.97500e+10	1.99500e+10	2	2
6	167	-108.553	33.1048	43.4000	2.97500e+10	1.99500e+10	2	3
6	168	-109.653	38.7491	43.4000	2.95000e+10	1.97000e+10	2	1
6	169	-109.653	38.7491	43.4000	2.95000e+10	1.97000e+10	2	2
6	170	-111.368	45.2020	43.4000	2.97500e+10	1.99500e+10	2	1
6	171	-111.368	45.2020	43.4000	2.97500e+10	1.99500e+10	2	2
6	172	-114.488	53.0989	43.4000	2.95000e+10	1.97000e+10	2	1
6	173	-123.477	64.7719	43.4000	2.97500e+10	1.99500e+10	2	1
6	174	-112.705	28.0941	43.4000	2.98750e+10	2.00750e+10	2	1
6	175	-113.820	33.2557	43.4000	2.96250e+10	1.98250e+10	2	1
6	176	-113.820	33.2557	43.4000	2.96250e+10	1.98250e+10	2	2
6	177	-113.820	33.2557	43.4000	2.96250e+10	1.98250e+10	2	3
6	178	-115.447	38.9573	43.4000	2.98750e+10	2.00750e+10	2	1
6	179	-115.447	38.9573	43.4000	2.98750e+10	2.00750e+10	2	2
6	180	-118.028	45.5111	43.4000	2.96250e+10	1.98250e+10	2	1
6	181	-118.028	45.5111	43.4000	2.96250e+10	1.98250e+10	2	2
6	182	-122.926	53.6434	43.4000	2.98750e+10	2.00750e+10	2	1
6	183	-141.590	66.9238	43.4000	2.96250e+10	1.98250e+10	2	1
6	184	-119.369	33.4679	43.4000	2.97500e+10	1.99500e+10	2	1
6	185	-119.369	33.4679	43.4000	2.97500e+10	1.99500e+10	2	2
6	186	-119.369	33.4679	43.4000	2.97500e+10	1.99500e+10	2	3
6	187	-121.634	39.2544	43.4000	2.95000e+10	1.97000e+10	2	1
6	188	-121.634	39.2544	43.4000	2.95000e+10	1.97000e+10	2	2
6	189	-125.335	45.9648	43.4000	2.97500e+10	1.99500e+10	2	1

6	190	-125.335	45.9648	43.4000	2.97500e+10	1.99500e+10	2	2
6	191	-132.950	54.5124	43.4000	2.95000e+10	1.97000e+10	2	1
6	192	-156.326	20.4238	43.4000	2.95000e+10	1.97000e+10	2	1

Satellite Number 7 -EUROPE2

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
7	1	39.0161	2.01486	43.4000	2.98750e+10	2.00750e+10	2	1
7	2	39.0282	6.06061	43.4000	2.96250e+10	1.98250e+10	2	1
7	3	39.0531	10.1555	43.4000	2.98750e+10	2.00750e+10	2	1
7	4	39.0923	14.3359	43.4000	2.96250e+10	1.98250e+10	2	1
7	5	39.1484	18.6441	43.4000	2.98750e+10	2.00750e+10	2	1
7	6	39.2258	23.1329	43.4000	2.96250e+10	1.98250e+10	2	1
7	7	39.2258	23.1329	43.4000	2.96250e+10	1.98250e+10	2	2
7	8	39.4776	32.9603	43.4000	2.96250e+10	1.98250e+10	2	1
7	9	39.6868	38.5516	43.4000	2.98750e+10	2.00750e+10	2	1
7	10	40.0080	44.9144	43.4000	2.96250e+10	1.98250e+10	2	1
7	11	40.5730	52.6163	43.4000	2.98750e+10	2.00750e+10	2	1
7	12	43.0644	2.01685	43.4000	2.95000e+10	1.97000e+10	2	1
7	13	100.545	2.22914	43.4000	2.95000e+10	1.97000e+10	2	1
7	14	43.1010	6.06668	43.4000	2.97500e+10	1.99500e+10	2	1
7	15	43.1763	10.1659	43.4000	2.95000e+10	1.97000e+10	2	1
7	16	44.0206	27.9079	43.4000	2.95000e+10	1.97000e+10	2	1
7	17	44.4650	33.0078	43.4000	2.97500e+10	1.99500e+10	2	1
7	18	45.1032	38.6163	43.4000	2.95000e+10	1.97000e+10	2	1
7	19	46.0873	45.0081	43.4000	2.97500e+10	1.99500e+10	2	1
7	20	47.8368	52.7714	43.4000	2.95000e+10	1.97000e+10	2	1
7	21	47.2240	6.07899	43.4000	2.96250e+10	1.98250e+10	2	1
7	22	47.3519	10.1870	43.4000	2.98750e+10	2.00750e+10	2	1
7	23	47.5537	14.3818	43.4000	2.96250e+10	1.98250e+10	2	1
7	24	48.2429	23.2160	43.4000	2.96250e+10	1.98250e+10	2	1
7	25	48.7909	27.9810	43.4000	2.98750e+10	2.00750e+10	2	1
7	26	49.5527	33.1048	43.4000	2.96250e+10	1.98250e+10	2	1
7	27	50.6533	38.7491	43.4000	2.98750e+10	2.00750e+10	2	1
7	28	52.3681	45.2020	43.4000	2.96250e+10	1.98250e+10	2	1
7	29	55.4877	53.0989	43.4000	2.98750e+10	2.00750e+10	2	1
7	30	56.4469	38.9573	43.4000	2.95000e+10	1.97000e+10	2	1
7	31	59.0276	45.5111	43.4000	2.97500e+10	1.99500e+10	2	1
7	32	63.9260	53.6434	43.4000	2.95000e+10	1.97000e+10	2	1
7	33	60.3688	33.4679	43.4000	2.96250e+10	1.98250e+10	2	1
7	34	62.6336	39.2544	43.4000	2.98750e+10	2.00750e+10	2	1
7	35	66.3347	45.9648	43.4000	2.96250e+10	1.98250e+10	2	1
7	36	73.9495	54.5124	43.4000	2.98750e+10	2.00750e+10	2	1
7	37	64.3034	28.4622	43.4000	2.95000e+10	1.97000e+10	2	1
7	38	66.3457	33.7544	43.4000	2.97500e+10	1.99500e+10	2	1
7	39	69.4473	39.6646	43.4000	2.95000e+10	1.97000e+10	2	1
7	40	74.7877	46.6242	43.4000	2.97500e+10	1.99500e+10	2	1
7	41	88.1444	56.0734	43.4000	2.95000e+10	1.97000e+10	2	1
7	42	68.3861	23.7821	43.4000	2.96250e+10	1.98250e+10	2	1
7	43	70.2533	28.7378	43.4000	2.98750e+10	2.00750e+10	2	1
7	44	72.9873	34.1375	43.4000	2.96250e+10	1.98250e+10	2	1
7	45	77.3195	40.2359	43.4000	2.98750e+10	2.00750e+10	2	1
7	46	85.6403	47.6483	43.4000	2.96250e+10	1.98250e+10	2	1
7	47	72.7597	19.3223	43.4000	2.95000e+10	1.97000e+10	2	1
7	48	72.7597	19.3223	43.4000	2.95000e+10	1.97000e+10	2	2
7	49	74.4763	24.0457	43.4000	2.97500e+10	1.99500e+10	2	1
7	50	76.9605	29.1014	43.4000	2.95000e+10	1.97000e+10	2	1
7	51	80.7452	34.6620	43.4000	2.97500e+10	1.99500e+10	2	1
7	52	87.2961	41.0864	43.4000	2.95000e+10	1.97000e+10	2	1
7	53	108.664	50.2498	43.4000	2.97500e+10	1.99500e+10	2	1
7	54	76.5532	10.6082	43.4000	2.98750e+10	2.00750e+10	2	1
7	55	76.5532	10.6082	43.4000	2.98750e+10	2.00750e+10	2	2
7	56	77.6120	15.0044	43.4000	2.96250e+10	1.98250e+10	2	1
7	57	77.6120	15.0044	43.4000	2.96250e+10	1.98250e+10	2	2
7	58	79.1881	19.5721	43.4000	2.98750e+10	2.00750e+10	2	1
7	59	79.1881	19.5721	43.4000	2.98750e+10	2.00750e+10	2	2
7	60	81.4962	24.3942	43.4000	2.96250e+10	1.98250e+10	2	1
7	61	81.4962	24.3942	43.4000	2.96250e+10	1.98250e+10	2	2
7	62	84.9783	29.6006	43.4000	2.98750e+10	2.00750e+10	2	1
7	63	90.7718	35.4420	43.4000	2.96250e+10	1.98250e+10	2	1
7	64	105.033	42.8427	43.4000	2.98750e+10	2.00750e+10	2	1
7	65	86.8726	19.9096	43.4000	2.95000e+10	1.97000e+10	2	1
7	66	90.2511	24.8861	43.4000	2.97500e+10	1.99500e+10	2	1
7	67	95.9370	30.3744	43.4000	2.95000e+10	1.97000e+10	2	1
7	68	112.338	37.3713	43.4000	2.97500e+10	1.99500e+10	2	1
7	69	93.7233	15.5719	43.4000	2.96250e+10	1.98250e+10	2	1
7	70	97.3265	20.4238	43.4000	2.98750e+10	2.00750e+10	2	1
7	71	104.121	25.7619	43.4000	2.96250e+10	1.98250e+10	2	1
7	72	101.670	6.72384	43.4000	2.97500e+10	1.99500e+10	2	1
7	73	104.314	11.3415	43.4000	2.95000e+10	1.97000e+10	2	1
7	74	110.399	16.2599	43.4000	2.97500e+10	1.99500e+10	2	1
7	75	39.0161	-2.01486	43.4000	2.96250e+10	1.98250e+10	2	1

7	76	39.0282	-6.06061	43.4000	2.98750e+10	2.00750e+10	2	1
7	77	100.545	-2.22914	43.4000	2.97500e+10	1.99500e+10	2	1
7	78	34.9839	2.01486	43.4000	2.95000e+10	1.97000e+10	2	1
7	79	34.9718	6.06061	43.4000	2.97500e+10	1.99500e+10	2	1
7	80	34.9469	10.1555	43.4000	2.95000e+10	1.97000e+10	2	1
7	81	34.9077	14.3359	43.4000	2.97500e+10	1.99500e+10	2	1
7	82	34.8516	18.6441	43.4000	2.95000e+10	1.97000e+10	2	1
7	83	34.7742	23.1329	43.4000	2.97500e+10	1.99500e+10	2	1
7	84	34.7742	23.1329	43.4000	2.97500e+10	1.99500e+10	2	2
7	85	34.6685	27.8719	43.4000	2.95000e+10	1.97000e+10	2	1
7	86	34.6685	27.8719	43.4000	2.95000e+10	1.97000e+10	2	2
7	87	34.5224	32.9603	43.4000	2.97500e+10	1.99500e+10	2	1
7	88	34.5224	32.9603	43.4000	2.97500e+10	1.99500e+10	2	2
7	89	34.3132	38.5516	43.4000	2.95000e+10	1.97000e+10	2	1
7	90	34.3132	38.5516	43.4000	2.95000e+10	1.97000e+10	2	2
7	91	33.9920	44.9144	43.4000	2.97500e+10	1.99500e+10	2	1
7	92	33.9920	44.9144	43.4000	2.97500e+10	1.99500e+10	2	2
7	93	33.4270	52.6163	43.4000	2.95000e+10	1.97000e+10	2	1
7	94	32.0064	63.4581	43.4000	2.97500e+10	1.99500e+10	2	1
7	95	30.9356	2.01685	43.4000	2.98750e+10	2.00750e+10	2	1
7	96	13.8515	2.04676	43.4000	2.98750e+10	2.00750e+10	2	1
7	97	9.10846	2.06088	43.4000	2.95000e+10	1.97000e+10	2	1
7	98	30.7050	14.3511	43.4000	2.96250e+10	1.98250e+10	2	1
7	99	29.9794	27.9079	43.4000	2.98750e+10	2.00750e+10	2	1
7	100	29.9794	27.9079	43.4000	2.98750e+10	2.00750e+10	2	2
7	101	29.5350	33.0078	43.4000	2.96250e+10	1.98250e+10	2	1
7	102	29.5350	33.0078	43.4000	2.96250e+10	1.98250e+10	2	2
7	103	28.8968	38.6163	43.4000	2.98750e+10	2.00750e+10	2	1
7	104	28.8968	38.6163	43.4000	2.98750e+10	2.00750e+10	2	2
7	105	27.9127	45.0081	43.4000	2.96250e+10	1.98250e+10	2	1
7	106	27.9127	45.0081	43.4000	2.96250e+10	1.98250e+10	2	2
7	107	26.1632	52.7714	43.4000	2.98750e+10	2.00750e+10	2	1
7	108	21.5936	63.8501	43.4000	2.96250e+10	1.98250e+10	2	1
7	109	26.4463	14.3818	43.4000	2.97500e+10	1.99500e+10	2	1
7	110	25.2091	27.9810	43.4000	2.95000e+10	1.97000e+10	2	1
7	111	24.4473	33.1048	43.4000	2.97500e+10	1.99500e+10	2	1
7	112	23.3467	38.7491	43.4000	2.95000e+10	1.97000e+10	2	1
7	113	23.3467	38.7491	43.4000	2.95000e+10	1.97000e+10	2	2
7	114	21.6319	45.2020	43.4000	2.97500e+10	1.99500e+10	2	1
7	115	21.6319	45.2020	43.4000	2.97500e+10	1.99500e+10	2	2
7	116	18.5123	53.0989	43.4000	2.95000e+10	1.97000e+10	2	1
7	117	18.5123	53.0989	43.4000	2.95000e+10	1.97000e+10	2	2
7	118	9.52306	64.7719	43.4000	2.97500e+10	1.99500e+10	2	1
7	119	9.52306	64.7719	43.4000	2.97500e+10	1.99500e+10	2	2
7	120	22.0902	14.4291	43.4000	2.96250e+10	1.98250e+10	2	1
7	121	21.6719	18.7715	43.4000	2.98750e+10	2.00750e+10	2	1
7	122	21.0925	23.3018	43.4000	2.96250e+10	1.98250e+10	2	1
7	123	20.2952	28.0941	43.4000	2.98750e+10	2.00750e+10	2	1
7	124	19.1801	33.2557	43.4000	2.96250e+10	1.98250e+10	2	1
7	125	17.5531	38.9573	43.4000	2.98750e+10	2.00750e+10	2	1
7	126	17.5531	38.9573	43.4000	2.98750e+10	2.00750e+10	2	2
7	127	14.9724	45.5111	43.4000	2.96250e+10	1.98250e+10	2	1
7	128	14.9724	45.5111	43.4000	2.96250e+10	1.98250e+10	2	2
7	129	10.0740	53.6434	43.4000	2.98750e+10	2.00750e+10	2	1
7	130	10.0740	53.6434	43.4000	2.98750e+10	2.00750e+10	2	2
7	131	-8.59031	66.9238	43.4000	2.96250e+10	1.98250e+10	2	1
7	132	17.5871	14.4944	43.4000	2.97500e+10	1.99500e+10	2	1
7	133	15.1597	28.2519	43.4000	2.95000e+10	1.97000e+10	2	1
7	134	13.6312	33.4679	43.4000	2.97500e+10	1.99500e+10	2	1
7	135	11.3664	39.2544	43.4000	2.95000e+10	1.97000e+10	2	1
7	136	11.3664	39.2544	43.4000	2.95000e+10	1.97000e+10	2	2
7	137	7.66525	45.9648	43.4000	2.97500e+10	1.99500e+10	2	1
7	138	7.66525	45.9648	43.4000	2.97500e+10	1.99500e+10	2	2
7	139	7.66525	45.9648	43.4000	2.97500e+10	1.99500e+10	2	3
7	140	0.0504837	54.5124	43.4000	2.95000e+10	1.97000e+10	2	1
7	141	0.0504837	54.5124	43.4000	2.95000e+10	1.97000e+10	2	2
7	142	0.0504837	54.5124	43.4000	2.95000e+10	1.97000e+10	2	3
7	143	13.3791	10.3221	43.4000	2.98750e+10	2.00750e+10	2	1
7	144	12.8745	14.5799	43.4000	2.96250e+10	1.98250e+10	2	1
7	145	7.65427	33.7544	43.4000	2.96250e+10	1.98250e+10	2	1
7	146	4.55267	39.6646	43.4000	2.98750e+10	2.00750e+10	2	1
7	147	4.55267	39.6646	43.4000	2.98750e+10	2.00750e+10	2	2
7	148	-0.787701	46.6242	43.4000	2.96250e+10	1.98250e+10	2	1
7	149	-0.787701	46.6242	43.4000	2.96250e+10	1.98250e+10	2	2
7	150	-0.787701	46.6242	43.4000	2.96250e+10	1.98250e+10	2	3
7	151	-14.1444	56.0734	43.4000	2.98750e+10	2.00750e+10	2	1
7	152	-14.1444	56.0734	43.4000	2.98750e+10	2.00750e+10	2	2
7	153	8.91341	6.20072	43.4000	2.97500e+10	1.99500e+10	2	1
7	154	8.50974	10.3962	43.4000	2.95000e+10	1.97000e+10	2	1
7	155	7.86740	14.6890	43.4000	2.97500e+10	1.99500e+10	2	1

7	156	1.01273	34.1375	43.4000	2.97500e+10	1.99500e+10	2	1
7	157	-3.31949	40.2359	43.4000	2.95000e+10	1.97000e+10	2	1
7	158	-3.31949	40.2359	43.4000	2.95000e+10	1.97000e+10	2	2
7	159	3.76903	6.25483	43.4000	2.96250e+10	1.98250e+10	2	1
7	160	3.25792	10.4896	43.4000	2.98750e+10	2.00750e+10	2	1
7	161	2.44025	14.8274	43.4000	2.96250e+10	1.98250e+10	2	1
7	162	-6.74520	34.6620	43.4000	2.96250e+10	1.98250e+10	2	1
7	163	-1.89698	6.32314	43.4000	2.97500e+10	1.99500e+10	2	1
7	164	-2.55319	10.6082	43.4000	2.95000e+10	1.97000e+10	2	1
7	165	-3.61203	15.0044	43.4000	2.97500e+10	1.99500e+10	2	1
7	166	-8.36995	6.41126	43.4000	2.96250e+10	1.98250e+10	2	1
7	167	-9.24475	10.7623	43.4000	2.98750e+10	2.00750e+10	2	1
7	168	-10.6786	15.2378	43.4000	2.96250e+10	1.98250e+10	2	1
7	169	34.9839	-2.01486	43.4000	2.97500e+10	1.99500e+10	2	1
7	170	34.9718	-6.06061	43.4000	2.95000e+10	1.97000e+10	2	1
7	171	34.9469	-10.1555	43.4000	2.97500e+10	1.99500e+10	2	1
7	172	34.9077	-14.3359	43.4000	2.95000e+10	1.97000e+10	2	1
7	173	34.8516	-18.6441	43.4000	2.97500e+10	1.99500e+10	2	1
7	174	34.7742	-23.1329	43.4000	2.95000e+10	1.97000e+10	2	1
7	175	13.8515	-2.04676	43.4000	2.96250e+10	1.98250e+10	2	1
7	176	30.5348	-18.6648	43.4000	2.96250e+10	1.98250e+10	2	1
7	177	30.3002	-23.1603	43.4000	2.98750e+10	2.00750e+10	2	1
7	178	29.9794	-27.9079	43.4000	2.96250e+10	1.98250e+10	2	1
7	179	29.5350	-33.0078	43.4000	2.98750e+10	2.00750e+10	2	1
7	180	25.2091	-27.9810	43.4000	2.97500e+10	1.99500e+10	2	1
7	181	24.4473	-33.1048	43.4000	2.95000e+10	1.97000e+10	2	1
7	182	21.6719	-18.7715	43.4000	2.96250e+10	1.98250e+10	2	1
7	183	21.0925	-23.3018	43.4000	2.98750e+10	2.00750e+10	2	1
7	184	20.2952	-28.0941	43.4000	2.96250e+10	1.98250e+10	2	1
7	185	19.1801	-33.2557	43.4000	2.98750e+10	2.00750e+10	2	1
7	186	17.0247	-18.8609	43.4000	2.97500e+10	1.99500e+10	2	1
7	187	16.2425	-23.4209	43.4000	2.95000e+10	1.97000e+10	2	1
7	188	15.1597	-28.2519	43.4000	2.97500e+10	1.99500e+10	2	1
7	189	13.6974	-6.15768	43.4000	2.98750e+10	2.00750e+10	2	1
7	190	13.3791	-10.3221	43.4000	2.96250e+10	1.98250e+10	2	1
7	191	12.8745	-14.5799	43.4000	2.98750e+10	2.00750e+10	2	1
7	192	12.1445	-18.9785	43.4000	2.96250e+10	1.98250e+10	2	1

Satellite Number 8 -ASIA2

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
8	1	117.016	2.01486	43.4000	2.98750e+10	2.00750e+10	2	1
8	2	117.028	6.06061	43.4000	2.96250e+10	1.98250e+10	2	1
8	3	117.226	23.1329	43.4000	2.96250e+10	1.98250e+10	2	1
8	4	117.331	27.8719	43.4000	2.98750e+10	2.00750e+10	2	1
8	5	117.331	27.8719	43.4000	2.98750e+10	2.00750e+10	2	2
8	6	117.478	32.9603	43.4000	2.96250e+10	1.98250e+10	2	1
8	7	117.478	32.9603	43.4000	2.96250e+10	1.98250e+10	2	2
8	8	117.687	38.5516	43.4000	2.98750e+10	2.00750e+10	2	1
8	9	118.008	44.9144	43.4000	2.96250e+10	1.98250e+10	2	1
8	10	118.573	52.6163	43.4000	2.98750e+10	2.00750e+10	2	1
8	11	119.994	63.4581	43.4000	2.96250e+10	1.98250e+10	2	1
8	12	121.064	2.01685	43.4000	2.95000e+10	1.97000e+10	2	1
8	13	121.101	6.06668	43.4000	2.97500e+10	1.95000e+10	2	1
8	14	121.176	10.1659	43.4000	2.95000e+10	1.97000e+10	2	1
8	15	121.295	14.3511	43.4000	2.97500e+10	1.95000e+10	2	1
8	16	121.465	18.6648	43.4000	2.95000e+10	1.97000e+10	2	1
8	17	121.700	23.1603	43.4000	2.97500e+10	1.95000e+10	2	1
8	18	122.021	27.9079	43.4000	2.95000e+10	1.97000e+10	2	1
8	19	122.465	33.0078	43.4000	2.97500e+10	1.95000e+10	2	1
8	20	123.103	38.6163	43.4000	2.95000e+10	1.97000e+10	2	1
8	21	124.087	45.0081	43.4000	2.97500e+10	1.95000e+10	2	1
8	22	125.837	52.7714	43.4000	2.95000e+10	1.97000e+10	2	1
8	23	125.224	6.07899	43.4000	2.96250e+10	1.98250e+10	2	1
8	24	125.352	10.1870	43.4000	2.98750e+10	2.00750e+10	2	1
8	25	128.653	38.7491	43.4000	2.98750e+10	2.00750e+10	2	1
8	26	130.368	45.2020	43.4000	2.96250e+10	1.98250e+10	2	1
8	27	133.488	53.0989	43.4000	2.98750e+10	2.00750e+10	2	1
8	28	132.820	33.2557	43.4000	2.97500e+10	1.95000e+10	2	1
8	29	132.820	33.2557	43.4000	2.97500e+10	1.95000e+10	2	2
8	30	132.820	33.2557	43.4000	2.97500e+10	1.95000e+10	2	3
8	31	134.447	38.9573	43.4000	2.95000e+10	1.97000e+10	2	1
8	32	137.028	45.5111	43.4000	2.97500e+10	1.95000e+10	2	1
8	33	141.926	53.6434	43.4000	2.95000e+10	1.97000e+10	2	1
8	34	160.590	66.9238	43.4000	2.97500e+10	1.95000e+10	2	1
8	35	138.369	33.4679	43.4000	2.96250e+10	1.98250e+10	2	1
8	36	138.369	33.4679	43.4000	2.96250e+10	1.98250e+10	2	2
8	37	138.369	33.4679	43.4000	2.96250e+10	1.98250e+10	2	3
8	38	140.634	39.2544	43.4000	2.98750e+10	2.00750e+10	2	1
8	39	140.634	39.2544	43.4000	2.98750e+10	2.00750e+10	2	2
8	40	140.634	39.2544	43.4000	2.98750e+10	2.00750e+10	2	3
8	41	144.335	45.9648	43.4000	2.96250e+10	1.98250e+10	2	1

8	42	151.950	54.5124	43.4000	2.98750e+10	2.00750e+10	2	1
8	43	166.144	56.0734	43.4000	2.95000e+10	1.97000e+10	2	1
8	44	143.490	10.3962	43.4000	2.98750e+10	2.00750e+10	2	1
8	45	117.016	-2.01486	43.4000	2.96250e+10	1.98250e+10	2	1
8	46	117.028	-6.06061	43.4000	2.98750e+10	2.00750e+10	2	1
8	47	117.226	-23.1329	43.4000	2.98750e+10	2.00750e+10	2	1
8	48	117.331	-27.8719	43.4000	2.96250e+10	1.98250e+10	2	1
8	49	117.478	-32.9603	43.4000	2.98750e+10	2.00750e+10	2	1
8	50	121.064	-2.01685	43.4000	2.97500e+10	1.95000e+10	2	1
8	51	125.162	-2.02090	43.4000	2.96250e+10	1.98250e+10	2	1
8	52	129.345	-2.02710	43.4000	2.97500e+10	1.95000e+10	2	1
8	53	133.656	-2.03563	43.4000	2.96250e+10	1.98250e+10	2	1
8	54	138.149	-2.04676	43.4000	2.97500e+10	1.95000e+10	2	1
8	55	142.892	-2.06087	43.4000	2.96250e+10	1.98250e+10	2	1
8	56	121.176	-10.1659	43.4000	2.97500e+10	1.95000e+10	2	1
8	57	121.465	-18.6648	43.4000	2.97500e+10	1.95000e+10	2	1
8	58	121.700	-23.1603	43.4000	2.95000e+10	1.97000e+10	2	1
8	59	122.021	-27.9079	43.4000	2.97500e+10	1.95000e+10	2	1
8	60	122.465	-33.0078	43.4000	2.95000e+10	1.97000e+10	2	1
8	61	125.352	-10.1870	43.4000	2.96250e+10	1.98250e+10	2	1
8	62	125.554	-14.3818	43.4000	2.98750e+10	2.00750e+10	2	1
8	63	125.843	-18.7069	43.4000	2.96250e+10	1.98250e+10	2	1
8	64	126.243	-23.2160	43.4000	2.98750e+10	2.00750e+10	2	1
8	65	126.791	-27.9810	43.4000	2.96250e+10	1.98250e+10	2	1
8	66	127.553	-33.1048	43.4000	2.98750e+10	2.00750e+10	2	1
8	67	129.910	-14.4291	43.4000	2.95000e+10	1.97000e+10	2	1
8	68	130.328	-18.7715	43.4000	2.97500e+10	1.95000e+10	2	1
8	69	130.908	-23.3018	43.4000	2.95000e+10	1.97000e+10	2	1
8	70	131.705	-28.0941	43.4000	2.97500e+10	1.95000e+10	2	1
8	71	132.820	-33.2557	43.4000	2.95000e+10	1.97000e+10	2	1
8	72	133.776	-6.12380	43.4000	2.98750e+10	2.00750e+10	2	1
8	73	134.413	-14.4944	43.4000	2.98750e+10	2.00750e+10	2	1
8	74	134.975	-18.8609	43.4000	2.96250e+10	1.98250e+10	2	1
8	75	135.757	-23.4209	43.4000	2.98750e+10	2.00750e+10	2	1
8	76	136.840	-28.2519	43.4000	2.96250e+10	1.98250e+10	2	1
8	77	138.369	-33.4679	43.4000	2.98750e+10	2.00750e+10	2	1
8	78	138.303	-6.15768	43.4000	2.95000e+10	1.97000e+10	2	1
8	79	139.125	-14.5799	43.4000	2.95000e+10	1.97000e+10	2	1
8	80	139.856	-18.9785	43.4000	2.97500e+10	1.95000e+10	2	1
8	81	140.877	-23.5783	43.4000	2.95000e+10	1.97000e+10	2	1
8	82	142.303	-28.4622	43.4000	2.97500e+10	1.95000e+10	2	1
8	83	144.346	-33.7544	43.4000	2.95000e+10	1.97000e+10	2	1
8	84	143.087	-6.20071	43.4000	2.98750e+10	2.00750e+10	2	1
8	85	144.133	-14.6890	43.4000	2.98750e+10	2.00750e+10	2	1
8	86	145.067	-19.1294	43.4000	2.96250e+10	1.98250e+10	2	1
8	87	146.386	-23.7821	43.4000	2.98750e+10	2.00750e+10	2	1
8	88	148.253	-28.7378	43.4000	2.96250e+10	1.98250e+10	2	1
8	89	150.987	-34.1375	43.4000	2.98750e+10	2.00750e+10	2	1
8	90	150.987	-34.1375	43.4000	2.98750e+10	2.00750e+10	2	2
8	91	148.231	-6.25483	43.4000	2.95000e+10	1.97000e+10	2	1
8	92	152.476	-24.0457	43.4000	2.95000e+10	1.97000e+10	2	1
8	93	154.961	-29.1014	43.4000	2.97500e+10	1.95000e+10	2	1
8	94	154.961	-29.1014	43.4000	2.97500e+10	1.95000e+10	2	2
8	95	165.296	-41.0864	43.4000	2.97500e+10	1.95000e+10	2	1
8	96	186.664	-50.2498	43.4000	2.95000e+10	1.97000e+10	2	1
8	97	153.897	-6.32314	43.4000	2.98750e+10	2.00750e+10	2	1
8	98	168.772	-35.4420	43.4000	2.98750e+10	2.00750e+10	2	1
8	99	183.033	-42.8427	43.4000	2.96250e+10	1.98250e+10	2	1
8	100	161.245	-10.7623	43.4000	2.97500e+10	1.95000e+10	2	1
8	101	164.873	-19.9096	43.4000	2.97500e+10	1.95000e+10	2	1
8	102	190.338	-37.3713	43.4000	2.95000e+10	1.97000e+10	2	1
8	103	171.723	-15.5719	43.4000	2.98750e+10	2.00750e+10	2	1
8	104	112.984	2.01486	43.4000	2.95000e+10	1.97000e+10	2	1
8	105	112.852	18.6441	43.4000	2.95000e+10	1.97000e+10	2	1
8	106	112.774	23.1329	43.4000	2.97500e+10	1.95000e+10	2	1
8	107	112.774	23.1329	43.4000	2.97500e+10	1.95000e+10	2	2
8	108	112.669	27.8719	43.4000	2.95000e+10	1.97000e+10	2	1
8	109	112.669	27.8719	43.4000	2.95000e+10	1.97000e+10	2	2
8	110	112.522	32.9603	43.4000	2.97500e+10	1.95000e+10	2	1
8	111	112.313	38.5516	43.4000	2.95000e+10	1.97000e+10	2	1
8	112	111.992	44.9144	43.4000	2.97500e+10	1.95000e+10	2	1
8	113	111.427	52.6163	43.4000	2.95000e+10	1.97000e+10	2	1
8	114	108.936	2.01685	43.4000	2.98750e+10	2.00750e+10	2	1
8	115	104.838	2.02090	43.4000	2.95000e+10	1.97000e+10	2	1
8	116	100.655	2.02710	43.4000	2.98750e+10	2.00750e+10	2	1
8	117	96.3437	2.03563	43.4000	2.95000e+10	1.97000e+10	2	1
8	118	91.8515	2.04676	43.4000	2.98750e+10	2.00750e+10	2	1
8	119	108.824	10.1659	43.4000	2.98750e+10	2.00750e+10	2	1
8	120	108.705	14.3511	43.4000	2.96250e+10	1.98250e+10	2	1
8	121	108.535	18.6648	43.4000	2.98750e+10	2.00750e+10	2	1

8	122	108.300	23.1603	43.4000	2.96250e+10	1.98250e+10	2	1
8	123	108.300	23.1603	43.4000	2.96250e+10	1.98250e+10	2	2
8	124	107.979	27.9079	43.4000	2.98750e+10	2.00750e+10	2	1
8	125	107.535	33.0078	43.4000	2.96250e+10	1.98250e+10	2	1
8	126	106.897	38.6163	43.4000	2.98750e+10	2.00750e+10	2	1
8	127	105.913	45.0081	43.4000	2.96250e+10	1.98250e+10	2	1
8	128	104.776	6.07899	43.4000	2.97500e+10	1.95000e+10	2	1
8	129	104.648	10.1870	43.4000	2.95000e+10	1.97000e+10	2	1
8	130	104.446	14.3818	43.4000	2.97500e+10	2.00050e+10	2	1
8	131	104.157	18.7069	43.4000	2.95000e+10	1.97000e+10	2	1
8	132	103.757	23.2160	43.4000	2.97500e+10	1.95000e+10	2	1
8	133	103.209	27.9810	43.4000	2.95000e+10	1.97000e+10	2	1
8	134	102.447	33.1048	43.4000	2.97500e+10	1.95000e+10	2	1
8	135	101.347	38.7491	43.4000	2.95000e+10	1.97000e+10	2	1
8	136	99.6319	45.2020	43.4000	2.97500e+10	1.95000e+10	2	1
8	137	96.5123	53.0989	43.4000	2.95000e+10	1.97000e+10	2	1
8	138	100.566	6.09785	43.4000	2.96250e+10	1.98250e+10	2	1
8	139	100.381	10.2193	43.4000	2.98750e+10	2.00750e+10	2	1
8	140	100.090	14.4291	43.4000	2.96250e+10	1.98250e+10	2	1
8	141	99.6719	18.7715	43.4000	2.98750e+10	2.00750e+10	2	1
8	142	99.0925	23.3018	43.4000	2.96250e+10	1.98250e+10	2	1
8	143	98.2952	28.0941	43.4000	2.98750e+10	2.00750e+10	2	1
8	144	97.1801	33.2557	43.4000	2.96250e+10	1.98250e+10	2	1
8	145	95.5531	38.9573	43.4000	2.98750e+10	2.00750e+10	2	1
8	146	92.9724	45.5111	43.4000	2.96250e+10	1.98250e+10	2	1
8	147	88.0740	53.6434	43.4000	2.98750e+10	2.00750e+10	2	1
8	148	96.2241	6.12380	43.4000	2.97500e+10	1.95000e+10	2	1
8	149	95.9773	10.2638	43.4000	2.95000e+10	1.97000e+10	2	1
8	150	95.5871	14.4944	43.4000	2.97500e+10	1.95000e+10	2	1
8	151	95.0247	18.8609	43.4000	2.95000e+10	1.97000e+10	2	1
8	152	94.2425	23.4209	43.4000	2.97500e+10	1.95000e+10	2	1
8	153	93.1597	28.2519	43.4000	2.95000e+10	1.97000e+10	2	1
8	154	91.6312	33.4679	43.4000	2.97500e+10	1.95000e+10	2	1
8	155	89.3664	39.2544	43.4000	2.95000e+10	1.97000e+10	2	1
8	156	85.6653	45.9648	43.4000	2.97500e+10	1.95000e+10	2	1
8	157	91.6974	6.15768	43.4000	2.96250e+10	1.98250e+10	2	1
8	158	89.1231	23.5783	43.4000	2.96250e+10	1.98250e+10	2	1
8	159	87.6966	28.4622	43.4000	2.98750e+10	2.00750e+10	2	1
8	160	85.6543	33.7544	43.4000	2.96250e+10	1.98250e+10	2	1
8	161	82.5527	39.6646	43.4000	2.98750e+10	2.00750e+10	2	1
8	162	77.2123	46.6242	43.4000	2.96250e+10	1.98250e+10	2	1
8	163	84.9328	19.1294	43.4000	2.95000e+10	1.97000e+10	2	1
8	164	83.6139	23.7821	43.4000	2.97500e+10	1.95000e+10	2	1
8	165	81.7467	28.7378	43.4000	2.95000e+10	1.97000e+10	2	1
8	166	79.0127	34.1375	43.4000	2.97500e+10	1.95000e+10	2	1
8	167	74.6805	40.2359	43.4000	2.95000e+10	1.97000e+10	2	1
8	168	81.2579	10.4896	43.4000	2.98750e+10	2.00750e+10	2	1
8	169	80.4402	14.8274	43.4000	2.96250e+10	1.98250e+10	2	1
8	170	79.2403	19.3223	43.4000	2.98750e+10	2.00750e+10	2	1
8	171	77.5237	24.0457	43.4000	2.96250e+10	1.98250e+10	2	1
8	172	75.0395	29.1014	43.4000	2.98750e+10	2.00750e+10	2	1
8	173	71.2548	34.6620	43.4000	2.96250e+10	1.98250e+10	2	1
8	174	64.7039	41.0864	43.4000	2.98750e+10	2.00750e+10	2	1
8	175	75.4468	10.6082	43.4000	2.95000e+10	1.97000e+10	2	1
8	176	74.3880	15.0044	43.4000	2.97500e+10	1.95000e+10	2	1
8	177	72.8119	19.5721	43.4000	2.95000e+10	1.97000e+10	2	1
8	178	70.5038	24.3942	43.4000	2.97500e+10	1.95000e+10	2	1
8	179	67.0217	29.6006	43.4000	2.95000e+10	1.97000e+10	2	1
8	180	61.2282	35.4420	43.4000	2.97500e+10	1.95000e+10	2	1
8	181	61.7489	24.8861	43.4000	2.96250e+10	1.98250e+10	2	1
8	182	112.984	-2.01486	43.4000	2.97500e+10	1.95000e+10	2	1
8	183	112.972	-6.06061	43.4000	2.95000e+10	1.97000e+10	2	1
8	184	112.947	-10.1555	43.4000	2.97500e+10	1.95000e+10	2	1
8	185	108.936	-2.01685	43.4000	2.96250e+10	1.98250e+10	2	1
8	186	104.838	-2.02090	43.4000	2.97500e+10	1.95000e+10	2	1
8	187	100.655	-2.02710	43.4000	2.96250e+10	1.98250e+10	2	1
8	188	96.3437	-2.03563	43.4000	2.97500e+10	1.95000e+10	2	1
8	189	108.899	-6.06668	43.4000	2.98750e+10	2.00750e+10	2	1
8	190	104.776	-6.07899	43.4000	2.95000e+10	1.97000e+10	2	1
8	191	100.566	-6.09785	43.4000	2.98750e+10	2.00750e+10	2	1
8	192	100.566	-6.09785	43.4000	2.98750e+10	2.00750e+10	2	1

Satellite Number 9 -ATLANTIC2

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
9	1	-26.3132	38.5516	43.4000	2.98750e+10	2.00750e+10	2	1
9	2	9.58232	2.10093	43.4000	2.98750e+10	2.00750e+10	2	1
9	3	15.9539	2.12963	43.4000	2.95000e+10	1.97000e+10	2	1
9	4	23.6701	2.16845	43.4000	2.98750e+10	2.00750e+10	2	1
9	5	34.5451	2.22914	43.4000	2.95000e+10	1.97000e+10	2	1
9	6	-13.5936	63.8501	43.4000	2.97500e+10	1.99500e+10	2	1
9	7	-18.1569	18.7069	43.4000	2.98750e+10	2.00750e+10	2	1

9	8	-17.7571	23.2160	43.4000	2.96250e+10	1.98250e+10	2	1
9	9	-10.5123	53.0989	43.4000	2.98750e+10	2.00750e+10	2	1
9	10	-14.3812	10.2193	43.4000	2.95000e+10	1.97000e+10	2	1
9	11	-14.0902	14.4291	43.4000	2.97500e+10	1.99500e+10	2	1
9	12	-13.6719	18.7715	43.4000	2.95000e+10	1.97000e+10	2	1
9	13	-13.0925	23.3018	43.4000	2.97500e+10	1.99500e+10	2	1
9	14	-12.2952	28.0941	43.4000	2.95000e+10	1.97000e+10	2	1
9	15	-6.97241	45.5111	43.4000	2.97500e+10	1.99500e+10	2	1
9	16	-2.07396	53.6434	43.4000	2.95000e+10	1.97000e+10	2	1
9	17	16.5903	66.9238	43.4000	2.97500e+10	1.99500e+10	2	1
9	18	-10.2241	6.12380	43.4000	2.96250e+10	1.98250e+10	2	1
9	19	-9.97732	10.2638	43.4000	2.98750e+10	2.00750e+10	2	1
9	20	-9.58708	14.4944	43.4000	2.96250e+10	1.98250e+10	2	1
9	21	-9.02471	18.8609	43.4000	2.98750e+10	2.00750e+10	2	1
9	22	-8.24250	23.4209	43.4000	2.96250e+10	1.98250e+10	2	1
9	23	-7.15972	28.2519	43.4000	2.98750e+10	2.00750e+10	2	1
9	24	-5.63118	33.4679	43.4000	2.96250e+10	1.98250e+10	2	1
9	25	-3.36640	39.2544	43.4000	2.98750e+10	2.00750e+10	2	1
9	26	0.334751	45.9648	43.4000	2.96250e+10	1.98250e+10	2	1
9	27	7.94952	54.5124	43.4000	2.98750e+10	2.00750e+10	2	1
9	28	-5.69739	6.15768	43.4000	2.97500e+10	1.99500e+10	2	1
9	29	-5.37913	10.3221	43.4000	2.95000e+10	1.97000e+10	2	1
9	30	-4.87452	14.5799	43.4000	2.97500e+10	1.99500e+10	2	1
9	31	-4.14447	18.9785	43.4000	2.95000e+10	1.97000e+10	2	1
9	32	-3.12309	23.5783	43.4000	2.97500e+10	1.99500e+10	2	1
9	33	-1.69661	28.4622	43.4000	2.95000e+10	1.97000e+10	2	1
9	34	0.345734	33.7544	43.4000	2.97500e+10	1.99500e+10	2	1
9	35	3.44733	39.6646	43.4000	2.95000e+10	1.97000e+10	2	1
9	36	8.78770	46.6242	43.4000	2.97500e+10	1.99500e+10	2	1
9	37	22.1444	56.0734	43.4000	2.95000e+10	1.97000e+10	2	1
9	38	-0.913412	6.20072	43.4000	2.96250e+10	1.98250e+10	2	1
9	39	-0.509737	10.3962	43.4000	2.98750e+10	2.00750e+10	2	1
9	40	0.132605	14.6890	43.4000	2.96250e+10	1.98250e+10	2	1
9	41	1.06719	19.1294	43.4000	2.98750e+10	2.00750e+10	2	1
9	42	2.38613	23.7821	43.4000	2.96250e+10	1.98250e+10	2	1
9	43	4.25329	28.7378	43.4000	2.98750e+10	2.00750e+10	2	1
9	44	6.98727	34.1375	43.4000	2.96250e+10	1.98250e+10	2	1
9	45	11.3195	40.2359	43.4000	2.98750e+10	2.00750e+10	2	1
9	46	19.6403	47.6483	43.4000	2.96250e+10	1.98250e+10	2	1
9	47	4.23097	6.25483	43.4000	2.97500e+10	1.99500e+10	2	1
9	48	4.74208	10.4896	43.4000	2.95000e+10	1.97000e+10	2	1
9	49	5.55975	14.8274	43.4000	2.97500e+10	1.99500e+10	2	1
9	50	6.75971	19.3223	43.4000	2.95000e+10	1.97000e+10	2	1
9	51	8.47626	24.0457	43.4000	2.97500e+10	1.99500e+10	2	1
9	52	10.9605	29.1014	43.4000	2.95000e+10	1.97000e+10	2	1
9	53	14.7452	34.6620	43.4000	2.97500e+10	1.99500e+10	2	1
9	54	21.2961	41.0864	43.4000	2.95000e+10	1.97000e+10	2	1
9	55	9.89698	6.32314	43.4000	2.96250e+10	1.98250e+10	2	1
9	56	10.5532	10.6082	43.4000	2.98750e+10	2.00750e+10	2	1
9	57	11.6120	15.0044	43.4000	2.96250e+10	1.98250e+10	2	1
9	58	13.1881	19.5721	43.4000	2.98750e+10	2.00750e+10	2	1
9	59	15.4962	24.3942	43.4000	2.96250e+10	1.98250e+10	2	1
9	60	18.9783	29.6006	43.4000	2.98750e+10	2.00750e+10	2	1
9	61	24.7718	35.4420	43.4000	2.96250e+10	1.98250e+10	2	1
9	62	16.3700	6.41126	43.4000	2.97500e+10	1.99500e+10	2	1
9	63	17.2448	10.7623	43.4000	2.95000e+10	1.97000e+10	2	1
9	64	18.6786	15.2378	43.4000	2.97500e+10	1.99500e+10	2	1
9	65	20.8726	19.9096	43.4000	2.95000e+10	1.97000e+10	2	1
9	66	24.2511	24.8861	43.4000	2.97500e+10	1.99500e+10	2	1
9	67	29.9370	30.3744	43.4000	2.95000e+10	1.97000e+10	2	1
9	68	24.2668	6.53135	43.4000	2.96250e+10	1.98250e+10	2	1
9	69	25.5453	10.9760	43.4000	2.98750e+10	2.00750e+10	2	1
9	70	27.7233	15.5719	43.4000	2.96250e+10	1.98250e+10	2	1
9	71	31.3265	20.4238	43.4000	2.98750e+10	2.00750e+10	2	1
9	72	38.1207	25.7619	43.4000	2.96250e+10	1.98250e+10	2	1
9	73	35.6703	6.72384	43.4000	2.97500e+10	1.99500e+10	2	1
9	74	38.3143	11.3415	43.4000	2.95000e+10	1.97000e+10	2	1
9	75	44.3986	16.2599	43.4000	2.97500e+10	1.99500e+10	2	1
9	76	9.58232	-2.10093	43.4000	2.96250e+10	1.98250e+10	2	1
9	77	15.9539	-2.12963	43.4000	2.97500e+10	1.99500e+10	2	1
9	78	23.6701	-2.16844	43.4000	2.96250e+10	1.98250e+10	2	1
9	79	34.5451	-2.22914	43.4000	2.97500e+10	1.99500e+10	2	1
9	80	11.6120	-15.0044	43.4000	2.98750e+10	2.00750e+10	2	1
9	81	13.1881	-19.5721	43.4000	2.96250e+10	1.98250e+10	2	1
9	82	15.4962	-24.3942	43.4000	2.98750e+10	2.00750e+10	2	1
9	83	18.9783	-29.6006	43.4000	2.96250e+10	1.98250e+10	2	1
9	84	24.7718	-35.4420	43.4000	2.98750e+10	2.00750e+10	2	1
9	85	16.3700	-6.41126	43.4000	2.95000e+10	1.97000e+10	2	1
9	86	17.2448	-10.7623	43.4000	2.97500e+10	1.99500e+10	2	1
9	87	18.6786	-15.2378	43.4000	2.95000e+10	1.97000e+10	2	1

9	88	20.8726	-19.9096	43.4000	2.97500e+10	1.99500e+10	2	1
9	89	24.2511	-24.8861	43.4000	2.95000e+10	1.97000e+10	2	1
9	90	29.9370	-30.3744	43.4000	2.97500e+10	1.99500e+10	2	1
9	91	24.2668	-6.53135	43.4000	2.98750e+10	2.00750e+10	2	1
9	92	25.5453	-10.9760	43.4000	2.96250e+10	1.98250e+10	2	1
9	93	27.7233	-15.5719	43.4000	2.98750e+10	2.00750e+10	2	1
9	94	31.3265	-20.4238	43.4000	2.96250e+10	1.98250e+10	2	1
9	95	38.1207	-25.7619	43.4000	2.98750e+10	2.00750e+10	2	1
9	96	35.6703	-6.72384	43.4000	2.95000e+10	1.97000e+10	2	1
9	97	38.3143	-11.3415	43.4000	2.97500e+10	1.99500e+10	2	1
9	98	44.3986	-16.2599	43.4000	2.95000e+10	1.97000e+10	2	1
9	99	-33.9936	63.4581	43.4000	2.97500e+10	1.99500e+10	2	1
9	100	-52.1485	2.04676	43.4000	2.98750e+10	2.00750e+10	2	1
9	101	-56.8915	2.06088	43.4000	2.95000e+10	1.97000e+10	2	1
9	102	-61.9847	2.07860	43.4000	2.98750e+10	2.00750e+10	2	1
9	103	-67.5823	2.10093	43.4000	2.95000e+10	1.97000e+10	2	1
9	104	-73.9539	2.12963	43.4000	2.98750e+10	2.00750e+10	2	1
9	105	-44.4064	63.8501	43.4000	2.96250e+10	1.98250e+10	2	1
9	106	-55.9260	53.6434	43.4000	2.98750e+10	2.00750e+10	2	1
9	107	-74.5903	66.9238	43.4000	2.96250e+10	1.98250e+10	2	1
9	108	-58.3348	45.9648	43.4000	2.97500e+10	1.99500e+10	2	1
9	109	-52.3026	6.15768	43.4000	2.96250e+10	1.98250e+10	2	1
9	110	-66.7877	46.6242	43.4000	2.96250e+10	1.98250e+10	2	1
9	111	-80.1444	56.0734	43.4000	2.98750e+10	2.00750e+10	2	1
9	112	-57.0866	6.20072	43.4000	2.97500e+10	1.99500e+10	2	1
9	113	-69.3195	40.2359	43.4000	2.95000e+10	1.97000e+10	2	1
9	114	-77.6403	47.6483	43.4000	2.97500e+10	1.99500e+10	2	1
9	115	-62.2310	6.25483	43.4000	2.96250e+10	1.98250e+10	2	1
9	116	-62.7421	10.4896	43.4000	2.98750e+10	2.00750e+10	2	1
9	117	-72.7452	34.6620	43.4000	2.96250e+10	1.98250e+10	2	1
9	118	-79.2961	41.0864	43.4000	2.98750e+10	2.00750e+10	2	1
9	119	-79.2961	41.0864	43.4000	2.98750e+10	2.00750e+10	2	2
9	120	-100.664	50.2498	43.4000	2.96250e+10	1.98250e+10	2	1
9	121	-67.8970	6.32314	43.4000	2.97500e+10	1.99500e+10	2	1
9	122	-68.5532	10.6082	43.4000	2.95000e+10	1.97000e+10	2	1
9	123	-76.9783	29.6006	43.4000	2.95000e+10	1.97000e+10	2	1
9	124	-82.7718	35.4420	43.4000	2.97500e+10	1.99500e+10	2	1
9	125	-82.7718	35.4420	43.4000	2.97500e+10	1.99500e+10	2	2
9	126	-97.0325	42.8427	43.4000	2.95000e+10	1.97000e+10	2	1
9	127	-74.3699	6.41126	43.4000	2.96250e+10	1.98250e+10	2	1
9	128	-75.2448	10.7623	43.4000	2.98750e+10	2.00750e+10	2	1
9	129	-78.8726	19.9096	43.4000	2.98750e+10	2.00750e+10	2	1
9	130	-82.2511	24.8861	43.4000	2.96250e+10	1.98250e+10	2	1
9	131	-87.9370	30.3744	43.4000	2.98750e+10	2.00750e+10	2	1
9	132	-104.338	37.3713	43.4000	2.96250e+10	1.98250e+10	2	1
9	133	-83.5453	10.9760	43.4000	2.95000e+10	1.97000e+10	2	1
9	134	-85.7233	15.5719	43.4000	2.97500e+10	1.99500e+10	2	1
9	135	-89.3265	20.4238	43.4000	2.95000e+10	1.97000e+10	2	1
9	136	-96.1207	25.7619	43.4000	2.97500e+10	1.99500e+10	2	1
9	137	-43.3450	-2.02710	43.4000	2.96250e+10	1.98250e+10	2	1
9	138	-47.6563	-2.03563	43.4000	2.97500e+10	1.99500e+10	2	1
9	139	-52.1485	-2.04676	43.4000	2.96250e+10	1.98250e+10	2	1
9	140	-56.8915	-2.06087	43.4000	2.97500e+10	1.99500e+10	2	1
9	141	-61.9847	-2.07860	43.4000	2.96250e+10	1.98250e+10	2	1
9	142	-67.5823	-2.10093	43.4000	2.97500e+10	1.99500e+10	2	1
9	143	-73.9539	-2.12963	43.4000	2.96250e+10	1.98250e+10	2	1
9	144	-81.6701	-2.16844	43.4000	2.97500e+10	1.99500e+10	2	1
9	145	-35.1010	-6.06668	43.4000	2.98750e+10	2.00750e+10	2	1
9	146	-39.2240	-6.07899	43.4000	2.95000e+10	1.97000e+10	2	1
9	147	-39.3519	-10.1870	43.4000	2.97500e+10	1.99500e+10	2	1
9	148	-39.5537	-14.3818	43.4000	2.95000e+10	1.97000e+10	2	1
9	149	-39.8431	-18.7069	43.4000	2.97500e+10	1.99500e+10	2	1
9	150	-43.4345	-6.09785	43.4000	2.98750e+10	2.00750e+10	2	1
9	151	-43.6188	-10.2193	43.4000	2.96250e+10	1.98250e+10	2	1
9	152	-43.9098	-14.4291	43.4000	2.98750e+10	2.00750e+10	2	1
9	153	-44.3281	-18.7715	43.4000	2.96250e+10	1.98250e+10	2	1
9	154	-44.9075	-23.3018	43.4000	2.98750e+10	2.00750e+10	2	1
9	155	-47.7759	-6.12380	43.4000	2.95000e+10	1.97000e+10	2	1
9	156	-48.0227	-10.2639	43.4000	2.97500e+10	1.99500e+10	2	1
9	157	-48.4129	-14.4944	43.4000	2.95000e+10	1.97000e+10	2	1
9	158	-48.9753	-18.8609	43.4000	2.97500e+10	1.99500e+10	2	1
9	159	-49.7575	-23.4209	43.4000	2.95000e+10	1.97000e+10	2	1
9	160	-50.8403	-28.2519	43.4000	2.97500e+10	1.99500e+10	2	1
9	161	-52.3688	-33.4679	43.4000	2.95000e+10	1.97000e+10	2	1
9	162	-52.3026	-6.15768	43.4000	2.98750e+10	2.00750e+10	2	1
9	163	-52.6209	-10.3221	43.4000	2.96250e+10	1.98250e+10	2	1
9	164	-53.1255	-14.5799	43.4000	2.98750e+10	2.00750e+10	2	1
9	165	-53.8555	-18.9785	43.4000	2.96250e+10	1.98250e+10	2	1
9	166	-54.8769	-23.5783	43.4000	2.98750e+10	2.00750e+10	2	1
9	167	-56.3034	-28.4622	43.4000	2.96250e+10	1.98250e+10	2	1

9	168	-58.3457	-33.7544	43.4000	2.98750e+10	2.00750e+10	2	1
9	169	-61.4473	-39.6646	43.4000	2.96250e+10	1.98250e+10	2	1
9	170	-66.7877	-46.6242	43.4000	2.98750e+10	2.00750e+10	2	1
9	171	-57.0866	-6.20071	43.4000	2.95000e+10	1.97000e+10	2	1
9	172	-57.4903	-10.3962	43.4000	2.97500e+10	1.99500e+10	2	1
9	173	-58.1326	-14.6890	43.4000	2.95000e+10	1.97000e+10	2	1
9	174	-59.0672	-19.1294	43.4000	2.97500e+10	1.99500e+10	2	1
9	175	-60.3861	-23.7821	43.4000	2.95000e+10	1.97000e+10	2	1
9	176	-62.2533	-28.7378	43.4000	2.97500e+10	1.99500e+10	2	1
9	177	-64.9873	-34.1375	43.4000	2.95000e+10	1.97000e+10	2	1
9	178	-69.3195	-40.2359	43.4000	2.97500e+10	1.99500e+10	2	1
9	179	-62.2310	-6.25483	43.4000	2.98750e+10	2.00750e+10	2	1
9	180	-62.7421	-10.4896	43.4000	2.96250e+10	1.98250e+10	2	1
9	181	-63.5597	-14.8274	43.4000	2.98750e+10	2.00750e+10	2	1
9	182	-64.7597	-19.3223	43.4000	2.96250e+10	1.98250e+10	2	1
9	183	-66.4763	-24.0457	43.4000	2.98750e+10	2.00750e+10	2	1
9	184	-68.9605	-29.1014	43.4000	2.96250e+10	1.98250e+10	2	1
9	185	-72.7452	-34.6620	43.4000	2.98750e+10	2.00750e+10	2	1
9	186	-67.8970	-6.32314	43.4000	2.95000e+10	1.97000e+10	2	1
9	187	-68.5532	-10.6082	43.4000	2.97500e+10	1.99500e+10	2	1
9	188	-69.6120	-15.0044	43.4000	2.95000e+10	1.97000e+10	2	1
9	189	-71.1881	-19.5721	43.4000	2.97500e+10	1.99500e+10	2	1
9	190	-74.3699	-6.41126	43.4000	2.98750e+10	2.00750e+10	2	1
9	191	-75.2448	-10.7623	43.4000	2.96250e+10	1.98250e+10	2	1
9	192	-82.2668	-6.53135	43.4000	2.95000e+10	1.97000e+10	2	1

Appendix A5: GEO(12) Sample Input File

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**********************************************************
GEO(12)
**********************************************************
12      number of sats
64      number of beams per sat
1       number of scan positions per beam
0       beam coordinate system [0=lon/lat, 1=relative Az/El]
1       channels per beam
1       number of polarizations
120.e6  bandwidth per channel (Hz)
92.e6   channel capacity (bits/sec)
6500.   comms power
_________________________________________________________
Inter-Satellite Links
0       Number of ISL per satellite
___________________________________________________________
Misc
beam.dat
____________________________________________________
Downlink
30.     power per channel (W)
79.6    Data Rate (dBHz)
5.0     Eb/No required (dB)
41.1    Gain Receiver (dB)
23.8    System Temperature (dBK)
-0.5    Circuit Losses (dB)
-2.0    Atmospheric Losses (dB)
___________________________________________________________
Uplink
3.0     Power per user (W)
55.8    Data Rate (dBHz)
7.2     Eb/No required (dB)
43.9    Gain Transmitter (dB)
31.8    System Temperature (dBK) - this is equivalent noise to Self Interference
___________________________________________________________
Satellite Number        1
Sat     Beam    Longitude    Latitude        Gain      Up Freq     Down Freq   Polar     Scan
1        1     -90.5224      32.9603      43.4000  2.92525e+10  1.94525e+10       1        1
1        2     -90.5224      32.9603      43.4000  2.97527e+10  1.99525e+10       1        1
1        3     -90.3132      38.5516      43.4000  2.90025e+10  1.92025e+10       1        1
1        4     -90.3132      38.5516      43.4000  2.95025e+10  1.97025e+10       1        1
1        5     -89.9921      44.9144      43.4000  2.92525e+10  1.94525e+10       1        1
1        6     -89.9921      44.9144      43.4000  2.97527e+10  1.99525e+10       1        1
1        7     -85.5350      33.0078      43.4000  2.92525e+10  1.95775e+10       1        1
1        8     -85.5350      33.0078      43.4000  2.97525e+10  2.00775e+10       1        1
1        9     -84.8968      38.6163      43.4000  2.90025e+10  1.93275e+10       1        1
1       10     -84.8968      38.6163      43.4000  2.95025e+10  1.98275e+10       1        1
1       11     -83.9127      45.0081      43.4000  2.92525e+10  1.95775e+10       1        1
1       12     -83.9127      45.0081      43.4000  2.97525e+10  2.00775e+10       1        1
1       13     -81.2091      27.9810      43.4000  2.90025e+10  1.92025e+10       1        1
1       14     -81.2091      27.9810      43.4000  2.95025e+10  1.97025e+10       1        1
1       15     -80.4473      33.1048      43.4000  2.92525e+10  1.94525e+10       1        1
1       16     -80.4473      33.1048      43.4000  2.97527e+10  1.99525e+10       1        1
1       17     -79.3467      38.7491      43.4000  2.90025e+10  1.92025e+10       1        1
1       18     -79.3467      38.7491      43.4000  2.95025e+10  1.97025e+10       1        1
1       19     -77.6319      45.2020      43.4000  2.92525e+10  1.94525e+10       1        1
1       20     -77.6319      45.2020      43.4000  2.97527e+10  1.99525e+10       1        1
1       21     -73.5531      38.9573      43.4000  2.90025e+10  1.93275e+10       1        1
1       22     -73.5531      38.9573      43.4000  2.95025e+10  1.98275e+10       1        1
1       23     -70.9724      45.5111      43.4000  2.92525e+10  1.95775e+10       1        1
1       24     -70.9724      45.5111      43.4000  2.97525e+10  2.00775e+10       1        1
1       25     -95.4776      32.9603      43.4000  2.92525e+10  1.95775e+10       1        1
1       26     -95.4776      32.9603      43.4000  2.97525e+10  2.00775e+10       1        1
1       27     -95.6868      38.5516      43.4000  2.90025e+10  1.93275e+10       1        1
1       28     -95.6868      38.5516      43.4000  2.95025e+10  1.98275e+10       1        1
1       29     -96.0079      44.9144      43.4000  2.92525e+10  1.95775e+10       1        1
1       30     -96.0079      44.9144      43.4000  2.97525e+10  2.00775e+10       1        1
1       31     -100.465      33.0078      43.4000  2.92525e+10  1.94525e+10       1        1
1       32     -100.465      33.0078      43.4000  2.97527e+10  1.99525e+10       1        1
1       33     -101.103      38.6163      43.4000  2.90025e+10  1.92025e+10       1        1
1       34     -101.103      38.6163      43.4000  2.95025e+10  1.97025e+10       1        1
1       35     -102.087      45.0081      43.4000  2.92525e+10  1.94525e+10       1        1
1       36     -102.087      45.0081      43.4000  2.97527e+10  1.99525e+10       1        1
1       37     -103.837      52.7714      43.4000  2.90025e+10  1.92025e+10       1        1
1       38     -103.837      52.7714      43.4000  2.95025e+10  1.97025e+10       1        1
1       39     -105.553      33.1048      43.4000  2.92525e+10  1.95775e+10       1        1
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1	40	-105.553	33.1048	43.4000	2.97525e+10	2.00775e+10	1	1
1	41	-106.653	38.7491	43.4000	2.90025e+10	1.93275e+10	1	1
1	42	-106.653	38.7491	43.4000	2.95025e+10	1.98275e+10	1	1
1	43	-108.368	45.2020	43.4000	2.92525e+10	1.95775e+10	1	1
1	44	-108.368	45.2020	43.4000	2.97525e+10	2.00775e+10	1	1
1	45	-111.488	53.0989	43.4000	2.90025e+10	1.93275e+10	1	1
1	46	-111.488	53.0989	43.4000	2.95025e+10	1.98275e+10	1	1
1	47	-110.820	33.2557	43.4000	2.92525e+10	1.94525e+10	1	1
1	48	-110.820	33.2557	43.4000	2.97527e+10	1.99525e+10	1	1
1	49	-112.447	38.9573	43.4000	2.90025e+10	1.92025e+10	1	1
1	50	-112.447	38.9573	43.4000	2.95025e+10	1.97025e+10	1	1
1	51	-115.028	45.5111	43.4000	2.92525e+10	1.94525e+10	1	1
1	52	-115.028	45.5111	43.4000	2.97527e+10	1.99525e+10	1	1
1	53	-119.926	53.6434	43.4000	2.90025e+10	1.92025e+10	1	1
1	54	-119.926	53.6434	43.4000	2.95025e+10	1.97025e+10	1	1
1	55	-116.369	33.4679	43.4000	2.92525e+10	1.95775e+10	1	1
1	56	-116.369	33.4679	43.4000	2.97525e+10	2.00775e+10	1	1
1	57	-118.634	39.2544	43.4000	2.90025e+10	1.93275e+10	1	1
1	58	-118.634	39.2544	43.4000	2.95025e+10	1.98275e+10	1	1
1	59	-122.335	45.9648	43.4000	2.92525e+10	1.95775e+10	1	1
1	60	-122.335	45.9648	43.4000	2.97525e+10	2.00775e+10	1	1
1	61	-129.950	54.5124	43.4000	2.90025e+10	1.93275e+10	1	1
1	62	-129.950	54.5124	43.4000	2.95025e+10	1.98275e+10	1	1
1	63	-153.326	20.4238	43.4000	2.90025e+10	1.93275e+10	1	1
1	64	-153.326	20.4238	43.4000	2.95025e+10	1.98275e+10	1	1

Satellite Number 2

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
2	1	-100.852	18.6441	43.4000	2.90025e+10	1.92025e+10	1	1
2	2	-100.852	18.6441	43.4000	2.95025e+10	1.97025e+10	1	1
2	3	-100.774	23.1329	43.4000	2.92525e+10	1.94525e+10	1	1
2	4	-100.774	23.1329	43.4000	2.97527e+10	1.99525e+10	1	1
2	5	-99.4270	52.6163	43.4000	2.90025e+10	1.92025e+10	1	1
2	6	-99.4270	52.6163	43.4000	2.95025e+10	1.97025e+10	1	1
2	7	-98.0064	63.4581	43.4000	2.92525e+10	1.94525e+10	1	1
2	8	-98.0064	63.4581	43.4000	2.97527e+10	1.99525e+10	1	1
2	9	-96.5348	18.6648	43.4000	2.90025e+10	1.93275e+10	1	1
2	10	-96.5348	18.6648	43.4000	2.95025e+10	1.98275e+10	1	1
2	11	-92.1632	52.7714	43.4000	2.90025e+10	1.93275e+10	1	1
2	12	-92.1632	52.7714	43.4000	2.95025e+10	1.98275e+10	1	1
2	13	-87.5936	63.8501	43.4000	2.92525e+10	1.95775e+10	1	1
2	14	-87.5936	63.8501	43.4000	2.97525e+10	2.00775e+10	1	1
2	15	-92.4464	14.3818	43.4000	2.92525e+10	1.94525e+10	1	1
2	16	-92.4464	14.3818	43.4000	2.97527e+10	1.99525e+10	1	1
2	17	-92.1569	18.7069	43.4000	2.90025e+10	1.92025e+10	1	1
2	18	-92.1569	18.7069	43.4000	2.95025e+10	1.97025e+10	1	1
2	19	-84.5123	53.0989	43.4000	2.90025e+10	1.92025e+10	1	1
2	20	-84.5123	53.0989	43.4000	2.95025e+10	1.97025e+10	1	1
2	21	-75.5231	64.7719	43.4000	2.92525e+10	1.94525e+10	1	1
2	22	-75.5231	64.7719	43.4000	2.97527e+10	1.99525e+10	1	1
2	23	-88.0902	14.4291	43.4000	2.92525e+10	1.95775e+10	1	1
2	24	-88.0902	14.4291	43.4000	2.97525e+10	2.00775e+10	1	1
2	25	-87.6719	18.7715	43.4000	2.90025e+10	1.93275e+10	1	1
2	26	-87.6719	18.7715	43.4000	2.95025e+10	1.98275e+10	1	1
2	27	-80.9724	45.5111	43.4000	2.92525e+10	1.95775e+10	1	1
2	28	-80.9724	45.5111	43.4000	2.97525e+10	2.00775e+10	1	1
2	29	-76.0740	53.6434	43.4000	2.90025e+10	1.93275e+10	1	1
2	30	-76.0740	53.6434	43.4000	2.95025e+10	1.98275e+10	1	1
2	31	-83.9773	10.2638	43.4000	2.90025e+10	1.92025e+10	1	1
2	32	-83.9773	10.2638	43.4000	2.95025e+10	1.97025e+10	1	1
2	33	-83.5871	14.4944	43.4000	2.92525e+10	1.94525e+10	1	1
2	34	-83.5871	14.4944	43.4000	2.97527e+10	1.99525e+10	1	1
2	35	-73.6653	45.9648	43.4000	2.92525e+10	1.94525e+10	1	1
2	36	-73.6653	45.9648	43.4000	2.97527e+10	1.99525e+10	1	1
2	37	-66.0505	54.5124	43.4000	2.90025e+10	1.92025e+10	1	1
2	38	-66.0505	54.5124	43.4000	2.95025e+10	1.97025e+10	1	1
2	39	-79.3791	10.3221	43.4000	2.90025e+10	1.93275e+10	1	1
2	40	-79.3791	10.3221	43.4000	2.95025e+10	1.98275e+10	1	1
2	41	-65.2123	46.6242	43.4000	2.92525e+10	1.95775e+10	1	1
2	42	-65.2123	46.6242	43.4000	2.97525e+10	2.00775e+10	1	1
2	43	-51.8556	56.0734	43.4000	2.90025e+10	1.93275e+10	1	1
2	44	-51.8556	56.0734	43.4000	2.95025e+10	1.98275e+10	1	1
2	45	-54.3597	47.6483	43.4000	2.92525e+10	1.94525e+10	1	1
2	46	-54.3597	47.6483	43.4000	2.97527e+10	1.99525e+10	1	1
2	47	-105.148	18.6441	43.4000	2.90025e+10	1.93275e+10	1	1
2	48	-105.148	18.6441	43.4000	2.95025e+10	1.98275e+10	1	1
2	49	-105.226	23.1329	43.4000	2.92525e+10	1.95775e+10	1	1
2	50	-105.226	23.1329	43.4000	2.97525e+10	2.00775e+10	1	1
2	51	-105.331	27.8719	43.4000	2.90025e+10	1.93275e+10	1	1
2	52	-105.331	27.8719	43.4000	2.95025e+10	1.98275e+10	1	1
2	53	-107.994	63.4581	43.4000	2.92525e+10	1.95775e+10	1	1

2	54	-107.994	63.4581	43.4000	2.97525e+10	2.00775e+10	1	1
2	55	-110.021	27.9079	43.4000	2.90025e+10	1.92025e+10	1	1
2	56	-110.021	27.9079	43.4000	2.95025e+10	1.97025e+10	1	1
2	57	-118.406	63.8501	43.4000	2.92525e+10	1.94525e+10	1	1
2	58	-118.406	63.8501	43.4000	2.97527e+10	1.99525e+10	1	1
2	59	-114.791	27.9810	43.4000	2.90025e+10	1.93275e+10	1	1
2	60	-114.791	27.9810	43.4000	2.95025e+10	1.98275e+10	1	1
2	61	-130.477	64.7719	43.4000	2.92525e+10	1.95775e+10	1	1
2	62	-130.477	64.7719	43.4000	2.97525e+10	2.00775e+10	1	1
2	63	-148.590	66.9238	43.4000	2.92525e+10	1.94525e+10	1	1
2	64	-148.590	66.9238	43.4000	2.97527e+10	1.99525e+10	1	1

Satellite Number 3

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
3	1	44.3315	27.8719	43.4000	2.90025e+10	1.92025e+10	1	1
3	2	44.3315	27.8719	43.4000	2.95025e+10	1.97025e+10	1	1
3	3	44.4776	32.9603	43.4000	2.92525e+10	1.94525e+10	1	1
3	4	44.4776	32.9603	43.4000	2.97527e+10	1.99525e+10	1	1
3	5	44.6868	38.5516	43.4000	2.90025e+10	1.92025e+10	1	1
3	6	44.6868	38.5516	43.4000	2.95025e+10	1.97025e+10	1	1
3	7	45.0080	44.9144	43.4000	2.92525e+10	1.94525e+10	1	1
3	8	45.0080	44.9144	43.4000	2.97527e+10	1.99525e+10	1	1
3	9	48.6998	23.1603	43.4000	2.92525e+10	1.95775e+10	1	1
3	10	48.6998	23.1603	43.4000	2.97525e+10	2.00775e+10	1	1
3	11	53.2429	23.2160	43.4000	2.92525e+10	1.94525e+10	1	1
3	12	53.2429	23.2160	43.4000	2.97527e+10	1.99525e+10	1	1
3	13	57.9075	23.3018	43.4000	2.92525e+10	1.95775e+10	1	1
3	14	57.9075	23.3018	43.4000	2.97525e+10	2.00775e+10	1	1
3	15	39.7742	23.1329	43.4000	2.92525e+10	1.95775e+10	1	1
3	16	39.7742	23.1329	43.4000	2.97525e+10	2.00775e+10	1	1
3	17	39.6685	27.8719	43.4000	2.90025e+10	1.93275e+10	1	1
3	18	39.6685	27.8719	43.4000	2.95025e+10	1.98275e+10	1	1
3	19	39.5224	32.9603	43.4000	2.92525e+10	1.95775e+10	1	1
3	20	39.5224	32.9603	43.4000	2.97525e+10	2.00775e+10	1	1
3	21	39.3132	38.5516	43.4000	2.90025e+10	1.93275e+10	1	1
3	22	39.3132	38.5516	43.4000	2.95025e+10	1.98275e+10	1	1
3	23	38.9920	44.9144	43.4000	2.92525e+10	1.95775e+10	1	1
3	24	38.9920	44.9144	43.4000	2.97525e+10	2.00775e+10	1	1
3	25	38.4270	52.6163	43.4000	2.90025e+10	1.93275e+10	1	1
3	26	38.4270	52.6163	43.4000	2.95025e+10	1.98275e+10	1	1
3	27	34.5350	33.0078	43.4000	2.92525e+10	1.94525e+10	1	1
3	28	34.5350	33.0078	43.4000	2.97527e+10	1.99525e+10	1	1
3	29	33.8968	38.6163	43.4000	2.90025e+10	1.92025e+10	1	1
3	30	33.8968	38.6163	43.4000	2.95025e+10	1.97025e+10	1	1
3	31	32.9127	45.0081	43.4000	2.92525e+10	1.94525e+10	1	1
3	32	32.9127	45.0081	43.4000	2.97527e+10	1.99525e+10	1	1
3	33	31.1632	52.7714	43.4000	2.90025e+10	1.92025e+10	1	1
3	34	31.1632	52.7714	43.4000	2.95025e+10	1.97025e+10	1	1
3	35	26.5936	63.8501	43.4000	2.92525e+10	1.94525e+10	1	1
3	36	26.5936	63.8501	43.4000	2.97527e+10	1.99525e+10	1	1
3	37	28.3467	38.7491	43.4000	2.90025e+10	1.93275e+10	1	1
3	38	28.3467	38.7491	43.4000	2.95025e+10	1.98275e+10	1	1
3	39	26.6319	45.2020	43.4000	2.92525e+10	1.95775e+10	1	1
3	40	26.6319	45.2020	43.4000	2.97525e+10	2.00775e+10	1	1
3	41	23.5123	53.0989	43.4000	2.90025e+10	1.93275e+10	1	1
3	42	23.5123	53.0989	43.4000	2.95025e+10	1.98275e+10	1	1
3	43	14.5231	64.7719	43.4000	2.92525e+10	1.95775e+10	1	1
3	44	14.5231	64.7719	43.4000	2.97525e+10	2.00775e+10	1	1
3	45	22.5531	38.9573	43.4000	2.90025e+10	1.92025e+10	1	1
3	46	22.5531	38.9573	43.4000	2.95025e+10	1.97025e+10	1	1
3	47	19.9724	45.5111	43.4000	2.92525e+10	1.94525e+10	1	1
3	48	19.9724	45.5111	43.4000	2.97527e+10	1.99525e+10	1	1
3	49	15.0740	53.6434	43.4000	2.90025e+10	1.92025e+10	1	1
3	50	15.0740	53.6434	43.4000	2.95025e+10	1.97025e+10	1	1
3	51	16.3664	39.2544	43.4000	2.90025e+10	1.93275e+10	1	1
3	52	16.3664	39.2544	43.4000	2.95025e+10	1.98275e+10	1	1
3	53	12.6652	45.9648	43.4000	2.92525e+10	1.95775e+10	1	1
3	54	12.6652	45.9648	43.4000	2.97525e+10	2.00775e+10	1	1
3	55	5.05048	54.5124	43.4000	2.90025e+10	1.93275e+10	1	1
3	56	5.05048	54.5124	43.4000	2.95025e+10	1.98275e+10	1	1
3	57	4.21230	46.6242	43.4000	2.92525e+10	1.94525e+10	1	1
3	58	4.21230	46.6242	43.4000	2.97527e+10	1.99525e+10	1	1
3	59	-9.14437	56.0734	43.4000	2.90025e+10	1.92025e+10	1	1
3	60	-9.14437	56.0734	43.4000	2.95025e+10	1.97025e+10	1	1
3	61	1.68051	40.2359	43.4000	2.90025e+10	1.93275e+10	1	1
3	62	1.68051	40.2359	43.4000	2.95025e+10	1.98275e+10	1	1
3	63	-8.29612	41.0864	43.4000	2.90025e+10	1.92025e+10	1	1
3	64	-8.29612	41.0864	43.4000	2.95025e+10	1.97025e+10	1	1

Satellite Number 4

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
4	1	118.226	23.1329	43.4000	2.92525e+10	1.94525e+10	1	1

4	2	118.226	23.1329	43.4000	2.97527e+10	1.99525e+10	1	1
4	3	118.331	27.8719	43.4000	2.90025e+10	1.92025e+10	1	1
4	4	118.331	27.8719	43.4000	2.95025e+10	1.97025e+10	1	1
4	5	118.478	32.9603	43.4000	2.92525e+10	1.94525e+10	1	1
4	6	118.478	32.9603	43.4000	2.97527e+10	1.99525e+10	1	1
4	7	118.687	38.5516	43.4000	2.90025e+10	1.92025e+10	1	1
4	8	118.687	38.5516	43.4000	2.95025e+10	1.97025e+10	1	1
4	9	119.008	44.9144	43.4000	2.92525e+10	1.94525e+10	1	1
4	10	119.008	44.9144	43.4000	2.97527e+10	1.99525e+10	1	1
4	11	122.295	14.3511	43.4000	2.92525e+10	1.95775e+10	1	1
4	12	122.295	14.3511	43.4000	2.97525e+10	2.00775e+10	1	1
4	13	122.465	18.6648	43.4000	2.90025e+10	1.93275e+10	1	1
4	14	122.465	18.6648	43.4000	2.95025e+10	1.98275e+10	1	1
4	15	124.103	38.6163	43.4000	2.90025e+10	1.93275e+10	1	1
4	16	124.103	38.6163	43.4000	2.95025e+10	1.98275e+10	1	1
4	17	125.087	45.0081	43.4000	2.92525e+10	1.95775e+10	1	1
4	18	125.087	45.0081	43.4000	2.97525e+10	2.00775e+10	1	1
4	19	126.224	6.07899	43.4000	2.92525e+10	1.94525e+10	1	1
4	20	126.224	6.07899	43.4000	2.97527e+10	1.99525e+10	1	1
4	21	126.352	10.1870	43.4000	2.90025e+10	1.92025e+10	1	1
4	22	126.352	10.1870	43.4000	2.95025e+10	1.97025e+10	1	1
4	23	129.653	38.7491	43.4000	2.90025e+10	1.92025e+10	1	1
4	24	129.653	38.7491	43.4000	2.95025e+10	1.97025e+10	1	1
4	25	131.368	45.2020	43.4000	2.92525e+10	1.94525e+10	1	1
4	26	131.368	45.2020	43.4000	2.97527e+10	1.99525e+10	1	1
4	27	133.820	33.2557	43.4000	2.92525e+10	1.95775e+10	1	1
4	28	133.820	33.2557	43.4000	2.97525e+10	2.00775e+10	1	1
4	29	138.028	45.5111	43.4000	2.92525e+10	1.95775e+10	1	1
4	30	138.028	45.5111	43.4000	2.97525e+10	2.00775e+10	1	1
4	31	139.369	33.4679	43.4000	2.92525e+10	1.94525e+10	1	1
4	32	139.369	33.4679	43.4000	2.97527e+10	1.99525e+10	1	1
4	33	141.634	39.2544	43.4000	2.90025e+10	1.92025e+10	1	1
4	34	141.634	39.2544	43.4000	2.95025e+10	1.97025e+10	1	1
4	35	145.335	45.9648	43.4000	2.92525e+10	1.94525e+10	1	1
4	36	145.335	45.9648	43.4000	2.97527e+10	1.99525e+10	1	1
4	37	118.331	-27.8719	43.4000	2.92525e+10	1.94525e+10	1	1
4	38	118.331	-27.8719	43.4000	2.97527e+10	1.99525e+10	1	1
4	39	118.478	-32.9603	43.4000	2.90025e+10	1.92025e+10	1	1
4	40	118.478	-32.9603	43.4000	2.95025e+10	1.97025e+10	1	1
4	41	123.465	-33.0078	43.4000	2.90025e+10	1.93275e+10	1	1
4	42	123.465	-33.0078	43.4000	2.95025e+10	1.98275e+10	1	1
4	43	141.634	-39.2543	43.4000	2.92525e+10	1.94525e+10	1	1
4	44	141.634	-39.2543	43.4000	2.97527e+10	1.99525e+10	1	1
4	45	145.346	-33.7544	43.4000	2.90025e+10	1.93275e+10	1	1
4	46	145.346	-33.7544	43.4000	2.95025e+10	1.98275e+10	1	1
4	47	146.067	-19.1294	43.4000	2.92525e+10	1.94525e+10	1	1
4	48	146.067	-19.1294	43.4000	2.97527e+10	1.99525e+10	1	1
4	49	147.386	-23.7821	43.4000	2.90025e+10	1.92025e+10	1	1
4	50	147.386	-23.7821	43.4000	2.95025e+10	1.97025e+10	1	1
4	51	149.253	-28.7378	43.4000	2.92525e+10	1.94525e+10	1	1
4	52	149.253	-28.7378	43.4000	2.97527e+10	1.99525e+10	1	1
4	53	166.296	-41.0864	43.4000	2.92525e+10	1.95775e+10	1	1
4	54	166.296	-41.0864	43.4000	2.97525e+10	2.00775e+10	1	1
4	55	184.033	-42.8427	43.4000	2.92525e+10	1.94525e+10	1	1
4	56	184.033	-42.8427	43.4000	2.97527e+10	1.99525e+10	1	1
4	57	113.852	18.6441	43.4000	2.90025e+10	1.93275e+10	1	1
4	58	113.852	18.6441	43.4000	2.95025e+10	1.98275e+10	1	1
4	59	113.774	23.1329	43.4000	2.92525e+10	1.95775e+10	1	1
4	60	113.774	23.1329	43.4000	2.97525e+10	2.00775e+10	1	1
4	61	113.669	27.8719	43.4000	2.90025e+10	1.93275e+10	1	1
4	62	113.669	27.8719	43.4000	2.95025e+10	1.98275e+10	1	1
4	63	109.535	18.6648	43.4000	2.90025e+10	1.92025e+10	1	1
4	64	109.535	18.6648	43.4000	2.95025e+10	1.97025e+10	1	1

Satellite Number 5

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
5	1	-90.5224	32.9603	43.4000	2.92525e+10	1.94525e+10	2	1
5	2	-90.5224	32.9603	43.4000	2.97527e+10	1.99525e+10	2	1
5	3	-90.3132	38.5516	43.4000	2.90025e+10	1.92025e+10	2	1
5	4	-90.3132	38.5516	43.4000	2.95025e+10	1.97025e+10	2	1
5	5	-89.9921	44.9144	43.4000	2.92525e+10	1.94525e+10	2	1
5	6	-89.9921	44.9144	43.4000	2.97527e+10	1.99525e+10	2	1
5	7	-85.5350	33.0078	43.4000	2.92525e+10	1.95775e+10	2	1
5	8	-85.5350	33.0078	43.4000	2.97525e+10	2.00775e+10	2	1
5	9	-84.8968	38.6163	43.4000	2.90025e+10	1.93275e+10	2	1
5	10	-84.8968	38.6163	43.4000	2.95025e+10	1.98275e+10	2	1
5	11	-83.9127	45.0081	43.4000	2.92525e+10	1.95775e+10	2	1
5	12	-83.9127	45.0081	43.4000	2.97525e+10	2.00775e+10	2	1
5	13	-81.2091	27.9810	43.4000	2.90025e+10	1.92025e+10	2	1
5	14	-81.2091	27.9810	43.4000	2.95025e+10	1.97025e+10	2	1
5	15	-80.4473	33.1048	43.4000	2.92525e+10	1.94525e+10	2	1

5	16	-80.4473	33.1048	43.4000	2.97527e+10	1.99525e+10	2	1
5	17	-79.3467	38.7491	43.4000	2.90025e+10	1.92025e+10	2	1
5	18	-79.3467	38.7491	43.4000	2.95025e+10	1.97025e+10	2	1
5	19	-77.6319	45.2020	43.4000	2.92525e+10	1.94525e+10	2	1
5	20	-77.6319	45.2020	43.4000	2.97527e+10	1.99525e+10	2	1
5	21	-73.5531	38.9573	43.4000	2.90025e+10	1.93275e+10	2	1
5	22	-73.5531	38.9573	43.4000	2.95025e+10	1.98275e+10	2	1
5	23	-70.9724	45.5111	43.4000	2.92525e+10	1.95775e+10	2	1
5	24	-70.9724	45.5111	43.4000	2.97525e+10	2.00775e+10	2	1
5	25	-95.4776	32.9603	43.4000	2.92525e+10	1.95775e+10	2	1
5	26	-95.4776	32.9603	43.4000	2.97525e+10	2.00775e+10	2	1
5	27	-95.6868	38.5516	43.4000	2.90025e+10	1.93275e+10	2	1
5	28	-95.6868	38.5516	43.4000	2.95025e+10	1.98275e+10	2	1
5	29	-96.0079	44.9144	43.4000	2.92525e+10	1.95775e+10	2	1
5	30	-96.0079	44.9144	43.4000	2.97525e+10	2.00775e+10	2	1
5	31	-100.465	33.0078	43.4000	2.92525e+10	1.94525e+10	2	1
5	32	-100.465	33.0078	43.4000	2.97527e+10	1.99525e+10	2	1
5	33	-101.103	38.6163	43.4000	2.90025e+10	1.92025e+10	2	1
5	34	-101.103	38.6163	43.4000	2.95025e+10	1.97025e+10	2	1
5	35	-102.087	45.0081	43.4000	2.92525e+10	1.94525e+10	2	1
5	36	-102.087	45.0081	43.4000	2.97527e+10	1.99525e+10	2	1
5	37	-103.837	52.7714	43.4000	2.90025e+10	1.92025e+10	2	1
5	38	-103.837	52.7714	43.4000	2.95025e+10	1.97025e+10	2	1
5	39	-105.553	33.1048	43.4000	2.92525e+10	1.95775e+10	2	1
5	40	-105.553	33.1048	43.4000	2.97525e+10	2.00775e+10	2	1
5	41	-106.653	38.7491	43.4000	2.90025e+10	1.93275e+10	2	1
5	42	-106.653	38.7491	43.4000	2.95025e+10	1.98275e+10	2	1
5	43	-108.368	45.2020	43.4000	2.92525e+10	1.95775e+10	2	1
5	44	-108.368	45.2020	43.4000	2.97525e+10	2.00775e+10	2	1
5	45	-111.488	53.0989	43.4000	2.90025e+10	1.93275e+10	2	1
5	46	-111.488	53.0989	43.4000	2.95025e+10	1.98275e+10	2	1
5	47	-110.820	33.2557	43.4000	2.92525e+10	1.94525e+10	2	1
5	48	-110.820	33.2557	43.4000	2.97527e+10	1.99525e+10	2	1
5	49	-112.447	38.9573	43.4000	2.90025e+10	1.92025e+10	2	1
5	50	-112.447	38.9573	43.4000	2.95025e+10	1.97025e+10	2	1
5	51	-115.028	45.5111	43.4000	2.92525e+10	1.94525e+10	2	1
5	52	-115.028	45.5111	43.4000	2.97527e+10	1.99525e+10	2	1
5	53	-119.926	53.6434	43.4000	2.90025e+10	1.92025e+10	2	1
5	54	-119.926	53.6434	43.4000	2.95025e+10	1.97025e+10	2	1
5	55	-116.369	33.4679	43.4000	2.92525e+10	1.95775e+10	2	1
5	56	-116.369	33.4679	43.4000	2.97525e+10	2.00775e+10	2	1
5	57	-118.634	39.2544	43.4000	2.90025e+10	1.93275e+10	2	1
5	58	-118.634	39.2544	43.4000	2.95025e+10	1.98275e+10	2	1
5	59	-122.335	45.9648	43.4000	2.92525e+10	1.95775e+10	2	1
5	60	-122.335	45.9648	43.4000	2.97525e+10	2.00775e+10	2	1
5	61	-129.950	54.5124	43.4000	2.90025e+10	1.93275e+10	2	1
5	62	-129.950	54.5124	43.4000	2.95025e+10	1.98275e+10	2	1
5	63	-153.326	20.4238	43.4000	2.90025e+10	1.93275e+10	2	1
5	64	-153.326	20.4238	43.4000	2.95025e+10	1.98275e+10	2	1

Satellite Number 6

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
6	1	-51.9839	2.01486	43.4000	2.90025e+10	1.92025e+10	1	1
6	2	-51.9839	-2.01486	43.4000	2.92525e+10	1.94525e+10	1	1
6	3	-51.6685	-27.8719	43.4000	2.92525e+10	1.94525e+10	1	1
6	4	-47.9356	-2.01685	43.4000	2.92525e+10	1.95775e+10	1	1
6	5	-43.8381	-2.02090	43.4000	2.92525e+10	1.94525e+10	1	1
6	6	-47.5348	-18.6648	43.4000	2.92525e+10	1.95775e+10	1	1
6	7	-47.3002	-23.1603	43.4000	2.90025e+10	1.93275e+10	1	1
6	8	-43.7760	-6.07899	43.4000	2.90025e+10	1.92025e+10	1	1
6	9	-43.1569	-18.7069	43.4000	2.92525e+10	1.94525e+10	1	1
6	10	-42.7571	-23.2160	43.4000	2.90025e+10	1.92025e+10	1	1
6	11	-39.5655	-6.09785	43.4000	2.90025e+10	1.93275e+10	1	1
6	12	-39.3812	-10.2193	43.4000	2.92525e+10	1.95775e+10	1	1
6	13	-39.0902	-14.4291	43.4000	2.90025e+10	1.93275e+10	1	1
6	14	-35.2241	-6.12380	43.4000	2.90025e+10	1.92025e+10	1	1
6	15	-56.0161	2.01486	43.4000	2.90025e+10	1.93275e+10	1	1
6	16	-56.0282	6.06061	43.4000	2.92525e+10	1.95775e+10	1	1
6	17	-60.0644	2.01685	43.4000	2.90025e+10	1.92025e+10	1	1
6	18	-64.1619	2.02090	43.4000	2.90025e+10	1.93275e+10	1	1
6	19	-72.6563	2.03563	43.4000	2.90025e+10	1.93275e+10	1	1
6	20	-77.1485	2.04676	43.4000	2.90025e+10	1.92025e+10	1	1
6	21	-60.1010	6.06668	43.4000	2.92525e+10	1.94525e+10	1	1
6	22	-64.2240	6.07899	43.4000	2.92525e+10	1.95775e+10	1	1
6	23	-64.3519	10.1870	43.4000	2.90025e+10	1.93275e+10	1	1
6	24	-68.4345	6.09785	43.4000	2.92525e+10	1.94525e+10	1	1
6	25	-68.6188	10.2193	43.4000	2.90025e+10	1.92025e+10	1	1
6	26	-68.9098	14.4291	43.4000	2.92525e+10	1.94525e+10	1	1
6	27	-69.3281	18.7715	43.4000	2.90025e+10	1.92025e+10	1	1
6	28	-72.7759	6.12380	43.4000	2.92525e+10	1.95775e+10	1	1
6	29	-73.0227	10.2638	43.4000	2.90025e+10	1.93275e+10	1	1

6	30	-73.9753	18.8609	43.4000	2.90025e+10	1.93275e+10	1	1
6	31	-74.7575	23.4209	43.4000	2.92525e+10	1.95775e+10	1	1
6	32	-77.3026	6.15768	43.4000	2.92525e+10	1.94525e+10	1	1
6	33	-79.8769	23.5783	43.4000	2.92525e+10	1.94525e+10	1	1
6	34	-56.0161	-2.01486	43.4000	2.92525e+10	1.95775e+10	1	1
6	35	-56.2258	-23.1329	43.4000	2.90025e+10	1.93275e+10	1	1
6	36	-56.3315	-27.8719	43.4000	2.92525e+10	1.95775e+10	1	1
6	37	-56.4776	-32.9603	43.4000	2.90025e+10	1.93275e+10	1	1
6	38	-56.6868	-38.5516	43.4000	2.92525e+10	1.95775e+10	1	1
6	39	-72.6563	-2.03563	43.4000	2.92525e+10	1.95775e+10	1	1
6	40	-77.1485	-2.04676	43.4000	2.92525e+10	1.94525e+10	1	1
6	41	-61.0206	-27.9079	43.4000	2.92525e+10	1.94525e+10	1	1
6	42	-61.4650	-33.0078	43.4000	2.90025e+10	1.92025e+10	1	1
6	43	-62.1032	-38.6163	43.4000	2.92525e+10	1.94525e+10	1	1
6	44	-64.2240	-6.07899	43.4000	2.90025e+10	1.93275e+10	1	1
6	45	-64.8431	-18.7069	43.4000	2.92525e+10	1.95775e+10	1	1
6	46	-65.2429	-23.2160	43.4000	2.90025e+10	1.93275e+10	1	1
6	47	-65.7909	-27.9810	43.4000	2.92525e+10	1.95775e+10	1	1
6	48	-66.5527	-33.1048	43.4000	2.90025e+10	1.93275e+10	1	1
6	49	-67.6533	-38.7491	43.4000	2.92525e+10	1.95775e+10	1	1
6	50	-69.3681	-45.2020	43.4000	2.90025e+10	1.93275e+10	1	1
6	51	-72.4877	-53.0989	43.4000	2.92525e+10	1.95775e+10	1	1
6	52	-68.4345	-6.09785	43.4000	2.90025e+10	1.92025e+10	1	1
6	53	-68.6188	-10.2193	43.4000	2.92525e+10	1.94525e+10	1	1
6	54	-69.3281	-18.7715	43.4000	2.92525e+10	1.94525e+10	1	1
6	55	-69.9075	-23.3018	43.4000	2.90025e+10	1.92025e+10	1	1
6	56	-70.7048	-28.0941	43.4000	2.92525e+10	1.94525e+10	1	1
6	57	-71.8199	-33.2557	43.4000	2.90025e+10	1.92025e+10	1	1
6	58	-73.4469	-38.9573	43.4000	2.92525e+10	1.94525e+10	1	1
6	59	-76.0276	-45.5111	43.4000	2.90025e+10	1.92025e+10	1	1
6	60	-72.7759	-6.12380	43.4000	2.90025e+10	1.93275e+10	1	1
6	61	-73.0227	-10.2639	43.4000	2.92525e+10	1.95775e+10	1	1
6	62	-73.4129	-14.4944	43.4000	2.90025e+10	1.93275e+10	1	1
6	63	-77.3026	-6.15768	43.4000	2.90025e+10	1.92025e+10	1	1
6	64	-77.6209	-10.3221	43.4000	2.92525e+10	1.94525e+10	1	1
Satellite Number 7								
Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
7	1	1.02819	6.06061	43.4000	2.92525e+10	1.94525e+10	1	1
7	2	9.16189	2.02090	43.4000	2.90025e+10	1.92025e+10	1	1
7	3	13.3450	2.02710	43.4000	2.90025e+10	1.93275e+10	1	1
7	4	31.9847	2.07860	43.4000	2.90025e+10	1.93275e+10	1	1
7	5	37.5823	2.10093	43.4000	2.90025e+10	1.92025e+10	1	1
7	6	5.10098	6.06668	43.4000	2.92525e+10	1.95775e+10	1	1
7	7	5.17632	10.1659	43.4000	2.90025e+10	1.93275e+10	1	1
7	8	6.46498	33.0078	43.4000	2.92525e+10	1.95775e+10	1	1
7	9	9.22400	6.07899	43.4000	2.92525e+10	1.94525e+10	1	1
7	10	9.35193	10.1870	43.4000	2.90025e+10	1.92025e+10	1	1
7	11	10.7909	27.9810	43.4000	2.90025e+10	1.92025e+10	1	1
7	12	11.5527	33.1048	43.4000	2.92525e+10	1.94525e+10	1	1
7	13	15.7048	28.0941	43.4000	2.90025e+10	1.93275e+10	1	1
7	14	20.8403	28.2519	43.4000	2.90025e+10	1.92025e+10	1	1
7	15	24.8769	23.5783	43.4000	2.92525e+10	1.95775e+10	1	1
7	16	26.3034	28.4622	43.4000	2.90025e+10	1.93275e+10	1	1
7	17	30.3861	23.7821	43.4000	2.92525e+10	1.94525e+10	1	1
7	18	32.2533	28.7378	43.4000	2.90025e+10	1.92025e+10	1	1
7	19	32.7421	10.4896	43.4000	2.90025e+10	1.93275e+10	1	1
7	20	33.5597	14.8274	43.4000	2.92525e+10	1.95775e+10	1	1
7	21	34.7597	19.3223	43.4000	2.90025e+10	1.93275e+10	1	1
7	22	37.8970	6.32314	43.4000	2.92525e+10	1.94525e+10	1	1
7	23	38.5532	10.6082	43.4000	2.90025e+10	1.92025e+10	1	1
7	24	39.6120	15.0044	43.4000	2.92525e+10	1.94525e+10	1	1
7	25	13.3450	-2.02710	43.4000	2.92525e+10	1.95775e+10	1	1
7	26	17.6563	-2.03563	43.4000	2.92525e+10	1.94525e+10	1	1
7	27	26.8915	-2.06087	43.4000	2.92525e+10	1.94525e+10	1	1
7	28	31.9847	-2.07860	43.4000	2.92525e+10	1.95775e+10	1	1
7	29	37.5823	-2.10093	43.4000	2.92525e+10	1.94525e+10	1	1
7	30	13.4345	-6.09785	43.4000	2.90025e+10	1.93275e+10	1	1
7	31	13.6188	-10.2193	43.4000	2.92525e+10	1.95775e+10	1	1
7	32	13.9098	-14.4291	43.4000	2.90025e+10	1.93275e+10	1	1
7	33	14.3281	-18.7715	43.4000	2.92525e+10	1.95775e+10	1	1
7	34	14.9075	-23.3018	43.4000	2.90025e+10	1.93275e+10	1	1
7	35	15.7048	-28.0941	43.4000	2.92525e+10	1.95775e+10	1	1
7	36	18.0227	-10.2639	43.4000	2.92525e+10	1.94525e+10	1	1
7	37	18.4129	-14.4944	43.4000	2.90025e+10	1.92025e+10	1	1
7	38	18.9753	-18.8609	43.4000	2.92525e+10	1.94525e+10	1	1
7	39	19.7575	-23.4209	43.4000	2.90025e+10	1.92025e+10	1	1
7	40	20.8403	-28.2519	43.4000	2.92525e+10	1.94525e+10	1	1
7	41	22.3688	-33.4679	43.4000	2.90025e+10	1.92025e+10	1	1
7	42	22.3026	-6.15768	43.4000	2.90025e+10	1.93275e+10	1	1
7	43	23.1255	-14.5799	43.4000	2.90025e+10	1.93275e+10	1	1

7	44	23.8555	-18.9785	43.4000	2.92525e+10	1.95775e+10	1	1
7	45	24.8769	-23.5783	43.4000	2.90025e+10	1.93275e+10	1	1
7	46	26.3034	-28.4622	43.4000	2.92525e+10	1.95775e+10	1	1
7	47	28.3457	-33.7544	43.4000	2.90025e+10	1.93275e+10	1	1
7	48	27.0866	-6.20071	43.4000	2.90025e+10	1.92025e+10	1	1
7	49	27.4903	-10.3962	43.4000	2.92525e+10	1.94525e+10	1	1
7	50	28.1326	-14.6890	43.4000	2.90025e+10	1.92025e+10	1	1
7	51	29.0672	-19.1294	43.4000	2.92525e+10	1.94525e+10	1	1
7	52	30.3861	-23.7821	43.4000	2.90025e+10	1.92025e+10	1	1
7	53	32.2533	-28.7378	43.4000	2.92525e+10	1.94525e+10	1	1
7	54	32.2310	-6.25483	43.4000	2.90025e+10	1.93275e+10	1	1
7	55	32.7421	-10.4896	43.4000	2.92525e+10	1.95775e+10	1	1
7	56	33.5597	-14.8274	43.4000	2.90025e+10	1.93275e+10	1	1
7	57	34.7597	-19.3223	43.4000	2.92525e+10	1.95775e+10	1	1
7	58	37.8970	-6.32314	43.4000	2.90025e+10	1.92025e+10	1	1
7	59	38.5532	-10.6082	43.4000	2.92525e+10	1.94525e+10	1	1
7	60	39.6120	-15.0044	43.4000	2.90025e+10	1.92025e+10	1	1
7	61	-3.02819	6.06061	43.4000	2.92525e+10	1.95775e+10	1	1
7	62	-3.47756	32.9603	43.4000	2.92525e+10	1.95775e+10	1	1
7	63	-7.10098	6.06668	43.4000	2.92525e+10	1.94525e+10	1	1
7	64	-8.46498	33.0078	43.4000	2.92525e+10	1.94525e+10	1	1

Satellite Number 8

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
8	1	94.2258	23.1329	43.4000	2.92525e+10	1.94525e+10	1	1
8	2	94.2258	23.1329	43.4000	2.97527e+10	1.99525e+10	1	1
8	3	102.162	2.02090	43.4000	2.90025e+10	1.92025e+10	1	1
8	4	102.162	2.02090	43.4000	2.95025e+10	1.97025e+10	1	1
8	5	98.4652	18.6648	43.4000	2.90025e+10	1.93275e+10	1	1
8	6	98.4652	18.6648	43.4000	2.95025e+10	1.98275e+10	1	1
8	7	98.6998	23.1603	43.4000	2.92525e+10	1.95775e+10	1	1
8	8	98.6998	23.1603	43.4000	2.97525e+10	2.00775e+10	1	1
8	9	102.224	6.07899	43.4000	2.92525e+10	1.94525e+10	1	1
8	10	102.224	6.07899	43.4000	2.97527e+10	1.99525e+10	1	1
8	11	102.352	10.1870	43.4000	2.90025e+10	1.92025e+10	1	1
8	12	102.352	10.1870	43.4000	2.95025e+10	1.97025e+10	1	1
8	13	102.554	14.3818	43.4000	2.92525e+10	1.94525e+10	1	1
8	14	102.554	14.3818	43.4000	2.97527e+10	1.99525e+10	1	1
8	15	102.843	18.7069	43.4000	2.90025e+10	1.92025e+10	1	1
8	16	102.843	18.7069	43.4000	2.95025e+10	1.97025e+10	1	1
8	17	106.910	14.4291	43.4000	2.92525e+10	1.95775e+10	1	1
8	18	106.910	14.4291	43.4000	2.97525e+10	2.00775e+10	1	1
8	19	107.328	18.7715	43.4000	2.90025e+10	1.93275e+10	1	1
8	20	107.328	18.7715	43.4000	2.95025e+10	1.98275e+10	1	1
8	21	107.907	23.3018	43.4000	2.92525e+10	1.95775e+10	1	1
8	22	107.907	23.3018	43.4000	2.97525e+10	2.00775e+10	1	1
8	23	112.757	23.4209	43.4000	2.92525e+10	1.94525e+10	1	1
8	24	112.757	23.4209	43.4000	2.97527e+10	1.99525e+10	1	1
8	25	102.162	-2.02090	43.4000	2.92525e+10	1.94525e+10	1	1
8	26	102.162	-2.02090	43.4000	2.97527e+10	1.99525e+10	1	1
8	27	106.345	-2.02710	43.4000	2.92525e+10	1.95775e+10	1	1
8	28	106.345	-2.02710	43.4000	2.97525e+10	2.00775e+10	1	1
8	29	89.7742	23.1329	43.4000	2.92525e+10	1.95775e+10	1	1
8	30	89.7742	23.1329	43.4000	2.97525e+10	2.00775e+10	1	1
8	31	85.3002	23.1603	43.4000	2.92525e+10	1.94525e+10	1	1
8	32	85.3002	23.1603	43.4000	2.97527e+10	1.99525e+10	1	1
8	33	84.9794	27.9079	43.4000	2.90025e+10	1.92025e+10	1	1
8	34	84.9794	27.9079	43.4000	2.95025e+10	1.97025e+10	1	1
8	35	81.1569	18.7069	43.4000	2.90025e+10	1.93275e+10	1	1
8	36	81.1569	18.7069	43.4000	2.95025e+10	1.98275e+10	1	1
8	37	80.7571	23.2160	43.4000	2.92525e+10	1.95775e+10	1	1
8	38	80.7571	23.2160	43.4000	2.97525e+10	2.00775e+10	1	1
8	39	80.2091	27.9810	43.4000	2.90025e+10	1.93275e+10	1	1
8	40	80.2091	27.9810	43.4000	2.95025e+10	1.98275e+10	1	1
8	41	77.3812	10.2193	43.4000	2.90025e+10	1.92025e+10	1	1
8	42	77.3812	10.2193	43.4000	2.95025e+10	1.97025e+10	1	1
8	43	77.0902	14.4291	43.4000	2.92525e+10	1.94525e+10	1	1
8	44	77.0902	14.4291	43.4000	2.97527e+10	1.99525e+10	1	1
8	45	76.6719	18.7715	43.4000	2.90025e+10	1.92025e+10	1	1
8	46	76.6719	18.7715	43.4000	2.95025e+10	1.97025e+10	1	1
8	47	76.0925	23.3018	43.4000	2.92525e+10	1.94525e+10	1	1
8	48	76.0925	23.3018	43.4000	2.97527e+10	1.99525e+10	1	1
8	49	75.2952	28.0941	43.4000	2.90025e+10	1.92025e+10	1	1
8	50	75.2952	28.0941	43.4000	2.95025e+10	1.97025e+10	1	1
8	51	74.1801	33.2557	43.4000	2.92525e+10	1.94525e+10	1	1
8	52	74.1801	33.2557	43.4000	2.97527e+10	1.99525e+10	1	1
8	53	72.0247	18.8609	43.4000	2.90025e+10	1.93275e+10	1	1
8	54	72.0247	18.8609	43.4000	2.95025e+10	1.98275e+10	1	1
8	55	71.2425	23.4209	43.4000	2.92525e+10	1.95775e+10	1	1
8	56	71.2425	23.4209	43.4000	2.97525e+10	2.00775e+10	1	1
8	57	70.1597	28.2519	43.4000	2.90025e+10	1.93275e+10	1	1

8	58	70.1597	28.2519	43.4000	2.95025e+10	1.98275e+10	1	1
8	59	66.1231	23.5783	43.4000	2.92525e+10	1.94525e+10	1	1
8	60	66.1231	23.5783	43.4000	2.97527e+10	1.99525e+10	1	1
8	61	64.6966	28.4622	43.4000	2.90025e+10	1.92025e+10	1	1
8	62	64.6966	28.4622	43.4000	2.95025e+10	1.97025e+10	1	1
8	63	58.7467	28.7378	43.4000	2.90025e+10	1.93275e+10	1	1
8	64	58.7467	28.7378	43.4000	2.95025e+10	1.98275e+10	1	1
Satellite Number 9								
Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
9	1	44.3315	27.8719	43.4000	2.90025e+10	1.92025e+10	2	1
9	2	44.3315	27.8719	43.4000	2.95025e+10	1.97025e+10	2	1
9	3	44.4776	32.9603	43.4000	2.92525e+10	1.94525e+10	2	1
9	4	44.4776	32.9603	43.4000	2.97527e+10	1.99525e+10	2	1
9	5	44.6868	38.5516	43.4000	2.90025e+10	1.92025e+10	2	1
9	6	44.6868	38.5516	43.4000	2.95025e+10	1.97025e+10	2	1
9	7	45.0080	44.9144	43.4000	2.92525e+10	1.94525e+10	2	1
9	8	45.0080	44.9144	43.4000	2.97527e+10	1.99525e+10	2	1
9	9	48.6998	23.1603	43.4000	2.92525e+10	1.95775e+10	2	1
9	10	48.6998	23.1603	43.4000	2.97525e+10	2.00775e+10	2	1
9	11	53.2429	23.2160	43.4000	2.92525e+10	1.94525e+10	2	1
9	12	53.2429	23.2160	43.4000	2.97527e+10	1.99525e+10	2	1
9	13	57.9075	23.3018	43.4000	2.92525e+10	1.95775e+10	2	1
9	14	57.9075	23.3018	43.4000	2.97525e+10	2.00775e+10	2	1
9	15	39.7742	23.1329	43.4000	2.92525e+10	1.95775e+10	2	1
9	16	39.7742	23.1329	43.4000	2.97525e+10	2.00775e+10	2	1
9	17	39.6685	27.8719	43.4000	2.90025e+10	1.93275e+10	2	1
9	18	39.6685	27.8719	43.4000	2.95025e+10	1.98275e+10	2	1
9	19	39.5224	32.9603	43.4000	2.92525e+10	1.95775e+10	2	1
9	20	39.5224	32.9603	43.4000	2.97525e+10	2.00775e+10	2	1
9	21	39.3132	38.5516	43.4000	2.90025e+10	1.93275e+10	2	1
9	22	39.3132	38.5516	43.4000	2.95025e+10	1.98275e+10	2	1
9	23	38.9920	44.9144	43.4000	2.92525e+10	1.95775e+10	2	1
9	24	38.9920	44.9144	43.4000	2.97525e+10	2.00775e+10	2	1
9	25	38.4270	52.6163	43.4000	2.90025e+10	1.93275e+10	2	1
9	26	38.4270	52.6163	43.4000	2.95025e+10	1.98275e+10	2	1
9	27	34.5350	33.0078	43.4000	2.92525e+10	1.94525e+10	2	1
9	28	34.5350	33.0078	43.4000	2.97527e+10	1.99525e+10	2	1
9	29	33.8968	38.6163	43.4000	2.90025e+10	1.92025e+10	2	1
9	30	33.8968	38.6163	43.4000	2.95025e+10	1.97025e+10	2	1
9	31	32.9127	45.0081	43.4000	2.92525e+10	1.94525e+10	2	1
9	32	32.9127	45.0081	43.4000	2.97527e+10	1.99525e+10	2	1
9	33	31.1632	52.7714	43.4000	2.90025e+10	1.92025e+10	2	1
9	34	31.1632	52.7714	43.4000	2.95025e+10	1.97025e+10	2	1
9	35	26.5936	63.8501	43.4000	2.92525e+10	1.94525e+10	2	1
9	36	26.5936	63.8501	43.4000	2.97527e+10	1.99525e+10	2	1
9	37	28.3467	38.7491	43.4000	2.90025e+10	1.93275e+10	2	1
9	38	28.3467	38.7491	43.4000	2.95025e+10	1.98275e+10	2	1
9	39	26.6319	45.2020	43.4000	2.92525e+10	1.95775e+10	2	1
9	40	26.6319	45.2020	43.4000	2.97525e+10	2.00775e+10	2	1
9	41	23.5123	53.0989	43.4000	2.90025e+10	1.93275e+10	2	1
9	42	23.5123	53.0989	43.4000	2.95025e+10	1.98275e+10	2	1
9	43	14.5231	64.7719	43.4000	2.92525e+10	1.95775e+10	2	1
9	44	14.5231	64.7719	43.4000	2.97525e+10	2.00775e+10	2	1
9	45	22.5531	38.9573	43.4000	2.90025e+10	1.92025e+10	2	1
9	46	22.5531	38.9573	43.4000	2.95025e+10	1.97025e+10	2	1
9	47	19.9724	45.5111	43.4000	2.92525e+10	1.94525e+10	2	1
9	48	19.9724	45.5111	43.4000	2.97527e+10	1.99525e+10	2	1
9	49	15.0740	53.6434	43.4000	2.90025e+10	1.92025e+10	2	1
9	50	15.0740	53.6434	43.4000	2.95025e+10	1.97025e+10	2	1
9	51	16.3664	39.2544	43.4000	2.90025e+10	1.93275e+10	2	1
9	52	16.3664	39.2544	43.4000	2.95025e+10	1.98275e+10	2	1
9	53	12.6652	45.9648	43.4000	2.92525e+10	1.95775e+10	2	1
9	54	12.6652	45.9648	43.4000	2.97525e+10	2.00775e+10	2	1
9	55	5.05048	54.5124	43.4000	2.90025e+10	1.93275e+10	2	1
9	56	5.05048	54.5124	43.4000	2.95025e+10	1.98275e+10	2	1
9	57	4.21230	46.6242	43.4000	2.92525e+10	1.94525e+10	2	1
9	58	4.21230	46.6242	43.4000	2.97527e+10	1.99525e+10	2	1
9	59	-9.14437	56.0734	43.4000	2.90025e+10	1.92025e+10	2	1
9	60	-9.14437	56.0734	43.4000	2.95025e+10	1.97025e+10	2	1
9	61	1.68051	40.2359	43.4000	2.90025e+10	1.93275e+10	2	1
9	62	1.68051	40.2359	43.4000	2.95025e+10	1.98275e+10	2	1
9	63	-8.29612	41.0864	43.4000	2.90025e+10	1.92025e+10	2	1
9	64	-8.29612	41.0864	43.4000	2.95025e+10	1.97025e+10	2	1
Satellite Number 10								
Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
10	1	118.226	23.1329	43.4000	2.92525e+10	1.94525e+10	2	1
10	2	118.226	23.1329	43.4000	2.97527e+10	1.99525e+10	2	1
10	3	118.331	27.8719	43.4000	2.90025e+10	1.92025e+10	2	1
10	4	118.331	27.8719	43.4000	2.95025e+10	1.97025e+10	2	1
10	5	118.478	32.9603	43.4000	2.92525e+10	1.94525e+10	2	1

10	6	118.478	32.9603	43.4000	2.97527e+10	1.99525e+10	2	1
10	7	118.687	38.5516	43.4000	2.90025e+10	1.92025e+10	2	1
10	8	118.687	38.5516	43.4000	2.95025e+10	1.97025e+10	2	1
10	9	119.008	44.9144	43.4000	2.92525e+10	1.94525e+10	2	1
10	10	119.008	44.9144	43.4000	2.97527e+10	1.99525e+10	2	1
10	11	122.295	14.3511	43.4000	2.92525e+10	1.95775e+10	2	1
10	12	122.295	14.3511	43.4000	2.97525e+10	2.00775e+10	2	1
10	13	122.465	18.6648	43.4000	2.90025e+10	1.93275e+10	2	1
10	14	122.465	18.6648	43.4000	2.95025e+10	1.98275e+10	2	1
10	15	124.103	38.6163	43.4000	2.90025e+10	1.93275e+10	2	1
10	16	124.103	38.6163	43.4000	2.95025e+10	1.98275e+10	2	1
10	17	125.087	45.0081	43.4000	2.92525e+10	1.95775e+10	2	1
10	18	125.087	45.0081	43.4000	2.97525e+10	2.00775e+10	2	1
10	19	126.224	6.07899	43.4000	2.92525e+10	1.94525e+10	2	1
10	20	126.224	6.07899	43.4000	2.97527e+10	1.99525e+10	2	1
10	21	126.352	10.1870	43.4000	2.90025e+10	1.92025e+10	2	1
10	22	126.352	10.1870	43.4000	2.95025e+10	1.97025e+10	2	1
10	23	129.653	38.7491	43.4000	2.90025e+10	1.92025e+10	2	1
10	24	129.653	38.7491	43.4000	2.95025e+10	1.97025e+10	2	1
10	25	131.368	45.2020	43.4000	2.92525e+10	1.94525e+10	2	1
10	26	131.368	45.2020	43.4000	2.97527e+10	1.99525e+10	2	1
10	27	133.820	33.2557	43.4000	2.92525e+10	1.95775e+10	2	1
10	28	133.820	33.2557	43.4000	2.97525e+10	2.00775e+10	2	1
10	29	138.028	45.5111	43.4000	2.92525e+10	1.95775e+10	2	1
10	30	138.028	45.5111	43.4000	2.97525e+10	2.00775e+10	2	1
10	31	139.369	33.4679	43.4000	2.92525e+10	1.94525e+10	2	1
10	32	139.369	33.4679	43.4000	2.97527e+10	1.99525e+10	2	1
10	33	141.634	39.2544	43.4000	2.90025e+10	1.92025e+10	2	1
10	34	141.634	39.2544	43.4000	2.95025e+10	1.97025e+10	2	1
10	35	145.335	45.9648	43.4000	2.92525e+10	1.94525e+10	2	1
10	36	145.335	45.9648	43.4000	2.97527e+10	1.99525e+10	2	1
10	37	118.331	-27.8719	43.4000	2.92525e+10	1.94525e+10	2	1
10	38	118.331	-27.8719	43.4000	2.97527e+10	1.99525e+10	2	1
10	39	118.478	-32.9603	43.4000	2.90025e+10	1.92025e+10	2	1
10	40	118.478	-32.9603	43.4000	2.95025e+10	1.97025e+10	2	1
10	41	123.465	-33.0078	43.4000	2.90025e+10	1.93275e+10	2	1
10	42	123.465	-33.0078	43.4000	2.95025e+10	1.98275e+10	2	1
10	43	141.634	-39.2543	43.4000	2.92525e+10	1.94525e+10	2	1
10	44	141.634	-39.2543	43.4000	2.97527e+10	1.99525e+10	2	1
10	45	145.346	-33.7544	43.4000	2.90025e+10	1.93275e+10	2	1
10	46	145.346	-33.7544	43.4000	2.95025e+10	1.98275e+10	2	1
10	47	146.067	-19.1294	43.4000	2.92525e+10	1.94525e+10	2	1
10	48	146.067	-19.1294	43.4000	2.97527e+10	1.99525e+10	2	1
10	49	147.386	-23.7821	43.4000	2.90025e+10	1.92025e+10	2	1
10	50	147.386	-23.7821	43.4000	2.95025e+10	1.97025e+10	2	1
10	51	149.253	-28.7378	43.4000	2.92525e+10	1.94525e+10	2	1
10	52	149.253	-28.7378	43.4000	2.97527e+10	1.99525e+10	2	1
10	53	166.296	-41.0864	43.4000	2.92525e+10	1.95775e+10	2	1
10	54	166.296	-41.0864	43.4000	2.97525e+10	2.00775e+10	2	1
10	55	184.033	-42.8427	43.4000	2.92525e+10	1.94525e+10	2	1
10	56	184.033	-42.8427	43.4000	2.97527e+10	1.99525e+10	2	1
10	57	113.852	18.6441	43.4000	2.90025e+10	1.93275e+10	2	1
10	58	113.852	18.6441	43.4000	2.95025e+10	1.98275e+10	2	1
10	59	113.774	23.1329	43.4000	2.92525e+10	1.95775e+10	2	1
10	60	113.774	23.1329	43.4000	2.97525e+10	2.00775e+10	2	1
10	61	113.669	27.8719	43.4000	2.90025e+10	1.93275e+10	2	1
10	62	113.669	27.8719	43.4000	2.95025e+10	1.98275e+10	2	1
10	63	109.535	18.6648	43.4000	2.90025e+10	1.92025e+10	2	1
10	64	109.535	18.6648	43.4000	2.95025e+10	1.97025e+10	2	1

Satellite Number 11

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
11	1	1.02819	6.06061	43.4000	2.92525e+10	1.94525e+10	2	1
11	2	9.16189	2.02090	43.4000	2.90025e+10	1.92025e+10	2	1
11	3	13.3450	2.02710	43.4000	2.90025e+10	1.93275e+10	2	1
11	4	31.9847	2.07860	43.4000	2.90025e+10	1.93275e+10	2	1
11	5	37.5823	2.10093	43.4000	2.90025e+10	1.92025e+10	2	1
11	6	5.10098	6.06668	43.4000	2.92525e+10	1.95775e+10	2	1
11	7	5.17632	10.1659	43.4000	2.90025e+10	1.93275e+10	2	1
11	8	6.46498	33.0078	43.4000	2.92525e+10	1.95775e+10	2	1
11	9	9.22400	6.07899	43.4000	2.92525e+10	1.94525e+10	2	1
11	10	9.35193	10.1870	43.4000	2.90025e+10	1.92025e+10	2	1
11	11	10.7909	27.9810	43.4000	2.90025e+10	1.92025e+10	2	1
11	12	11.5527	33.1048	43.4000	2.92525e+10	1.94525e+10	2	1
11	13	15.7048	28.0941	43.4000	2.90025e+10	1.93275e+10	2	1
11	14	20.8403	28.2519	43.4000	2.90025e+10	1.92025e+10	2	1
11	15	24.8769	23.5783	43.4000	2.92525e+10	1.95775e+10	2	1
11	16	26.3034	28.4622	43.4000	2.90025e+10	1.93275e+10	2	1
11	17	30.3861	23.7821	43.4000	2.92525e+10	1.94525e+10	2	1
11	18	32.2533	28.7378	43.4000	2.90025e+10	1.92025e+10	2	1
11	19	32.7421	10.4896	43.4000	2.90025e+10	1.93275e+10	2	1

11	20	33.5597	14.8274	43.4000	2.92525e+10	1.95775e+10	2	1
11	21	34.7597	19.3223	43.4000	2.90025e+10	1.93275e+10	2	1
11	22	37.8970	6.32314	43.4000	2.92525e+10	1.94525e+10	2	1
11	23	38.5532	10.6082	43.4000	2.90025e+10	1.92025e+10	2	1
11	24	39.6120	15.0044	43.4000	2.92525e+10	1.94525e+10	2	1
11	25	13.3450	-2.02710	43.4000	2.92525e+10	1.95775e+10	2	1
11	26	17.6563	-2.03563	43.4000	2.92525e+10	1.94525e+10	2	1
11	27	26.8915	-2.06087	43.4000	2.92525e+10	1.94525e+10	2	1
11	28	31.9847	-2.07860	43.4000	2.92525e+10	1.95775e+10	2	1
11	29	37.5823	-2.10093	43.4000	2.92525e+10	1.94525e+10	2	1
11	30	13.4345	-6.09785	43.4000	2.90025e+10	1.93275e+10	2	1
11	31	13.6188	-10.2193	43.4000	2.92525e+10	1.95775e+10	2	1
11	32	13.9098	-14.4291	43.4000	2.90025e+10	1.93275e+10	2	1
11	33	14.3281	-18.7715	43.4000	2.92525e+10	1.95775e+10	2	1
11	34	14.9075	-23.3018	43.4000	2.90025e+10	1.93275e+10	2	1
11	35	15.7048	-28.0941	43.4000	2.92525e+10	1.95775e+10	2	1
11	36	18.0227	-10.2639	43.4000	2.92525e+10	1.94525e+10	2	1
11	37	18.4129	-14.4944	43.4000	2.90025e+10	1.92025e+10	2	1
11	38	18.9753	-18.8609	43.4000	2.92525e+10	1.94525e+10	2	1
11	39	19.7575	-23.4209	43.4000	2.90025e+10	1.92025e+10	2	1
11	40	20.8403	-28.2519	43.4000	2.92525e+10	1.94525e+10	2	1
11	41	22.3688	-33.4679	43.4000	2.90025e+10	1.92025e+10	2	1
11	42	22.3026	-6.15768	43.4000	2.90025e+10	1.93275e+10	2	1
11	43	23.1255	-14.5799	43.4000	2.90025e+10	1.93275e+10	2	1
11	44	23.8555	-18.9785	43.4000	2.92525e+10	1.95775e+10	2	1
11	45	24.8769	-23.5783	43.4000	2.90025e+10	1.93275e+10	2	1
11	46	26.3034	-28.4622	43.4000	2.92525e+10	1.95775e+10	2	1
11	47	28.3457	-33.7544	43.4000	2.90025e+10	1.93275e+10	2	1
11	48	27.0866	-6.20071	43.4000	2.90025e+10	1.92025e+10	2	1
11	49	27.4903	-10.3962	43.4000	2.92525e+10	1.94525e+10	2	1
11	50	28.1326	-14.6890	43.4000	2.90025e+10	1.92025e+10	2	1
11	51	29.0672	-19.1294	43.4000	2.92525e+10	1.94525e+10	2	1
11	52	30.3861	-23.7821	43.4000	2.90025e+10	1.92025e+10	2	1
11	53	32.2533	-28.7378	43.4000	2.92525e+10	1.94525e+10	2	1
11	54	32.2310	-6.25483	43.4000	2.90025e+10	1.93275e+10	2	1
11	55	32.7421	-10.4896	43.4000	2.92525e+10	1.95775e+10	2	1
11	56	33.5597	-14.8274	43.4000	2.90025e+10	1.93275e+10	2	1
11	57	34.7597	-19.3223	43.4000	2.92525e+10	1.95775e+10	2	1
11	58	37.8970	-6.32314	43.4000	2.90025e+10	1.92025e+10	2	1
11	59	38.5532	-10.6082	43.4000	2.92525e+10	1.94525e+10	2	1
11	60	39.6120	-15.0044	43.4000	2.90025e+10	1.92025e+10	2	1
11	61	-3.02819	6.06061	43.4000	2.92525e+10	1.95775e+10	2	1
11	62	-3.47756	32.9603	43.4000	2.92525e+10	1.95775e+10	2	1
11	63	-7.10098	6.06668	43.4000	2.92525e+10	1.94525e+10	2	1
11	64	-8.46498	33.0078	43.4000	2.92525e+10	1.94525e+10	2	1

Satellite Number 12

Sat	Beam	Longitude	Latitude	Gain	Up Freq	Down Freq	Polar	Scan
12	1	94.2258	23.1329	43.4000	2.92525e+10	1.94525e+10	2	1
12	2	94.2258	23.1329	43.4000	2.97527e+10	1.99525e+10	2	1
12	3	102.162	2.02090	43.4000	2.90025e+10	1.92025e+10	2	1
12	4	102.162	2.02090	43.4000	2.95025e+10	1.97025e+10	2	1
12	5	98.4652	18.6648	43.4000	2.90025e+10	1.93275e+10	2	1
12	6	98.4652	18.6648	43.4000	2.95025e+10	1.98275e+10	2	1
12	7	98.6998	23.1603	43.4000	2.92525e+10	1.95775e+10	2	1
12	8	98.6998	23.1603	43.4000	2.97525e+10	2.00775e+10	2	1
12	9	102.224	6.07899	43.4000	2.92525e+10	1.94525e+10	2	1
12	10	102.224	6.07899	43.4000	2.97527e+10	1.99525e+10	2	1
12	11	102.352	10.1870	43.4000	2.90025e+10	1.92025e+10	2	1
12	12	102.352	10.1870	43.4000	2.95025e+10	1.97025e+10	2	1
12	13	102.554	14.3818	43.4000	2.92525e+10	1.94525e+10	2	1
12	14	102.554	14.3818	43.4000	2.97527e+10	1.99525e+10	2	1
12	15	102.843	18.7069	43.4000	2.90025e+10	1.92025e+10	2	1
12	16	102.843	18.7069	43.4000	2.95025e+10	1.97025e+10	2	1
12	17	106.910	14.4291	43.4000	2.92525e+10	1.95775e+10	2	1
12	18	106.910	14.4291	43.4000	2.97525e+10	2.00775e+10	2	1
12	19	107.328	18.7715	43.4000	2.90025e+10	1.93275e+10	2	1
12	20	107.328	18.7715	43.4000	2.95025e+10	1.98275e+10	2	1
12	21	107.907	23.3018	43.4000	2.92525e+10	1.95775e+10	2	1
12	22	107.907	23.3018	43.4000	2.97525e+10	2.00775e+10	2	1
12	23	112.757	23.4209	43.4000	2.92525e+10	1.94525e+10	2	1
12	24	112.757	23.4209	43.4000	2.97527e+10	1.99525e+10	2	1
12	25	102.162	-2.02090	43.4000	2.92525e+10	1.94525e+10	2	1
12	26	102.162	-2.02090	43.4000	2.97527e+10	1.99525e+10	2	1
12	27	106.345	-2.02710	43.4000	2.92525e+10	1.95775e+10	2	1
12	28	106.345	-2.02710	43.4000	2.97525e+10	2.00775e+10	2	1
12	29	89.7742	23.1329	43.4000	2.92525e+10	1.95775e+10	2	1
12	30	89.7742	23.1329	43.4000	2.97525e+10	2.00775e+10	2	1
12	31	85.3002	23.1603	43.4000	2.92525e+10	1.94525e+10	2	1
12	32	85.3002	23.1603	43.4000	2.97527e+10	1.99525e+10	2	1
12	33	84.9794	27.9079	43.4000	2.90025e+10	1.92025e+10	2	1

12	34	84.9794	27.9079	43.4000	2.95025e+10	1.97025e+10	2	1
12	35	81.1569	18.7069	43.4000	2.90025e+10	1.93275e+10	2	1
12	36	81.1569	18.7069	43.4000	2.95025e+10	1.98275e+10	2	1
12	37	80.7571	23.2160	43.4000	2.92525e+10	1.95775e+10	2	1
12	38	80.7571	23.2160	43.4000	2.97525e+10	2.00775e+10	2	1
12	39	80.2091	27.9810	43.4000	2.90025e+10	1.93275e+10	2	1
12	40	80.2091	27.9810	43.4000	2.95025e+10	1.98275e+10	2	1
12	41	77.3812	10.2193	43.4000	2.90025e+10	1.92025e+10	2	1
12	42	77.3812	10.2193	43.4000	2.95025e+10	1.97025e+10	2	1
12	43	77.0902	14.4291	43.4000	2.92525e+10	1.94525e+10	2	1
12	44	77.0902	14.4291	43.4000	2.97527e+10	1.99525e+10	2	1
12	45	76.6719	18.7715	43.4000	2.90025e+10	1.92025e+10	2	1
12	46	76.6719	18.7715	43.4000	2.95025e+10	1.97025e+10	2	1
12	47	76.0925	23.3018	43.4000	2.92525e+10	1.94525e+10	2	1
12	48	76.0925	23.3018	43.4000	2.97527e+10	1.99525e+10	2	1
12	49	75.2952	28.0941	43.4000	2.90025e+10	1.92025e+10	2	1
12	50	75.2952	28.0941	43.4000	2.95025e+10	1.97025e+10	2	1
12	51	74.1801	33.2557	43.4000	2.92525e+10	1.94525e+10	2	1
12	52	74.1801	33.2557	43.4000	2.97527e+10	1.99525e+10	2	1
12	53	72.0247	18.8609	43.4000	2.90025e+10	1.93275e+10	2	1
12	54	72.0247	18.8609	43.4000	2.95025e+10	1.98275e+10	2	1
12	55	71.2425	23.4209	43.4000	2.92525e+10	1.95775e+10	2	1
12	56	71.2425	23.4209	43.4000	2.97525e+10	2.00775e+10	2	1
12	57	70.1597	28.2519	43.4000	2.90025e+10	1.93275e+10	2	1
12	58	70.1597	28.2519	43.4000	2.95025e+10	1.98275e+10	2	1
12	59	66.1231	23.5783	43.4000	2.92525e+10	1.94525e+10	2	1
12	60	66.1231	23.5783	43.4000	2.97527e+10	1.99525e+10	2	1
12	61	64.6966	28.4622	43.4000	2.90025e+10	1.92025e+10	2	1
12	62	64.6966	28.4622	43.4000	2.95025e+10	1.97025e+10	2	1
12	63	58.7467	28.7378	43.4000	2.90025e+10	1.93275e+10	2	1
12	64	58.7467	28.7378	43.4000	2.95025e+10	1.98275e+10	2	1