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**Assessment of User Requirements**

**For Mobile Communications**

**in Canada**

**Executive Summary**



**GOSS, GILROY  
& ASSOCIATES LTD.**

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## EXECUTIVE SUMMARY

Mobile communications in Canada are now an important component of our telecommunications infrastructure. Mobile communications, which provide the capability to stay in touch wherever a person travels, offer businesses an opportunity to increase productivity, and public safety officials with the ability to become more effective and efficient. Various forms of mobile communications have been developed for use in automobiles, ships, airplanes and trains, and for carrying by human beings.

The expansion of socio-economic activity, coupled with technological advances, have contributed to the rapid expansion of mobile communications in Canada and worldwide. 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.

In light of the rapid changes occurring in mobile communications and the introduction of new technology such as MSAT, the Federal Department of Communications (DOC) retained Goss, Gilroy & Associates Ltd. (GGA), an Ottawa-based management consulting firm, to undertake a study of the user requirements for mobile communications in Canada. The study Terms of Reference specified that an overview of mobile communications in Canada be provided, together with information on user requirements and characteristics, and documentation on the social and economic importance of mobile communications. The primary emphasis of the study was land mobile communications.

The study, which involved the collection of comprehensive information on the mobile communications market, focused primarily on Canada, but information pertaining to other countries was obtained where it helped in understanding overall trends. Information was collected through library searches, from the DOC and from suppliers of mobile communications equipment and services. As well, a number of service providers in Canada, the United States and the United Kingdom were interviewed.

In conducting the study, due to the size and complexity of the market, it was not possible to investigate all the various market niches in sufficient 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. The areas selected in conjunction with the DOC for more in-depth investigation, were the cellular market, personal communications, mobile satellite services and mobile data services. A survey of over sixty users was conducted to collect information on the four identified segments. The results of the survey, which must be regarded as being indicative but not conclusive, were integrated with the other information collected.

## 1.0 LAND MOBILE COMMUNICATIONS

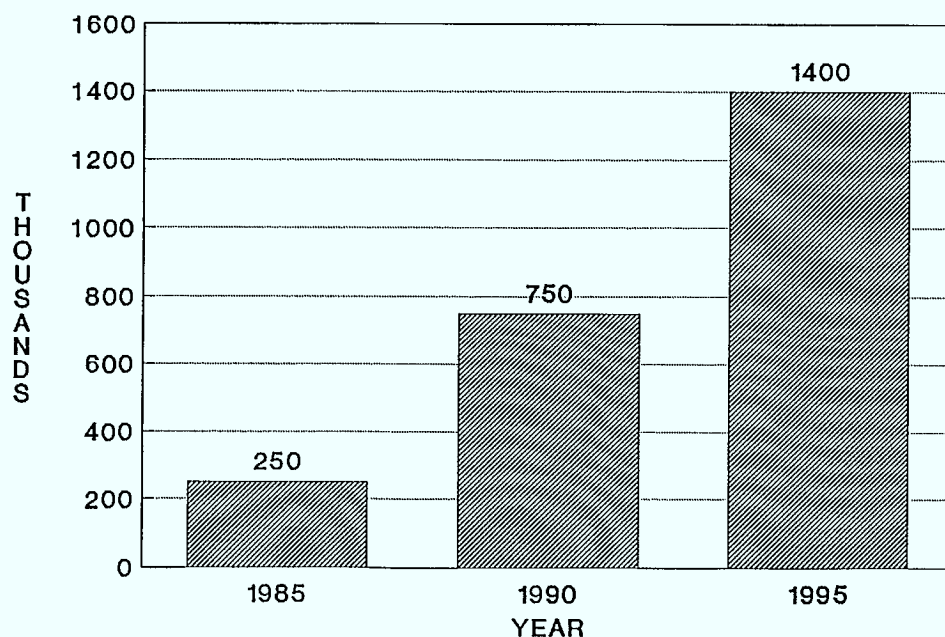
### 1.1 Paging

Radio paging service consists of one-way communication in which a brief message/tone is transmitted to the user. Pagers can be used to alert an individual to call a pre-specified number, provide a short voice message (that has been transmitted), or provide information using a numeric or alphanumeric display. This service is offered by radio common carriers (RCC's) and telephone companies (Telcos).

The three types of pagers available on the market are tone/voice, numeric LCD display, and alphanumeric display. Subscribers to the first two pager types, which are the most common, include doctors, service personnel, sales people, real estate agents, gardeners and landscapers, motion picture crews and trade show exhibitors/organizations. Alphanumeric pagers, which are capable of receiving and storing messages, have been slow to catch on. They are more expensive and require an operator with a special message entry terminal; however, the subscriber receives the full message instantaneously without having to immediately use a phone. Subscribers of alphanumeric pagers include stockbrokers and their clients, lawyers, trucking firms and delivery companies.

It is anticipated that the pager market will grow to 750,000 units in 1990. Using U.S. estimates of growth in the 1990-95 period, we forecast that the pager market will grow to approximately 1.4 million units by 1995. This trend is illustrated below:

Exhibit 1: The Canadian Pager Market  
(1985 - 1995)



Source: DOC & Goss, Gilroy & Associates

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).

From the two surveys undertaken as part of the 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 continue to increase given growth in their organizations.

In the U.S., there has been a significant shift from tone/voice paging to numeric display paging. This is due to the fact that the transmission of a voice message requires from 10 to 12 seconds of airtime, whereas a digital message requires less than half a second. Paging companies have been discouraging the use of tone/voice paging to conserve communications spectrum. It is anticipated that Canada will follow a similar pattern in the future, as spectrum becomes more of a concern.

## 1.2 Mobile Radio Service (MRS)

The conventional form of mobile radio service (MRS) is a two-way system used by industry and government for short messages to dispatch delivery vehicles and taxis, aid emergency services, and direct 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". For example, an organization might 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.

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 improved grade of service (i.e., users experience less waiting time in obtaining a channel), and improved spectrum efficiency as each channel is used more efficiently because it carries more traffic.



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.

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 an annual growth rate of close to 2.5% can be expected in equipment sales between 1989 and 1997.

With the rapid growth in cellular 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 in MRS will continue, but will slow in the period prior to 1995. In the two surveys carried out as part of this study, no companies 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.

### 1.3 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 suffered from limited spectrum, limited access, lack of privacy, and limited coverage. The advent of CTS overcame most of the disadvantages of conventional MTS, as the concept of reusing channels throughout a coverage area greatly increased the number of channels available. For example, New York City could accommodate only 730 conventional MTS users, whereas with CTS, 500,000 subscribers can be served in the same area.

Another mobile telephone technology that will be available shortly, 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 2. This Exhibit shows the relative market positioning of traditional cordless phones, Telepoint and CTS.

Further, 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. The primary market for this MSAT service, is expected to be in rural and remote regions where its wide-area coverage and extended range features are of greatest benefit.

### 1.3.1 Cellular Telephone Service (CTS)

In Canada, CTS is provided by Cantel Inc. and by telephone company subsidiaries which are members of Cellnet Canada. Since beginning service in 1985, growth has been exceptionally rapid with an estimated 180,000 customers using the two systems by the end of 1988. This rapid growth is expected to continue, as an estimated 1,000,000 to 1,800,000 customers are forecast to use CTS by 1993. This expected growth is shown graphically in Exhibit 3.

Exhibit 3: Forecasts of Cellular Customers (1985 - 1993)

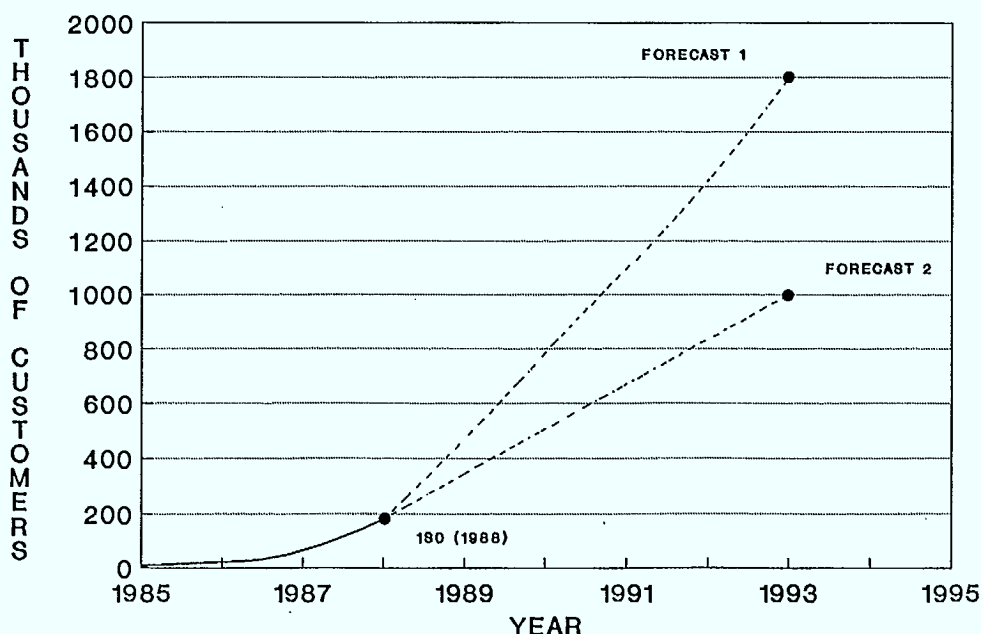



Exhibit 2: Market Breakdown for Mobile Telephony by User Class, Location of Use, and Level of Mobile Telephone Technology

Location of Use	User Class		
	Individual consumer	Small business	Medium-sized to large business
On site (home, office, etc)	Phoning while moving about home and garden	Customer phoning while at bar, restaurant, etc.	Phoning while away from desk
			Phoning while moving about factory or plant
Public facility (gas station, airport, shopping centre)	Phoning home	Proprietor calling staff	Travelling manager, service engineer or salesperson phoning office
	and other personal calls	or customers when travelling	or customers
Free roaming (highway)	Phoning home and other personal calls	Proprietor calling staff or customers when travelling	Travelling manager, service engineer, or salesperson phoning office or customers

 = Traditional cordless phone



= Next generation cordless phone, cordless PABX, telepoint



= High density cellular phone

Source: Arthur D. Little, Inc.



At the end of 1988, approximately 16.9 million people or about 65% of the Canadian population were in areas served by CTS. By 1992, 74% of the population will have access to CTS. Today, 35 centres and travel corridors in British Columbia, Alberta, Manitoba, Ontario, Québec and Nova Scotia are covered. Both Cantel and Cellnet have announced plans to provide coverage coast-to-coast along the TransCanada Highway. For the major centres, the coverage areas extend to the rural areas surrounding the cities to capture commuter, cottage and sales oriented trip traffic. 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, which offer Canadian CTS users access while travelling in the U.S.

To date, a major focus of the cellular carriers has been in covering as broad a geographic area as possible. In addition, 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.

The primary customers for CTS are small businesses, independent professionals and sales persons. However, to achieve the expected growth in customers in the next 4 years, large businesses must begin to use CTS. It is anticipated that the sales personnel in larger businesses will form a major market for CTS.

The cost of a cellular telephone is decreasing at about 25% per year. 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. Along with these price reductions, 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 telephones in new cars beginning in 1991. It is anticipated that CTS will be initially a dealer installed option, then a factory installed option and eventually a factory de-installed option. Currently, Bell Cellular has an agreement with the Cadillac Division of General Motors, and Cantel with Ford.

The conversion from analog to digital will increase the capacity of the systems to handle 4 to 6 times, and possibly up to 15 times, the current number of subscribers. The introduction of digital will not be a sudden change, 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.

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 distribution 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, CTS carriers capture long distance traffic originating from cellular telephones, 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 telephone network. 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 opportunity. 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, resulting in higher subscriber costs for conventional telephone service. Recognizing the versatility of a cellular telephone, the result could be that the CTS carriers will become direct competitors for conventional telephone service, where cellular transmission replaces the local loop.

### 1.3.2 Personal Communications (Telepoint)

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 telephone network. 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.

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, and battery charges last longer. Further, cost of usage will be much lower than for cellular. As a rough estimate, using information obtained from the U.K., the handset 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.

In the U.K., the system is expected to become operational in the late Summer of 1989. Forecasts of 500,000 customers in two years and from 3-6,000,000 customers by 1995 have been publicized.

Both Canadian cellular carriers stated that they were considering Telepoint, but have no immediate plans for implementation. They are currently monitoring the situation. In Canada, the average cost of cellular usage is roughly 65% of the 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. It is noted that our survey of business users indicated little or no interest in Telepoint.

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; and/or,
- it could be used as a cordless PABX; however, it might then be preferable to wait for subsequent technology 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

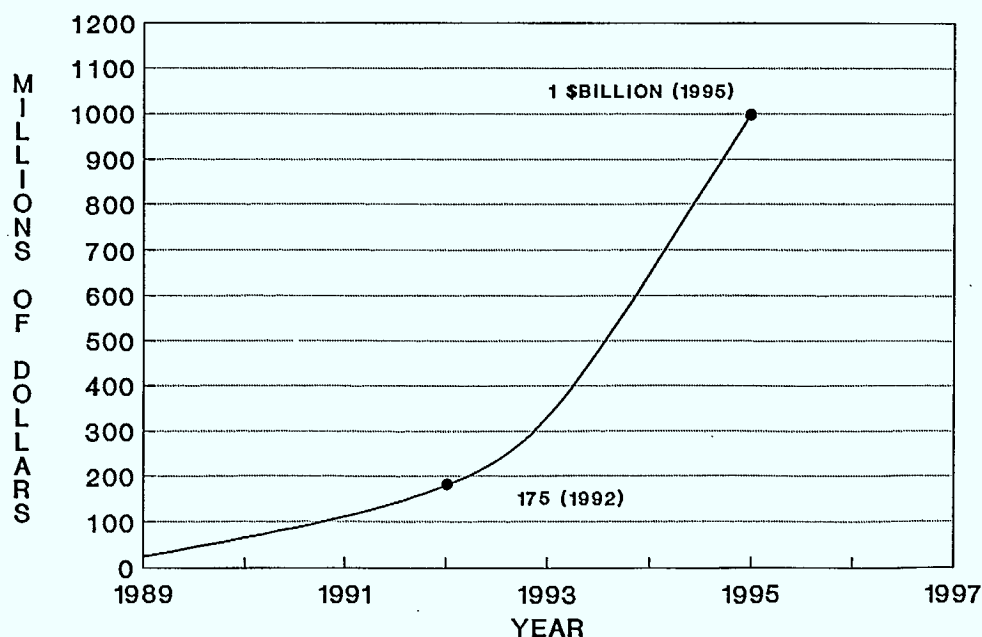
possibility that was advanced was that Telepoint could be introduced as a Telco service, perhaps in part, as a replacement or substitute for payphones.

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

#### 1.4 Mobile Satellite Services (MSS)

The MSS market for land-based vehicles is starting to develop, as it has recently received considerable attention from communications suppliers. A 1988 U.S. study estimates that the worldwide annual revenue for MSS will reach \$150-\$200 million by 1992, and \$1 billion by 1995. This trend is illustrated below:

Exhibit 4: Mobile Satellite Services  
Worldwide Annual Revenue



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

There are at least four suppliers focusing on the mobile satellite market:

- INMARSAT, which began in the 1970's by providing satellite communications to ships, is introducing small satellite data communications terminals for use on smaller ships, aircraft and land vehicles. This service offering, called Standard-C, will be fully operational by the end of 1989.
- MSAT, a North American system offered in Canada by Telesat Mobile Inc. (TMI), will provide preliminary service via INMARSAT starting in 1990, and will offer a full range of services beginning in 1993 after the launch of its own satellite. TMI plans to offer voice, message and data communications services to land vehicles, ships and aircraft.
- QualComm provides two-way messaging and position reporting via satellite in North America. Since entering service in 1988, it has concentrated on the trucking industry, and has installed an estimated 4500 terminals and has another 4500 terminals on order.
- Geostar provides a similar service to QualComm. Since beginning operation in 1988, it has installed approximately 1500 truck terminals.

As noted above, the initial growth market for land MSS is the trucking industry. Mobile communications requirements of the trucking industry are essentially messaging and position reporting, which can be efficiently accommodated by mobile satellite data services. In general terms, MSS services are expected to find their highest potential in rural and remote regions where wide-area coverage and extended range features are of greatest benefit. Applications in public safety and in data collection and control, as well as in marine and aeronautical communications, are envisioned for MSS.

### 1.5 Mobile Data Services (MDS)

A significant and growing component of mobile communications is concerned with the transmission of data. In fact, virtually all forms of mobile communications have the capability to transmit data either directly or via modem. MDS are available and are currently being used in paging, MRS, MTS (CTS) and MSS.

Alphanumeric pager usage, which involves the transmission of data, was discussed above. In the area of MRS, police, taxi and other transportation companies use private mobile data networks. Packet radio is one economically attractive and accurate method used to transmit data over mobile radio.

For CTS, modems are available to transmit data over cellular phones. This type of data transmission is used in conjunction with a printer, microcomputer and/or facsimile machine.

Although there is a growing interest in data transmission, it represents less than 1% of cellular usage, with the main area of interest being in the transmission of facsimiles. The cost of purchasing the mobile phone, modem, interface and facsimile machine, and then mounting them in an "unfriendly" automobile, has been a deterrent to greater usage.

In July 1989, two new mobile public data services, Mobitex and MobiData, began operation. Mobitex is owned 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 telephone network. 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 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. Examples are 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.



## **2.0 MARINE AND AIR MOBILE COMMUNICATIONS**

The marine and air mobile communications markets were also investigated, but not to the same extent as the land mobile market.

### **2.1 Marine Mobile Communications**

The primary mode of communications for the marine user is through the use of VHF, HF and MF mobile radios. VHF is used 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. The marine user, who is equipped with a suitable VHF, MF or HF radio, can also access the telephone network using duplex telephone calls, message relay, or the transmission of low speed data. The means of doing this is provided throughout Canada by the Transport Canada Coast Guard Radio Station (CGRS) 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.

In addition, satellite communications (both voice and data) via INMARSAT satellites have been available since the mid-1970's for larger marine users, while in the near future a service called Standard-C, a slow-speed data service, will be introduced for small users. 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 worldwide basis. The rapid growth of CTS in inshore areas and the 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 CTS is likely growing; however, there are no readily available statistics on the number of users. It is noted that marine users are required to carry a standard marine band radio to meet safety of life at sea requirements.

### **2.2 Air Mobile Communications**

The primary means of air communications are the Flight Services Stations and Air Traffic Services public frequencies. These frequencies are used for air traffic control and advisory information for air crews. 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 public telephone network. 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.

Teleglobe Canada has 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/min. 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.

More 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, which is currently being field tested on two of its 747s. Teleglobe's partners are the Société internationale de télécommunications aéronautiques (SITA), OTC Limited of Australia and France Telecom. The service will be in-flight worldwide telephony, 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. Teleglobe estimates that the market for aeronautical communications services will be more than \$1 billion by the year 2000.

### 3.0 SOCIAL AND ECONOMIC IMPORTANCE OF MOBILE COMMUNICATIONS

Mobile communications can be viewed as a technological response to our highly-mobile, service-oriented society. Mobile communications facilitates the exchange of information between people who are on the move 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 communications 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 study to the impacts noted in the previous paragraph. Moreover, in keeping with the study's emphasis, we have focussed on 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 populated areas.

Paging devices are used by individuals to facilitate dynamic routing based on information received via the page. Pager users are typically people who must be alerted when an event occurs, so that their sequence of activities can be changed. 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.

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/or explanation of the message is required. In addition, taxis and dial-a-bus services require verification.

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.

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 use of mobile telephone, specifically 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 saving 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 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, 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, and their findings indicated that accident rates for CTS users were lower than for non-users. 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. The preponderance of calls related to fires, accidents, reckless drivers, etc., and very few to reporting crimes. CTS 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;
- **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; and,
- **stress reduction** - relates to the ability to make "late arrival" calls while stuck in traffic. It also helps in fighting boredom while travelling;

Mobile satellite services have made a contribution in the trucking industry. In trucking, MSS helps keep drivers driving without wasting valuable time tracking down payphones or charging long-distance phone bills while waiting for an available dispatcher. It also improves customer service through facilitating online tracking reports for just-in-time

delivery. Moreover, it avoids costly delays when equipment breaks down or changes occur in routing, as well as in controlling fleet resources. Telesat Mobile Inc. estimates that time savings alone from the installation of their proposed system could mean \$0.07 to 0.12 per kilometre to each driver and vehicle.

Frederick Transport Ltd. of Dundas Ontario, estimates that they average 500 extra miles per truck each month without incurring more driver hours through the use of Geostar MSS terminals. The payback for the system was 14 to 16 months, largely because of the requirements dictated by just-in-time automobile parts haulage. The drivers have also used the system for emergency distress calls.

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 the Ontario Air Ambulance Service, which has allowed quality voice contact in northern areas at altitudes below 30,000 feet (which had been a problem with previous technology). The potential for use in emergencies and by emergency services is a major social benefit to be obtained in MSS deployment, particularly in remote locations.



## 4.0 CONCLUSIONS

### 4.1 Study Conclusions

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.

The mobile communications market (\$425 million), in 1987, was estimated to represent approximately 2% of the overall combined telecommunications equipment and services market (\$20.4 billion) in Canada. However, the mobile communications market growth rate of 20% is four times greater than the overall market rate of just under 5%.

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 are not experiencing the level of growth of CTS.

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 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.

The 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 MSS area, trucking is the first significant market identified for mobile satellite communications. There are several companies that are currently offering services, which may make it difficult for Telesat Mobile Inc. 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. 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, were 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.

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.

#### **4.2 Suggested Improvements**

A number of suggested improvements were identified during the study. In the area of technology, a major concern to the cellular carriers is the need to put up towers in built-up areas. 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 sizes must be reduced, and as the cell sizes reduce, 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 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.

In regard to regulation, 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 equipment is introduced. Further, as telephone headsets are not currently allowed by vehicle regulation, a headset that doesn't impede traffic noise would be a welcome addition because it would allow "hands free" operation. Finally, the railway companies requested that for security reasons, they be given protected VHF channels for their ATCS installations.

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