MARKET AND TECHNOLOGY TRENDS IN MOBILE COMMUNICATIONS

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MARKET AND TECHNOLOGY TRENDS IN MOBILE COMMUNICATIONS

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EXECUTIVE SUMMARY

The personal communications network of the future will allow Canadians to communicate with anyone, any machine, anywhere, at anytime. Such a network will evolve from existing mobile communications technologies, networks and services such as cellular, paging, telepoint, mobile satellites and mobile data services.

In order to appreciate the evolution of personal communications, it is important to understand existing mobile communications products and services. This paper summarizes the various services, identifies trends and assesses the social and economic benefits of mobile communications.

CELLULAR MOBILE TELEPHONE

- The cellular mobile telephone industry has experienced a dramatic growth worldwide during the past seven years, both in the manufacture of terminals and related equipment and in the construction and operation of service networks.

- The population of cellular subscribers in Canada has grown at a compound annual rate of 79% (which is outstanding compared to the substantial growth rate of 7.8% for the telecommunications industry in general) since the network's first full year of operation in 1986. At the end of 1989, there were approximately 375,000 cellular subscribers in Canada, an increase of 77% over the end-1988 level of 212,000.

- Growth of cellular in Canada consistently exceeded all expectations. In fact, the cellular penetration in Canada (at 1.5%) is the second highest in the world after the Scandinavian countries where cellular was introduced much earlier. Our penetration is slightly higher than the U.S. and is more than twice the average European penetration. It is perhaps the nature of our geography that makes mobile communications such a natural requirement for us.

Due to advances in digital technology, a number of trends are evident. The network will start digital conversion sometime in 1991. This will increase the network capacity by a factor of three or so, and will also result in lower cost.

The trend towards portable phones has already accelerated. While portable units were only 6% of the total number of units shipped in 1988, they represented 16% in 1989 and will grow to 23% in 1990.

The price of mobile phones started out at around $2,000 but quickly began to drop. At present, a mobile unit can be had for well under $1,000.

In terms of the Canadian market share for the cellular telephone, it is interesting to note that the two largest players are North American rather than Japanese: Novatel, a Canadian company; and Motorola, a U.S. Company. Each company has a market share of 15-20%. This is unusual for a consumer electronics market: the fax market, for example (to take another communications product), is 100% Japanese at the top.

In terms of network equipment, Northern Telecom is one of the two major suppliers to the Canadian market; the other being Ericsson of Sweden with a Canadian office in Montreal.

To summarize, not only do we have one of the best domestic market for cellular, we also have top quality service and equipment suppliers to serve our market as well a export their products to other markets.

The dramatic growth in the demand of cellular service and the tremendous technological advances resulting in higher capacities, better quality and lower costs are already speeding up the evolution of mobile communications towards the personal communications network of the future.

PAGING

- Canada has the second highest penetration of paging (2.4%) in the world, the U.S. being the highest penetrated market at 3.2%. The Canadian penetration is four times that of Western Europe.

- The number of paging subscribers in Canada has grown from 250,000 in 1985 to 510,000 in 1989 for an average growth rate of 20%.

- While the major service providers for paging are Canadian-owned and earned $160 million in 1989, the major equipment suppliers are foreign-owned (with offices in Canada) and earned $35 million in 1989.

- The trend in paging is towards alphanumeric and numeric pagers; their combined share is expected to increase from 30% in 1989 to 60% by 1993.

- The future of paging industry is very much linked with that of other mobile communications technologies. Pagers will be used in conjunction with cellular and Telepoint (CT2) technologies and will thus help advance the evolution of mobile communications towards the personal communications network of the future.

- A recent trend in paging services is the emergence of national and international paging services.

MOBILE SATELLITE SERVICES

- Telesat Mobile Inc. (TMI) and the American Mobile Satellite Corporation (AMSC) will construct and operate the first commercial mobile satellite communications network in the world.

- MSAT services will serve specific market niches (rural area mobile telephony, wide-area fleet management, oil, gas, mining and forestry) not well served by terrestrial-based systems. It will thus enable all Canadians to have access to mobile communications services anywhere in the country. MSAT is expected to have over 100,000 users by the year 2000.

- MSAT will provide an important component of the infrastructure required for the eventual emergence of personal communications network which will provide service to all Canadians anywhere and anytime.

TELEPOINT SYSTEMS (CT2)

- The British have developed a second-generation cordless phone service, called Telepoint or CT2. Using a wallet-sized phone, customers can originate (but not receive) calls within 100 meters of base stations located in public places. Charges for this service will be much lower than cellular and will, therefore, open up the residential consumer market for mobile communications. CT2 could be an important interim service before the availability of the true personal communications network of the future.

- The CT2 system became operational in the UK in 1989. Customer forecasts are to have 500,000 customers in two years and from 3-6 million customers by 1995.

- In Canada, the Department of Communications issued a Public Gazette Notice in 1989 inviting applications for CT2 field trials and inviting comments on standards and other policy matters. The field trials will be conducted till September 1991. Should the field trials prove to be successful from a technical and marketing point of view, and spectrum, institutional, industrial, technical, service and regulatory issues be satisfactorily resolved, the Department will establish a radio licensing policy to license these services.

PERSONAL COMMUNICATIONS

Personal communications is still in a very early stage of development and no clear definition of the product or service has yet been declared. Encouraged both by the market demand and technological advances in mobile communications (especially cellular and paging), the concept of personal communications is gaining widespread support.

While most of the existing mobile communications services are used mainly by businesses, personal communications is aimed both at the business and the residential users. It has to be, therefore, provided at a much lower cost than, for example, cellular telephone. It is expected that its functionality, for the foreseeable future, will lie somewhere between those of CT2 and cellular telephone.

UK currently leads the developments in personal communications. A discussion document entitled: "Phones on the Move", which proposed this concept was circulated by the Department of Trade and Industry (DTI) in January 1989. DTI received eight applications of which it approved the following three:

- Mercury PCN (a group featuring Mercury Communications, Motorola and Telefonics)
- BAC (British Aerospace, Pacific Telesis, Millicom, Matra and Sony)
- Unitel (STC, US West, Thorn EMI and Deutsche Bundespost)

These three groups are expected to define, develop and introduce personal communications services in UK sometime in the 1990's.

MOBILE DATA COMMUNICATIONS

. Compared to mobile voice communications, the market for mobile data is fairly small. The most noteworthy development in this area is the recent emergence of two public networks: MobiData and Mobitex. Their combined customer base is expected to grow from 6,000 in 1990 to 25-30,000 by 1992. This will be less than 5% of the cellular voice customers.

MARINE MOBILE COMMUNICATIONS

. Marine radio remains a small market, with slower rates of growth than the rest of the two-way market. The trend for marine communications is clearly towards increased use of satellites and mobile telephone service away from the conventional two-way radio. Currently, there are 47,000 marine licenses in Canada.

AIR MOBILE COMMUNICATIONS

. The air mobile communications area is far more limited than either the marine or land mobile areas. Presently, two companies, Skytel in Canada and GTE Airfone in the U.S., are offering air-to-ground telephone service using land mobile frequencies. British Airways has introduced such a service on a trial basis using Inmarsat satellites. Recently, Teleglobe Canada announced that it, in conjunction with three other partners, will be offering such a service via Inmarsat, to world's airlines.

SOCIAL AND ECONOMIC BENEFITS OF MOBILE COMMUNICATIONS

. North American society is highly mobile and is characterized by long computing times between home and work, a large amount of intercity highway travel and a well developed public service delivery network that utilizes trucks and cars. Mobile communications can be viewed as a technological response to this service-oriented mobile society.

The main benefits of mobile communications are: improved productivity, improved safety, expansion of communications to areas previously unserved and improved overall communications infrastructure allowing more extensive coverage of the populated areas.

VISION 2000

Although mobile communications has grown more than expected in recent years, due to its relatively high price, its use has been somewhat limited. Due to major recent advances in technologies and service innovations, many feel that the time is right to introduce personal communications services at a lower price such that the use of mobile communications can be further expanded to the business user as well as to the residential user. The project Vision 2000 is an attempt to do so in the Canadian context such that the benefits of this new service are maximized both to the Canadian suppliers and users.

CHAPTER 1

MARKET AND TECHNOLOGY TRENDS IN MOBILE COMMUNICATIONS

INTRODUCTION

Background

In March of 1989, sixty of the most senior representatives of the Canadian telecommunications industry met at St-Sauveur to discuss the advisability of developing a major national project in the area of communications. They unanimously agreed that a coordinated strategy should be pursued to develop advanced technologies and networks in the area of personal communications. They called this project Vision 2000. The purpose of Vision 2000 is to encourage the development in Canada by the turn of the century of the world's most advanced personal communications system. Following the St-Sauveur conference, seven working groups were established to further develop the concept of Vision 2000.

The objective of Vision 2000 is to position the Canadian telecommunications industry competitively in both domestic and international product, application and service markets through a concerted R&D strategy.

The strategy will focus primarily on the implementation, further development and innovative exploitation of technology in relation to its potential for the enhancement of personal communications and associated information services. It will be designed to enable users to communicate with anyone, anywhere, any machine, at anytime through cost effective, easy to use networks and terminals and to increase their productivity and capabilities.

Such a strategy will allow Canadian users generally and business in particular, to obtain from Canadian sources the capabilities they will require to satisfy their personal communications needs and to maintain and improve their economic viability and competitiveness in the global marketplace.

Personal communications will be a form of mobile communications and is expected to evolve from the existing mobile communications technologies, networks, and services. The existing equipment manufacturers will play a large role in developing new and/or improving the existing technologies and products needed for the personal communications network.

It is therefore, useful to take stock of the existing situation in mobile communications in terms of market and technology trends. The present document is the attempt to do this. The information given in this document is derived from available literature which includes technical journals, government publications, private consultant reports and recent studies contracted out by the Department of Communications in this area.

It is hoped that the information given in this note will be useful to various working groups in further developing the concept of personal communications and formulation of a business plan, as well as in the preparation of Cabinet submissions or any other similar documents.

Definition of Mobile Communications

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

To define mobile communications in more detail, it is convenient to describe various mobile communications services:

Radio Paging Service

One way communications 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. 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. 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.

Conventional 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 extremely popular prior to the introduction of cellular telephone service (CTS). The service had lengthy waiting lists and it was often difficult to get a clear channel to use the system in many North American cities as there were only 12 to 25 channels available to the entire city.

Cellular Telephone Service (CTS)

The introduction of CTS was an eagerly awaited communications market development, and has essentially eclipsed conventional MTS. Cellular radio makes use of some 600 radio channels in a new higher frequency band designed for its use (825-845 MHz for transmit and 870-890 MHz for

reception of base transmit). The large number of channels available for cellular is a major advance in comparison to the limited number of channels (12-25) for the conventional system. But the greatest advantage of cellular radio is the new concept of dividing these channels among a number of small geographical areas known as "cells". Each channel can be used simultaneously within other cells, provided that two cells using the same frequency are separated by other cells. The service was launched in Canada on July 1, 1985. The current number of subscribers (375,000 plus) are distributed almost evenly between Cantel and the telephone companies.

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 both allow a reduction in size and service price, are opening up new opportunities for personal communications. For example, the number of portable cellular phones as a percentage of total cellular phones has grown considerably, and this trend is expected to continue. The U.K. service offering of Telepoint as a lower cost alternative to cellular may offer considerable opportunity to certain market segments. Also three licenses have already been awarded to provide personal communications services in the UK by mid-1990's.

Mobile Satellite Services (MSS)

These 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.

Citizen Band Service

A specific type of mobile radio service 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 clearly 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.

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.

Cordless Telephones

Provide 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 units.

Report Organization

Including this introductory chapter, the report consists of 11 chapters.

Chapter 2 describes the market and technological trends in cellular telephone service both in domestic and foreign markets. A brief discussion of equipment suppliers is also given in this chapter.

Chapter 3 describes paging services and products of various type. In addition to the Canadian market, a discussion of the U.S. and Western European markets is also given.

Chapter 4 discusses the market and technology trends of mobile radio services, along with a brief discussion of equipment suppliers.

Chapter 5 discusses cordless telephones and Telepoint systems (CT2). Since the UK leads in the development and implementation of such systems, the discussion is mainly about the recent developments in the UK and other European countries.

Chapter 6 discusses what is called personal communications, a new development in mobile communications which emerged in 1989. Since the development of this concept is currently confined to the UK, the discussion in this chapter is mainly about the experience in the UK.

Chapter 7 describes developments in mobile data communications in terms of the recent emergence of two public mobile data communications services: MobiData and Mobitex.

Chapter 8 discusses mobile satellite communications services such as Inmarsat, MSAT, Geostar and QualComm.

Chapters 9 and 10 give brief discussion of marine and aeronautical mobile communications.

The last chapter discusses briefly the social and economic significance of mobile communications.

CHAPTER 2

MOBILE TELEPHONE SERVICE

CONVENTIONAL 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 2,000.

- 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 re-using 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.

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

CELLULAR TELEPHONE SERVICE (CTS)

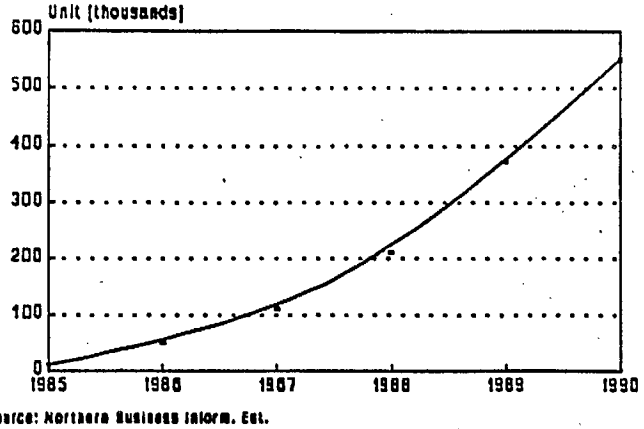
The cellular mobile telephone industry has experienced dramatic growth worldwide during the past seven years, both in the manufacture of terminals and related equipment and in the construction and operation of service networks. In North America, cellular mobile communication service began in November of 1983 in the United States and in July of 1985 in Canada. The population of cellular subscribers in Canada has grown at a compound annual rate of 80% since the network's first full year of operation in 1986.

The cellular system divides a designated service area into cells, each served by its own base station consisting of a low power transmitter and receiver. Calls are automatically handed over from one base station to another as users move between calls.

In Canada, CTS is offered by Cellnet Canada and Cantel Inc. (controlled by Rogers Communications). Cellnet Canada is an association of cellular subsidiaries and divisions of the country's major telephone companies such as Bell Cellular and B.C. Cellular.

Cellular Subscribers

EXHIBIT 1
CELLULAR SUBSCRIBERS IN CANADA



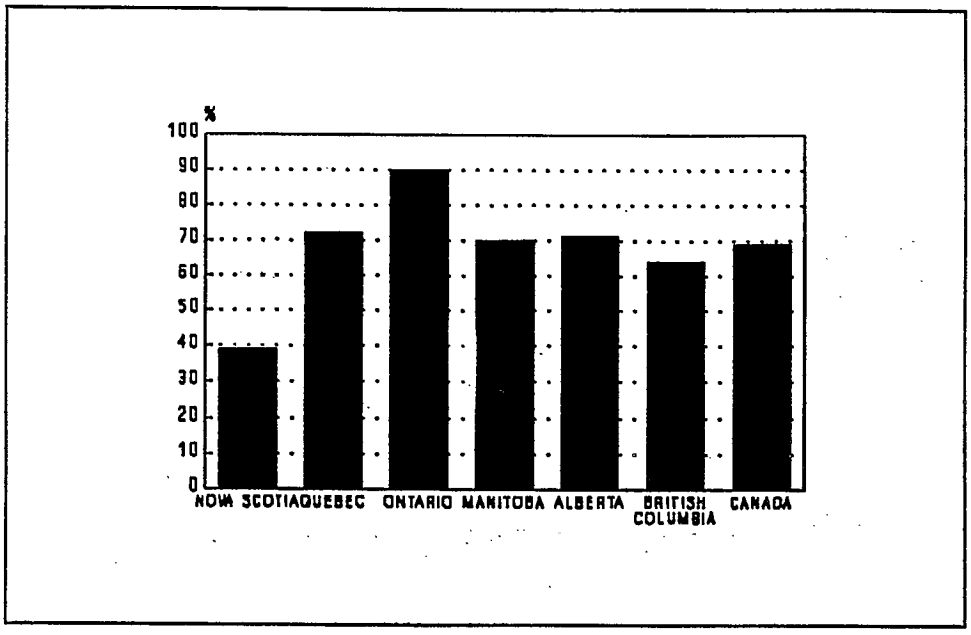
At the end of 1989, there were approximately 375,000 cellular subscribers in Canada, an increase of 77% over the end-1988 level of 212,000. As is shown in Exhibit 1, the number of subscriber is expected to increase to 550,000 by 1990, for a growth rate of 47%.

Service Coverage

EXHIBIT 2

Percentage of Total Population Covered by Cellular

June 1988



SOURCE: Derived from coverage maps supplied by Cantel and Cellnet and using Statistics Canada's census maps.

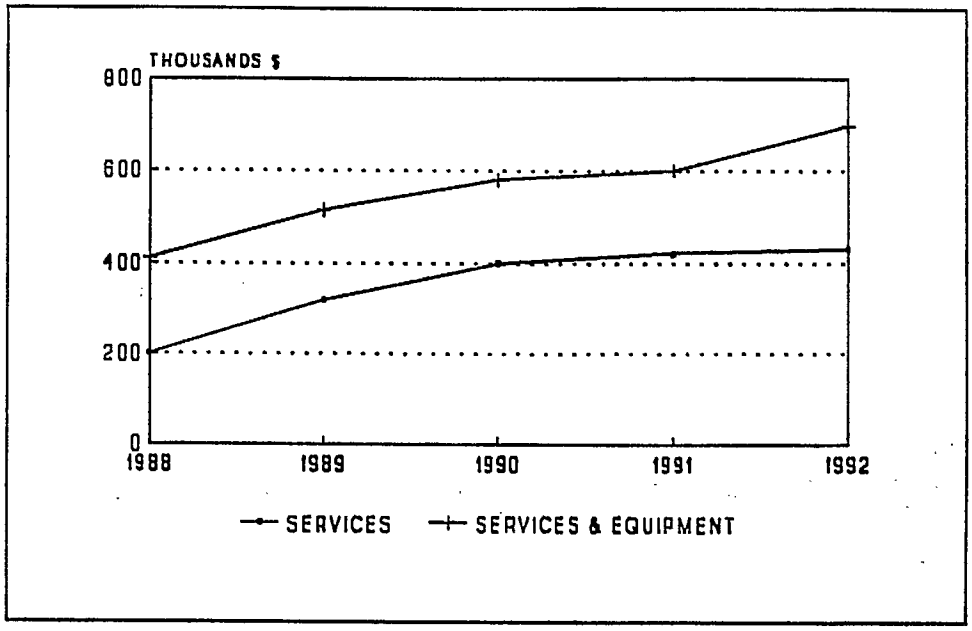
Although originally only the 23 largest metropolitan areas were licensed for the service, surrounding areas and additional territories were soon added as the service proved an instant success with its customers. Currently between Cantel and Cellnet, over 65% of the Canadian population is covered for the service (Exhibit 2) and the service is quickly expanding to cover more areas.

Equipment and Service Market

EXHIBIT 3

Canadian Cellular Equipment and Services Market

1988-1992



SOURCE: Northern Business Information

By 1992, the Canadian cellular market for equipment and services will have grown to $700 million from $413 million in 1988 for an average growth rate of 14%. The service component will grow from $208 million in 1988 to $454 million by 1992 for a growth rate of 21%.

Although cellular has been a tremendous growth industry, it is still very small compared to the wireline telephone industry. For example, the 1988 cellular service revenues of $208 million were only 1.7% of the total telephone service industry revenues of $12.3 billion.

Equipment Sales of Cellular Telephones

EXHIBIT 4

Market Shares of Cellular Telephone Sales, 1989

Motorola, Novatel	15-20%
Audiovox, Radio Shack, Uniden	10-15%
GE, Mitsubishi, NEC, Nobia-Mobira, OKI, Panasonic	3-10%
Fujitsu, Hitachi, MEI, NT, Philips, Technaphone	<3%

Total 1989 Market = $120 Million

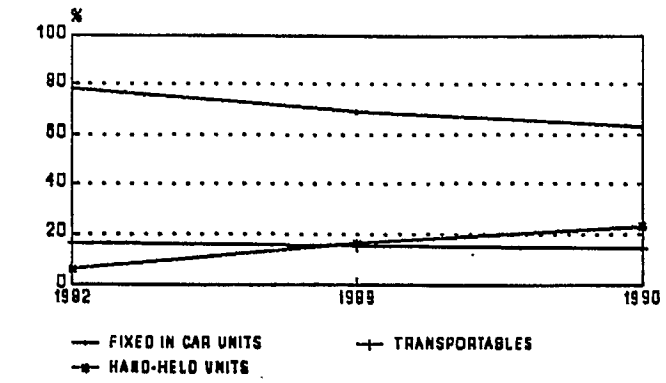
SOURCE: Various Sources

The total number of cellular phones sold in Canada in 1989 reached 170,000 units. This represents an increase of 67% from the 1988 volume of 105,000 units. There are now 17 suppliers in the market. As is shown in Exhibit 4, the two largest players are North American rather than Japanese: Novatel, a Canadian company; and Motorola, a U.S. company. The most recent significant new entrant is also Canadian: Northern Telecom, having shipped its first product in late 1989.

Shipments by Type of Unit

Cellular phones come in three basic types: fixed-in-car, or mobile units which are installed in a vehicle; transportable units, which can be carried about but have a battery and transmitter pack about the size of a woman's purse that is usually carried with a strap over the shoulder; and portable or hand-held units, which are about the size of a walkie-talkie and can be carried about with relative ease. As is shown in Exhibit 5, the trend is clearly towards portables.

EXHIBIT 5
SHIPMENT BY TYPE OF UNIT



SOURCE: NORTHERN BUSINESS INFORMATION

Shifts in unit type are due to a combination of factors. The preeminent one is price. In the early stages of the cellular market, the only type that was affordable to most users was the mobile, or fixed-in-car model. The price of mobile phones started out at around $2,000 but quickly began to drop, most dramatically in the U.S. At present, a mobile unit costs well under $1,000. When portable phones were introduced, they cost $3,000-$4,000, beyond the price-range of most customers. In recent months, the price for portables has dropped to between $1,000 and $2,000, bringing about a marked increase in demand. Other factors, however, have also been significant. The size of a portable phone has shrunk, so that it is no longer quite such a weighty device to lug around. We are moving steadily toward the day when a portable phone will be the same size as a pocket calculator; some people in the industry are even talking about Dick Tracy-style wrist-watch phones. While the scenario is still a ways off, the smaller size of today's portable phones has made them more attractive to users.

Cellular Network Equipment

The market for cellular network equipment in Canada consists of Cantel and members of Cellnet. These companies together spent $175 million on network expansion, capacity addition, the construction of microwave networks and other capital in 1988, In 1989, total capital expenditures increased to $500 million, coinciding with major expansion of coverage areas.

Each operating company has its own source of supply for various network components. In the case of Cantel, all network components (switches, base stations and voice control units) are supplied by L.M. Ericsson, a Swedish firm with a Canadian office in Montreal. At the end of 1988, Cantel had 8 Ericsson's Axe 10 cellular switches. By the end of 1990, Cantel should have 12-15 Axe 10 switches. Each switch costs approximately $1-3 million. By the end of 1989, Cantel had 300 base stations and 9000 VCU's (voice control units) installed.

On the Cellnet side of the industry, the network is based on Northern Telecom's DMS-MTX cellular switches. Northern also supplies base stations to Cellnet members. VCU's in Cellnet come from GE. Recently Northern has also entered this market.

Customer Characteristics

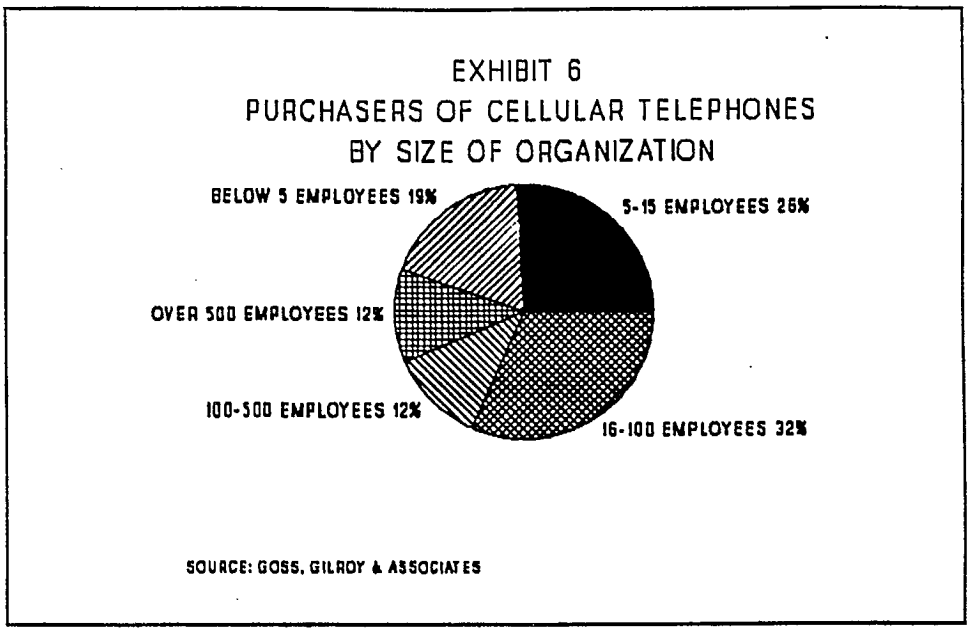


Exhibit 6 gives the breakdown of the purchases of cellular telephones by size of organization. Almost 75% of purchases are made by organizations with less than 100 employees. Also the predominant use of cellular telephone is still for business (96% of total use) as opposed to personal use. This is due to the high cost of cellular.

Cellular subscribers are typically 35-45 years of age and manage private companies as president or owner, as is shown in Exhibit 7.

EXHIBIT 7

Cellular Ownership by Occupation

Proprietaire/President	48.8%
Professional	8.4%
Marketing	8.5%
Administration	12.2%
Sales	15.2%
Others	6.8%

SOURCE: Cellnet Canada, Cellular Guide

EXHIBIT 8

Cellular Ownership by Industry

Wholesale	13.4%
Retail	6.2%
Real Estate	13.6%
Business Services	12.6%
Manufacturing	14.5%
Construction	14.5%
Transportation	6.9%
Other	18.6%

SOURCE: Cellnet Canada, Cellular Guide

In the private sector, the majority of subscribers are in the wholesale, construction, manufacturing and real estate sectors. They spend an average of two to four hours on the road daily, and earn typically over $40,000.

The U.S. Market for CTS

As is shown in Exhibit 9 and Exhibit 10, the number of cellular subscribers in the U.S. increased from 300,000 in 1985 to 3.1 million in 1989 for an average growth rate of 80%. The service revenues increased accordingly.

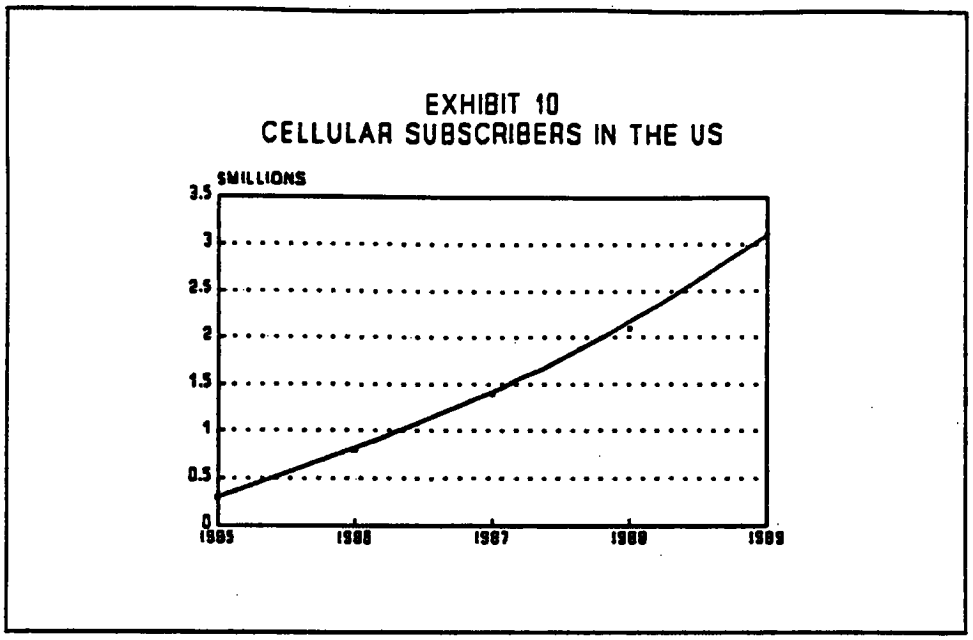
EXHIBIT 9

The U.S. Market for Cellular Telephone Service

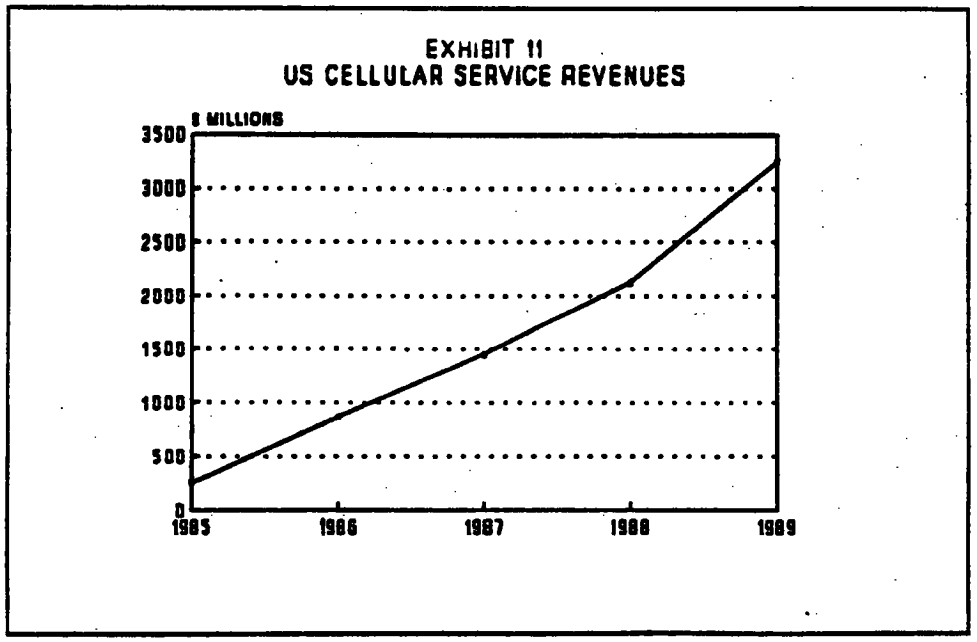
	1985	1986	1987	1988	1989
Subscribers (millions)	.3	.8	1.4	2.1	3.1
Service Revenues ($ millions)	250	870	1,450	2,130	3,250
Equipment Revenues* ($ millions)	275	350	435	525	630
Average Cellular Equipment Prices ($)	1,600	1,400	1,100	900	800

*Excludes Network Equipment

SOURCE: IRD, Feb. 1990

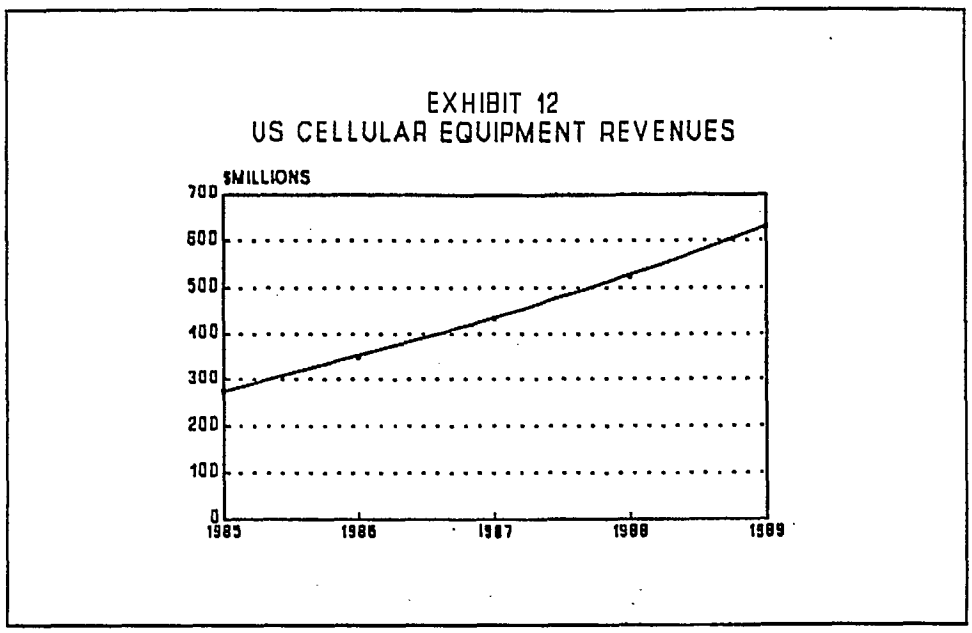


SOURCE: BIS MacKintosh



SOURCE: IRD

The growth of cellular in Canada both in terms of service subscribers and revenues has paralleled that in the U.S. The number of Canadian subscribers is about 1/10th that in the U.S.



SOURCE: IRD

EXHIBIT 13

Leading Cellular Terminal Equipment Suppliers in the U.S.

Supplier	Estimated Market Share
Audiovox	20%
Motorola	16%
NEC	14%
Panasonic	12%
Mitsubishi	12%
Others	26%

SOURCE: IRD

Penetration of Cellular Telephone in Various Countries

EXHIBIT 14

Penetration of Cellular Telephone in Various Countries

1989

Country	Total Installed Base	Penetration per 1000 Population
Norway	175,000	41.7
Sweden	335,000	39.9
Finland	155,000	32.3
Denmark	120,000	23.1
Canada	**375,000**	**15**
United Kingdom	800,000	14.2
United States	3,000,000	12
Switzerland	70,000	11.7
Austria	60,000	7.9
Netherlands	55,000	3.8
France	200,000	3.6
Belgium	30,000	3.0
Ireland	10,000	2.9
West Germany	160,000	2.6
Italy	60,000	1.0
Spain	25,000	.7
Portugal	3,000	.3
Western Europe	2,259,000	6.4

SOURCE: CIT Research

As is shown in Exhibit 14, the Canadian penetration (1.5%) of cellular telephone is more than twice that of Western Europe (.6%). Scandinavian countries were the first to introduce cellular technology and have the highest penetration (4.1%).

Pan-European Digital Cellular Network (GSM)

The most recent development in cellular is occurring in Europe with the implementation of GSM (a pan-European Digital Cellular Network). GSM is an attempt by the European Commission to provide a cellular system encompassing a number of features: low energy consumption, high power output and lightweight equipment, all at low cost to the end user. The prospect of each of these components being achieved simultaneously is questionable: more over, the introduction of such innovative systems across countries at very different stages of development is economically ambitious. The current European cellular networks are a range of analog systems, which are incompatible with each other except for the four Scandinavian countries and Switzerland.

GSM is timed to coincide with the single market of 1992. GSM is the answer to many of the problems of European cellular, particularly in respect to coping with the phenomenal demand.

The advantages of GSM are two-fold:

- economies of large scale manufacturing in Europe;
- widespread, pan-European use of system-equipment.

The ultimate objective of GSM is to cover all the important European towns by 1993 and major routes by 1995. The ultimate target for GSM is that it should be equal in functionality to existing analogue systems in respect of the following features:

- system efficiency;
- low cost;

- hand portability of units;
- ease of introduction.

In addition, GSM should be an improvement on existing systems in at least one of the above areas.

The range of services planned for inclusion on pan-European digital cellular systems will appeal almost exclusively to the business sector. Services will include:

- emergency call;
- facsimile transmission;
- teletex;
- videotex;
- data transmission;
- short message service;
- interconnection with circuit and packet switched data networks.

A fully coherent pan-European system has a number of potential advantages, amongst which are improved quality service to all areas and easing congestion in urban areas.

Despite the innovative nature of the pan-European digital cellular concept, GSM will not advance without overcoming a number of difficulties. A major problem is the timing, which best suits those European countries where digitalization will act as a relief for congestion on the radio spectrum. Others will encounter less immediate demand for the new service. In addition to the number of relatively new cellular networks across Europe, some countries have been forced to launch interim analogue networks, prior to GSM, in order to alleviate existing demand. By doing this, these countries will automatically restrict the need for GSM in its early stages.

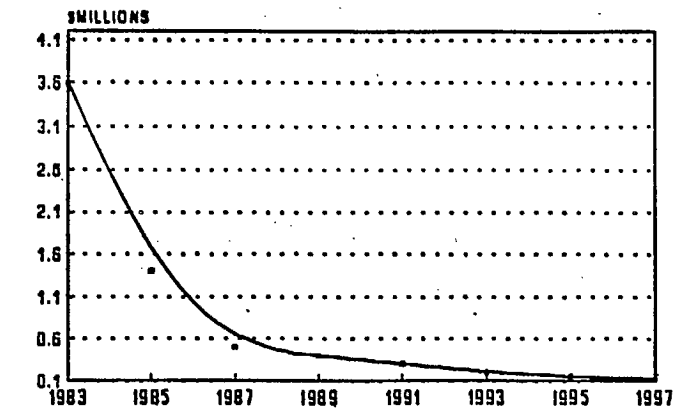
GSM is primarily an attempt to harmonize a market which has the potential to truly benefit from open market forces. The project is seen as a chance to break down some of the domestic barriers restricting full competition in the equipment market. Inevitably some European countries are more prepared for GSM than others and in this respect the venture could prove an expensive exercise in European politics.

FUTURE TRENDS

Use of Digital Technology

Currently cellular technology uses digital switching and analogue transmissions as does much of the land-line system. However, both cellular and land-line systems are moving towards an all digital capability for access, switching and transmission. Digital technology offers substantial improvements in services and reductions in costs. Technology trends (according to Future Technology Inc.) indicate that conversion to completely digital systems will occur by 1997.

EXHIBIT 15
INVESTMENT COST PER CELL

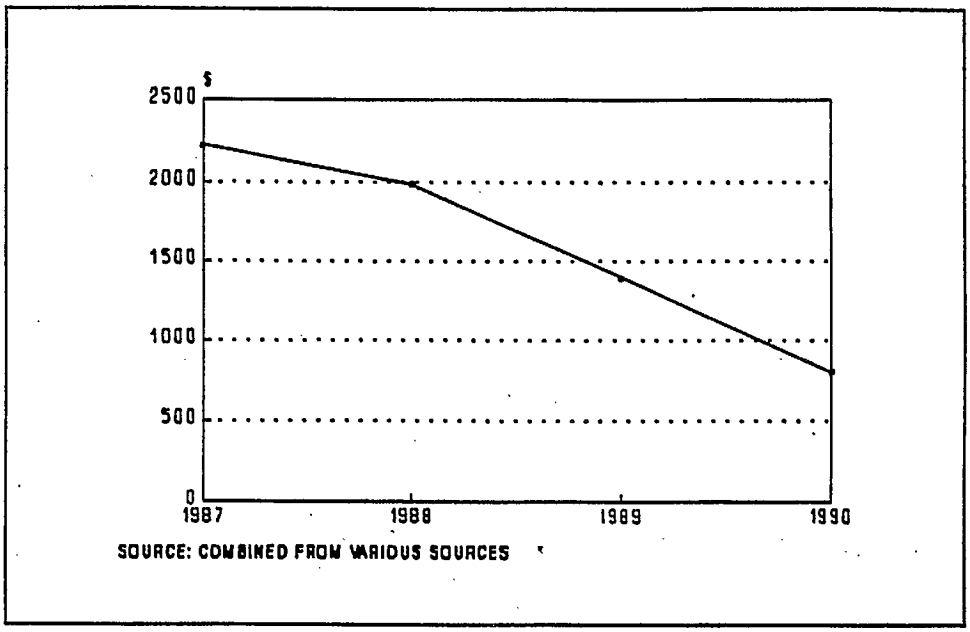


SOURCE: FUTURE TECHNOLOGY INC., 1988

Investment costs for cellular systems should come down from the present $.5-$1.0 million per cell cost to $.2 million by 1997, largely as a result of digital technology.

EXHIBIT 16

Average Retail Price of Fixed Cellular Telephone



The price of mobile phones started out at around $2,000 but quickly began to drop, most dramatically in the U.S. At present, a mobile unit can be had for well under $1,000.

MAJOR ISSUES

Use of Digital Technology

The digitization of the Canadian (and U.S.) cellular networks will affect everybody in the industry, from network operators to end-users, because it implies the extension of digital communications from the network switches right out to the individual handset. Just how

this transition will be handled - from analog handsets and RF equipment to digital - is a question that has attracted considerable attention in the last few years. If the networks were to implement the new digital network in the space of a few weeks, perhaps on the surface the tidiest solution, the current base of users would have to replace their hardware. This would clearly be unacceptable, unless some sort of massive buy-back or trade-in program were agreed upon between operators and phone manufacturers. The more practical approach would be to implement a gradual phase-in of digital transmission, entailing the maintenance of what would in effect be a hybrid network for a number of years. This would give users a reasonable amount of time to acquire new hardware.

A further implication of the gradual phase-in approach identified above would be the introduction of an intermediary type of handset to bridge the gap between today's analog set and the digital set of the future. This would be a switchable set that would look for digital channels and use them wherever they exist, but would switch to an analog channel in the absence of a digital one. The switchable set will likely be more expensive than either the present analog or future digital models. This will not be popular with users who will note the contrast with the declining price of analog phones, the higher cost will be short-term pain for long-term gain.

Increasing Number of Base Stations

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.

Voice Response Systems

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.

Use of Spectrum

The CTS suppliers are running out of spectrum in the large urban areas, and would like the full 838 cellular channels made available. This requirement will become urgent once digital is introduced.

CHAPTER 3

PAGING

INTRODUCTION

While the paging market has been eclipsed in recent years by the high-profile cellular market, it has grown at a fast clip, 20% annually. There are a number of forces driving the paging market. First, there has been a significant drop in equipment prices, with some pagers sold in the $150 range. At the same time, there have been marked improvements in the variety and sophistication of pagers, including the introduction of digital and alphanumeric pagers.

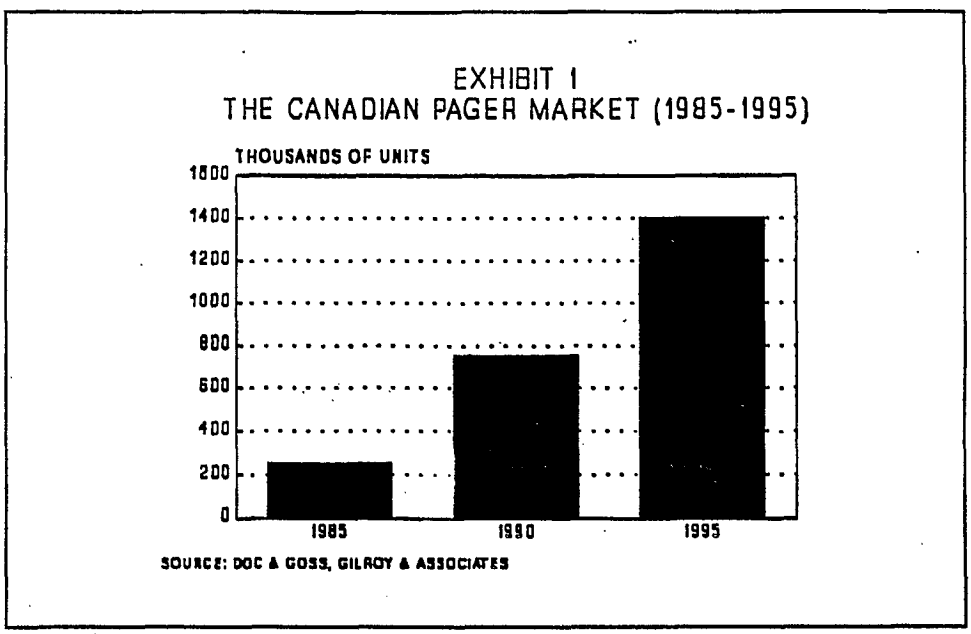
Another factor in the growth of the paging market has been the cellular roll-out. While cellular has been much more successful in marketing to certain segments, notably professional users, the paging market has benefitted from the increased public awareness of mobile radio products. In addition, the paging industry has successfully focused its marketing efforts on the medical, construction and service industries.

There are two basic types of paging services. Wide-area paging, the most common type in Canada, is the provision of paging service to subscribers by an independent radio common carrier (RCC). In-house paging networks are low power, local application networks, owned by the end user. Although in-house paging is only 10-15% of the size of the wide-area paging market in Canada, it is more common of the two types of paging services in Europe.

The Market Size

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 650,000 units in 1990, representing a penetration rate of 2.5% of the total Canadian population. Most paging services (85%) are provided through the RCC's. As of 1985 there were some 600 RCC's in Canada. The

RCC's earned about $160 million in subscriber revenues in 1989. National Pagette, MacLean Hunter Paging and Scotpage are examples of larger Canadian RCC's providing paging services. Not far behind the leaders there is Motorola Vetrapage, a division of Motorola. The Beeper People is a Toronto-based RCC which recently won a license to expand into markets outside Greater Toronto using a nation-wide frequency. B.C. Tel operates the most extensive paging network in B.C.



As far as the consumer market is concerned, there is little perceived demand for paging services. However, if paging was priced low enough and acquired the status of cellular telephones, for example, then paging could make serious in-roads in the consumer market.

Types of Pagers Available in the 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 pre-determined 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.

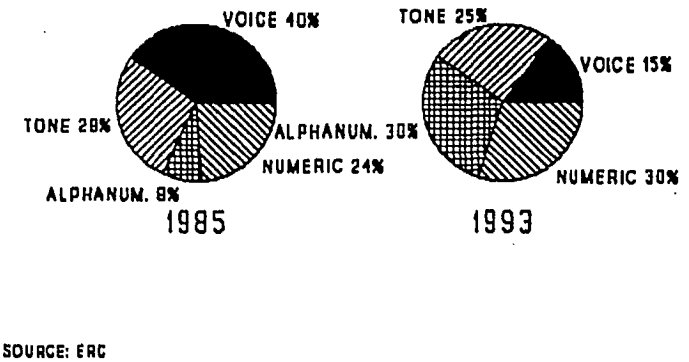
3) **Alphanumeric Display** - Capable of receiving and storing messages. In addition, a hardcopy of the message may be obtained if a subscriber has an optional adaptable printer. Subscribers of alphanumeric pagers include stockbrokers and their clients, lawyers, trucking firms and delivery companies.

EXHIBIT 2

Different Types Of Pagers

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

EXHIBIT 3
MARKET BY PAGER TYPE



SOURCE: ERC

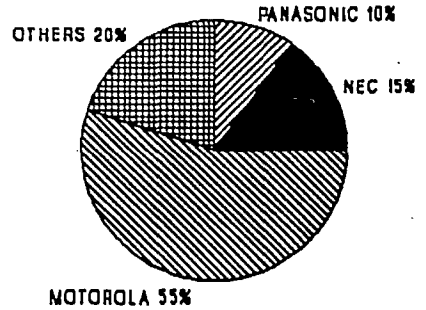
As is shown in Exhibit 3, alphanumeric and numeric pagers will be the biggest growth area; their combined share will increase from 30% in 1989 to 60% by 1993.

Equipment Manufacturers

Exhibit 4 shows the Canadian pager market shares of the principal equipment manufacturers for 1989.

EXHIBIT 4

PAGER MANUFACTURERS CANADIAN MARKET SHARE, 1987



TOTAL MARKET = $14 MILLION

SOURCE: EVANS RESEARCH CORP.

The market for pagers is dominated by three suppliers: Motorola (55%), NEC (15%) and Panasonic (10%). The major equipment suppliers are all foreign-based.

Paging Market in the U.S.

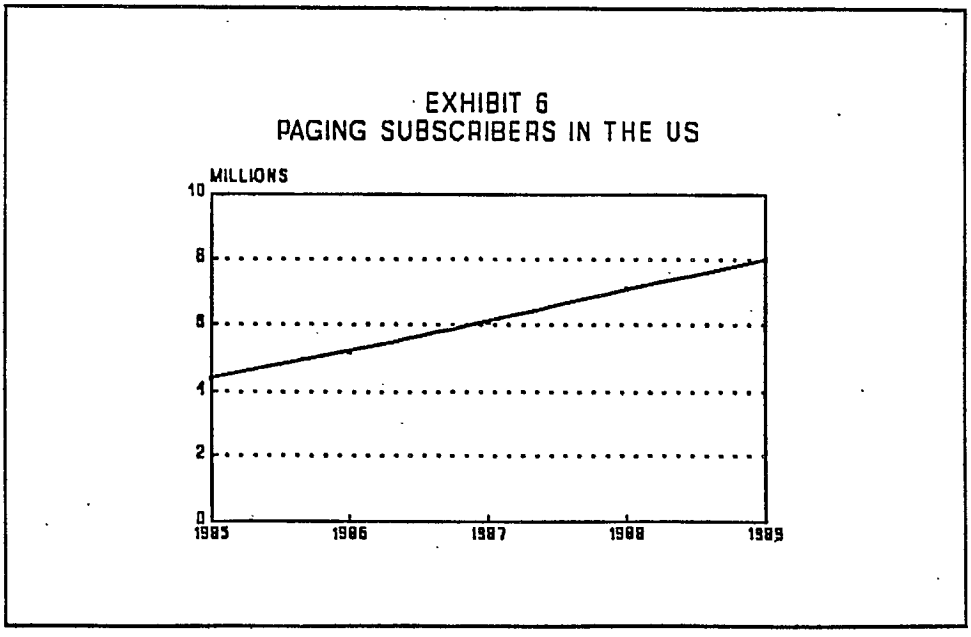
As is shown in Exhibit 5, the number of paging subscribers has grown from 4.4 million in 1985 (1 million in 1979) to 8 million in 1989 for an average growth rate of 16%.

EXHIBIT 5

Paging Market in the U.S.

	1985	1986	1987	1988	1989
Subscribers (millions)	4.4	5.2	6.1	7.1	8.0
Services Revenues ($ millions)	$960	$1140	$1340	$1560	$1750
Equipment Revenues ($ millions)	$150	$170	$200	$240	$300

SOURCE: International Resource Development Inc., Feb. 1990



The paging equipment market, while much smaller than the services sector ($1.75 billion), totalled $300 million in 1989.

EXHIBIT 7

Leading Paging Equipment Suppliers in the U.S.

Supplier	Estimated Market Share
Motorola	61%
NEC	19%
Panasonic	9%
Others	11%

As is the case in Canada, Motorola also dominates the market for paging equipment in the U.S. with a share of 61%.

Paging Market in Western Europe

EXHIBIT 8

Penetration of Paging in Various Countries

(1989)

Country	Total Installed Base	Penetration for 1000 of Population
United States	800,000	32
Canada	**510,000**	**20.4**
Norway	70,000	16.7
Sweden	125,000	14.9
Netherlands	210,000	14.5
United Kingdom	660,000	11.7
Luxembourg	3,000	10.0
Switzerland	55,000	9.2
Austria	70,000	9.2
Denmark	40,000	7.7
Finland	35,000	7.3
Belgium	60,000	6.1
France	190,000	3.4
West Germany	200,000	3.3
Western Europe	1,816,000	5.1

SOURCE: CIT Research Ltd., IRD and Evans Research

As is shown in Exhibit 8, there is much higher penetration of pagers in North America than in Europe. Canada's penetration of paging devices is four times that of Western Europe.

FUTURE TRENDS

From a recent survey undertaken by Goss Gilroy and Associates on behalf of the Department of Communications, 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:

- growth in the service sector (higher penetration of pagers 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 paging with cellular; a cellular pager can screen his calls and only respond to those which have priority; and

- pagers used in conjunction with the Telepoint CT2 phones now being used in Britain can turn these normally one-way phones into virtual two-way devices.

A recent trend in paging services is the development of nation-wide, networked service. Rather than being simple conglomerates of unconnected local services, the largest RCCs now offer users one transparent network across the country. This allows a Toronto user, for instance, to take his pager with him to Vancouver and be accessible while there to Toronto callers through a local Toronto number. These national networks are now being extended even further through international agreements between Canadian RCCs and RCCs in the United States and other countries. The federal government recently awarded two national licenses, one to Cantel and one to "MBM", a consortium of Motorola-Ultrapage, The Beeper People and Maclean Hunter Paging. The ability of the largest operating companies to offer inter-regional, networked coverage is an additional advantage for them competing against local independents.

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).

Radio-paging 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.

To conclude, radio-paging is a vibrant industry and is expected to have a high future growth rate inspite of the emergence of cellular telephone. The major future opportunities lie in the provision of complementary services where paging service is only one component of the total mobile communications service.

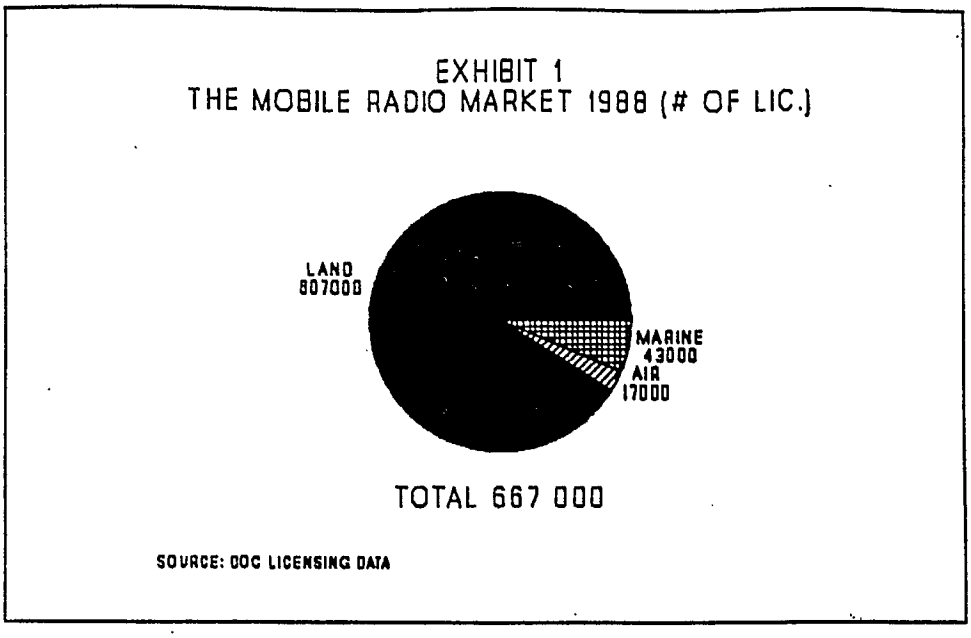
CHAPTER 4
MOBILE RADIO SERVICE (MRS)

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 systems 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.

The MRS Market

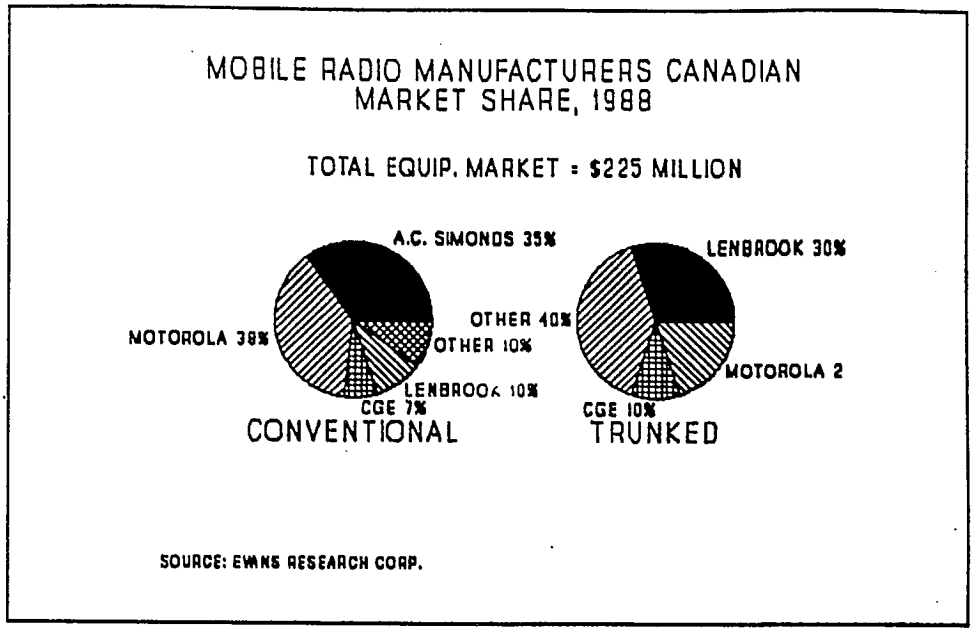
In 1988, there were 667,000 mobile licenses issued in Canada, of which 607,000 were for land-based applications. For marine and air applications, 43,000 and 17,000 licenses respectively were issued. The distribution is illustrated below in Exhibit 1.



Equipment Manufacturers

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. Exhibit 2 shows graphically the market share of the major manufacturers for both the conventional and trunked markets.

EXHIBIT 2



Services

Mobile radio services are supplied by both RRC'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, carried out by Goss Gilroy and Associates, 55% of the firms indicated that they used MRS. 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 utilize 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.

Mobile Radio Service in the U.S.

EXHIBIT 3

Two-Way Mobile Radio Equipment Market (1989)

($ Millions)

Segment	Revenues
Land Mobile	$1,620
Marine	15
Air-to-Ground	50
CB	20
Amateur	15
Total	$1,720

SOURCE: IRD, Feb. 1990

The two-way mobile is almost exclusively an equipment market, with $1.72 billion in annual sales from land, marine, air-to-ground, mobile data and amateur radio equipment. By far the largest segment is two-way land mobile, which had $1.62 billion in equipment sales in 1989. Exhibit 3 sets forth 1989 revenue figures for the two-way market.

EXHIBIT 4

Land Mobile Market Revenues (1989)

($ Millions)

Segment	Revenues
Public Safety	$ 540
Industrial	$ 850
Land Transportation	$ 230
Total	$1,620
Trunked radio equipment	$ 200
Total	**$1,800**

Exhibit 4 gives revenues for various sectors in the land mobile market.

Public Safety

Public safety applications for land mobile include dispatch, vehicle tracking and location, data base access and other uses for police, fire, emergency and other services. The public safety sectors is dominated by Motorola.

Industrial

The industrial market is the largest conventional land mobile segment, with $850 million in annual revenues. This sector is also dominated by Motorola. A large number of industries, including power, construction, manufacturing, telecommunications, forestry, agriculture and even motion pictures use two-way land mobile extensively.

Transportation

The railroad and taxi cab industries account for the largest segments with other applications in urban transit and other land transportation systems.

EXHIBIT 5

Two-Way Mobile: Leading Supplier Market Shares

Supplier	Estimated Market Share
Motorola	60%
E.F. Johnson	13%
GE	12%
Midland	7%

SOURCE: IRD, Feb. 1990

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%.

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 have a slight negative impact on MRS customers. Within the MRS market, trunked radio systems will continue to obtain a larger share of the market.

To conclude the discussion, MRS is a highly developed service but is not expected to have a high future growth rate due to developments in cellular technologies. The growth rate will be steady but small (0.5%). There are no major Canadian equipment manufacturers in this field.

CHAPTER 5

CORDLESS TELEPHONES AND TELEPOINT SYSTEMS

Cordless Telephones

Cordless telephones, although technically based on mobile radio technology, represent a somewhat different market from the rest of the mobile radio industry. For the most part, the cordless telephone market is residential and consumer based, rather than largely commercial and professional like the rest of the industry. Because of base in the home telephone market, cordless telephones are marketed and distributed more like other telephone equipment than like mobile radio systems.

Consumer demand for cordless telephones has grown fairly steadily since the shaky beginnings of the industry in the late 1970's and early 1980's. Cordless telephones provide a convenient, low-cost portable phone that can be operated effectively in and around most houses. While they do not offer the range and scope of other types of mobile radio, they are also much less expensive.

By and large, cordless telephones are purchased as second units, to provide more mobility than the stationary unit. In addition, most cordless telephones are sold to consumers who are accustomed to shopping for and purchasing telephones. While cordless telephones remain a somewhat discretionary purchase for upscale consumers and, therefore, face competition from enhanced telephone equipment, including answering machines, integrated answering machine/digital dialling telephones and other equipment with enhanced features, cordless telephones have maintained fairly steady growth in the past few years.

Telepoint (CT2) Systems

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. 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.

In January 1989, four Telepoint licenses were awarded in the UK (out of 11 applications). The new licensees will operate Telepoint networks based on the UK developed CT2 advanced digital cordless telephony technology. The licenses provide forty 100 KHz channels spaced from 864 MHz to 868 MHz.

EXHIBIT 1

Successful UK Telepoint Applicants

System Name	Launch	Shareholding
Phonepoint 'Phonepoint'	August 1989	BT (45%), STC (25%), NYNEX (10%), France Telecom (10%), Deutsche Bundespost (10%)
Ferranti Creditphone 'Zonephone'	End October 1989	Ferranti (60%), Telephone Rentals, British Technology Group, Fleming Investments, British Linen Band
Mercury Callpoint	5 December 1989	Mercury (33.3%), Motorola (33.3%), Shaye (33.3%)
BYPS	Spring 1990	Philips (33.3%), Barclays (33.3%), Shell (33.3%)

The Telepoint handset weighs around 270 grams with an effective radiated power (EIRP) of 10 mW.

To make a call, the user presses one of the handset keys and waits till he is given a voice prompt to enter his personal identification number (PIN). The system then verifies the PIN and the call can be made in the normal manner. All details of the call are logged by the base station and passed on to a billing computer. Subscribers receive a bill for the calls made every quarter and this can be itemized if required.

The system became operational during 1989. Customer forecasts are to have 500,000 customers in two years and from 3-6 million customers by 1995.

Other European Developments

The first Telepoint trial outside the UK was operated by the Helsinki Telephone Company in Finland, in October 1989. The trial, which involves five base stations and a number of hand terminals, all supplied by Shaye Communications of the UK, is limited to staff of the telephone company. However, the trial network is connected to the public switched telephone system.

In November, 1989, the Deutsche Bundespost took a further step towards creating a Telepoint system in West Germany by inviting informal opinions from companies interested in the operation of networks. The invitation is part of a process which also involves a public trial of two Telepoint systems in three West German cities next spring. The two trials include:

- the analogue 'cordless telephone 1-plus' (CT1+) in Munster and Dortmund; and

- the UK Telepoint system, classified as CT2, in Munster and Munich, over six months from April/May 1990.

The Bundespost is testing two systems because it believes that performance for the end user could be equally good on both analogue and digital. If this turns out to be true, it will select both systems at end of trial. It has not yet been decided whether the DBP will keep a monopoly on network operation, or whether another operator will be licensed.

In France, the test trial of France Telecom's Pointel Telepoint system is expected to start by the end of 1989, and will run until March 1990. The experimental system will employ 250 base stations. France Telecom has now issued a tender for the supply of 2,000 - 10,000 Pointel receivers to operate at 864 - 868 MHz. It expected to receive around ten

bids. This service is due to start at the beginning of 1991 and the value of the network is put at several hundred million francs.

The Irish government in early November was coming under pressure from its telecommunications industry to issue Telepoint licenses. In the last few months it has received several unsolicited applications to operate Telepoint services based on the UK's digital cordless standard.

Developments in Canada

The Canadian Department of Communications issued a Public Gazette Notice in 1989 inviting field trials of public cordless telephone service in Canada for the purpose of determining spectrum requirements, technical standards, and licensing requirements. The deadline for response was March 1, 1990.

In addition, an industry advisory committee has been established under the auspices of the Radio Advisory Board of Canada to consider product and service definition and standards issues related to public cordless telephone service.

Twenty-seven organizations responded to the Department's notice. These included the following:

Service Providers

AGT, Bell Canada, BC Tel, ED Tel, SaskTel, Maritime Telephone and Telegraph Co., Telecom Canada, Telesat, Telesat Mobile Inc., The Beeper People Inc., BCE Mobile, Cantel, Cablecasting Ltd., Maclean Hunter Communications Inc., and CNCP.

Manufacturers

Northern Telecom, Novatel, BNR (R&D Co.), Motorola Canada, and Lan Ser Telecom Inc.

Associations

CBTA (Canadian Business Telecommunications Alliance), APCO Canada (Associated Public-Safety Communications Officers), Canadian Hearing Society, and Radio Communications Association of Canada.

Governments

Ontario Ministry of Culture and Communications, and Government of Newfoundland and Labrador.

So far, three organizations have applied for field trials. These are: BCE Mobile for a trial in Montreal; Bell Canada for a trial in Montreal; and The Beeper People Inc. for a trial in Toronto. These trials will utilize about 10-15 base stations and 300 users.

It is generally felt by all the respondents that DOC's initiative is a step in the right direction.

Many respondents felt that it is premature to comment on standards and other policy questions before the trial experience is available.

A number of respondents felt that the Department's proposal for four national service providers had no justification other than the fact that UK had decided on four. Canada has different needs and the number of service providers should be decided by the marketplace subject to spectrum availability.

Should the experimental trials of public cordless telephone services prove to be successful from a technical and marketing point of view, and spectrum, institutional, industrial, technical, service and regulatory issues can be satisfactorily resolved, the Department will establish a radio licensing policy in the future for public cordless telephone service to license these services.

The Department is establishing a deadline in this work of September 1, 1991. By that time, all field trials will cease and a decision on the commercial licensing of public cordless telephone service will be made.

The U.S. Market

EXHIBIT 2

Cordless Telephone Revenues: 1985-1989

($ Millions)

1985	1986	1987	1988	1989
160	270	380	470	600

While the market still suffers from the bad reputation of its early years, the industry has recovered, and had 1989 revenues of $600 million. The quality of the phones has improved markedly, and that itself has become a major selling point.

While introduction of Telepoint in the United States will occur later than in Europe, Telepoint has already sparked considerable interest in the U.S. An American equipment company, Cellular II America, has already begun bids for equipment production, and several other manufacturers, including GPT and Ericsson, are gearing up for the North American market.

CHAPTER 6

PERSONAL COMMUNICATIONS

A totally new development to emerge in 1989 is that of personal communications. Development of this concept is currently confined to the UK. A discussion document entitled "Phones on the Move", which proposed the introduction of a whole new generation of mobile telephony, was circulated by the Department of Trade and Industry (DTI) in January 1989. The Personal Communications Network (PCN) would provide a new two-way voice and data communications system by the second half of the 1990's.

What is PCN?

The DTI has received eight applications for PCN licenses. PCN is therefore still in a very early stage of development and no clear definition of the product or service has thus far been declared. It is known, however, that PCN will be a two-way communications device, using digital technology and operating between 1.7 GHz and 2.3 GHz. This implies a product with the features of cellular radio, but the cost and size of Telepoint. Such a balance is difficult to reconcile and many questions remain unanswered about exact features and cost.

The conception of a new national telecommunications network, introducing light-weight, personally numbered mobile handsets, and open to all, confirms a number of trends within mobile communications. It was perhaps inevitable that rapid growth of mobile markets should eventually encroach on the fixed telecommunications network. PCN represents some continuation of the trend towards a smaller cells structure, as encountered by cellular systems. It must provide something additional to existing mobile and cordless communications, if it is to reach some unfulfilled market need between the digital cellular networks of the 1990's and Telepoint.

The decision to operate PCN at the higher end of the spectrum, enforced by the scarcity of frequency, creates some advantage for PCN. A greater amount of spectrum becomes available with these higher frequencies, which are able to accommodate a smaller cell pattern. This lends itself to light-weight, low power handsets which can be produced at low cost and are potentially attractive to the mass consumer. Depending on demand, the greater costs involved by a complex small cell infrastructure could therefore be compensated by large manufacturing volumes, allowing a realistic equipment price range of $200-$300.

While digital cellular is almost certain to remain a business phenomenon, PCN, with greater emphasis on price, will encompass less mobile functionality (i.e. restricted handover facility), and will be aimed at the residential customer.

Exhibit 1 lists the eight applicants for PCN licenses, mainly comprising consortia groups. There is a distinctive international flavour to these groups, including telcos, manufacturers and industrial enterprises. Whichever groups win the right of network provision, they are likely to present a powerful lobbying force to global governments for PCN, once it is established in the UK. The precise target market for PCN will become clearer over time. However, PCN's ultimate success will come by attracting mass consumer demand.

The UK Government announced on December 11, 1989, that personal communications network (PCN) licenses would be awarded to three consortia. This will enable these groups to provide mass market mobile communications systems in the UK in the 1990's.

The successful applicants were: Mercury PCN (a group featuring Mercury Communications, Motorola and Telefonica); BAe (comprising British Aerospace, Pacific Telesis, Millicom, Matra and Sony); and Unitel (with STC, US West, Thorn EMI and the Deutsche Bundespost).

EXHIBIT 1

Applicants for UK PCN Licenses

Applicant	Members	% Share
Mercury PCN	Mercury/C&W	60
	Motorola	20
	Telefonica	10
PCN One	GEC	40
	BellSouth	25
	Philips	10
	Kingston Communications	5
Unitel	STC	30
	US West	30
	Thorn EMI	25
	Deutsche Bundespost	15
BAe	British Aerospace	35
	Pacific Telesis	20
	Millicom	14
	Matra	10
PCN Ltd.	Ferranti	
	GTE	
	Hutchison Telecom	
	Jonathan Clark & Associates	
Intouch	Gooding Investments	
	Murray International	
	Noble Grossart	
	Welsh Water	
	Technophone	
	Hambro	
	Eurocell	
	Contel Cellular	
	MTel	
21st Century	21st Century Networks Ltd.	100
Mr. R.G. Maling	Private applicant	100

Technology and Standards

The infrastructure for PCN will give most clues to its functionality. Because high frequencies have been set aside for PCN, cells are certain to be small, but variable. Each network is likely to consist of a two-tier cell structure. A base grid of 'macro' cells (from around 5-15 km in diameter) would serve two functions: as a connection to fixed links, and as network coverage in all rural areas. This would provide a national vehicle-user network and also interlink with smaller overlaying 'micro' cells in more congested areas.

These micro cells (as many as 200 m) will overlay the macro cell structure and will be used in the following special instances:

- in urban areas where high usage is expected to cause overcrowding;
- for more specific needs, where PCN acts as a cordless PBX, or in a shopping centre/railway station;
- in remote areas on the edge of macro cells, acting as a booster, or joining a location which covers two existing cells.

This scenario covers urban shoppers and commuters as well as the major part of the domestic market. These micro cell users could dispense with existing fixed links and communicate locally via radio. Micro cells should prove cheaper, both in terms of equipment and usage charge. Savings will be possible due to a high system capacity over a small surface area. Other cell types may emerge, including elongated cells providing extended coverage along motorways and major routes. This would allow some slow speed handover facility. For incoming calls, there is speculation that paging technology will be included as a cost effective means of tracking the PCN device.

The nature of the PCN handset will have an inevitable bearing on both the functionality of, and demand for, personal communications. In order to appeal to the mass consumer (and achieve cost-effective production volumes), the PCN device must be small and light. This

means that it cannot have integral batteries of a range comparable with digital cellular. Blanket coverage will only therefore be feasible where micro cells are commonplace - urban areas, special points (shopping centres, airports and railway stations) and along major routes. Elsewhere, total coverage will only be possible if the user can boost the power of the device, presenting an equivalent power range to digital cellular.

The power output of the PCN unit would be considerably less than that of cellular; however, it would enable a considerable weight reduction in the handset and lower cost. Handover would not be possible at speeds above 30km/h, but this emphasizes the difference between the mobile PCN (for consumer convenience) and cellular (for the businessman on the move).

There are some clear distinctions between cellular and PCN, therefore, but with PCN technology still at a very early stage, the period prior to the formal launch of PCN (expected around 1993) will be crucial in terms of deciding upon standards and building the technology.

One area still at the centre of the PCN debate concerns the technical standard likely to be adopted for the system. The DTI has proposed that PCN be developed to conform to a publicly available standard, so that operators and equipment suppliers can benefit from a mass market for mobile systems in Europe.

The DTI will ultimately decide which standard to pursue, however, the emergence of a de facto standard is one likely course. No specification exists for radio equipment around 2 GHz.

The UK's decision to introduce this new force into the telecommunications market brought initial criticism from other European countries, notably France and West Germany. Both believed that plans for PCN would undermine the development of digital cellular and Telepoint. France Telecom and the Deutsche Bundespost are each involved in Telepoint consortia, although the DBP is now also active in one of the PCN applications.

However, ETSI, the European Telecoms Standards Institute, recently asked the DTI to allow it to prepare the standard for a European PCN, believing in the adoption of a harmonized approach. European nations showing an interest in developing PCN in their own country are likely to be in favour of a pan-European approach to the standards issue, rather than wait for the UK to establish a de facto standard.

RACE Personal Communications Mobile Project

A number of European companies and research institutes are being led by Phillips Radio Communications System to develop a personal communicator by 1998 which would combine the functionalities of radio paging, cellular and cordless technologies, through the development of micro cells with a radio capacity for mass traffic at 1.7 GHz.

Participants

Phillips Radio Communications	NOKIA
AEG	OTE
Alcatel	Phillips Research Labs
British Broadcasting Corporation	Phillips Komm. Ind.
British Telecommunications	TRT
THEM	SESA
DNL	TELETTRA
EB Technology	THORN
Ericsson	UOS
FUB	Plessey
GEC Marconi	Telenorma
MULLARD	STAL
Nat. Microelec. Research Centre	IRL

Under the RACE program this project is referred to as The Race Mobile Project R1043. This project began in 1988. The Race Mobile project covers two main classes of mobile service:

Universal Mobile Telecommunications System

To provide speech and low to medium rate data services.

Microwave Broadband

To provide very high bit rate connections to mobile units. Such systems cannot in the foreseeable future provide complete geographical coverage but will be important for certain specified applications.

The goal of the Universal Mobile Telecommunications System (UMTS) is a standard flexible air interface for all classes of service (e.g. cordless telephony, cordless PABX, cellular radio, etc.). The UMTS concept is an approach within RACE which is expected to evolve during the course of the program. The key elements of UMTS are:

- a common standard for public cellular systems and private cordless telephones with full interworking;
- very low cost personal terminals, i.e. a mass market pocket telephone;
- an infrastructure comprising a mixture of public and private cells connected to the IBCN so as to allow growth constrained only by economics; and
- high bit-rate radio channels designed to carry a wide range of data services including video and graphics, short messages, large data files.

The work described in this project proposal aims to work towards standards for the connection of mobile services to the Integrated Broadband Communications Network (IBCN) which is the main focus of the RACE programme.

The Future Market for PCN

PCN is strictly a UK entity at present, although the international composition of license bidders suggests a global future. It is unlikely that the announcement of PCN will affect the current and short term market for mobile communications, although ultimately there will be an element of competition with cellular and Telepoint systems.

In addition, both Telepoint and cellular have time to consolidate before the launch of PCN; and even if PCN evolves into a concept fairly close to cellular, then existing operators may be at a market advantage, with infrastructure already in place. It is therefore clear that the risk factor is firmly with PCN for the moment. However, with substantial investment, innovative planning and the use of extensive mobile and telecommunications experience, PCN has potential to provide great opportunities to industry.

Another area as yet uncharted is the technology of PCN. The rather complex cell structure is bound to present some problem to operators, who will face a struggle to launch PCN by the required date as well as a strain on their financial, operational and technological resources.

Once technical difficulties are overcome, marketing will become the crucial factor. Already Telepoint licensees have found this should never be ignored. Like Telepoint, PCN represents a new departure in communications and market awareness and demand must be generated for the product. In this respect, cellular holds a distinct advantage because it represents a refined product for an existing customer base. For initial appeal to the consumer market, however, PCN must not only be cheap, but also present itself in a very different light from cellular's 'executive' image. If it can achieve these, PCN could come to represent a solution to the current void in the latent mass telecommunications needs of the public.

CHAPTER 7

MOBILE DATA COMMUNICATIONS

Introduction

Compared to mobile voice communications, the market for mobile data is fairly small. Data communication using mobile radio is used by private organisations such as police, taxi and transportation companies. The most noteworthy development in this area is the recent emergence of two public mobile data communications services: MobiData and Mobitex. This section gives a brief description of these two services.

MobiData Network

The MobiData network is owned jointly by BCE Mobile (60%) and Motorola (40%) and is operated by MobiData Communications Inc. Since the MobiData was launched in July 1989, one major corporate customer has signed up, Tandem Computers. Tandem will bring about 150 customers to the service by the end of 1990. During 1990, the company expects to have some 3500 subscribers. Service charges are anticipated to be roughly $70-80 per month.

It is to be noted that only Motorola/MDI manufactured terminal equipment will operate on the network which operates at a speed of 4800 bps. The terminal is priced at about $5000. This shortcoming will be remedied somewhat when the company begins selling its RF modems in mid 1990's. The modem will enable proprietary laptops to be utilized via an RS232 port and will cost about $1000.

To increase the range of services offered by MobiData, the company has connected its network to Telecom Canada's Datapac, Envoy, and iNet services and to CNCP's Infoswitch public packet data network. In addition, MobiData in Canada is expected to link up with Motorola's US Data Radio Network in 1990 to further extend coverage.

Mobitex Network

Mobitex, the second mobile data network, is owned by Cantel and its network equipment is supplied by Ericsson. The network had been operational on a trial basis for some time before its official launch in April 1990.

Mobitex operates at 1200 bps but will increase to 8000 bps in the mid 1990's. In contrast to Motorola, Ericsson has decided to publish full technical data on the terminal interface to allow other manufacturers to supply terminal equipment. The company hopes that the adoption of this "open standard" will establish its system as a de facto standard in different countries. Companies other than Ericsson which are developing suitable terminals are Mobile Data International (MDI), Gandalf, Coded Communications, Glenayre, Nokia, and Phillips.

The basis for interconnecting the Canadian Mobitex system with a similar network in the US has been established. Ericsson will supply RAM Broadcasting's Mobile Data Company division with the Mobitex System. The US network is not expected to offer services until mid-1992. In this regard, the Mobitex network lags behind MobiData considerably.

Primary User Groups

Mobile data service users will typically come from the following four segments:

Transportation
Field sales (real estate, industrial marketing)
Professional (accountants, engineers)
Field service (oil and gas, construction)

MobiData expects 3500 customers by the end of 1990 while Mobitex estimates its 1990 customer base at 2500 for a combined user base of 6000 subscribers. The number of total subscribers is expected to grow to 25-30,000 by 1992. This will be less than 5% of the cellular voice customers. Thus, the mobile data communications market will be fairly small compared to voice.

CHAPTER 8

MOBILE SATELLITE COMMUNICATIONS

Satellites have been used in mobile radio since the inception of the satellite industry. However, their role has been limited primarily to the marine sector, since satellite technology was the most effective means of communications for vessels at sea. The Navy, Coast Guard and commercial shipping industries have used satellite communications for many years.

In the land mobile area, satellites have not played a major role, since the technology was expensive and, until recently, there was little end user demand. However, during the 1980s, technological improvements in satellite systems and price decreases have spurred greater interest in satellites. In addition, the Department of Communications pioneered an investigation into mobile satellite services, which encouraged system development in the private sector. While there are some remaining problems in the delivery of voice, primarily because of the voice delay and difficulties with resolving echo problems, satellite systems have already proved to be effective in delivering data.

There are currently four satellite services which are either commercially available or being planned for mobile communications. These are briefly discussed below:

Inmarsat

Inmarsat has provided satellite communications to ships, to provide access to telex, telephone, and data communications since 1979. The number of ship terminals has grown from 1000 in 1979 to 7600 by late 1988. Inmarsat currently has 54 member countries, with Canada through Teleglobe Canada Inc. having 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% and Japan with 9.5%.

This year, Inmarsat will introduce a new service using small, simple, robust satellite terminals. The service called Standard-C communicates text messages to and from mobile terminals anywhere in the world. Standard-C equipment is very small and can be easily carried as a portable in a briefcase. Standard-C entered a pre-operational stage in April, 1989, with 1000 terminals in use and will become fully operational at the end of 1989. Pricing estimates place the transmission cost at $.80 to $1.00 for 125 characters.

MSAT

In late 1988, Telesat Canada announced that Canadian Pacific Limited and a Japanese Investment Group were its partners in a $360 million venture to bring mobile satellite service to Canada. A subsidiary of Telesat, named Telsat Mobile Inc. (TMI), will construct and operate mobile satellite service in Canada. TMI in conjunction with a U.S. consortium, the American Mobile Satellite Consortium (AMSC), will create a North American system. Each will back up the other's satellite so that neither will have to launch a costly spare. In addition, users of each system will be able to "roam" anywhere in the U.S. and Canada.

TMI plans to offer a mobile messaging and vehicle locations service in Eastern Canada using Inmarsat facilities. This preliminary service will be commercially available in mid-1990. Organizations which are currently trialling this service include three trucking companies (Allied Van Lines, Frederick Transport, and Thompson Transport) and a remote data collection agency. The use of Inmarsat allows TMI to build its customer base, develop terminal equipment, and assess market risk before launching its own MSAT satellite in 1993, with a full range of mobile services being available by late 1993.

TMI plans to offer voice message and data communications services to land vehicles, ships and aircrafts. These MSAT services are expected to find their highest potential in rural and remote regions where their work-area coverage and extended range features are of greatest benefit. TMI has gained financial support from the Canadian government and large Canadian companies. It has obtained an agreement worth $126.5 million to provide mobile services for the Canadian population not covered by cellular service.

TMI forecasts that there will be over 100,000 MSAT units in operation by the year 2000. Thirty-three per cent (33%) of these will be for mobile voice operations, and the remaining 67% will be for data applications. Pricing for MSAT is not yet final, but should resemble the following:

Mobile terminal	$4000 - $6000
Access charges per month/terminal	$50 - $150

Voice	$1.50/minute
Data	$.25 to $.75 per one-way message (32-128 characters)

Equipment vendors which are involved with TMI in the development of mobile satellite technology include: Spar Aerospace, CAL, Gandalf, Glenayre Electronics and Hughes Network Systems. Discussions are also underway with Motorola to look into developing both mobile voice and data units.

Geostar and Qualcomm

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 user for mobile satellite communications 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.

Since beginning service last summer, QualComm of San Diego has won several large contracts to install at least 20,000 truck terminals. The system can be used for two-way messaging and position reporting, including the transmission of permits, bill of landing, time of departure, etc. The truck terminal costs from $4200 - $5000 U.S. and the cost of sending messages per truck averages less than $5.00 U.S. per day.

Geostar also provides data services for truckers. Since beginning operation in June, 1988, more than 50 fleets and over 2000 vehicles have installed Geostar's Radio Determination Satellite System (RDSS). The average cost for truck for the two-way system is $4800 U.S. The cost of communications is less than 5 cents per 100 character message. Under its subsidiary, Geostar Messaging Corp., Geostar plans to build and launch a $350 million, two-satellite system that will provide the technology to support digital voice and data personal communicators. According to Gartner Froup Inc., Motorola is believed to be developing the hand-held mobile communicator for the Geostar Messaging system and will likely be priced at $500. That terminal can connect to a user's laptop PC to provide instant communications to remote databases. Geostar predicts it will have two million users and gross revenues of $1 billion by 1997.

Current Mobile Satellite Market

EXHIBIT 1

Satellite Mobile Radio Market Revenues: 1989

(North American Market)

	$ Millions
Equipment	$40
Services	$10
Total	$50

The mobile satellite market is still small, with only two vendors; Geostar and QualComm. Exhibit 1 sets forth 1989 revenues for the mobile satellite market.

There are currently two primary suppliers of end user equipment to commercial mobile satellite services - Sony and Hughes. Since current units are priced far above other competing mobile radio systems, mobile satellite units are restricted to intensive, high-end applications such as those in the long-haul trucking area. Both Geostar and QualComm currently lease satellite space from GTE.

End User Demand

While vendors in the U.S. predicted considerable demand for MSS in the license applications, there are still significant questions about the extent and the nature of end user demand. Certainly, in the RDSS area, early demand has been demonstrated by the trucking industry, particularly by companies which transport perishable goods. And while the mobile satellite terminals are far more expensive than other mobile units, certain end users benefit significantly from the location capability afforded by RDSS. Increased penetration of RDSS in the long-haul trucking industry can therefore be expected within the next few years.

A much greater problem for the satellite industry is the demand for other MSS systems. Geostar, for example, has announced that its System Three service, which will provide end users with hand-held MSS terminals, will begin operation in 1992. Geostar is anticipating demand for these personal terminals from a variety of end users, including sales people, public safety personnel and other individuals who need to maintain contact or have their location fixed by their headquarters location.

Personal MSS

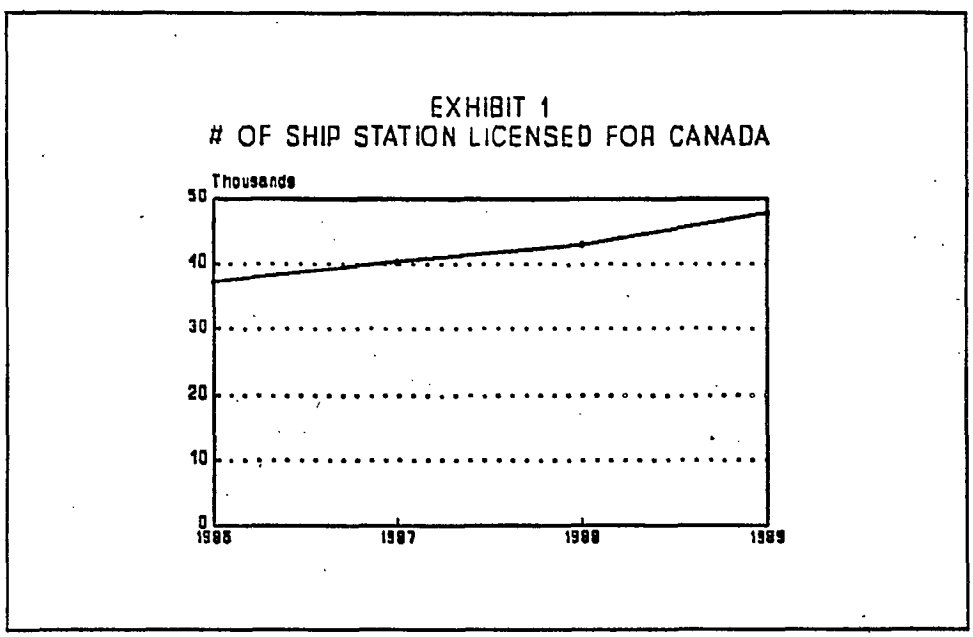
The roll-out of personal MSS systems, as well as satellite applications for alarm signalling, telecopier and fax systems, paging and other systems now in operation in the mobile radio field, will depend to a great extent on pricing. For most end users, significantly higher prices for satellite systems cannot be justified unless the additional geographical scope of MSS provides specific advantages. This will, of course, depend on the individual end user's needs.

While MSS will be able to capture a certain segment of users who must operate on a national or regional basis beyond the scope of individual land mobile networks, most end users will not, at least initially, be attracted by this feature of MSS. Only when the price of MSS is truly competitive with other mobile radio systems will it begin to tempt the bulk of consumers.
Even then, it may face serious competition from cellular and two-way radio systems that provide efficient regional or national interconnect services. This is particularly true in the case of voice delivery, since MSS systems still have the built-in downside of a time delay in voice delivery, and some residual problems with echo.

CHAPTER 9

MARINE MOBILE COMMUNICATIONS

Marine radio remains a small market, with slower rates of growth than the rest of the two-way market. As is shown in Exhibit 1, there are 47,000 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.



SOURCE: DOC

There are three types of mobile communications services available to the Marine users.

Conventional Radio Service

The primary mode of communications for the marine user is through the use of VHF, MF and HF mobile radios. The users can also access the Public Switched Telephone System (PSTN) using duplex telephone calls 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 services in British Columbia.

The Coast Guard Radio Station (CGRS) network operates 39 manned radio stations and 89 remotely controlled facilities on both Canadian coasts, in the Arctic and along the shores of important inland waterways. This radio station 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.

At the present time, the primary service provider is the Coast Guard Radio Station system. The service is 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 are aware of, Polestar Communications (Darmouth, N.S.) and Sealink (St. John's, Newfoundland), only Sealink remains in business.

Inmarsat Service

The link of voice privacy and the time and difficulty of making connections through the CGRS, or any of the Coast Radio Systems in other countries has lead to 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).

At present, there are 7584 Inmarsat terminals throughout the world. Canada has seventy-five, twenty-one of which are government-owned. 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 if the ship has an INMARSAT terminal. In addition, the International Marine Organization will be overhauling the Convention with the introduction of its Future Global Marine Distress and Safety System (FGMDSS) in the early 1990's. The FGMDSS will rely heavily on satellite communications.

Cellular Radio Telephone

The rapidly growing cellular telephone system in in-shore areas and increased use of land mobile VHF "Autotel" (an automated form of mobile radio using the VHF band with the capability to connect to the PSTN) 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.

The U.S. Market

EXHIBIT 2

The U.S. Marine VHF Radio Market, 1989

Installed Base	525,000
Units Shipped	55,000
Revenues	$15 million

Source: IRD, Feb. 1990

The U.S. market is about 11 times that of Canada.

Despite the small size of Marine market, the number of competing manufacturers have stimulated drops in equipment prices. In addition, the fluctuating nature of the pleasure boat market, which varies considerably according to the price of oil and general economic conditions, has added uncertainty to the market.

Future Trend

The trend for Marine Communications is clearly towards increased use of satellites and mobile telephone services away from the CGRS service.

CHAPTER 10

AIR MOBILE COMMUNICATIONS

The air mobile communications area is far more limited than either the marine or land mobile areas. The primary means of communications used by air users is the 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.

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 those 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.

British Airways has introduced the trial of a passenger service using INMARSAT satellites. Four cordless 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 is successful during this trial period, it will be extended to all British Airways long-haul flights.

Recently, Teleglobe Canada announced that it in conjunction with three other partners will be offering satellite service, via INMARSAT, to the world's airlines. 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. Teleglobe estimates that the market for aeronautical communications services will be more than $1 billion by the year 2000.

The U.S. Market

EXHIBIT 1

Air-to-Ground Market Segment in the U.S., 1989

Installed Base	280,000
Units Shipped	20,000
Revenues	$50 million

SOURCE: IRD Study, Feb. 1990

As is shown in Exhibit 1, the air-to-ground market in the U.S. is quite limited with an installed base of only 280,000 units.

CHAPTER 11

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 intercity highway travel;
- 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 or customers who are based at fixed sites or are themselves on the move.

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 areas; and,
- improved overall communications infrastructure allowing more extensive coverage of the populated areas.

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

Paging

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 benefits of paging 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.

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.

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, saving lives and/or reducing the severity of injuries. Certainly, productivity improvements will result in cost reductions for providing the equivalent level of service, and the reduction in fuel consumption.

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. The primary benefits of CTS to users are given below.

- **Improved Productivity:** by allowing the use of unproductive time (struck in traffic, telephone tag). A study undertaken by AT&T estimated the average time saving at approximately four hours per week.

- **Quick Customer Response:** 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 or reschedule appointments because of traffic delays is also viewed as being advantageous.

- **Emergency Uses:** both cellular carriers provide all 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. Most calls related to fires, accidents, reckless drivers and reporting of crimes.

- **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 the traffic;

- **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 database 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.

Mobile Satellite Services (MSS)

Mobile satellite services have already made a contribution in the trucking industry. In trucking, the benefits of using MSS are to:

- keep drivers from wasting valuable time tracking down payphones or charging long-distance phone bills while waiting for an available dispatcher. It has been estimated that drivers save up to 45-60 minutes per day in phone calls.

- 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.

Another application which 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.

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.

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