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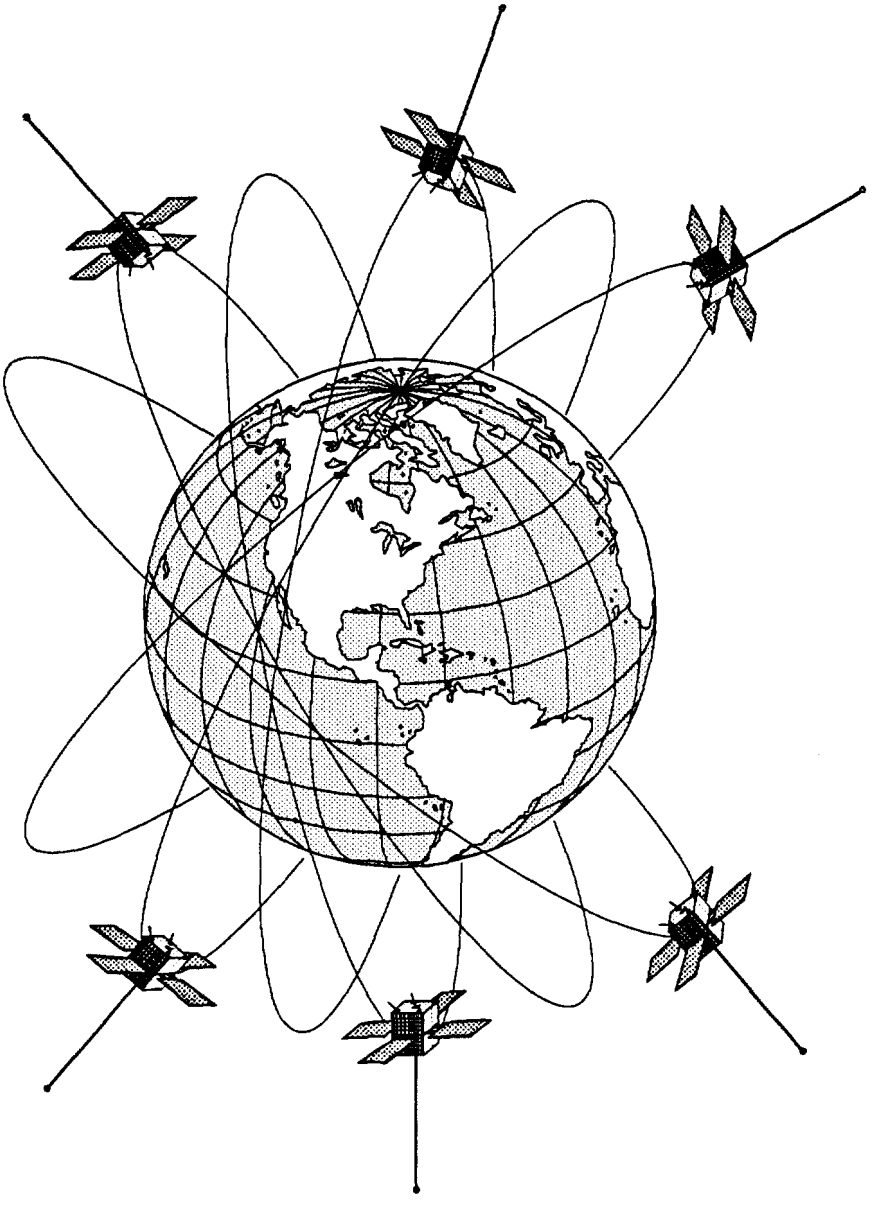
I. SYSTEM OVERVIEW



STARNET CONSTELLATION

PART I

THE STARNET SYSTEM EMPLOYS A PIONEERING COMBINATION OF LOW EARTH ORBIT SATELLITE, HIGH SPEED COMPUTER AND LOW COST USER TERMINAL TECHNOLOGY TO PROVIDE A PRIVATE MOBILE COMMUNICATIONS SERVICE OF UNPRECEDENTED CAPACITY AND SCOPE

Applicant has strategically blended together the separate technologies of low earth orbit (LEO) satellites, high-speed computers and low-cost user terminals to produce a truly state-of-the-art and market-responsive mobile communications service. No other private mobile communications system has ever been developed with the multi-million user capacity, worldwide scope, and universally-accessible pricing of Applicant's STARNET system.

A. THE STARNET SERVICE

The key features of the STARNET service are two-way communications and positioning, marketing under a private, non-common carrier distribution structure, and a worldwide coverage capacity adequate to handle many millions of users. Applicant believes that this unique combination of service features will find a vast market in America's maturing telecommunications market of the 1990s.

1. Two-way Communications and Positioning

STARNET system users will enjoy full two-way data communications, digital speech output, and reliable Doppler-based positioning services. Applicant believes it has developed a pioneering combination of these services that is unmatched by any other proposed operating system.

Two-way data communications will consist of messages of up to thrity-two (32) characters in either the send or receive directions. Longer messages of up to 100 characters may be sent in separate

packets and will be assembled into an integrated whole message in the user terminal logic circuitry. Messages may also be sent from any user terminal to any other user terminal simply by addressing its unique ID code. Messages may also be sent to any compatible data display device - such as PCs, smart phones, or faxes - via the STARNET X.25 interface to the global telecommunications system.

Messages received on the STARNET user terminal may be displayed in one of three ways. The messages may be scrolled across the user terminal's LCD display. The messages may be printed on an optional thermal micro-printer. The messages may also be "spoken out" via a digital speech synthesis chip, incorporated into STARNET user terminals.

Positioning services include reporting the location of a user terminal to someone else, and giving a lost person his or her own location via their user terminal. Applicant's affiliates have more experience than any other organization in the world in the use of LEO satellites for positioning services. Applicant has built upon this experience to design a commercial version of its technology that promises to deliver yet greater benefits to the private marketplace.

Positioning of any user terminal occurs automatically in the STARNET system. User transmissions are received via a STARNET satellite and then downlinked to a regional processing station. The signals are then fed into STARNET computers where sophisticated software programs determine latitude and longitude. Applicant believes that its Doppler-shift positioning software, together with the ranging technique, is the most accurate in the world.

After a position in terms of latitude and longitude is calculated, that information may be sent anywhere - to a distant dispatch computer control center, to a fax machine, to another user terminal, or back to the user terminal via the new "Voice Locator" service. When the "Voice Locator" service is activated, the STARNET positioning computer performs two additional functions:

- the latitude and longitude are translated into human language references such as "Corner of 19th and M Street" or "Washington Beltway at Exit 30";

- the human language references are provided as digital speech output into the public switched telephone system.

As a result of Applicant's revolutionary "Voice Locator" capability, many new positioning services can be provided to the general public. For example, if one family member is worried about another who has not arrived when expected, they can phone a number such as 1-800-STARNET. A voice STARNET response system will prompt them to type in (using their touchtone phone) the ID code of the STARNET unit they are interested in. STARNET's voice response system will then "speak out" a message such as "At 6 PM, your user terminal was on the San Diego Freeway, near Torrance." The family can then rest a bit more at ease, knowing that another L.A.-area traffic jam is their biggest concern.

Applicant's "Voice Locator" feature also has potential for several safety of life ramifications. For example, a forest ranger can query for the location of a lost backpacker; the Coast Guard can query for the location of a lost mariner; a parent can query for the last location of a lost child.

2. Private, Non-Common Carrier Offering Tailored to Market Requirements

The STARNET capacity will be sold in bulk to providers of related products. Each such arrangement is certain to be unique due to varying market requirements and the tremendous flexibility of the STARNET system. Customers will include manufacturers of automobiles, mobile communications equipment, pollution control sensors, and health care devices. Capacity will also be sold in bulk to organizations involved in related services. These customers will include insurance companies, automobile associations, and travel and entertainment concerns.

Oftentimes the kind of organizations that are best at building space hardware may not be at all successful in marketing consumer products. Applicant's market research has indicated that many applications of LEO mobile satellite services will be frustrated if the user is burdened with any kind of a recurring charge. On the other hand, the incorporation of a LEO mobile satellite service capability into a related product - such as a car, all-terrain-vehicle, bio-sensor - may enable significantly increased sales for that product, if the purchaser does not get "stuck" with yet another recurring bill. The private, non-common carrier structure of the STARNET offering enables the greatest flexibility in arranging to deliver LEO mobile satellite services in accordance with market requirements. This is because bulk purchasers of STARNET capacity can establish their own pricing policies for the service on the basis of their expert knowledge of consumer market needs.

3. Capacity of Millions and Worldwide Coverage

The STARNET system's greatest attribute is its design as a mass consumer system. Applicant's market research indicates a capturable market of 10% of the U.S. population, or twenty-five (25) million user terminals. The STARNET system has been designed to handle this traffic load flexibly and reliably.

Furthermore, the STARNET system is an inherently global system. This feature is increasingly important in the 1990s, a decade in which government policymakers and industrialists alike are telling us to prepare for global travel, a global economy, and, ultimately, a global lifestyle.

B. PIONEERING COMBINATION OF HIGH-TECH AND LOW-COST TECHNOLOGY

One of the most exciting features of the STARNET system is its combination of high-technology and low-cost technology. The result of this combination is that the largest number of people get access to some

of the world's most sophisticated telecommunications services. This feature of the STARNET system is manifestly in the public interest.

1. STARNET Multiple Satellite Constellation

The STARNET Multiple Satellite Constellation (see Figure I.B.1) described in detail in Part VII of the Application, is the result of several high-technology trends. The satellites will be built of new high-strength, lightweight materials to enable maximum lifetime in orbit for a given payload mass. The satellites will incorporate newly-developed, simple, reliable, and efficient telemetry and diagnostic systems. The result of these high-tech advancements is to develop a more reliable, cost-effective and useful LEO mobile satellite service to the user community.

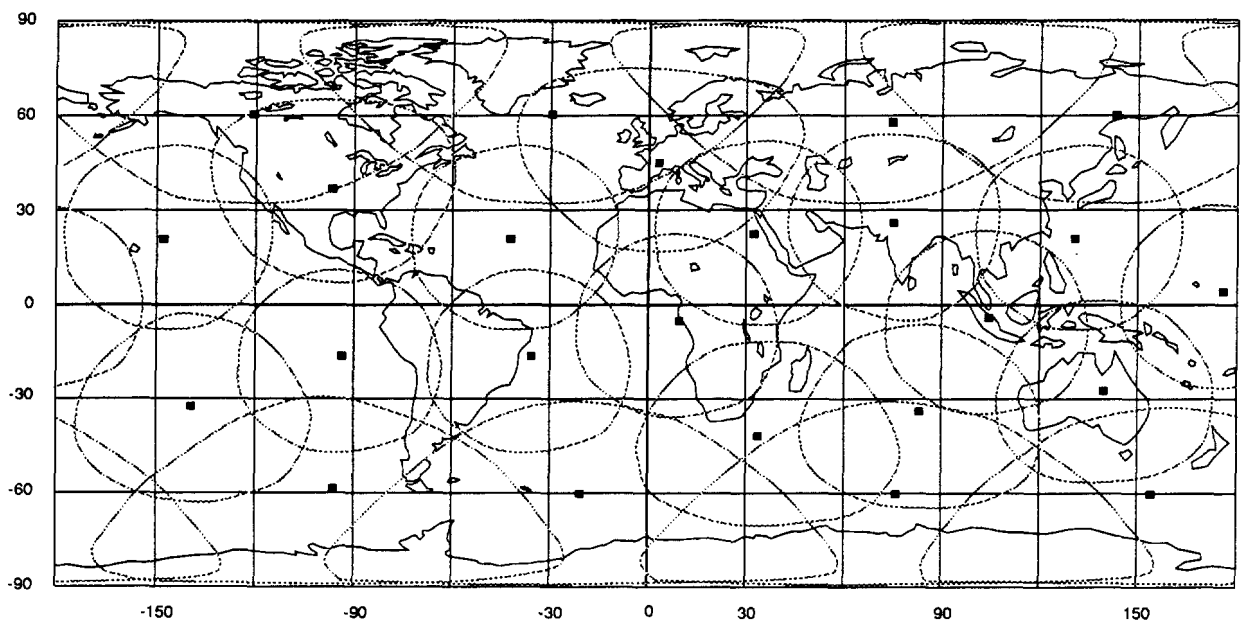


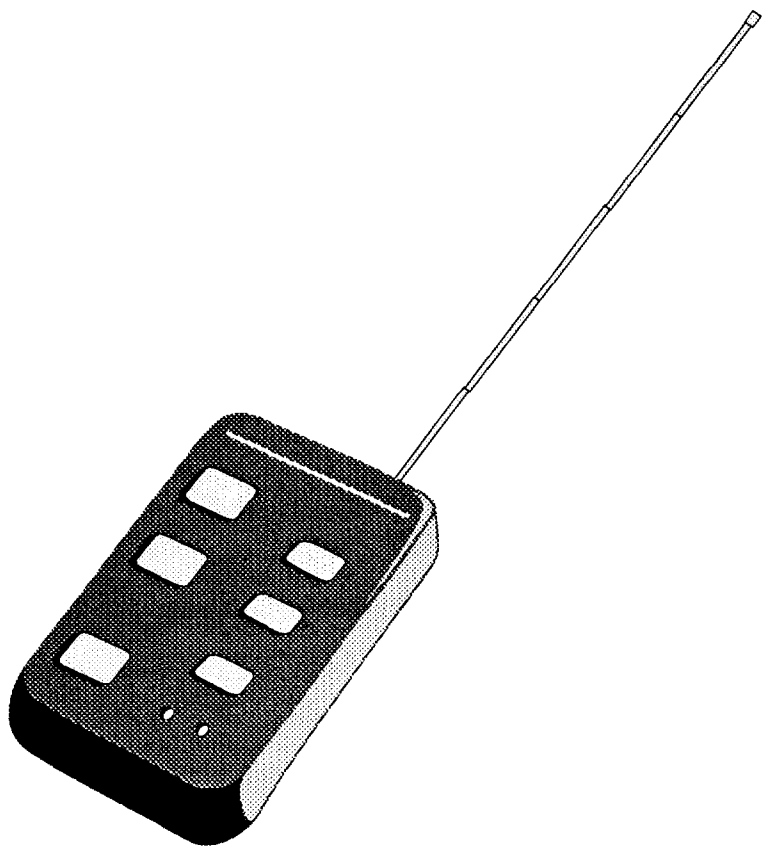
Figure I.B.1

2. STARNET Low Cost User Terminal

Some STARNET applications do not require a two-way system, so the LOCPAC Extra Low-Cost User Terminal, at an estimated retail price of less than $50, will provide preprogrammed transmission according to the number of daily requested locations or messages (data collection)

such as environmental control, drifting buoy tracking, animal tracking, etc.

The STARNET HELPAC Low Cost Two-Way User Terminal had an estimated retail price of less than $75, a dramatic breakthrough in the cost of satellite access equipment (see figure I.B.2). Applicant and its affiliates can speak with great credibility in terms of user terminal pricing several suppliers today provide Applicant's affiliate, with Argos, user terminals for less than $1000.



HELPAC

Figure I.B.2

As the chart below shows, Applicant's existing satellite user terminals are already by far the least expensive satellite access equipment available:

MANUFACTURER	SATELLITE ACCESS	PRICE
Telonics	CLS Argos	<$1000
Magnavox	NNSS TRANSIT	$1200
Marinetek	GPS NAVSTAR	$1700
Various	Galaxy Ku band	$2500
Various	Galaxy C band	$3000
Magellan	GPS	$3000
Hughes	Geostar	$4100
Qualcomm	GTE Gstar Ku Band	$4100
Sony	Geostar	$4100

It is particularly important to recognize that the Applicant will be able to incorporate a substantial amount of state-of-the-art technology into its user terminals. Among the new technology to be incorporated, (with estimated parts cost) are:

- Two-way communications and positioning — $11
- Digital speech synthesis — Optional
- Thermal micro-printer — Optional
- Power-saver circuitry for long life — $2
- VLSI logic circuitry for greater reliability and flexibility — $10
- One megabyte of RAM standard — $2

TOTAL ESTIMATED PARTS COST — $25
(1993 purchases; large volume)

The user terminals will be manufactured entirely on automated lines, with very little labor input. American factories will therefore be in a strong competitive position.

3. STARNET High Speed Control Segment

The STARNET high-speed control segment will downlink signals from the orbiting constellation of satellites, perform message switching functions, make positioning calculations, control system operations, and offer a wide array of wide-driven value-added services. In order to cover continental and U.S. territories, two (2) regional stations will receive signals from the satellites as they come into view. These regional stations will be connected to the STARNET Processing, Analysis and Control Center (PACC) located on the East Coast and another PACC located on the West Coast via a hub network using high quality fiber optic and ISDN terrestrial links.

The PACC East and West will have a number of separate processing computers as indicated in Part VII of this Application. The STARNET PACCs also offer interconnection to the public switched telephone network, and through regional and international telecommunications networks. Applicant and its affiliates have several years experience in interconnecting its existing Argos control center in Landover, Maryland to the regional and international telecommunications networks. In its eleven years of operation, Argos has successfully provided over 6 million minutes of 99.99% reliable telecommunications network links.

II. MARKET DEMAND

PART II

THE STARNET SYSTEM SERVES CRITICAL MARKET REQUIREMENTS IN THE AUTOMOBILE, MOBILE COMMUNICATIONS, HEALTH CARE, ENVIRONMENTAL PROTECTION AND RECREATIONAL ELECTRONICS INDUSTRIES

The following two stories, and many more like them, are true.

On a stormy day at sea a yachtsman is washed overboard. He has the time to grab onto nothing other than his CLS Argos satellite transmitter. Signals from his transmitter are received by a low earth orbit Argos satellite receiver and beamed down to a ground station on earth. Sophisticated computer programs quickly calculate his location and send an appropriate SOS to local rescue officials. The yachtsman is saved, thanks to the low earth orbit mobile satellite technology of CLS Argos.

A truck driver parks his rig in downtown Los Angeles to visit a restaurant for a well-deserved break. When he returns, the truck is gone - stolen. Fortunately his company had equipped the truck with a CLS Argos satellite transmitter. The Los Angeles police receive the precise location via satellite, recovere the truck and apprehend the thief.

The CLS Argos low earth orbit mobile satellite system, although restricted by bandwidth, regulation and government agreements to special applications, has demonstrated for over eleven years, numerous safety of life and property benefits. Because of the many restrictions on CLS Argos, excepting certain demonstration projects such as the two stories above, STARSYS was incorporated to offer the many benefits of LEO MSS technology to the public on a commercial basis.

The STARNET system is a multi-industry, multi-market technology. The same technology that provides critical communications and positioning services to the automobile industry also provides safety-of-life services in the health care and recreational electronics industries. Applicant has

performed thousands of hours of market research into LEO mobile satellite service markets. Some of this research, especially as it pertains to the instant Application, is summarized below.

A. AUTOMOBILE INDUSTRY MARKETS FOR STARNET

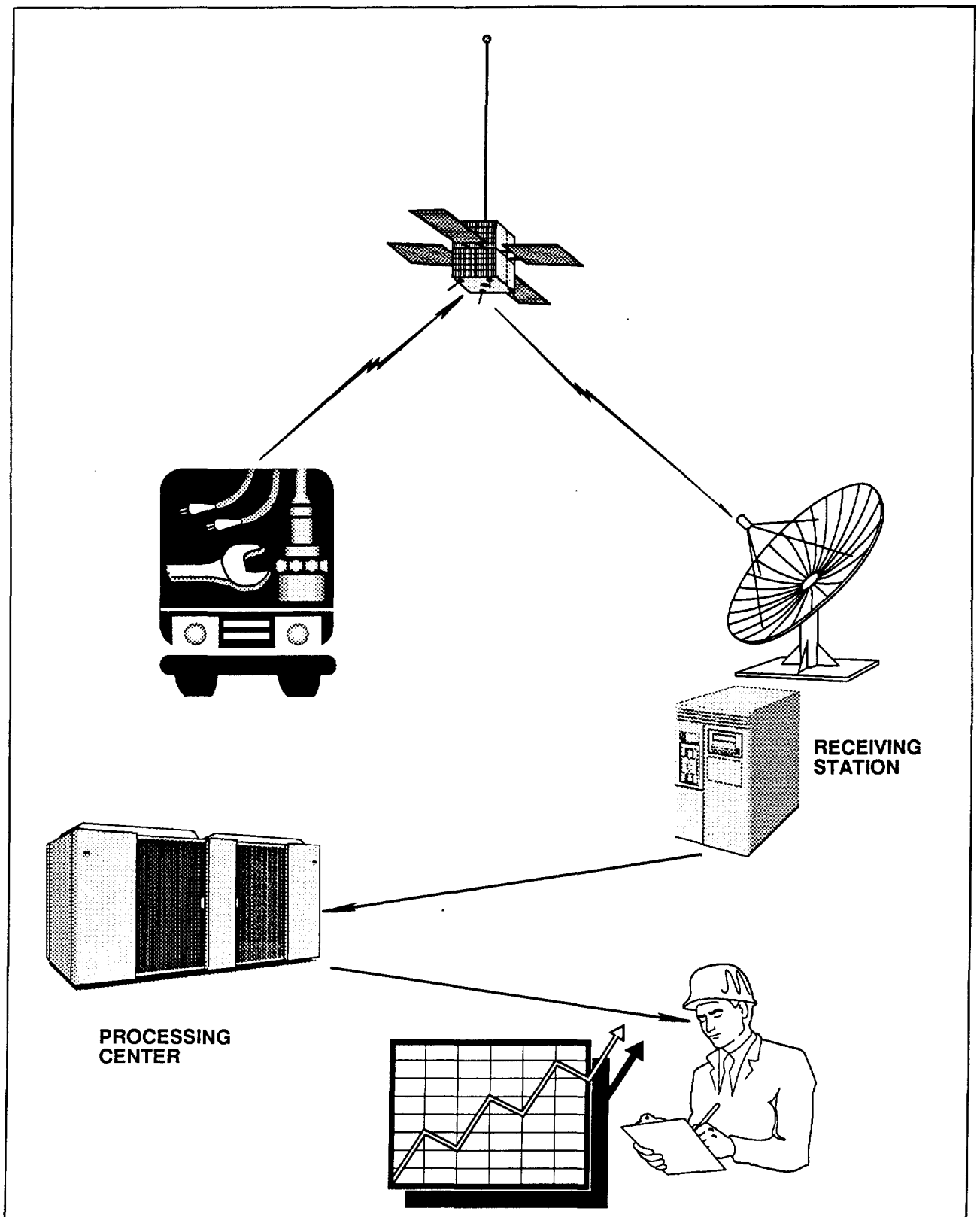
Market research has indicated that automobile industry requirements for STARNET services may be divided into three main categories: Electronic Vehicle Monitoring, Anti-Theft Technology, and Vehicle Location information. Each of these market requirements may be addressed with a single STARNET user terminal in each vehicle.

1. Electronic Vehicle Monitoring

There are approximately 170 million vehicles in the United States, including trucks, buses, autos and motorcycles. The fastest growing portion of automobile costs in the United States are electronic systems, currently representing upwards of 30% of vehicle cost.

STARNET user terminals may be conveniently and inexpensively built into new vehicles as an electronic vehicle monitoring system. If any electronic-controlled system, including in particular a pollution-control system, is operating outside of commercial specifications or federal and state regulations, the STARNET user terminal can be programmed to automatically send a notification as to which system is deficient (see Figure II.A.1).

Alternatively, the STARNET user terminal may be designed to transmit information on a wide variety of automotive systems. For example, any unscheduled maintenance required - braking, engine, or passive restraint systems - could be silently transmitted via STARNET to the dealer from which the vehicle was purchased. The dealer can then call or send a letter to the registered owner advising them of a need for unscheduled maintenance. Use of the STARNET system for unscheduled maintenance alerts can save lives due to avoidance of mechanical automobile failure. STARNET systems can also establish a better



VEHICLE EMISSION MONITORING Figure II.A.1

partnership relationship between the automobile companies and their consumer customers.

2. Anti-theft Technology

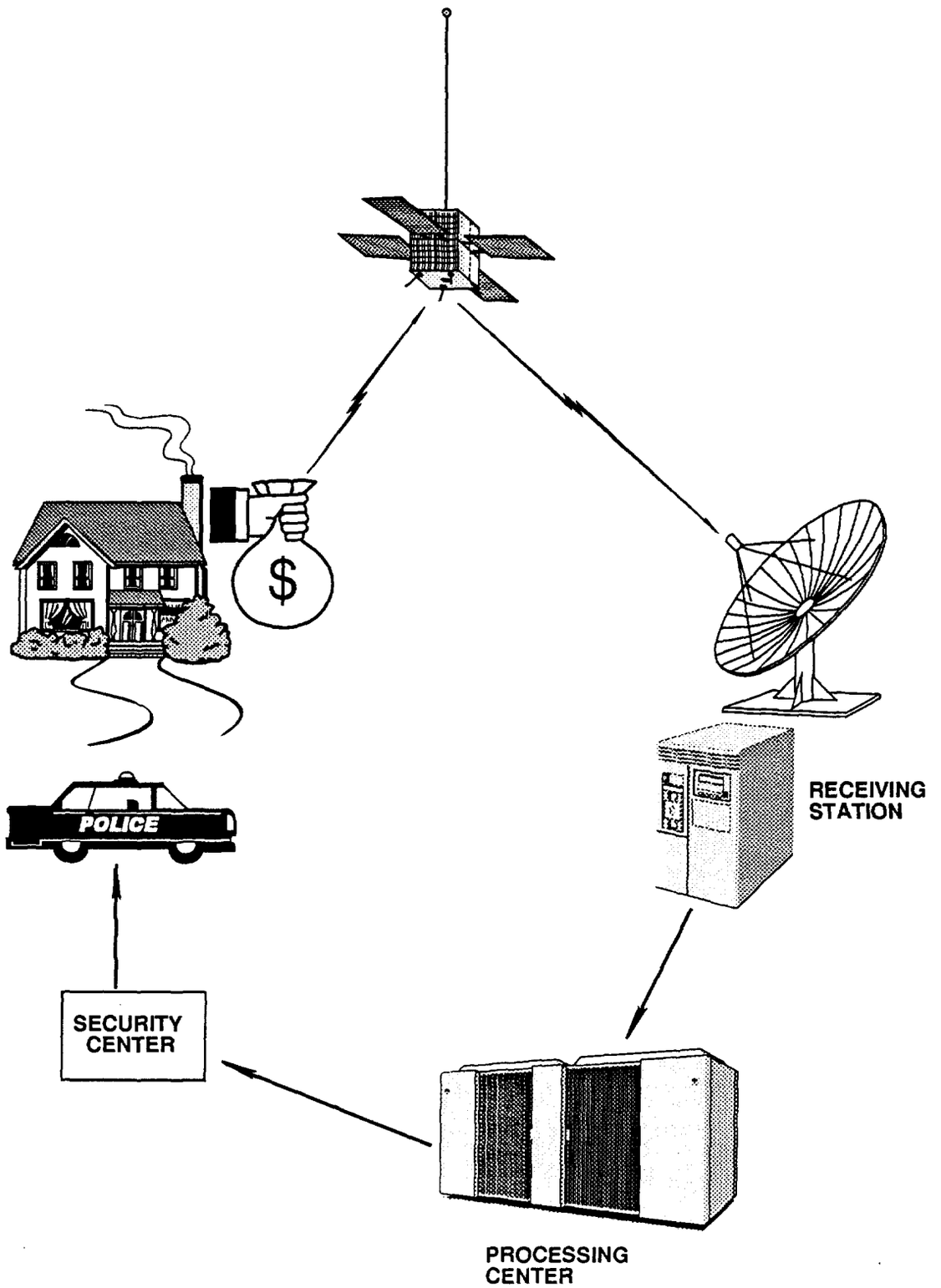
There are about 2,000 major construction equipment robberies in the U.S. annually. Every house, farm or warehouse in this country is susceptible to robbery. The STARNET system will allow the subscriber's property to send SOS signals; information about the location of the building, time and date, is rapidly transmitted to a security center, (police, insurance company, fire department) and consequently the criminals can be quickly intercepted (see Figure II.A.2).

The STARNET system offers a superior solution to anti-theft technology. Current land-based systems, such as Lo-Jack, are limited to nearby coverage areas (such as a single state), and cost as much as $600 per car. Nevertheless, such systems are already credited with the recovery of many stolen cars. Consequently, insurance deductions of about 15% are reported for Lo-Jack users.

Unlike terrestrial anti-theft systems, the STARNET system will provide complete U.S. (and global) coverage, and is projected to cost only $75 per vehicle. This nearly twelve-fold reduction in price, and vast increase in coverage, will contribute to a major increase in the utility and availability of anti-theft technology.

Market research has indicated that anti-theft technology offers the following key benefits:

- Early location of stolen vehicles will limit damage done to the vehicle;
- Early location of stolen vehicles more often results in the arrest of thieves;
- Effective anti-theft locating systems reduce insurance bills.



ANTI-THEFT TECHNOLOGY

Figure II.A.2

Applicant's research for this system revealed there are over 1.4 million car thefts per year, of which less than 20% are ever recovered. At an average recovery value of 60%, and an average car value of $10,000, the total cost of car theft to owners and insurers is in excess of $10 billion dollars per year!

Applicant's marketing strategy will enable automobile manufacturers to offer satellite anti-theft systems as a standard feature in their new models. This approach is likely to result in much faster market penetration than current or alternative concepts based on after-market sales or recurring subscription service bills.

In practice, a phone call to a number such as 1-800-STARNET would be made after a car is stolen. A voice response system would direct the caller to key in their license plate number on a touchtone phone. The current location of the car would be reported via a voice synthesis capability, as well as a notification that fax and telex messages (as appropriate) were being sent to the closest police department and the state department of motor vehicles.

If an automobile manufacturer wishes instead to handle all the 1-800-STARNET functions themselves, such an approach is perfectly acceptable under the STARNET private, satellite operator structure. The important point is to implement a nationwide satellite anti-theft system. There is no organization better able to do this than Applicant, due to the experience of its affiliated companies. In fact, the first vehicle ever recovered via satellite monitoring was a tractor-trailer rig in Los Angeles - located via Applicant's affiliate Argos satellite system transmitter, marketed by Geostar Corporation of Washington, D.C., and recovered by the Los Angeles Police Department.

3. Vehicle Location Information

America's love affair with the automobile has no end in sight. Recent announcements have been made by General Motors of a high performance electric car, and projections were just released by the

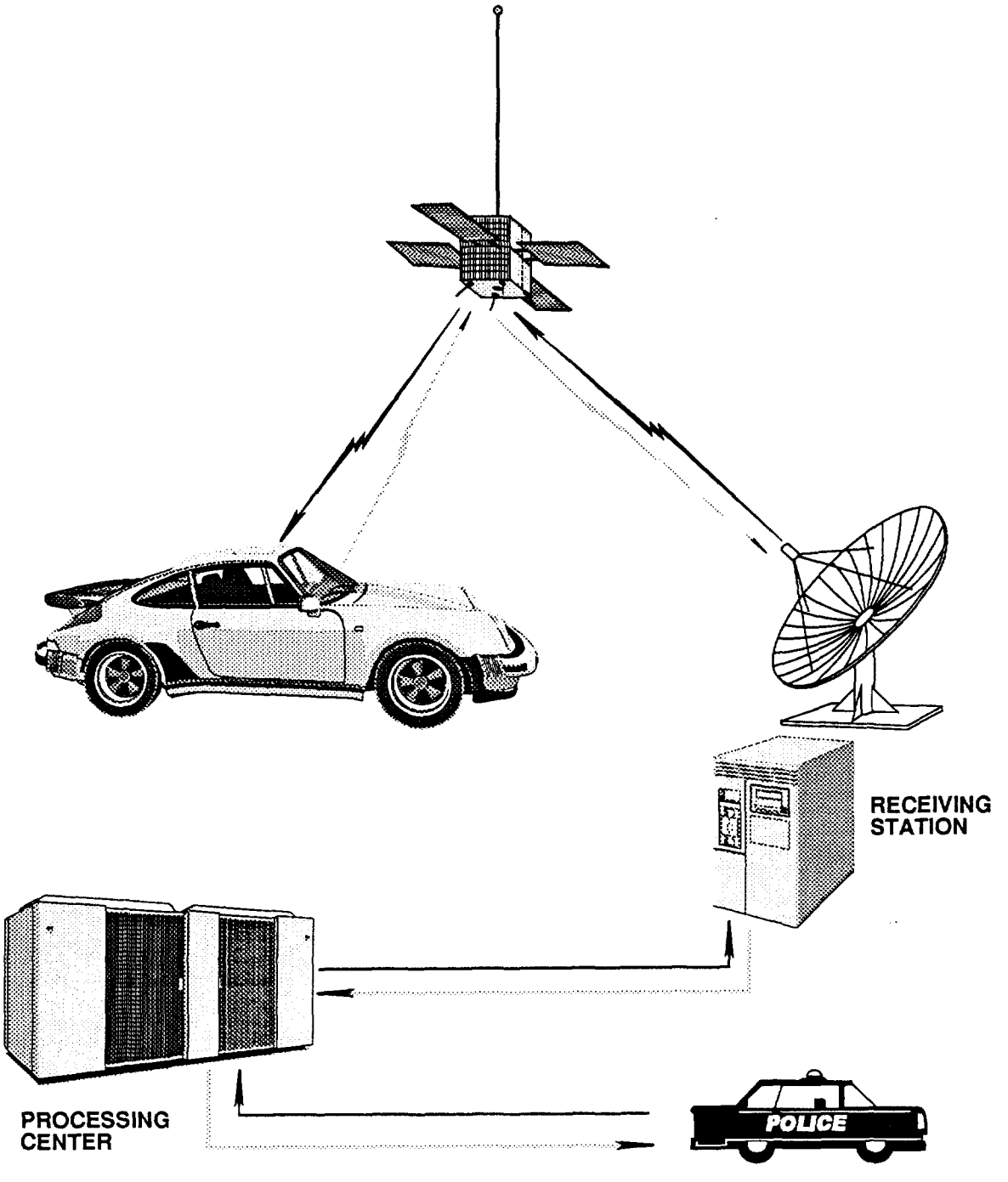
Department of Transportation showing continued automobile growth throughout the 21st century. As cars become smarter (more electronics), and highways become more congested, the need for communications with cars is certain to become increasingly acute.

Substantial progress in automobile communication has been accomplished using cellular communications technology. However, cellular technology is too expensive and not optimally designed for basic vehicle location information functions. The STARNET system complements the voice-oriented cellular communications network by providing a very inexpensive, and automatic, means of identifying a car and its location at nearly all times (see Figure II.A.3).

The market for Applicant's STARNET vehicle location service is sized as follows:

POTENTIAL MARKET	170 Million U.S. Vehicles
ADDRESSABLE MARKET	130 Million Personal Vehicles (assumes commercial vehicles use more expensive and sophisticated systems)
CAPTURABLE MARKET	40 Million Vehicles Covered by Automobile Club Membership

Applicant's STARNET vehicle location service would operate much like the anti-theft service. A phone call to a number such as 1-800-STARNET will trigger a voice response menu asking the user to press 1 if they are reporting a theft, 2 if they want to know a car's location, or 3 for other services. In this case, the user would press 2, and be queried as to the ID number of the STARNET terminal. After a brief pause of no more than a few seconds, a clear quality digital voice would tell the caller that at a specified time the vehicle was near a determined intersection.



ANTI-THEFT VEHICLE MONITORING

Figure II.A.3

B. MOBILE COMMUNICATIONS INDUSTRY NEED FOR STARNET

In addition to the strong market for STARNET within the automobile industry, there is a also a robust demand for it in the general mobile communications industry. In this market sector, strong demand for STARNET services have been identified as a personal communications technology, as a low-cost two-way messaging system, and as a global messaging network.

1. Personal Communications Technology

Personal communications technology is experiencing explosive growth. Previously the only options available were private half-duplex radio systems or CB radio. However, the 1980s engendered a new age of personal communications technology with cellular communications, nationwide alphanumeric paging, and cordless telephones. Nevertheless, as is usually the case, some technology usually stimulates the public's appetite for more technology. It is very rare indeed that one communications system renders obsolete any other form of communication. For example, paging is growing even more rapidly than previously now that cellular is available.

Despite the development of cellular and cordless telephony, there is still a vast unmet demand for personal communications. Cordless telephony is only useful for a very limited range of about 1000 feet (300 m), and cost factors have limited cellular service penetration to less than 2% of the U.S. population. Although new concepts such as Personal Communication Networks and Land Mobile Satellite Service are on the drawing boards, these technologies will also fall far short of satisfying America's appetite for personal communications. The Personal Communications Networks are envisioned as urban-area only systems, and are expected to be as costly as cellular for airtime. The Land Mobile Satellite Service requires expensive (multi-thousand dollar) user equipment to reach distant geostationary satellites.

Figure II.B.1 is a Personal Communications Technology Product Market Grid showing the large U.S. market that STARNET is able to address.

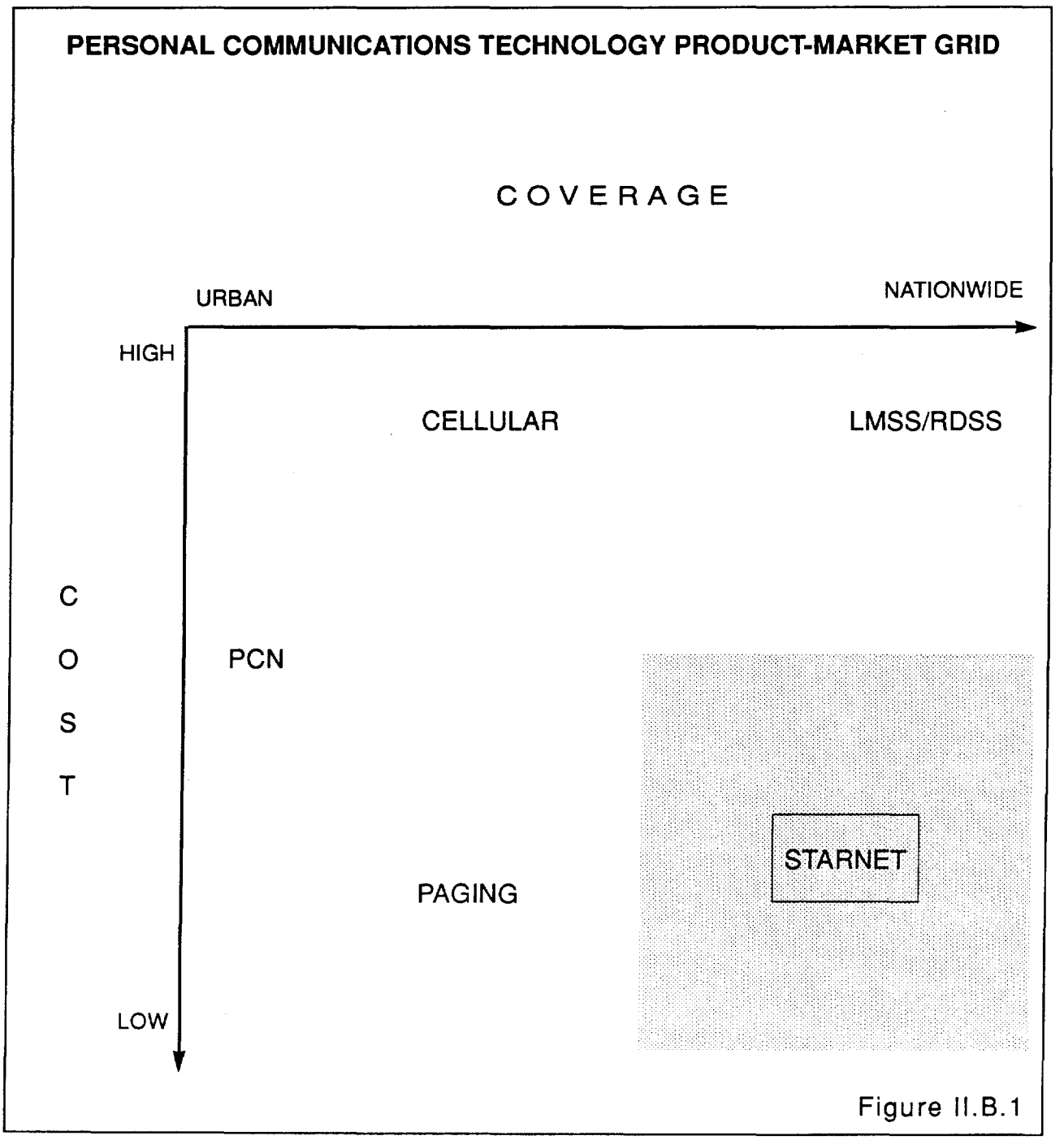


Figure II.B.1