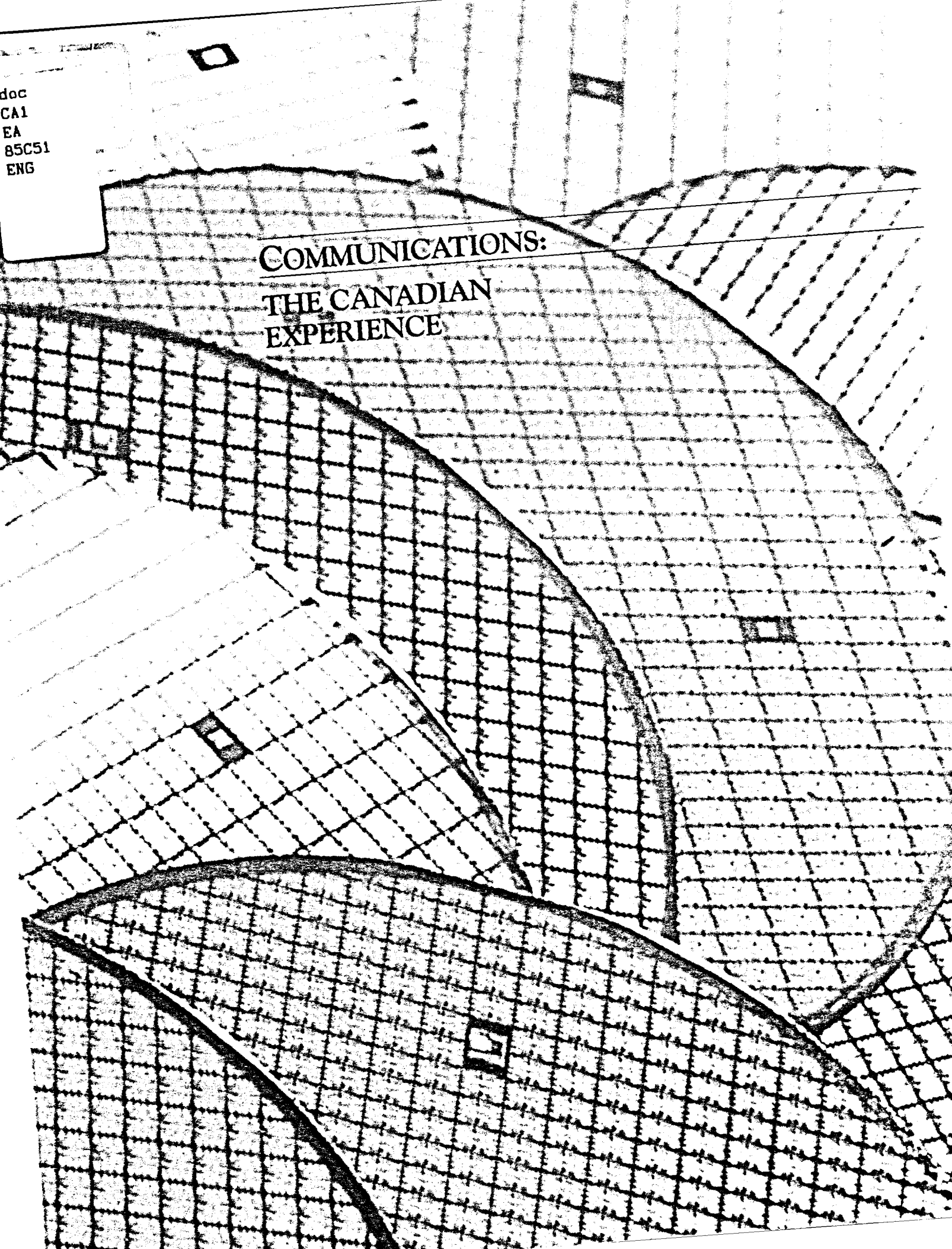
COMMUNICATIONS: THE CANADIAN EXPERIENCE



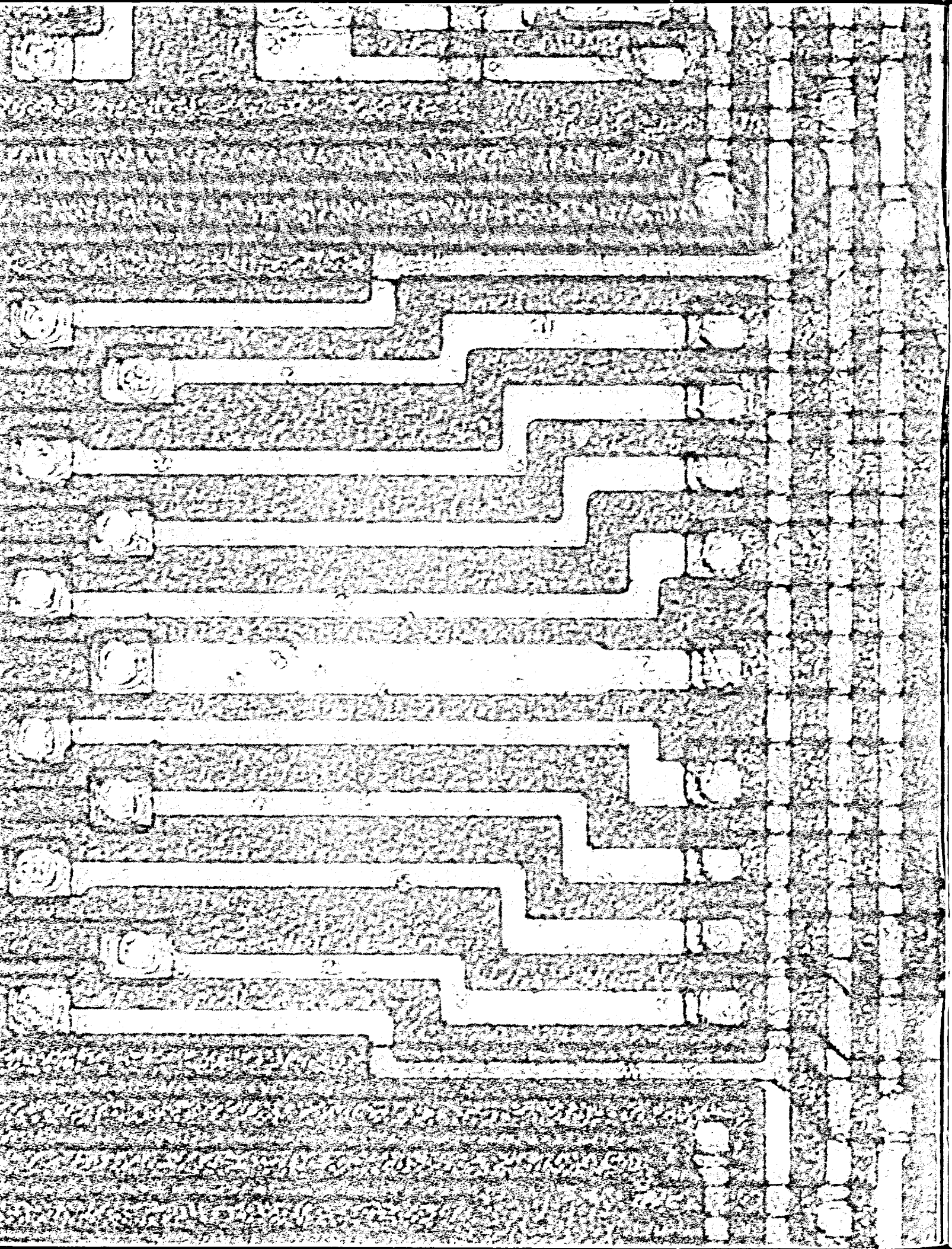


TABLE OF CONTENTS

Cover:
Processed silicon wafers each containing hundreds of chips.

Inside front cover:
Microphotograph of a section of a chip displaying pathways of the circuits.

The purpose of the science and technology series is to inform readers of current trends in Canadian research and development. Only Canadian designs are discussed at length in this series, rather than designs of other countries which may be developed and produced in Canada.

Published by Authority of the
Right Honourable Joe Clark,
Secretary of State for External Affairs,
Government of Canada, 1985

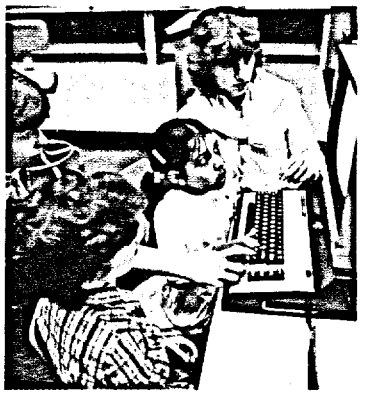
Communications has long played a vital role in Canadian history. Ours is a vast country — 9 970 000 square kilometres — spanning seven time zones and with a population of only 25 million people living in communities often separated by great distances and geographical barriers. It is also a country with two official languages, many different cultures and distinct regional identities. Excellent communications networks have enabled Canadians not only to conquer distance, but also to express and benefit from the nation's rich diversity.

Canada has pioneered many telecommunications developments from the world's first long-distance telephone call, to the world's first commercial domestic communications satellite, to a sophisticated new information technology called Telidon. In every part of the country, even remote Arctic settlements, Canadians now enjoy sophisticated communications services. Telephone, business communications and broadcasting services are delivered by cable, microwave and satellite systems. Canada is also a pioneer in innovative technologies that serve the nation's social, cultural and economic needs — broadcasting that fosters cultural diversity, projects that bring health and education services to remote communities, research into social implications of new technology, to give some examples.

Today, communications technology is more important than ever. We have entered the so-called "information age", an era in which information itself is becoming a dominant commodity and the capacity to generate, process, store and transmit information becoming critical to economic strength.

Communications is one of the fastest growing sectors of our economy, and it is undergoing revolutionary transformations. Increasingly, the boundaries between telecommunications, computers and other technologies are dissolving thus creating whole new industries, sophisticated new services and products and dramatic changes to our working and leisure environments. In Canadian offices, for example, there is an increasing tendency towards multifunctional equipment and integrated systems that enable greater productivity. In the home, television sets are beginning to be used not only for conventional programming but also for information retrieval, computer games, remote emergency alarms and other services.

Canada's early involvement in telecommunications and our continuing communications needs have placed us in the forefront of the new information era. We have contributed to advances in many areas including digital switching and transmission, satellite communications, fibre optics, videotex and standards for computer communications. Our products, services and expertise are in high demand throughout the world.



Kids and computers.

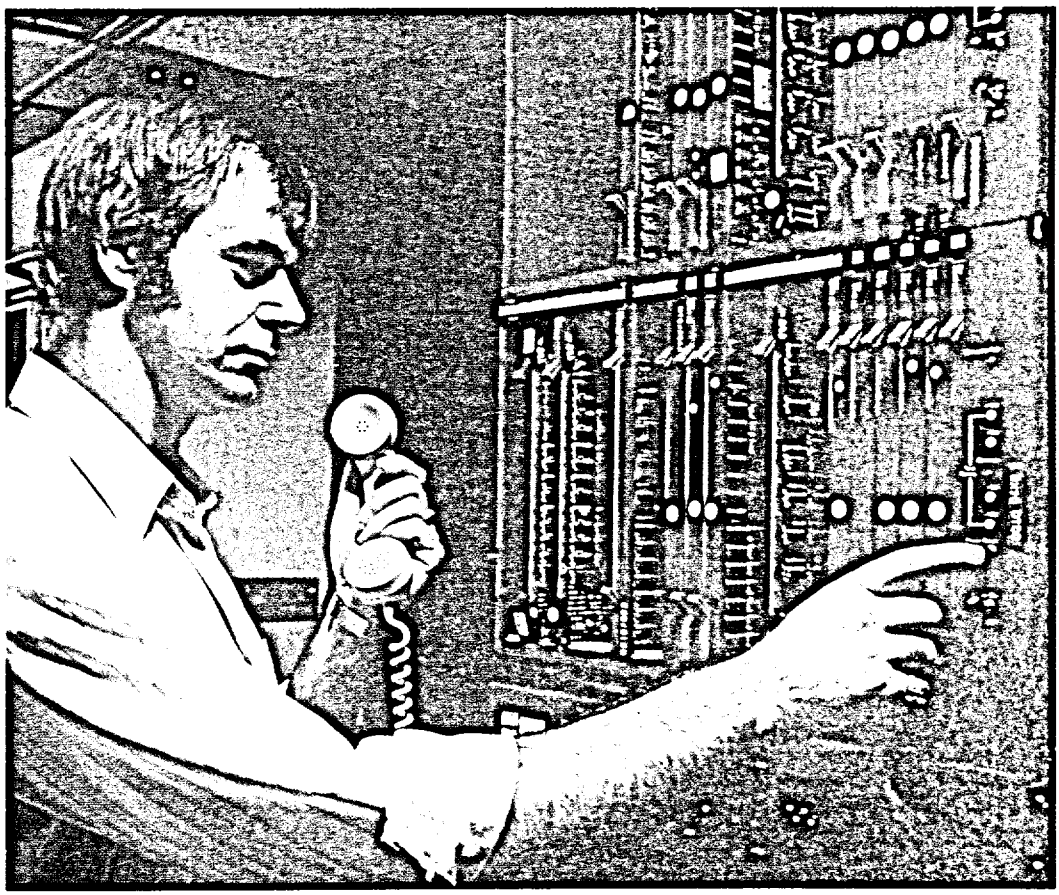
Computer use is increasing.

The Technology

The merging of various communications technologies into integrated information systems has largely been possible through the use of a common technological "language" — binary digits, or bits. In digital systems, information is reduced to binary codes (series of Os and Is) and transmitted as groups of discrete pulses. Any kind of information — numbers, text or images — can be encoded in digital form, the primary way in which information is represented in computers.

By contrast, in traditional telecommunications systems, information is transmitted in analog form, that is, as a continuous wave pattern following the changes of a voice signal or other signal. Analog transmission is adequate for such uses as ordinary telephone conversations, but not for high speed data transmission and processing. When an analog signal is amplified, any noise or distortion it picks up, or is inherent in the transmission system, is also amplified. The human ear and eye can easily adjust to such signal corruptions and interpret the received information correctly, but computers cannot. Hence the need for a transmission format that computers can interpret without error.

In a digital system it is the presence or absence of a pulse that is important, not its loudness, softness or exact shape. Thus, as long as the presence or absence of a pulse can be identified, the information received will be far less susceptible to errors due to transmission impairments such as noise and distortion. In addition, information that is already in digital form (i.e. information from computers) need not be converted to analog form for transmission. These considerations can make it advantageous to convert voice or image information to the digital mode.



Northern Telecom technician turns on the power for a new peripheral unit, called a digital trunk carrier.

Digital Leased Line Services

In recent years, more and more communications systems in Canada have been "going digital", bringing Canadians a wide range of exciting new services and stimulating our growing industry of digital communications products and services. In 1973, Telecom Canada (then called the TransCanada Telephone System) introduced the world's first commercially available nation-wide digital data transmission system — Dataroute. In the same year CNCP Telecommunications introduced its own nation-wide digital data transmission network — Infodat.

Both systems use time-division multiplexing, a technique which permits several users to employ the same transmission line by allotting each a unit of time on that channel. Dataroute and Infodat offer users point-to-point private line service. This kind of arrangement is suitable for organizations transmitting high volumes of data, but is costly for those with lesser transmission needs.

Digital Packet and Circuit Switching

The next step was to switched digital data networks which could accommodate a variety of user needs at much lower cost. In 1977, TransCanada Telephone System introduced its Datapac network which uses packet switching, while CNCP Telecommunications introduced Infoswitch, a network employing both packet and circuit switching.

In a circuit switched system, a connection is made between two terminals for the duration of a call. The user only pays for connection time whereas, with a leased line, a fixed charge is levied for the communications facility, whether or not it is being used.

In packet switching, messages are divided into electronic "packets", each with its own "address". A network of circuits is connected constantly and at each juncture a computer decides the most direct and open route through which an information packet will travel to its destination. The various packets that form a message may thus travel different routes to reach the same destination. All packets are checked for accuracy at points along the route. Packet switching is both efficient and economical because many users can share paths through a network, thus capacity is not wasted. Users are charged only for the amount of information sent, a further refinement in communications costing.

Virtually any data terminal in the country can access Datapac and Infoswitch. This is possible because there is a standard for interfacing terminals with packet switching networks. Without it the packet switching nodes in the networks might be unable to decipher coded instructions for handling packets, while terminals and computers might not be able to process packets received from the network. Telecom Canada led the way in developing an internationally recognized packet switching standard called X.25, which has been ratified by the International Telegraph and Telephone Consultative Committee (CCITT). CNCP Telecommunications has also announced its support of X.25 devices.

Both Infoswitch and Datapac can be connected to numerous other countries through Teleglobe Canada's Globedat, an international data gateway, which routes both packet and circuit switched traffic and provides low-to-medium speed data transmission.

Digital Voice and Data Switching

The use of digital technology is increasing not only for data transmission but for all other forms of communications services as well. In telecommunications exchanges across the country, the digital electronic switch is gradually supplanting electro-mechancial step-by-step and crossbar switching equipment. Programs to eventually create fully integrated digital systems and networks carrying voice, data, messages and images are under way in every province of Canada. Telecom Canada expects its intertoll network to be entirely digital by the year 2000.

View of Mitel's manufacturing activities at Kanata, near Ottawa.

Digital Teleconference

An innovative application of digital technology was introduced by Teleglobe Canada recently with the launching of Confratel, the world's first intercontinental digital teleconference service. Customers in Canada and Britain are linked through full motion, two-way colour, video and voice communication, as well as a variety of audio-visual aids. Using digital video compression, the Teleglobe service uses less satellite capacity than other services, resulting in savings for customers.

Digital Products

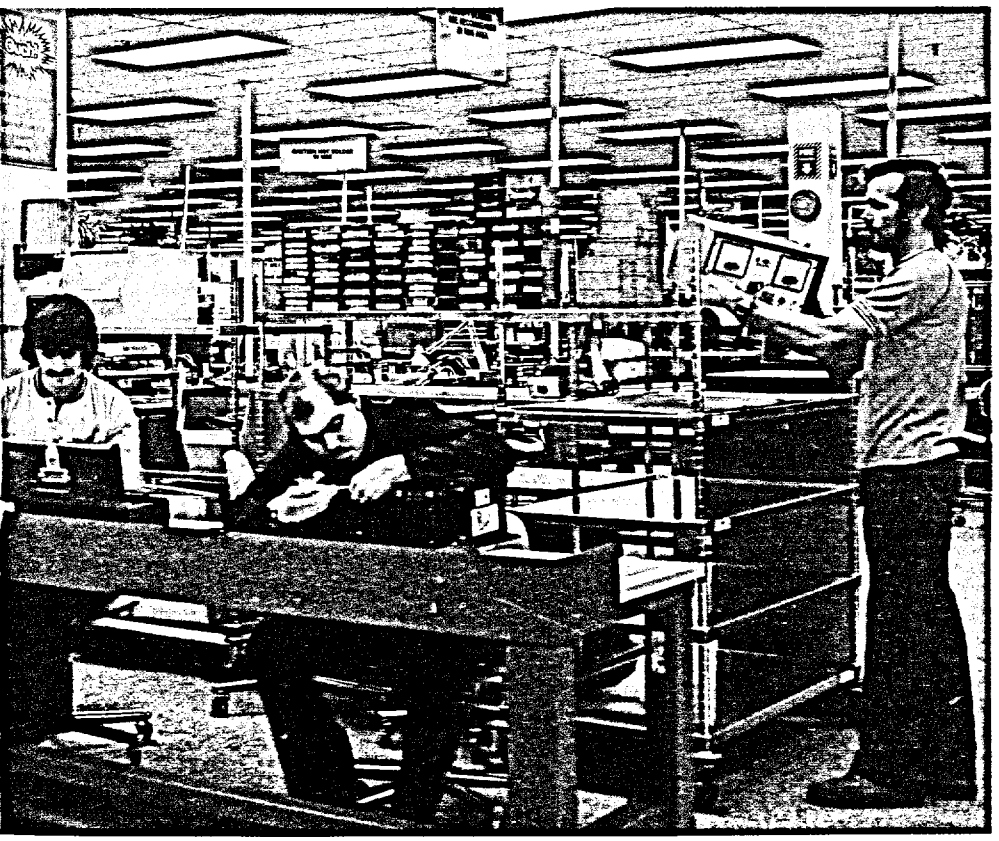
Commitment to state-of-the-art telecommunications has enabled Canada to achieve international recognition as a major producer of communications equipment, especially of digital switches and digital transmission systems.

Northern Telecom, the country's leading telecommunications manufacturer, is one of the largest suppliers of fully digital switching systems in the world. Northern Telecom has two major digital product lines: the Digital Multiplex System (DMS) — a central office switching and transmission system; and the SL Family of digital business communications systems. These products are among the most advanced of their kind. The SL-1, a particularly popular private branch exchange (PBX) used to control the internal communications networks of organizations, has been sold in 40 countries. The SL-10 is a digital packet switching system for data communications. Telecom C, Canada's Datapac network, employs SL-10 machines for its switching nodes. A number of other countries, including West Germany, Austria and Switzerland, have also selected the SL-10 for their national packet switching data networks.

Northern Telecom's DMS (Digital Multiplex Systems) Family of central office switches are widely used by telephone companies for local, long-distance and international switching.

Another Canadian company with an international reputation in telephones and switching systems is Mitel Corporation of Kanata (near Ottawa). Mitel recently introduced its first fully digital switching system, the SX-2000, a private automatic branch exchange (PABX), which can support from 150 to 10 000 lines. The SX-2000 has already met the rigorous standards of British Telecom, the principal operator of the United Kingdom's public telecommunications services, and has been approved for use in the UK — a sign that the system is likely to be well received elsewhere abroad.

AEL Microtel, a subsidiary of the British Columbia Telephone company, is another major producer of digital switching equipment. The company was selected to install what is described as the largest local digital network in the world, near Quebec City, on behalf of Quebec Telephone Company.



The Government of Canada Switches to Digital
-Enhanced Exchange Wide Deal Service (EEWD)

The government of Canada is upgrading its telephone service in the national capital region to state-of-the-art digital technology through what is called Enhanced Exchange Wide Deal Service (EEWD). The service involves modern digital switching equipment, 100 per cent Canadian, that will permit integrated office communications systems to meet both voice and data requirements.

Early in 1984, three SL-100 private branch exchanges, manufactured by Northern Telecom Ltd., were installed in the Ottawa-Hull government exchanges, significantly improving the switching, transmission quality, reliability and administration of inter-city services. Local improvements such as call transfer, consultation hold and three-party conference are being phased in. The full range of EEWD station features, including touchtone sets and call-forward, will be available by the end of 1985. Through the new service, calls can be processed more efficiently, internal communications are improved and service to the public is enhanced.

Universal Communications Through Open Systems Interconnection

The rapid pace of technological development and demand for services has resulted in the application of many new kinds of communications equipment and systems that are incompatible with one another. This has been a barrier to the orderly growth and realization of the full potential of new information services. For example, simple transactions *via* computer between one organization and another may be impossible because of system incompatibilities.

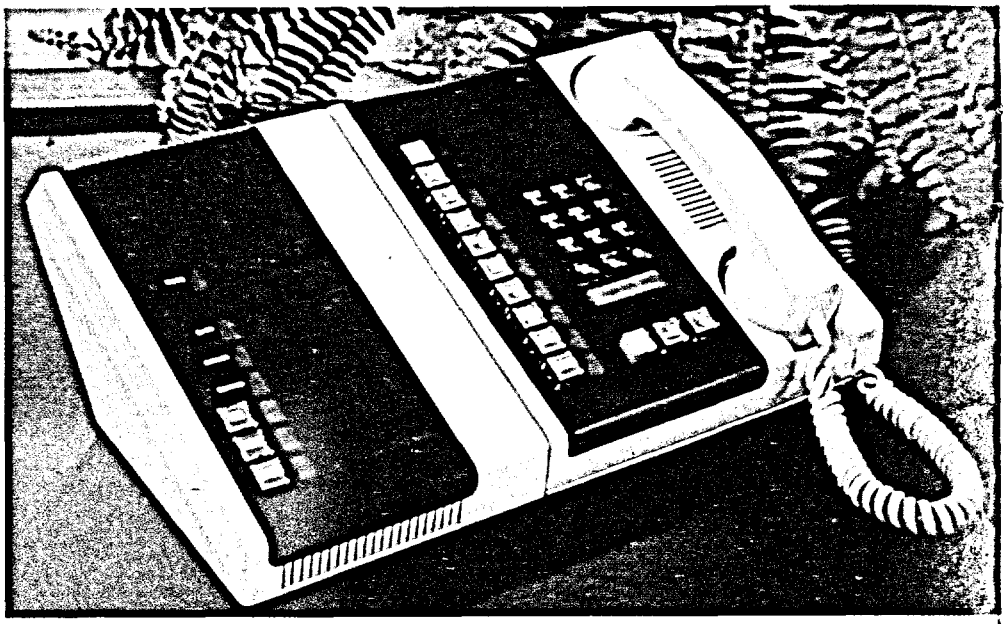
In theory, computer communications could be as universal and unrestricted as the telephone. For this to happen, internationally-accepted technical standards for computer communication protocols and services are needed. (A protocol is a set of rules defining the grammar between communicating systems.)

The International Organization for Standardization (ISO) and the International Telegraph and Telephone Consultative Committee (CCITT) have been working towards developing such standards and, in 1980, proposed a framework for enabling data, computer and integrated office communications worldwide. The framework is called the Reference Model for Open Systems Interconnection.

In this model, seven layers of technical specifications will be defined to allow systems, possibly of different manufacturers, but conforming to the framework and standards, to communicate with one another. Standards have already been agreed upon for the lower five layers of the model and while the remaining ones are under discussion, a complete set of Open Systems Interconnection standards may be confidently expected by early 1985.

Canada, a strong proponent of Open Systems Interconnection, is involved, with other countries, in developing the various standards needed. In October 1983, Canada hosted the ISO Technical Standards Committee on Open Systems Interconnection, which significantly advanced the work towards development of draft international standards.

Adherence to the standards will be voluntary. It is likely, however, that manufacturers will adhere to the standards to satisfy the growing demand for communications products that are compatible with others, that can be used in a wide range of applications, and that can be sold into the international marketplace which Open Systems Interconnection stimulates.



The SL-1, a popular internal communications system, has been sold to some 40 countries.

One manufacturer firmly committed to the goal of compatibility of products and services is Northern Telecom Ltd. In 1983, the company announced a $1.2 billion program for developing integrated information management systems that would perform a wide variety of functions and accommodate many kinds and brands of equipment and provide users with enhanced communications. Northern Telecom calls this the OPEN (Open Protocol Enhanced Networks) World concept.

The aim of the OPEN World is to enable organizations to develop their information systems over time without having to discard existing equipment or being locked into a single supplier. The system will be designed around the communications function, a digital switch, either in a telephone company's central office, using the DMS 100, or on a user's premises in the form of a private branch exchange or SL-1.

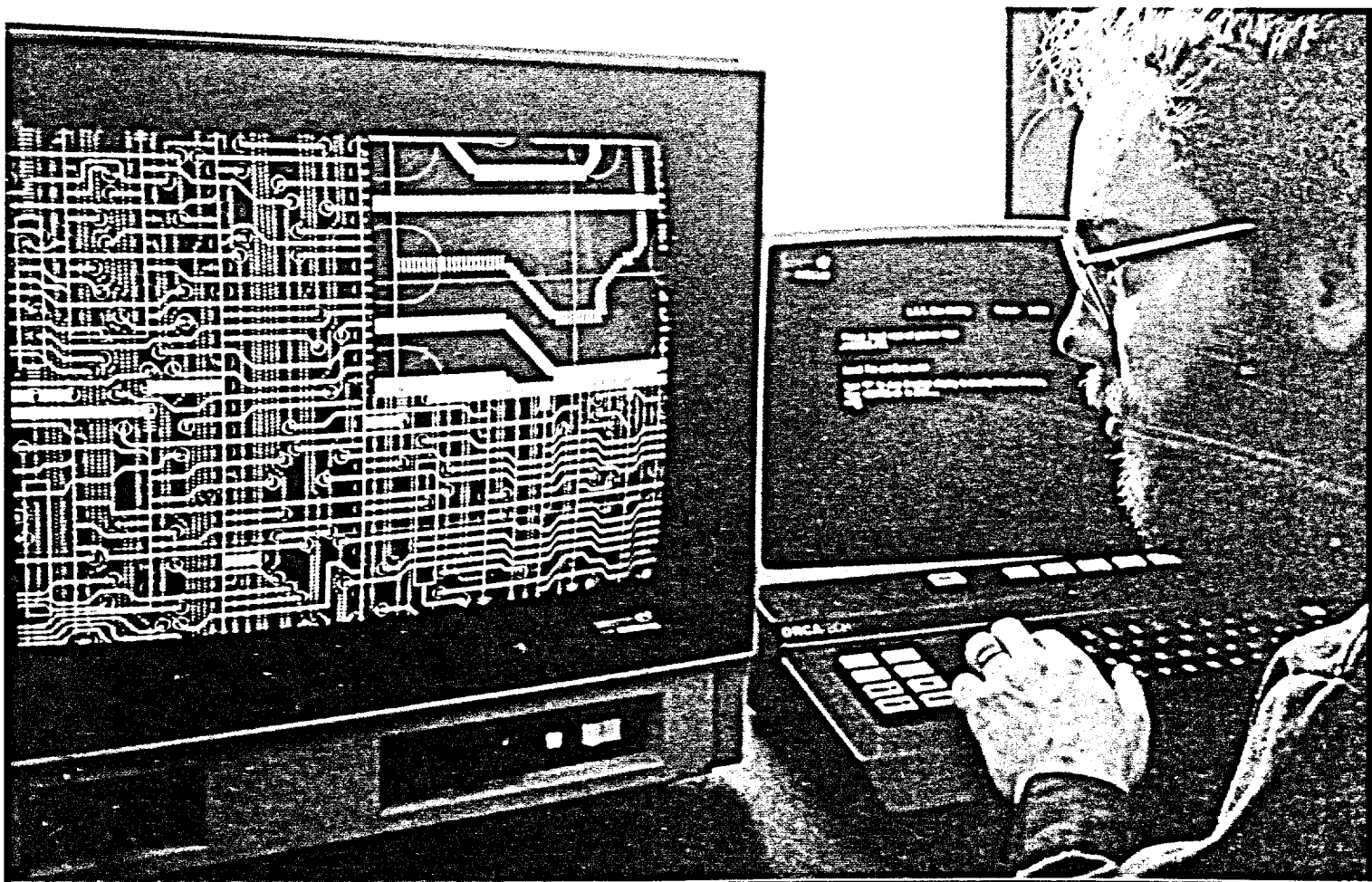
Northern Telecom intends that its OPEN World products and services will meet five criteria: continuity, by evolving to avoid obsolescence; compatibility, to enable diverse components to work together; congeniality, to ensure that equipment and systems are easy to use and attractive; control, to manage optimum performance of the system; and cost-effectiveness. Northern Telecom will use these criteria as a framework for helping organizations plan their information management systems.

Other elements of the OPEN World include:

- New terminals such as sophisticated telephones with display capabilities for a variety of information services. There will also be new versions of Northern Telecom's Displayphone, a combined telephone and data terminal which has a retractable keyboard and video display screen. The company will introduce an even more powerful terminal capable of graphics, image, voice and text communications.

- Additional higher transmission capabilities to accommodate more powerful terminals. The company will substantially increase the bandwidth (range of frequencies) used on twisted pair wire, the same wire which telephones use and which is already installed in most buildings. Under the direction of a digital controller, the existing telephone wiring can become a very powerful local area network, that is, private network.

For the past two decades, Northern Telecom and Bell-Northern Research have been designing computers for increasingly sophisticated and cost-effective telecommunications systems. An advanced computer terminal is used to design complex, multi-layer printed circuit boards for Northern Telecom's digital switching and transmission systems.



For applications which require even greater transmission speeds, Northern Telecom will provide gateway connections, that is, interconnecting equipment, to commercial local area networks.

• A commitment by Northern Telecom to accommodate the equipment of other manufacturers on OPEN World systems. This will be done in a number of ways. First, the company will offer to license, at a nominal fee, some of the key interface specifications for its SL-1 business communications system.

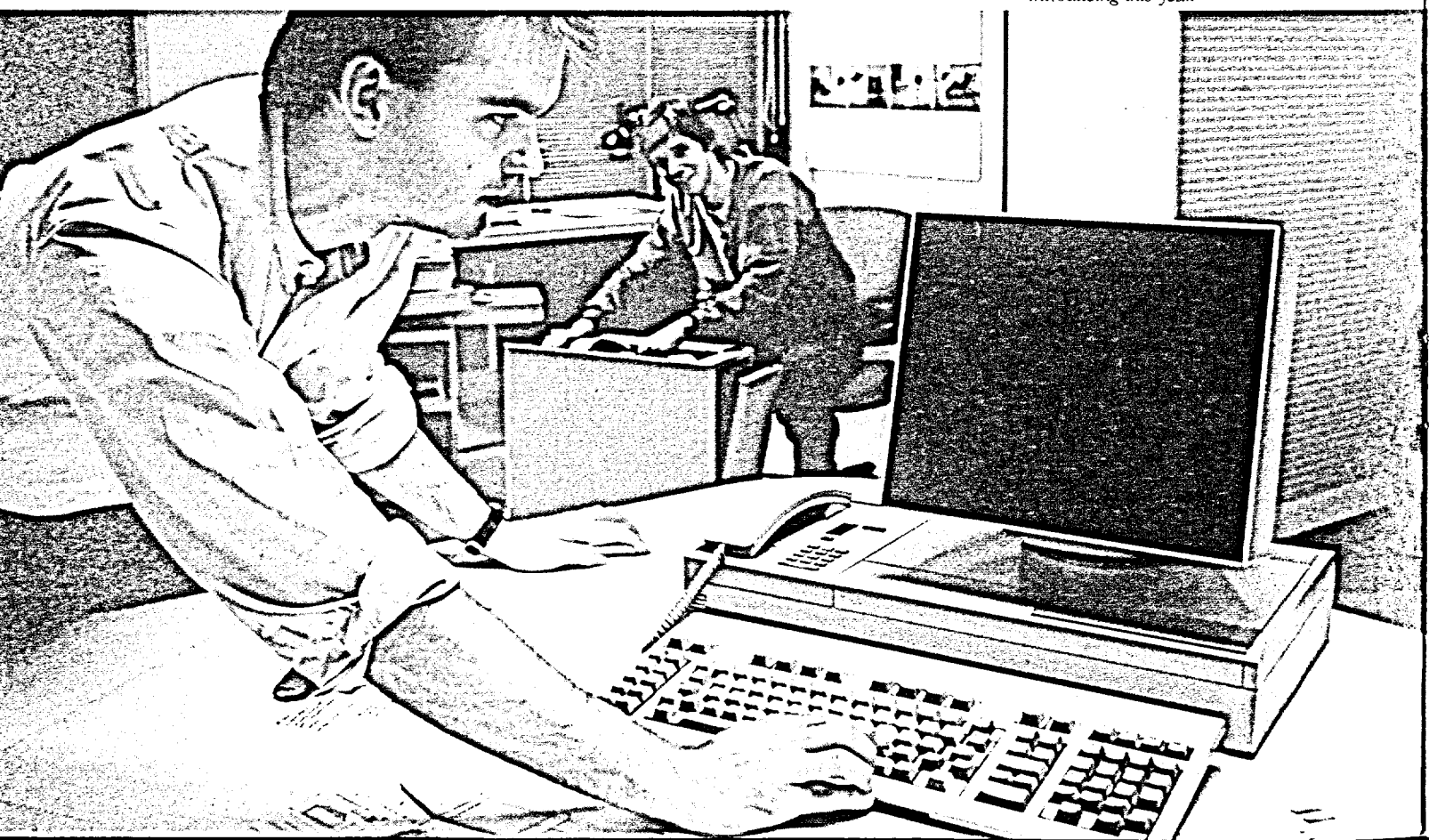
Secondly, Northern Telecom is working closely with leading data processing and office equipment manufacturers to ensure compatibility of systems. The company has already announced co-operation agreements with Sperry Univac, Digital Equipment Corporation, Hewlett Packard, Data General and Wang, and other agreements are being negotiated.

Thirdly, Northern Telecom's OPEN World system will support selected IBM terminal equipment and proprietary protocols, including IBM's Systems Network Architecture (SNA) and its SDLC (synchronous data link control) protocol.

Finally, Northern Telecom will support equipment using X.25, the most internationally-accepted packet switching protocol.

• An offer by Northern Telecom of a variety of enhanced services as part of its OPEN World program including: integrated messaging service, which allows calls to be recorded in a central file for subsequent recall; teleconferencing through desk-top terminals; systems which will allow electronic storage and retrieval of voice, text, graphic and image files; multimedia messaging in text, voice, graphic or image format.

Bell-Northern Research industrial designers study the features of a new integrated voice and data terminal and processor that Northern Telecom is introducing this year.



The central spot on the TV monitor is the output distribution of infra-red light from a single mode fibre.

Even with the use of highly efficient digital technology, Canada's existing transmission systems are in danger of eventually becoming overloaded. The off-air radio frequency spectrum is congested and cable networks are dense in many cities. At the same time, many remote communities are not receiving a full range of telecommunications services because of the high costs involved.

The solutions to these problems may come in part through the use of optical fibres — highly refined fibres of glass, each about the diameter of a human hair that can transmit information-carrying signals impressed on a beam of guided light, instead of using electrical signals guided by metallic wires. From half a dozen to thousands of such fibres are bundled into comparatively slim, flexible cables that are nearly impervious to environmental influences. Since each fibre can carry thousands of voice channels or equivalent amounts of video and digital traffic, the capacity of such fibre optics cable is, to all intents and purposes, unlimited.

To transmit information through an optical communication system, the electrical equivalents of voice, data or image signals can be converted into a series of light impulses by a device such as a laser or light emitting diode (LED). The light impulses are put into one end of a cabled fibre and transmitted down the cable to be reconverted to their original form at the destination. Where distance dictates, the signal is regenerated by a "repeater" and sent on, reconstituted in its original strength and clarity.

The advantages of fibre optic transmission include:

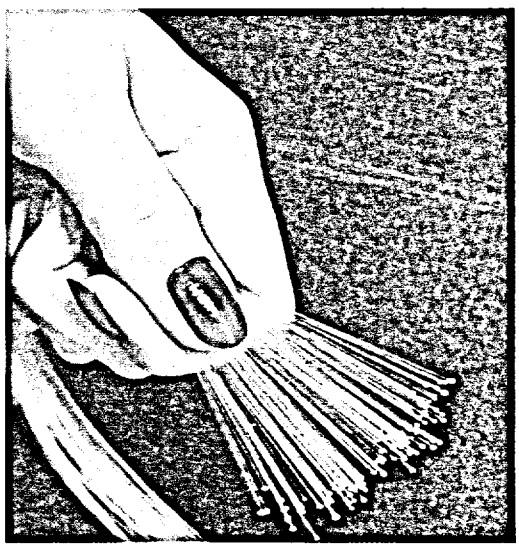
- the ability to carry not only voice, but data and video signals on the same cable;
- the ability to carry signals up to 50 kilometers without the need for repeaters (conventional copper based systems require repeaters every 3 kilometres);
- much higher transmission capacity compared to bulkier copper cable;
- low cost — glass optical fibres with sufficiently high performance for use in mass market telecommunications can now be fabricated at a cost of a few cents per metre;
- transmission quality that is virtually free of cross-talk or interference and it is very difficult to tap optical fibres without detection;
- the suitability of optical fibre for fully integrated digital telecommunications systems.

Fibre Optics Systems in Canada

The first fully operational optical communication system in Canada was installed in 1976 by Bell Northern Research at the national headquarters of the Department of National Defence. By 1979, Canada had its first commercial optical communication system which was located at Weir, Quebec.

But it was project Elie that marked Canada as a pioneer in the implementation of fibre optics technology. Project Elie the world's first rural fibre optic network, was designed to bring the latest in telecommunications services on a trial basis to two small, under-served communities in Canada's western province of Manitoba. When Project Elie became operational in 1981, 150 households in the area received single service telephone, cable television, FM radio, and Telidon, Canada's videotex system.

The $10-million trial has been a joint venture of the Department of Communications, the Canadian Telecommunications Carriers Association (CTCA), Northern Telecom Ltd., the Manitoba Telephone System and Infomart. The success of Elie has led to the extension of Telidon services throughout Manitoba and the Manitoba Telephone System is maintaining the Elie system to test new services. It is hoped that improving rural telecommunications will encourage residents to remain in their communities instead of migrating to large cities.



Fibre optics involves the transmission of information and voice communication through glass fibres by means of light pulses. A hair-thin fibre can carry several thousand one-way voice circuits simultaneously.

A Fibre Optics Network Across the Canadian Prairie

In 1980, the Saskatchewan telephone company, Sask Tel, began a 3 200 kilometre optical fibre system which will be the longest digital, integrated telecommunications network in the world. When completed, this year, this digital network will link 52 of Saskatchewan's largest communities and provide voice, data and video services to over half the province's residents and will form the basis for a province-wide digital broadband network. Plans for additional fibre routes will increase the total length to 3 400 kilometres.

The contract to supply the Sask Tel fibre optic transmission system was won by Northern Telecom, which, in 1982 opened a manufacturing facility for the production of optical fibre communications systems in Saskatoon, Saskatchewan. This is the only facility in Canada that designs and produces complete optical fibre systems, including manufacture of the basic fibre and the electronic components. Phillips Cables Ltd./Digital Telecommunications Ltd. was selected to supply the video coding/decoding equipment for the projects.

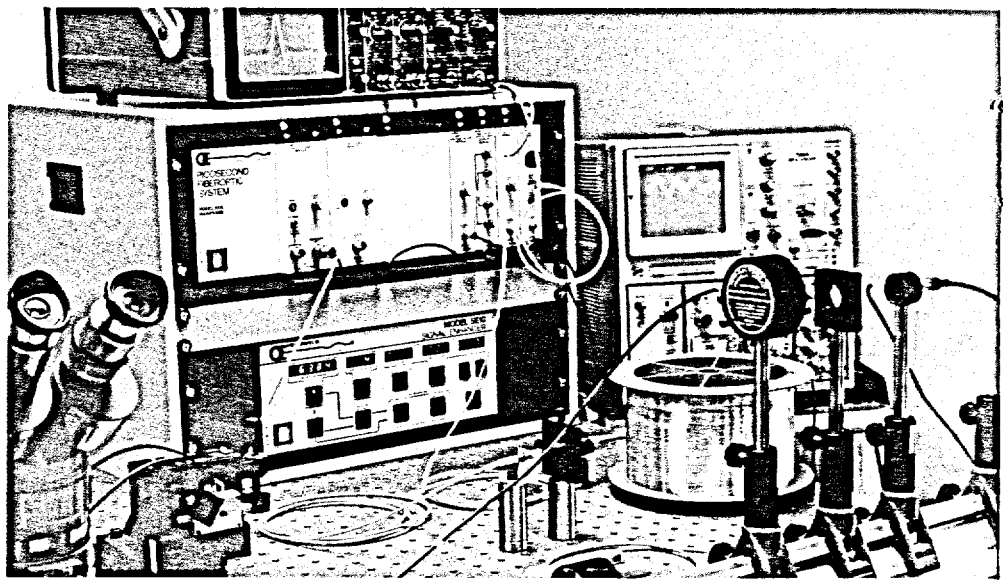
Bell Canada

Bell Canada, the country's largest telecommunications supplier, plans to replace, as required, all copper trunking cable with optical fibre. Bell will also use fibre exclusively for all new inter office trunk cables. Currently, Bell has some 40 systems, representing 16 000 kilometres of fibre optics cable in use in Ontario and Quebec. Other Canadian telephone companies are also implementing fibre optics technology in many areas to enhance network capabilities.

Fibre optics systems are also being considered as an alternative to digital radio for long-distance communication in certain situations. Telecom Canada network planners are exploring the idea of installing underwater optical cable through Canada's large inland lakes, and using it as well for other water crossings that are unfavourable to digital radio.

Cable Television

A number of Canadian cable companies are also interested in the potential of fibre optics to transmit their services. BCN Fibre Optic Inc. is a consortium of CATV companies formed to research, develop and test optical cable transmission technology. Its first project was installation of a fibre-optic supertrunk cable, 7.8 kilometres long, employing digital transmission techniques in London, Ontario.



The Picosecond Fibre Optic System, seen here, made by Opto-Electronics of Oshawa, Ontario, tests the high frequency performance of optical communication fibres. The company says that the pulsed lasers and photodetectors it makes are the latest available in the world.

The eight-fibre optical cable used in the BCN project was supplied by Canstar Communications, a subsidiary of Canada Wire and Cable Ltd., and one of Canada's leading fibre optics manufacturers. Canstar specializes in designing optical transmission systems and manufactures, among other things, bi-directional couplers which permit two-way traffic through a single fibre.

Hubnet

University of Toronto researchers in conjunction with Canstar Communications have developed a unique fibre-optics based local area network (LAN). A local area network is a private communications network within a building or buildings of an organization. The new system, called Hubnet, is capable of carrying information five times faster than conventional coaxial cable-based LANs. Canstar plans a field test of Hubnet at the federal Department of National Defence base in Winnipeg, Manitoba. A fibre optics communications system is particularly well-suited for military security needs because it can become virtually impossible to tap.

Automated Traffic Management

Another innovative use of fibre optics is in an automated traffic management system being planned by the Ontario Ministry of Transportation and Communications. The aim is to improve the flow of traffic

along a busy highway through the city of Toronto by diverting the flow into different lanes as needed. The route will be monitored by cameras and data collecting detectors placed under the highway and, according to the information gathered, signals will be automatically activated to direct traffic.

The Ontario government has chosen fibre optics for the system because it has the required transmission capacity, is not sensitive to electromagnetic interference and can easily stand the environmental stress.

Special Applications

Opto-Electronics Ltd. of Oakville, Ontario and Canadian Instrumentation and Research Ltd. of Mississauga, Ontario, manufacture high performance instruments and devices for optical communications. These range from high-speed laser pulsers for testing purposes to sophisticated couplers for local area networks and optical-fibre sensor applications.

Fibre optics systems may also be extremely useful in marine applications. One reason for this is that fibre is not sensitive to electromagnetic disturbances, which can be considerable aboard ships. A company in Nova Scotia, Focal Marine Ltd. is studying, among other things, the conversion of ship communications systems from copper wire to fibre optics.

Export Sales

Canadian expertise in fibre optics manufacture has enabled Canadian companies to secure significant export agreements. For example, MCI Telecommunications Corporation, the largest specialized common carrier in the United States, will use 100 000 kilometres of fibre optic cable manufactured by Northern Telecom Ltd. in a system being installed between New York and Washington.

Canstar Communications is serving the export market with a number of its products, in particular, fibre optics couplers. Photo detectors used in optical communications systems are produced by RCA Inc. of Ste. Anne de Bellevue, Quebec, and exported to many countries.

In addition, several small Canadian high-technology firms are successfully marketing their specialized opto-electronics products abroad.

The network control centre keeps an eye on telecommunications traffic to minimize congestion on the international routes.

Until recently, technologies such as telecommunications, data processing and office equipment were considered separate entities. But these different technologies are now evolving and converging into integrated information systems performing a multitude of functions and providing an array of new services. Large mainframe computers and powerful "mini" computers linked through telecommunications networks to numerous terminals, make possible such services as automated airline reservation systems, automated bank tellers and electronic cash registers (known as point-of-sales terminals). In Canada, as in other industrialized countries, these computer applications are already taken for granted. Other consumer services such as teleshopping, remote emergency alarm monitoring and videotex data banks, are increasingly becoming a reality of Canadian life.

It is the office environment, however, that is the major focus of technological change. Virtually every kind of office work, from exchanging information to decision-making, is being enhanced by computer communications technology, a term referring to a combination of computing, telecommunications, information services and related technologies. Business is increasingly being conducted with the help of such tools as electronic mail, teleconferencing and data banks. Today's office is evolving into an integrated information management system in which separate pieces of equipment such as telephones and word processors are combined in multifunctional workstations which in turn communicate with other "intelligent" office machines.

Not surprisingly, the computer communications industry has grown rapidly in recent years, despite world recession. According to the estimates of one government analyst, Canadians are expected to spend some $10-12 billion on computer communications products and services by 1985, almost double the amount that was spent in 1980. By 1990, the figure is likely to reach $16-20 billion.

Canada has a vibrant and growing computer communications industry. In addition to several major companies, numerous excellent small and medium-sized firms produce computer hardware, peripherals and software and offer time-sharing, consulting and other services. An area of particular strength is in the computer services industry which includes such areas as time-sharing, software production and a wide range of consulting services, including systems development, custom programming, systems engineering, training and research. In the area of equipment, Canadian-owned firms have generally focused on specialized product lines designed to meet the needs of a particular market niche. Our products and services are in demand both domestically and abroad.

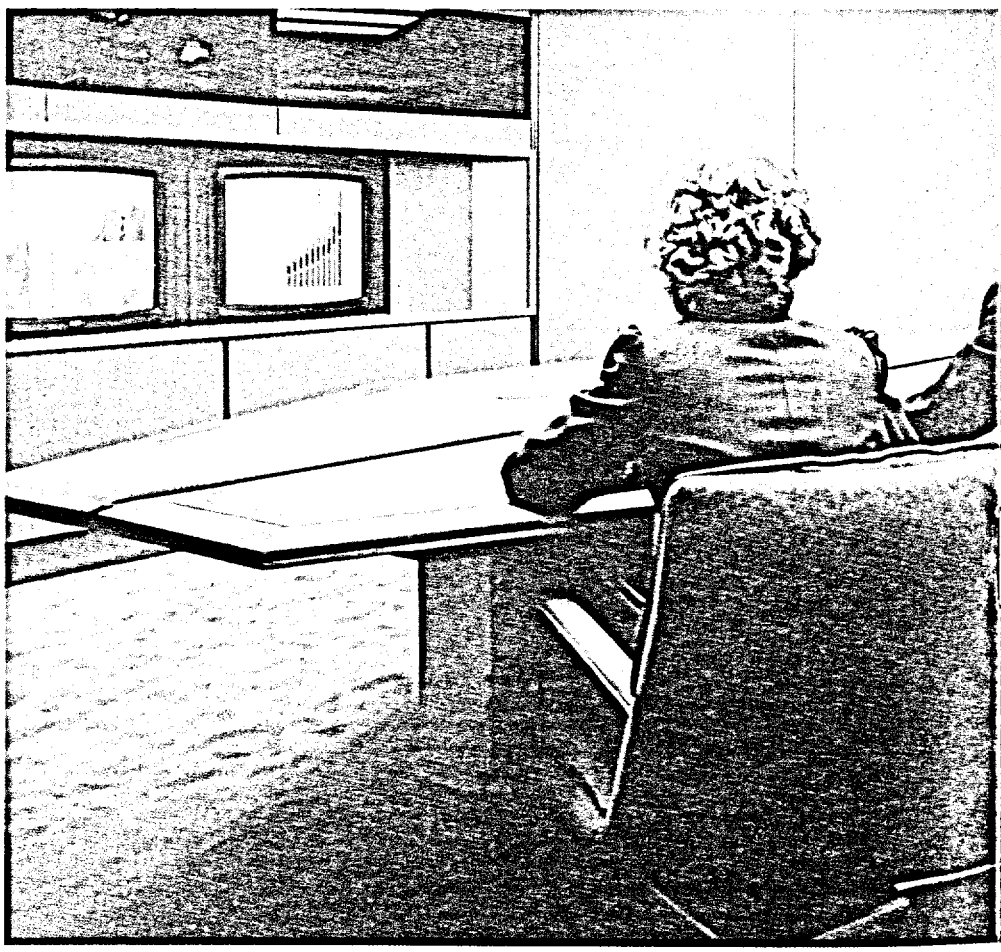
The Office Communications Systems Program

It is clear that Canada's economic well-being in years to come will depend very much on (a) successful applications of new technology, particularly in the office environment and (b) capturing a large share of the market in information-handling systems.

The impetus towards office automation in industrialized countries is fuelled by the need to improve the productivity of office work, especially since office costs now constitute a large proportion of business expenditures. But how quickly and to what extent new technology can be introduced depends on how it is adapted to human and organizational needs. There is still much debate on how new systems can be put to most efficient, effective use and how people using the new systems will be affected.

To help answer these questions and promote the development of our information technology industries, the government of Canada is conducting several

From this studio in Toronto, Teleglobe Canada provides international teleconference services between Canada and Britain.



series of field trials of Canadian office automation technology within federal departments. The trials are part of the Office Communications Systems (OCS) Program, an initiative of the Department of Communications to give Canadian office automation firms the opportunity to test, evaluate and refine their systems in the largest office environment in Canada. The program is also examining what consequences communications technology will have on tomorrow's offices and office workers and is studying how it can make the office more productive.

The field trials, costing $12 million, will not only benefit industry but also enable government managers to make sound decisions about the introduction of the automated office — what kind of equipment, how fast, at what cost — cutting down on the costly trial and error process.

The research and planning phase of the program began in 1980 and ended in 1982. During the second phase, which will continue until 1985, field trials are taking place within five major government departments, each of which involves different kinds of administration, policy-making and communication methods. The suppliers conducting the trials represent diverse philosophies and emphases and will employ different kinds of hardware, software and media of communications in each department.

The field trials are as follows:

- Systemhouse Ltd., Canada's largest computer software company, is conducting a trial in the Department of National Defence concentrating on the financial services. The aim is to produce an integrated office system which will provide general office support systems and which can interface with present and planned computer-based systems.

- At the Department of National Revenue (Customs and Excise) Bell Northern Research is providing an integrated electronic office system which will involve digital private branch exchanges supporting, at the outset, 100 workstations. The equipment combines voice, text and data allowing employees to communicate with one another and retrieve information easily.

- Officesmiths, a software and business system firm, has been paired with the Department of Energy, Mines and Resources, where it is developing an automated system for storing and disseminating information on policies and procedures.

- At Environment Canada, OCRA Communications Inc. is implementing systems to automate a wide range of tasks. This field trial is the most general in the series, touching many areas and situations. Eventually the trial will involve 200 workstations and 12 000 employees.

- A field trial at the Department of Communications will introduce office communications systems to 70 users, ranging from the minister and deputy minister to support staff.

Electronic Mail

The telephone call, teletype message and mail service have long been the mainstay of office communications, but the pace and competitiveness of today's business world often require more rapid and efficient means of exchanging information. Therefore, more and more Canadian businesses are turning to electronic mail to supplement and, in some cases, replace traditional forms of communications.

The term electronic mail may be used to refer to a wide range of systems and services, including innovations such as voice and computer-based message services. Computer-based message systems allow people to create, edit or send messages to others through computers. The message is instantly transmitted to an electronic "mail box", that is, a file in the recipient's computer, where it can be retrieved and displayed on the video screen at any time. Voice message systems are audio "mail boxes" through which one can send, receive, store or broadcast voice messages to any other user of the system. The spoken word may be converted to a digital form and stored within the computer system for subsequent delivery. During playback, the digital image is reconverted into sound closely resembling the actual voice of the sender. The voice message may also be received as spoken (in analog form) for later delivery.

Electronic messaging has a number of advantages: it reduces time delays; overcomes frustrations such as "telephone tag" and interrupting phone calls; eliminates time-consuming processes such as copying material or labelling envelopes; and it can be a cost effective substitute for long-distance telephone calls or mailing costs.

In large organizations, communicating word processors that allow staff to key in messages from one branch to another or to other locations in a private network are becoming a common medium of information exchange. In this case, the output is usually paper copy.

A number of electronic mail services are now available to the Canadian public through Canada's telecommunications carriers as well as through other firms, thus allowing even small businesses to enjoy the benefits of electronic mail.

Examples of Electronic Mail Services

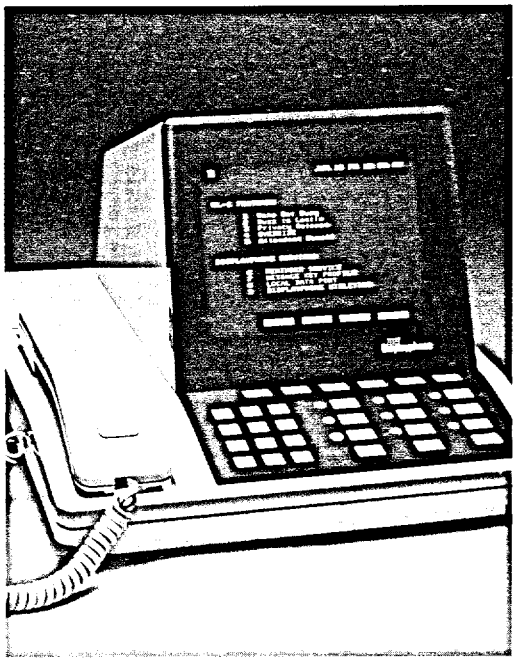
Telepost, provided jointly by CNCP Telecommunications and the Canada Post Corporation, is one of several new services that combine electronic messaging with the established postal network. Through Telepost, messages submitted by telex, telephone or computer tape are transmitted electronically to a specially equipped post office close to their destination, where they are printed and sent by the next mail delivery. Telepost messages can be sent anywhere in Canada or the continental United States.

Globefax, provided through Teleglobe Canada, is a public high-speed digital facsimile service between Montreal and 28 destinations in 12 countries.

Intelpost is a facsimile transmission service offered through Teleglobe Canada and the Canada Post Corporation. The service is available from eight Canadian cities and guarantees office-to-office delivery of documents within a specified time using priority postal service and Teleglobe's satellite facilities.

Envoy 100 is a computer-based message service, offered by Telecom Canada. Through a computer terminal, telephone line and the Envoy 100 system, subscribers can send messages to other subscribers. This gives customers the advantages of an internal electronic mail network without the expense of large computer facilities.

EnvoyPost allows Envoy 100 subscribers to send messages to non-subscribers throughout Canada. The messages travel electronically to the Canada Post electronic mail centre nearest the recipient and are sent as hard copy by the next day's mail.



In 1982, Northern Telecom began making commercial shipments of Displayphone, the world's first integrated voice and data terminal.

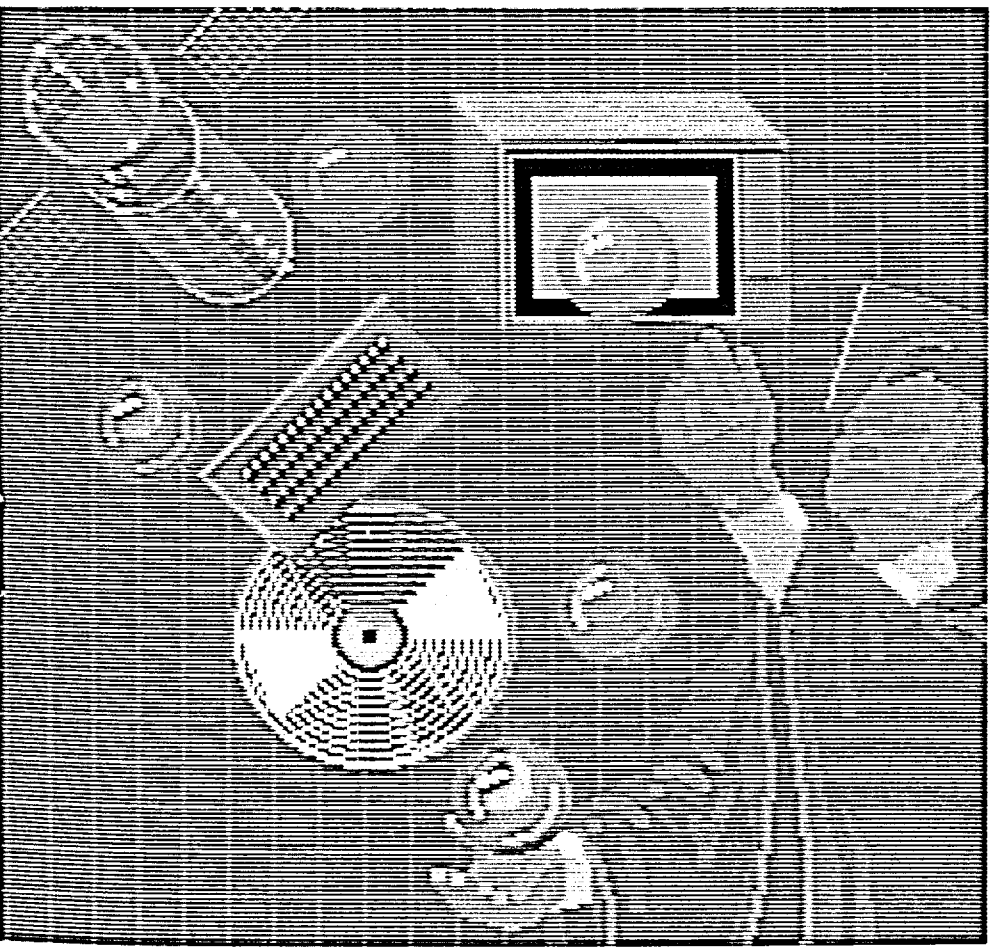
Both Telecom Canada and CNCP have services which allow word processors made by different manufacturers to communicate with each other. Infotex is the main CNCP service, while Telecom Canada offers a service known by the generic name teletex. Both services, which enable users to communicate nationally and internationally, can form the basis of a wide variety of communications applications. In addition to services provided by the telecommunications carriers, there is growing involvement in electronic mail service by private firms which are offering public computer-based messaging and document transfer services as well as some voice mail services.

In 1978 researchers at the government of Canada's Department of Communications announced the development of a sophisticated new electronic information technology called Telidon — the most advanced system of its kind in the world.

Telidon is an information technology that combines the storage and processing capabilities of computers, the pictorial capabilities of television and the universal communications access of telephones. Through a modified TV monitor, Telidon users receive up-to-the-minute information, displayed in clear text and lively graphics, from a network of data banks. It can also be used for a wide variety of interactive functions such as teleshopping, telebanking and reservation services.

The Canadian system differs radically from European systems in its capability to create high-resolution graphics. Telidon uses the natural language of drawing, building up an image from its basic geometric elements — points, lines, rectangles, arcs and polygons. Page creation is thus very simple and requires little instruction.

Thanks to satellites and computers and the newer features of high technology such as video discs, Telidon applications in educational broadcasting are unlimited.



There are now three basic forms of Telidon technology:

a) Telidon videotex is an interactive system in which the viewer, by means of a telephone line or two-way cable, calls up information for display on a modified television set. Information can be retrieved from a wide range of databases. By means of simple controls, the viewer can browse through menus and select the information he or she would like displayed.

b) Telidon teletext is the broadcast mode which permits viewers to receive text and graphics on a television set equipped with a Telidon decoder. The decoder enables the user to choose from several hundred Telidon pages of information which are broadcast in continuous cycles repeated every few seconds. The Telidon "pages" are transmitted in the unused lines of regular television signals (the vertical blanking interval). Teletext has been described as a "broadcast magazine" containing pages of continuously updated news, information and advertising.

c) Telidon audio-visual systems are used as effective low-cost audio-visual presentations. The systems use terminals which can store about 100 Telidon pages of animated graphics and text and display them in a sequence. The display, which can be synchronized with a sound track, can be updated almost instantly.

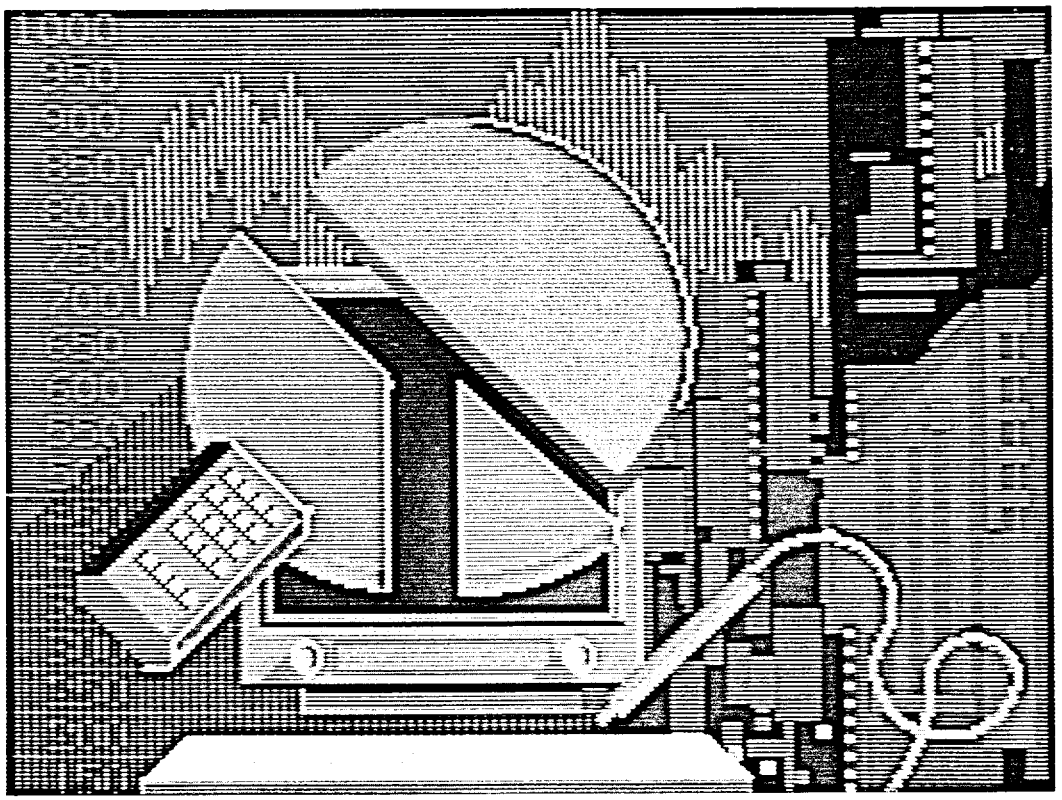
Applications

Since Telidon's introduction in 1978, some 40 field trials and services have been implemented in Canada, the US as well as several other countries, resulting in international acceptance and recognition of Telidon as a superior technology for videotex and teletext services.

There are now at least 100 companies in Canada involved in Telidon equipment or services and about 20 colleges and universities using and researching Telidon technology. Current Telidon projects include:

- Cantel, the government of Canada's Telidon information bank that provides information about federal programs and services as well as facts and statistics on Canadian lifestyles. It is described as the largest publicly available government database in the world.

- BN Infovision, a Telidon-based news service developed for cable television by Broadcast News Ltd., a national news agency. Produced in both English and French, Canada's two official languages, Infovision is an open channel teletext system delivering a 30-minute information package.



Home banking and stock market analysis are just two of many services available at the touch of a button.

• Marketfax by Faxtel, a stock market analysis service that provides more than 300 000 pages of information about the performance of stocks traded on the Toronto, Vancouver, as well as New York and other US stock exchanges. Faxtel also offers Telichart, in co-operation with Statistics Canada, which gives graphical presentations of data in Statistics Canada's CANSIM database.

• Project Iris, a joint project of the Canadian Broadcasting Corporation and the Department of Communications to develop a national teletext service that includes news, weather reports, consumer guides and other information. The project, in operation as a field trial since 1983, recently received a three-year extension and $6 million in development funds from the federal government.

• Grassroots, a service to agricultural communities provided by Infomart, Canada's largest electronic publisher. Through Grassroots, farmers in isolated locations have access to current agribusiness information on subjects such as: local weather, commodities, equipment, and fertilizers. There is also education, community, and entertainment information. The Bank of Montreal has introduced a home banking service to Grassroots subscribers. Customers using Telidon equipment will be able to manage bank accounts and pay bills without leaving their homes.

Grassroots, first available in Manitoba, now serves communities in four Canadian provinces and throughout the United States.

• Infomart also offers Teleguide, a videotex tourist guide to Ontario providing information on entertainment, events, attractions, accommodation, food and a variety of other topics of interest to visitors as well as residents. Terminals are located in shopping malls, hotels, tourist sites, information bureaus and transportation centres.

• InfoNorth, a Telidon service which, when fully operational, will use a combination of videotex, teletext and/or open channel distribution systems to provide nearly 200 000 people in 11 northern Ontario communities with a wide range of consumer information, as well as education.

• Le Palais des Congres de Montréal, inaugurated in May 1983, one of the largest convention centres in North America to install an integrated Telidon office communications system to meet all the information and communication needs of a convention centre.

• Tele-Sante, an interactive health care service that provides information in both English and French on a variety of health problems. Tele-Sante also executes some of the preliminary diagnostic work that is normally carried out by a physician.

• Tele-Université de l'université du Québec, a long-distance education service that will give students on remote campuses in the province of Quebec access to sophisticated educational software *via* Telidon terminals.

• Videopress, a public information service offered by Cableshare Inc. that uses Telidon terminals to deliver advertising, news and information to the public in high traffic areas such as shopping malls.

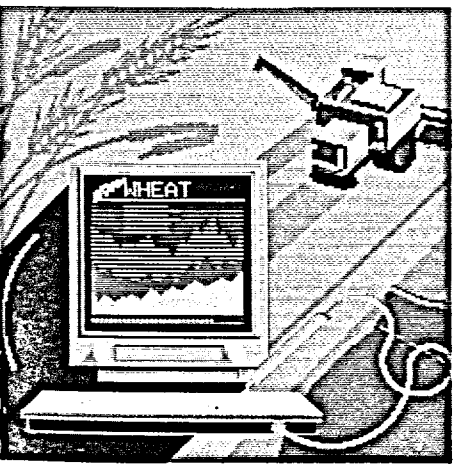
• the development by the Genesis Research Corporation in Winnipeg, of a presentation of children's stories over cable TV using Telidon graphics accompanied by text. The idea is that parents will read the stories to their children as the graphics are being displayed. "Genesis Story Time" is available in Winnipeg and has been sold to the four US cable operators for distribution *via* satellite to some four million subscribers.

Telidon technology is also being used by several US companies and organizations including:

- a financial institution in Buffalo, New York for an electronic banking service;
- an educational network in Alaska for supplementing distance education courses;
- another electronic publisher, who has successfully tested and is now offering a consumer information service and transactional services such as home banking, teleshopping and electronic mail.

In addition, the Department of Communications recently announced that 27 new projects will be eligible for assistance under the Telidon Content Development Program. The funds will aid Canadian companies and organizations to develop sophisticated software and content for Telidon systems.

Agribusiness information on such subjects as wheat marketing, fertilizers and weather, is proving to be a boon for farmers and agriculturalists.



Telidon Equipment

Canadian companies have gained experience producing a wide range of Telidon terminals and equipment to serve the needs of various videotex and teletext system users. The basic Telidon equipment includes: user terminals; page creation terminals; decoders which allow the user to interact with the system; modems for videotex systems that operate over telephone lines; and encoders which translate information into television signals for transmission.

Standards Ensure Durability

The special Telidon alphageometric coding scheme for creating graphics has become the basis for a North American videotex standard called North American Presentation Level Protocol Syntax (NAPLPS). The NAPLPS standard, which includes some important enhancements to the original Telidon scheme, will mean that a variety of terminals will be able to display the new technology.

Terminals with high, medium or low resolutions and different ranges of colour capabilities, could still decode the NAPLPS signals showing the essential information. The NAPLPS approach ensures both "forward and backward compatibility". Forward compatibility means that existing terminals can receive all future command formats including future enhancements. Backward compatibility means that future terminals will be able to access old data.

The NAPLPS standard received official joint ratification by the Canadian Standards Association (CSA) and the American National Standards Institute (ANSI) in January 1984. This ratification is seen as a boost to the Canadian Telidon industry since manufacturers and content providers can develop products and services confident they will not require modifications due to changed standards.

A standard for teletext called North American Broadcast Teletext Standard (NABTS) is also based on Telidon-style graphics and has been widely accepted in North America.

Computerized databases are rapidly becoming one of the most important management tools in business and professions. Databases allow easy access to huge amounts of continuously updated information and often eliminate the need for time-consuming activities such as searching libraries.

The range of information available through public databases is vast — it includes news wire services, historical data, professional and technical journal abstracts, stock market data, legal and medical information, to give a few examples.

One of the most important of such "electronic libraries" in Canada is the CANSIM database, created by Statistics Canada. CANSIM, or the Canadian Socio-Economic Information Management System, includes thousands of time series, i.e. time histories of key economic and social indicators. Statistics available are on population, gross national product, manufacturing, social data and employment.

Videotex systems are becoming an important source of electronically stored information in Canada (see Telidon section). In addition, there are other information providers (distributors of databases) whose resources can be tapped through various kinds of computer systems. In some cases, virtually any computer terminal can be used to access a particular database. In other cases, clients must be users of a specific system.

QL Systems Ltd., a leading distributor of electronic databases was the first Canadian company to develop a commercial information retrieval system. QL operates over 60 databases on subjects such as government, law, news, the environment, energy, pollution, business, mining, communications and the Canadian North, among others.

The Globe and Mail, a Canadian newspaper sold nation-wide, operates Info Globe, a data bank of the paper's articles from the past six years. Info Globe offerings also include stock market databases, on-line access to abstracts from international news publications and access to a database on Canadian corporations developed by Canada Systems Group (CSG). CSG, a widely diversified computer services company is one of the largest in Canada.

I.P. Sharp Ltd., a major Canadian firm offering time-sharing services, makes available to its customers the world's largest on-line source of numeric data bases covering mainly financial and economic subjects. The company is also expanding its services to include non-numeric data such as news bulletins.

The Canadian Institute for Scientific and Technical Information (CISTI) offers CAN/OLE (Canadian Online Inquiry System) distributing more than 20 databases mainly on scientific and technical subjects. Several Canadian databases offered by CAN/OLE are unique to this system. CISTI, is a division of the National Research Council of Canada, one of the leading federal research agencies.

Another important Canadian information provider is Dataline Inc. which offers its clients two major databases. Its Western Information System for Energy Resources (WISER) contains information on oil and gas well production over the past 20 years and is updated monthly. Another offering is an on-line, interactive stock market quotation service.

One of the most important electronic libraries in Canada is the CANSIM database, created by Stats Canada.

There are now more than 500 publicly-available databases in Canada, over 2 000 in the US and the market is growing constantly. Keeping track of the many available services can be difficult. It may also be time consuming and confusing to maintain contact with separate information services since each has its own set of passwords, account codes and information retrieval routines.

In response to these problems, Telecom Canada has developed a new service designed to greatly simplify matters for database users. Called iNet 2000, the system acts as a guide and gateway, analogous to the classified section of the telephone directory, to a wide range of computer-based information services. Through iNet 2000, users can browse through directories of databases, gain immediate access to the services banks they wish to search, gain access to electronic messaging and pay only one monthly bill for most services used.

Operating on Telecom Canada's nationwide public packet switched network, Datapac, the iNet 2000 system can be used to access databases in other countries *via* packet switched networks.

The system also supports a wide range of terminals and can be tailored to the user's language needs (either English or French), as well as to specific personal, business or closed user group needs. A profile on each user is stored in the system which thus "remembers", among other things, the person's language preference, his or her level of expertise with the system and the services that the user is authorized to access. Users sign on and identify themselves to the system only once, regardless of the number of services they access.

There are three directories in the system:

a) A national directory that lists all databases available through iNet. Listings are indexed by subjects and name and can be searched using a menu, or key words.

b) An organization directory, which is suited to the needs of a particular organization, that lists which services can be accessed by members of the organization.

c) A personalized directory that allows individuals to list by service name the databases they access on a regular basis.

Telecom Canada completed a successful technical field trial of the system in July 1983 and the service is currently undergoing an 18-month market trial which will include participants from a wide variety of industries and fields. The system has been enhanced for the market trial so that it will be easier to use, will accommodate various levels of expertise and will allow a transaction capability.

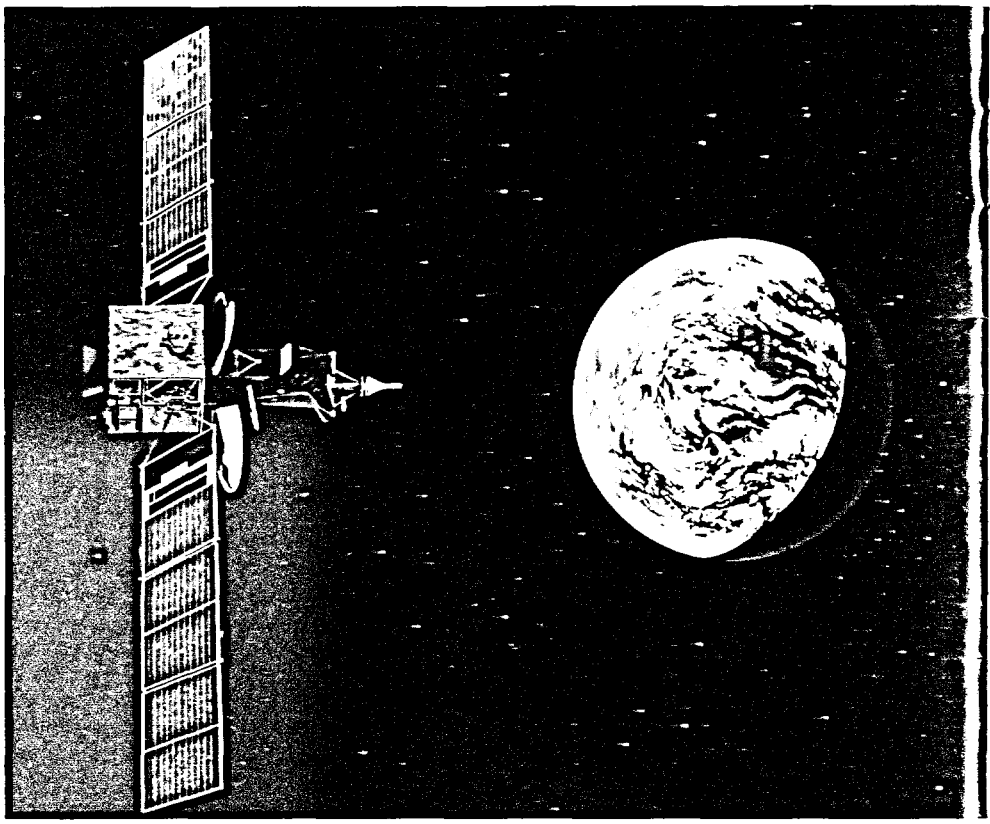
Canada has an outstanding domestic communications satellite system and a world-class space industry. Ours was the third nation — after the Soviet Union and the United States — to enter the space age. Canada's designed-and-built Anik A satellites were the first geostationary domestic communications satellites in the world. Since 1962, when Canada entered the space age, 13 Canadian satellites have been launched into orbit, with two more scheduled for 1984.

Thanks to our sophisticated satellite technology, Canadians in the most far-flung reaches of the country have access to advanced telecommunications and broadcasting services. Satellites are used for improved voice, data, facsimile, radio and television transmission; for new services such as pay-television, teleconferencing, tele-education (students and teachers thousands of kilometres apart communicating with one another *via* satellite) and telehealth (use of satellite communications to extend health services to remote communities).

Canada's technical expertise has benefited many countries through such activities as consulting services; the development of complete satellite systems; testing of satellites and components at the federal government's David Florida Laboratory, one of the few of its kind in the world; and the development of highly innovative technology — the Remote Manipulator System, or Canadarm, used in the US space shuttle program, is a prime example.

Major new projects under way include: the development of mobile communications satellite (MSAT) which would serve cars, airplanes and ships; participation in an international program for a satellite-aided search-and-rescue system (SARSAT); participation in the European Space Agency's L-SAT, or large satellite; and the design of RADARSAT, a highly advanced remote sensing satellite.

A more detailed discussion of this important subsector of Canada's communications industry can be found in *Satellites: The Canadian Experience* another booklet in this series.

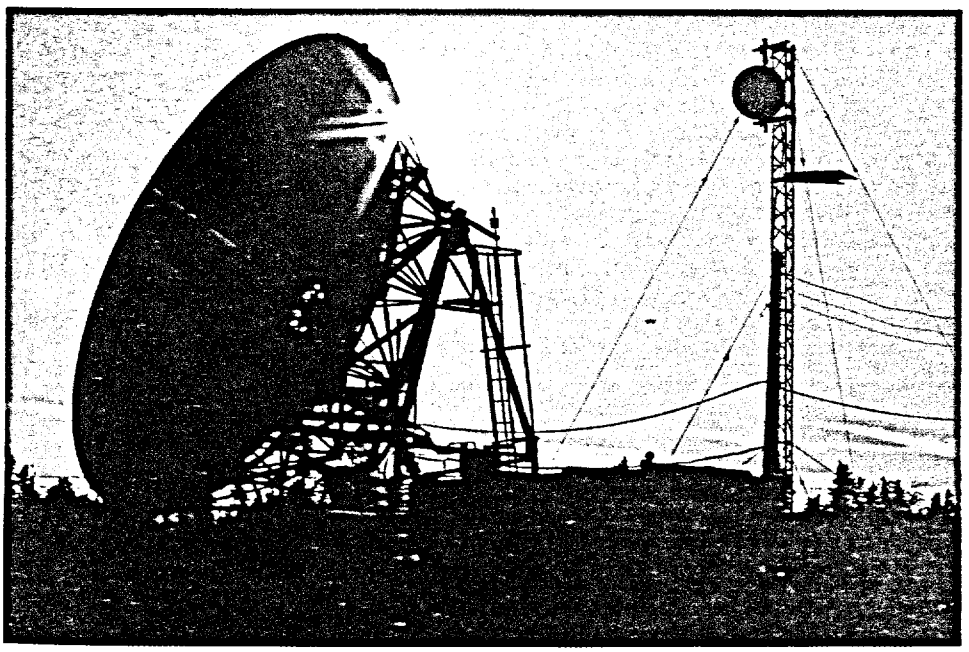


INTELSAT *satellites like this one carry 65 per cent of telecommunications traffic.*

Canada's vast territory, widely dispersed population, different regions, two official languages and proximity to the United States have presented many challenges to Canadian broadcasters. Evolving to meet these challenges, our broadcasting system has become one of the world's finest. In fact, Canada has the most technically advanced, and, *per capita*, the most extensive system for broadcasting in the world. Cable, microwave and satellite technologies have made possible the extension of broadcasting services to almost all communities in the country, including the most remote.

More than 98 per cent of Canadian households own radio receivers and more than 97 per cent own television sets. The publicly-owned Canadian Broadcasting Corporation's programming is distributed to 99.1 per cent of the population. Canada also has several large private television networks, several educational television broadcasters and a number of pay television companies. The five million cable subscribers in the country are served by 524 licensed cable operators distributing services through a network of some 90 000 kilometres of coaxial cable.

In every part of the country, even in remote Arctic settlements, Canadians now enjoy sophisticated communications services.



Pay TV

Pay television was introduced to Canadians in February 1983. As with other elements of broadcasting, pay TV is viewed as a potential means, not only of bringing entertainment and information but of reinforcing Canadian culture and national identity. A specified percentage of pay TV programming has Canadian subject matter, uses Canadian creative resources or what in other ways has "Canadian content". Thus, the new pay television services are able to increase the diversity of programming, enhancing the quality, distinctiveness and Canadian character of Canadian programs; and providing new opportunities and resources for the Canadian program production industry.

Pay television was able to attract, in less than a year, about half a million subscriptions and some operators have exceeded their own projections.

There are now two national pay TV services (one English one French) and three regional services. Pay TV is available, through cable operators, in all major regions of the country, including parts of the Northwest Territories.

Innovative Services

Cable distribution systems are extensive in Canada, nevertheless there are under-served communities in remote areas receiving only a limited amount of radio and television programming. Now, thanks to broadcasting technology *via* satellite, people in remote parts of the country are able to receive a much broader range of broadcast services.

A company called Canadian Satellite Communications Inc. (known as Cancom) is using Canada's Anik D satellite to distribute a package of AM and FM radio and several television program signals to affiliates in isolated communities. In addition to signals of Canadian radio and television stations, Cancom distributes several channels from the United States. The service carries programs in both English and French as well as some native language programming.

More than 1 400 communities have applied for Cancom licences and, by the end of February 1984, 868 communities were licensed to receive the Cancom package. Individual owners of earth stations can also have access to the Cancom services.

Thus, under-served communities or individuals will be able to receive direct-to-home broadcasting *via* satellite in one form or another. (The subject of direct broadcasting *via* satellite is discussed more fully in *Satellites: The Canadian Experience*.)

New Cable Services

Developments in information technology are enabling cable companies to supplement broadcast distribution with a wide range of new services. It is likely that a growing number of cable companies will offer their subscribers such services as teletext information channels, videotex data banks, remote emergency alarms, meter reading and teleshopping.

Two examples of new services offered *via* cable are:

The NABU Network of Ottawa, Ontario, which provides a system of delivering home-computer software to subscribers *via* the cable television network. Through the NABU Network a cable subscriber can receive the resources of large computer databases at relatively low cost;

Le Groupe Videoway Inc. of Montreal, Quebec, which has developed an integrated home information system using high technology methods in the field of teledistribution and communications. The Videoway system will include home information services such as Pay TV, electronic databases, news headline information (teletext) and other services, thus transforming the home television set into a multi-use terminal.

Satellite services are also seen as playing an important role, especially in isolated areas where cable systems are not practical. For this reason, individual Canadians are no longer required to obtain a licence to operate their own satellite earth stations for personal use. Certain commercial establishments, such as bars and taverns, which display but do not distribute satellite signals, may also operate earth station licences.

To strengthen Canadian programming, the government of Canada has created a new Canadian Broadcast Program Development Fund to support the production of high quality Canadian shows for both the domestic and world markets. The fund, which will rise to $60 million in its fifth year, will be matched by other sources.

Broadcasting services to native communities in northern Canada will also be improved through a special Northern Native Broadcast Access Program.

These, and other measures that have been either adopted or proposed, are designed to enable Canada to respond to the challenges and opportunities of a new broadcasting environment.

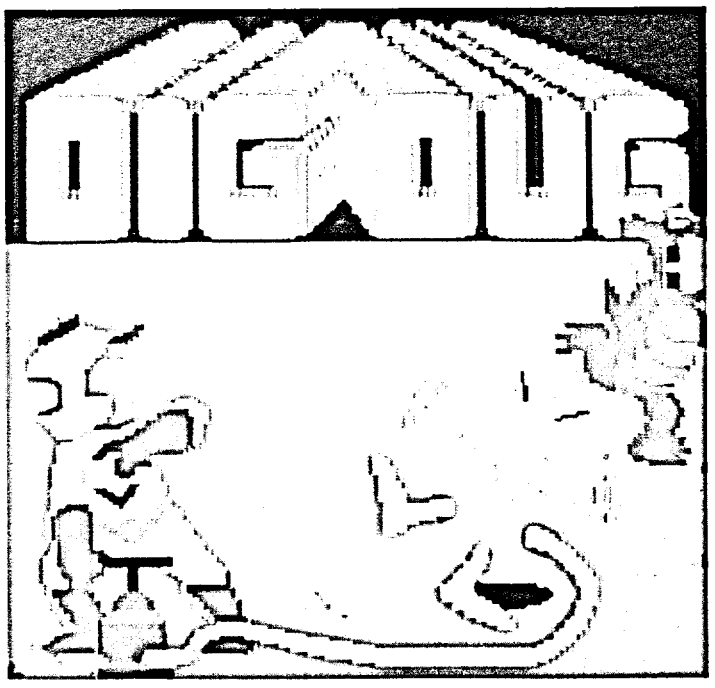
Cable TV subscribers can receive a wide range of new services including NABU *Network's* Dig Dug, *a computer game. Education is one of the popular applications in this system.*

New Broadcasting Policies

The advent of sophisticated information distribution technologies presents both challenges and opportunities for Canada. The challenge is to foster the Canadian broadcasting industry and culture in an era of greater availability of foreign programs. The opportunity is for the delivery of more services, both foreign and domestic, to more Canadians.

To ensure that Canadian consumers, broadcasters and other entrepreneurs benefit as much as possible from the modern technological environment, the government of Canada introduced a new broadcasting strategy on March 1, 1983. Increased viewing choice for Canadians and a stronger Canadian television production industry are its key elements.

The new policies stress cable as the prime vehicle for bringing Canadians more and better programming as well as non-programming services such as Telidon. Cable will be allowed to carry a wide range of new television channels and special services on a "tiered" basis, that is, as a package of services.



Mobile radiotelephone, a necessity for police, taxis and many other services, is an important modern means of communication, but its use has been limited because of a crowded radio spectrum in urban areas. Within the next two years, however, Canadians will have access to a superior kind of mobile service — cellular mobile radiotelephone — made possible by advanced computer and radio communications technologies. Cellular mobile radio can offer convenient, private and high-quality mobile telephone service to several hundred times more subscribers than conventional systems.

A conventional mobile system uses a single high-powered transmitter to cover a large geographical area, up to 50 kilometres in radius. Each call is assigned successively through the service area until all available channels (typically only about 25) are busy. As a result, only a few subscribers can use the system simultaneously and, during periods of heavy demand, subscribers may have to wait some time for an available channel. Such a system cannot easily be expanded; and transmission quality decreases drastically with the distance of the mobile unit from the base station.

In contrast, cellular systems break down large areas into small "cells" with radii of between 1.5 to 15 kilometres in diameter. Each cell is equipped with one low-powered base station linked to a public-switched telephone network (a transmitter receiver). A master computer automatically tracks the location of each mobile telephone, assigns users to available radio channels in the proper cell, automatically reassigns frequences as mobile units move from cell to cell, and compiles billing information. The configuration permits frequency re-use, multiplying the number of channels available and allowing interconnection with the public-switched telephone network.

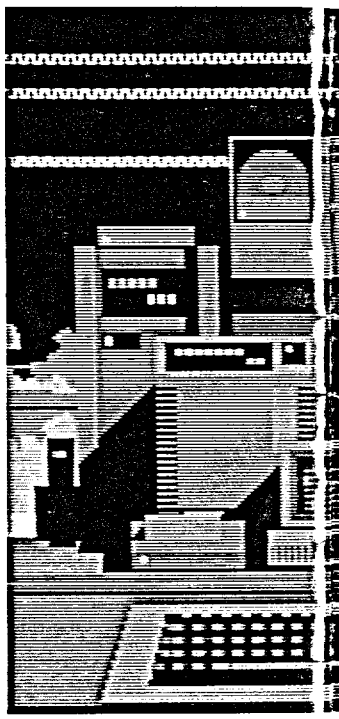
The radiotelephone is given a regular telephone number. Two-way conversations either between two mobile units or between mobile and regular telephones can continue uninterrupted as the user moves from cell to cell throughout the entire cellular area.

Two national cellular mobile radiotelephone systems are being established in Canada: one operated by local telephone companies; the other by CANTEL (Cantel Cellular Radio Group Incorporated) of Montreal. The two systems will be fully compatible with each other and with similar systems in the United States; both will be connected to the public-switched telephone network. It is expected that cellular radio service will become available in 23 cities throughout Canada in 1985 and will eventually expand to many smaller communities as well as along major transportation corridors.

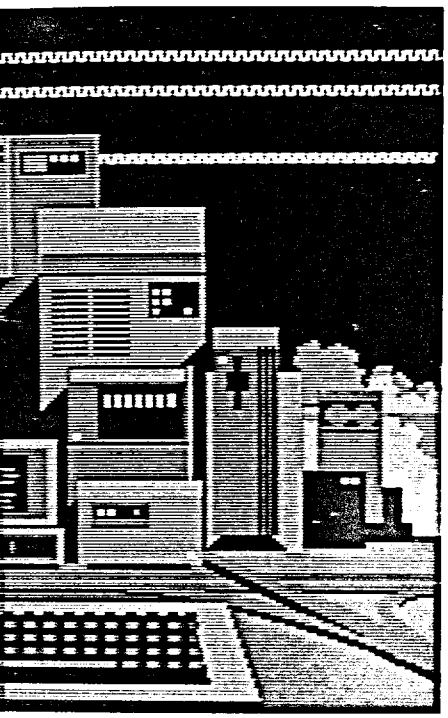
It is estimated that the industry will generate gross revenues of $180 million a year by 1990 in Canada. The world market is estimated to reach $10 billion annually by 1990.

Future enhancements of the system may include such services as call transfer and forwarding.

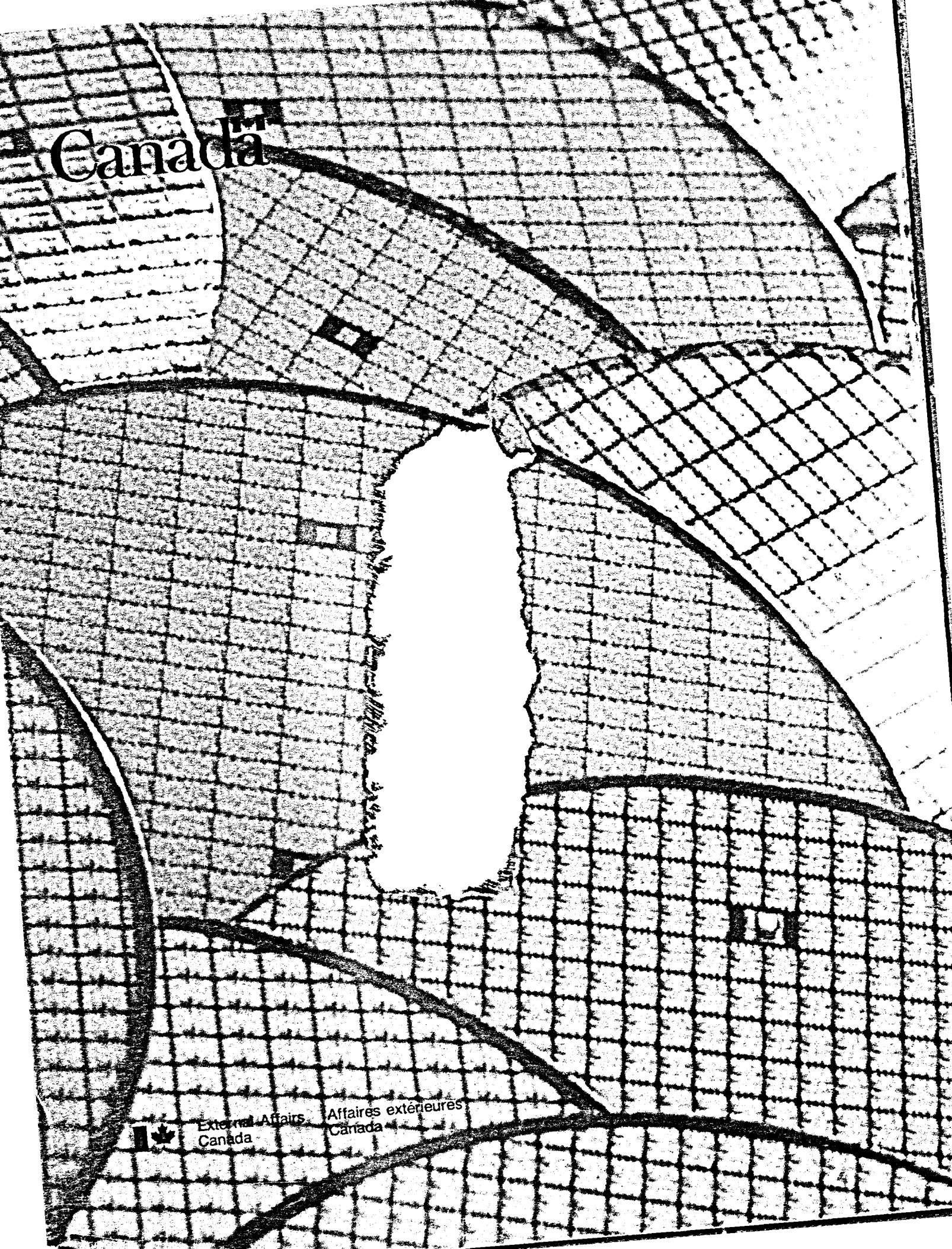
Cantel Inc. will launch Canada's first cellular telephone service in the Montreal and Toronto markets on July 1, 1985.



Alphageometric	A high resolution videotex display technique. Pictures are created by instructions such as: draw a line, draw a circle, fill in an area, etc., and picture definition is dependent upon the resolution capability of the display terminal.
Bandwidth	The bandwidth of a communication channel defines the range of frequencies which can safely be conveyed in the channel. A television channel requires a much greater bandwidth than, for example, a telephone speech channel.
Broadband channel	A transmission path having a wide bandwidth.
Circuit	A physical transmission path between two or more points.
Coaxial cable	A cable consisting of one or more tubes each of which has a wire contained within and insulated from a surrounding conductor.
DBS	Direct broadcasting by satellite (to low-cost earth station small enough to be located on or near a single home).
Data	Any values, numbers, characters or symbols arranged to represent information in accordance with predefined rules.
Digital	Pertaining to digits or to the representation of data or physical quantities by digits.
Earth station	Ground facilities established for transmission and/or reception of telecommunications traffic to and/or from a satellite.
Facsimile	Transmission of pictures, maps, diagrams, etc. The image is scanned at the transmitter, reconstructed at the receiving station and duplicated on paper or film.
Gateway	Equipment to interconnect telecommunications networks allowing terminals on one network to communicate with terminals on another network.
Hardware	The physical, tangible and permanent components of a computer or data processing system. Contrast with software.



Information retrieval	A system or technique for searching quantities of stored information and making selected information available.
Interactive	Implies continuous interaction between a user and a system.
Leased line	A telecommunications channel leased between two or more service points in one exchange or different exchanges, usually at a monthly rate.
Local area network (LAN)	A communications network within a building or buildings (e.g. college campus).
Multiplexing	Techniques performed while directly connected to or under control or into one facility or transmission path.
On-line	Operations performed while directly connected to or under control of a computer. Also refers to operations performed while connected to a communications channel.
Private branch exchange (PBX)	Telephone service provided for a customer's use consisting of central office trunks, a switchboard, and extension telephones which may be connected with the trunks or each other through the switchboard and associated equipment.
Repeater	A bi-directional device used in channels to amplify or regenerate signals.
Software	Computer programs, procedures, rules and any associated documentation concerned with the operation of a computer system.
Store and forward	Technique of receiving a message, storing it until the proper outgoing circuit and station are available, and then retransmitting it to its destination.
Time sharing	A method of operation in which a computer is shared by several users for different purposes at such high speeds that it appears to be the same time.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