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**A Study to Forecast
Datacasting Services in Canada**

June 12, 1991

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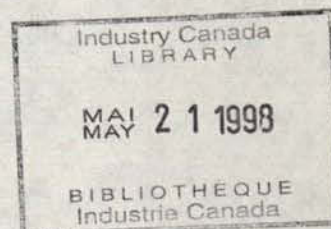
**A Study to Forecast
Datacasting Services in Canada**

by NGL Consulting Ltd.

**On behalf of the Communications Research Centre
Department of Communications**

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June 12, 1991



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EXECUTIVE SUMMARY

Background and Study Objectives

The Communications Research Centre (CRC) of the Department of Communications (DOC) engaged NGL Consulting Ltd. to conduct a study to forecast datacasting services in Canada. The Department is cooperating with industry, broadcasters and other government departments in developing applications for teletext. In addition, it is also involved in planning for the delivery of new services such as Digital Radio and Advanced Television. Therefore, DOC needs to ensure that an appropriate amount of channel and spectrum capacity is allocated for datacasting signals.

Specifically, the study had the following objectives:

- describe the various technologies now being used for datacasting;
- describe the datacasting services now in existence and those likely to emerge during the forecast period;
- forecast the potential demand for datacasting services using such technologies as teletext, FM sidebands and VSAT's for government, business, and consumer applications in the short term (one to five years) below 512 Kbit/s;
- forecast the long term potential demand for datacasting services in the time frame when Digital Radio and Advanced TV services will be introduced (1995 - 2015) below 512 Kbit/s;
- provide an opinion on the potential demand for datacasting services above 512 Kbit/s and the rationale for that opinion; and,
- provide conclusions drawn from the results of the study.

Approach

The study involved a two-phased approach. In the first phase, we reviewed relevant literature and conducted over 100 interviews with network providers, service providers, equipment providers, government officials and potential datacasting users. We then assessed the factors, trends and events that could influence the demand for datacasting services. Following this, we developed preliminary demand estimates by market segment, technology, type of service, and range of data speed for the short- and long-term time frames.

In the second phase of the study, the preliminary results and assumptions were reviewed by a group of industry experts. The experts generally agreed with the study results, particularly with the five year forecasts. However, while all experts are optimistic about a strong, long term demand, they cautioned us that it is difficult to forecast accurately over that time frame. From our research, we too are of the opinion that there is a very large potential for datacasting services in Canada. However, given the small size of the industry today, and uncertainty associated with predicting the longer term, we have presented in this report what we consider to be conservative forecasts.

Following this feedback process, we made appropriate revisions and issued the final report.

Findings and Conclusions

Datacasting Technologies

- Satellites and Vertical Blanking Internal (VBI) networks will be the preferred technologies for datacasting over wide geographic areas. Satellites will be used where high data rates are required.
- There will likely be two VBI national networks implemented before 1995. These networks could serve the datacasting needs of Canada Post, some provincial governments and various large business users. In addition, some information will be distributed to residential subscribers with teletext decoders built into their television sets.
- FM subcarrier will be used mainly for paging and distribution of traffic information to automobile drivers. In addition, there may be some distribution of satellite-based information in Canada's largest cities using FM subcarrier.
- The cable system will be used to datacast in Canada's major markets. Sideband will be used to deliver services to government and business users locally.

New Services and Market Segments

- Vidéoway currently uses one full channel of a cable system to datacast at 4 Mbit/s to consumers. The Vidéoway type of application will continue to grow throughout this decade. By 2015, a second or third generation "Vidéoway-type" service will likely have penetrated over 6 million Canadian households via fibre optics. The datacasting component of the system will also be distributed via satellite.

- ° New applications and services will be implemented by governments, institutions and Crown corporations for purposes of distributing internal information as well as distributing information to business users and the general public. The number of locations using datacasting will increase from about 3,000 in 1993 to over 6,000 in 1996. By 2000, over 12,000 sites will use datacasting.
- ° The business sector will use datacasting for a variety of applications, the more significant of which include the following:
 - distribution of corporate information, data and software to branch sites;
 - distribution of entertainment, information and promotional information to retail locations, bars and restaurants;
 - distribution of specialized databases for commercial purposes (e.g., electronic real estate multiple listing, etc.)

Government and business datacasting receive sites will increase from 1,600 now to about 14,000 by the end of 1993. In 1996, there will be about 35,000 government and business sites using datacasting technologies. By the year 2000, 70,000 sites will be using datacasting.

Datacasting Transmission Speeds

- ° By 1996 - 85% of all satellite datacasting applications will be delivered at speeds less than 128 Kbit/s. Television VBI applications will operate at speeds of 64 Kbit/s or less (most will operate at 19.2 Kbit/s or less). FM subcarrier datacasting applications will transmit at speeds up to 9.6 Kbit/s. Cable TV sideband will distribute government and business applications in local areas at speeds of 64 Kbit/s or less. Videoway will use at least a full cable at 4 Mbit/s to distribute information and software.
- ° By 2000 - satellite could be distributing data at much higher speeds, i.e., 70% of which will be in the 128 to 512 Kbit/s range. Five percent of traffic carried by satellites will be carried at speeds over 512 Kbit/s. VBI applications will require speeds up to 128 Kbit/s. Cable TV will distribute datacasting signals at speeds up to 128 Kbit/s.

- ° Over the long term (i.e., by 2015), we expect that the majority of satellite carried datacasting applications will be at speeds above 512 Kbit/s. Fibre and cable systems will distribute signals in urban centres at similar speeds. Radio-based technologies such as cellular will distribute a significant amount of data to personal communications devices at speeds likely less than 256 Kbit/s.

1.0 INTRODUCTION

1.1 Introduction and Study Background

Datacasting services and techniques have been in existence since before World War II, when experiments were conducted in the U.S. that attempted to provide electronic newspaper delivery to homes using FM subcarriers. However, in the 1980s, we have witnessed an increase in the delivery of datacasting services using both broadcasting and non-broadcasting radio spectrum.

Datacasting is the use of electronic means to make data broadly available to geographically dispersed sites at the same time. The transmission can use a full communication channel on any frequency band, a satellite transmission, or an ancillary signal which is transmitted as part of a radio or television broadcast. For the purposes of this study, this includes use of the cable television network but excludes the use of the public switched or private telephone networks.

When one considers the overall information industry, i.e., newspapers, television, magazines, radio, on-line services, the datacasting business is very small. The U.S. information industry was in the order of \$50 billion last year. Even when compared to on-line information services (i.e., two-way via telephone), the datacasting business is relatively small. Datacasting services have only recently become more attractive due to a number of factors including, for example, the following:

- increased penetration of computers in both businesses and homes;
- the development and penetration of satellite technologies, particularly Very Small Aperture Terminals (VSATs), which are economical for a variety of data broadcasting applications;
- the development of coding standards such as NAPLPS;
- the development of delivery systems and products that are cost-effective when compared to using other communications alternatives for communicating on a point-to-multipoint basis;
- a more flexible approach to regulating datacasting in the broadcasting environment; and
- increased interest, on the part of businesses, governments and consumers in using information services.

Datacasting has become very cost-effective as a means of delivering information; however, the distribution of electronic information is dominated by the telecommunications carriers.

The Department of Communications is cooperating with industry, broadcasters and other government departments in developing applications for teletext. In addition, it is also involved in planning for the delivery of new services such as Digital Radio and Advanced Television. The spectrum requirements for these new services are now being discussed in international fora. Therefore, DOC needs to ensure that the appropriate amount of channel (and spectrum) capacity is allocated for datacasting signals.

1.2 Study Objectives

The objective of the study, as outlined in the Statement of Work, is to determine the current and the potential requirements for datacasting services below 512 Kbit/s in Canada. The specific objectives include the following:

- describe the various technologies now being used for datacasting;
- describe the datacasting services now in existence and those likely to emerge during the forecast period;
- forecast the potential demand for datacasting services using such technologies as teletext, FM sidebands and VSATs for government, business, and consumer applications in the short term (one to five years) below 512 Kbit/s;
- forecast the long term potential demand for datacasting services in the time frame when Digital Radio and Advanced TV services will be introduced (1995 - 2015) below 512 Kbit/s;
- provide an opinion on the potential demand for datacasting services above 512 Kbit/s and the rationale for that opinion; and,
- provide conclusions drawn from the results of the study.

1.3 Methodology Used in the Study

The forecasting methodology used for this study followed a two-staged process. In the first stage, the information collected on the datacasting environment and related factors was used to develop a preliminary estimate of demand for datacasting services.

In the second stage, the preliminary demand estimates were reviewed by a select group of industry experts. The comments and opinions of the industry experts were then used to develop the final demand estimates.

Exhibit 1-1 outlines the general research approach that was used. Following is a brief description of the activities and process used at various stages in the forecasting exercise:

Stage 1 - Develop Preliminary Demand Estimates

Review of the Datacasting Environment

In this part of the forecasting exercise, current datacasting applications, services and initiatives were identified through a series of detailed interviews with Canadian and U.S. equipment manufacturers, service providers, information providers and industry experts. The information collected from these interviews was classified according to type of service, transmission technology, geographical location and customer segment served.

Assessment of Factors Affecting Demand For Datacasting Services

In this stage of the forecasting exercise, factors that will influence demand were identified and assessed. The factors examined included market factors, policy/regulatory issues, technological trends, and economic matters.

Develop Preliminary Demand Estimates

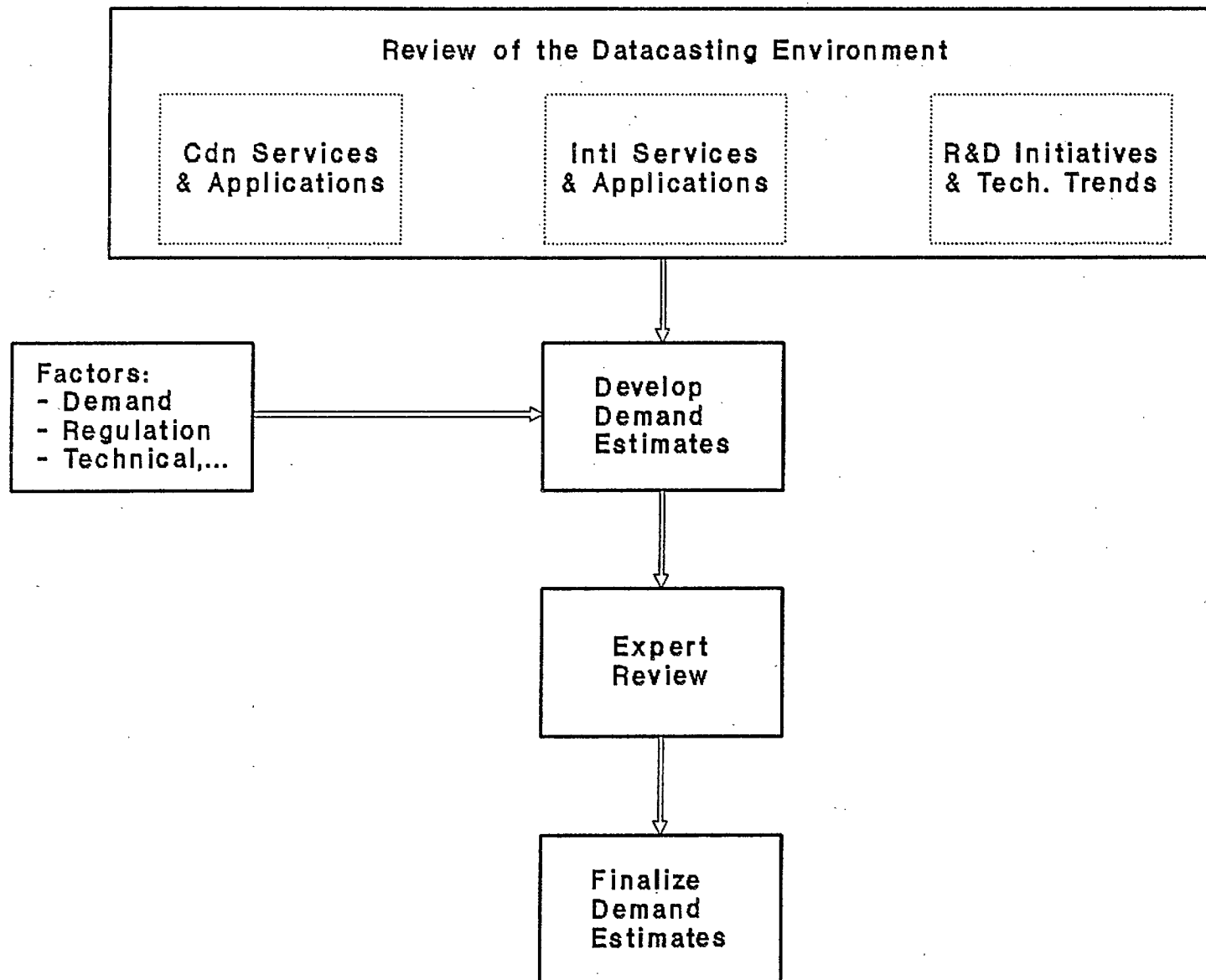
The information collected and analyzed in the previous two parts was then combined to develop preliminary demand estimates. The demand estimates were developed according to market segment, technology, type of service and range of data speed for the short-term and long-term time frames.

Stage 2 - Development of Final Demand Estimates

Expert Review

The demand estimates developed in the first stage were then reviewed by five industry experts. In choosing the reviewers, a concerted effort was made to seek a balanced range of opinions from communications services providers, equipment suppliers, and user groups.

Exhibit 1-1: Study Methodology



Finalize Demand Estimates

Final demand estimates were then developed which incorporate the comments and opinions of the expert reviewers. The demand forecasts included the potential short-term and long-term demand for datacasting services and an opinion on the potential demand for datacasting services above 512 Kbit/s.

2.0 DATACASTING TECHNOLOGIES

Datacasting can make use of any one or more of the following technologies:

- satellites;
- television;
- FM radio;
- cable systems;
- dedicated radio channels;
- switched terrestrial networks.

This section provides a factual description and comparison of these datacasting technologies.

2.1 Satellite Technologies

Datacasting services are provided in Canada by satellites usually by means of Very Small Aperture Terminals (VSATs) which generally use one uplink and several remote sites. There are several transmission techniques including the following:

- Frequency Division Multiple Access (FDMA) is the access technique used for Single Channel Per Carrier (SCPC) systems. In FDMA, the transmission to the satellite is continuous, as each system would be using its own frequency band which is a small fraction of the total channel bandwidth. Currently, the Department of National Defence's Weather Channel and Atmospheric Environmental Services METSIS weather channel both use SCPC technology. These operate at speeds of 128 Kbit/s and 56 Kbit/s respectively. SCPC technology could conceivably allow for speeds of 90 Mbit/s on Ku-band and 60 Mbit/s on C-band (although there is no hardware currently on the market enabling such speeds).
- Code Division Multiple Access (CDMA) is the access technique used with spread spectrum data distribution, such as that used in Telesat's Anikom 100 service.

- Subcarrier is an access technique in which the data signal is carried with an existing television signal. The standard format for a TV signal includes a number of "sub-carriers" which can be resold for transmission of voice or data services. Cancom used this technique in its Satlink data broadcast service. While the incremental costs of providing the space segment are low, the users are required to use the same downlinks required for television signals (which are currently in the 1.2 to 3 metre range for TVROs and in the 2.4 to 4.5 metre range for cable head-end sites).
- FM² or "FM squared" is an access technique where several data and audio channels are modulated onto an RF channel where the video signal would reside. This is the modulation technique used by two main U.S. suppliers of satellite facilities, Microspace and SpaceCom Systems Inc. Currently, Novanet is the only space segment provider in Canada using FM² technology.
- FM³ or "FM cubed" technology has been recently announced by SpaceCom Systems Inc. and International Datacasting Corporation of Canada (IDC). The service is intended to provide increased space segment efficiency and reliability of service. This technology is different from FM² in the way in which the numerous streams of information are multiplexed on the satellite signal. The suppliers anticipate that it will provide a 20 percent increase in space segment efficiencies as well as increased addressability capabilities.

Signal Coverage

All of the satellite-based technologies provide Canada-wide coverage on Anik D's C-band satellite and Anik D's Ku-band satellite. In addition, Anik E will enable full Canada and U.S. coverage in the C or Ku-bands. The only restrictions on coverage are where locations do not have line of sight to the satellite. In this case, it is necessary to backhaul from another location or distribute the signal using other telecommunications techniques such as FM subcarrier.

Satellite databroadcasting services can provide digital signals from 75 bit/s to 2 Mbit/s. However, most services are currently provided in the 1.2 Kbit/s to 9.6 Kbit/s range.

Reliability and Configuration Flexibility

Current satellite datacasting technologies provide reliability measures that exceed telecommunications landline levels.

Costs

As shown below, there is a wide difference in the installed equipment and space segment costs associated with various satellite transmission technologies:

TECHNOLOGIES	SPREAD SPECTRUM	SUB-CARRIER	FM ²
Antenna, LNB and Receiver at Site	\$ 5,000	\$1,200 -\$1,500	\$1,000 -\$1,500
Monthly Space Segment Rental (9.6 Kbit/s)	\$25,000	Similar to FM ²	\$7,500

While there is a significant difference in the costs of each technology, one must consider a variety of factors including security, antenna size and noise immunity. Telesat's Anikom 100 Service, for example, is designed to maximize the security of the signal reception.

2.2 FM Radio Subcarrier Communications

A subsidiary communication multiplex operations (SCMO) channel is a frequency band containing one or more subcarriers, which are outside the normal tuning range or response of consumer FM receivers (i.e., requires a separate tuner). A variety of signals, including speech, music, tones, and data can be transmitted over these channels. Subcarrier frequencies currently used by Canadian broadcasters are centred at 67 KHz and 92 KHz. Today, the uses of FM subcarrier include distributing news wire services, signalling pagers and broadcasting utility load control signals. Transmission rates of 19.2 Kbit/s are possible with advanced equipment, but Canadian systems typically operate between 1.2 Kbit/s and 9.6 Kbit/s.

In Canada, the CRTC pursued a deregulated approach throughout the 1980s which culminated in 1989 with the release of Public Notice 1989-23 which essentially removed regulatory restrictions on the content of data transmitted on an FM subcarrier. However, a broadcaster must still seek the technical approval of the DOC prior to commissioning a new service.

Internationally, the regulation of the use of subcarriers has differed from Canada. Since 1961, American broadcasters have been able to lease subcarrier capacity to third parties. In Europe, detailed specifications for the "Radio Data System (RDS)" have been developed under the auspices of the European Broadcasting Union to standardize the

introduction and use of subcarrier frequencies (see Appendix C for abbreviated specifications for RDS).

Signal Coverage

The reach of a data signal transmitted on an FM subcarrier is dependent upon the broadcasting power and data speed. Paging signals, which are required to penetrate buildings, are typically transmitted at a data speed of 0.6 to 1.2 Kbit/s. Other applications, such as news wire signals have been transmitted at data rates of 19.2 Kbit/s.

Signal Coverage and Reliability

The coverage area of a subcarrier signal corresponds with the coverage area of the main radio signal. When an injection rate of 105% is used, the signal coverage area can be equivalent to the main signal coverage area. However, applications using high data rates (i.e., greater than 1.2 Kbit/s) may require the use of high gain antennas in fringe areas to reduce error rates.

The reliability of subcarrier data broadcasting is determined by the reliability of the main broadcasting system. In addition, most subcarrier leasing agreements specify that the broadcaster has the right to terminate the lease if the main broadcast signal is degraded by the datacasting signal.

An inherent problem with FM subcarrier technology is multipath interference. This problem is most pronounced in built-up urban areas and may cause a significant increase in the bit error rate. Forward error correction schemes have been introduced to address this problem. In October, 1988, Mainstream Data announced that the Dow-Jones service was achieving a bit error rate of 1×10^{-7} , better than the error rate for telephone lines.

A trade-off between data rates and ease of reception exists with data services carried on an FM subcarrier. A low data rate is easier to receive because there is a high amount of energy per bit. High data rate services (i.e., 1200 bit/s and above) may require external antennas and stationary installations to ensure adequate signal reception.

Costs

The costs of datacasting equipment are falling as demand increases. Signal injection equipment typically costs under \$10,000, with indications that this cost could fall to \$2000 in the near future.

The cost of receivers is dependent on their configuration. Automotive radio receivers capable of decoding RDS signals (European standard) currently carry a premium price of approximately \$100.

The cost of air time is market driven. In Canada, the typical urban lease rate for a subcarrier channel is in the order of \$1000 per month. In the United States, where the market is more developed, subcarrier lease rates have been known to exceed \$10,000 per month in high demand markets such as New York City. An SCA channel in a smaller city such as Las Vegas costs about \$1500 per month.

2.3 Television

Datacasting by means of television signals can make use of the Vertical Blanking Interval (VBI) or the subchannels associated with the main audio channels.

Television Sub-channels

Television channels have, in addition to the main stereo audio channels, two sub-channels, the Secondary Audio Program (SAP) and Professional (PRO). While the SAP will be primarily used to transmit a second language, the PRO is a 3 KHz subchannel that was intended for production program messages. These channels could also be used for datacasting applications.

The Vertical Blanking Interval (VBI) of a Television Signal (Teletext)

In North America, the 525-line 60 field-per-second television signal includes a Vertical Blanking Interval (VBI). The VBI is the brief period of time which recurs approximately 60 times per second between successive scans of television pictures. During the VBI, a total of 21 lines are transmitted. Lines 1 to 9 are used for vertical synchronization of the television picture. According to DOC's Broadcast Standard No. 3 (BTS-3) of May 1990, ancillary signals can, subject to some constraints, be inserted in the interval beginning with Line 10 and continuing with Line 21. The line allotment standards are as follows:

- Lines 10 to 14 are reserved for temporary experimental uses subject to special approval;
- Lines 15 to 18 and Line 20 may be used for the transmission of any ancillary signal;
- Line 19 is used only for the vertical interval reference (VIR) signal; and,

- Line 21 may be used for "closed captioning", a program-related data signal, or other types of ancillary signals.

Lines 15 to 18 and 20 are of particular interest because they can currently be used for public services such as teletext. In the U.S., the FCC has allowed the use of lines 10 to 18 and 21 for teletext and other services. There is a potential for use of lines 10 to 20 for teletext in Canada (i.e., 11 lines).

Currently, four lines of the VBI used for teletext transmission equates to a rate of about 50 Kbit/s under the Electronics Industry Association (EIA) recommended standard, i.e., the North American Basic Teletext Specifications (NABTS). NABTS also forms part of an international teletext recommendation issued by the International Radio Consultative Committee (CCIR). The standard defines the coding scheme for textual or pictorial graphics for display on the television screen.

Norpak staff has supplied over 60 NABTS systems around the world to organizations such as CBS, ABC, Univision, IBM, VISA, CBC, Radio Quebec, etc. While NABTS is an open standard, PBS and FNN in the U.S. operate NABTS-like systems that use proprietary closed standard equipment. In addition, some systems operate on the World Standard Teletext (WST) standard, used in Europe.

The data capacity of the VBI depends on the transmission and error correction scheme used. Most equipment currently being manufactured supports effective data rates (i.e., after error correction) up to 9600 bit/s for each line of the VBI. PBS' system, for example, provides a VBI line-specific data stream of 9600 bit/s. Under the NABTS/Norpak approach, the number of VBI lines enabled determines the total bandwidth available. Once selected, this total bandwidth is treated as a single "pool" to which the packet multiplexed data is fed. A single data stream, which can be as fast as 19.2 Kbit/s, is not necessarily restricted to any single VBI line. This enables maximum utilization of the available bandwidth at all times.

Signal Coverage and Reliability

The coverage of data transmitted over the VBI of a television signal generally conforms to the coverage of the main signal. However, multi-path interference still poses a problem for off-air reception in high-density building areas. Transmission over a cable television system is acceptable if it is inserted at the headend and DOC standards are met¹. According to Norpak staff, typical raw error rates for VBI data broadcast reception are 10^{-3} to 10^{-6} . For "random" errors, basic NABTS Forward Error Correction

¹ DOC Report PD8302, March 1983

(FEC) will improve the output in a rate to 10^{-5} to 10^{-14} respectively and accept 16.2 Kbit/s of RS-232 data input per VBI line. The more sophisticated "NORPAK Code" FEC will improve the output error rate to 10^{-7} to 10^{-20} respectively and accept 13.887 Kbit/s of RS-232 data input per VBI line.

Costs

The equipment costs associated with implementing a data service over the VBI is dependent on the type of service offered and the programming structure of the network. A basic central multiplexer costs in the order of \$30,000. However, if the network has affiliates running different programs, network bridges are required for each affiliate at a cost of about \$10,000. A bridge and local inserter at an affiliate site would cost in the area of \$35,000.

The equipment costs for user decoders vary from application to application. However, for general applications, these cost in the range of \$400 to \$650. Intelligent receivers required for more sophisticated applications can exceed \$2,000. We also noted that decoders are being built into some television sets currently on the market.

Due to the limited number of VBI systems offering data transmission services to third parties in North America, spectrum leasing costs are not well documented. However, a low speed application on Radio Quebec's network (i.e., 1.2 to 9.6 Kbit/s full time) would cost in the order of \$4000-\$5000 per month. Costs are considerably less for part-time and delayed transmissions. In the U.S., one line of the VBI distributed on WTBS (to 54 million homes) costs about \$16,000 per month (\$Cdn).

2.4 Cable Delivery

Datacasting on cable systems can occur through use of a full channel, sideband, and the VBI. Full channel delivery can currently provide data speeds up to 3.5 Mbit/s (on NABTS standard). However, in analogue mode they can make use of conventional cable decoders.

Sideband uses the guard bands between television channels on the cable systems to transmit data at speeds up to 112 Kbit/s or more.

Signal Coverage

Use of cable for datacasting limits the application to the cable operator's territory. In addition, the datacaster must negotiate with more than one cable operator to cover a full metropolitan area. However, as with telephone lines, use of cable systems extends service to locations that cannot be served by satellite.

Reliability and Availability

Cable system signal quality varies from system to system. However, most systems in the larger Canadian markets have upgraded their plant to provide bit error rates acceptable for data transmission.

Costs

Full channel services thus far have been provided by the cable companies at no additional charges to their subscribers (e.g., electronic television guide). However, there would be high transmission costs associated with obtaining a full cable channel for a private business application.

End user sideband modem costs are in the order of \$125-\$150; however, transmission costs will vary depending on the arrangement negotiated between the local cable companies and the datacaster. Such costs can range from \$10 to \$50 per month per site or be negotiated on a monthly flat rate basis for use of the whole system.

2.5 Dedicated Radio Channels

For the purposes of this section, a dedicated radio channel is defined as a radio channel that is dedicated to the transmission of data for one application or group of users. This definition includes the following radio transmission method:

- MF frequencies;
- HF frequencies;
- VHF frequencies; and,
- UHF frequencies.

Shared radio systems such as trunked mobile radio, cellular, and paging are discussed in the next section, Switched Terrestrial Networks.

Several equipment manufacturers offer systems which can perform point-to-multipoint data broadcast functions. The data capacity, coverage and reliability of the system are dependent on the chosen frequency. Exhibit 2-1 outlines the generic capabilities of each frequency band. Depending on the frequency band chosen, the achievable data rates can range from 100 bit/s to 9.6 Kbit/s.

Exhibit 2-1
Dedicated Data Radio Channel Characteristics

FREQUENCY BAND	DATA RATE	COVERAGE	FLEXIBILITY/ AVAILABILITY
MF	100 bit/s	150 to 400 mi.	limited availability - restricted bandwidth - high congestion
HF	300 bit/s	100 to 150 mi.	low quality channel - congestion - high environmental noise
UHF	9600 Kbit/s	40 to 60 mi.	limited availability in urban areas - subject to multi-path interference
VHF	9.6 Kbit/s	40 to 60 mi.	limited availability in urban areas - subject to multi-path interference

Signal Coverage

The coverage area of dedicated radio channels in the MF and HF bands range between 150 and 400 miles. The coverage of the higher frequency VHF and UHF bands decreases to line-of-sight ranges of approximately 60 miles.

Reliability and Configuration

An advantage of dedicated radio channel systems is that they can be custom designed to suit the intended applications. They also feature the security of owning the signal distribution system and thus avoid the insecurity of having to repeatedly negotiate distribution rights with suppliers.

A significant disadvantage of dedicated radio systems is the relative scarcity of spectrum. In urban areas, it may not be possible to gain exclusive access to a radio channel.

Costs

The cost of implementing a dedicated radio system is quite dependent on the coverage and receiver requirements of the system. Direct load control systems for electrical utilities can feature receive costs as low as \$100 each. As the receivers incorporate additional features, prices tend to increase. For example, general purpose radio modems (2-way) cost over \$1000 each.

2.6 Switched Terrestrial Networks

Switched networks can be segmented into land-based and mobile services. Land-based services, provided by the telecommunications companies, include normal telephone lines, dedicated voice and data circuits and switched data services. Most of the on-line database industry uses telephone lines where data rates up to 19.2 Kbit/s can be achieved using modems on conventional business lines priced in the \$40-\$60/month range. Telephone charges can, however, be quite high for long distance users who are required to pay rates based on distance and usage (refer to Section 2.7).

Mobile services include two-way services such as cellular, trunked mobile radio systems and one-way services such as paging systems. Two-way services generally target applications such as dispatching which are characterized by short bursts of bi-directional activity. The relatively high price of transmission capacity, \$0.08 per 256 bit packet, discourages the transmission of high volumes of data on these networks. Paging networks by their design are intended for short message bursts. As such, switched mobile networks can be characterized as being suitable for applications which have very low communications traffic.

2.7 Comparison of Datacasting Technologies

In Exhibit 2-2, various technologies used for datacasting are compared in terms of their key characteristics. Since the majority of data transmission currently occurs over telephone lines, we have included this technology in our comparison.

**Exhibit 2-2
Features of Datacasting Technologies**

FEATURE / TECHNOLOGY	TELEVISION (VBI)	FM SUBCARRIER	SATELLITE (E.G., FM ²)	CABLE E.G., SIDEBAND	RADIO	SWITCHED NETWORKS (TELEPHONE, PAGING, TRUNKED RADIO)
Network Coverage	<ul style="list-style-type: none"> • Ranges from local (40 km radius) to national via bridged network or satellite TV 	<ul style="list-style-type: none"> • Limited to local and cabled FM reach • 40 km radius from transmitter 	<ul style="list-style-type: none"> • Full national coverage (some line-of-sight and rooftop restrictions in urban centres) 	<ul style="list-style-type: none"> • Within cable system territories (i.e., partial regional or local) 	<ul style="list-style-type: none"> • Generally local (40 to 150 mi) • Can be increased by adding repeaters 	<ul style="list-style-type: none"> • National
Transmission Speeds	<ul style="list-style-type: none"> • Up to 178.2 Kbit/s for 11 VBI lines⁽¹⁾ 	<ul style="list-style-type: none"> • Up to 19.2 Kbit/s (2 subcarriers per FM signal) 	<ul style="list-style-type: none"> • 2.4 Kbit/s to 2 Mbit/s or higher (usually in the 9.6 to 19.2 Kbit/s range) 	<ul style="list-style-type: none"> • 19.2 Kbit/s or higher 	<ul style="list-style-type: none"> • Depends on frequency • UHF/VHF-9600 b/s 	<ul style="list-style-type: none"> • Up to 9.6 Kbit/s in urban areas (some 19.2 Kbit/s) • Can go higher with data services
Transmission Costs (\$ Cdn) (2.4 Kbit/s)	<ul style="list-style-type: none"> • Varies with market e.g., about \$4k per month on Radio Quebec's signal 	<ul style="list-style-type: none"> • \$6000/mo for large U.S. cities or Toronto • Vary with market size e.g., \$1000 per month for medium Cdn urban area • Costs can be much higher 	<ul style="list-style-type: none"> • \$3,750/mo. 	<ul style="list-style-type: none"> • \$2,000 per month 	<ul style="list-style-type: none"> • Nil (DOC license fee) 	<ul style="list-style-type: none"> • \$40-60/mo per user in local areas • Distance and usage sensitive for long-haul
End User Costs (\$ Cdn) (excluding the service)	<ul style="list-style-type: none"> • In the \$400-\$2,000 range. Decoders are being built into some TV sets • As low as \$150 in the U.S. for WST 	<ul style="list-style-type: none"> • \$350-\$1,000 	<ul style="list-style-type: none"> • As low as \$1,000 for antenna, LNB and receiver 	<ul style="list-style-type: none"> • \$125-\$150 	<ul style="list-style-type: none"> • Receivers as low as \$100 	<ul style="list-style-type: none"> • \$50-\$300 for a modem
Reliability	<ul style="list-style-type: none"> • Can be subject to multipath interference 10^{-5} to 10^{-14} BER with basic NABST FEC⁽²⁾ 	<ul style="list-style-type: none"> • Has been subject to interference in the past. Newer systems claim BER's at 10^{-7} • Perception that multipath interference is a significant problem 	<ul style="list-style-type: none"> • BERs better than 10^{-6} • 99.9 availability on C-band • 99.8 on Ku-band (subject to rain fade) 	<ul style="list-style-type: none"> • Older cable systems can have interference problems 	<ul style="list-style-type: none"> • Can be subject to multipath 	<ul style="list-style-type: none"> • Established technology with BER of 10^{-5} for 25 km distances
Standards for Data Transmission	<ul style="list-style-type: none"> • Two main standards (i.e., NABTS and World Standard) 	<ul style="list-style-type: none"> • Proprietary coding and error correction schemes dominate 	<ul style="list-style-type: none"> • Proprietary 	<ul style="list-style-type: none"> • Proprietary 	<ul style="list-style-type: none"> • Proprietary 	<ul style="list-style-type: none"> • Industry standards are used
Two-way capability?	No	No	No	No	Yes	<ul style="list-style-type: none"> • Yes (but network is not set up for point-to-multipoint broadcast)

Notes: (1) Current Norpak Systems are capable of up to 19.2 Kbit/s for any single data stream. A single data stream is not necessarily restricted to any single VBI line.
(2) The more sophisticated "NORPAK Code" FEC will improve the output error rate to an estimated 10^{-7} to 10^{-20} respectively.



3.0 THE CURRENT CANADIAN DATACASTING MARKET

3.1 Overview of the Canadian Datacasting Industry

As shown in Exhibit 3-1, the Canadian broadcasting industry can be generally subdivided into facilities providers, service providers, information providers and end users. In addition, there are various equipment suppliers and systems integrators providing network equipment, end user equipment, software and/or systems integration services. While we have generally classified these under the four datacasting technologies, it should be recognized that there is some overlap between categories. For example, it is our understanding that Seltech Satellite Systems provides services using satellite and FM-subcarrier facilities. In addition, Telecommunications VSAT Inc. provides system integration services using several technologies. It should also be noted that the Canadian datacasting market only represents a portion of the business that all of these companies are involved in.

The following subsections discuss in more detail the Canadian facilities providers and service providers, as well as some of the equipment suppliers and systems integrators associated with satellite, FM subcarrier, television and cable technologies.

3.1.1 Satellite Service Providers and Equipment Providers

The datacasting market is currently dominated by satellite technology.

Telesat Canada owns the basic facilities (i.e., the satellites) and provides space segments to Canadian service providers. As a facilities-based carrier, Telesat must file tariffs with the CRTC. Novanet, Cancom and Seltech provide datacasting services and are free to set prices without reference to the CRTC. In addition, users of satellite services can resell unused capacity by time or by bandwidth to other users. For example, TSN is reselling capacity to the Globe and Mail for distribution of its newspaper to regional printing houses.

Following is a brief description of the datacasting services of the satellite service providers:

Exhibit 3-1: Overview of Canadian Datacasting Industry

Technology	Satellite			FM Subcarrier			Television (VBI)	Cable TV	
Facilities Providers	Telesat			FM Broadcasters			Television Broadcasters	Cable TV Operators	
Service Providers	Telesat	Novanet	CANCOM	Seltech Cue Networks	Sherbank Mktg.	Silent Radio Intl.	Radio Quebec	Vidoeway	Miscellaneous
Information Providers/ End-Users	e.g. - Canadian Press - AES - Digital Media - NTN			e.g. - paging - newswire			e.g. - Telemedia - Hydro Quebec	e.g. - cable subs - Grassroots	
Equipment & Systems Int. Suppliers	e.g. - Intl Datacasting - Spar Aerospace - Wegner (US) - Scientific Atlanta - Comlink Systems			e.g. - Applied Electronics - Sherbank Mkt. - Electroline			e.g. - Norpak - DTI Telecom - Telecom VSAT	e.g. - Nexus Eng. - General Inst. - Comlink - Cabletel	

- **Telesat Canada** - is Canada's domestic satellite carrier and provides the raw space segment for all Canadian domestic applications with the exception of some U.S.-based services that spill across the border. Under current regulations, Telesat is required to own and obtain licenses for all downlinks associated with all transborder "business-related" services. Telesat's one-way satellite services are provided using spread spectrum and SCPC transmission techniques.
- **Novanet Communications** - is a resell carrier that provides audio and data distribution services using FM² technology. Novanet provides complete end-to-end services under sale, lease arrangements or on shared facilities. As with Telesat, Novanet will also provide backhaul using SCPC.
- **Canadian Satellite Communications Inc. (CANCOM)** - provides one-way services under its Satlink Business Services Division. All of its one-way applications are currently provided using subcarrier above video. CANCOM recently completed a trial of a high speed datacasting image broadcast system at 1.544 Mbit/s.
- **Seltech Satellite Systems** - sells subcarrier above video services. In addition, it owns Cue Networks Inc., a U.S. company that provides paging systems on FM subcarrier. Cue Networks Inc. currently has a paging network on Moffat's FM radio network in British Columbia and is considering implementing services in other Provinces.

Some of the key Canadian equipment providers and system integrators include the following:

- **Spar Aerospace** - is Canada's major supplier of space segment and earth station equipment. The Communications Group designs and implements networks and communications systems for private industry, government agencies, and international communications requirements.
- **Comlink Systems Inc.** - is a national distributor of high technology products serving the broadcast, CATV and telecommunications industries. Comlink also provides system design, installation and maintenance services on the products it distributes.
- **International Datacasting Corporation** - designs, manufactures and markets satellite and cable-based digital communications systems. IDC's satellite datacasting products include Low Noise Block Down-Converters (LNBs), modulators, antennas and low-cost receivers for low and high speed data applications. Its cable products provide high speed distribution of data,

digital audio and digital video on cable TV systems. IDC also provides end-to-end design, integration and implementation of networks.

- **INFOSAT** - designs, manufactures and provides complete turnkey satellite systems used for one-way and two-way voice, data and video applications.

There are also several U.S. companies that provide equipment and integration services to the Canadian satellite industry. The most noteworthy of these is Wegener Communications Inc. of Atlanta, Georgia which developed the FM² technology and has registered FM² as a trademark for the technology. In addition, Scientific Atlanta provides a full range of equipment and system integration services.

3.1.2 Television (VBI) Service and Equipment Providers

The development of services based on the television VBI is in its early stages. Radio Quebec, Radio Canada and CBC are all either working on pilot projects or are in the process of implementing VBI-based services. Other broadcasters such as the CTV network, TSN and TVOntario are also investigating potential opportunities in this area.

Norpak Corporation is a leading North American supplier of datacasting equipment. This company, based in Kanata, has developed a line of head-end and subscriber equipment based upon the NABTS standard. International clients include CBS and ABC. There are over 60 Norpak insertion systems in place around the world.

Organizations that have offered systems integration services in this area include the following:

- **DTI Télécom** - offers systems integration capabilities in several technologies including television VBI and FM radio subcarrier
- **Telecommunications VSAT Inc.** - provides systems integration capabilities in various technologies, particularly using satellite and television VBI.

3.1.3 FM Subcarrier Service Providers

Between the years 1980 and 1990, over 60 FM radio broadcasters notified the CRTC that they were intending to use subcarrier channels to carry ancillary services. The subcarrier channels that are used for ancillary services are typically centred at either 67 KHz or 92 KHz. No broadcasters are known to use the 57 KHz frequency, which corresponds to the European Broadcasting Standard (see section 4.1.2).

Datacasting services operating on an FM subcarrier are typically offered by third party service providers which lease subcarrier channels from broadcasters. Due to the limited number of subcarrier channels leased in Canada, it is difficult to establish a typical lease price. In general, broadcasters strive to charge the prevailing American rate for a subcarrier channel, which ranges from \$1000 per month in small centres to over \$10,000 per month for major metropolitan areas.

Most FM subcarrier datacasting equipment is imported from American manufacturers. In Canada, Sherbank Marketing Services develops datacasting equipment and services for specific applications.

3.1.4 Cable Datacasting Service Providers and Equipment Providers

Several cable companies provide information services over their facilities (e.g., electronic TV directory, news and community events, etc.). A few cable operators have made their facilities available to datacasting service providers to provide business services. An example of this is in Toronto where Eastern Datacom provided a service called CableQuote over the sideband on Rogers Cablesystems (between channels 3 and 4). This service, recently discontinued, provided financial information to brokerage houses at 9.6 Kbit/s.

The largest datacasting service provider in Canada is Les Entreprises Vidéoway Ltée. Les Entreprises Vidéoway markets its system around the world to cable TV operators and service providers. It currently has over 60,000 subscribers to its Vidéoway information and entertainment service (described in the next section).

Canadian equipment providers and systems integrators in the cable area include:

- **Nexus Engineering** - designs, manufactures and markets commercial high frequency communications equipment. Nexus specializes in very reliable, high performance video and audio signal processing products for satellite television, cable television and broadcast television markets.
- **General Instruments** - is a manufacturer of broadband communications equipment such as RF head-end systems and RF distribution systems for the broadcast industry.

3.2 Current Canadian Services

This section describes and compares the key datacasting services that are currently marketed in Canada today. In addition, various private applications have been implemented by the service providers, equipment suppliers, systems integrators and/or the users.

3.2.1 Current Satellite Services

Audio and Data Satellite Distribution Network (Novanet)

Novanet's Audio and Data Distribution Network is a one-way audio and data distribution service providing Canada-wide coverage using C-band FM² technology. In a typical FM² application, audio signals are frequency modulated onto subcarriers and data signals use FSK, BPSK or QPSK subcarriers, which are in turn combined and modulated onto a main carrier. The RF bandwidth of the main carrier is limited to 16 MHz which virtually eliminates interference from terrestrial carriers.

Novanet's service on Anik D has the following characteristics:

- low cost receive equipment that can be installed inexpensively;
- high immunity to terrestrial interference;
- data rates from 75 bit/s to 1.544 Mbit/s;
- audio signals can be broadcast in either analogue or digital formats;
- data bit error rates better than 10^{-8} ;
- unlimited number of receive sites in the network that are addressable and can be remotely controlled.

Audio and data signals can be mixed, transmitted and received at a very low cost to the broadcaster or data distributor. Thus, the service has a low monthly cost for the satellite transmission capacity.

Typical Novanet prices are as follows:

- \$1,000 per receive site (if sold outright)

- monthly data rates from Toronto's Teleport as follows:

\$ 3,750 for 2.4 Kbit/s;
\$ 7,500 for 9.6 Kbit/s;
\$10,800 for 19.2 Kbit/s.

Anikom 100 (Telesat)

Anikom 100 is a one-way data distribution service providing Canada-wide coverage using C-band spread spectrum technology. Spread spectrum technology is unique in that it subdivides each data bit into a number of smaller units and transmits the signal over a 5 MHz bandwidth. This results in a very reliable data flow which produces interference-free communications.

However, because of the relatively wide bandwidth signal used to carry the data, the low cost of the receive station is offset by the relatively high monthly cost of the satellite transmission capacity.

Anikom 100 has the following service characteristics:

- ° small, lightweight, low-cost antennas - .75m in diameter that are easy to install;
- ° high system availability/reliability;
- ° usable in urban areas - resistant to microwave and other interference;
- ° data rates up to 19.2 Kbit/s per uplink - two uplinks in operation;
- ° unlimited number of receive sites in the network
- ° can be accessed by means of a recently introduced transportable earth station; and,
- ° pricing as follows:
 - one-time charge of \$2,500 for initial network configuration
 - \$5,000 per receive site (if sold outright)
 - monthly tariffed rates from major cities are as follows:

DATA RATE (bps)	ASYNCHRONOUS (\$)	SYNCHRONOUS (\$)
Under 300	1,000	1,200
300	1,800	2,200
450	2,100	2,500
600	2,500	3,000
900	4,000	4,800
1,050	4,500	5,400
1,200	5,300	6,400
1,800	7,300	8,800
2,000	8,300	10,000
2,400	9,400	11,300
3,600	12,800	15,400
4,800	15,700	18,800
7,200	20,800	25,000
9,600	25,000	30,000
19,200	40,000	N/A

3.2.2 Television VBI Services

At the time of the review, no commercial datacasting services using television VBI distribution were identified in Canada. Organizations exploring using the VBI for either internal applications or as part of a new service include Canada Post, Government of Canada and Government of Ontario (see section 4.3). Two organizations, Hydro Quebec and Télémédia, used the VBI technology for internal applications.

- **Hydro Quebec** - has conducted a series of advanced pilot projects to explore various communications systems to support their load management and bi-energy programs. One project involved installing 150 micro-processor-based controllers to receive the VBI signals through satellite, over-the-air and cable in the province of Quebec. Another project involved the evaluation of CATV (bi-directional and Telco return), FM-SCMO (with Telco return) and paging (with Telco return) in 650 residential locations (note: network is now dismantled).
- **Télémedia** - uses the VBI for internal messaging and network control.

3.2.3 FM Radio Subcarrier (SCMO) Services

Organizations offering FM subcarrier-based datacasting services in Canada include:

- **Sherbank Marketing Services**
 - offers a point-to-multipoint data distribution service in the metropolitan Toronto area (35 mi. radius of the CN Tower)
 - currently uses one subcarrier channel to offer eight 1200 bit/s data channels.
- **Cue Networks (Seltech Satellite Corp.)**
 - offers paging services in the Vancouver area using a CFOX (Moffat Communications) subcarrier channel
 - paging service is available for \$63 per month
 - is expected to expand service to include Calgary, Edmonton, and Winnipeg
 - has indicated an intention to offer data distribution services in the future.
- **Silent Radio International**
 - currently leases a subcarrier channel on CKUT-FM in Montreal
 - conducting technical trials of subcarrier equipment (Modulation Sciences) for an information service.

3.2.4 Cable Services

Vidéoway

Vidéoway is an interactive television delivery system intended for use by general and selectable audiences in a one-way or two-way manner. It operates on existing cable TV networks using different telecommunications links such as coaxial cable, fibre optics, microwave, and satellite.

The Vidéoway terminal is an addressable TV converter with enhanced on-screen display functions, multilevel scrambling schemes for Pay-TV and various forms of Pay-Per-View. It incorporates an interactive TV decoder exclusive to Vidéoway to allow the viewer to alter the course of an interactive TV show through its own selections. Interactive broadcasts at Vidéotron include live shows (nightly news, hockey, baseball, quiz, public affairs programs and concerts) and taped shows (children's animated shows, game shows, pop music selections). However, it also allows external information/service providers to distribute basic, optional, modifiable and addressable video and data services.

One-way (datacasting) services consist of the following:

- ° Information and addressed services
 - multilingual subtitling and captioning
 - multistandard teletext (WST, NABTS, NCI)
 - multistandard videotext (NAPLPS, MINTEL, ARESTEL and BTX)
- ° E-mail
 - one-way direct mail on a mass or personalized basis (i.e., accessible using a PIN code)
- ° Software and Data Downloading
 - video games and special software to the Vidéoway terminal or to a PC
- ° Multimedia Services
 - e.g., a combination of video, stereo-sound and data can present the viewer with video catalogues for real estate and automobile advertisement.

Vidéoway technology allows a cable operator to introduce the system on the basis of phased services introduction starting with the existing services and allowing them to expand to new services including two-way communication using cable or telephone networks, such as the following:

- In-home communications
 - integration with protocols such as X-10 and CEBUS to allow existing electrical wiring to carry data using the Power Line Carrier technology. This would allow for delivery of home-based services such as Energy Management, Home Security and Medical Alert
- Transactional services such as teleshopping and telebanking
- Two-way electronic mail and messaging
 - user to user
 - user to service provider
 - service provider to user

The Vidéoway technology allows for a downstream data rate of 4 Mbit/s from the headend on a 6 MHz cable television channel.

In Montreal, the Vidéoway Service costs \$18.95 per month on top of basic cable service or about \$5.00 per month on top of pay television service. The price includes the subscriber equipment and access to 24 different services. Pay-per-view services and user-pay information services (in the future) would be additional charges.

3.3 Current Applications and Market Segments

There are currently about 30 datacasting applications in Canada today (excluding trials) and likely about 10 more if "spillover" applications from the U.S. are all taken into account. In addition, there are likely some private applications that we could not identify. In Appendix A, we present a description of the Canadian datacasting applications, most of which utilize satellite technology. As shown in Exhibit 3-2, summarized from Appendix A, datacasting applications can be grouped into the following 9 types of applications:

- **News, Audio and Wire Photo Distribution** - primarily involving the distribution of news to newspapers, magazines, television broadcasters and radio broadcasters. This includes the Globe and Mail's daily distribution of its entire newspaper to regional printing houses.
- **Trading Networks** - currently only involving the distribution of auto parts information throughout North America.
- **Financial Information** - the distribution of stock quotations, commodities indexes, financial newsletters and other information to stock brokers, banks and other financial institutions.

Exhibit 3-2
Current Datacasting Applications

Technology	Application	Information Providers/Users	Approx. Locations	Range of Data Speeds
Satellites	News, Audio and Wire Photo Distribution	Canadian Press/Broadcast News Globe and Mail Reuters Telbec VBI Time Inc. Satellite Radio Network Standard Broadcast News	750	Most are 19.2 Kbit/s or less Wirephoto applications are 56 Kbit/s Globe and Mail users 1.544 Mbit/s
	Trading (Auto Parts)	Allied Info. Network	116	600 bit/s
	Financial Information	Reuters, TSE	50 (in addition to news)	19.2 Kbit/s or less
	Weather Information	AES (Customer) AES/DND METSIS McLaren Plansearch	300 17 65	10.8 Kbit/s or less 2 X 128 Kbit/s 2 X 56 Kbit/s
	Telemetry (Broadcast Program Control)	CBC	5	300 bit/s
	Entertainment	NTN Entertainment Network Electronic Program Guide	Over 180	9.6 Kbit/s or less
	Place-based Media and Advertising to LED Signs	Digital Media Perception Electronic Publishing	Less than 50	2.4 Kbit/s or 64 Kbit/s
FM Subcarrier	Paging	Cue Networks	Vancouver	1.2 to 9.6 Kbit/s
	Data Transmission	Silent Radio	Montreal	
Television (VBI)	Program Control	Télémedia	Quebec Locations	1.2 Kbit/s
	Load Management	Hydro Quebec	150	1.2 Kbit/s
Cable	Entertainment	Vidéoway	60,000	4 Mbit/s
	Financial Information	Eastern Datacom	N/A	9.6 Kbit/s
	Weather Information	Grassroots	Manitoba Cable Subs	9.6 Kbit/s

- **Weather Information** - includes the distribution of AES METSIS meteorological information including satellite imagery, charts and alphanumeric forecasts to AES weather offices, Transport Canada Flight Service Stations, Airlines, fishermen, DND, etc.. In addition, McLaren Plansearch adds value to that information and distributes additional graphics.
- **Telemetry and Program Control** - currently CBC and Télémedia use datacasting to control programming to various stations in their networks.
- **Commercial Entertainment** - the NTN Entertainment Network provides real time sports, trivia, information and targetted advertising to patrons of hotels, bars and restaurants. NTN is also involved in providing customized corporate information services to large businesses.
- **Place-based Media** - includes the provision of targetted messages, advertising and other forms of information such as graphics by means of audio and/or video to places frequented by consumers. Place based multi-media datacasting applications provide a means to target advertising and improve customer service (e.g., the patron of a bar, restaurant, bank, etc.)
- **Paging** - FM subcarrier paging networks.
- **Load Management** - includes the use of datacasting, currently over the VBI, for utility load management control of commercial sites.
- **Consumer Entertainment** - the Vidéoway service provides a full range of television, entertainment and information services to cable television subscribers. The data portion of the service transmits a 4 Mbit/s data stream over a full cable channel, currently in a one-way form. Vidéoway will also make use of cable or telephone facilities to provide some upstream capability from the subscriber's premises.

All of these datacasting applications communicate timely information to a geographically dispersed audience at a national, regional or local level. Typically the information that is sent:

- has a value that declines with age and/or must be used in real-time;

- ° is currently transmitted at data speeds less than 19.2 Kbit/s. Most of the information services are in the 1.2 Kbit/s to 9.6 Kbit/s range with some operating at speeds of 19.2 Kbit/s. Only the imaging services and Globe and Mail newspaper distribution application transmit at higher speeds (i.e., 56 Kbit/s and 1.544 Mbit/s respectively); and
- ° is useable as transmitted and does not require any significant amount of return communications. Some of the applications require a minor return capacity which is easily handled via dial-up modems.

As shown in Exhibit 3-3, current datacasting applications are primarily in the business segment. The media applications dominate the business segment with about 750 locations (that we identified) served. Other business user groups include utilities, automotive dealers, financial services, hospitality, retail and other services, as well as professionals and tradesmen who would likely subscribe to paging services. The key government application is the AES system which is used primarily by Environment Canada, Transport Canada and the airlines.

While there are various low speed data services such as the Electronic Program Guide delivered to cable head ends (and provided via full channel), the key cable application emerging is Vidéoway which now has over 60,000 subscribers.

Exhibit 3-3
Characteristics of Current Canadian Datacasting Market

Segment	Business	Government	Consumer
User Groups (Locations)	Media (750) Automotive (116) Financial Services (50) Hospitality (50) Utilities (300) Retail and Services (50) Paging (n/a)	AES/Transport Canada Airlines (300) AES/DND (17) METSIS (65)	Vidéoway subscribers (60,000) Other information services to cable subscribers
Data Speeds	1.2 to 19.2 Kbit/s (news) 56 Kbit/s (wirephoto) 1.544 Mbit/s (newspaper)	10.8 Kbit/s 128 Kbit/s (AES/DND)	4 Mbit/s (Vidéoway) 9.6 Kbit/s (InfoServices)
Technologies Used	Satellite (most) VBI (utilities) FM subcarrier (paging)	Satellite	Cable (full channel)

4.0 EMERGING APPLICATIONS AND SERVICES

4.1 Approach

Prior to developing our demand forecasts, we reviewed some of the key applications and services:

- ° currently operating in the United States and Europe; and
- ° currently under development in Canada.

Some of the applications currently in the trial stages in Canada and/or operational in other countries will be operational in the short term (i.e., before 1995). In addition, some of the key R&D initiatives may result in operational applications and services over the longer term.

4.1.1 Applications in the United States

The U.S. datacasting industry is much larger than that of Canada. There are approximately 105,000 locations served (versus about 2,000 for Canada excluding Vidéoway). The U.S. business market is much further advanced than Canada's due to several factors including the following:

- ° the U.S. has a much larger market (in excess of 12 times that of Canada);
- ° FM² satellite technology was introduced in the U.S. two years earlier than in Canada;
- ° the U.S. has more relaxed regulatory conditions regarding provision of the satellite space segment and ownership of earth stations;
- ° the U.S. has higher cost local telephone service than Canada (this has stimulated the use of alternative means of datacasting such as FM subcarrier and VBI);
- ° the U.S. has a more complex telecommunications environment for setting up shared user telecommunications networks in the U.S. (i.e., must deal with several local and long distance carriers). This has resulted in the establishment of specialized datacasting resellers such as Mainstream Data which has a hybrid FM² satellite network with local distribution via FM subcarrier.

All of these factors, combined with lower prices for information, transmission and equipment have resulted in many more cases where the critical mass of user sites has justified using datacasting technologies. Exhibit 4-1 identifies the types of applications currently available in the U.S. More detailed information on these applications is presented in Appendix B.

In comparing the datacasting applications and services of the two countries, we noted 13 types of applications currently not provided in Canada (or not provided in a datacasting manner):

- **Petroleum Information** - provided to "jobbers" in the U.S. who supply gasoline to retail outlets. The Canadian industry indicated that this could be a potential future application in Canada.
- **Agricultural Information** - there are about 30,000 sites (mostly farms) receiving agricultural information and commodities prices via satellite. These services are provided at a cost of about \$30/mo. (U.S.). In Canada, Canadian agricultural information is provided via landlines.
- **Construction Industry Information** - McGraw Hill distributes various types of information (e.g., requested bids, etc.) to the U.S. construction industry.
- **Trading Information** - while auto parts information is already available in Canada and the U.S., several new trading applications are available. These include ARTIS (art, antiques, etc.) and Information Networks Incorporated which provides information on coins, stamps, baseball cards, etc.
- **Human Resources** - there is a network that distributes information to talent agencies in order to locate people for commercials, etc.
- **Teletext Information** - several teletext networks have been established that serve national and local networks. Most provide general information (e.g., news, sports, etc.) over the VBI to consumers, however there are some electronic magazines serving major cities in the U.S.
- **Advertising/Shopping** - Cablesop is a trial teletext-based advertising service available in the U.S. Home shopping services, available in Canada, use full cable channels.

Exhibit 4-1
Current U.S. Datacasting Applications (Examples)

APPLICATION	INFORMATION PROVIDERS/USERS	MEANS OF DELIVERY
News Services and Photo Distribution	UPI, Associated Press, Reuters, North American Quotations, U.S. Newswire, Knight-Ridder, Bay City News, Business Wire, Journal Graphics, PR Newswire	Satellite and FM subcarrier
Advertising/Information to LED Signs	AdNet, North American Visual Communications (NAVC), Cybernetic Data Products, Tribune Media Services	Satellite and FM subcarrier
POP/Place-based Media	Broadcast International, AEI Music Network, Digital Media	Satellite and FM subcarrier
Weather Information	WSI, WeatherBank Inc.	Satellite and FM subcarrier
Automobile Parts Information	Autoinfo, Allied	Satellite and FM subcarrier
Petroleum Information	Bonneville Market Info, DTN	Satellite
Agricultural Information	DTN	Satellite
Financial Information	Data Broadcasting Corp, Dow Jones, Federal Filings Inc., FirstCall Market News Services, MMS International, Telerate, etc.	Satellite and FM subcarrier
Entertainment	NTN Communications, Sports Ticker Inc.	Satellite
Construction Industry Information	McGraw Hill	Various

Exhibit 4-1
Current U.S. Datacasting Applications (Examples)
(Cont'd)

APPLICATION	INFORMATION PROVIDERS/USERS	MEANS OF DELIVERY
Trading Information - art - coins, etc.	ARTIS, Information Networks Incorporated	Satellite and FM subcarrier
Human Resources	Breakdown Services Ltd.	Satellite and FM subcarrier
Paging	Skytel, Cue Networks, AT&E Corp.	Satellite and FM subcarrier
Teletext Information - magazines - general info.	Keycom Electronic Publishing, CBS Extravision, NBC Teletext, KSL "Teletext 5"	VBI
Advertising/Shopping	Cableshop (trial)	VBI
Program Control	CBS, ABC, Univision	VBI
Educational Information	Central Educational Network (PBS)	VBI
Irrigation Control	Cue Network	FM subcarrier
Advanced Driver Information Systems (traffic messages)	Watogo Corp, OM Developments, etc.	FM subcarrier, cellular radio, VBI
Credit Card Authorization	Verifone	VBI, FM subcarrier, satellite
Utility Load Control	Oslethorpe Power	radio, FM subcarrier, satellite
VCR Control	Insight Telecast	VBI
Corporate Information Distribution	Southern, Satellite, CBS, ABC, Mainstream, etc.	VBI

- **Educational Information** - a portion of PBS' VBI is used to distribute educational information to schools in the U.S.
- **Irrigation Control** - there are some datacasting applications used to control irrigation in the U.S. So far in Canada the only telemetry and control applications are load management (utilities) and program control (broadcast industry).
- **Advanced Driver Information Systems** - in the U.S., there are several trials in place testing the delivery of messages and traffic information to vehicles. In California, an ARI System that delivers real-time traffic information to drivers on a subscription basis has been operating commercially. As part of the project PATHFINDER, the California Dept. of Transportation (Caltrans) is collecting and delivering real-time traffic information over public television on the VBI. In Canada, several advanced driver information system initiatives are currently in the planning stages.
- **Credit Card Authorization** - in the U.S., there are commercial applications that broadcast updated credit card authorization information to fast food restaurants and bars to check transactions less than \$50. In Canada, credit card systems are two-way (i.e., involving a call and real-time update of the central database). In addition, fast food restaurants in Canada are installing debit machines rather than establishing systems and procedures for accepting credit cards. Nevertheless, Canadian service providers consider datacasting credit card authorization systems as a potential market in Canada.
- **VCR Control** - Insight Telecast has a VBI system under trial which simplifies VCR programming (requires the appropriate VCR).
- **Corporate Information Distribution** - in the U.S., there are several point-to-multipoint services available for distributing text and images. Text applications range from simple messages to full documents. Image applications range from facsimile to high quality photo or CAD/CAM image distribution. This area is considered to be a high potential growth area in both the U.S. and Canadian markets.

There are also several local applications in the U.S., while nearly all of the Canadian applications tend to be long distance in nature. This is due to the differences in the telecommunications industries and pricing between the two countries.

It is also interesting to note that the U.S. does not have a cable-based mass consumer targetted information/entertainment/advertising service like Vidéoway. The U.S.,

however, has several telephone-based consumer information services, the fastest growing of which is Prodigy (a joint venture between Sears and IBM). Nintendo and AT&T are expected to introduce, in the near future, a telephone-based entertainment/information/advertising service targetted at consumers. Vidéoway is marketing its technology to U.S. cable operators and information providers.

4.1.2 Applications in Europe

In the United Kingdom and other European countries, the "world standard" teletext has already achieved a high level of penetration. In the U.K., both the BBC and ITV networks carry teletext information on the VBI. These services are targeted at a national audience. Services carried on the VBI include a wide variety of information services (news, weather, betting, etc.) and private data distribution systems (e.g., price updates, training information, etc.).

European countries are in the advanced stages of adopting a form of FM radio subcarrier standard, called the Radio Data System² (RDS) which provides for a silent data system superimposed on normal FM broadcasts. Appendix C presents some of the primary applications of RDS and an abbreviated specification of the RDS. Program identification and automatic tuning information is one of the leading applications for this technology because broadcasters receive a direct benefit from increased listening audiences. In France, paging services based on the RDS standards are in wide use. Pilot projects are currently demonstrating the usefulness of transmitting real-time traffic information in several jurisdictions (e.g., London, Paris, Rotterdam). Several automotive manufacturers, including Bosch and Philips have announced plans to begin installing RDS equipped radios in mid and high level cars before the 1993 product year.

The adoption of VSAT systems is behind North America due to regulatory restrictions. Recent moves toward deregulating the ownership of VSATs in some jurisdictions are expected to improve the performance of this segment of the market. As services based on the VSAT technology emerge, it is expected they will target pan-European applications.

In general, the European market for datacasting services is similar to the American market. Most applications and services found in Europe have counterparts in North America. However, the penetration of teletext in the domestic consumer market is significantly higher while the adoption rate of VSAT systems is lower. As such, one finds

² Two American groups, the RDS Users Group and the National Radio Systems Committee, are currently working on developing similar standards for the United States.

that most of the services offered in Europe are domestic based rather than a pan-European.

4.2 R&D Efforts, Trials and Initiatives

4.2.1 Combined Technology Trials

Direct Load Control by Electrical Utilities - Hydro Quebec

In North America, several electrical utilities have developed energy consumption management programs in an effort to efficiently match generation capacity with energy consumption. In a direct load control program, electrical consumers allow the electrical utility to control the electrical consumption of specific appliances, such as water heaters, in return for reduced rates. The electrical utility can then lower peak energy consumption by disconnecting the appliances for short periods of time.

Hydro Quebec recently conducted a project with an objective to evaluate the feasibility of integrating a power load shedding capability into the overall control operations. The load shedding was performed by telecontrolling remote modules responsible for driving the customer equipment (heating systems, water heaters and bi-energy systems). The telecontrol systems evaluated included one or more of the following signal transmission methods:

- vertical blanking interval of a television signal;
- FM radio subcarrier (with return telephone line)
- radio pager (with return telephone line)
- cable television system
- telephone system.

The residential report stated that the performance of each of the transmission methods was acceptable. The significant differences between the technologies was cost and flexibility. In general, fully bi-directional systems were judged to be more flexible but more expensive to implement.

4.2.2 VBI Trials

Road and Weather Information System - Ontario MCC/DOC

This project will develop a new kind of point-to-multipoint data distribution network for the Ontario government. It will deliver via "teletext" a database called "Road and Weather Information System (RWIS)" used by the maintenance branch of the

Ministry of Transportation (MTO). It is a joint project between the Ontario Ministry of Culture and Communications (MCC), the federal Department of Communications (DOC) and the Canadian Broadcasting Corporation (CBC).

The pilot system will distribute about 3 megabytes of data per day to remote sites. The information will be transmitted from the RWIS database, which is provided by World WeatherWatch, to the CBC broadcast facilities in Montreal. In Montreal, the data will be encoded onto the VBI of the TV signal, which will be broadcast locally and via satellite. The data information will be re-broadcast on the CBC French in Toronto and Ottawa using a "data bridge."

For the development work, there will be four monitoring site terminals for the MCC, DOC, CBC and World WeatherWatch and two trial sites in MTO work sites. At the receive sites, the data is decoded and inserted into a local database.

The initial goal of this project is to verify the ability to reliably transmit accurate data to remote sites. Assuming a successful demonstration of the system, a potential exists for an additional 20 to 30 sites to be installed in the fall of 1991. The system would be incrementally expanded to serve up to 350 remote sites.

Other potential government applications will also be explored during the roll out stage. Other applications, such as the distribution of water level information, could be launched sometime between 1993 and 1995.

Newspapers for the Visually Impaired

Sponsored by the CRC, in cooperation with Visuaid 2000, L'institute Nuzerath Louis Braille and the CNIB (Ottawa), a trial system is using VBIs to transmit the full text of daily newspapers and other periodicals to a PC equipped with a voice synthesizer. Using the PC's numeric keypad, a visually impaired person could direct the system to read headlines as well as the text of any story in the publication (control by the user as opposed to a radio reading service).

An estimated 500,000 Canadians between the ages of 15 and 64 are unable to read a newspaper due to visual impairment. The trial is to last for 6 weeks and will include 5 or 6 terminal locations.

Canada Post - VBI Data Distribution

Canada Post is exploring the feasibility of operating a national datacasting network using the VBI of a national television signal. The service, which is still in the planning stages, could be used for both internal corporate applications as well as the electronic distribution of various types of information. In addition, the network could be shared with other large businesses. Product offering, pricing packages and roll-out schedules are not publicly available at this time.

Banking

A major Canadian bank is currently exploring the feasibility of using VBI technology to distribute information to its branch offices.

Treasury Board

The Treasury Board is currently exploring the feasibility of developing an electronic system to distribute the Treasury Board's personnel policy manual. The 13 volume manual is currently distributed to about 15,000 people and there are about 50 updates per year.

4.2.3 SCMO Initiatives

Ministry of Transportation of Ontario - Radio Data Channel

The Ministry of Transportation of Ontario is exploring the feasibility and potential business models for the operation of a *Traffic Messaging Channel* in the metropolitan Toronto area. The service, which would be modeled on the European RDS-Traffic Message Channel, would collect its data from a variety of sources including the Freeway Traffic Control System and police bulletins.

The tentative data requirements for the RDS-TMC system would grow from approximately 600 bit/s to over 4800 bit/s over the first five years of operation. At this time, it has not been decided if the data transmission will be compatible with the new RDS standards developed in Europe.

4.2.4 Satellite Trials

Current satellite trials recently completed or currently in process in Canada include the following:

- Telesat's testing of Vidéoway's 4.0 Mbit/s data channel over satellite; and,
- CANCOM's test of two point-to-multipoint data services that it was considering adding to its C-band service. One of these was intended to transmit data and images at speeds up to 1.544 Mbit/s. This would allow customers to transmit maps, charts, aircraft maintenance documents, electronic parts catalogues as well as graphics and photos for newspaper ads. Canadian government officials tested the use of the system for updating harbour maps as well as other geographic images.

In addition, as previously mentioned, International Datacasting Corporation is manufacturing the receiver for SpaceCom Systems' new FM³ service to be launched in July of this year.

4.2.5 Other Canadian Initiatives

Marine Communications

The Canadian Centre for Marine Communications (CCMC) is exploring the feasibility of establishing an information service to provide information to marine vessels which could include the following:

- weather: general and specific;
- news: local, national, and international;
- sports: local, national, and international;
- message services with reliability and in some cases, security.

In a report commissioned by CCMC³, it was concluded that MF and HF broadcast bands appear to be suitable options for datacasting of new information services at communication rates of approximately 300 bit/s at a distance of 100-400 miles. The

³ Report on Communications Channel Alternatives for Project Fishcast

report went on to state that VBI delivery does not offer sufficient coverage⁴ and that satellite delivery is too expensive at this time.

4.3 Identified Potential User Requirements and Applications

In this section, we identify short and long-term potential user requirements by market segment. These requirements were identified based on our full research efforts, including:

- discussions with U.S. and Canadian information providers, service providers, and equipment manufacturers;
- our review of current and emerging applications in Canada, the U.S. and Europe; and,
- discussions with a selected group of government and industry personnel representing potential users.

The potential applications and services, summarized in Exhibit 4-2, are identified by market segment and industry sector as follows:

BUSINESS APPLICATIONS AND SERVICES

Financial Services/Banking

- Broadcast of financial information, stock quotations, commodity prices, etc. to handheld terminals. Transmission will be via satellite to FM subcarrier and digital cellular over the short-term and via personal communications networks using digital cordless and satellite technologies over the long-term, thus moving more of this information into the consumer market. Data speeds will be in the 8 Kbit/s range or less.
- There will be an increasing requirement for more specialized reports and data in real time from various parts of the world. Such information will be distributed via a variety of datacasting techniques.

⁴ Note: CCMC, in conjunction with DOC and IDON Corporation are undertaking a trial of VBI teletext using the facilities of the CBC English television network in St. John's to determine the extent and quality of coverage of a VBI/teletext signal.

- Canadian banks will likely utilize datacasting services, for a variety of applications including:
 - distribution of applications software updates;
 - real-time update of interest rates (currently such information is provided over telephone networks);
 - distribution of data;
 - distribution of corporate procedures manuals and training information;
 - messaging and instruction; and,
 - broadcast of text and graphics with video to provide promotional information and entertainment to customers waiting in line. In addition to advertising the banks' services, this will decrease the perceived waiting time in line-ups and therefore improve the level of customer service.

Data Processing/Communications

- The data processing industry relies heavily on two-way dial-up and dedicated networks for software and data transfer. However, datacasting networks could be used to distribute sales manuals, product descriptions and maintenance manuals from corporate offices to the field.
- One or two key players in Canada's communications industry will likely implement a national datacasting network for distribution of corporate information to post offices and regional terminals across the country. This network may also be used for public applications such as the transfer of documents and high quality images (with printing and delivery at the other end). Use of satellite with VBI or FM subcarrier will permit end-to-end datacasting where users have the appropriate decoders (i.e., in computers or television sets).
- We would also expect that excess capacity on such networks will be resold to businesses and on closed user groups for specialized applications (e.g., as Mainstream Data does today).

Transportation

- **Automobile Driver Information Systems** - The major emerging application for datacasting in the management of the traffic infrastructure is the provision of traffic and road information to the driver. Pilot projects currently being planned or conducted in North America envisage the broadcast of real-time traffic data in local areas at rates up to 4800 bit/s.
- Longer term datacasting requirements are quite variable depending on which data transmission strategy is chosen by transportation agencies. While road-side beacons are expected to be the transmission technology of choice, the large investment in infrastructure may encourage the adoption of datacasting technologies as an interim step. Estimates of the datacasting traffic for 10 to 15 year time frame range from 4800 bit/s at the low end to above 512 Kbit/s for high intensity applications such as the transmission of digital maps to on-board navigation units.
- **Urban Transit Authorities** - envisage multiple uses for datacasting technologies. One of the most suitable is the provision of real-time schedule and route information to riders. The information could be designed to provide either single or multi-modal information. Revenues derived from advertising could potentially support such systems. Since no pilot projects are under way, no firm estimates of data channel requirements have been developed. Estimated data speed requirements vary between 1.2 Kbit/s to 9.6 Kbit/s.
- **Airport/Airline Applications** - Current datacasting applications in the airline industry include the display of arrival and departure information at airline terminals on closed circuit systems. Applications which may emerge in the future include the transmission of fares and schedule information to reservation agents and the distribution of arrival and departure information to homes and offices. Potential internal uses include the distribution of maintenance information and administrative messaging.
- **Marine Applications** - As discussed, a potential marine application involves the transmission of advertiser-supported information services (i.e., news/weather/sports information) and messaging services targeted at vessels operating in the coastal waters off Canada. Potential longer term markets include the transmission of high-definition, digital charts and other navigation information.

Electrical Utilities

- **Direct Load Control Systems, Residential** - Several utilities in Canada have explored the feasibility of implementing direct load control systems to balance power demand with generating capacity. Hydro Quebec's trial with residential clients included over 625 sites (i.e., about 200 FM, 200 pager and 200 two-way cable television).
- The potential number of receiver sites for direct load control is enormous, with every home with either electrical central or water heating systems a potential site. However, utilities are generally motivated to implement direct load control systems when demand for electricity is highly variable (e.g., a high penetration rate of electrical heating systems) and when the power generation system is operating near capacity (or has a slow response cycle). Conversations with utility representatives indicate that the environment in some provinces may not meet these criteria. In fact, Ontario Hydro discourages the implementation of direct load control systems by municipal utilities.
- Several factors discourage the use of datacasting technologies for direct load control. Some of the more significant factors are:
 - utilities want complete control of the transmission system, thus they tend to favour systems which use the power line carrier or dedicated radio frequencies;
 - two-way communication capability, which enable the systems to perform equipment monitoring and remote meter reading, is seen as the future trend;
 - some utilities are encouraging customers to convert electrical systems to other form of energy (e.g., natural gas);
 - utilities, such as Ontario Hydro, which have a relatively flat load curve, are focusing on reducing total energy consumption instead of shifting loads.
- In the short term, the growth of direct load control systems in the residential sector is expected to be modest due to the relatively high capital cost. Over the longer term, direct load control may be built into more elaborate two-way communication systems that include remote meter reading capabilities. Hydro Quebec is evaluating the feasibility of installing between 20,000 and 30,000 two-way communication systems (1992 or 1993). These systems

would be used to control loads, provide customer information, and possibly read meters remotely. They will likely use a combination of VBI and two-way cable system signal delivery.

- ° **Industrial Energy Management Systems** - Hydro Quebec has demonstrated various methods of managing energy consumption and bi-energy systems using both datacasting and conventional communications systems. Ontario Hydro has also been involved with the demonstration of several industrial energy management systems. With the introduction of microprocessor-control time-of-use metering, the longer term communications requirements for industrial systems tend to favour the introduction of two-way communications systems, which are capable of performing remote meter reading and control functions.

Wholesale/Retail Sector

- ° **Product Information/Price Updates** - The distribution of product promotional and price information throughout a retail network is a potential application of datacasting technology. This information could be distributed either in response to a request from the end-user (retail employee) or on a scheduled basis.
- ° **Payment Authorization Systems** - Several payment authorization systems which check for invalid (credit) cards operate in the United States. Datacasting technology can be used in these systems to periodically update invalid card records. Over the longer term, it is expected that these systems will evolve into a back-up facility for on-line transaction systems.
- ° **Place-based Media** - Current point-of-purchase radio applications in supermarkets, departments stores and other retail outlets will continue to utilize datacasting services. However, the audio signals will evolve to CD quality, i.e., likely using 128 Kbit/s. However, we are also witnessing the emergence of place-based multi-media applications where text and graphics are being combined with television signals to provide promotional information, entertainment and targetted advertising to consumers in stores, bars, banks, etc. Through "microtargetting", specific messages and graphics can be addressed to individual locations. For example, an application currently under development in the U.S. entitled the "Check-Out Channel" would provide a compressed video signal at 2 Mbit/s with addressed text and graphics overlaid on the picture to check-out counters in U.S. supermarkets. While shoppers are waiting in line and watching the television, an advertisement could, for example, overlay a message on an automobile advertisement indicating where the nearest dealers are to the

specific supermarket. In addition to targetted advertising, place-based multimedia applications are intended to increase the overall service experience to the client.

- **Retail Promotional Applications** - Multimedia text, graphics and digital video product and promotional information will be distributed using datacasting technologies to retail establishments. Such applications could be used to describe and promote such products as:

- wine and liquor (e.g., datacasting of recipes to liquor stores);
- pharmaceutical products;
- clothing;
- books;
- food; and,
- sporting goods.

Agriculture/Resource Sector

- **Commodity Price Distribution** - A potential exists to implement services which distribute spot price information on commodities such as natural gas, oil, lumber etc. This information can be used by spot buyers in both local and international markets. As such, the geographical scope could be both local and international. Currently, several international services are available over either satellite or telephone networks.
- **Sector Specific Information Services** - Currently Grassroots offers an on-line service targeted at the agricultural market. Additional subscription-based or advertiser supported information services targeted at specific user groups (i.e., farmers, oil drillers, etc.) could emerge in the future. A probable introduction scenario would have the information service packaged with a commodity price information service.

Hospitality

- **Multimedia Entertainment Applications** - Applications such as the NTN Entertainment Network will continue to grow in the hospitality sector. Such use of information and interactive entertainment applications are used to increase revenues by attracting more customers to bars and restaurants.
- **Payment Authorization Systems** - Are also expected to be applied in the hospitality sector, particularly in the fast food areas where low dollar value sales can be verified on-site without the requirement to incur long distance fees (refer to the retail sector).

Media

- ° **High Quality Photo and Image Transmission** - Several news and information service providers are currently in the process of enhancing their systems for transmitting photographs and images. Such systems will transmit high resolution graphics to desktop terminals at speeds in the order of 56 Kbit/s to 128 Kbit/s. Reuters' system entitled the "Electronic Picture Desk" is expected to be introduced later this year.
- ° **Expanded Distribution of Newswire Services** - It is expected that present newswire services, currently distributed to newspapers, television and radio stations will be expanded to a much larger user base. Such applications could ultimately be extended to consumers as premium cable services (i.e., the electronic newspaper).

Real Estate

- ° **Electronic Multiple Listings** - Datacasting techniques could be used to provide real time updates to multiple listing directories stored on personal computers in real estate offices. This would enable use of colour images as well as several images associated with each listing (i.e., views of the property, adjoining properties and each room).

Corporate Information

- ° **Document and Image Transfer** - It is expected that there will be a significant increase in private and shared datacasting networks distributing corporate information to branch sites. Such information could include, for example, the following:
 - high resolution images;
 - policies and procedures;
 - corporate communications information (e.g., newsletters);
 - public relations information to public locations;
 - training manuals;
 - maintenance manual revisions; and
 - parts catalogue updates.

GOVERNMENT AND INSTITUTIONAL APPLICATIONS AND SERVICES

Federal and Provincial Government Departments

Department-Specific Applications - Several departments at the provincial and federal levels already have a significant amount of on-line information that is provided to the public using various modes, e.g., hard copy, on-line, CD-ROM. Some of this information that requires continual update could be provided via datacasting to subscribers' personal computers. In addition, individual departments could use datacasting for a variety of applications including:

- distribution of road maintenance information in text and graphics form (e.g., in Ontario to 350 maintenance sites across the province);
- distribution of federal filings and decisions (e.g., CRTC, Justice, Transport, Tax Rulings, etc.);
- distribution of health information (e.g., information on AIDs, etc.);
- distribution of the Bank of Canada rates;
- distribution of press releases, Gazette notices, etc. (this service already exists in the U.S.);
- distribution of Requests for Proposal by specific departments or central procurement departments;⁵
- distribution of maps and images (e.g., for geographical and nautical chart updates, police and security information, etc.);
- distribution of taxation guides and information bulletins; and,
- distribution of key statistics.

Initially, such information could be distributed to business users on a tiered subscription basis and/or government offices for display on terminals. Ultimately some of this information could be made available to the general public over the VBI to addressable decoders.

⁵ OASIS (Office Automation, Services and Information Systems Directorate) is currently exploring datacasting options for this application.

Internal Government Information - As with the business segment, headquarters and regional offices could distribute policies, procedures and other management information around the organization via datacasting techniques.

Health Care

Discussions with the health care sector indicate that the medical profession is cautious about sharing patient information in a broadcast mode because it is necessary to maintain patient confidentiality. However, several potential applications were identified:

- **Distribution of General Medical Information** - Datacasting techniques could be used to distribute up-to-date bulletins, research activities, etc. to the medical community. This could include major hospitals distributing information to remote sites around a Province.
- **Continuing Education** - It is expected that there will be a requirement in the medical profession to take more continuing education courses in order to maintain their licenses. Datacasting techniques could be used to distribute information and course material to the various specialities in the medical profession to support their continuing education.

Education

- **Distribution of Educational Material** - In Canada and the U.S., the educational community is currently investigating the use of datacasting to distribute administrative and educational material throughout regions.

CONSUMER APPLICATIONS

- **Information/Entertainment/Advertising** - Cable and telephone-based consumer applications have emerged recently in both the U.S. and Canada. These include Vidéoway (cable), ALEX (telephone), Prodigy (telephone in the U.S.), etc.. In addition, the NTN Entertainment Network, currently in bars and restaurants, could also be extended to the home via cable or telephone. While we cannot predict which services will appeal to consumers on a mass basis over the long term, we would expect that there will be a growth in the use of datacasting to provide information to cable head-ends and telephone service gateways used to distribute such services to the consumer. The cable system will provide a significant portion of these services in a datacasting form directly to the subscriber with some services provided in an interactive mode (upstream on the cable system

or via telephone dial-up). However, the telephone services will all be provided in a two-way interactive mode.

5.0 FACTORS INFLUENCING DEMAND

5.1 Factors Influencing Demand

Prior to estimating the future demand for datacasting services, we identified and assessed the key technological, policy/regulatory, market and economic factors, trends and events that will influence datacasting service supply and demand. These are described below.

Technological Developments

Advancement in Telecommunications and Computing

In general, the datacasting industry provides a more cost-effective means of distributing real time information on a point-to-multipoint basis than other means of telecommunications such as the telephone company networks. However, due to the relatively small and specialized size of the datacasting market, it will be driven by whatever telecommunications and computing technologies and services are available at the time. Key developments will likely be the following:

- **Cellular Technologies** - operating in the 8 Kbit/s range will be utilized for low speed datacasting over the short-term. Over the longer term, as digital cellular and cordless telephone technologies achieve penetration, higher speed datacasting applications will emerge; however, most personal datacasting services will be low speed (i.e., 32 Kbit/s or less).
- **Integrated Services Digital Network (ISDN)** - Over the next ten to fifteen years, the digitization of business and residential telephone loops will occur. The result will likely be a Public Switched Telephone Network that has a capability of transmitting data at speeds of 64 Kbit/s. This will have two major effects on the datacasting market. First, it will drive the development of datacasting applications that broadcast large quantities of data (i.e., for updating stored digital audio, voice and video applications). Secondly, it will enable the cost-effective distribution of data in the local environment (i.e., without usage charges). This would reduce the requirement to use local datacasting technologies such as the VBI and FM subcarrier. The impact on applications which transmit large volumes of data will be lower because the head-end equipment required to store and retransmit the information will negate the advantages of the lower usage charges.

- **Telecommunications-based Technologies** - such as Group IV facsimile and CCITT H.261 digital video applications will be applied in the datacasting environment, i.e., for document transfer, real-time file updates, etc.

Advancements in Software Development Tools

Datacasting system integrators indicated that new software development tools such as object-oriented languages have greatly reduced the level of effort required to develop datacasting applications. As a result, more datacasting applications and services will be introduced.

Advancements in Satellite Earth Station Technologies

Further developments in satellite earth station technologies will reduce the size and cost of antennas and increase their performance. Significant developments under way include:

- **Flat Plate Antennas** - with flat plate antennas, the beam is focused electronically rather than through a curved metal dish. This will reduce the size of antennas and allow for more mobile datacasting applications, e.g., to ships and oil rigs.
- **Ultra-Small Aperture Terminals (USATs)** - in the U.S., several datacasting Ku-band applications are already using .75 m dishes. The size of dishes is expected to be reduced further in the future.

Future generation satellites, e.g., in the EHF band (30-300 GHz) will enable further miniaturization of antennas (i.e., in the 30cm range or less). In the 2005-2015 time frame, there will likely be handheld devices capable of transmitting voice and data directly to and from satellites.

Emergence of More Efficient and Reliable Satellite Transmission Technologies

The emergence of more efficient and reliable satellite transmission technologies in recent years is one of the primary reasons for the rapid growth in datacasting applications in the U.S.. In less than three years following the introduction of FM² technology, over two-thirds of the U.S. datacasting applications were using that technology. FM² dropped the space segment costs by more than a factor of 20, and the earth station costs by a factor of 5 (compared to spread spectrum technology). As this form of technology is relatively new to the Canadian environment, i.e., launched by

Novanet in January, 1990, we expect that it will significantly stimulate demand for satellite-based datacasting applications. FM³ technology could, over the longer term, further reduce transmission costs. However, its effects on prices will, in the short term, be relatively insignificant, given the available capacity on FM².

Need for Multi-Delivery Modes of Datacasting

For full national and regional datacasting via satellite, no single mode of datacasting delivery will be sufficient. Therefore, Canadian datacasting network providers will build hybrid networks likely using two or more modes of delivery (i.e., satellite and FM subcarrier and/or VBI). Users will examine the most cost-effective means of receiving datacasting services on a site-by-site basis, if necessary.

Advancement in Data Storage Technologies

Current PC-based disk storage is relatively inexpensive up to 100 Mbytes or more. However, where Mbytes of storage are now used for current text and graphics applications, Gbytes will be required to store future graphics and digital video data. Within the next five to 10 years, Gbyte erasable storage systems using advanced hard drive and optical storage technologies will be developed. This, combined with the development of inexpensive digital video terminals and digital telecommunications networks (i.e., ISDN), will result in significantly more datacasting applications in the 64 Kbit/s to 128 Kbit/s range.

Limitations in Over-the-air Datacasting via FM Subcarrier and Teletext

It is recognized that over-the-air datacasting using FM subcarrier or television (VBI) has inherent multipath interference limitations in high density urban areas preventing some locations from adequately receiving the signal. However, satellite, cable systems or telephone systems will be used to ensure delivery of information to all sites in major urban centres.

Standardization of Data Transmission Over FM Subcarrier

Development of a standard and equipment for transmitting digital information to car radios will open up use of FM subcarrier for early mobile applications. In Europe, the specifications of the Radio Data System were developed under the auspices of the European Broadcasting Union [EBU 1984]. In addition, the European

electrotechnical standards organization, CENELEC, is developing a standard for RDS receivers⁶.

Development of voice synthesis will increase ease of use for drivers (man-machine interface).

Video Compression

Advancements in video compression will enable satellite datacasters to distribute compressed cable television quality video signals in conjunction with data. For example, a datacaster using FM² technology will be capable of broadcasting 3 compressed video signals on the band edge in addition to the FM² data signals now carried. It is expected that in 5-10 years, 6 to 8 compressed video signals could be carried (in addition to the FM² datacasting signal).

Advancements in Fibre Optics

Over the long term, fibre optics transmission facilities will be used in both a two-way interactive and one-way broadcast mode. Products are being commercialized in the U.S. and Canada that will allow cable operators to provide analogue television signals directly to the home. In addition, the U.K. is developing a passive optic fibre network that will be capable of providing 280 HDTV channels to cable subscribers throughout England.

Telephone companies in Canada have been deploying fibre to business premises in high density urban centres. Fibre is expected to be deployed up to or near residences beginning later this decade. It is projected that 80 per cent of all residences in Bell Canada's territory will be served by fibre by the year 2025.⁷

Fibre will, over the longer term, provide the means to distribute data at very high speeds to business and residential locations. Satellite datacasting technologies will play an integral role in distributing data in real-time to information providers who will distribute such information using a variety of terrestrial technologies (e.g., fibre, cellular, etc.).

⁶ John Walker, Mobile Information Systems

⁷ A Study of Competition in Current and Future Local Distribution Networks in Canada, NGL Consulting Ltd. for the Ontario Ministry of Culture and Communications, 1990.

Policy/Regulatory Factors, Trends and Events

Regulatory Changes in Transborder VSAT Rules

As a general rule, all Canadian satellite networks must operate with a Canadian satellite. Users and carriers can own and operate uplinks and/or downlinks. With respect to transborder applications, the rules, currently under review by the DOC, are as follows:

- Telesat is required to own or obtain the license for earth stations in Canada that are receiving "business signals", i.e., information that will be resold for a profit;
- for signals intended to be received as a broadcast undertaking, that spill into Canada, a user can purchase a downlink without obtaining a license. However, the signal may not be distributed using any means of telecommunications.

It is probable that with respect to VSATs, DOC will, within the next year, announce the liberalization of earth station ownership policies for transborder networks. In conjunction with this, DOC may decide to liberalize the rules governing the use of satellite capacity for transborder networks and allow any user to lease capacity for VSATs from any Canadian or U.S. space segment provider. The relaxed earth station rules will likely also allow for distribution of signals using any available telecommunications and datacasting technologies.

The changes in rules will likely stimulate the demand for satellite-based datacasting applications in Canada in the following ways:

- there will be an increase in the number of earth stations receiving U.S. satellite-based applications; and,
- the use of Canadian space segment will be stimulated where U.S. applications will be uplinked to provide full Canada coverage. On the other hand, some Canadian signals may no longer be required.

In addition, the relaxed earth station rules will stimulate the use of various means of telecommunications for distributing down-linked signals including use of FM subcarrier and VBI.

The relaxation of the rules will also have a significant effect on the structure of the datacasting industry. Telesat will face competition from the two major U.S. datacasting space segment providers, i.e., Microspace and SpaceCom. In addition, service providers

such as Novanet will face competition from the U.S. resellers that specialize in the provision of local and long distance datacasting networks. The main U.S. datacasting reseller is Mainstream, which has an FM² satellite network integrated with FM subcarrier in thirteen major U.S. cities. We would expect that Mainstream would consider extending its network into at least Toronto, Montreal and Vancouver. By the same token, Canadian service providers will likely serve the U.S. market as well.

Regulation of Telecommunications in Canada Versus the U.S.

As mentioned earlier, the Canadian telephone industry has been much more regulated than the U.S. industry. This has contributed to the wide difference in local service costs between the two countries. One American supplier we spoke to had examined the feasibility of putting in a local FM subcarrier network in Toronto and concluded that it was more cost-effective to use normal telephone lines. While there will likely be increased competition in the Canadian telecommunications industry, we expect that all efforts will be made to maintain inexpensive basic local telephone service. Therefore, we would expect that the proportion of datacasting sites in Canada versus the U.S. served by the datacasting technologies, as opposed to telephone lines will be lower. Thus, while the Canadian datacasting information services market will likely be about 1/12th that of the U.S., the datacasting technology market will likely be more in the order of 1/15th to 1/20th of the U.S. market.

Delivery of VBI and FM Subcarrier Services Over Cable

On March 23, 1989, the CRTC issued public notice CRTC 1989-23: Services using the Vertical Blanking Interval (Television) or Subsidiary Communications Multiplex Operation (FM). Essentially the decision encourages the use of VBI/SCMO for data delivery but not in a manner that circumvents current broadcast policies. As part of the decision, the following is stated:

"... Cable television licensees shall not curtail or alter VBI/SCMO services; if the carriage of these services causes undue technical interference to the programming on a main channel, the Commission may, upon application, exempt the cable licensee from this obligation by condition of licence ..."

"Where appropriate and where capacity is available, licensees are encouraged to provide access to third parties on a mutually-agreed basis..."

While cable companies are not permitted to alter VBI/SCMO services, there are cases where the VBI is already being used for other reasons (e.g., cable TV encryption). In these cases individual cable operators may have to incur costs to modify their systems to enable pass-through of a VBI signal. This is not considered to be a significant barrier to setting up national or regional VBI networks in Canada.

Closed Captioning Policy

A decision by the FCC to require television receivers to be equipped with closed captioning capabilities could stimulate the introduction of teletext receivers in the consumer sector. The low marginal cost of adding decoders with the ability to receive teletext may encourage manufacturers to add this feature. With an increased penetration rate of teletext decoders, many new forms of consumer information services could emerge.

Market Factors

Growth in the Information Industry

If one considers the information industry in its widest sense, it is huge. The information industry is composed of newspapers, magazines, directories, database and on-line services, reports, newsletters, audiotex, television, cable TV, radio, conference, CD ROM, information software, videocassettes and audiocassettes. In total, this is roughly about a \$6 billion industry in Canada and is growing at about 8 percent a year. The on-line database industry in Canada is a \$150 million business and is growing at about 20 percent per year. The datacasting business is about a \$15 million business in Canada (which includes some revenues for distributing audio signals). This business is however growing at more than 25 percent per year, largely due to the reduction in equipment and transmission costs.

Growth in the Size of Databases

The significant growth in the size of some of the databases is requiring several information providers to upgrade the speeds of their datacasting services to ensure that data can be delivered in real-time. We will therefore see an increase of what was previously transmitted at 2.4 Kbit/s and 9.6 Kbit/s to the 9.6 Kbit/s to 19.2 Kbit/s range.

Availability of Datacasting Facilities

In Exhibit 5-1, we have prepared a chart illustrating the availability of Canadian datacasting facilities for national and regional applications.

The chart shows that the CBC and CTV television networks are both sources of national VBI systems. In addition, there are several specialty channels distributed via satellite to cable across the country. All of these channels could potentially use the VBI.⁸

Use of full channel or sideband on cable systems would restrict the service provider to the cable operators' territories. In most Canadian cities, a service provider would have to deal with two or more cable operators to get full access.

FM subcarrier has the CBC network at the national level as well as several operations covering multiple major cities. Satellite has several service providers with national coverage.

In addition to the above, we should consider the potential availability of U.S. satellite capacity as well as VBI networks such as CBS Extravision.

Economic Factors

The prime economic factors influencing the demand for datacasting services can be segmented into two parts:

- receiver costs; and,
- transmission capacity costs.

⁸ Subject to being able to pass the signals through all cable systems.

Exhibit 5-1
Sources of Canadian Datacasting Facilities

TECHNOLOGY	NATIONAL COVERAGE	WESTERN CANADA	ONTARIO	QUEBEC	ATLANTIC CANADA
Television VBI	CBC CTV	CanWest	Global	Quatre Saisons Radio Quebec Télé-Métropole	No independent broadcasters with full regional coverage
Television VBI via Satellite to Cable	MuchMusic TSN Newsworld YTV Vision TV Weather Now	Knowledge Network Access Alberta SCN	Legislative Channel TV Ontario La Chaîne française	MusiquePlus Meteomedia TV-5	ASN
Cable - Full Channel (mostly local / partial regional)		Rogers, Moffat, Shaw, Cablecasting	Rogers, CUC, Maclean Hunter, Cablenet, Cablecasting	Vidéotron, CF Cable	Fundy Cable
FM Radio Subcarrier	CBC	Multiple Major Centres: - Moffat Communications - CHUM Ltd. - WIC - Rawlco Communications - Redmond Broadcasting	Multiple Major Centres: - Télémedia - CHUM Ltd. - Standard	Multiple Major Centres: - Cogeco - Radiomutuel - Télémedia	- Newfoundland Broadcasting (Nfld), - Chum Ltd
Satellite	Telesat Novanet Cancom Seltech				
Other	MSAT, MobiData, Mobitex, Telecom Canada, Cellnet, Rogers Cantel ° (longer term potential for digital cellular, cordless or fibre based services)				

Receiver Costs - At this time, the costs of 4.8 Kbit/s receivers with built-in error correction are estimated to be as follows:

- satellite FM² about \$1,000
- television VBI \$400 to \$650
- FM radio subcarrier \$300 to \$450
- CATV sideband about \$150.

The cost of all types of receivers is expected to fall in real terms. While the cost predictions depend highly on the production level of the receivers, the following costs are generally accepted as possible **in five years time**:

- satellite FM² \$400 to \$600
- television VBI \$150 to \$300
- FM radio subcarrier \$150 to \$300
- CATV sideband \$ 75 to \$125.

Transmission Capacity Costs - The prices for VBI, FM subcarrier and cable transmission capacity have not been clearly established in Canada. Cable television and FM radio signals are still operating well below capacity, so the pricing structure is based upon market value instead of cost. Satellite FM² capacity is also priced well above its cost base. At this time, the estimated market price per month of a 2.4 Kbit/s channel is as follows:

- satellite FM² \$3,750 (national)
- television VBI \$4,000 (regional, Quebec)
- FM radio subcarrier⁹ \$1,000 to \$4,000 (local)
- CATV sideband \$2,000 (local).

In five years time, it is expected that there will be established prices for all technologies which are dependent on geographic coverage, population served and means of access. The effective cost of a 4.8 Kbit/s channel on a satellite system is expected to fall with the introduction of more efficient coding schemes.

Assuming the above pricing scenario, VSAT systems will be favoured for national applications that have low concentrations of receivers in any one area and require higher data rates. Dedicated telephone lines and FM subcarrier will probably be the preferred technologies for reaching the few customers unable to directly receive satellite signals.

⁹ An FM subcarrier channel could carry up to 19.2 Kbit/s if the intended customer is stationary and can install an external antenna.

Applications which are characterized by high concentrations of receivers in urban areas may tend to favour distribution by either VBI or FM subcarrier. Since the data capacity of an FM subcarrier is limited to 19.2 Kbit/s, this technology will be best suited to applications characterized by low data rates.

5.2 Estimation of Demand Forecasts: 1991-2015

In this section we present the demand estimates for the short-term (1991-1995) and long-term by market segment and technology. In addition, we have indicated the range of data speeds that will be employed in delivering datacasting applications via the various technologies.

In developing the short-term forecasts, we used two lines of evidence:

- 1) top-down forecasts of the number of sites and data speeds based on estimates provided by service providers as well as comparisons with the U.S. market; and
- 2) bottom-up forecasts based on our estimates of the expected value of applications that would likely be implemented.

These forecasts were also tested against the criteria specified in the previous section, i.e., factors influencing demand.

Current Datacasting Services

As shown in Exhibit 3-2 and Appendix A, there are currently about 1500 to 2000 datacasting sites receiving business services, over half of which are comprised of the Canadian Press/Broadcast News Service, and AES's METSIS system. The remaining business services are all relatively small (e.g., financial information, program control, automobile parts, etc.). The majority of these business services are provided on a subscription basis and operate at data speeds in the 1.2 Kbit/s to 9.6 Kbit/s range. We are, however, witnessing the emergence of some value-added informational and promotional services, such as Digital Media's service that designs and delivers promotional information in text and graphics form to points of purchase. In addition, the NTN Entertainment Network, an advertiser and subscription-based service, is provided by a company that designs much of the program content, creates the software development, and sells the service.

On the consumer side, Vidéoway has attracted over 60,000 subscribers and is growing at over 12,000 per month. As mentioned previously, the datacasting channel in Vidéoway operates at a speed of 4 Mbit/s over a full cable channel. Should Vidéoway require more data capacity, another cable channel could be dedicated.

Forecast of Datacasting Services: 1993

Exhibit 5-2 presents our forecast of the Canadian datacasting market in 1993. By year end, 1993, the datacasting market will increase significantly. The number of sites served by satellite will increase to 8500. Most of these sites will be served by FM² technology. The increase in sites will result from the following applications:

- a significant increase in the sites served by Newswire, audio and new high resolution photograph and image distribution services;
- an increase in specialized financial information services;
- one of the Canadian banks or large financial institutions using FM² technology to distribute corporate information, software and data. By removing the one-way administrative data from their telecommunications networks, the banks will save money and improve customer service to ATMs;
- retail applications such as price distribution and point-of-purchase advertising and promotional services;
- the introduction of one or two resource industry specific applications distributing commodity price information, etc. In addition, the agricultural sector will subscribe to services similar to those offered in the U.S.;
- the introduction of some miscellaneous information services such as trading networks.

About half of these satellite services will operate at speeds in the 1.2 to 19.2 Kbit/s range. However, the increase in image transmission services coupled with larger information databases in general will significantly increase the number of applications operating in the 19.2 Kbit/s to 56 Kbit/s range. There will also be continued use of occasional high speed newspaper transmission (e.g., the Globe and Mail) at 1.544 Mbit/s.

Exhibit 5-2
Forecast of Datacasting Services - 1993

Market Segment	Satellite		Television (VBI)		FM Subcarrier		CATV	
	Sites	Application	Sites	Application	Sites	Application	Sites	Application
Government	600 300	METSIS Education/ Health	200 1500 100	RWIS Canada Post Other appl.	100	Traffic Radio Data System (trial)	200	Canada Post
Business	1800 800 1000 1500 1000 900 600	Media/Audio Finance Banking Retail Ag./Resource Hospitality Misc.	1000 200	Banking Utility	100 500	Misc. Paging	200 300 1000	Utility Retail Media/ others
Consumer	- -	-	- RWIS feed free to consumers - 50,000 to 100,000 receivers (built in)		10,000 RDS equipped receivers; no commercial services projected due to low data capacity		Videoway estimate over 250,000 subs	
Total	8500 sites		3000 sites		700 receivers		1700 sideband subs	
Range of Speeds	1.2 to 19.2 Kbit/s 50% 19.2 to 56 Kbit/s 40% over 56 Kbit/s 10%		1.2 to 19.2 Kbit/s 100%		0.5 to 4.8 Kbit/s 100%		1.2 to 9.6 Kbit/s 100% (gov't. & business) 4 Mbit/s (Videoway)	
	Globe & Mail - 1.544 Mbit/s							

By 1993, there will be about 1800 government/Crown corporation sites and 1200 business sites receiving information on the VBI. We expect that two large organizations (e.g., one bank and Canada Post) will be using the VBI for corporate information distribution to branch offices. In addition, it is likely that Canada Post will, by this time frame, begin to use the system to serve its clients (e.g., distribution of electronic promotional information to public sites, etc.).

By 1993, we would expect that two regional applications will be fully in service, one by a Provincial Government and one by a utility (e.g., Road Information in Ontario and utility load management). Data speeds will be in the 1 to 19.2 Kbit/s range. On the consumer side, about 50,000 to 100,000 televisions in Canada will have built-in teletext decoders.

FM subcarrier will be used on a limited basis, the main commercial application of which will be paging. One or two government/industrial trials of driver information via Radio Data Systems (RDS) will be in progress by this time. Some European cars (e.g., Mercedes Benz) will be integrating RDS receivers into their car radios by this time. Thus, there will be about 10,000 receivers in the consumer marketplace. Overall data speeds will be low, i.e., in the .5 to 4.9 Kbit/s range.

Cable TV sideband will be used by about 1,700 sites to receive satellite-delivered datacasting services.

Vidéoway predicts that it will have over 250,000 subscribers by this time frame and will offer a variety of information services to consumers. This could stimulate demand by consumers in other areas for a satellite-delivered Vidéoway "data" service.

Forecast of Datacasting Services: 1996

As shown in Exhibit 5-3, there will be about 20,000 satellite data receive sites in Canada by year-end, 1996. Services in 1996 will consist of the following:

- ° use of datacasting in one or two provinces to deliver educational and administrative information to school boards;
- ° a significant expansion in the number of organizations receiving news information and photographs. In addition, there will be more distribution of graphics and animation using digital video at speeds of 64 to 128 Kbit/s;
- ° a second bank will have introduced satellite-based datacasting to its branches. In addition to corporate applications, banks will be using datacasting for a variety of customer applications (e.g., broadcast of interest rate changes via audiotex to remote sites, using promotional text and graphics combined with compressed video signals, etc.;

Exhibit 5-3
Forecast of Datacasting Services - 1996

Market Segment	Satellite		Television (VBI)		FM Subcarrier		CATV	
	Sites	Application	Sites	Application	Sites	Application	Sites	Application
Government	600 1500 500	METSIS Education Health	350 1500 1000 500	RWIS Canada Post misc. govt. Multi-modal scheduling	100	RDS Traffic System	400	Canada Post
Business	2000 2500 2500 500 4500 2000 2000 1500	Media/Audio Finance Banking Data Pro. Retail Ag./Resource Hospitality Misc.	1000 2500 500 1000 500 1000	Utility Banking Data Pro. Retail Real Estate Corporate Comm.	100 500	Misc. PagIng	4500	Local Delivery
Consumer			- Free feed to consumers - 450,000 receivers (built in)		100,000 RDS equipped receivers (20,000 receiving traffic information)		- Videoway estimate over 500,000 subs (could include 20,000 to 30,000 Hydro Quebec systems)	
Total	20,000	(rounded)	10,000 sites	(rounded)	700 receivers	(excluding RDS)	4500	sideband subs
Range of Speeds	1.2 to 19.2 Kbit/s 30% 19.2 to 128 Kbit/s 55% 128 to 512 Kbit/s 10% over 512 Kbit/s 5% Globe & Mail - 1.544 Mbit/s		9.6 to 19.2 Kbit/s 65% 19.2 to 64 Kbit/s 35%		0.5 to 9.6 Kbit/s 100%		under 19.2 10% 19.2 to 64 Kbit/s 90% (govt. & business) 4 Mbit/s (Videoway)	

- with the success of the banking applications, other data processing intensive organizations will utilize datacasting;
- specialized trial promotional applications will increase this category to 4000 sites. In addition, the hospitality sector will be subscribing to a variety of services to attract more business. For example, Vidéoway could be distributed to a portion of the more than 6000 hotels and motels across the country;
- real-time broadcast of price information, etc. to the agriculture and resource sectors could easily increase that category to 2000 sites (given that there are over 30,000 receive sites in the U.S. today just for the agricultural sector);
- miscellaneous applications that may have emerged by this time in Canada include:
 - specialized trading networks; and,
 - human resources information distributed at the regional or national level (e.g., job openings, people looking for work, etc.).

By 1996, 30% of traffic will be delivered in the 1.2 to 19.2 Kbit/s range and 55% of traffic delivered at speeds in the 19.2 to 64 Kbit/s range as more clear channel 64 Kbit/s applications emerge (e.g., broadcast of Group IV facsimile). Ten percent of traffic will be in the 128 to 512 Kbit/s range with 5 percent of traffic over 512 Kbit/s (for distribution of digital video and high resolution images).

VBI applications will increase the number of sites to approximately 10,000 with two national networks and a few local networks in service offering VBI on a resale basis. About 1000 federal and provincial government sites will be operating specific applications similar to those referred to in Section 4.

On the business side, there will be banking, data processing, retail and corporate communications applications where it is more appropriate to use VBI than satellite. Hydro Quebec will probably be operating at least 1000 systems for commercial and residential bi-energy control customer information functions. The real estate sector will, by this time, be testing an electronic "Multiple Listing with Image and Audiotex" application in one of Canada's major cities.

By year-end, 450,000 consumer receivers will be equipped with VBI decoders enabling some distribution of business and government information, likely at no charge.

Sixty-five percent of VBI applications will be in the 9.6 to 19.2 Kbit/s range.

FM subcarrier and dedicated radio channels in Canada will be used on an increasing basis for mobile applications (e.g., handheld, paging and driver information) as the personal communications world unfolds.

Forecast of Datacasting Services: 2000

Exhibit 5-4 presents our demand estimates for the year 2000. Business and government satellite service growth rates will begin to level off as satellite datacasting services mature. We expect that there will be about 45,000 satellite receive sites in Canada as there is an increased requirement for:

- "real time" industry information;
- advertising-supported multimedia applications; and
- distribution of corporate software, data and administrative information.

Datacasting via satellite will continue to maintain a cost advantage over terrestrial networks, particularly for higher speed applications. Ninety-five percent of government and business traffic will be below 512 Kbit/s; however, there will be more use of local telephone and cable facilities for distribution at 128 Kbit/s or less.

By 2000, we expect that there will be a significant penetration of "flat plate" antennas into homes. About 50,000 of these homes will subscribe to a "Vidéoway-like" service where such a service is not available on their own local cable systems.

On the VBI side, businesses will begin to migrate to "satellite-to-cable or fibre" services. Government applications will increase their user sites to 6000. In addition, the 2 million receivers with built-in decoders will likely receive various types of government information. Such information will also be provided via Vidéoway as well as telephone-based information services.

**Exhibit 5-4
Forecast of Datacasting Services - 2000**

Market Segment	Satellite Sites Application	Television (VBI) Sites Application	FM Subcarrier Sites Application	CATV Sites Application
Government	5,000	6,000	Driver Information Systems to migrate to integrated two-way communications systems.	1200 Local Delivery
Business	40,000	8,000		9500 Local Delivery
Consumer	50,000 Rural/ "off-network Videoway"	2 million receivers (built in)	100,000 RDS equipped receivers Growth of DAB receivers	- Videoway estimate over 1,500,000 subs
Total	95,000	14,000 sites		11,700 + Videoway
Range of Speeds	< 128 Kbit/s 25% 128 to 512 Kbit/s 70% over 512 Kbit/s 5% Videoway 4 Mbit/s or more Globe & Mail - 1.544 Mbit/s	< 64 Kbit/s 80% 64 to 128 Kbit/s 20%	< 9.6 Kbit/s 100%	4 Mbit/s (Videoway), possible multiple channels 64 to 128 Kbit/s

Data speeds via the VBI will remain in the 128 Kbit/s range or less.

With respect to FM subcarrier, we expect that some driver information will be available to the 100,000 RDS equipped receivers. However, driver information systems will begin to migrate over to two-way technologies such as cellular. Local delivery over cable systems will increase; however, dedicated digital local telephone circuits will likely be the preferred distribution technology.

Forecast of Datacasting Services: 2015

Over the long term, we expect that there will be fibre penetration into all businesses and 80 percent of residences in urban areas. Satellites will still have the advantage for datacasting information on a point-to-multipoint basis across wide geographic areas and remote sites. However, in urban areas, datacasting will be via fibre to fixed locations. We expect that about 6.6 million residential subscribers will be provided with information services (most of which will be advertiser supported). Ten percent of the subscribers will receive the service by satellite. Most datacasting applications will be high resolution graphics and video; therefore, speeds in excess of 512 Kbit/s will be required.

We also expect that there will be information services (e.g., audiotex, etc.) broadcast via terrestrial radio to automobiles and personal communications handsets. Most of this traffic will be transmitted at speeds of 256 Kbit/s or below. It is likely that FM subcarrier applications will be in decline by the year 2015 as digital audio broadcast takes over. Similarly, business and government television VBI applications will have mostly migrated over to fibre delivery systems.

Exhibit 5-5
Forecast of Datacasting Services - 2015

Market Segment	Satellite	Fibre/Cable	Terrestrial Radio
Government & Business	35,000 subs Digital broadcast off satellite (part of 2-way network)	300,000 Digital broadcast on fibre	Datacasting applications migrate toward 2-way systems.
Consumer	600,000 subs Future generation of consumer entertainment and information systems	6 million subs Future generation of consumer entertainment and information systems	Datacasting applications migrate toward 2-way systems.
Range of Speeds	below 512 Kbit/s (35%) above 512 Kbit/s (75%)	above 512 Kbit/s	below 256 Kbit/s

6.0 CONCLUSIONS

Datacasting Technologies

- ° Satellites and Vertical Blanking Internal (VBI) networks will be the preferred technologies for datacasting over wide geographic areas. Satellites will be used where high data rates are required.
- ° There will likely be two VBI national networks implemented before 1995. These networks could serve the datacasting needs of Canada Post, some provincial governments and various large business users. In addition, some information will be distributed to residential subscribers with teletext decoders built into their television sets.
- ° FM subcarrier will be used mainly for paging and distribution of traffic information to automobile drivers. In addition, there may be some distribution of satellite-based information in Canada's largest cities using FM subcarrier.
- ° The cable system will be used to datacast in Canada's major markets. Sideband will be used to deliver services to government and business users locally.

New Services and Market Segments

- ° Vidéoway currently uses one full channel of a cable system to datacast at 4 Mbit/s to consumers. The Vidéoway type of application will continue to grow throughout this decade. By 2015, a second or third generation "Vidéoway-type" service will likely have penetrated over 6 million Canadian households via fibre optics. The datacasting component of the system will also be distributed via satellite.
- ° New applications and services will be implemented by governments, institutions and Crown corporations for purposes of distributing internal information as well as distributing information to business users and the general public. The number of locations using datacasting will increase from about 3,000 in 1993 to over 6,000 in 1996. By 2000, over 12,000 sites will use datacasting.

- ° The business sector will use datacasting for a variety of applications, the more significant of which include the following:
 - distribution of corporate information, data and software to branch sites;
 - distribution of entertainment, information and promotional information to retail locations, bars and restaurants;
 - distribution of specialized databases for commercial purposes (e.g., electronic real estate multiple listing, etc.)

Government and business datacasting receive sites will increase from 1,600 now to about 14,000 by the end of 1993. In 1996, there will be about 35,000 government and business sites using datacasting technologies. By the year 2000, 70,000 government and business sites will be using datacasting.

Datacasting Transmission Speeds

- ° By 1996 - 85% of all satellite datacasting applications will be delivered at speeds less than 128 Kbit/s. Television VBI applications will operate at speeds of 64 Kbit/s or less (most will operate at 19.2 Kbit/s or less). FM subcarrier datacasting applications will transmit at speeds up to 9.6 Kbit/s. Cable TV sideband will distribute government and business applications in local areas at speeds of 64 Kbit/s or less. Vidéoway will use at least a full cable at 4 Mbit/s to distribute information and software.
- ° By 2000 - satellite will be distributing data at much higher speeds, i.e., 70% of which will be in the 128 to 512 Kbit/s range. Five percent of traffic carried by satellite will be carried at speeds over 512 Kbit/s. VBI applications will require speeds up to 128 Kbit/s. Cable TV will distribute datacasting signals at speeds up to 128 Kbit/s.
- ° Over the long term (i.e., by 2015), we expect that the majority of satellite carried datacasting applications will be at speeds above 512 Kbit/s. Fibre and cable systems will distribute signals in urban centres at similar speeds. Radio-based technologies, such as cellular, will distribute a significant amount of data to personal communications devices at speeds likely less than 256 Kbit/s.

APPENDIX A
CANADIAN DATACASTING APPLICATIONS

Appendix A
Canadian Datacasting Applications - Satellite

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	LOCATIONS SERVED
News, Audio and/or Wire Photo Distribution	Canada News Wire (via Novanet)	- news Distribution (audio and data)	150 (included below)
	Canadian Press/Broadcast News (via Novanet)	- Supernet distributes 40 news wire services (data at 19.2 Kbit/s) - news distribution (audio and data) - photo distribution - entire network is 230 Kbit/s	508 150 (included above)
	Globe and Mail (via TSN)	- distribution of newspaper to printing plants - uses subcarrier above video (T1 speed)	6
	Reuters (via Novanet)	- news and wirephoto distribution to large newspapers - fees vary with size of newspaper	9
	Telbec (via Telesat)	- distribution of news releases to 100 newsrooms and 60 private subscribers (e.g. gov'ts and PR firms) - 600 bit/s	31
	United Press International	- reception of news	N/A
	Time Inc.	- T1 receive only from the U.S.	1
	Western Information Network (WIN) (via Telesat)	- distribution of CD quality audio plus data services - uses SCPC	21
	Satellite Radio Network (Rogers via Knowledge Network)	- audio plus news	Western Canada
	Standard Broadcast News (Seltech)	- audio and news feed (competitor to Canadian Press) - uses subcarrier above video	100 E/S

Appendix A
Canadian Datacasting Applications - Satellite
(cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	LOCATIONS SERVED
Used Auto Parts Information	Allied Information Network (via Telesat)	- Exchange of used auto parts information - 300 bps	116
Weather Information Distribution	Atmospheric Environment Services (AES) (via Telesat)	- distribution of meteorological information, METSIS to AES customers such as Transport Canada Flight Service Stations, Airlines, fishermen, etc. (10.8 Kbit/s) - AES/DND (2 X 128 Kbit/s) - METSIS (3 X 56 Kbit/s)	110 to AES sites 55 AES customers 115 to Transport Canada locations 25 (included under AES customers above) 17 65
	McLaren Plansearch (via subcarrier)	- distribution of weather information including charts and alphanumeric forecasts	25
Financial Information Distribution	Reuters (via Novanet)	- distribution of trading information - 65,000 pages which are selectively subscribed to - 100 Kbit/s total	56
	Toronto Stock Exchange	- distribution of stock market prices, etc.	150 (part of Canadian Press)
	Star Data Systems - StarQuote	- Canadian and U.S. financial info.	N/A
Telemetry and Control	CBC All News (via Telesat)	- downloading of program control information 300 bit/s	5
Entertainment	NTN Entertainment Network (via U.S. satellites)	- real time sports, trivia, information and targeted advertising to patrons of hotels, bars and restaurants	- to U.S. and Canadian locations

Appendix A
Canadian Datacasting Applications - Satellite
(cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	LOCATIONS SERVED
Advertising, Audio and Place-based Media	Perception Electronic Publishing (via Telesat 8.5 KHz channel)	<ul style="list-style-type: none"> - distributes talking yellow pages and newspaper systems (audiotex) - accessed via local and "900" services in U.S. - requires 64 Kbit/s or 7.5 KHz audio channel - caller hears digital information (on disk at the site) 	<ul style="list-style-type: none"> - 6 locations in Canada - 100 in the US - via Telesat 7.5 KHz audio channel - via United Video in the U.S.
	Digital Media Inc. (via satellite subcarrier in Canada, FM ² in the U.S.)	<ul style="list-style-type: none"> - provides news, sports, trivia, and entertainment with targeted advertising in text and graphics form to service industries - original "Scoreboard" provides information on LED signs (2400 bit/s) - new multi-media service overlays text and graphics on a TV picture (e.g. CIBC) 	<ul style="list-style-type: none"> - less than 50 in Canada via satellite - about 400-500 in U.S. via satellite and cable sideband
Other Information	Electronic Program Guide (EPG) (via Cancom)	<ul style="list-style-type: none"> - electronic TV listings distributed to cable companies - converted from the subcarrier of a U.S. superstation and distributed to cable subscribers on a full channel 	<ul style="list-style-type: none"> - several in Canada - a United Video Service in the U.S.

Appendix A
Canadian Datacasting Applications - FM Subcarriers

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Paging	Cue Networks/Dial Direct Paging Ltd. (Vancouver distributor)	<ul style="list-style-type: none"> - paging network - \$63.00 per month, unlimited number of pages 	<ul style="list-style-type: none"> - FM subcarrier (Moffat Network) 	<ul style="list-style-type: none"> - Vancouver coverage in 3,500 North American cities
Data Distribution	Sherbank Marketing	<ul style="list-style-type: none"> - multi-point data distribution in metro Toronto region - 8x12 bit/s channels 	<ul style="list-style-type: none"> - FM subcarrier 	<ul style="list-style-type: none"> - approx. 35 mi radius of CN Tower
News/Info Distribution	Silent Radio Intl. (trial)	<ul style="list-style-type: none"> - will subscribe to news wires when launched - still in trial/pilot stage - 9.6 Kbit/s 	<ul style="list-style-type: none"> - leased subcarrier on CKUT-FM subcarrier 	<ul style="list-style-type: none"> - 20 mi. radius of coverage of Montreal

Appendix A
Canadian Datacasting Applications - VBI

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	LOCATIONS SERVED
Telecontrol	Télémedia (via Radio Quebec)	- use of VBI to control programming - 1200 bit/s	° Télémedia locations in Quebec
Load Management (trial)	Hydro Quebec (via Radio Quebec)	- use of VBI for utility load management (trial) - 1200 bit/s	° 140 locations served via VBI



Appendix A
Canadian Datacasting Applications - Cable

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	LOCATIONS SERVED
Entertainment and Information <ul style="list-style-type: none"> ◦ Information and addressed services <ul style="list-style-type: none"> - subtitling - teletext - videotex ◦ One-way E-mail ◦ Software and data downloading ◦ Multimedia services 	Vidéoway (via Vidéotron)	<ul style="list-style-type: none"> - an interactive television delivery system intended for use by general and selectable audiences in a one-way or two-way manner - uses a full cable television channel to transmit data at 4 Mbit/s 	<ul style="list-style-type: none"> - 60,000 subscribers in the Montreal area and is growing at 12,000 subscribers per month
Financial Information	"CableQuote" (provided by Eastern Datacom via Rogers)	<ul style="list-style-type: none"> - financial information to brokerage houses, etc. - \$100 to \$2000 per month depending on portion of menu selected by clients - uses sideband on cable (between channels 3 and 4) - 9600 bit/s 	<ul style="list-style-type: none"> - temporarily discontinued until a new source of information is found - will use phone lines and data broadcast in the future
Weather Information	Department of Highways, Manitoba (provided by Grassroots via cable systems in Manitoba)	<ul style="list-style-type: none"> - updates weather maps and road conditions - a videotex service using NAPLPS standard decoded at cable head-ends and distributed on a full channel - a stock information service is provided on another channel 	<ul style="list-style-type: none"> - Manitoba cable subscribers

APPENDIX B
U.S. DATACASTING APPLICATIONS

Appendix B
U.S. Datacasting Applications

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
News Services	United Press International (U.P.I.)	<ul style="list-style-type: none"> - distributes news service, stock quotes, etc. - also uses satellites for digital photo transmission 	<ul style="list-style-type: none"> - via Contel ASC C-band using spread spectrum technology; as a customer of Mainstream It transmits via Microspace KU-band using FM² technology and as a customer of Microspace It transmits at C-band over Spacecom System using FM² technology - also transmits over Mainstream's FM subcarrier network 	<ul style="list-style-type: none"> - UPI leases several 19.2 Kbit/s channels plus two 15 KHz audio channels
	Associated Press	<ul style="list-style-type: none"> - transmits AP's news wire services via C-band to 3-metre dishes - will operate a Shared User Network (SUN) that will transmit in 9600 bps over C-band 	<ul style="list-style-type: none"> - Satnet (subsidiary of AP) 	<ul style="list-style-type: none"> - 1200 sites - \$250/month to transmit data and \$170 per drop per month including equipment (100,000 words per day or less) - targeted at law offices, start-up companies, retail businesses, franchise operations and gov't organizations



Appendix B
U.S. Datacasting Applications
 (cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
News Services (cont'd)	Knight-Ridder	- news wire, financial information	- via Mainstream Ku-band and FM subcarrier	- national - multiple target markets
	Bay City News	- distribution of San Francisco news	- Mainstream satellite and FM subcarrier	
	Business Wire	- delivery of news	- Mainstream satellite and FM subcarriers	- 1200 news media and 500 investment firms in U.S.
	Federal News Service	- text of speeches, briefings, hearings from Washington - coded by key words and topics and distributed according to specified categories	- Mainstream satellite and FM subcarrier	- N/A
	Journal Graphics	- distribution of television transcripts	- Mainstream satellite and FM subcarrier	- N/A
	PR Newswire	- for corporations to issue press releases to media and investment clients	- Mainstream satellite and FM subcarrier	- N/A

Appendix B
U.S. Datacasting Applications
 (cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
News Services (cont'd)	Reuters Info. Services	- news wire service offering general and business reports and bulletins for distribution to subscribers according to specified categories	- Mainstream satellite and FM subcarrier	- N/A
	North American Quotations (London, Ontario)	- news wire service	- via spread spectrum and FM ²	- N/A
	U.S. Newswire	- corporate press release network		- Washington area
Advertising/ Information to LED signs	Ad Net (MediaStar/ AdStar)	- advertising supported sports, news, and trivia broadcast to three colour LED signs in truck stops, fast food restaurants and bars	- Mainstream's satellite and FM subcarrier network	- about 20 locations; will expand to 100 by the end of 1991
	North American Visual Communications (NAVC)	- transmits sports, news and weather feeds to LED signs	- satellite	- 600 installations; 250 via broadcast - \$75-\$100/month for a daily feed

Appendix B
U.S. Datacasting Applications
(cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Advertising/ Information to LED signs (cont'd)	Cybernetic Data Products	<ul style="list-style-type: none"> - Silent Radio transmits advertiser supported feeds to bars, restaurants, beauty salons, grocery stores - VBI decoder is about \$100 	- Microspace ku-band, VBIs and FM subcarrier	- 5300 locations in 45 markets
	Tribune Media Services	- advertising-supported news and graphics to sports bars, airport lounges and other locations	- Mainstream satellite and FM subcarrier	- N/A
POP Radio	Broadcast International	- transmits music, point-of-purchase advertising and electronic mail to grocery chains, drug stores and wholesalers	- Satellite	- N/A
	AEI Music Network	- audio and data to retailers, restaurants and hotels	- Mainstream satellite and FM subcarrier	- N/A
Weather Information	WSI	<ul style="list-style-type: none"> - provision of weather information - 56 Kbit/s 	- via Mainstream FM ² and FM subcarrier	- N/A
	WeatherBank Inc.	- weather information and graphics including forecasts, lightening strikes, radar cloud cover, etc. delivered to corporations and the media	- Mainstream satellite and FM subcarrier	- N/A
Automobile Parts Information	Autoinfo	- parts locator network for automobile salvage yards in the U.S. and Canada	- satellite (uses landlines to 20 Cdn sites)	- N/A
	Allied Information Networks	- exchange of used parts among farm truck, and construction equipment dealers	- Mainstream satellite and FM subcarriers	- N/A

Appendix B
U.S. Datacasting Applications
(cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Petroleum Information	Bonneville Market Information	<ul style="list-style-type: none"> - Energy service transmits oil prices, etc. over Bonneville's network - service includes software to receive the data on a PC 	- satellite	- used by petroleum wholesalers (jobbers) who purchase oil products from refineries and sell them to gasoline stations. Service is paid for by refineries
	DTN	- DTNergy service provides similar information to a "dumb" terminal (will be linkable to a PC in the future)	- satellite	- users pay \$29.95 per month to receive prices over the network
Agricultural Information	DTN	- provides commodities information to the agricultural sector	- satellite	- about 30,000
Financial Information	Data Broadcasting Corp (FNN/Infotech)	<ul style="list-style-type: none"> - Marketwatch, Quotrek and Signal Financial data services - Quotrek provides data to handheld terminals using FM subcarrier 	- satellite, FM subcarrier and VBI	- Signal provides data via FM subcarrier or satellite receiver to a PC
	Dow Jones	- "Professional Investor Report" financial news reports and data	- Mainstream satellite and FM subcarrier	- several thousand
	Federal Filings Inc. (Dow Jones)	- real time summaries of Security Exchange Commission (SEC) filings that will impact the financial markets	- Mainstream satellite and FM subcarrier	- N/A



Appendix B
U.S. Datacasting Applications
 (cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Financial Information (cont'd)	FIRST CALL	- investment research opinions	- Mainstream satellite and FM subcarrier	- 300 institutional investment firms
	Market News Service	- international interest rate and currency markets	- Mainstream satellite and FM subcarrier	- N/A
	MMS International	- analysis of domestic and international money markets	- Mainstream satellite and FM subcarrier	- N/A
	Telerate	- financial information	- Mainstream satellite and FM subcarrier	- available throughout North America
	Data Broadcasting Corp.	- real time stock, option, commodity quotation service delivered	- CATV - broadcast television VBI	- serves 2500 subscribers on over 700 systems
	Press Information Services	- news, sports, financial and weather information		- 9 million subscribers on 25 cable systems

Appendix B
U.S. Datacasting Applications
(cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Financial Information (cont'd)	Bonneville Telecommunications Co.	- real-time stock, commodity and option information	- satellite - FM subcarrier	- National USA
	Telemet America Inc.	- stock, option, commodities and news broadcast by subcarrier to Pocket Quote and Radio Exchange receivers	- satellite (VSAT) - FM subcarrier (Pocket Quote)	- National USA Southern Canada
	Knight-Ridder	- AWS commodity futures quotation service	- satellite, FM subcarrier	- National USA



Appendix B
U.S. Datacasting Applications
 (cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Entertainment	NTN Communications Inc.	- NTN Entertainment Network produces real-time, interactive sports and trivia games in conjunction with the NFL, CFL, etc. for patrons of hotels, bars and restaurants	- via Ku-band (Mainstream) and C-band	- to U.S. and Canadian locations
	SportsTicker Inc. (Telerate Sports)	- 24-hour sports news and score reporting wire service for hotels, bars, sports teams and the media	- satellite	- N/A
Construction Industry Information	McGraw Hill	- distributes construction industry information	- various	- to U.S. locations

Appendix B
U.S. Datacasting Applications
(cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Trading Information	ARTIS	- electronic network for dealers of art and collectibles	- Mainstream satellite and FM subcarriers	- N/A
	Information Networks Incorporated	- trading network for coins, precious metals, and baseball cards	- Mainstream satellite and FM subcarrier	- N/A
Human Resources	Breakdown Services Ltd.	- "Commercial Express" casting agent to talent agency network to fill talent requests for commercials, TV movies, etc.	- Mainstream satellite and FM subcarrier	- N/A
Paging	Skytel	- national paging network	- Ku and C-band	- links major markets in the U.S.
	Cue Networks	- national paging network	- FM subcarrier	- major market coverage in U.S.
	AT&E Corp.	- trial of a wristwatch pager	- FM subcarrier	- N/A



Appendix B
U.S. Datacasting Applications

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Information Distribution	Keycom Electronic Publishing (KeyFax)	- Keyfax is an experimental teletext magazine that includes over 100 pages of constantly updated information 24 hours a day	- "Keyfax by satellite" is a national magazine that transmits on the VBI of Superstation WTBS	- National USA
	CBS Extravision	- national teletext service in NABTS specification (see KSL-TV Teletext 5)	- CBS network signal (VBI)	- National USA
	NBC Teletext	- network teletext service carried by NBC affiliates	- NBC network signal	- National
	KSL-TV "Teletext 5"	- news/weather/sports information - partially supported by advertising	- local on KSL signal - national on CBS signal	- National USA
Advertising/ Shopping	Cableshop	- a shopping information service involving in a 10-month test in Peabody, Mass.	- VBI	- Peabody, Mass

Appendix B
U.S. Datacasting Applications

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Point-to-multipoint data channels	Southern Satellite Systems	- national VBI "common carrier" service for all owners of special boxes or Zenith System 3 televisions (world service standard)	- VBI of WTBS (Atlanta)	- reaches 54 million households - tariff rate e.g. 9600 b/s @ \$13,500 per mo.
	Mainstream Data	- leases national point-to-multipoint data network/channels	- satellite FM ² and SCA data distribution	- American coverage
	Multicomm	- leases national point-to-multipoint data network/channels		



Appendix B
U.S. Datacasting Applications
(cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVICES
Network Control	CBS	- news bulletin alert - Newsnet (newswire) - E-mail	- CBS network signal	- National
	ABC	- internal-affiliate messaging	- ABC network signal	- National
	Univision	- internal-affiliate messaging	- network signal	- N/A

Appendix B
U.S. Datacasting Applications
(cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Educational	Central Educational Network	<ul style="list-style-type: none">- regional network serving public television stations- funded by network and sponsors (not-for-profit)	<ul style="list-style-type: none">- PBS national datacast	<ul style="list-style-type: none">- tested PBS's VBI network for transmitting data to schools
Irrigation Control	Cue Network Corp (owned by Seltech Satellite Corp. of Toronto)	<ul style="list-style-type: none">- used by Network Services Corp. to control irrigation systems	<ul style="list-style-type: none">- FM subcarrier	<ul style="list-style-type: none">- California



Appendix B
U.S. Datacasting Applications
(cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Radio Data Systems (RDS)	Trial Sponsors: <ul style="list-style-type: none"> ◦ Castle Rock Consultants (traffic message channel) ◦ Sage Alerting Systems (emergency broadcast system) ◦ Bosch (European projects) ◦ ARI System 	<ul style="list-style-type: none"> - Delco has produced 100 RDS equipped radios for demonstration projects (primarily for Castle Rock Consultants) - Automatic volume level control for traffic alert broadcasts 	<ul style="list-style-type: none"> - FM subcarrier - FM subcarrier 	<ul style="list-style-type: none"> - 18 of 5,000 FM stations in the U.S. are broadcasting RDS. However, 90 percent of stations in the U.K. and Germany are using the technology - RDS-TDC compatible radio units will be available for the 1993 model year in the U.S.

Appendix B
U.S. Datacasting Applications
(cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Advanced Driver Information Systems	Michigan Department of Transportation, Environmental Research Institute of Michigan, University of Michigan	<ul style="list-style-type: none"> - \$5 million, 3-year demonstration program to compare technologies for driver information systems 	<ul style="list-style-type: none"> - FM Subcarrier using RDS-TMC - Cellular radio - low power highway advisory radio (HAR) - automatic interrupt highway advisory radio (AHAR) 	- Michigan
	OM Development	<ul style="list-style-type: none"> - transports traffic information via paging networks to handheld terminals that will advise on route to take - price is \$4,500 for the terminal and \$30/month for the information (Expected to drop to \$99 and \$5-7 per month for the terminal and service respectively in 5 years) 	- paging network	- to be marketed to consumers and commercial drivers (e.g. truck drivers, couriers, salespeople, service technicians, etc.)
	California Department of Transportation (Caltrans)	<ul style="list-style-type: none"> - Com-TV (Commuter Television) is a 6 month demonstration project delivering reports on freeway traffic conditions to lobbies of Los Angeles office buildings (part of Project PATHFINDER) 	- television VBI	Los Angeles



Appendix B
U.S. Datacasting Applications
(cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Credit Card Authorization	Verifone (trial)	- Vericast, a credit card authorization system	- PBS National Datacast (VBI)	- National USA
	Cue Networks Corp.	- used by Irintech to distribute credit card authorization information	- FM subcarrier	- N/A
	Merchantec International (part of Indesys)	- broadcasts credit card information to restaurants, movie theatres, etc. for verification of under \$50 purchases - also includes E-mail and music services	- satellite	- N/A

Appendix B
U.S. Datacasting Applications
 (cont'd)

APPLICATION	USER/INFORMATION PROVIDER (Network Provider)	DESCRIPTION	DELIVERED BY	LOCATIONS SERVED
Utility Load Control	- multiple utility trials, e.g. Oslethorpe Power (Georgia)	- direct utility load control - water heater - bi-energy - heating systems	- dedicated radio channel - FM subcarrier - power-line carrier - fixed land line (telco or CATV)	- Various locations across USA
VCR Control	Insight Telecast	- VBI system which simplifies VCR programming (trial)	- PBS National Datacast	- National



APPENDIX C

SOME IMPORTANT RDS APPLICATIONS

ABBREVIATED SPECIFICATIONS
OF THE RADIO DATA SYSTEM (RDS)

Appendix C

Some Important RDS Applications

Tuning Functions		
PI	Program Identification	16-bit machine code giving a unique (within any one country) serial number to a program service
PS	Program Service Name	8 ASCII characters for display on the receiver (e.g., "BBC R1," "Capital")
AF	Alternative Frequency	List of frequencies on which a given program service can be found in adjacent service areas
EON	Enhanced Other Network Information	PI, AF of other program services (usually those operated by the same broadcasting organization)
PTY	Program Type Code	Indicates the type of program material broadcast in a particular service
Traffic Station - Announcement Identification		
TP	Traffic Program Flag	One-bit code which indicates if a station carries traffic messages as part of its sound program
TA	Traffic Announcement Flag	One-bit code which indicates that a traffic announcement is currently on-air from the tuned station
Other Information		
CT	Clock-Time and Date	Transmitted as Universal Time Code and Modified Julian date
RT	Radio Text	Text for display (or reproduction via a voice synthesizer)
PIN	Program Item Number	Scheduled start time and date for an individual program
TDC	Transparent Data Channel	Unformatted text or data
M/S	Music-Speech Code	One-bit flag to indicate music or speech
DI	Decoder Identification	Four-bit code to indicate, for example, mono, stereo, <u>et cetera</u>
IH	In-House Applications	Data which are used by the broadcaster for his own applications: not to be decoded by ordinary RDS receivers
Radio Paging		
RP	Radio Paging Service	Paging service using FM broadcasts as the transport mechanism
Traffic Message Channel		
TMC	Traffic Message Channel	A means of conveying traffic messages separately from the sound program signal by using densely coded predetermined messages which are broadcast within the RDS multiplex (It is still under development)

Appendix C (cont'd)
Abbreviated Specifications of the Radio Data System (RDS)

5A.1 MODULATION OF THE DATA CHANNEL

- 1.1 *Subcarrier frequency:* 57 KHz, locked in-phase or in-quadrature to the third harmonic of the pilot tone 19 KHz (± 2 Hz) in the case of stereophony. (Frequency tolerance: ± 6 Hz).

If used simultaneously with the ARI traffic broadcast identification system, the ARI subcarrier will have a phase difference of 90 degrees ± 10 degrees, and the recommended nominal deviation of the main carrier will be ± 12 KHz due to the RDS signal and ± 3.5 KHz due to the unmodulated ARI subcarrier.

- 1.2 Subcarrier level: the recommended nominal deviation of the main FM carrier due to the modulated subcarrier is ± 2 KHz. The decoder should, however, be designed to work with subcarrier levels corresponding to between ± 1 KHz and ± 7.5 KHz deviation.
- 1.3 *Method of modulation:* the subcarrier is amplitude-modulated by the shaped and biphase-coded data signal. The subcarrier is suppressed.
- 1.4 *Clock frequency and data rate:* the basic clock frequency is obtained by dividing the transmitted subcarrier frequency by 48. Consequently, the basic data rate is 1187.5 bit/s ± 0.25 bit/s.
- 1.5 *Differential coding:* when the input data level from the coder at the transmitter is zero, the output remains unchanged from the previous output bit, and when an input of one occurs, the new output bit is the complement of the previous output bit.

5A.2 BASEBAND CODING

- 2.1 *Coding structure:* the largest element in the structure is called a "group" of 104 bits. Each group comprises four blocks of 26 bits. Each block comprises an information word and a checkword, of 16 and 10 bits, respectively.
- 2.2 *Order of bit transmission:* all information words, checkwords, and addresses have their most significant bit transmitted first.

- 2.3 *Error protection:* the 10-bit cyclic redundancy checkword, to which a 10-bit offset word is added for synchronization purposes, is intended to enable the receiver-decoder to detect and correct errors which occur in reception.
- 2.4 *Synchronization of blocks and groups:* the data transmission is fully synchronous, and there are no gaps between the groups of blocks. The beginnings and ends of the data blocks may be recognized in the decoder by using the fact that the error-checking decoder will, with a high level of confidence, detect block synchronization slip. The blocks within each group are identified by different offset words added to the respective 10-bit checkwords.
- 2.5 *Message format:* the first five bits of the second block of every group are allocated a 5-bit code, which specifies the application of the group and its version. The group types specified are given below. There is also space left to add applications yet to be defined.

Group Type Codes

Decimal Value	Group Type Binary Code					APPLICATIONS
	A3	A2	A1	A0		
0	0	0	0	0	X	Basic tuning and switching information
1	0	0	0	1	X	Program item number
2	0	0	1	0	X	Radio text
3	0	0	1	1	X	Other network information (superseded by enhanced version in Type 14 groups)
4	0	1	0	0	0	Clock time and date
5	0	1	0	1	X	Transparent channels for text or other graphics (32 channels)
6	0	1	1	0	X	In-house applications
7	0	1	1	1	0	Radio paging
8	1	0	0	0	X	Reserved for traffic message channel
9-13						Applications not yet defined
14	1	1	1	0	X	Enhanced other network information
15	1	1	1	1	1	Fast basic tuning and switching information

Note: X indicates that value may be "0" (Version A) or "1" (Version B).

APPENDIX D
LIST OF INTERVIEWEES

Appendix D

List of Interviewees

Canadian Information Service Providers

Stephen Pozgaj, Vice President, Operations, Digital Media Networks Inc.
Bob Wardrop, President, Digital Media Networks Inc.
Sid Belzberg, President, Eastern Datacom
Ken Starkell, Grassroots
Nickie Bonner, Media Sales Executive, Reuters
Howard Gross, Perception Electronic Publishing
David Taylor, General Manager, O1 Cablesystems
Brad Schroeder, Vice President, Operations, NTN (Toronto)
Pierre Levesque, Product Director, Les Entreprises Vidéoway Ltée
Gerry Foryes, CMQ Canada (Telerate)
Gary Strickler, Sherbank Marketing Services
Dave Grenier, Star Data Systems
M. Pervan, Silent Radio International
Jacques Langois, General Manager, Mediasat

Canadian Network Providers

Dick Bondy, Telesat Canada
Tom Moorehead, Vice President and General Manager, Satlink Business Services Inc.,
Canadian Satellite Communications Inc. (CANCOM)
Randy Zedic, President, Novanet Communications Ltd.
Don Witzel, Novanet Communications Ltd.
Bruce Cabin, Director, One-Way Services, Canadian Satellite Communications Inc.
(CANCOM)
Jean-Robert Côté, Director of Marketing, MobiData Communications

Canadian Equipment and System Providers

Jean Lajoie, President, Telecommunications VSAT Inc.
Gary Carter, Vice President, Sales & Marketing, International Datacasting Corporation
Dave Zuvik, Network Products Division, Norsat
Jim Carruthers, President, Norpak Corporation
E.C. (Ted) McClelland, Marketing Manager, Norpak Corporation
Darell Haverson, Infosat Communications
Gunter Gauss, Robert Bosch Inc.
Bob Norton, Applied Electronics
Norm Walker, Glenayre Electronics

Brahm Menton, Dataradio Inc.
Gerry Bachmayer, Director, Oracle Communications
Wayne Jolly, Teleride Sage

Canadian Broadcasters and Cable Operators

Vic Reid, Skyline Cablevision
Michael Allen, Rogers Communications Inc.
Jean-Claude Asselin, Radio Canada
David Hunter, CTV Network
Jim McLaughlin, Moffat Communications
Gregg Jardine, Chief Engineer, CFOX Inc.
Tak Negoro, V.P. Engineering, BC TV
Terrence Flanagan, CKCU
Richard Shepard, CKFM

Communications Research Centre (Department of Communications)

Ron Morley, Data Broadcast Systems
Roy Marsh, Director, Informatics Applications
Ken Hill, Director Optical Communications and Electrophotonic Technologies
Bob Huck, Director, Satellite Communications
Lewis Scott, Manager, Advanced Informatics Technologies (Project Authority)
Bernard Caron, Director, Information Processing

Canadian Policy-makers/Regulators

Murray Fyfe, Manager, Satellite Network Policy, Department of Communications
Andy Kolada, Director General, Technical Planning and Analysis, CRTC

Other Canadian Industry Experts and Players

Barrie Kirk, Satellite Information Services (SIS), Telesat Enterprises Inc.
Herb Bown, IDON Corporation
Jean-Pierre Lauzon, DTI Telecom
Jeffrey Bond, Senior Communications Specialist, Ministry of Culture and Communications
Ed Bitmanis, Manager, ISDN Product Management, Bell Canada

Canadian Users (Existing and Potential)

Transportation Agencies:

Ryerson Case, R&D Branch, Ontario Ministry of Transportation
 Gabriel Heti, R&D Branch, Ontario Ministry of Transportation
 Louis Strasberg, R&D Branch, Ontario Ministry of Transportation
 Jackson Wang, R&D Branch, Ontario Ministry of Transportation
 Lamberto Gomes, Ontario Ministry of Culture and Communications (seconded to MTO)
 Lewis Sabonghi, Technology Applications, Transportation Development Centre
 Jan Konazewski, Director of Research, Alberta Transportation

Transit Agencies:

John Donaldson, Director, Public Information, OC Transpo
 Eve Wyatt, Go Transit
 Dr. Brendon Hemily, Canadian Urban Transit Association

Electrical Utilities:

Gerry Meade, Section Head - Product Development, Energy Management Branch, Ontario Hydro
 Carolyn Kinsman, Energy Management Branch, Ontario Hydro
 Steve Previdsa, Energy Management Branch, Ontario Hydro
 Bill Palmer, Superintendent of Telecommunication Services, Ontario Hydro
 Harvey Douglas, Canadian Electrical Association
 Ronald Elliot, Energy Management Engineering
 Carl Crop, General Manager, Ottawa Hydro

Business Sectors:

Tom Egan, Canadian Tire Acceptance (Retail)
 B. Commerford, Royal Bank (Banking)
 Gerome McManus, Royal Bank (Banking)
 Brent Clarke, Senior Systems Specialist, Corporate Information Systems, Petro Canada (Oil & Gas)
 Mitch Hodgkins, Supervisor, Network Services, MacMillan Bloedel (Forestry)
 Kevin Tuttle, Canadian Hospitality Foundation (Hospitality)
 Canadian Bankers Association (Banking)
 Canadian Association of Insurance Agents and Brokers (Insurance)
 Martin Kaiser, Ontario Forest Industries Association (Forestry)
 Peter Millistver, Canada Post (Communications)

Government and Institutions:

Erin Keough, Director, Telemedicine Centre, Faculty of Medicine, Memorial University
Glen Verma, Canadian Medical Association
Brian Terry, Canadian Centre for Marine Communications
Bruce Read, Director of Engineering, TVOntario

U.S. Service and Network Providers

Wes Hanemayer, Vice President, Satellite Systems, CNN
Al Stem, Vice President/General Manager, SpaceCom Systems Inc.
Keith Smith, Microspace
Dave Webb, KSL-TV
Tom Barker, Cue Networks Corporation
Jerry LeBow, Sage Alerting Systems/Sage Broadcasting
Adam Grow, Southern Satellite Systems
Barbara McMann, Director of Marketing, Commodity New Network (Knight-Ridder)
Dan Smith, Bonneville Telecommunications
Timothy Bruske, Director, Marketing & Sales, Mainstream Data, Inc.
Mark S. Richer, PBS National Datacast
Michael Garr, PBS National Datacast
Michael Hurd, Harris Enterprises
Marcus Pedriks, Databroadcasting International (U.K.)
Chuck Grant, President, Waytogo Corporation

U.S. Equipment Providers

John McMullen, Executive Vice-President, Satellite Technology and Research (STAR)
Terry Beale, Delco Electronics
Allan Kirson, Director, Technology, Intelligent Vehicle/Highway Systems, Motorola Inc.
Sue Genson, Lotus Development Corporation
Max Fox, Cybernetic Data Products
David Chancey, National Sales Manager, Moseley Associates Inc.
Bruce Atkins, Teletext Solutions Inc.
Mike Freedman, Coastcom

APPENDIX E
LIST OF REFERENCES

Appendix E List of References

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- Joshua Harris, President, Jupiter Communications Inc.
- Daniel Downs, Executive Director, NTN Communications Inc.
- Dr. Gerald Bennington, President, Xpress Information Services Ltd. and Executive Vice President, TCI Information Services Inc.
- Michael Ridder, Consultant
- Richard Atkins, Maxwell Communications
- Maria Pirone, WSI Corp.
- Vince Godleski, National Sales Manager, Scientific Atlanta

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