ASSESSMENT OF USER REQUIREMENTS FOR MOBILE COMMUNICATIONS IN CANADA

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FOR MOBILE COMMUNICATIONS

IN CANADA

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1.0 INTRODUCTION

Canada is a world leader in the use of telephones. The penetration of telephones in business and residences (i.e., 98.2% of the residential sector in 1985) is among the highest in the world. Canadians have a history of making more phone calls per capita (1,361 in 1985) than any other nation.[1] With this propensity for personal communications, it is not surprising that there is also substantial demand for more versatile or mobile communications systems in Canada.

Moreover, the expansion of socio-economic activity coupled with technological advances have contributed to the rapid expansion of mobile communications in Canada and worldwide. In particular, as business strives to become more productive and public safety officials strive for increased efficiency, various forms of mobile communications have been developed for use in automobiles, ships, airplanes and trains, and for carrying by human beings.

Mobile communications provide the capability to stay in touch wherever a person travels. The continual improvements in mobile communications products, both in terms of cost-effectiveness and capability, indicate that mobile communications usage will continue to grow for the foreseeable future, and new services will be developed and introduced.

The following are some of the anticipated developments which, among other things, will continue to improve mobile communications:

- the introduction of digital radio transmission products;
- uniform telephone interconnection techniques;
- introduction of voice recognition schemes;

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[1]Communications for the Twenty-First Century, Communications Canada, P.45.

- continued improvement in battery technology;
- development of reasonably priced, flexible antennas for both land and direct satellite-based services; and,
- development of central-office switching software that permits recognition of different user groups and provides adaptable services to different classes of subscribers.

In light of the rapid changes occurring in mobile communications and the advent of new technology such as MSAT, the Federal Department of Communications (DOC) recognized a requirement to investigate the mobile communications market. The investigation was required to provide information that will assist the DOC in ensuring an orderly development of mobile communications services, systems and industry in Canada. A Statement of Work was prepared by the DOC, and a number of consulting firms were requested by Supply and Services Canada to submit proposals to assess the user requirements for mobile communications in Canada. Following the evaluation of several proposals, Goss, Gilroy & Associates Ltd. (GGA), an Ottawa-based management consulting firm, was retained to undertake the study.

1.1 Statement of Work

The Statement of Work required the successful consulting firm to complete the following tasks:

1. ***Conduct an Overview Mobile Communications*** *- the contractor was requested to provide a brief overview of the developments in mobile communications in terms of various classes, e.g., maritime, aeronautical, land-based - paging, mobile radio, mobile telephone, CB radio, etc. For this task, the contractor was expected to synthesize readily available information from sources such as existing literature, previous government reports and on-line databases;*

2. ***Requirements of Mobile Communications*** *- for this task, the contractor was requested to focus on the land-based market and to document qualitatively and/or quantitatively the level of user satisfaction with current services and identify areas for*

improvement, and forecast the growth trends of different types of mobile communication services....consistent with technology trends; and,

3. ***Social and Economic Importance of Mobile Communications*** *- for this task, the contractor was required to document qualitatively and/or quantitatively the usefulness and benefits of different types of mobile communications services to different groups of users. Both social and economic benefits were to be included in this task.*

1.2 This Report

This report summarizes the work carried out, and the conclusions reached in addressing the Statement of Work given above. More specifically, this report is structured as follows:

- **Background and Approach:** - Section 2.0 provides a definition of mobile communications and describes the approach used in this study;

- **Part I - Land Mobile Communications:** - provides an overview of the land-based mobile communications market as well as a possible new delivery technology for mobile communications. The current situation, user requirements and future trends are covered for the various market segments in the following sections:
  - Section 3.0 - Paging
  - Section 4.0 - Mobile Radio Services (MRS)
  - Section 5.0 - Mobile Telephone Services (MTS)
  - Section 6.0 - Mobile Satellite Services (MSS)
  - Section 7.0 - Mobile Data Services (MDS)

  Section 8.0 - discusses SHARP, a possible new delivery technology for mobile and other communications;

- **Part II - Marine and Air Mobile Communications:** - provides an overview of the marine and air mobile communications markets. While recognizing the study emphasis was on land-based mobile

communications, the current situation, user requirements and future trends are covered. Marine mobile is covered in Section 9.0 and air mobile in Section 10.0;

- **Part III - Social and Economic Impacts:** - Section 11.0 describes the social and economic impacts associated with mobile communications; and,

- **Part IV - Conclusions:** - Section 12.0 provides conclusions and suggested improvements made by users, based on the research carried out in this study.

2.0 BACKGROUND AND APPROACH

This section provides a definition of mobile communications, information on market size, and a brief description of the approach and survey used in undertaking this study.

2.1 Definition of Mobile Communications

Mobile communications, as it currently exists, includes a diverse range of applications and services. As the study is focussed on user requirements rather than on specific technologies, considerable effort was expended in developing a description of the market from a user perspective. This subsection provides several definitions of mobile communications, and describes the services that are included in the study.

In terms of definition, The ITU Radio Regulations broadly defines mobile communications as *"A radiocommunication service between mobile and land stations, or between mobile stations"*. Another definition describes mobile communications as *"wireless communication"*.

Due to the diversity and multiplicity of uses, it is not possible to define a set of functions provided by different types of mobile communications that are mutually exclusive. However, it is useful to differentiate, where possible, on the way they are used:

- **Paging** - generally involves signalling a person that there is a message waiting to be received by some other method of communication;

- **Distribution Management** - provides the capability to redirect personnel and vehicles that are in the field, thereby optimizing their utilization;

- **Vehicle Monitoring** - allows monitoring vehicle positions and performance data in the field to provide more efficient vehicle deployment;

- **Emergency Beacon** - notifies a base station or appropriate authorities of an emergency;

- **Data Transmission** - provides data to a mobile computer, facsimile or printing devices, and allows data to be transmitted from a mobile computer; and,

- **Conversation** - verbal exchange between two or more individuals for business or personal reasons.

To define mobile communications in more detail, it is best to do so by describing services:

- **Radio Paging Service** - one-way communication in which a brief message is transmitted to a recipient. Frequently, this message is no more than a signal (tone) to the recipient to call a pre-arranged number. Paging services are also available in a variety of voice and digital displays. The "page" can be addressed to individual subscribers whenever they are in their home cities, and when travelling, in other cities depending on the technology/service. Moreover, a service in which an individual can be "paged" throughout the world will soon be possible. These services are offered by Radio Common Carriers (RCC's) and telephone companies (Telcos).

- **Mobile Radio Service (MRS)** - this service involves 2-way voice communications over private networks. Technical advances in recent years, such as trunked mobile communications, have increased MRS capability. The addition of data transmission via radio is now used in a number of situations. MRS is used by

emergency services (police, ambulance and fire), taxis and commercial organizations. The messages are typically brief and usually consist of instructions concerning deployment.

- **Mobile Telephone Service (MTS)** - this service allows a mobile user to essentially use a mobile phone in much the same way as a regular telephone. Interconnection with the Public Switched Telephone Network (PSTN) is an essential feature of this service. MTS was initially offered using operator assistance to interconnect with the PSTN. More recently, however, cellular telephone services (CTS's) have radically improved the availability, cost-effectiveness and quality of MTS. In addition, a new service designed specifically for remote areas using a mobile satellite will soon be introduced. In a number of countries, the development and introduction of "personal communications" telephone technology is also being undertaken. Moreover, the coupling of MTS technology with microcomputers, facsimile and/or printers has opened up new applications for mobile data communications.

- **Citizens Band (Two-Way Radio) Service** - a specific type of MRS that grew rapidly in the late 1970s. CB Radio has a limited range and provides a very large number of users with what is essentially a "party line". Its popularity has largely disappeared due to its inherent characteristics, which include short range, channel congestion and lack of privacy.

In addition to the above services, there are a number of ancillary services which complement some of the above services:

- Telephone Answering Services - services that answer when people are away from the phone; and,

- **Voice Mail Services** - used by travellers to stay in touch while away from their office/home. These services range from large corporate systems to small telephone answering machines.

Finally, under a broader definition of mobile communications, the following could be considered:

- **Payphones** - for many individuals, the payphone is the most frequently used form of "mobile" communications; and,

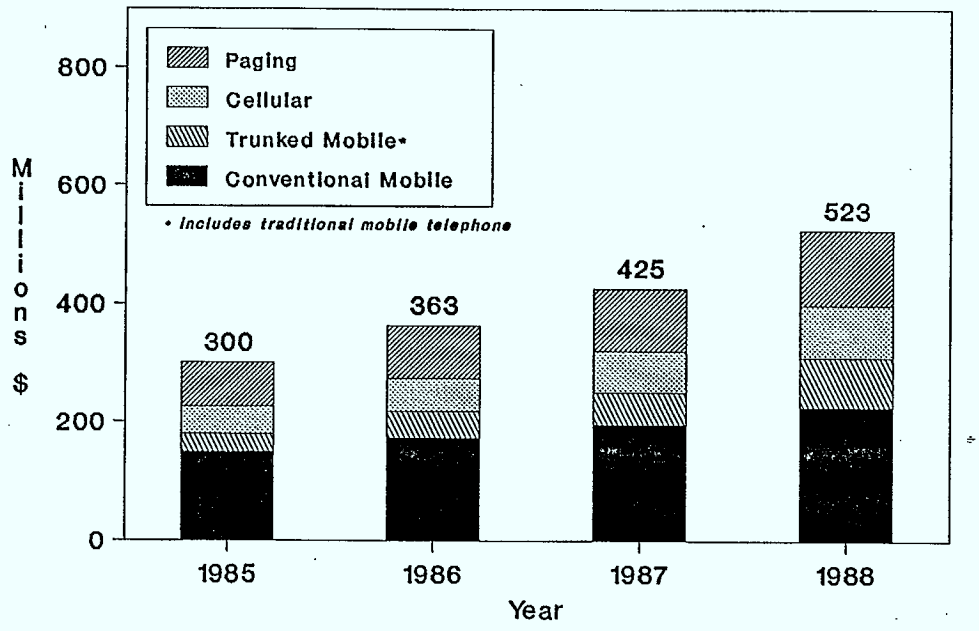
- **Cordless Telephones** - provides a user with very limited mobility around a base unit. These telephones are often used in a household to allow communications while away from fixed (wired) units. In addition, they also have limited application in business. Improved forms of cordless telephones are under development, but because they will have increased functionality, they are included under MTS as "personal communications".

While recognizing that complementary services, payphones and cordless telephones are important to the travelling public, we have restricted our focus in this study to the narrower definition of mobile services given above. Moreover, because CB Radio has such limited functionality, it is not considered further in this study.

2.2 Mobile Communications Market Segmentation

Between 1985 and 1988, the mobile communications market in Canada grew at the average annual rate of 20%. The market revenues for the mobile communications market and its four major segments are given in Exhibit 2.1.

Exhibit 2.1: The Mobile Communications Market In Canada by Segment (Millions $)



Source: Evans Research Corp.

The 1987 figures given in the above Exhibit can be contrasted with the overall Canadian telecommunications market, estimated to be $20.4 billion* in 1987. This $20.4 billion market, which grew at an annual rate of just under 5%* in the 1984-87 period, is made up of $12.3 billion* in telecommunications services and $8.1 billion* in telecommunications equipment. It is clear that although mobile communications represent only a small percentage (2.1%) of the overall market, its growth rate of 20% is four times greater than the overall market growth rate of just under 5%*.

Exhibit 2.1, above, indicates that each of the four segments illustrated are continuing to grow at a substantial rate.

The market for mobile communications can also be segmented in terms of end usage.

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* DOC Figures.

- **Public Safety and Security** - this segment includes police, ambulance, search and rescue, fire fighting, park and game wardens, and emergency relief workers;

- **Transportation** - this segment includes trucks and other road vehicles such as buses, and railways.

- **Exploration, Resource Exploitation and Construction** - this segment includes mining, forestry, fishing, trapping, hunting and remote construction;

- **Monitoring, Control and Data Acquisition** - included in this segment are pipeline and oil well operations, hydro electric applications, environmental monitoring and various forms of data acquisition; and,

- **General Business** - included in this segment are business uses such as personal use, trades, services, sales and marketing personnel, management, professionals, and financial specialists.

However, for the description of the mobile communications market given herein, we have chosen to follow the service stratification approach given in the previous sub-section, with a recognition of user community impacts. This stratification, given below, best fits the generic technologies and the way they are purchased.

- **Land Mobile Communications**
  - Paging (tone and voice, numeric LCD display, and alphanumeric);
  - Mobile Radio (including trunked mobile radio);
  - Mobile Telephone (including cellular, satellite and personal communications);
  - Mobile Data Services; and,
  - Other.

- **Marine Mobile Communications**
- **Air Mobile Communications**

Each type of mobile communications technology/service will address the needs of one or several of the user segments noted above.

2.3 Approach

The study involved the collection of comprehensive information on the mobile communications market. The focus of the information collection was Canada, but information pertaining to other countries was also obtained. The DOC requested that the land mobile market be emphasized to a greater extent than the marine or air mobile markets. Information was collected through library searches at the DOC, the National Research Council (NRC) and Industry, Science and Technology Canada (ISTC), and directly from the DOC client group and suppliers of mobile communications equipment. In addition, interviews with a number of service providers in Canada, the United States and the United Kingdom were undertaken. In our search, we focussed on procuring information pertaining to the definition and forecasting of user requirements, and to the social and economic importance of mobile communications.

In addition, due to the size and complexity of the market, it was not possible to investigate all the various market niches in considerable detail to determine their individual requirements. It was therefore necessary to narrow the detailed user needs investigation, in which primary research involving user interviews was undertaken, to the more important application areas. This approach ensured that more comprehensive data would be obtained. To select the areas of emphasis, we identified through our literature search, market areas that would likely develop rapidly in the next 10 years, and might therefore have a requirement for:

- unmet demands in terms of technology, cost and DOC policy;
- the definition of future product/technology to aid the DOC research groups;
- industry development; and,
- spectrum allocation.

The above criteria were developed in conjunction with the DOC. From a review of the various market areas, the following four segments were selected for more in-depth investigation:

- **the cellular market** - To achieve the anticipated growth forecasts for CTS, many new customers will need to enter the market. The change from digital to analog will dramatically increase the capability of CTS to accommodate users, which will perhaps in turn, result in expansion of the service to price-sensitive customers through a reduction in the cost of service. At present, personal use only accounts for roughly 4% of CTS users;
- **personal communications** - this area is viewed as being one of the major opportunities in communications in the next decade. The availability of new technologies that allow a reduction in both size and service price, are opening up new opportunities for equipment suppliers and service providers. For example, the CTS service firms are finding that portable phones as a percentage of total mobile phones has grown considerably, and this trend is expected to continue. The U.K. service introduction of Telepoint as a lower cost alternative to CTS may offer considerable opportunity in Canada. Moreover, a system that falls between CTS and Telepoint is also under consideration in the U.K. and other countries. Each system offers different features (i.e., range,

outgoing call capability, etc.) which will likely appeal to different user groups;

- **mobile satellite services (MSS)** - the advent of mobile satellite services indicates that a market for these services is developing. The intention here is to understand where MSS fits into the overall mobile communications market, and what are the plans of the various participants; and,

- **mobile data services** - data services are increasingly becoming part of mobile communications. They will be the first services implemented by MSAT, and are one of the growth areas in CTS. INMARSAT's Standard C is a data only service. In this segment, we will consider the types of applications for which people will use data services, to gain an appreciation of growth opportunities.

A survey of over sixty users, which is described in more detail below, was conducted to collect information on these identified segments. The results of the survey have been integrated in the appropriate sections of this report, with the other information collected.

Due to the large quantity of information available for each of the segments, this report is, by necessity, a synthesis and summary of the available information. Additional information on each type of service is available from the reference material. The list of references used in this study is given in Appendix A.

The economic and social importance of mobile communications, which focussed on the impacts to the end user, was also obtained from the literature and the interviews.

2.3.1 User Survey

A telephone survey of sixty-three (63) users and potential users of mobile communications was undertaken as part of this study. The survey was designed to be carried out by telephone. A structured and comprehensive questionnaire was developed to collect information on user requirements now and in the future, and to identify problems with current technology that might possibly be addressed by the DOC. In addition, the respondents were also asked if there were any gaps in available technology/services. A copy of the questionnaire is provided in Appendix B.

It was recognized that in terms of the end user, the four areas selected for in-depth investigation are not independent (e.g., a firm that uses cellular telephone, may also use data communications and express an interest in personal communications). It was also recognized that identifying users or potential users of personal communications and data communications would be exceptionally difficult. It was subsequently decided to request information for these two segments from the organizations identified for the survey of the cellular and mobile satellite segments.

Organizations were easily identified for interviewing regarding mobile satellite communications, while the large diversity of cellular users made sample selection much more difficult for cellular communications. The survey consisted of the following samples:

- **Mobile Satellite Survey** - potential users were identified from the organizations that might possibly use mobile satellite communications. For the purposes of the survey, these organizations were classified into one of three groups: Transportation users (eight organizations), Remote Communication users (18 companies) and Emergency Communication users (four public service organizations). The Transportation users were divided into two main categories - road (five potential users, two

of which were inter-city bus companies and the rest, 'for-hire' trucking companies) and rail. In all, 30 potential mobile satellite users were contacted.

- **Cellular Survey** - 33 small, medium and large businesses in the Toronto and Ottawa areas was selected to investigate the cellular market. Businesses were selected on the basis of the distribution of user type information provided by the cellular service providers. The distribution of users was selected from the construction industry (20% of total users), sales professions (20%), services (12%) and real estate (6%). The remainder of users, who represent 42% of the total, were not classified in detail, and were therefore not included except for transportation firms. Transportation organizations were known to be a significant user of cellular telephone, and therefore, a number of transportation firms were included. To control for size of urban area, users were selected in both Toronto and Ottawa. Businesses were arbitrarily selected from the "yellow pages" of the telephone directory, without any prior knowledge of whether or not they used cellular telephones.

The following exhibit shows the survey participants by type of business and location.

Exhibit 2.2: Distribution of Businesses Selected For Cellular Market Survey

INDUSTRY	LOCATION	
	OTTAWA	TORONTO
CONSTRUCTION	3	4
REAL ESTATE/ PROPERTY MANAGEMENT	2	1
SALES AND SERVICE:		
•Landscaping	2	1
•Heating	1	2
•Electrical	1	2
•Other	4	7
TRANSPORTATION	3	0
TOTAL NUMBER OF COMPANIES SURVEYED	16	17

A list of survey participants for the two surveys described above, and other individuals/organizations contacted as part of the study, is provided in Appendix C.

CAUTION: It should be noted that these two surveys are not based on statistical samples, and thus any interpretations drawn in this report based on the results can be regarded as being indicative but certainly not conclusive.

PART I - LAND MOBILE COMMUNICATIONS

3.0 PAGING

Pagers are, in essence, specialized radios accepting signals only from the towers of carriers providing paging services. Radio pagers, which were initially an (open) voice-paging service for doctors, have evolved into selective voice, tone-only, and digital paging services that now can be uniquely addressed to individual subscribers whenever they are in their home cities, and frequently, in other metropolitan areas when they are travelling. Pagers can alert an individual to call a specific number, provide a short voice message (that has been transmitted), or provide information using an alphanumeric display. This service is offered by local radio common carriers (RCC's) and telephone companies (Telcos).

In Canada, the paging market has grown rapidly, and is expected to grow at the annual rate of 25% from 250,000 units in 1985 to 750,000 units in 1990. Most paging services (85%) are provided through the RCC's. As of 1985 there were some 600 RCC's in Canada. Distacom Paging, National Pagette, and MacLean Hunter Paging are examples of larger Canadian RCC's providing paging services. In 1988, the paging industry generated approximately $125 million in revenue. More detail on the RCC's can be obtained by referring to the DOC report entitled "The Impact of MSAT on the Radio Common Carrier Industry".

3.1 The Paging Market

There are 3 types of pagers available on the market:

1) Tone or Voice - a subscriber is notified by a beep or voice to call a predetermined number for a message. More recently, a pager that vibrates rather than emitting a tone has become available;

2) Numeric LCD Display - a subscriber is notified what number to call;

Subscribers to the above two pager types include doctors, service personnel, sales people, real estate agents, gardeners and landscapers, motion picture crews and trade show exhibitors/organizations.

3) **Alphanumeric Display** - capable of receiving and storing messages. In addition, a hardcopy of the message may be obtained if a subscriber has an optional adaptable printer. Subscribers of alphanumeric pagers include stockbrokers and their clients, lawyers, trucking firms and delivery companies.

This last pager type has been slow to catch on. In addition to being more expensive, there are several reasons for this. First, the entry of an alphanumeric message cannot easily be made from an ordinary telephone keypad as can be done with a numeric display pager, and thus requires a dedicated message entry terminal situated on the dispatcher's desk. Second, there must always be someone standing by to key in the data to the person receiving it. A software package does exist which enables alphanumeric messages to be sent from an IBM-compatible personal computer, but this again, is expensive. As mobile data communications grow, the alphanumeric pager may be an economical alternative to cellular communications for one-way applications.

On the plus side, however, the subscriber receives the full message instantaneously and accurately without having to get to a phone, and allows the subscriber to refer back to the message in the pager memory or produce a hardcopy if he or she has the optional adaptable printer.

In the U.S., there is significant shift from tone and voice paging to numeric display paging. This is due to the fact that leaving a voice message requires from 10 to 12 seconds of airtime, whereas a digital message requires less than half a second. Airtime is very valuable and since VHF frequencies in the U.S. have filled up, paging companies are discouraging the use of tone and voice paging. In Canada, this has not yet happened, but could become a concern in the future.

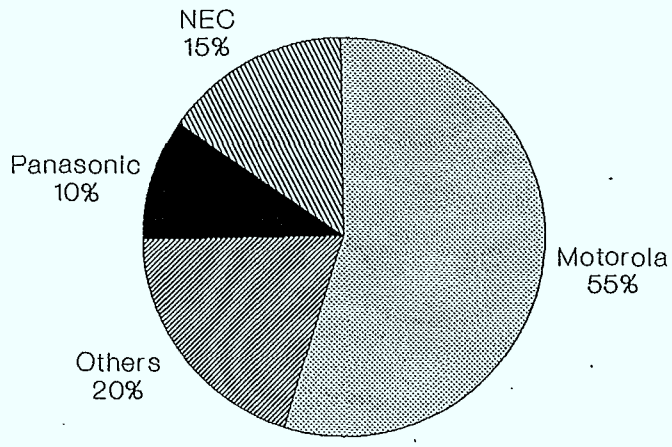
In the cellular survey, conducted as part of this study, it was found that 61% of the 33 businesses surveyed were using pagers. Usage by real estate/property management companies was heaviest, with 100% of the organizations using pagers.

As part of the mobile satellite survey, questions concerning the current and expected use of pagers were asked. Since the contact person for the mobile satellite survey was often a technical expert and not always aware of the breadth of communication practices in an individual company (many of which were very large organizations - e.g., Ontario Hydro, CN Rail, MacMillan Bloedel), it was not possible to obtain information regarding the use of pagers for all the companies contacted. Of those organizations supplying information, 55% utilized pagers for some facet of their operation. This figure is undoubtedly higher. Not unexpectedly, the emergency response organizations showed extensive use of pagers, as did the transportation and remote users.

3.2 Equipment Manufacturers

Exhibit 3.1 shows the Canadian pager market shares of the principal equipment manufacturers for 1987.

Exhibit 3.1: Pager Manufacturers
Canadian Market Share, 1987



Source: Evans Research Corp.

The following price information includes airtime, and were provided by paging companies to the DOC for a 1988 Overview of the Canadian Mobile Communications Industry.

Pager Type	Rental Price/Month	Purchase Price
Tone Only	$15-$26	$150-$200
Tone and voice	$24-$40	$400-$450
Numeric	$30-$38	$450
Alphanumeric	$40-$60	$700-$750

Price variability in the above figures is explained by the added value of extra services or available options.

The following are examples of recent additions to paging services provided by Canadian RCCs:

- **Telelink** - Subscribers can be reached by a party calling the pager number, when their pager is immediately alerted that a telephone call has been received. The person carrying the pager quickly goes to the nearest phone, enters a "reply" number and is directly connected to the person originating the call. If the subscriber doesn't answer the page within 2-3 minutes, the system will take a message through its voice mail-box.

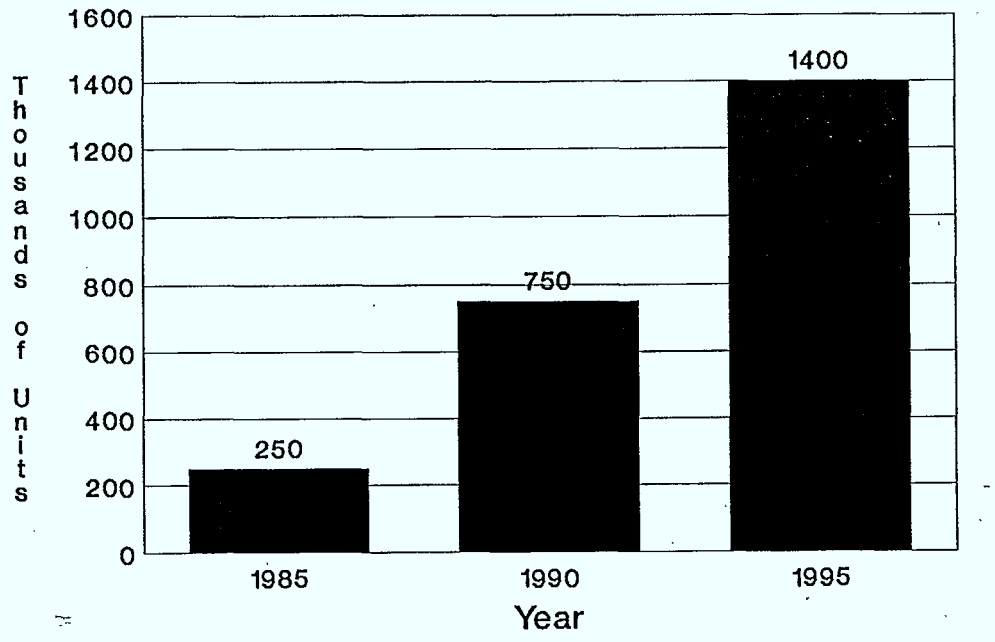
- **"Memo-Page"** - This service allows subscribers to program his or her appointments a month in advance from any phone; a message will be transmitted at the set time and date to their pager.

- **LifePage** - This service is sponsored by the Canadian Radio Common Carriers Association (CRCCA). Outpatients registered for transplants receive complimentary pagers through their transplant coordinators.

3.3 Future Trends

Figures given earlier in this section stated that the paging market will grow to 750,000 units in 1990. The penetration rate of pagers in 1990, will thus be approximately 3% of the population. U.S. estimates of pager growth, based on a current penetration rate of 2.5%, anticipate a growth rate of 13% annually between 1990 and 1995. If a similar growth rate is experienced in Canada, the paging market will grow to approximately 1.4 million by 1995. This forecast is illustrated in Exhibit 3.2.

Exhibit 3.2: The Canadian Pager Market (1985-1995)



Source: DOC & Goss, Gilroy & Associates

From the two surveys undertaken as part of this study, companies stated that while they had no explicit plans to buy a certain number of pagers, the unanimous opinion was that the number of pagers used would increase given growth in their organization.

The reasons for growth include:

- mushrooming growth in the service sector;
- prices of pagers decreasing;
- pagers becoming smaller and lighter;
- increased service coverage (i.e., nationwide coverage); and,
- increased functionality (e.g., used in combination with a voice mail box, and used in combination with cellular service).

Moreover, present trends indicate that the future lies in the merging of complementary services in mobile communications. Specifically, in the paging area, the following are anticipated:

- the merging of local tone-only and tone-voice paging with voice mail and telephone answering machines;

- the merging of alphanumeric paging with a variety of electronic mail services so that brief text messages can be automatically relayed to individual travelling subscribers;

- the merging of regional and nationwide multicity paging and text (alphanumeric) messaging with voice mail services; and,

- the move from analogue to digital will see the digital paging system used as an effective data transmission system linked to, for example, an in-car printer. This system could be used to relay updated delivery schedule information to delivery drivers out on the road.

Market research has shown that increased coverage is one of the main attributes required by the pager market. The ability to use one pager while travelling outside the home urban areas is being addressed by a number of firms.

An example of a new pager capability that will expand the coverage area internationally, is about to be introduced by British Telecom. In the Spring of 1990, the U.K. customers of British Telecom, through an exclusive agreement with an American consortium called "Metrocast", will be able to use a single pager capable of receiving personal messages both at home and in the major cities of the U.S. (and later in Canada).

The technology which will allow this to happen is called PageScanner. The PageScanner, a microprocessor-based device which uses custom VLSI (Very Large Scale Integration) technology, converts the conventional fixed-frequency paging receiver into a scanning receiver which skips across 14 VHF paging frequency channels looking for paging information intended for a particular subscriber. To use the pager's capability, a subscriber must inform the radiopaging bureau - or the network's computer system through direct input - of his destination before leaving the U.K.

Radiopaging signals will be transmitted from the U.K. by satellite or undersea cable to the Metrocast control centre in San Diego. The system will then hold all messages for a specified period while the customer is travelling, before forwarding them to the U.S. for transmission in the appropriate location.

In addition, the development of a paging device using the INMARSAT mobile satellite system is also underway. This pager will be a small vehicle-based device and can be used to transmit alphanumeric information to a truck, bus, etc. It is important to realize that this pager is too large to be carried by a person.

4.0 MOBILE RADIO SERVICE (MRS)

The conventional form of mobile radio is a two-way system used by industry and government for short messages in dispatching delivery vehicles and taxis, aiding emergency services, and directing field operations and personnel. MRS is used extensively by emergency services (e.g., police, ambulance) and by fleet operators (e.g., truck, taxi, bus).

Communications between the operations centre and the mobile units, and between mobile units, are done through the dispatcher located at the operations centre. Essentially, the system is similar to having a large "party line". An organization will be assigned a dedicated radio channel for its exclusive use, and all mobile units within that organization will be set up to use it. If more than one unit wishes to transmit, they must join a queue and wait until the channel is free.

Usually, a conventional system only has one speech path (i.e., operated in simplex mode) which means that it is impossible to transmit and receive at the same time. Therefore, only one individual can speak at a time (i.e., the dispatcher or one of the mobile unit operators). When the dispatcher wishes to speak to one of the mobile units, he or she will indicate which unit verbally. Communication between mobile units is usually done through the dispatcher. Additional features have been added over time to address problem areas, such as where someone "walks on" (i.e., cuts in) someone else's conversation.

Two-way radio users are principally concerned that a channel is available the moment they want it. To address the problems of frequency congestion and interference, trunking radio systems have been developed. These systems, which can replace conventional systems, allow users to access several two-way channels to find one that is free when they wish to communicate. Trunking radio systems provide advantages to users, operators and licensing authorities. Benefits include an improved grade of service which means that users will experience less waiting time in

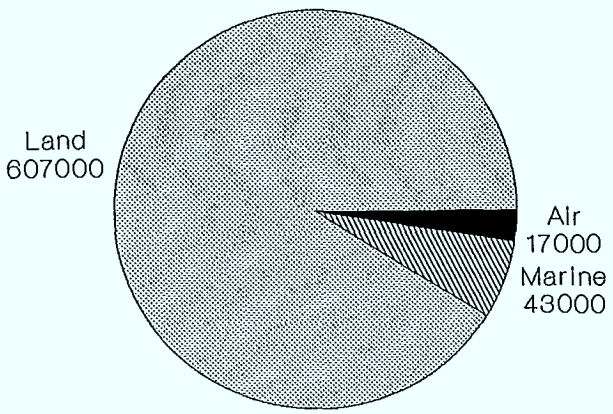
obtaining a channel, and improved spectrum efficiency as each channel is used more efficiently because it carries more traffic.

It is noted that trunked systems are also used for conventional MTS, as the technology used for conventional MTS and MRS is similar. A description of conventional MTS, and the differences between it and MRS, are given in Section 5.0.

4.1 The MRS Market

In 1988, there were 667 thousand mobile licenses issued in Canada, of which 607 thousand were for land-based applications. For marine and air applications, 43 thousand and 17 thousand licenses respectively were issued. This distribution is illustrated below in Exhibit 4.1.

Exhibit 4.1: The Mobile Radio Market (Number of Licenses)

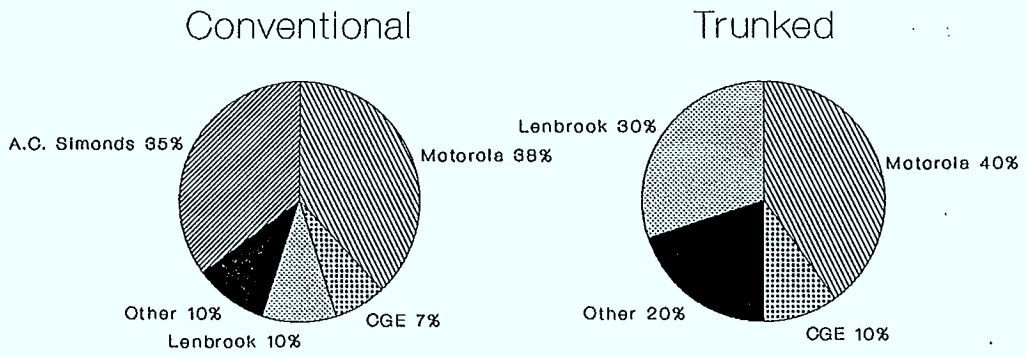


Total 667,000

Source: DOC Licensing Data

According to market data, based on sales (and supplied by Evans Research Corp.), the principal supplier of mobile radio equipment is Motorola Canada Ltd. which holds 38% of the market, followed by A.C. Simmonds and Sons Limited with 35%, Lenbrook Industries Limited with 10% and CGE with 7%. Motorola also has the dominant share of the trunking radio market with a 40% share. In the trunking market, Motorola is followed by Lenbrook with 30% and CGE with 10%. Motorola sells through direct sales, Lenbrook and A.C. Simmonds sell through dealer networks, and CGE sells through a combination of dealer and direct sales. Exhibit 4.2 shows graphically the market shares of the major manufacturers for both the conventional and trunked markets.

Exhibit 4.2: Mobile Radio Manufacturers
Canadian Market Share (1988)



Source: Evans Research Corp.

Mobile radio services are supplied by both RCC's and Telcos. In addition, some organizations that have larger requirements, make the decision to be their own "communications company" and develop and manage their own network facilities. The choice is usually made on the basis of a "make or

buy" analysis. For a small user, it is more economical to utilize the services of a common carrier (i.e., RCC or Telco) where the user shares the channels with other users, than it is to build the necessary infrastructure (assuming that there would be no licensing problems).

In the survey related to cellular usage, 42% of the firms indicated that they used MRS, with the construction, and parts of the sales and service, sectors being the heaviest users. In the survey related to mobile satellite communications, 70% of the organizations contacted utilized mobile radios. This figure is a low estimate due to lack of respondent knowledge in some cases, and in others, the organization of the company made it difficult to obtain a comprehensive response (e.g., some companies are decentralized into smaller independent units, with the result that the economic activity where the use of mobile radio would be expected, is in some cases a stand-alone organization. For such organizations, senior personnel in the parent company were unable to describe mobile communications use). All emergency response organizations utilized mobile radios. The lowest rate of MRS use was found in the road transportation sector, where only one of the companies contacted used mobile radios.

4.2 Future MRS Trends

Between 1985 and 1988, the number of land-based mobile licenses grew at the annual rate of 5.3%. Revenues, on the other hand, from equipment sales increased by close to 20%, made up of 14.4% for conventional mobile radio and 41.5% for trunked mobile radio. Figures from the U.S. indicate that a growth rate of close to 2.5% can be expected in equipment sales between 1989 and 1997.

With the rapid growth in cellular telephone service in the last few years, the question can be asked if it will impact future growth of MRS. It is considered that MRS and cellular service address two different market requirements. However, cellular is a uniform standard adopted by all manufacturers with attendant price competition because of market size, and

with digital service planned for the near future (which will allow privacy including encryption for customers such as the police forces), it is expected that cellular will cannibalize MRS customers to some extent. Within the MRS market, trunked radio systems will continue to obtain a larger share of the market.

There was no readily available information on the growth of Canadian MRS. As there are no anticipated developments that would rapidly increase the number of MRS licenses, and cellular may impact to some extent, it is anticipated that growth will continue but will be very slow in the period prior to 1995. In the two surveys carried out as part of this study, no company identified an explicit plan to expand use of mobile radios, and only one organization had a strategy to enhance use of their mobile radio function. Nonetheless, respondents able to supply information about the growth of MRS in their company, concluded that use would increase on an "as needed" basis.

5.0 MOBILE TELEPHONE SERVICE (MTS)

MTS has been available for approximately 40 years, and until the introduction of cellular telephone service (CTS), it had undergone relatively little advancement. Conventional MTS suffers from the following drawbacks as a communications medium:

- Frequency spectrum is limited, which has resulted in demand greatly exceeding supply particularly in major urban areas. For example, in 1983, because of spectrum limitations, there were only 730 conventional MTS users in New York City with a waiting list of 2000.

- A conventional MTS communications channel is essentially a large party line with the disadvantages of limited access and lack of privacy; and,

- Coverage is limited in certain areas which results in inconvenience to the user, as he or she must terminate the conversation and re-establish on a different channel or wait until the signal strength improves.

The advent of CTS overcame most of the disadvantages of conventional MTS. The concept of reusing channels throughout a coverage area greatly increased the number of channels available compared to conventional MTS. With reference to the New York City example, CTS can handle up to 500,000 subscribers in the same area.

Another mobile telephone technology that has been developed, is based on cordless telephone system technology. This service will allow customers to place, but not receive, calls within the range of transceivers located in key public places. This new service, called Telepoint, will soon be introduced in the U.K.

A market overview of mobile telephony by type of user, location of use and type of telephone technology is given in Exhibit 5.1. This exhibit shows the relative positioning of traditional cordless phones, Telepoint and CTS.

Finally, it is planned that voice telephone services will be provided by MSAT. TMI, a Telesat subsidiary, plans to offer voice communication services to land vehicles, ships and aircraft. This MSAT service is expected to find its highest potential in rural and remote regions where its wide-area coverage and extended range features are of greatest benefit. In areas serviced by cellular (i.e., urban and major inter-city transportation corridors), satellite will not be able to compete with cellular. CTS is cheaper, of higher quality, and more spectrum efficient than even the third-generation spot-beam satellite systems. TMI is planning voice services similar to the service presently being offered to the Ontario Air Ambulance. A complete description of MSAT is given in Section 6.0.

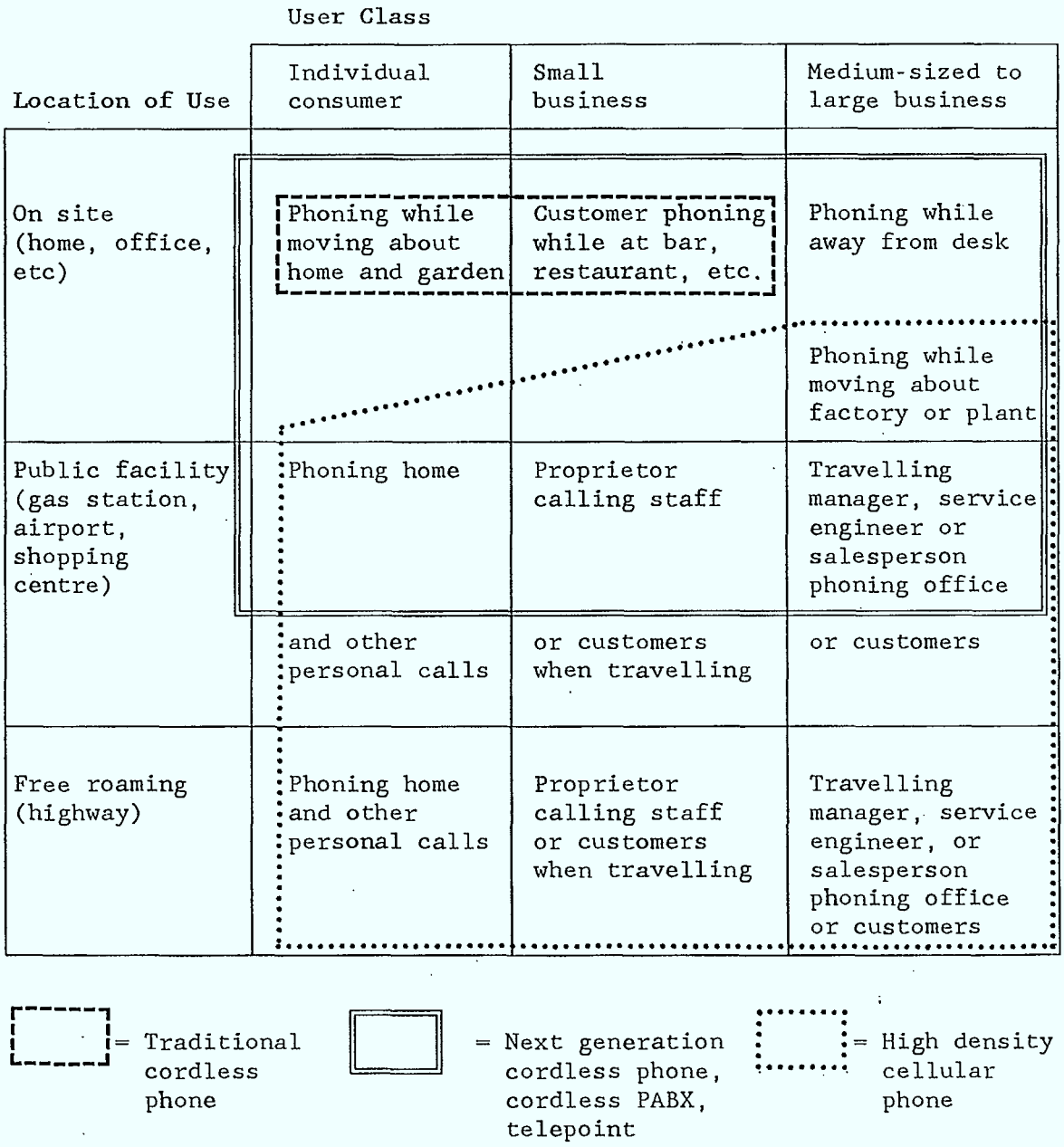
This Section describes conventional MTS, the rapidly growing CTS market, and the Telepoint cordless telephone technology. It is noted that because of their limited functionality, traditional cordless phones have not been included.

5.1 Conventional Mobile Telephone Service (MTS)

Conventional mobile telephone uses technology that is similar to that used by mobile radio. The main differences between MTS and MRS are as follows:

- MTS uses separate transmit and receive frequencies, making full-duplex (i.e., both parties can transmit simultaneously) operation possible. MRS typically operates either on the same frequency in a simplex mode (i.e., communications channel can transmit in one direction only, and cannot be reversed) or on different

Exhibit 5.1: Market Breakdown for Mobile Telephony by User Class, Location of Use, and Level of Mobile Telephone Technology



Source: Arthur D. Little, Inc.

frequencies in a half-duplex mode (i.e., only one party can transmit at a time);

- MTS units are connected directly to the PSTN, and can be used to originate and terminate telephone calls, with billing rendered directly to the mobile telephone number. MRS, if connected to the telephone network, is connected through a coupler to the telephone line. Billing, if any, is to the wireline telephone; and,

- MTS signaling is based on a 10-digit dialing plan, while MRS uses loudspeaker paging or selective signalling that does not fit into the Telco dialing plan.

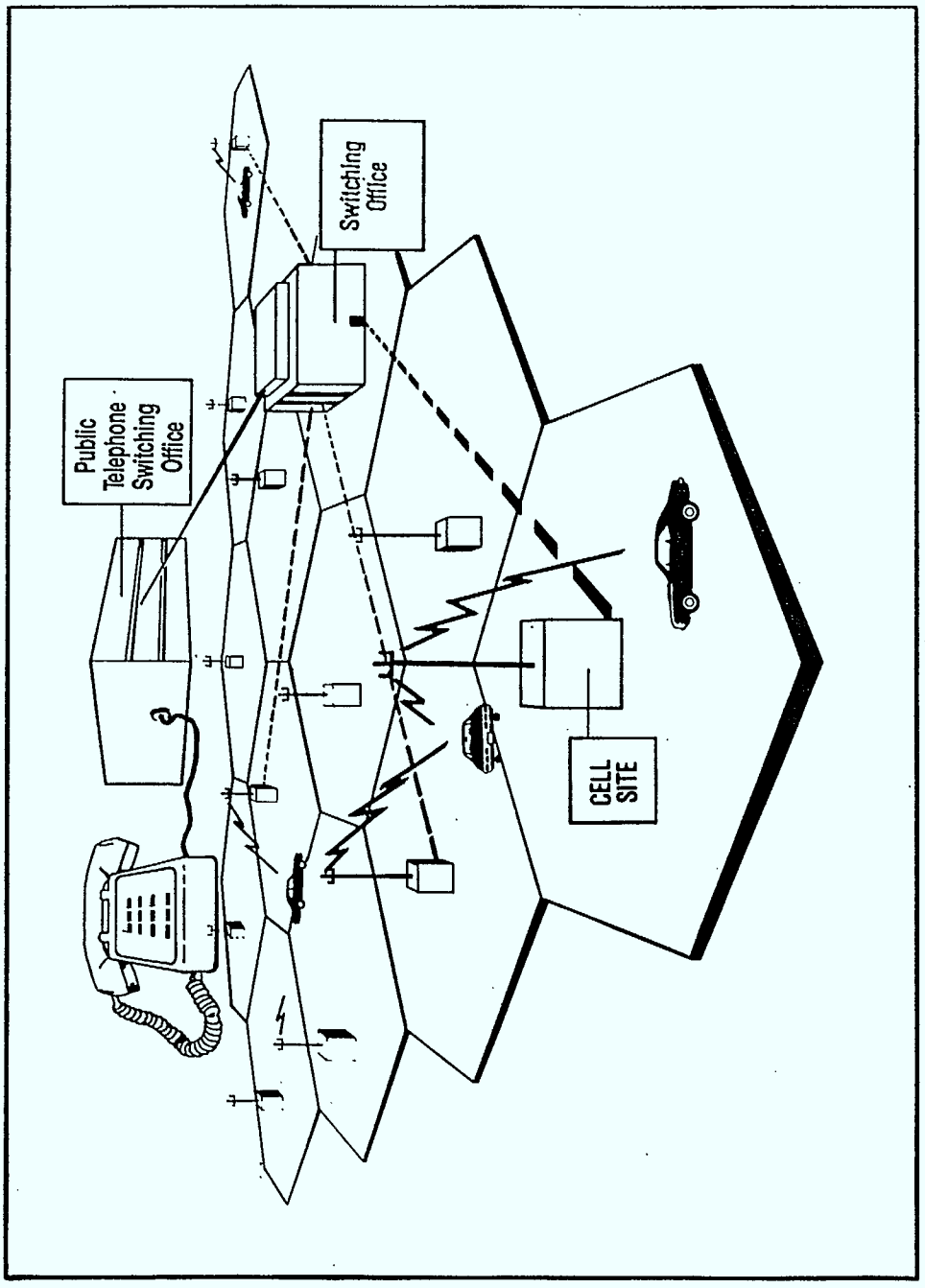
MTS was extremely popular prior to the introduction of CTS. As noted earlier, waiting lists were lengthy, and it was difficult to get a clear frequency to use the system in many North American cities (i.e., there were only 12 to 25 channels available to service an entire city of subscribers). The service was also relatively expensive and suffered from poor sound quality.

The introduction of CTS was an eagerly awaited communications market development, and has essentially eclipsed conventual MTS.

5.2 Cellular Telephone Service (CTS)

CTS evolved from the concept of using low-powered transmitters covering "cells" one to eight miles in radius, which allowed the same frequencies to be reused several times in the same metropolitan area. This was combined with computerized electronic switching technology that allowed users to travel from cell to cell (i.e., transfer or "hand-off" the call) without interrupting the call. An illustration of the cellular concept is given in Exhibit 5.2.

EXHIBIT 5.2: ILLUSTRATION OF CELLULAR TELEPHONE SERVICE



In Canada, CTS is offered by Cellnet Canada and Cantel Inc. Cellnet is made up of the CTS subsidiaries of the following Telcos ("wireline companies"):

- Bell Cellular Inc.;
- Québec Téléphone Cellulaire;
- NBTel Co. Ltd.;
- MT & T Cellular;
- NFDTel Co. Ltd.;
- B.C. Cellular;
- AGT Cellular;
- edmonton telephone Cellular;
- SaskTel;
- MTS Cellular; and,
- Thunder Bay Telephones.

Cantel (a "non-wireline company"), although allowed to interconnect with the PSTN, is not affiliated with the Telcos, and can offer services coast-to-coast.

In introducing CTS, the DOC decided to award a license to a wireline company and one to a non-wireline applicant in each market. Following an inundation of applications from non-wireline applicants, the DOC requested national applications to offer the non-wireline service in the 23 major metropolitan areas across Canada. As a result of the competition, Cantel, in 1983, was selected to compete against the cellular divisions of the Telcos. Cantel was allotted half the frequencies (i.e., half of the 800-900 megahertz spectrum) and was given the right to offer CTS in all provinces in Canada. To offer service, Cantel was required to negotiate interconnection with the Telcos to have access to the PSTN. In addition, the DOC makes interconnection a prerequisite to the launch of cellular service in each city. CTS was first launched in Canada in 1985, when the Montreal and Toronto services were introduced.

5.2.1 The Current Market

At the end of 1988, it was estimated that there were over 2,000,000 cellular subscribers worldwide. There are an estimated 1,500,000 users in the United States, 250,000 in the Nordic countries, 350,000 in the United Kingdom and 180,000 in Canada. Service in the United States began in 1983.

Cellular growth in Canada has been rapid. At the end of 1988, approximately 16.9 million people or about 65% of the Canadian population had access to CTS. Today, 35 centres and travel corridors in British Columbia, Alberta, Manitoba, Ontario, Québec and Nova Scotia are covered. Coverage maps for Cantel and Cellnet are provided in Appendix D. As might be expected, the coverage contours of the two competing firms are similar.

For the major centres, the coverage areas extend to the rural areas surrounding the cities to capture commuter, cottage and sales oriented trip traffic. In addition, major corridors between metropolitan areas are also covered to provide travellers with access to communications. It is noted that where cities and/or travel corridors are adjacent to bodies of water, CTS is also available to marine users. "Roaming" agreements with U.S. CTS service providers have been made, to give Canadian CTS users access while travelling in the U.S.

To date, the focus of the cellular carriers has been in covering as broad a geographic area as possible. However, rapid subscriber growth in Montreal and Toronto has resulted in cell splitting which has been required to allow the carriers to maintain an acceptable grade of service.

Customer Characteristics

Early adopters of CTS were entrepreneurs, business people and professionals who needed to communicate while outside the office, travel frequently and/or wish to take advantage of commuting time for

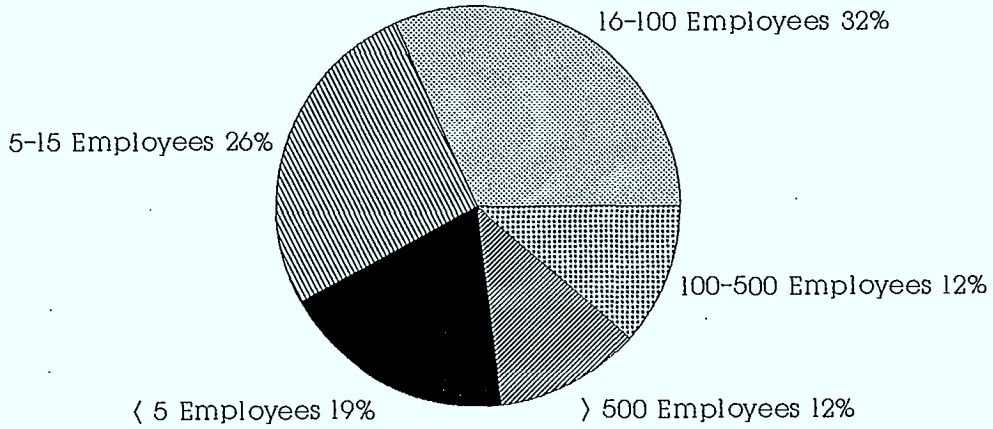
communications. Essentially, CTS provides individuals with the opportunity to increase their productive working time without extending their business day. The estimated customer profile of Canadian cellular companies, based on research done by Burns Fry Limited, is as follows:

• Construction/Real Estate	28%
• Transportation (trucks, couriers)	18%
• Trade/Service	12%
• Sales/Marketing Personnel	15%
• Small Business Management	12%
• Professional/Finance	7%
• Government, Utilities	4%
• Personal Use	4%

From the above table, it is noted that 96% of CTS subscribers are used for business purposes and 4% are for personal use. This is not surprising given the costs associated with usage. However, although 96% are purchased for business, some will be used, on occasion, for personal calls.

A breakdown of the size of organization purchasing cellular telephones is illustrated in Exhibit 5.3.

Exhibit 5.3: Purchases of Cellular Telephones By Size of Organization (Number of Employees)



Source: Goss, Gilroy & Associates

From the above, due to the large number of small businesses, it can be seen why sales of 50-100 units of cellular phones have been unusual. The distribution of sales by position in the organization is as follows:

- owner/partner/president 55%
- sales/marketing management 11%
- sales representatives 11%
- other managers 11%
- miscellaneous 12%

Over time, the market share of owner/partner/president is declining, while the shares for the remaining groups are increasing. Only ten (10%) percent of cellular telephone purchases are currently made by women, although this percentage is increasing.

In addition, as part of this study, a sample of 33 businesses in Toronto and Ottawa were contacted regarding their cellular experience and plans. The survey found that seventy-nine percent (79%) of these businesses are currently using a cellular phone. Findings by segment are as follows:

- The construction industry were found to use CTS for senior executives and managers to maintain contact with their offices, clients and building sites. In addition, they were used on building sites until the Telco installed regular telephone service (particularly in the Toronto).

- The real estate industry is made up of independent sales agents who have the choice of communications technology to assist their sales efforts. While almost 100% of sales agents use a pager, only "successful" ones use a cellular telephone. CTS use is largely one way, with the sales agent keeping his/her cellular phone number unlisted.

- The landscaping, heating and electrical industries used cellular telephones extensively, with 7 of 9 firms stating that they used them. CTS is viewed as enhancing productivity, because access to the PSTN is critical to overall business success.

- For the remainder of the sales/services industry, 9 of the 10 businesses surveyed used CTS. The users of CTS were the senior managers and/or the sales representatives. CTS was viewed as providing access to an important business tool, the telephone, at all times independent of the office.

In addition, as part of this study, 30 companies were contacted regarding their current and projected use of Mobile Satellite Services. During the interviews, an attempt was made to measure the use and expected growth of cellular telephone services. As mentioned earlier in this report, it was not always possible to gather definitive information about the use of cellular during these interviews, because the respondent was not necessarily aware of the details of the company's use of cellular technology.

The findings for this survey are presented below by segment, i.e., transportation (road, rail), remote and emergency:

- in road transportation, the trucking industry showed interest in the use of cellular phones as a means of maintaining voice contact between drivers and dispatchers in areas where cellular coverage was available. Since these areas correspond to areas of heavy "for-hire" trucking utilization, growth can be expected to occur as more and more trucking firms ascertain the possible benefits. The point here is that growth can be expected to occur as cellular coverage expands, but probably only in those areas where truck traffic is high. In addition, it is not likely that an individual trucking company would make a blanket decision to equip all trucks with cellular phones, as only those on the high-volume routes

would be considered for inclusion. The trucking industry is becoming increasingly price competitive, so decisions regarding communications equipment are being considered very carefully, as there is a great deal of interest in keeping capital costs low.

- The inter-city bus transportation industry views cellular as a means of enhancing their service to customers. One company is currently engaged in a six-month trial of cellular telephones. For this test, buses are equipped with a cellular telephone and the driver uses it for emergency communication (eg. delays, need for mechanical services, etc.). The company plans to introduce the service throughout their system, expanding it as the cellular network facility itself grows.

- a similar experiment is currently taking place for passenger rail services. Cellular telephones are employed on high volume runs in southern Ontario for use by the train "customer service manager". Plans to expand the service as the cellular network expands, are in existence and cellular pay phones will be introduced.

- most users identified to provide input on remote communications, already employ cellular telephones as an element of their overall communication strategy. For these companies, the cellular telephone is employed as an adjunct to mobile radio communications in the field. It is used to relieve traffic on the mobile network where feasible and to ensure privacy where sensitive communications are required.

- three of the four emergency response organizations contacted employed cellular telephones. The police forces utilize them for administrative functions and in some emergency situations where privacy is desired, or where other conditions dictate a need for access to the PSTN. In Emergency Preparedness Canada, cellular telephones are included as part of the field deployment equipment

of response teams. An element of the philosophy of EPC is to provide a coordination role in times of crises. Since information flow is a critical element of coordination, EPC equips its crews with as much technology as is required to achieve their goals.

Services Offered

The basic service provided by Cantel and Cellnet is the ability to use the PSTN from a mobile telephone. Current mobile telephone technology allows the use of fixed, transportable and portable cellular telephones, as well as laptop computers and facsimile machines. The transportable and portable units allow a user, provided that he or she is within the CTS coverage area, to utilize the mobile telephone away from his/her vehicle, or in a home or office similarly to a wireline phone.

A CTS user has access to all the capabilities of the PSTN including long distance calling. Specialized services such as no answer transfer, call forwarding, call waiting, three-way conference calling, voice messaging, data services, and information services (e.g., traffic, weather, sports) have been introduced by CTS companies. Also, pagers are being used to alert cellular customers that a message has been received, and is stored in the voice messaging service. One of the primary intentions of these added services is to stimulate incoming calls, as the current ratio is 80% outgoing and 20% incoming.

Another feature that the market perceives as having considerable value is "roaming", where users can use their cellular phones outside their home area. Once notified that a user is located in another service area, the cellular telephone switch in their home area will route incoming calls to the area where that phone is now located.

The cost of using a cellular phone is made up of three components:

- a flat monthly service charge;
- a usage-sensitive or per-minute airtime charge; and,
- charges for any enhanced or marked-up service that the subscriber has contracted/utilized.

The cost of using a cellular telephone is illustrated by Cantel's current charges:

- Initiation Fee - $40.00
- Basic Service Fee - $15.00/month
- Traffic Charges - Peak Hours: 7:00 AM - 7:00 PM Monday to Friday
  - $0.50/minute for the first 130 minutes;
  - $0.35/minute for the next 170 minutes; and,
  - $0.25/minute for all additional minutes.
- Traffic Charges - Non-Peak Hours
  - discount of 33.3% off per minute rates given above

Calls are billed in tenths of a minute increments. In addition, "air time" for outgoing "busy" calls and for calls received by the mobile user, are charged to the mobile user. Any initiated long distance calls are charged to the user at a premium of roughly 15% over normal wireline costs. In addition, users are offered "tailor made" or "usage time" packages that provide savings over regular rates. The average gross revenue per subscriber in 1988, including all services, was in the range of $95 and $120 per month.

In addition, a prospective CTS user must buy, lease or rent a cellular telephone. Current purchase prices range from approximately $1,500 to $3,000 at distributors associated with the CTS service providers, but they can also be purchased at other outlets. Rental and leasing arrangements are easy to arrange.

CTS has the capability of accommodating data communications, which allows users to utilize a facsimile or microcomputer over the telephone. Some problems have been encountered in the hand-off between cells for data applications. It is now possible to use a cellular phone to transmit at 300 or 1200 baud.

In addition, the CTS carriers are developing specialized applications for specific market segments. One example is the arrangement between Cummins Engine Company and CellNet Canada, who have reached a three-year deal in which Cummins' Truckphone will be supplied to Canadian truck fleets. Truckphone will provide coast-to-coast and North America-wide CTS coverage. Currently, CTS access is available in 306 U.S. cities and 34 Canadian cities.

The special features incorporated in the Truckphone are:

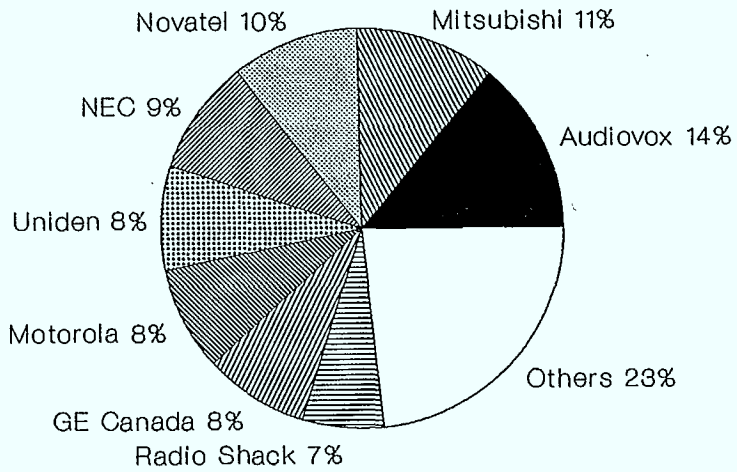
- built to withstand the rugged environment of an 18-wheeler;
- a five-year warranty;
- speed dialing and "hands free" microphone;
- call restriction feature to prevent airtime abuse;
- removable handset to prevent theft;
- electronic lock to prevent unauthorized use;
- sleeper extension that allows drivers to talk from their bunks;
- high output audio control which lets drivers hear above road and engine noise; and,
- modem capability so that fleets can install mobile data terminals, facsimile machines or microcomputers.

Industry Structure

In addition to the service providers, Cellnet and Cantel, the industry structure includes equipment suppliers required to install the cell site network, and the manufacturers of cellular telephones and transreceivers. The network equipment suppliers include Ericsson Communications, General

Electric and Northern Telecom. The market shares in terms of shipments of cellular telephones and transreceivers are Audiovox (15%), Mitsubishi (12%), Novatel (11%), NEC (10%), Uniden (9%), Motorola (9%), GE Canada (9%), Radio Shack (7%), and Others (25%). This large number of participants is characteristic of a rapidly growing market associated with a new technology. These market shares are illustrated below in Exhibit 5.4.

Exhibit 5.4: Market Share of Cellular Telephone and Transreceiver Shipments (1988)



Source: Northern Business Information Inc.

Only Cantel and Cellnet can sell subscriptions to CTS. Included in the subscription is a telephone number and a billing account. Telephones and other related products are provided by Cantel through their Cantel Service Centres, a network of 40 sales, installation and service centres, and through an extensive network of Cantel approved agents. On the other hand, Cellnet's distributors are "authorized attachers" who are general

electronics dealers and do not necessarily specialize in cellular products. Cellnet, recognizing the profile gained by Cantel's approach, is setting up its Key Dealer Network. Eventually, it is anticipated that as phones become cheaper and gain wider appeal, sales will spread from specialized dealers into mass merchandising. In addition, automobile manufacturing firms may start to provide cellular phones as an option on new cars. Moreover, cellular phones are already available in some rental cars.

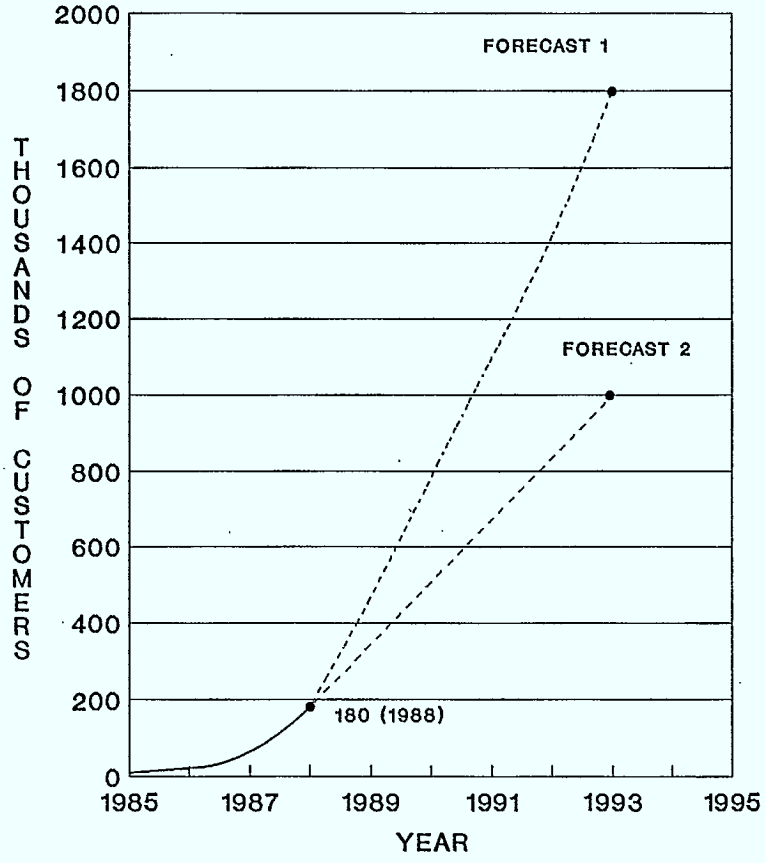
5.2.2 The Future

By 1992, it is anticipated that CTS coverage will extend to 74% of the Canadian population. This will restrict coverage to centres with populations of more than 150,000 and major transportation corridors. With the advent of digital transmissions techniques and the associated cost per user reduction, it is anticipated that CTS will eventually be available in centres of over 50,000. It is noted that at present, the CTS suppliers are increasing their capacity in Toronto and Montreal, and particularly along major transportation routes. Cantel has announced plans to create a 7,800 kilometre, coast-to-coast, continuous cellular network along the TransCanada Highway. Cellnet has indicated its intention to match Cantel's investment.

Customer Trends

The forecasts of CTS customer growth indicate a very rapid increase in the number of subscribers over the next few years. From the estimated 180,000 customers at the end of 1988, CTS forecasts for the end of 1993 place the number of subscribers between 1,000,000 and 1,800,000. This subscriber growth is illustrated in Exhibit 5.5.

Exhibit 5.5: Forecasts of
Cellular Customers (1985-1993)



In the future, it is anticipated that large businesses will begin to use CTS to a greater extent. A major problem for larger businesses has been the measurement of the payoff from buying large quantities of cellular telephones, particularly when the cost is well known. It is anticipated that sales personnel for large organizations will be a major market, perhaps where an employee, in combination with the company, purchases the service. Recently, there has been an increase in the number of larger firms purchasing CTS. To encourage the use of CTS, the cellular suppliers have been looking at ways to integrate cellular into the firm's existing communications structures (e.g., private networks).

Another market is individuals who currently do not own a cellular telephone, but view their time as being valuable or invaluable and therefore will want to buy one. As well, in certain areas, the use of CTS

will move from a perquisite to being a necessity. It is anticipated that increased penetration of the blue collar workforce and lower-end sales personnel will take place. Also, some purchases by the consumer market are anticipated for principally safety reasons.

The survey conducted as part of this study indicated that virtually none of the 33 businesses had any concrete plans to expand their use of cellular phones (or any other type of mobile communication technology). This finding is probably more a function of the nature and size of organizations contacted, than the lack of a coherent mobile communications strategy. Most of the organizations interviewed were small enough that the communications strategy was what the owner/manager felt was desirable at a given point in time.

Based on the interviews, it appears that growth will occur where there are business functions which require contact with other organizations or the public, in industries where the owner/manager/sales person is not able to physically be in the office at all times. While there was no commitment to expanding use of mobile communications in general and cellular telephones in particular, most respondents (especially the ones from smaller organizations) had not ruled out expansion entirely. The general attitude is one of restraint: if future business conditions warrant expansion, then equipment will be purchased; but until conditions are right, companies will stay with what they have. Of specific interest, only one current cellular user identified price as a problem associated with the CTS, but in that case the benefits far outweighed the cost.

No instances of technology substitution were found; that is, no organization was giving any consideration to replacing pagers or mobile radio with cellular telephones (one organization was studying the feasibility of adding mobile radio to their operation). It appears that, at least among the businesses contacted, there is a good grasp of the choice of appropriate technology. For the respondents, the current equipment properly serves the role it was bought for and there is no need

to replace and/or enhance it. This attitude, of course, does not preclude purchase of CTS for business functions where access to the PSTN is needed.

Cellular growth will occur in all segments of the transportation sector, although growth will be uneven. Companies carrying people will expand the use of cellular as a means of increasing transportation efficiency and as a way of providing more services to customers while in transit. Companies carrying goods will expand their use of cellular in a piecemeal and carefully considered fashion. Only where the need for goods movement information can be considered critical, can we expect to see an increase in the use of cellular telephones and even then, only in areas where cellular coverage is broad and reliable.

In the emergency response sector, cellular use is largely administrative, so growth will be slow if at all. In general, police forces concentrate on the use, expansion and enhancement of radio systems to meet their emergency response needs, as does the Ontario Air Ambulance service.

While information about cellular use, by companies contacted for the remote communications aspect of the mobile satellite survey was incomplete, it appears that cellular telephones have already found a place in many companies. Cellular phones are most often used as a supplement to existing radio communication systems. Only one company was considering the replacement of mobile radio by cellular telephones, and this planning was still in the very early stages.

In general, the survey respondents were taking a very cautious attitude to the expansion of their cellular services (and for that matter the expansion or modification of their communication services in general). The one common element which emerged in the study was the fact that expansion would be "needs" driven, and only undertaken when a "need" had been demonstrated and an appropriate cost-benefit analysis done.

Equipment/Service Trends

Cellular telephone costs are decreasing at about 25% per year. Some of the price decrease is coming from reductions in dealer margins, which have shrunk from 40% to 20%. Sustaining revenue for the dealers comes from carriers rather than equipment. By 1992, it is anticipated that a mobile unit will decrease to less than $800 installed due to the competition of off-shore manufacturers. Portable units will also decrease in price to about $1,150 per unit by 1992 from approximately $1,750 per unit at present. Together with these price reductions, it is anticipated that there will be an improvement in the size, weight and reliability of the transportable and portable units. There is also a noticeable trend to transportable and portable units.

Automobile manufacturers are expected to install cellular in new cars beginning in 1991. It is anticipated that the process will be initially a dealer installed option, then a factory installed option and eventually a factor de-installed option. Currently, Bell Cellular has an agreement with the Cadillac Division of General Motors, and Cantel with Ford.

The conversion to digital will increase the capacity of the systems to handle 4 to 6 times, and possibly up to 15 times, the current subscribers. The standard for digital cellular will be set in August/September, 1990. The introduction of digital will not be sudden, as existing analog phones will not be immediately discarded. New digital network equipment will go into each cell site alongside the analog equipment. Digital equipment will begin absorbing call traffic, and analog communications will be gradually phased out on a channel-by-channel basis. The introduction of digital communications will:

- reduce congestion;
- possibly result in reduced service charges;
- increase demand for cellular telephone and network equipment;

- result in better data communications; and,
- increase security.

Price discounting to attract new users could be a possibility, due to the digital systems increased capacity; however, both service suppliers stated that pricing will either stay the same or increase due to the investment involved. However, prices may go down in real terms. It is noted that segment specific pricing may be used, where a different rate plan would be applied depending on not using the system during specific hours (i.e., confine usage to off-peak hours), to increase overall system utilization.

Digital cellular phones will be approximately 15% cheaper than the current analog ones. However, manufacturers may provide combination analog and digital phones which will result in a price increase of approximately 15%. The combination phones will be able to be used universally, while digital capability is gradually being added to all cell sites.

Dimensions of Future Competition

The basic aspects of CTS such as technology, pricing and features are not viewed as being differentiating factors between the two competitors. Essentially, as soon as one competitor introduces a feature or adjusts pricing, the other will do the same. Customer service is the primary dimension in which a firm can differentiate itself, as it is the key to satisfied customers and to word-of-mouth advertising. Due to the fact that the firms do not own their distribution channels, control of user service is difficult. Moreover, the number and type of channels is changing as automobile manufacturers and mass merchandisers enter the business. Thus, distribution channel servicing is viewed by the cellular carriers as being very important in maintaining competitiveness. Some forward integration by the CTS carriers is a distinct possibility in the future, in order that they can exercise increased control over servicing provided by their distribution network.

In the longer term, CTS offers tremendous potential. First, the CTS carriers capture long-distance traffic originating from a cellular telephone, and are allowed to carry the traffic from the city of origin on their own networks to the destination city (or a location closer to the destination) and then enter it into the PSTN. The CTS carrier, therefore, receives the bulk of originating long distance revenue. Cantel as a "non-wireline" carrier, through its connection with CNCP Telecommunications, is ideally positioned to capitalize on this. Second, as cellular telephone and service costs decrease, the cost differential between a business wireline telephone and a cellular telephone will decrease. This is particularly true if rate rebalancing occurs. Recognizing the versatility of a cellular telephone, the result could be that the CTS carriers will be essentially new telephone companies, where cellular transmission replaces the local loop.

Suggested Improvements

A number of suggested improvements were provided in the interviews. They have been classified below into technology and regulatory related.

- Technology

A major concern to the cellular carriers is the need to put up towers. The carriers are experiencing serious problems with municipalities and building owners in finding tower locations. These problems would be mitigated if the towers were not "big, massive and ugly". The problems have become particularly acute in urban areas where cell size must be reduced, and as the cell size reduces, antennas must be more accurately placed. It was suggested that if the antennas could be designed to be more aesthetic, there would be less problems in obtaining appropriate sites.

In addition, there is a distinct need to include voice response/ recognition capability in cellular phones. Among other things, this will contribute substantially to cellular phone operation and vehicle safety.

- **Regulatory**

The CTS suppliers are running out of spectrum in the large urban areas, and would like the full 832 cellular channels made available. This requirement will become urgent once digital is introduced.

Telephone headsets are not currently allowed by vehicle regulation. However, a headset that doesn't impede traffic noise would be a welcome addition as it would allow "hands free" operation.

5.3 Cordless Telephones (Telepoint) - Personal Communications

Cordless telephones in which a handset can be used within a certain distance of a base unit have been available for a number of years. Cordless phones are used extensively in homes and are sometimes used in plant and industrial settings.

The British have developed a second-generation cordless phone service, called Telepoint. It is based on cordless telephone system (CT2) technology and not on cellular technology. Using a wallet-sized phone, customers can originate (but not receive) calls within 100 metres of receivers located in public places. The receivers are, in turn, connected by wire to the PSTN. It is anticipated that "Telepoints" will be placed in railway stations, airports, garages, service stations, department stores, restaurants and pubs, and busy street corners. Telepoint customers can also use the same cordless phones at home and in offices equipped for the service.

To use Telepoint, a customer must first register as a user to get a personal identification number (PIN). Then, to make a call while away from home or office, the user would need to be within 100 metres of the Telepoint transceiver, which is identified by a distinctive symbol. The caller would log onto the network by pressing a button on the handset and entering his or her PIN. After validation, the caller would receive a dial tone and make a call in the normal way. There is no direct way to reach a Telepoint customer while away from home or office. It is suggested that the Telepoint customer carry a pager, and that perhaps in the future, the Telepoint phone will incorporate a paging capability.

However, it is possible to receive a call at home or office if the handset is "enrolled" with the base station. The current Telepoint configuration allows for a maximum of 6 handsets to a base station.

The Telepoint service has limitations in comparison to cellular. It will only work within 100 metres of a base station. In public, only outgoing calls can be made and there is no provision for roaming. However, it is smaller, lighter and cheaper than cellular. It will last longer between recharges, even days or weeks as it can be completely switched off when not being used. Charges for usage will be much lower than cellular charges. As a rough estimate, the handheld and associated base station will cost roughly 25% of a cellular unit (e.g., $300-$500). The cost of usage is estimated on a fixed monthly basis to be $40-$50/month, and on a call-by-call basis, to cost twice a payphone call. This usage cost is roughly a third of cellular usage costs.

Estimates of the cost to build the Telepoint network are roughly 20% of the cost of a cellular network. The installation of the Telepoint receivers in public places is relatively easy compared to setting up a node for cellular phones. The system utilizes 40 channels which avoids the interference and security problems often associated with cordless telephones where two users have units with the same pre-programmed frequency. Moreover, Telepoint can accommodate approximately 13,000 users per square mile, which is roughly 200 times the maximum number of cellular subscribers.

It is anticipated that the Telepoint technology will lead to cordless PABXs. Within the EC, there is considerable discussion about standards, and the Telepoint CT2 technology has not received general acceptance.

In the U.K., the four consortia that have been selected to negotiate for licences by the Department of Trade and Industry (DTI) are:

- Phonezone - Ferranti has a 65% interest;
- Phonepoint - a joint venture between British Telecom, Nynex of the U.S., France Telecom, and STC;
- Callpoint - consortium of Shaye, Motorola and Mercury; and,
- Philips - consortium of Philips with Shell Oil and Barclays Bank.

The system is expected to become operational in the Summer of 1989. Customer forecasts are to have 500,000 customers in two years and from 3-6,000,000 customers by 1995.

The above consortia were phoned to inquire who would be the likely users of Telepoint system. Due to the fact that the consortia will be introducing their services this year, there was obvious reluctance to talk about market entry strategy. However, we were advised that the entry point would most likely be middle-to-low businesses, those that would not purchase cellular. Once installed in businesses, it is anticipated that business users might then buy a base station for home.

The Canadian Market

Both cellular carriers stated that they were considering Telepoint, but had no immediate plans for implementation. They are currently monitoring the situation.

In Canada, the average cost of cellular usage is roughly 65% of U.K. cost, and cellular telephones are considerably cheaper. Given the lower prices in Canada for cellular, it is questionable as to whether or not there is room for a cheaper mobile telephone service in the market. Without extensive market research, it is impossible to say if a Telepoint service would be successful in Canada, and if so, what type of strategy should be used to enter the market. However, the following thoughts were advanced regarding the possible implementation of Telepoint:

- it could provide low-end cellular users with a cheaper alternative to CTS, and thereby cannibalize CTS;

- it could introduce new customers to mobile communications, who might subsequently move up to CTS;

- it would provide an improved quality cordless telephone with extra capability for consumers.

- it could be used as a cordless PABX; however, it might then be preferable to wait for subsequent technology (e.g., DECT) which has more capability in this regard.

It is noted that because Telepoint might find considerable acceptance in the consumer market, it could result in increased regulation in the mobile communications market. One possibility that was advanced, was that it could be introduced as a Telco service, perhaps in part, as a replacement or substitute for payphones.

Nevertheless, it is clear that eventually, there would be considerable overlap between a Telepoint service and CTS.

The surveys undertaken as part of this study also asked questions concerning interest in the Telepoint technology. Because respondents were contacted to solicit their views about the business applications of mobile communications technology, it was decided to maintain that thrust of the questionnaire. Telepoint, as noted above, is expected to receive acceptance first as a business-related service.

Contacts were asked to comment on the perceived utility of Telepoint for their needs for mobile communications in their business operations. In each case, the respondent could not think of any organizational function requiring mobile communication that was not already met by existing or proposed systems. Primarily, users felt that current communication systems were adequate, and the installation of a Telepoint system would not enhance their operation. Nonetheless, given the widespread attitude amongst many companies, especially the larger ones, of investigating alternative technologies, it is entirely possible that some may find a use for Telepoint. It is clear, however, that few companies will spend their resources investigating a technology which is not yet in place. Only when

a "hard" system is constructed and firm costs are available, will organizations engage in a cost-benefit assessment that may lead to technology substitution.

An entirely different view of Telepoint could possibly emerge from contacting private individuals and soliciting their opinions about the service. Given the requirement that such opinions be representative of the phone using population as a whole, it would be necessary to undertake a consumer market research study involving interviews of a random sample of Canadian telephone users. Such a survey was clearly beyond the purview of the present investigation.

6.0 MOBILE SATELLITE SERVICES (MSS)

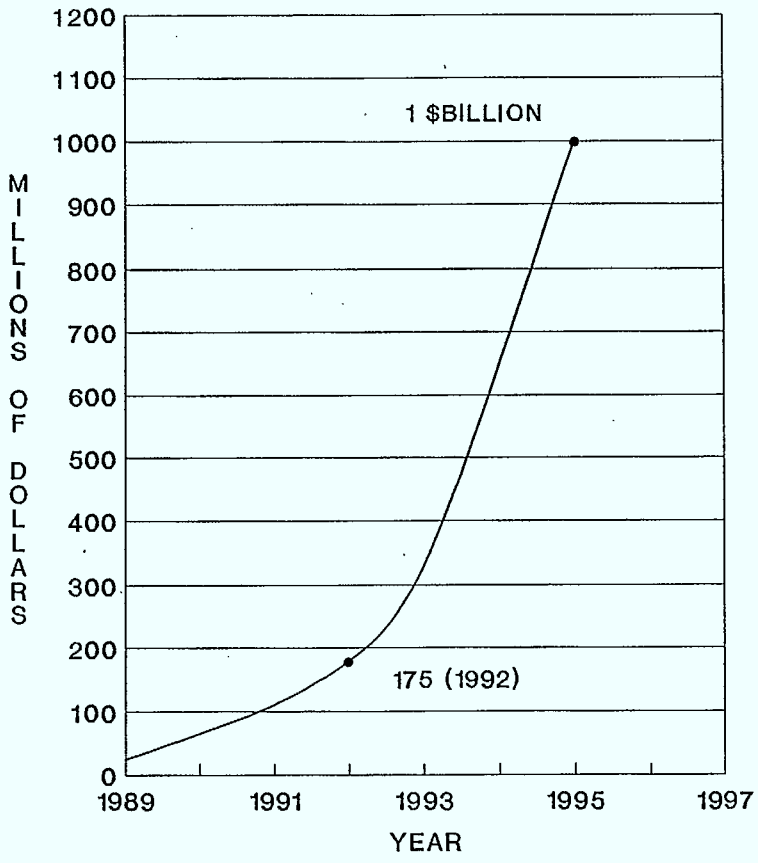
During the last 10 years, INMARSAT has provided satellite communications to ships, to provide access to telex, telephone, and data communications up to 1.5 megabits per second. More recently, INMARSAT has expanded its service offerings to include small satellite communications terminals that can be used by smaller vessels, aircraft and land vehicles.

In the near future, the Canadian and U.S. MSAT systems will begin operations. MSAT will be used for data and voice applications for aircraft, boats and land vehicles.

In addition to INMARSAT and MSAT, there are two other commercially available services that can be used for land vehicles, particularly trucks. These services are offered by Geostar and QualComm. Further services that provide the same capability, using meteor bursts instead of satellite transmission, are planned by Transtrack, Inc. and Pegasus Message Corp.

A 1988 U.S. Department of Commerce study entitled "Space Commerce: An Industry Assessment" estimated that world-wide annual revenue for MSS could reach $150-$200 million by 1992, and $1 billion by 1995. This trend is shown graphically in Exhibit 6.1. The report also projects that more than 135,000 mobile transmitters/receivers will be in operation by the end of 1990.

Exhibit 6.1: Mobile Satellite Services
Worldwide Annual Reveune (1989-1995)



Source: U.S. Dept. of Commerce, 1988

INMARSAT and MSAT are discussed below, followed by the other services providing similar capability. The results of the survey of potential users of mobile satellite is given after the discussion of the other services. The emphasis in this section is land mobile applications, while marine and air mobile are discussed in Part II of this report.

6.1 INMARSAT

Commercial use of satellites for mobile communications began in the mid-1970's with the launching of three MARISAT satellites by a consortium of U.S. companies. These satellites were positioned over the Atlantic, Pacific and Indian Oceans. At the same time, the European Space Agency (ESA) had developed a similar maritime communications satellite (MARECS) and supporting infrastructure. INMARSAT, which was created in 1979 after considerable international negotiations, assumed control of the network of satellites and the 1000 Standard-A ship earth stations then in operation. Since that time, the number of ship terminals has grown to about 7600 in late 1988. INMARSAT currently has 54 member countries, with Canada through Teleglobe Canada Inc, having a 1.5% investment share. The largest participating countries are the United States with approximately 27.5%, the United Kingdom with 15.1%, Norway with 14.0% and Japan with 9.5%. INMARSAT essentially covers the whole world, although there is currently a small gap down the centre of North America which will be rectified soon.

This year, INMARSAT will introduce a new service using small, simple, robust satellite terminals. The service called Standard-C was initially developed as a two-way messaging service for marine use. However, its potential for land-based mobile communications became quickly apparent. Standard-C communicates text messages to and from mobile terminals anywhere in the world. It is an all-digital, store-and-forward system operating at 600 bps between the mobile, the satellite and the receiving/transmitting earth station. At the earth station, messages are reformatted and transmitted over the international telecommunications network to their destination. Standard-C mobile equipment is very small, with the electronics being not much larger than the average car radio. Its power requirements are minimal, and the omni-directional antennae is small and can be easily fitted to any vessel or vehicle, or carried as a portable in a briefcase. It is noted that for many applications, data transmission to text display terminals is equally effective as voice communications, and offers additional benefits in terms of improved

transmission efficiency, privacy, and cost. Further, it is easier to store a text message if an individual is away from the receiving unit.

Standard-C entered a pre-operational stage in April 1989, with a thousand terminals in use. Standard-C becomes fully operational at the end of 1989. Pricing estimates place the transmission cost at $0.80 to $1.00 for 125 characters.

6.1.1 Land Mobile Opportunities

The potential for land mobile satellite applications is somewhat limited due to the availability of vehicle cellular radio in urban areas and along major transportation corridors. However, even though cellular will continue to expand, satellite has a distinct advantage in meeting communication requirements in remote areas. Mobile satellite services will, therefore, complement cellular in those areas where cellular is not economically viable. However, as cellular reaches offshore and pushes out into rural areas, the market available to mobile satellites will likely become smaller.

In addition to two-way messaging, Standard-C can be used in the following ways:

- **One-way Message Broadcasts** - messages can be sent to predesignated groups of receivers (e.g., a company shipping or transport fleet, or subscribers to a news service) or to all receivers in a designated area (e.g., for traffic or accident reports, weather bulletins, etc.). In addition to Standard-C, special receive-only terminals are available. This service will become operational in 1989.

- **Satellite Paging** - a paging device, developed by British Telecom, will operate worldwide. The device can be fitted to a vehicle or hand-carried, and provides a brief message in addition to

providing a "beep" alert. This pager has been undergoing field trails.

- **Monitoring and Position Reporting** - Standard-C can be equipped to periodically transmit, or be remotely polled and respond with, data collected from automatic sensors or other devices. On a truck, for instance, the data could include such information as speed, power train operating parameters, refrigerated load temperature and condition, and fuel. With built-in or associated position determination equipment (e.g., GPS, Decca, Loran-C, etc.), the transmitted data can also include the truck's precise position. Regular information would improve the efficiency of scheduling loads, maintenance and staff. Other applications include standalone units for water resource and other environmental monitoring and control.

The following are some of the applications envisioned by INMARSAT for Standard-C:

- **Trucks and Road Transport** - Standard-C could enable long-distance road transport operators to maintain communications with their fleet, almost anywhere in the world. This application has been successfully tested during European field trails. Specific uses include:
  - Two-way messaging;
  - Engine and mechanical monitoring;
  - Crew monitoring, movements & rostering;
  - Road and traffic reports;
  - Weather reports;
  - Container/trailer tracking;
  - Real-time market information;
  - Paging and personal messages;
  - Overall fleet management;
  - Load monitoring;

- Re-routing;
- Hijack/theft alerts and tracking;
- Position reporting;
- Bus passenger messages;
- Customs documentation; and,
- Loading manifests and coordination.

- **Railways** - In many remote or isolated areas, communications are antiquated or non-existent along railway rights-of-way. A problem with one train can result in considerable delays to all rail traffic in the system. Standard-C communications will allow trains to automatically report their position, independent of trackside sensors, and communicate any problem direct to a central controller, who would then be able to issue appropriate instructions to efficiently coordinate all movements within the system. Specific application areas include:
  - Freight, container and rolling stock location reporting;
  - Back-up signalling and control communications;
  - Crew movements and rosters;
  - Medical services;
  - Load manifests and coordination;
  - Maintenance scheduling;
  - Rescheduling;
  - Passenger text messages;
  - Customs and freight documentation;
  - Emergency/safety communications; and,
  - Crew and passenger paging.

- **Remote Monitoring, Control and Data Collection** - Standard-C units can operate in remote areas using solar, battery or thermoelectric sources, making them suitable for remote monitoring, control and data collection applications. Each site is independent of the other, and can be set up to transmit data at preset intervals or have the base station interrogate them. The units could also be

used for remote control applications. Specific application areas envisioned include:

- Natural resource monitoring and control;
- Survey team communications;
- Pipeline information and control;
- Wildlife location and tracking;
- Atmospheric pollution checking;
- Environmental monitoring;
- Weather reporting;
- Lock controls;
- Seismic monitoring; and,
- Flood forecasting.

- **Remote Area Communications** - Standard-C has many potential uses in providing short-term communications to remote areas. These include:
  - Emergency and rescue communications;
  - Seismic survey teams;
  - Backpackers and climbers;
  - Rangers and foresters;
  - Mineral and other exploration;
  - Adventurers and tourists;
  - Medical services; and,
  - News reporting.

For transportation applications, one area of concern with mobile satellite applications is the possibility of signal blockage due to bridges and interchanges, landscaping, overhead lighting, tunnels, passing trucks and topography (e.g., mountains, road cuts, etc.). With the exception of blockage by topography, blockage was not found to be a serious problem. Certainly, problems would also occur in heavily built-up areas.

A market study of truckers conducted in Europe in 1988 determined that for both "for hire" and for private (owned) fleets, the features most required

for vehicle non-voice messaging included positioning information and two-way messaging. A subscriber base of 2 million was predicted for the EC in the year 2000, of which 35% would be shared by the mobile satellite operators.

6.2 MSAT

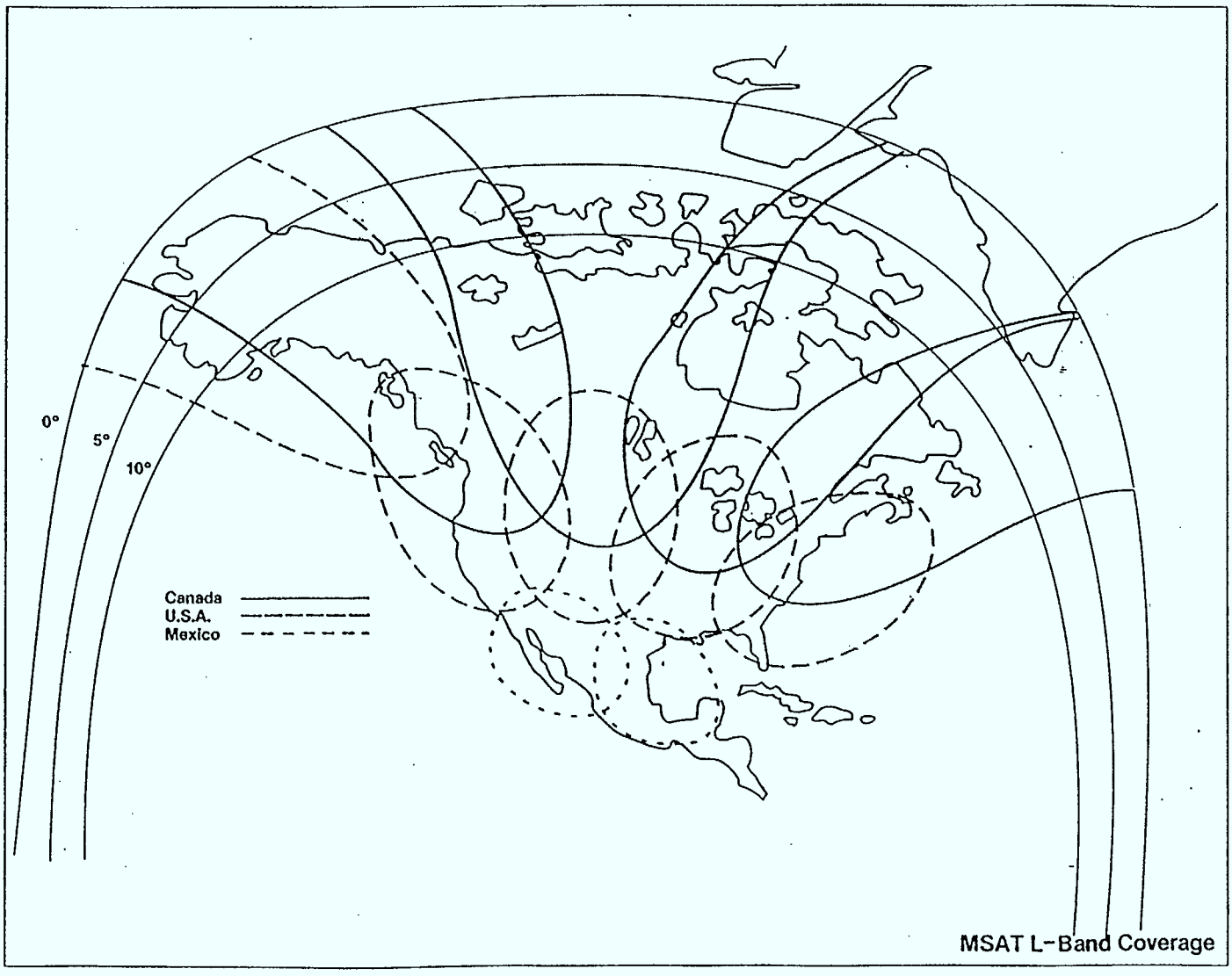
In late 1988, Telesat Canada Inc. announced that Canadian Pacific Ltd. and a Japanese investment group headed by C.Itoh, were its partners in a $360 million venture to bring mobile satellite services to Canada. A subsidiary of Telesat, named Telesat Mobile Inc. (TMI), will construct and operate mobile satellite services in Canada. Telesat is investing $50 million for a 50% ownership, Canadian Pacific $30 million for a 30% ownership and the Japanese group $20 million for a 20% ownership. The Federal Government signed a 10-year lease in September 1988 for $126.5 million, to provide "seed money" for MSAT. The Canadian cellular carriers, Cantel and Bell Cellular, have agreed to participate as distributors for MSAT. In addition, Bell Cellular has stated that it will loan TMI $30 million, and will receive warrants to buy 14% of TMI.

TMI in conjunction with a U.S. consortium, the American Mobile Satellite Consortium (AMSC), will create a North American system. The planned MSAT coverage contours are given in Exhibit 6.2.

As its first service offerings, TMI plans to offer a mobile messaging and vehicle locations service in Eastern Canada using INMARSAT facilities. This preliminary service will be available in mid-1990. The use of INMARSAT allows TMI to build its customer base, develop terminal equipment, and assess market risk and acceptance before launching its satellite. TMI expects to launch its own MSAT satellite in 1992, with a full range of mobile services being available by 1993.

TMI plans to offer voice, message and data communication services to land vehicles, ships and aircraft. These MSAT services are expected to find their highest potential in rural and remote regions where their wide-area coverage and extended range features are of greatest benefit. The applications areas envisioned are:

EXHIBIT 6.2: MSAT L-BAND COVERAGE



Source: MSAT News, No.7, February 1989.

- **Public Safety**
  - police;
  - ambulance;
  - search and rescue;
  - fire fighting; and,
  - emergency relief operations.

- **Aeronautical**
  - operational communications to commercial aircraft;
  - public correspondence;
  - air traffic control; and,
  - safety.

- **Marine**
  - operational communications to domestic coastal fishing vessels;
  - coast guard operations;
  - research vessels;
  - oceanography data acquisition; and,
  - electronic data broadcast to marine vessels;

- **Land Applications**
  - construction projects in remote areas;
  - resource development - forestry, and oil and mineral explorations;
  - environmental monitoring;
  - pipeline and oil well operations;
  - hydro electric generation;
  - transportation - shipment of hazardous cargo, just-in-time operations, wide-area vehicle monitoring, and vehicle positioning.

TMI forecasts that there will be 80,000 MSAT mobile units in operation by the year 2000. Thirty-three percent (33%) of these will be for mobile

voice operations, and the remaining 67% will be for data applications. Pricing for MSAT service is not yet final, but should resemble the following:

- Mobile Terminal $4000-$6000
- Access Charges (per month/terminal) $50-$150
- Transmission Charges
  - Voice $1.50/minute
  - Data $0.25 to $0.75 per one-way message (32 to 128 characters)

TMI is giving priority to providing data services to truckers. Its "Road KIT" fleet management system which is currently being developed, will provide fleet operators with:

- periodic updates of vehicle position location;
- two-way digital messaging using pre-programmed message codes;
- general two-way demand messaging; and,
- a text transfer service.

The system is expected to result in reduced costs and improved efficiency in operations, and consequently, to improve the company's/industry's competitive position.

In addition to Road KIT, Telesat/TMI is planning a ship tracking and two-way message service for the east coast fishery, and data acquisition and control services. In the area of voice communications, Telesat/TMI is planning voice services such as a service presently being offered to the Ontario Air Ambulance. These additional services will use INMARSAT in the short term and will migrate to MSAT in 1993.

6.3 Other MSS Services

As previously mentioned, two firms that are competing with TMI in the data services area are Geostar and QualComm. At the present time, the trucking industry is the major market for mobile satellite communication services. QualComm is the current front runner in servicing the trucking industry, and both Geostar and QualComm are ahead of TMI in that they have their systems operational.

QualComm provides two-way mobile messaging communication and position reporting via GTE Spacenet's Ku-band satellite. Since beginning service last summer, QualComm has installed 4500 OmniTRACS truck terminals and has another 4500 terminals on order. The system can be used for two-way messaging and position reporting, including the transmission of permits, bill of lading, time of departure, delivery status, hotel reservations, etc. The truck terminal costs from $4200-$5000 U.S., and the cost of sending messages per truck is estimated to average less than $5.00 U.S. per day.

Geostar also provides data services for truckers. Since beginning operation in June 1988, 1500 Radio Determination Satellite System (RDSS) units have been installed. Geostar's primary service offering is a one-way capability (from truck to dispatcher), and is currently field testing a two-way system that is to enter commercial service this year. The system allows a remote console operator to locate the position of any vehicle and/or trailer. It would also be used to interrogate the vehicle's on-board systems, cargo and driver console to determine their status. The vehicle operator can also advise the dispatcher if an emergency occurs. The cost of communications is less than 5 cents per 100-character message. The average cost per truck for the two-way system is $4800 U.S. Geostar, who has teamed up with Sony to produce the RDSS equipment, also plans to introduce digital voice service in combination with the RDSS capability, which will be called MetroTRAC. Within three to five years, Geostar plans to launch its own satellites, and has awarded a

$100 million contract for two satellites and has options for two others. Geostar RDSS terminals are sold through distributer agreements with Sony and Hughes.

Another comparable service that doesn't use satellites is currently being tested by Transtrack Inc. The service which is two-way, communicates by bouncing its signals off the ion trails of meteors. The chief advantage of this system is cost as no satellite capacity is required for communications. The FCC has authorized the construction of a nationwide network. It is planned that first production units will be available next March. Another company, Pegasus Message Corp., is also testing a meteor-burst tracking system, and hopes to inaugurate U.S.-wide coverage next year.

6.4 Results of the Survey of Potential Users of Mobile Satellite Services

The results of the survey of potential users of mobile satellite, carried out as part of this study, have been segmented into the transportation, emergency and remote markets.

6.4.1 Transportation Communications

The railway companies responding to the survey, showed no interest in the use of satellite communications for voice or data. For the railways, it appears that the choice of technology for the future will be based on the ATCS configuration of track-side transponders and ground-based transmitters. At this point in time, both freight carrying services are engaged in field tests of ATCS installations along discrete areas of their rail systems. The decision to proceed with ground-based systems appears to be based on the following factors:

- the ATCS product is available at the present time. The technology to fill an information need is already in place and has demonstrated capability; and,

- land-based systems are considered to be more reliable, cheaper and easier to maintain than a satellite system.

Like many other participants in the survey, the railway companies would not rule out the possibility of using MSS at some point in the future. Any technology which could be demonstrated as cost-effective would be considered.

Similarly, for road transportation, no company contacted would explicitly say they had virtually no interest in the use of satellite communication technology for their service. In all cases, the issue was one of economic benefit for the price. It appears that future communication technology use is not driven by the need for better communications but rather by the

need to remain price competitive, especially in the trucking industry. While there were no explicit plans to adopt the technology in a wholesale fashion, there was every indication that MSS would be used where an individual company could convince itself that its use would be beneficial for certain runs. Certainly, it was apparent that the use of cellular telephones as an alternate means of providing communication services will limit the adoption of satellite services by the trucking industry.

6.4.2 Emergency Services

For emergency service organizations, only one had no interest in pursuing the subject of satellite communications. This organization is currently in the final phases of installing an extensive ground based voice/data communications system. The new system is projected to meet their communication requirements for at least the next 15 years. Of the other three organizations contacted, two had direct interests in MSAT services. The Ontario Air Ambulance Service is scheduled to switch their air-to-ground voice channels to MSAT from INMARSAT as soon as the MSAT system becomes available. The RCMP are currently scheduled to take part in east coast trials of the MSAT system as a means of data transmission. The RCMP also expressed a great deal of interest in using MSAT as a means of providing voice communication in northern remote areas, as they see the technology as a means of cost-effectively enhancing police services. Emergency Preparedness Canada (EPC) did not have any plans to use the MSAT system, but they certainly see it as being useful in crisis situations. EPC has the need for VSAT communications at the present time, and is going ahead with plans to install a system using other private satellites for voice and data (facsimile) communication. The system will incorporate five systems installed at high-risk locations, which are ready for immediate deployment. EPC also uses an ANIK satellite to transmit televised pictures of crisis situations back to their headquarters to aid planners.

6.4.3 Remote Communications

Of the potential users of remote communications who participated in the survey, only two are currently using satellite communications. Ontario Hydro uses a satellite system as a data platform for administrative information and for hydraulic telemetry, while Nova Corporation is currently installing a satellite system to provide telemetry from a remote transmission site not currently served by its AGT land system. No organization had explicit plans to use any sort of satellite communication, be it MSAT or any alternative system. However, by the same token, none would explicitly rule out the possibility of using satellite communication. Ontario Hydro for instance, views MSAT as a possible means of establishing voice communication to remote northern sites and for serving as a data collection platform for northern areas. With few exceptions the responding organizations would be willing to utilize satellite communication technology if a clear cost-benefit could be shown. Everyone appears to be open to the idea as an alternative, but only as one choice of a range of alternative.

7.0 MOBILE DATA SERVICES (MDS)

As can be noted from the previous sections, a significant and growing component of mobile communications is concerned with the transmission of data. The MSS applications such as Road KIT and Standard C, and alphanumeric and numeric paging are illustrations of mobile data applications. In this Section, data applications that have not been previously discussed are described in some detail, while those that have already been discussed, are noted. The organization of this Section is stratified based on the service technologies covered in the previous sections.

7.1 Paging

Section 3.0 described numeric and alphanumeric pagers which are used to receive message data. Although slow to catch on, these pagers allow users to refer to them at will, rather than having to scribble down details. In addition, the message can be stored and optionally printed at a later time.

The majority of alphanumeric customers come from business sectors where paging is unknown. Stockbrokers and their clients, lawyers, trucking and delivery workers, and auxiliary law enforcement personnel are a few examples. These people would rather have a full message display, or hardcopy (available with optional printers) in front of them as soon as possible, instead of having to find a phone for a callback. The major strength of these pagers versus traditional pagers is the fact that the message is immediate, which results in time saved.

One chief advantage of these pagers over voice pagers, is the amount of air time required to transmit the message. The principal disadvantage of the alphanumeric pager and to a lesser extent, the numeric pager, is difficulty of providing input. Alphanumeric pagers also cost almost four times that of a simple beeper pager. Proponents state that once this

problem is solved (perhaps with an alphanumeric encoder), many applications will become apparent.

7.2 Mobile Radio

Significant interest has developed in the use of narrow land mobile frequencies for the transmission of data ranging from telemetry and data acquisition in industrial fields, to links between computers and microcomputers in commercial use. These applications are now involving both mobile as well as fixed point-to-point and multi-point communications, as users consider ways to transfer data accurately and efficiently.

Techniques are available to transmit data over mobile radio. Packet radio is one economically attractive and accurate method used to send data over mobile radio. Other applications are discussed below under MTS.

Private mobile data networks are fairly common in Canada, and are used by police, taxi and transportation companies (e.g., Federal Express uses MDI's network).

7.3 Mobile Telephone

CTS, which has essentially eclipsed traditional MTS, is the principal area within MTS currently involving mobile data communications. With reference to Telepoint, we are unaware of any plans to use it for data communications. Data transmission over CTS, and two recently announced mobile networks, are discussed below.

In Section 5.0, it was noted that modems are available to transmit 300 and 1200 baud over cellular phones. This type of data transmission is used in conjunction with a printer, microcomputer and/or facsimile machine. Currently, although there is growing interest in data transmission, it

represents less than 1.0% of usage. The main area of interest has been in transmitting facsimiles.

The cost of purchasing the mobile phone, modem, interface and facsimile, and then mount them in an "unfriendly" automobile, has been a deterrent to greater usage. As well, the charge for transmitting data over cellular is more expensive than voice usage, as the cellular carriers differentiate between voice and data when charging.

In July 1989, two new mobile public data services, Mobitex and MobiData, will begin operation. Mobitex is offered by Cantel, while MobiData is 60% owned by BCE Mobile Communications Inc. and 40% owned by Motorola Inc. Both these systems, which are overlaid on the cellular network, have available specialized data terminals to use with the network. MobiData is promoting a $5,000 terminal that can be used to send messages, bills, reports, monitor warehouse supplies and check current stock market prices without accessing the PSTN. The terminal can also be used as a modem. A separate modem to use the network would cost approximately $1,000. Service charges are anticipated to be roughly $70 to $80 per month. The Mobitex transmission speed will be 1200 bps when the service starts but will increase to 8000 bps in the mid-1990's.

Mobitex is offering a "message electronic mailbox" to ensure that the message reaches its location. If a mobile unit is out of communication for some reason, perhaps because it is passing through a road tunnel, then any messages destined for it can be stored within the network for re-transmission later. Another feature allows the broadcast of a message to a select group of users. It is also possible to transmit digitized voice over the network, although this is viewed as a minor application. It is noted that "handoff" between cells is not possible with the data services.

The customer base for these services is expected to be public and private sector organizations such as the police, warehousing and transport companies, utilities, taxi cab fleets and sales organizations. These

organizations will be present users of private MRS for traffic dispatch purposes. It is also foreseen that organizations for whom private MRS has not been a satisfactory solution will use mobile data networks. For example, service and maintenance organizations with teams of field staff. It is clear that these new services will compete directly with private MRS voice and data applications.

MobiData's implementation schedule will start with Toronto in July, Montreal in September, and Vancouver, Calgary, Edmonton, Ottawa and Québec next year. Mobitex will implement its service in the Windsor/Montréal corridor in July, Vancouver by the end of 1989, and other sites within 24 months.

Mobitex equipment is being supplied by Ericsson, who have run a Mobitex system in Sweden since 1986. MobiData equipment is supplied by Motorola.

Other major equipment suppliers are MDI, who have recently been acquired by Motorola, and Philips through a marketing agreement with E F Johnson. Relatively minor players are Gandalf (taxi despatch only) and Electro Communications. Two other firms, GE and Glenayre are considering entering the market.

7.4 Mobile Satellite

Section 6.0 of this report has discussed in considerable detail data applications envisioned by INMARSAT, TMI and several other carriers. The reader is therefore referred to Section 6.0 for information on mobile satellite data services.

7.5 Survey Results

The survey performed to obtain information on the cellular market failed to identify any user with a need to transmit data. However, the survey of the potential satellite users revealed disparate opinions concerning the need to transmit data either by cellular phone or by satellite.

For the emergency communication sector, police forces have a need for data transmission. The new OPP system will be used extensively for data communication, and the RCMP tests of the MSAT system will utilize mobile data terminals in patrol cars. However, the RCMP intend to utilize only voice services of MSAT for northern remote regions at least in the initial stages of utilization. The Ontario Air Ambulance Service have no plans to utilize data transmission claiming that the information to be transmitted is of such a critical nature that even the slightest error could produce erroneous prescriptions. As a result, they prefer to rely on voice communication to convey information taken from on-plane medical monitoring equipment. Emergency Preparedness Canada sees only a small need for data communication, as the ability to "fax" messages from crisis sites to a receiving station connected to the PSTN is adequate.

For the rail transportation sector, the ATCS system is, of course, data intensive. Given that current system tests are positive, the growth of railway system needs for data transmission will increase sharply (depending on the speed at which railways introduce the technology on a system-wide basis). For the road transportation sector, the Road KIT and other similar systems are, like the railway systems, data only. Growth of this need can be expected to be moderated somewhat, to the extent that cellular phone voice services enter the trucking market and by the motivation of the trucking industry as a whole to move to satellite based communication systems.

The remote communication sector is one where the greatest need for data communication would be expected. Data communication is used extensively

by some of the companies responding to the interview. For example, Ontario Hydro is already using satellites to transfer both telemetric and administrative data; Nova Corporation has telemetered lines throughout most of their pipeline system; and MacMillan-Bloedel is beta testing a Glenayre system to connect their logging camps to the company headquarters for the purposes of providing instant data and voice communication for all facets of their operation. Some of the companies contacted are not using data communication. For example, Western Geophysical employs a voice only system, and the Ontario Ministry of Transportation sees no need to add data communication to what they regard as an adequate voice communication system. These observations are an affirmation of a point made in previous discussions: when companies (at least large companies) perceive a need, they act, but not before the need has become apparent. Once the need is seen then solutions are examined and the most cost-beneficial alternative selected. A conclusion from the (limited) survey is that the growth of the data transmission market will, for larger economic organizations at least, be slow and deliberate.

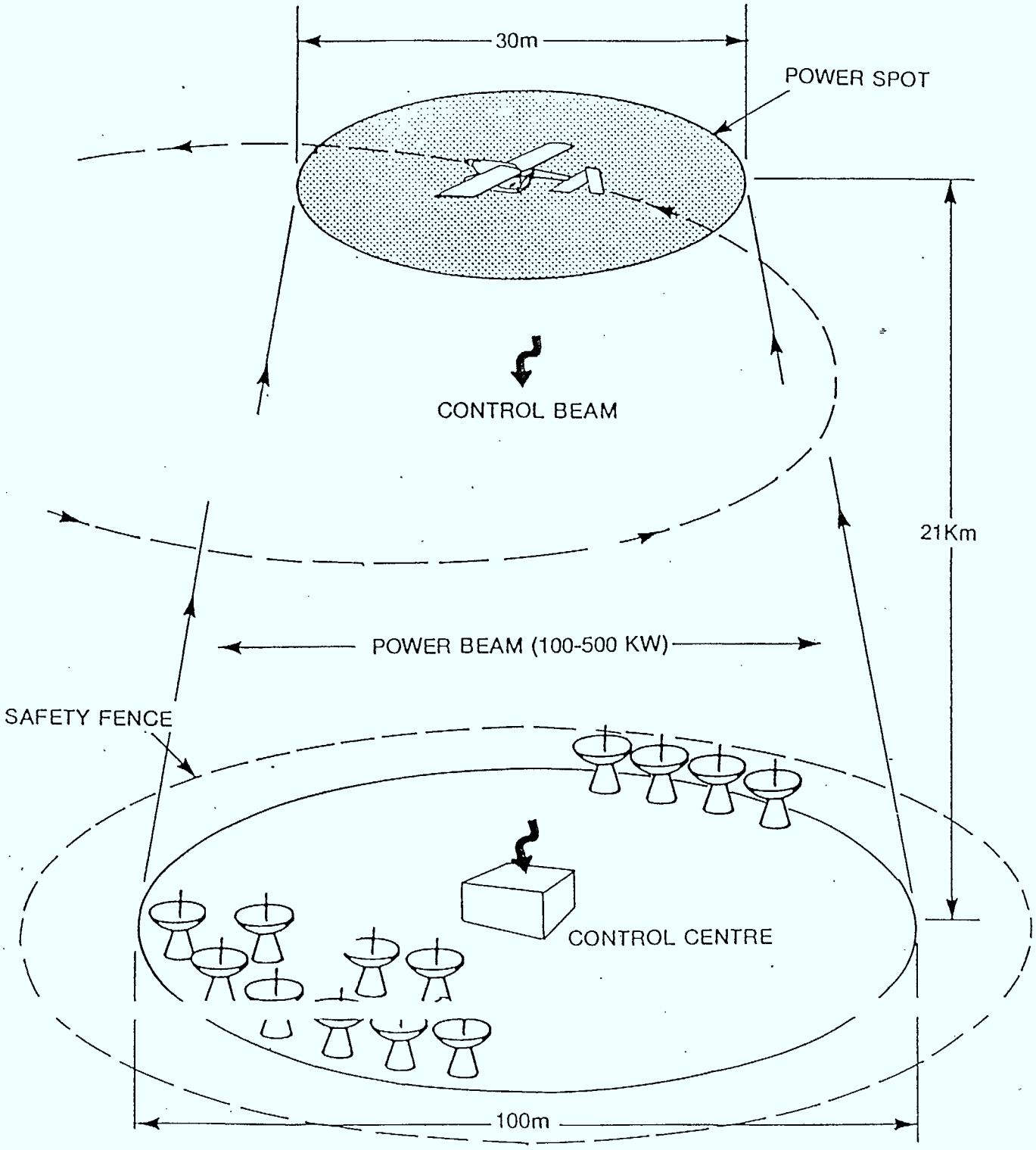
8.0 SHARP

During the last seven years, the DOC has been researching the technological and economic feasibility of utilizing a stationary high altitude relay platform (SHARP) as a transmission medium to provide a number of communications services. The platform being considered by the DOC is an unmanned, propeller-driven aircraft, powered by high-efficiency electrical motors. Power for the motors, housekeeping and the on-board communications payload, would be supplied by a microwave power transmission system located on the ground. This approach to providing power to the aircraft overcomes the operational undesirability of fossil fuels, which would require the SHARP to be frequently refuelled. An illustration of the DOC's SHARP concept is given in Exhibit 8.1. In October 1987, a test flight of a SHARP model was successfully made to demonstrate the feasibility of the concept.

At a proposed operating altitude of approximately 20 km, the SHARP is able to service a circle on the earth's surface whose diameter is roughly 600 km, and whose area is thus nearly 280,000 sq. km. The SHARP can be used to provide telecommunications and broadcast services to customers anywhere within this field of view.

The SHARP is seen by the DOC, as filling a need for a less-expensive complement to communications satellites. The SHARP, as a communications platform, is capable of providing virtually all the services discussed in the previous sections. A number of possible mobile communications service offerings were investigated in a 1985 report entitled: "SHARP Requirements Study" (Goss, Gilroy & Associates Ltd.). The study also investigated the financial viability based on MSAT, DBS and other market studies, and preliminary cost estimates available at that time.

EXHIBIT 8.1: ILLUSTRATION OF THE SHARP CONCEPT



SHARP at the present time continues to be researched by the Communications Research Centre (CRC) within DOC. It is anticipated that should the DOC or other parties proceed with SHARP, it will be a number of years before it becomes operational.

PART II - MARINE AND AIR MOBILE COMMUNICATIONS

9.0 MARINE MOBILE COMMUNICATION

The primary mode of communications for the marine user is through the use of VHF, HF and MF mobile radios. In addition, larger marine users can take advantage of satellite communications, generally through the use of the INMARSAT satellite. The marine user, who is equipped with a suitable VHF, MF or HF radio, can also access the Public Switched Telephone System (PSTN) using duplex telephone calls, message relay, or the transmission of low speed data over the PSTN. The means of doing this is provided throughout Canada by the Transport Canada Coast Guard radio station network and through the BC TEL marine mobile communications service in British Columbia. This latter telephone system is the only service to offer a mobile communications service in the marine bands.

The Coast Guard Radio Station (CGRS) network operates thirty-nine manned radio stations and eighty-nine remotely controlled facilities on both Canadian coasts, in the Arctic, and along the shores of important inland waterways. This radio station network provides three major communication services: Safety Service, Public Correspondence Service, and Coast Guard Fleet Command and Control Service.

The safety service consists of a listening watch on international distress frequencies and the broadcasting of a wide range of information to advise the Marine community of weather conditions, the status of Aids to Navigation or any potentially developing dangerous situation. The public correspondence service provides the transfer of paid messages ship-to-shore, the interconnection of ships to the telephone voice network, and the interconnection of ships into the telex network. CGRS also relays messages of a safety nature shore-to-ship and ship-to-shore at no charge.

Present terrestrial ship/shore communications' systems operate in three radio frequency bands: VHF for short ranges (approx. 50 km), MF for medium ranges (approx. 240 km) and HF for long ranges (up to several thousands of kilometers, depending on the equipment installed). VHF is

the primary frequency used. The characteristics of these three frequencies are reflected by the type, complexity of the radio equipment required and the operating procedures used.

Customers of the Canadian Maritime Mobile Communication Service include:

- Canadian vessels (cargo, fishing) operating in Canadian waters;
- Canadian vessels operating outside Canadian waters but within range of the Canadian radio stations;
- foreign vessels carrying Canadian exports and imports across the oceans;
- ships of the Coast Guard and other government departments; and,
- pleasure boats.

To date, there are 47,700 mobile communications ship stations licensed for all of Canada. This is up from 40,284 licensed ship stations in March of 1987 and 37,718 in March 1986. This number includes all vessel types but the majority would be pleasure boats.

The marine user in each of the frequency bands can communicate on a party line system with any other operator who is tuned into the same frequency. As such there is no voice privacy unless voice scrambling or data is transmitted. Some users who have a requirement for a private channel can request and be licensed for the private use of a particular channel in each of the bands subject to availability.

To access the PSTN worldwide, the marine user is required to first make radio contact with a CGRS radio station and to then request a connection from the mobile operator. This connection can be used for voice, low speed data and facsimile transmission as any other telephone line.

The marine user operating in one of the bands such as VHF, MF or HF is constantly faced with the difficulty and delay of first contacting the CGRS radio station and then waiting for an open circuit, so that the connection desired can be completed. To get around this, many marine operators who are near shore and within range of the VHF autotel or cellular systems will make use of these systems for their communications needs. The user, however, will have to carry a standard marine band radio to meet safety of life at sea requirements.

Finally, the lack of voice privacy and the time and difficulty of making connections through the CGRS system, or any of the Coast Radio systems in other countries, has led to a migration of users to greater use of INMARSAT terminals which provide instant direct communications around the world for voice and data requirements. This is especially true with the advent of the small C-terminal (data only) INMARSAT terminal.

In fact, in preference to the older technologies of MF, HF, and VHF, an increasing number of ships are installing and using INMARSAT ship earth stations. While the Safety of Life at Sea (SOLAS) Convention still requires the carriage of a standard marine band radio by ocean-going vessels, several countries have introduced equivalency rules to exempt such carriage of the main transmitter if the ship has an INMARSAT terminal. In addition, the International Maritime Organization, as the SOLAS custodian, will be overhauling the Convention with the introduction of its Future Global Maritime Distress and Safety System (FGMDSS) in the early 1990's. The FGMDSS will rely heavily on satellite communications.

There is one final note on alternative service providers. At the present time, the primary service supplier in Canada is the CGRS radio station system. This is a service available to the public user on a cost-recovery basis. There are a few small private companies who are attempting to provide the same type of service on a more restricted basis to larger users. Of the two that we were aware of, Polestar Communications

(Dartmouth, Nova Scotia) and Sealink (St John's, Newfoundland), only Sealink remains in business. It provides HF and MF services for users with a tie into the PSTN system. The system is apparently highly automated.

9.1 Mobile Satellite Systems

INMARSAT, as described in Section 6.0, provides worldwide maritime satellite communications. Services provided include:

- telephone (including fax and low- to medium- speed data) and telex (including telegrams) in both ship-to-shore and shore-to-ship directions;
- ship-to-shore high-speed data;
- priority access to the space segment for distress communication; and,
- assistance and information services (e.g., medical, weather, etc.) from the ship.

At present, there are 7584 INMARSAT terminals in use throughout the world. Canada has 75, 21 of which are government-owned. These 21 include the Coast Guard and/or fishing vessels.

Standard-C Satellite Communications System

The INMARSAT Council has awarded contracts worth about $1.3 million for operation of Standard-C Network Coordination Stations (NCS), which provide automatic call connection and control services for each satellite. The stations are scheduled to enter service between August 1989 and January 1990.

The Standard-C system is designed for two-way message communications anywhere in the world using very small, lightweight and low-cost terminals, compact enough to be fitted to any vessels or vehicle or even hand held.

In order to assist manufacturers to test and demonstrate their products, a pre-operational service of NCS was scheduled to start in the Atlantic Ocean in November of 1988, followed by pre-operational service in the Pacific and Indian Oceans around the middle of 1989. This pre-operational service is publicly available to any user with a Standard-C ship earth station.

Several INMARSAT Signatories have declared plans for building Standard-C coast earth stations. These include Norway, China, the United Kingdom and France. Germany, Australia and Canada have a declared interest in doing so. Even though service is not yet available, Standard-C mobile terminals are already in production (Thrane & Thrane A/S, Denmark) and orders have grown rapidly.

9.2 Current Trends

The Coast Guard fleet and commercial users are expanding their use of satellite communications. The main rationale for this is the easy access to the system for both voice and data on a world-wide basis.

The rapidly growing cellular telephone systems in inshore areas and increased use of land mobile VHF "Autotel" services are posing a real alternative to standard CGRS VHF marine service. The number of pleasure boats now equipped with either VHF Autotel or cellular telephone is likely growing. However, there are no readily available statistics on the number of users. It should be noted that the VHF Autotel (an automated form of mobile radio using the VHF band with the capability to connect to the PSTN), and the newer cellular telephones, are primarily for land mobile radio use. A recent survey of the CGRS operators and managers, as well as

a survey of the Service Providers (Goss, Gilroy & Associates Ltd., 1988), has identified a suspected increase in use of these services by marine users.

10.0 AIR MOBILE COMMUNICATIONS

The Air mobile communications area is far more limited than in either the marine or land mobile areas. The primary means of communications used by air users, is the Flight Services Stations and Air Traffic Services public frequencies. These frequencies are used for air traffic control and advisory information for airmen. There are very limited private or public commercial correspondence services available. Private and commercial aircraft can generally communicate privately on DOC assigned VHF-AM frequencies. There are 9 channels in the 450 MHz range available for private aircraft owners. At present, there are no aeronautical frequencies available for public telephone use.

Presently, two companies, SKYTEL in Canada and GTE AIRFONE in the U.S., are offering air-to-ground telephone service using land mobile frequencies. The public aeronautical radio telephone service provided by these two companies allows passengers on a commercial aircraft to place direct calls from an aircraft pay telephone to any North American telephone serviced by the PSTN. Passengers initiate and place direct dial calls by using participating credit card services such as VISA, American Express, etc. International calls can be made with the aid of a SKYTEL/AIRFONE operator.

The system operates in the 890 to 960 MHz frequency band. The ground station transmit frequencies (aircraft receive frequencies) are in the 944-946 MHz range, and the ground station receive frequencies (aircraft transmit frequencies) are in the 899-901 MHz band.

Recently, Teleglobe Canada announced plans for a satcom service for light aircraft. To be called AEROSAT, the service would offer voice and data communications for general-aviation aircraft. AEROSAT is scheduled to begin initial commercial service in 1990. The traffic will be handled by the dedicated aeronautical earth stations at Weir on the east Coast and Lake Cowichan on the west, working with INMARSAT's Atlantic and Pacific

satellites respectively. Cost to the user for placing a call from one point in the coverage zone to any other is estimated at $6.50/minute. Because it does not meet the full INMARSAT specifications, AEROSAT will not be able to offer the high "toll quality" voice service demanded by the airlines. However, Teleglobe hopes to meet INMARSAT's target specifications for a general-aviation terminal and antenna.

British Airways has introduced the first ever in-service trial of a passenger-voice aeronautical satcoms system using a Racal Skyphone terminal and GTE Airfone cordless handsets. Four telephone handsets, two in first class and two in business class, have been installed on two British Airways Boeing 747s flying various routes during a six-month trial period. If the service, which operates using INMARSAT satellites, is successful during this trial period, it will be extended to all British Airways long-haul flights.

Airborne telephone service has already been in service on flights within North America, but these services use air-to-ground communications and once the plane is over the ocean, the service doesn't work. The British Airways service is the first intercontinental telephone service. The problem of losing service over the ocean has been solved by using satellite. Once the call is encoded in the aircraft it goes up to the satellite and down to the ground digitally, then connected into the PSTN. Direct dialling is available to 190 countries for a flat rate of $9.50 U.S. a minute, with operator-assisted calls to the rest.

Skyphone predicts that soon passengers will be able to receive incoming calls or facsimiles while flying or even make use of their own portable telephones. British Telecom, in conjunction with its partners in Norway and Singapore, is planning to offer the Skyphone service to the world's airlines later this year.

Recently, Teleglobe Canada announced that, in conjunction with three other partners, it will be offering satellite service, via INMARSAT, to the

world's airlines. This service will compete with British Telecom's Skyphone service. Teleglobe's partners are the Société internationale de télécommunications aéronautiques (SITA), OTC Limited of Australia and France Telecom. The service to be offered will be in-flight telephony worldwide, and will eventually include such services as facsimile and personal computer access to data bases and electronic mail networks. The service will also include air traffic control communications, airline operational and administrative information, and generally improved communications.

As part of the agreement, Teleglobe is investing $36 million to add new facilities to existing earth stations at Weir, Québec and Lake Cowichan, British Columbia. Teleglobe estimates that the market for aeronautical communications services will be more than $1 billion by the year 2000.

PART III - SOCIAL AND ECONOMIC IMPORTANCE OF MOBILE COMMUNICATIONS

11.0 SOCIAL AND ECONOMIC IMPORTANCE OF MOBILE COMMUNICATIONS

North American society is highly mobile and is characterized by:

- long commuting times between home and work in metropolitan areas;
- a large amount of inter-city highway travel;
- a high degree of trucks to transport goods;
- a well developed public service delivery network that utilizes trucks and cars; and,
- an elaborate system of providing commercial services to homes and offices.

Mobile communications can be viewed as a technological response to this service-oriented, mobile society. Mobile communications facilitates the exchange of information between people who work out of vehicles and their co-workers, supervisors, managers, or customers who are based at fixed sites or are themselves on the move.

The primary economic benefits are realized by the ability to achieve productivity improvements (e.g., an organization's ability to service the same number of customers with fewer vehicles and/or personnel). These benefits are essentially private benefits in that they accrue to organizations employing the devices. Widespread deployment also leads to social benefits and costs, which accrue to society in general. These benefits are derived from the potential for faster response time, especially in emergency situations such as accidents, crimes, fires or illness.

In addition, there are a number of macro benefits that are achieved. Examples of these are direct industrial benefits, research and development, substitution of communications for transportation, increased energy efficiency in the transportation sector resulting in the displacement of oil imports, and productivity gains in the service sector. Although recognizing these benefits make a positive contribution to our

society, we have restricted the scope of our investigation in this Section to the impacts noted in the previous paragraph, as we were requested to focus on the users of land mobile communications.

The main types of benefits that can be achieved from mobile communications can be categorized as follows:

- improved productivity. In the private sector, this leads to increased profitability and/or competitiveness. In the public sector, it leads to lower costs required to provide a given level of service;
- improved safety;
- improved response capability and improved coordination in emergencies;
- expansion of communications to areas previously unserved;
- improved transmission quality for remote communications; and,
- improved overall communications infrastructure, allowing more extensive coverage of the populated areas.

The social and economic impacts of mobile communications technologies presented in the previous sections are discussed below. The information used in the discussion was excerpted from information obtained through the literature search and through interviews with both users and service suppliers.

11.1 Paging

Paging devices are used by individuals to facilitate dynamic routing based on information received via the page. For traditional tone and numeric pagers, proximity to a telephone is essential to obtain information regarding the page. For voice and alphanumeric pagers, the reason for the page is directly transmitted to the person carrying the pager.

Pager users are typically people who must be alerted when an event occurs, so that their sequence of activities can be changed. Illustrations of users include physicians, service people, sales people, real estate agents, gardeners and landscapers, motion picture crews and trade show exhibitors/organizations. Although used much less frequently, in part because of their greater cost, are alphanumeric pagers whose users include stockbrokers and their clients, lawyers, trucking firms and delivery companies.

The major disadvantage of a pager is the inability to immediately respond to the page, except by finding a telephone. One way paging systems are inappropriate for police, fire and ambulance services where prompt confirmation of receipt and explanation of the message is required. In addition, taxis and dial-a-bus services require verification.

The benefits are largely private, although some social benefit is derived from, for example, a medical specialist being on-call to meet certain types of emergencies. Another illustration is the Canadian Radio Common Carriers Association (CRCCA) who are sponsoring a service, LifePage, in which outpatients registered for transplants receive complimentary pagers through their transplant coordinators.

11.2 Mobile Radio

Mobile radio is ideally suited to transmit short messages to dispatch vehicles and taxis, aid emergency services, and to direct field operations and personnel. MRS use is predominately concentrated in organizations involved in emergency situations (i.e., medical, government, and police) or organizations that need to respond quickly to customer demands (i.e., transportation/distribution, repair/service).

Previous studies have found that MRS for dispatch purposes resulted in an increased organizational capability for assigning personnel and material, more intensive and effective servicing of existing customers, and an

expansion of the number of customers that could be served within a given geographic area. Some smaller firms used the mobile system to centralize their technical resources by keeping specialists at the home base, thus increasing their productivity. Both field workers and supervisors/managers agreed that dispatch services provide greater control over, and support for, field personnel.

For MRS users, the economic benefits through productivity improvement are substantial, as is indicated by the number of organizations that have incorporated it into their operations. In addition, there are substantial social benefits in aiding emergency services, in that dynamic routing will result in reduced property loss, saved lives and/or reduced severity of injuries. Certainly, productivity improvements will result in cost reductions for providing the equivalent level of service, and the reduction in fuel consumption.

The system has drawbacks in terms of privacy, and contention for available airtime. Essentially, all individuals on the same private or shared system are connected to a "party line".

11.3 Mobile Telephone

The discussion on MTS relates primarily to the impacts associated with the rapid penetration of cellular telephone (CTS). CTS has in the last four years, had a tremendous impact on business and the travelling public. The number of units in major cities testifies to their value for business applications. CTS makes travelling time productive, but it also provides a capability for information on emergency situations to be much more quickly communicated to the appropriate authorities. The primary benefits of CTS to users are in:

- reducing "shadow" time, i.e., using what was unproductive time (stuck in traffic, telephone tag) productively. We were advised

that a study undertaken by AT&T estimated the average time saved at approximately 4 hours per week; and,

- providing quick response to callers/customers. For example, being able to provide a quick response to a customer while away from the office gives a CTS user a distinct advantage. Being able to reconfirm appointments or dynamically reschedule appointments because of traffic delays is also viewed as being advantageous.

One of the chief problems, particularly for larger companies, is quantifying the benefits to be obtained in using CTS. The benefit of increased profits derived from increased sales and sales costs, resulting from CTS usage is much more difficult to quantify than the bill from the cellular carrier stating that the monthly cost of CTS was a set amount. Nevertheless, there is a growing segment of the business community that views CTS as having positive utility.

With the introduction of CTS in automobiles, there was considerable concern that there would be negative safety aspects associated with usage. Two studies undertaken by AT&T in conjunction with the American Automobile Association (AAA), and by the California Highway Patrol have addressed this concern. The AT&T study which surveyed cellular and non-cellular (members of the AAA) users in the Baltimore/Washington area, found that drivers with CTS drove twice as many miles as non-users, and that the accident rate of CTS users was about 75% of non-users. This study, which was based on self-reported data, also found that the accident rate for CTS users dropped from 8.2% per year prior to installation, to 6.6% per year after installation. The study by the California Highway Patrol stated "To the extent that such calls do reduce anxiety, they promote safety by making the driver less likely to speed or drive unsafely to make up for lost time."

Both cellular carriers in Canada are stressing safety and recommending hands-free speakerphones and speed dialing. One of Cantel's instructions

for new users is entitled "Hands On! For Safety", and states that "Cellular safety means safe driving first!"

From a positive safety perspective, CTS is making a number of contributions that relate to public safety:

- **emergency uses** - both cellular carriers provide 9-1-1 emergency assistance service at no cost to their subscribers. Figures from a June 1987 article, stated that 1500 Cantel users were reporting emergency situations monthly, of which 700 were in Toronto. The preponderance of calls related to fires, accidents, reckless drivers, etc., and very few to reporting crimes. (This experience is very similar to the U.S. experience.) No current Canadian figures were available, although considerable growth in the number of calls would have no doubt taken place. Exhibit 11.1 is a letter from the Canadian Association of Chiefs of Police to Cantel subscribers encouraging them to use 9-1-1 to report serious emergencies and hazardous situations;

- **traffic advisories** - in conjunction with radio stations, traffic information is made available through CTS users calling in traffic conditions. CTS users are located over the entire road network, and can provide details on road conditions because of their direct involvement;

- **personal security** - provides a rapid way to obtain assistance in the event of a vehicle breakdown or other emergency. As well, for non-CTS users, solar-powered cellular telephones are currently being tested on Hwy 417 between Ottawa and Montreal for public usage;

- **stress reduction** - relates to the ability to make "late arrival" calls while stuck in traffic;

EXHIBIT 11.1: LETTER ENCOURAGING 9-1-1 CELLULAR USAGE

Canadian Association of Chiefs of Police | **l'Association canadienne des Chefs de Police**

Tower B, Place de Ville, Suite 1908
112 Kent St., Ottawa, Ontario, K1P 5P2
(613) 233-1106

Dear Cantel subscriber:

As a cellular user, you can report an incident in a fraction of the time it would take an average motorist to do so. Your timely call to 9-1-1 can help us respond more quickly to serious emergencies and hazardous situations.

The Canadian Association of Chiefs of Police encourages you to carefully read the enclosed 9-1-1 brochure for suggestions on how to report emergencies using your cellular phone. 9-1-1 is reserved in your area for situations in which human life is in danger and police, fire or medical assistance is needed quickly. There is no cellular usage charge for calling 9-1-1.

Please remember that your concentration on driving must always be your first priority. Make calls only when safe to do so and never try to apprehend an erratic driver or place yourself in jeopardy.

We encourage you to drive safely and courteously and to join the ranks of Cellular Samaritans who are making a valuable contribution to the safety of our streets and highways.

Sincerely,

R.J. Stewart
Chief Constable

- alertness aid - helps in fighting boredom; and,

- additional communications links - can be used in emergencies to join doctors, nurses, firemen and police. Both voice and data communications can be made. For example, CTS has been used effectively in hostage takings, and can be used by firemen to interrogate a remote data base on hazardous substances. Further, links between ambulances and hospitals have been used for transmitting information from a portable cardiograph.

CTS is also being used by disabled people to maintain 24-hour emergency communications.

11.4 Mobile Satellite

As noted in Section 6.0, mobile satellite services have made a contribution in the trucking industry. In trucking, the benefits of using MSS are to:

- help keep drivers driving without wasting valuable time tracking down payphones or charging long-distance phone bills while waiting for an available dispatcher;

- improve customer service through online tracking reports for just-in-time delivery;

- avoid costly delays when equipment breaks down or changes occur in the routing; and,

- control fleet resources by sending and receiving voice and data messages, allocating the right number of operators to vehicles, and scheduling maintenance stops.

Frederick Transport Ltd. of Dundas, Ontario, which is participating with TMI in the development of the Road KIT system, has equipped 250 of its 600 trucks with Geostar terminals. Frederick estimates that they average 500 extra miles per truck per month without incurring more driver hours. The payback for the system was 14 to 16 months, largely because of the requirements dictated by just-in-time automobile parts haulage. It is noted that in their cost justification for acquiring the Geostar system, it was estimated that drivers would save 30 to 40 minutes in phone calls per day, whereas in fact, experience found it to be 45 to 60 minutes per day.

The drivers have also used the system for emergency distress calls. The dispatcher knows exactly where the truck is, and can therefore telephone a service centre in the vicinity to request assistance. It is planned that the additional features of MSS (see Section 6.0), will be introduced next year.

TMI estimates that time savings alone from the installation of Road KIT could mean $0.07 to 0.12 per kilometre to each driver and vehicle.

The application of MSS in other areas is planned in the next few years. At this time, there has been little experience with the technology to provide specific benefits. As a result, the interested reader is referred to the MSAT economic and social impact studies.

However, one application that is currently being pilot tested is mobile communications for air ambulance services. The Ontario Air Ambulance Service, operated by the Ontario Ministry of Health, is used to bring people from Northern Ontario communities to the larger medical centres in Southern Ontario. A TMI voice service using INMARSAT has been tested, and the Ontario Air Ambulance Service reports a great deal of satisfaction with it. The use of satellite technology has allowed the service to achieve quality voice contact in northern areas at altitudes below 30,000 feet (which had been a problem with previous technology). An unintended

but highly beneficial consequence of satellite voice communication, has been the capability to establish "normal" voice communication between the paramedic attendant on the air ambulance in flight and medical personnel on the ground. By "normal", we mean a conversation style similar to using telephone land lines. Instead of the limitations imposed by a simplex radio system, all actors can communicate in a natural fashion. This is especially advantageous for ground based medical practitioners not comfortable or familiar with one-way simplex radio communication. These people had experienced a great deal of frustration with the older technology and reportedly feel that they can perform their roles more effectively using the satellite link.

Certainly, one of the key benefits to be obtained from MSS is communications to remote locations. The potential for use in emergencies and by emergency services is a major social benefit to be obtained in MSS deployment.

11.5 Mobile Data

As noted in Section 7.0, many of the social and economic impacts of mobile data applications have been discussed in the foregoing sections. They have application in a variety of organizations resulting in benefits to the organizations themselves and to the public. In many cases, data applications are a direct substitute or complement for previous voice applications. Illustrations are taxi and courier dispatch, and police communications, etc. In these cases, the overall system cost has been found to be less expensive, and the activity requested more accurately undertaken.

The implications of Mobitex and MobiData are unknown at present as they are still in their infancy, and therefore, we are unable to comment further at this time.

11.6 Survey Results

The cellular and mobile satellite surveys confirmed the above conclusions regarding the social and economic benefits of mobile communications technology. All persons contacted for the cellular market survey who were users of cellular telephones, felt that the equipment had made a direct contribution to personal and company productivity. The same point can be made for those users who employed pagers in their operations, as the capacity to achieve communication quickly with desired personnel constitutes increased productivity.

Many of the companies contacted for the investigation of potential satellite use were able to identify safety functions served by cellular telephones and mobile radios. In some cases (primarily the gas/oil pipeline transmission companies), the radio transmission systems were in fact the backbone of the safety system. These organizations were similar to the cellular survey respondents in their view that mobile communications was a fundamental aspect of smooth day-to-day operation, and that the availability of the technology has become a requirement for productivity. Large companies will consider a new technology, such as satellite communications, when it fits into day-to-day operations and it becomes a requirement for productivity.

The social benefits of mobile communication technology are most apparent when emergency communications are considered. Certainly, the RCMP view the capacity to ensure reliable and fast voice communication in remote northern areas as a necessary condition for the provision of a proper police service in those areas. A similar sentiment is expressed by the OPP who feel their new province-wide MRS system will greatly enhance their ability to respond to community needs.

PART IV - CONCLUSIONS

12.0 CONCLUSIONS

This section provides conclusions based on the investigation and analyses undertaken in this report. The information contained in the report was obtained from literature searches and personal interviews with service suppliers. This information was supplemented by two small surveys. The conclusions, and suggestions where DOC might be of assistance, are given below:

12.1 Study Conclusions

Our conclusions are as follows:

- the general level of satisfaction with mobile communications is high, and the users who were contacted in the two surveys, could not identify any organizational functions that required mobile communications that were not already met by existing or proposed systems. Some suggestions on enhancements to the services were noted and they have been provided in section 12.2;

- the bulk of mobile communications is voice communications, and is expected to remain so for the foreseeable future. CTS is the major growth area and it is almost entirely voice. A number of other areas, including pagers and MSS, have growing data components but have not achieved the level of CTS growth. It is noted that some of the services (e.g., CTS) will migrate from analog to digital in the next few years;

- at present, the mobile communications services are meeting specific market needs, and there is not much overlap or "cannibalism" taking place among the services. However, there will be considerable overlap in a few years, as each technology attempts to penetrate new markets;

- the pager and mobile radio (MRS) markets, which can be considered to be reasonably mature, are still satisfying particular market needs, and are expected to continue to grow in the next 5 to 10 years;

- cellular telephone service (CTS) has grown rapidly since its introduction, and is expected to continue its growth in the foreseeable future. The competitiveness created by the Canadian duopoly appears to be working well, as each firm must match the other in terms of innovations, features and coverage to remain competitive.

- in the mobile satellite service (MSS) area, trucking is the first significant market identified for mobile satellite communications. There are several companies that are currently offering services, which will make it difficult for TMI when it enters the market. The growth of cellular has also encroached on what was the potential market for mobile satellite communications. Within the trucking industry, cellular usage is expected to increase as the cellular network expands, particularly as cost containment is an important consideration. From the small user survey conducted as part of this study, there is considerable interest for MSS, both voice and data, in remote areas;

- personal communications will be tested this summer when Telepoint is introduced in the U.K. market. Both Canadian cellular carriers stated that they are considering Telepoint, but have no immediate plans for implementation, as they are currently monitoring the situation. Telepoint is seen as initially a business-related product, which will subsequently become a consumer product. In Canada, our limited survey of businesses did not find much interest in using Telepoint in their operations. There are several differences between the U.K. situation and the Canadian one: first, CTS is considerably more expensive in the U.K. than in

Canada, and second, the cost of payphone usage is time metered in the U.K. Without extensive market research of businesses and consumers, it is impossible to say if Telepoint would be successful in Canada, and if so, what type of strategy should be used to enter the market;

- in July 1989, two public mobile data services (MDS's), Mobitex and MobiData, are being introduced in Canada. These new services have the potential to open up new applications, as well as to possibly penetrate to some extent the private MRS dispatch market; and,

- mobile communications are contributing to the efficiency of businesses and other organizations through productivity improvements. In addition, mobile communications are providing a substantial contribution in social benefits to the users and to society in general.

12.2 Suggested Improvements

A number of suggested improvements were provided in the interviews. They have been classified below into technology and regulatory related.

12.2.1 Technology

A major concern to the cellular carriers is the need to put up towers. The carriers are experiencing serious problems with municipalities and building owners in finding tower locations. These problems would be mitigated if the towers were not "big, massive and ugly". The problems have become particularly acute in urban areas where cell size must be reduced, and as the cell size reduces, antennas must be more accurately placed. It was suggested that if the antennas could be designed to be more aesthetic, there would be less problems in obtaining appropriate sites.

In addition, there is a distinct need to include voice response/ recognition capability with cellular phones. Among other things, this will contribute substantially to cellular telephone operation and vehicle safety.

The Ontario Air Ambulance Service requested that a Loran-C transmitter be located in the north, to aid in navigation.

12.2.2 Regulatory

The CTS suppliers are running out of spectrum in the large urban areas, and would like the full 832 cellular channels made available. This requirement will become urgent once digital is introduced.

Telephone headsets are not currently allowed by vehicle regulation. However, a headset that doesn't impede traffic noise would be a welcome addition as it would allow "hands free" operation.

The railway companies requested that for security reasons, they be given protected VHF channels for their ATCS installations.

GLOSSARY

AGT - Alberta Government Telephones

AMSC - American Mobile Satellite Consortium

ATCS - Advanced Train Control System

CB Radio - Citizen's Band Radio

CGE - Canadian General Electric

CGRS - Canadian Coast Guard Radio Station

CRC - Canadian Research Centre

CRCCA - Canadian Radio Communications Carriers Association

CT2 - United Kingdom's Digital Cordless Telephone

CTS - Cellular Telephone Services

DECT - Digital European Cordless Telephone

DOC - Department of Communications (Canada)

DTI - Department of Trade and Industry (United Kingdom)

FCC - Federal Communications Commission (United States)

FGMDSS - Future Global Maritime Distress and Safety System

HF - High Frequency

INMARSAT - International Maritime Satellite Service

ISTC - Industry, Science and Technology Canada

ITU - International Telecommunications Union

LCD - Liquid Crystal Display

MARECS - Maritime Communications Satellite

MARISAT - Maritime Satellite

MDS - Mobile Data Services

GLOSSARY (continued)

MF - Medium Frequency

Mobidata - Mobile Public Data Service (Bell Cellular and Motorola)

Mobitex - Mobile Public Data Service (Cantel)

MRS - Mobile Radio Services

MSAT - Mobile Satellite

MSS - Mobile Satellite Services

MTS - Mobile Telephone Services

NCS - Network Coordination Stations

NRC - National Research Council (Canada)

PABX - Private Automated Branch Exchange

PIN - Personal Identification Number

PSTN - Public Switched Telephone Network

RCC - Radio Common Carriers

RCMP - Royal Canadian Mounted Police

RDSS - Radio Determination Satellite System

SHARP - Stationary High Altitude Relay Platform

SITA - Société International de Télécommunications Aéronautiques

SOLAS - Safety of Life at Sea

Telcos - Telephone Companies

TMI - Telesat Mobile Inc.

VHF - Very High Frequency

VLSI - Very Large Scale Integration

APPENDIX A: REFERENCES

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APPENDIX B: QUESTIONNAIRE

March 1989

MOBILE COMMUNICATIONS USER REQUIREMENTS STUDY QUESTIONNAIRE

1.0 CONTACT INFORMATION

Organization: _____

Business Mission _____

Contact Name: _____

Title: _____

Address: _____

_____

Telephone Number: ( ) _____

Size of Organization: Sales: ____ Employees: ____

Geographic Areas of Business: _____

_____

_____

Interviewer: _____

Date: _____

Questionnaire Parts Completed (Please):

Part 1 ____
Part 2 ____
Part 3 ____
Part 4 ____

2.0 GENERAL OVERVIEW OF MOBILE COMMUNICATIONS

2.1 Current Use of Mobile Communications

Would you please describe your current use of mobile communications within your organization, both voice and data?

2.1.1 Equipment:

	No. of Units Voice	Data	Comments/No. of Units
Pagers	____	____	Tone___Voice___Display___
Mobile Radio (MRS)	____	____	Trunked___Regular___
Traditional Mobile Telephone	____	____	_____
Cellular Telephone	____	____	_____
Other _____	____	____	_____
_____	____	____	_____
_____	____	____	_____

2.1.2 Description of Current Applications

Current Application 1.

How is the mobile communications equipment above used in your operations?

_____
_____
_____
_____
_____
_____
_____

Why is it used (including any economic benefits)? Are there any social benefits associated with its use?

_____
_____
_____
_____
_____
_____
_____
_____

Current Application 2.

How is the mobile communications equipment above used in your operations?

Why is it used (including any economic benefits)? Are there any social benefits associated with its use?

Current Application 3.

How is the mobile communications equipment above used in your operations?

Why is it used (including any economic benefits)? Are there any social benefits associated with its use?

Current Application 4.

How is the mobile communications equipment above used in your operations?

Why is it used (including any economic benefits)? Are there any social benefits associated with its use?

2.1.3 Problems with current technology/services?

Are there any problems that restrict or otherwise impede your current use of mobile communications? Please provide details or suggestions under the indicated categories.

Size of Equipment: ___

Performance of Equipment: ___

Type/Range of Service: ___

Features (Please Specify): ___

Cost of Equipment: ___

_____

_____

_____

Cost of Service: ___

_____

_____

_____

Other (Please Specify): ___

_____

_____

_____

2.2 Future Use of Mobile Communications

Would you please indicate your anticipated future use of mobile communications, both voice and data, in your organization?

2.2.1 Equipment:

Refer to current usage levels in 2.1 above. Probe any substitution of one technology by another.

A. Forecast for 1995

	1995 No. of Units Voice	Data	Comments/No. of Units
Pagers	____	____	Tone___Voice___Display___
Mobile Radio (MRS)	____	____	Trunked___Regular___
Traditional Mobile Telephone	____	____	_____
Cellular Telephone	____	____	_____
Mobile Satellite (eg., MSAT)	____	____	_____
Other _____	____	____	_____
_____	____	____	_____
_____	____	____	_____

B. Forecast for 2000

	2000 No. of Units Voice	Data	Comments/No. of Units
Pagers	____	____	Tone___Voice___Display___
Mobile Radio (MRS)	____	____	Trunked___Regular___
Traditional Mobile Telephone	____	____	_____
Cellular Telephone	____	____	_____
Mobile Satellite (eg., MSAT)	____	____	_____
Other _____	____	____	_____
_____	____	____	_____
_____	____	____	_____

2.2.2 **Description of Future Applications**

Future Application 1.

How will the mobile communications equipment above be used in your operations? Indicate timeframe of implementation.

_____
_____
_____
_____
_____
_____
_____
_____

Why will it be required (including any economic benefits)? When and how fast will it be introduced? Has a firm decision been made? Are there any social benefits associated with its use?

_____
_____
_____
_____
_____
_____
_____
_____

Future Application 2.

How will the mobile communications equipment above be used in your operations? Indicate timeframe of implementation.

Why will it be required (including any economic benefits)? When and how fast will it be introduced? Has a firm decision been made? Are there any social benefits associated with its use?

Future Application 3.

How will the mobile communications equipment above be used in your operations? Indicate timeframe of implementation.

Why will it be required (including any economic benefits)? When and how fast will it be introduced? Has a firm decision been made? Are there any social benefits associated with its use?

Future Application 4.

How will the mobile communications equipment above be used in your operations? Indicate timeframe of implementation.

Why will it be required (including any economic benefits)? When and how fast will it be introduced? Has a firm decision been made? Are there any social benefits associated with its use?

2.3 Problems with anticipated future technology/services?

Are there any problems that will restrict or otherwise impede your utilization of mobile communications in the future? Please provide details or suggestions for improvements under the indicated categories.

Size of Equipment: ___

Performance of Equipment: ___

Type/Range of Service: ___

Features (Please Specify): ___

Cost of Equipment: ___

Cost of Service: ___

Other (Please Specify): ___

Are there any gaps in the available technology that would be important to your organization's requirements? If yes, please provide details on the requirement and desirable features?

3.0 TRANSPORTATION, EMERGENCY AND REMOTE MARKET

This section is to be completed in cases where the respondent has an involvement in one of the areas defined above. Please note that only certain sections below may be applicable.

3.1 Transportation

There are currently a number of technologies either available or being planned that could possibly assist transportation firms increase the efficiency of their (truck, train, bus) fleets. These include mobile radio, pagers, cellular telephone, and in the near future mobile satellite.

What equipment/services are you currently using? (Extract from Section 2.0 to avoid extensive repetition)

Are you aware of any new equipment/services that can be of assistance? Probe on the appropriate technologies available for the application. Also probe on any choice between voice and data.

What equipment/services are you planning to use? Describe applications and reasons why desirable (economic benefit)? Are there any social benefits associated with its use?

3.2 Emergency

What equipment/services are you currently using? (See Section 2.0)

Are you aware of any new equipment/services that can be of assistance? Probe on the appropriate technologies available for the application. Also probe on any choice between voice and data.

What equipment/services are you planning to use? Describe applications and reasons why desirable (economic benefit)? Are there any social benefits associated with its use?

3.3 Remote Communications

What equipment/services are you currently using? (See Section 2.0)

Are you aware of any new equipment/services that can be of assistance? Probe on the appropriate technologies available for the application. Also probe on any choice between voice and data.

What equipment/services are you planning to use? Describe applications and reasons why desirable (economic benefit)? Are there any social benefits associated with its use?

4.0 CELLULAR MARKET

4.1 Current Usage

Are you currently using cellular telephone service in your business? If Yes, please indicate the total number of units in use within the organization and by each functional area? Where functional breakdown is unavailable, request a percentage breakdown?

	No. of Units
Sales/Marketing	_____
Manufacturing/Production/Transportation	_____
Finance	_____
Human Resources	_____
Senior Management	_____
Other (Please Specify?) _____	_____
Total	_____

What features are you currently using with your cellular telephone service:

	Yes/No?
Message Service	_____
Message Service with Paging	_____
Roaming	_____
Network Services (Busy Transfer, No Answer Transfer, Call Forwarding, Call Waiting, 3-Way Conferencing, Call Restriction, Detailed Billing)	_____
Data Transmission (Facsimile, Microcomputer)	_____
Other Services (Please Specify)	_____

_____
_____
_____
_____
_____

5.2 Future Usage

Please indicate by giving the number of cellular sets, your planned usage for 1995 and 2000, for your overall organization and for each functional area?

	No. of Units 1995	No. of Units 2000
Sales/Marketing	_____	_____
Manufacturing/Production/Transportation	_____	_____
Finance	_____	_____
Human Resources	_____	_____
Senior Management	_____	_____
Other (Please Specify?) _____	_____	_____
Total	_____	_____

In terms of your organization, why are you anticipating the growth in cellular usage noted above?

_____
_____
_____
_____
_____
_____
_____

In terms of cellular service, what assumptions have you included in deriving your forecast?

Continued reduction in equipment cost ____

Reduced "air time" service cost ____

Other (Please specify) _____

Are there any problems that will restrict or otherwise impede your utilization of cellular telephone service in the future? Read headings below. Please provide details or suggestions for improvements under the indicated categories.

Size of Equipment: ___

Performance of Equipment: ___

Type/Range of Service: ___

Features (Please Specify): ___

Cost of Equipment: ___

Cost of Service: ___

Other (Please Specify): ___

Are there any additional service improvements (i.e., features) that you would like to utilize if available?

Yes ____ No ____ If Yes, please elaborate: _____

5.0 PERSONAL COMMUNICATIONS

As a mobile communications user, we would like to ask you a few questions about whether or not you would consider a personal communications device/service which provides, at a lower cost, less functionality than cellular telephone? Read the following.

> One service which is being introduced this year in the United Kingdom will essentially involve the use of cordless phones that can originate calls (but not receive) within 100 metres of receivers located at street corners, train stations, etc. The service, called Telepoint, will allow calls to be received only at the individual's base station which will be located in his/her home or office. The cost of the telephone, which fits in a person's pocket, is estimated to be roughly $300 to $500, with a fixed charge for usage of $40-50/month. The technology used in Telepoint is superior to cordless phones as has solved interference and security problems present with current cordless phones. There is also a plan to have the telephone function as a pager, to alert the person carrying the telephone to call for a message.

Are you currently using any of the following?

Cellular ____ Pager ____ Cordless Telephone ____

Would you consider using this type of service if it were available in Canada?

Yes ____ No ____

If Yes, Why? Probe, if cellular user, for reasons such as price, while if pager user, probe for increased functionality at somewhat lower cost than cellular. If a cordless telephone user, probe for increased usefulness of the telephone.

_____

_____

_____

_____

_____

_____

_____

_____

If No, Why Not? Probe, if cellular user, for reasons such as reduced functionality due to inability to converse while travelling or to receive calls. If pager or cordless telephone user, probe for increased cost.

APPENDIX C: CONTACT LIST

Cellular Survey Contact List

NAME OF COMPANY	ADDRESS	NAME OF CONTACT	POSITION
G.G. Kearney Construction	34 Beverely Ave. Nepean, Ont.	Sherry Kennedy 613-226-7425	Office Administrator
R.J. Nicol	1755 Courtwood Cr., Ottawa, Ont.	Chris Ready 613-225-9041	Purchasing Agent
J.P. Perez	2932 Baseline Rd., Nepean, Ont.	Sheryl Wolff 613-738-9000	Executive Assistant to V.P.
Thomas Assaly	1510 Walkley Rd. Ottawa, Ont.	Linda Assaly 613-731-4002	Coordinator
C.A. Fitzsimmons	265 Carling Ave. Ottawa, Ont	Pat Link 613-232-7185	Executive Assistant
McIntosh Equipment Rentals	3436 Rideau Rd. Ottawa, Ont.	Shawn Brown 613-822-2252	Rental Manager
Van's Mobile Wash	12 Cleopatra St., Ottawa, Ont.	Glen Scanlon 613-225-9533	Office Manager
V.O.N.	5335 Canotek Rd. Gloucester, Ont.	Lorrie Heron 613-749-7557	Assistant Manager
MAG Facilities	1135 Newmarket, Ottawa, Ont.	Michel Methot 613-744-8227	Manager
Ottawa Valley Landscaping	14 Novice Dr. Nepean, Ont.	Henry Mageveau 613-225-7288	Manager
Chemlawn	3244 Hawthorne Rd., Ottawa, Ont.	Bob Ruddock 613-523-8317	Branch Manager
Francis Fuels	508 Gladstone Ave., Ottawa, Ont.	Dave Francis 613-238-4700	Senior Manager
Newell Electric	141 Knoxdale Rd. Nepean, Ont.	Ron Newell 613-224-0663	President
Maitland Ross	181 Eglington Ave. East Toronto, Ont.	Bruce Satmmonds 416-487-3626	Project Manager

Cellular Survey Contact List (continued)

NAME OF COMPANY	ADDRESS	NAME OF CONTACT	POSITION
Konvey	PO Box 520, Milliken, Ont.	Peter Warren 416-298-9106	Purchasing Agent
Ellis-Don	2 Sheppard East Suite 2000 Toronto, Ont.	Carlo Jurizevik 416-226-6202	Purchasing Agent
Royal LePage	33 Younge St. Toronto, Ont.	Phil Bates 613-862-0611	Technical Assistant
Irwin Toys	43 Hannah St. Toronto, Ont.	Louise Deublois 416-533-3521	Assistant Controller
TSB International Inc.	5399 Eglington East, Etobicoke	Debbie Kusturin 416-626-7177	Administrative Assistant
RBC Dominion Securities	PO Box 21, Commerce Crt. E. Toronto, Ont.	Cathy Colebatch 416-864-4184	Telecommuni-cations Analyst
Suter Instruments	201 Sheppard E. Willowdale, Ont.	Bruce Davis 416-225-4994	President
Storwall International	156 Front St. W. Toronto, Ont.	Nancy Steep 416-598-0716	Administrative Assistant
ADANAC	1489 Merivale Rd. Nepean, Ont.	Kevin O'Driscoll 613-225-1424	Manager
Ontario Business Equipment	51 Younge St. Toronto, Ont.	Mr. Feller 416-366-0514	President
Sullivan Landscape	PO Box 1710 Station "R" Toronto, Ont.	Dave Clark 416-475-2100	Accountant
Central Burner Service	151 Turbine Dr. Weston, Ont.	Terry Thistle 416-741-6055	Service Manager
Burns Heating	2700 Dufferin Rd. Toronto, Ont.	Mr. Burns 416-781-5228	President
J.B. Houlden Electrical	31 John St. Weston, Ont.	Natholda Murray 613-241-3813	Office Manager

Cellular Survey Contact List (continued)

NAME OF COMPANY	ADDRESS	NAME OF CONTACT	POSITION
Campbell and Kennedy Electrical	411 Horner Unit 1, Toronto, Ont.	Kelly Hunt 416-252-7703	Office Manager
Weeman General Contracting	222 Gerard East Toronto, Ont.	Mary Cross 416-961-0065	Accounting
Lakeshore Intl. Movers	2770 Sheffield Rd., Ottawa, Ont.	Don McCall 613-741-1800	Manager
Checker Movers	6-645 Belfast Rd. Ottawa, Ont.	Joan Hand 613-235-6683	Office Manager
ALLTRANS	1890 Bantree Rd. Ottawa, Ont.	Mike O'Neil 613-741-9000	Operations Supervisor

Mobile Satellite Survey Contact List

NAME OF COMPANY	ADDRESS	NAME OF CONTACT	POSITION
Ontario Hydro	700 University Ave., Toronto Ont.	Mike Yee 416-592-7928	Telecommunic-ations Engineer
NOVA	9888 Jasper Ave. Calgary, Alberta.	Les Potolicki 403-423-6302	Telecommunic-ations Technician
Western Geophysical	PO Box Station A Calgary, Alberta.	J. Taylor 403-291-8100	Manager
Placer Geo	600-530 8th Ave. S.W., Calgary Alta.	Tony Webb 403-266-4651	Corporate Safety Manager
Trans-Canada Pipelines	PO Box 54 Commerce Crt. W. Toronto, Ont.	Ray Hobson 416-869-2566	Senior Engineer
MTC	1201 Wilson Ave. Downsview, Ont.	G. Kudrewatych 416-235-4827	Analyst
MacMillan - Bloedel		Brent Sauder 604-439-8667	Director Wood Harvesting
Boise - Cascade		F. Ball 807-274-8834	Controller
Mobil	330-5th Ave. S.W. Calgary, Alberta	Mike Warby 403-260-7910	Purchasing Coordinator
Geologic Survey		Bonnie Hrycyk 613-990-1505	Coordinator
Noranda		B. Bradfield 416-982-7111	
Consolidated Bathurst		Bob Pullen 514-875-2160	Manager
RCMP	222 Nepean St. Ottawa, Ont.	T. McDermont 613-998-7338	Data Engineer

Mobile Satellite Survey Contact List (continued)

NAME OF COMPANY	ADDRESS	NAME OF CONTACT	POSITION
Emergency Preparedness Can.	122 Bank St. Ottawa, Ont.	Nick Evanoff 613-991-7005	Coordinator
CN Rail	935 L'Hauderie Montreal, Que.	Fred Marciel 514-399-6983	Analyst
VIA		R.McCaie 514-871-6387	Project Leader
Ontario Provincial Police	2 Golden Gate Crt., Scarborough Ont.	Peter Unger 416-965-6859	Mobile Radio Engineer
Ontario Air Ambulance Services		Hank Brown 416-963-0772	Manager
Greyhound	877 Greyhound Way Calgary, Alta.	Bruce Taylor 403-260-0877	V.P. Labour Relations
Thompson Transport	PO Box 547 St. Thomas, Ont.	K. McGregor 416-283-4020	Manager
CPR*		Henry Kirkhoven 514-395-7229	
Frederick Transport*		Brian Ranger 416-628-4000	
AULT*		Mr. Cook 613-232-4281	
Glengary Transport*		416-736-7383	Manager
ESSO*		J.Kaiser 403-237-2565	
Cominco*		G. Kennedy 604-682-0611	

Mobile Satellite Survey Contact List (continued)

NAME OF COMPANY	ADDRESS	NAME OF CONTACT	POSITION
Ontario Ministry of Energy*		Steven Hobbes 416-323-4246	
Quebec Hydro*		Mrs. Yelle 514-286-4984	
INCO*		Mr. Bingham 416-361-7511	
Westcoast Energy*		Cathy Logan 604-664-5500	

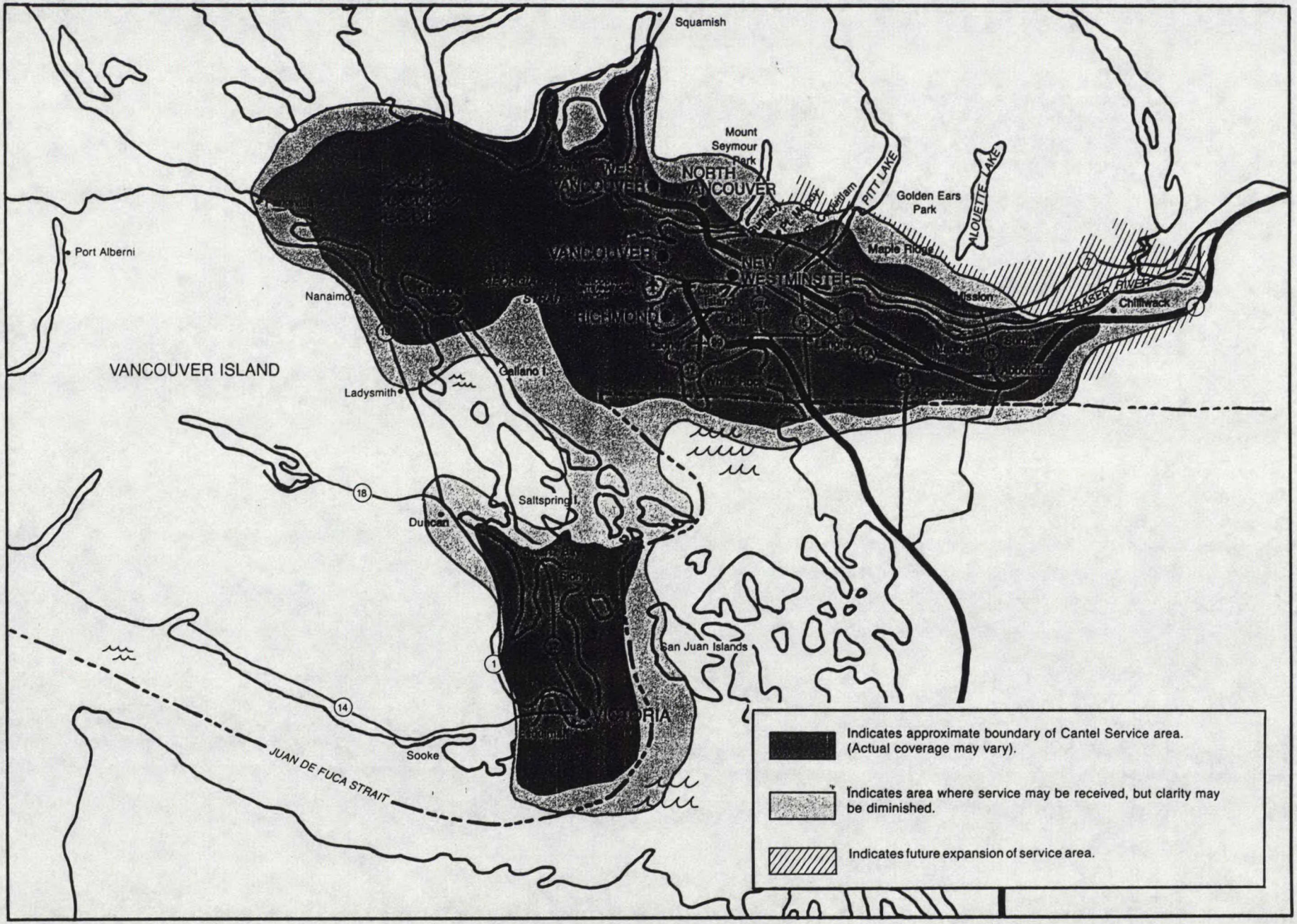
* no responses

Other Contacts

NAME OF COMPANY	ADDRESS	NAME OF CONTACT	POSITION
Ferranti	United Kingdom	Bob Jones 061-683-4691	Phone Zone Consortium
Philips	United Kingdom	M. Bowerman 223-467-422	Marketing Director
Department of Trade and Industry	United Kingdom	Mary Tait 01 215 8147 -and- David Hardin 01 215 8190	
Cantel	40 Eglington Ave. East, Toronto, Ont Ottawa, Ontario	Leonard Katz 416-480-8712 C. Eberts 613-594-8514	Assistant Vice-President Government Accounts Manager
Bell-Cellular	10 Carlson Crt. Rexdale, Ont. Ottawa, Ontario	Charles Brown 416-674-2220 David Gillespie 613-724-9465	Director, Business - Planning
Teleglobe Canada	680 Rue Sherbrooke Ouest, Montreal, Quebec	D. B. Falle 514-289-7272	Manager Private Net - work Services
Nynex	Nynex, New Jersey U.S.A.	G. Brubeck 914-644-6040	

APPENDIX D: CANTEL AND CELLNET CONTOURS

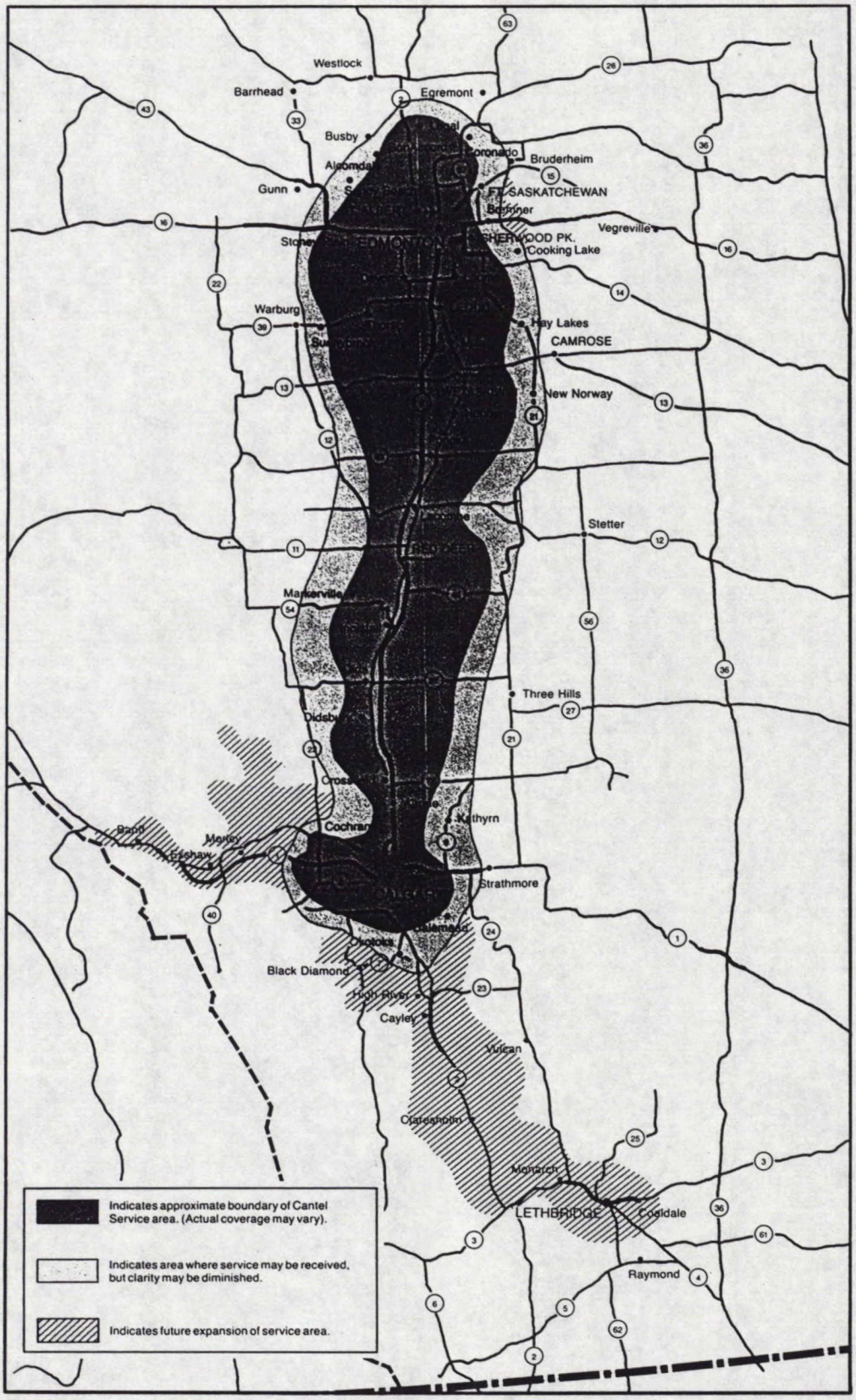
CANTEL® BRITISH COLUMBIA CELLULAR SERVICE AREA



1037-51-03

Effective: Autumn 1988

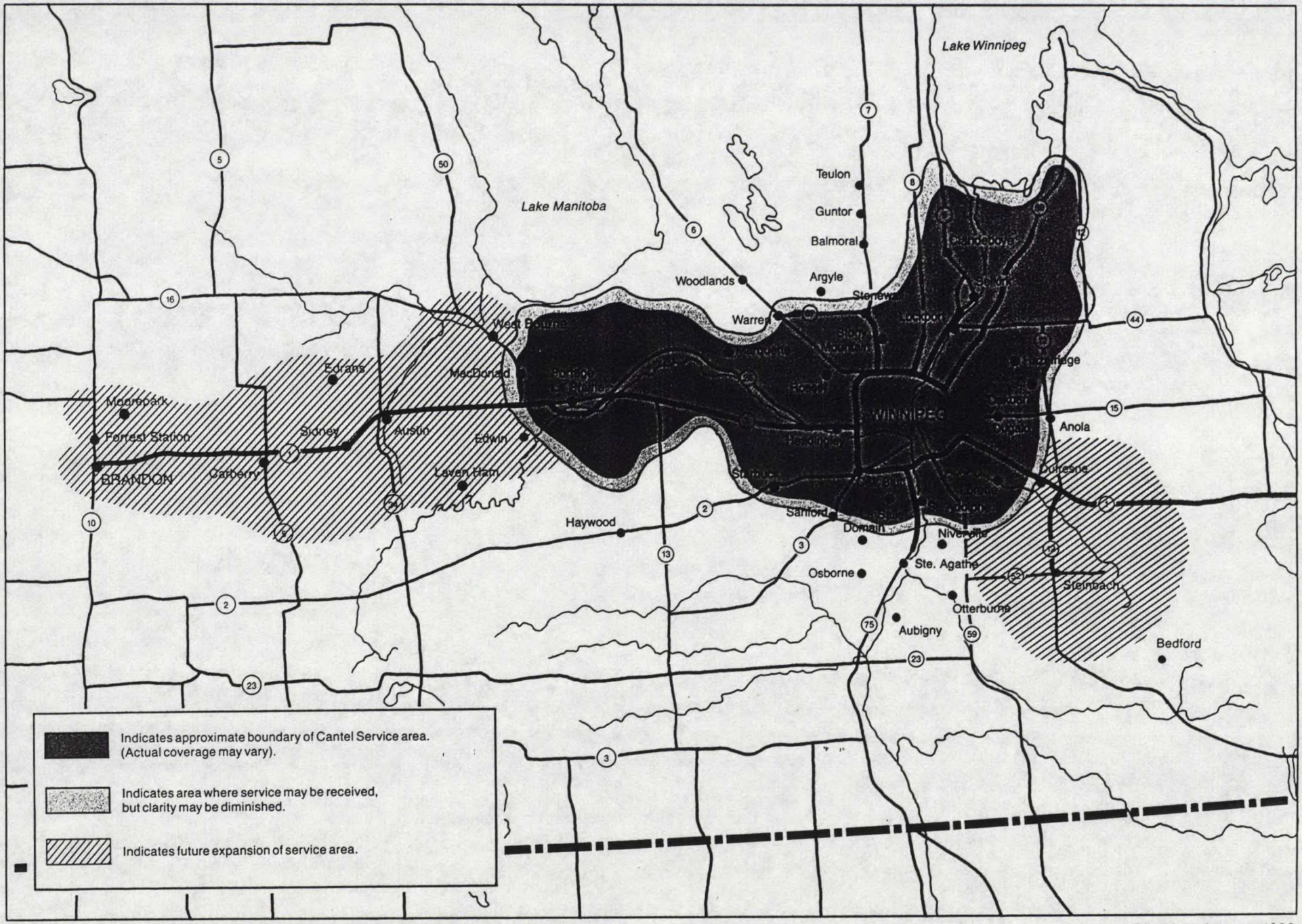
CANTEL ALBERTA CELLULAR SERVICE AREA



1036-51-02

Effective: Autumn 1988

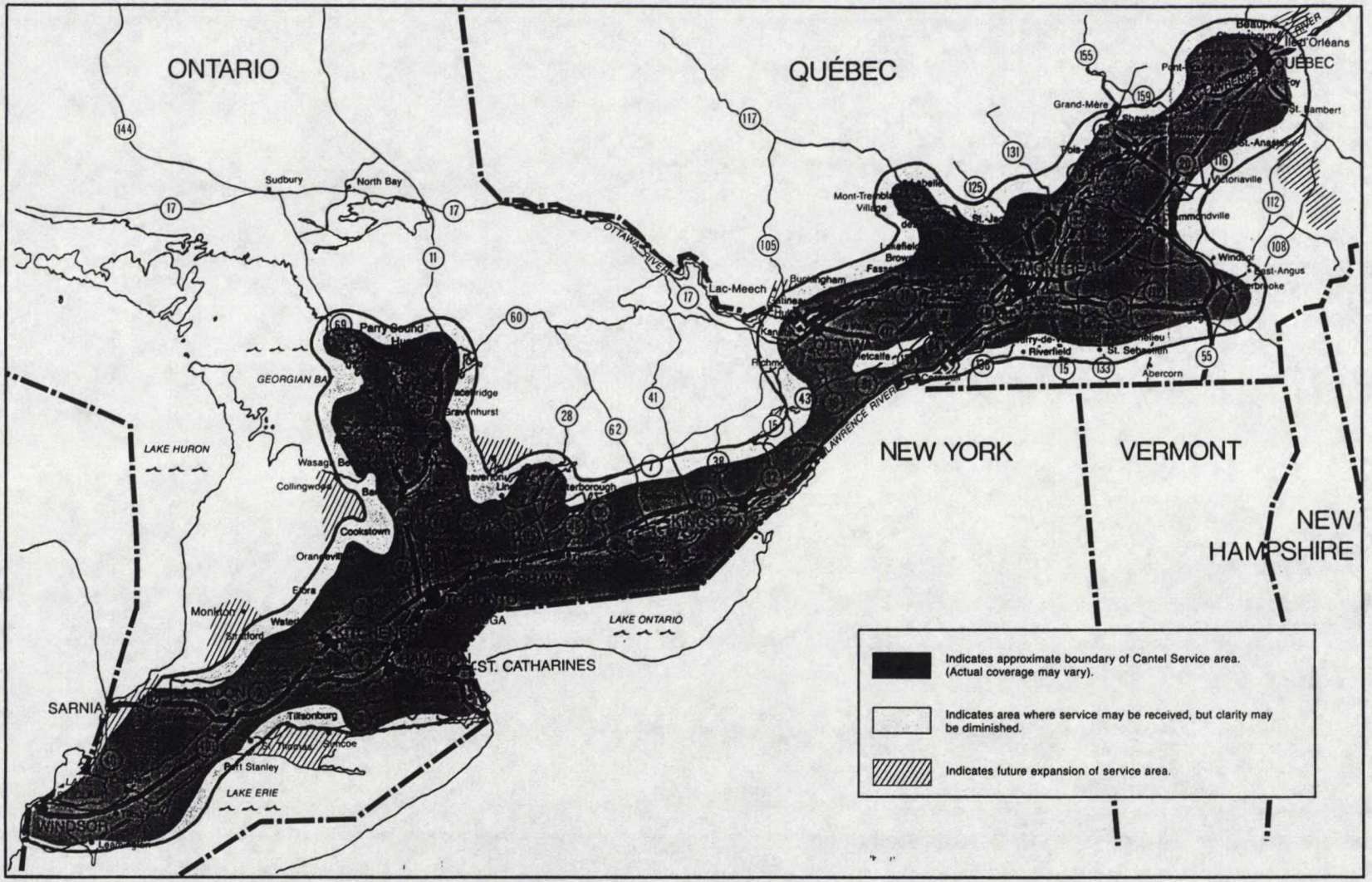
CANTEL® MANITOBA CELLULAR SERVICE AREA



1040-51-02

Effective: Autumn 1988

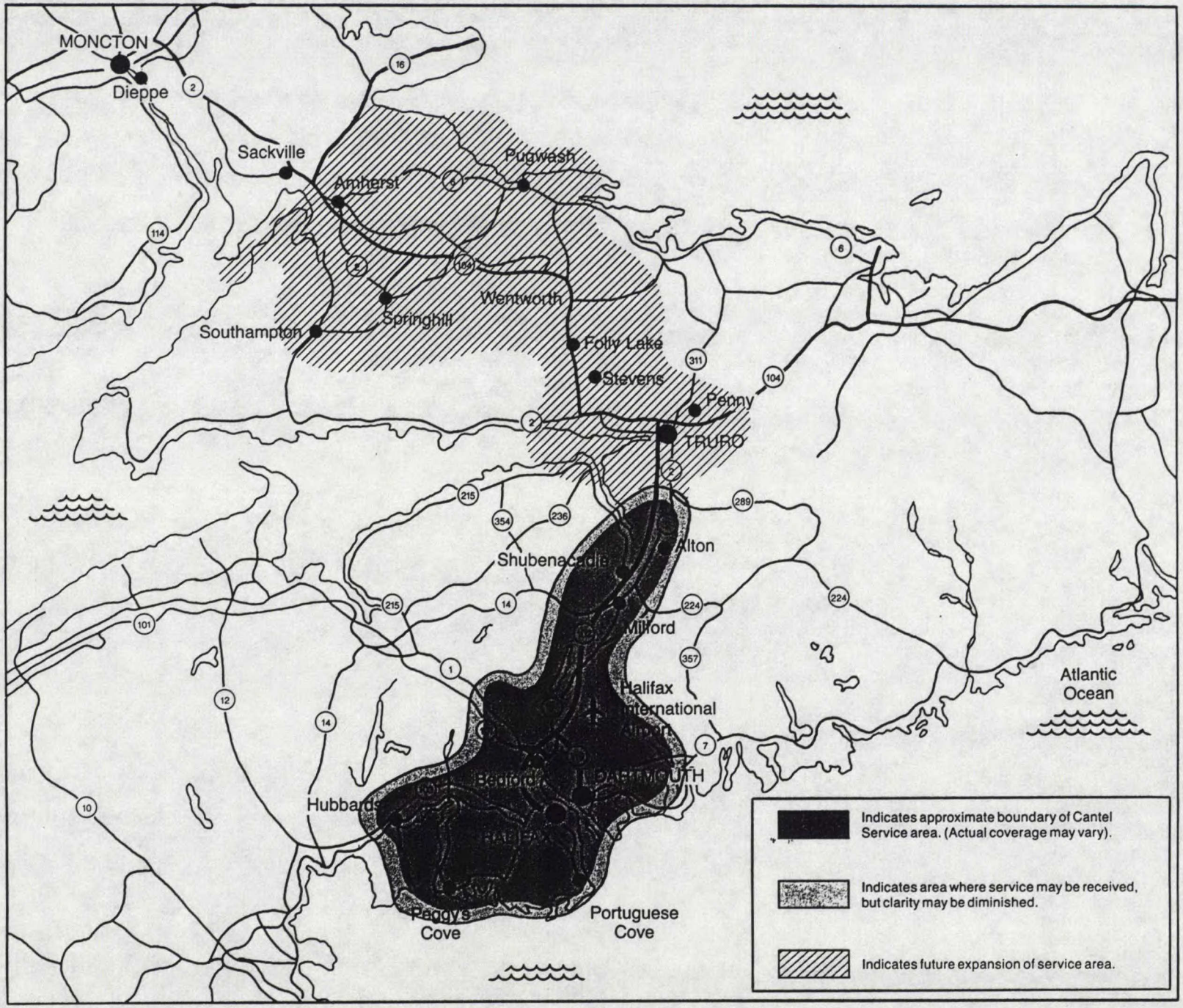
CANTEL® ONTARIO/QUEBEC CELLULAR SERVICE AREA



1038-51-02

Effective: Autumn 1988

CANTEL® NOVA SCOTIA CELLULAR SERVICE AREA

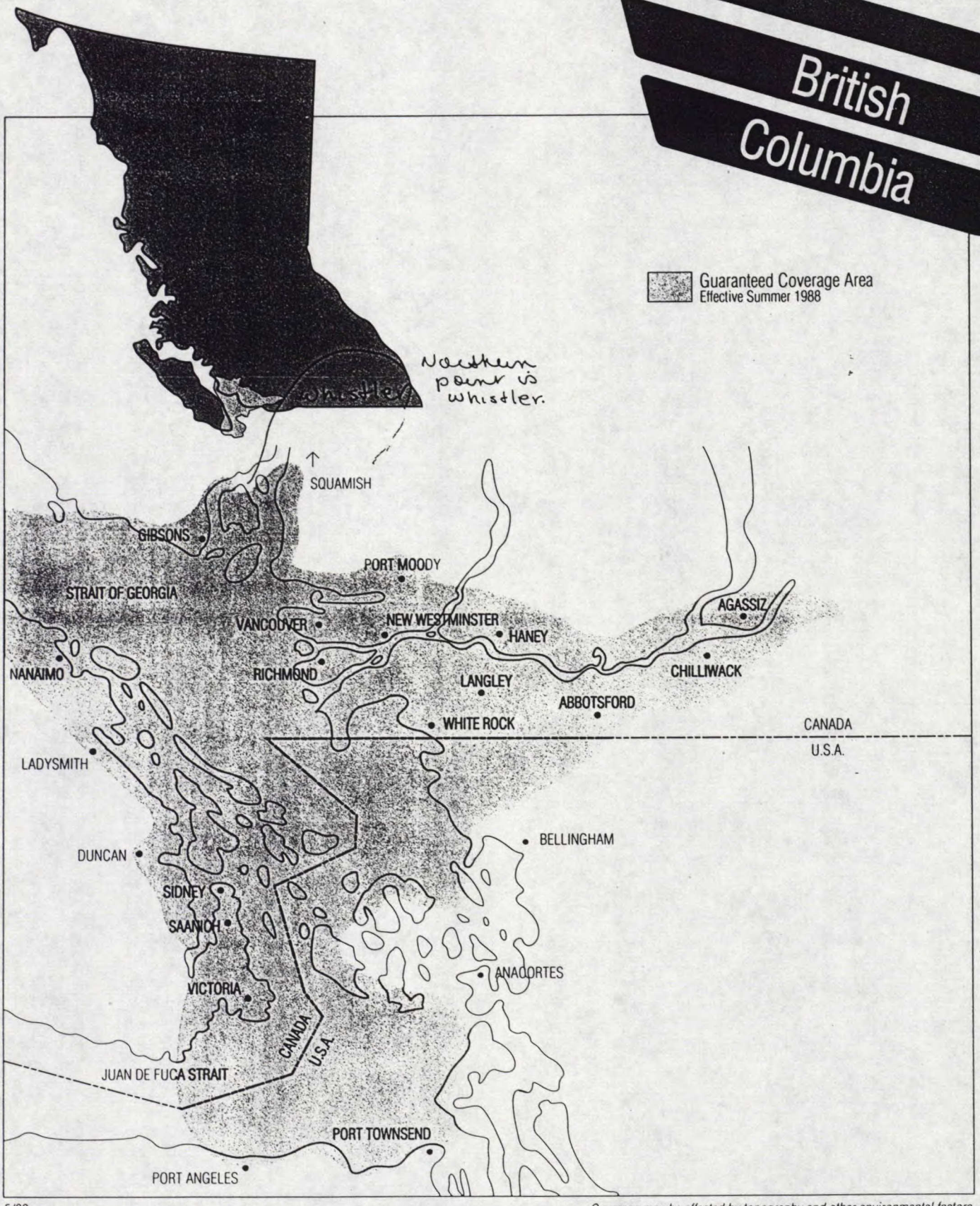


1039-51-02

Effective: Autumn 1988

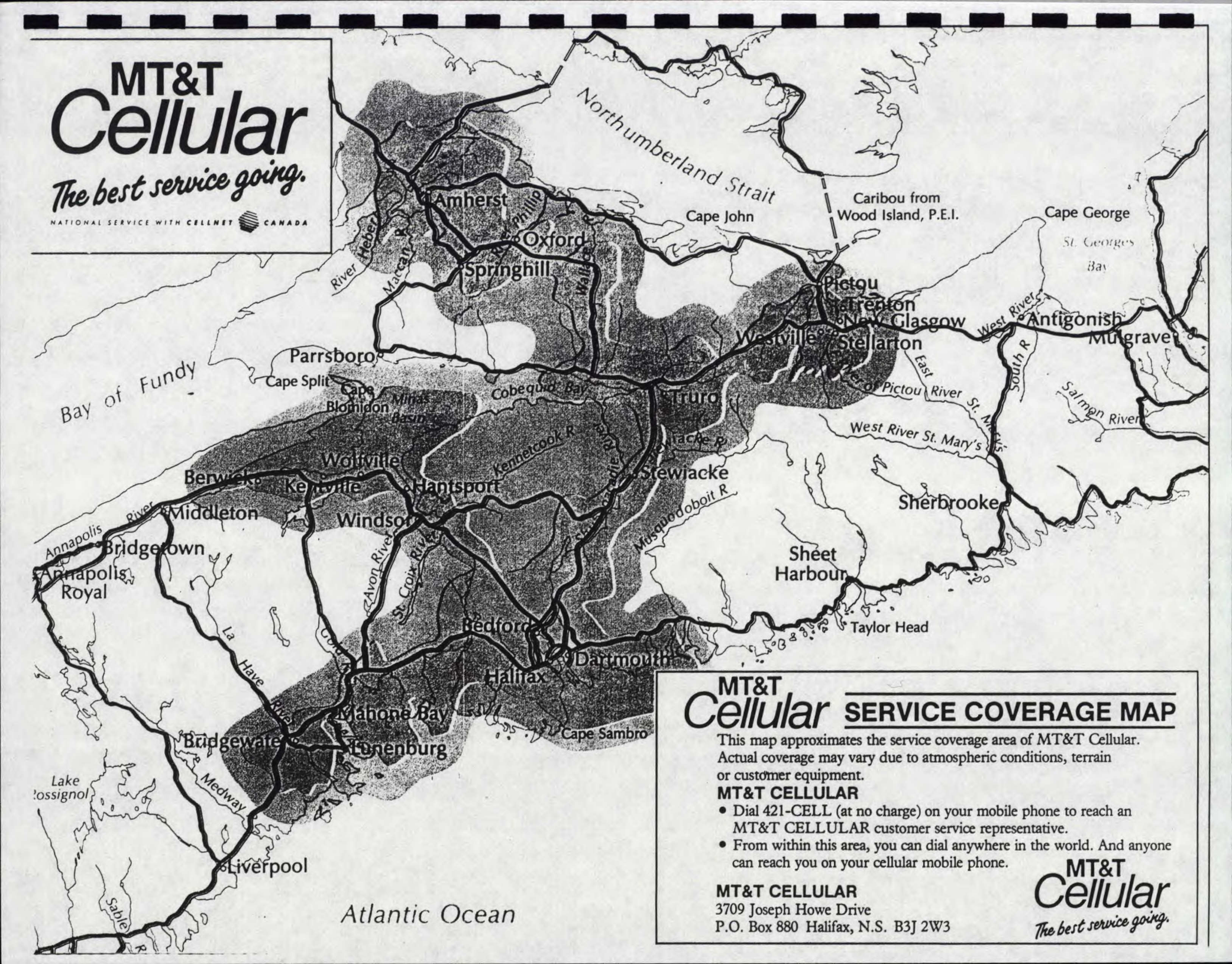
CELLNET CANADA

British Columbia



5/88

Coverage may be affected by topography and other environmental factors.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Caribou from
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Cape John
Cape George
St. Georges
Bay
Amherst
Oxford
Springhill
River Hebert
Maccan R.
Phillip R.
Wallace R.
Pictou
Trenton
New Glasgow
West River
Antigonish
Mulgrave
Westville
Stellarton
Parrsboro
Cape Split
Bay of Fundy
Cape
Blomidon
Minas
Basin
Cobequid Bay
Truro
East
River of Pictou
St. Mary's R.
South R.
Salmon River
West River St. Mary's
Kennetcook R.
Stewiacke R.
Stewiacke
Wolfville
Berwick
Kentville
Hantsport
Middleton
Windsor
Annapolis
River
Annapolis
Royal
Bridgetown
Avon River
St. Croix River
Musquodoboit R.
Sherbrooke
Sheet
Harbour
Taylor Head
Bedford
Dartmouth
Halifax
La Have River
Mahone Bay
Cape Sambro
Bridgewater
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SERVICE COVERAGE MAP
This map approximates the service coverage area of MT&T Cellular.
Actual coverage may vary due to atmospheric conditions, terrain
or customer equipment.
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Manitoba Coverage Area

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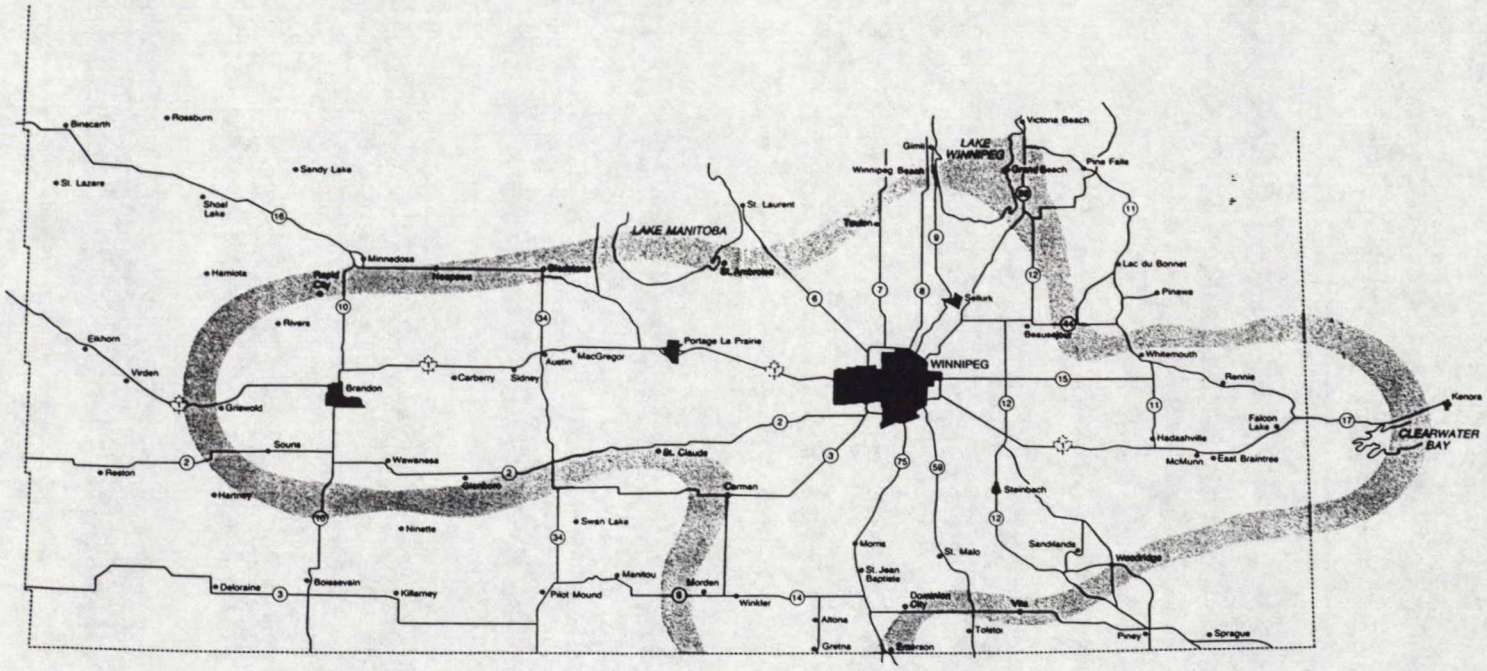


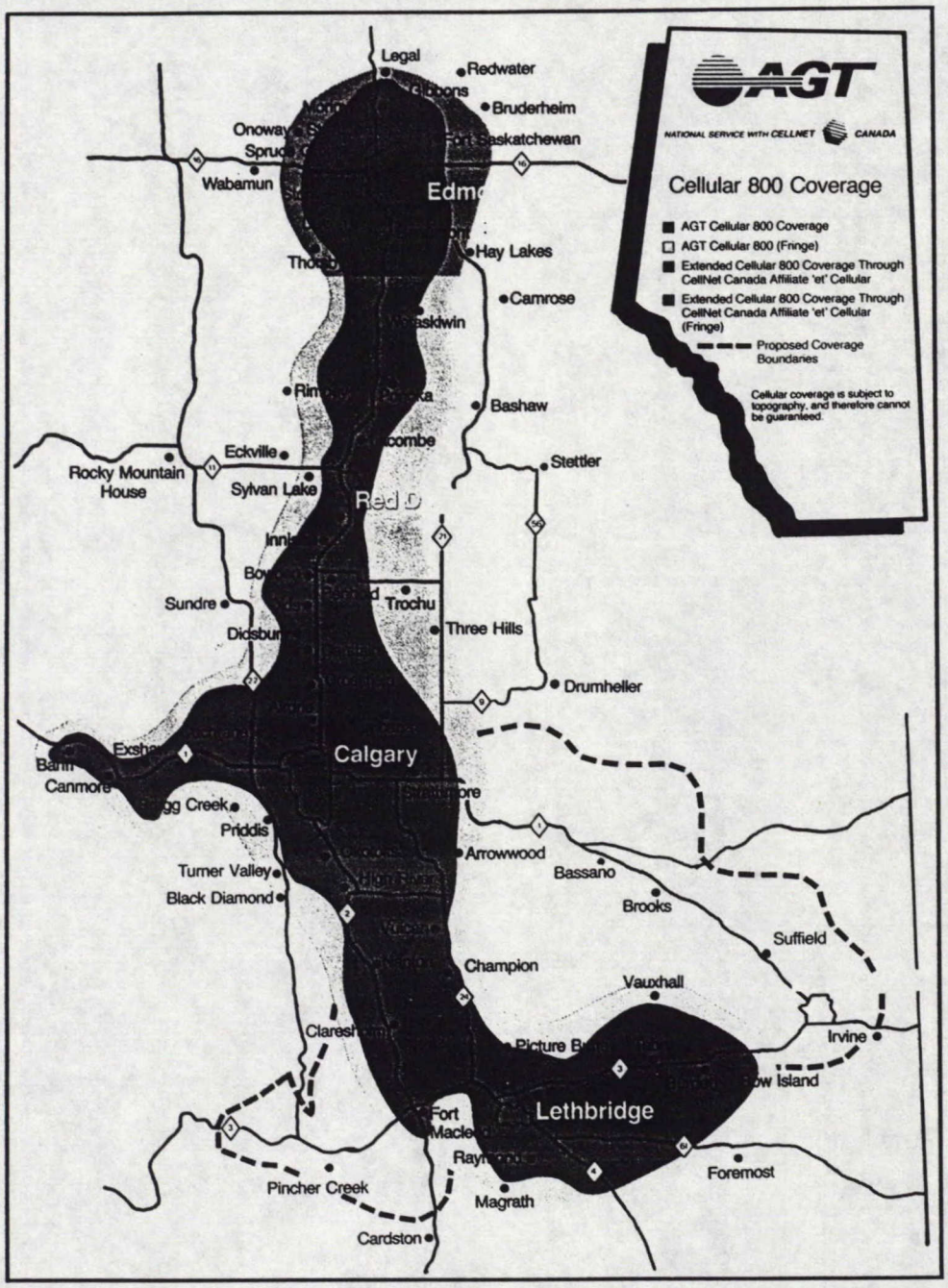
APPROXIMATE MTS CELLULAR COVERAGE

EFFECTIVE DECEMBER 1988

Shaded area indicates our Fringe Coverage Area.

Coverage may vary due to atmospheric conditions, type of phone used and precise user location.

COVERAGE

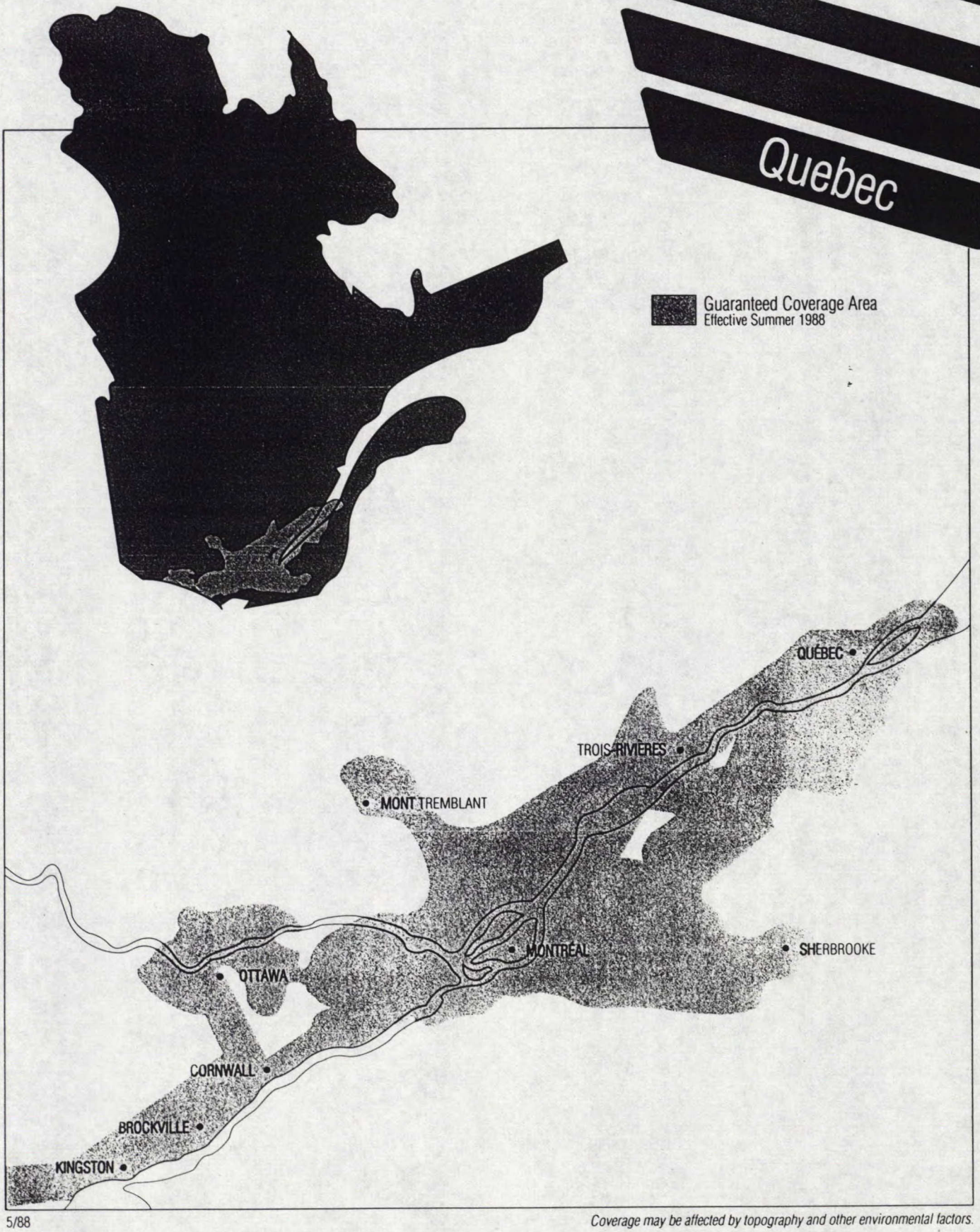


CELLULAR PLUS

AGT

CELLNET CANADA

Quebec



5/88

Coverage may be affected by topography and other environmental factors.

CELLNET CANADA

Ontario

5/88

Coverage may be affected by topography and other environmental factors.

ASSESSMENT OF USER REQUIREMENTS FOR MOBILE COMMUNICATIONS IN CANADA

Goss, Gilroy & Associates Ltd., Ottawa, Canada (613) 230-5577