Reaching for tomorrow

Communications Research Centre

Canada

Government of Canada
Department of Communications

Gouvernement du Canada
Ministère des Communications

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A changing world

Surely and steadily, the communications revolution is changing our world. At home and at work, in our studies and our recreation, it is reaching into almost every corner of our lives. Meanwhile it has created whole new industries, providing hundreds of thousands of jobs in Canada alone.

Earlier, the industrial revolution altered the way we produce and handle things we can actually touch. Today the communications revolution is transforming the way we handle ideas, images and information. In Canada, the Communications Research Centre is playing a pioneer role in bringing this about.

We already enjoy innumerable benefits from the continuing research that has made this revolution possible. Radio and television now can close enormous distances — greater than the distance to the nearest planets. With the help of satellites, we can talk to someone across the ocean as easily as talking to a neighbour. We can hold a simultaneous video conference with people in several different cities, or in several different countries.

Besides improved broadcasting, telephone service and other telecommunications, we have better radar for sea and air navigation, national defence and other uses. Along with better and faster news coverage, we have more reliable weather forecasting — all made possible by satellites, computers and new developments in radar, radio transmission and reception.

This technology has also ended the isolation of many remote communities, now with regular telephone, radio and television service.

This same technology has proved its worth in other ways, too. It has greatly simplified the task of mapping Canada's vast expanses, including large areas that would otherwise be almost inaccessible. It is also used to survey and monitor our forests, farm crops, soil and other resources, to detect and keep track of icebergs and forest fires.

Other applications include telemedicine — enabling a doctor to advise on the treatment of patients far away, with the aid of television or telephone links. Similarly, satellite television can put a teacher into remote communities where no regular schools exist. With the newest radar and radio technology, satellites also play an important part in national defence, through improved surveillance and military communications.

Canada's Department of Communications, established in 1969, has worked closely with the Canadian space industry in developing many of these applications. For example, researchers at the department's Communications Research Centre, near Ottawa, pioneered the use of satellites to locate missing aircraft and ships in distress. Today this is an international effort known as SARSAT, involving Canada, the United States, France, the Soviet Union and other countries. Since the Soviet Union launched the first rescue satellite in 1982, this project has helped save more than 250 lives.

Meanwhile, advances in ground communications have kept pace with achievements in space. One such advance is Telidon, developed at the Communications Research Centre in co-operation with Canadian industry. Introduced in 1978, Telidon has become the North American standard for teletext and videotex — the transmission, storage and retrieval of color graphics and text by computers, large or small. In both forms — teletext and videotex — Telidon can transmit color graphics of superior quality.

Teletext is a one-way system that gives television viewers access to regularly updated electronic "magazines", just by touching a few buttons. Videotex is a two-way system which allows the exchange of information over telephone lines or cable networks. This makes it a useful business and administrative tool, as well as an excellent teaching aid.

In developing Telidon, Department of Communications' scientists and engineers got help from Canadian computer hardware manufacturers, software companies and communications carriers. Thanks to Telidon, we may soon be able to choose merchandise and transact business without leaving home. We may also have electronic newspapers, allowing us to read the news on a television screen and print selected items on a home printer.

More benefits ahead

The kind of research that made these benefits possible is keeping Canada in the forefront of the communications revolution. As the new technology advances, it will change our lives even more. It promises to make them safer, more interesting, more enjoyable and more productive.

Thanks to fibre optics, we can look forward to more reliable telephone and cable service, free of interference and the risk of interception. The Department of Communications has helped Canadian industry pioneer important aspects of this technology, which uses hair-thin strands of glass to transmit pulses of light. A single optical fibre can carry more than 20,000 telephone conversations at once — many times more than a pair of copper wires.

Mobile radiotelephones will keep us in constant touch with relatives, friends and associates as they travel across the country — thanks to the new "cellular" technology. This will operate through a nationwide grid of local calling zones or "cells," possibly linked by Telesat Canada's proposed MSAT satellite. As travellers move from one zone to another, the system will automatically relay their calls through the nearest transmitter.

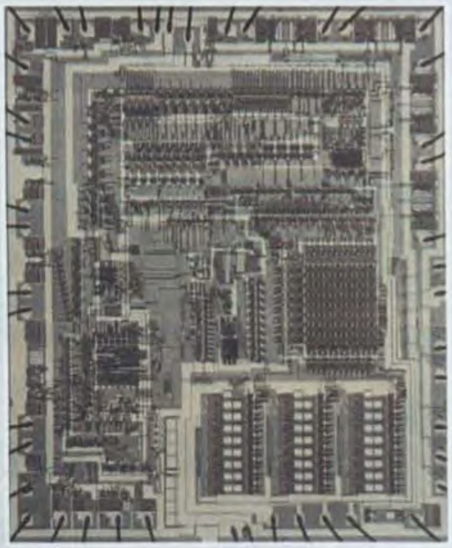
Communications will be made still more efficient by recent developments in microelectronics. Among them are new high-speed switches and other electronic components. Many of these will be made of gallium arsenide, an artificial compound used increasingly in transistors, microchips and other devices.

Such developments will transform the office of the future, where most Canadians will be employed. They will streamline the operation of our plants and factories, our farms and other industries. Then, too, they will enable business, industry and government to plan more wisely and effectively, on the basis of more and better information.

This revolution can mean a better life for people everywhere — but only if we adapt and organize the new communications technology to meet human needs. This is why the Department of Communications carries on research on office organization and terminal design, behavioural studies and other investigations into the human impact of this technology.

Meanwhile, researchers in private industry and universities are also working to bring us still more benefits from the new technology. In Canada the Department of Communications is helping them to meet this challenge.

VLSI: Colour video display generator



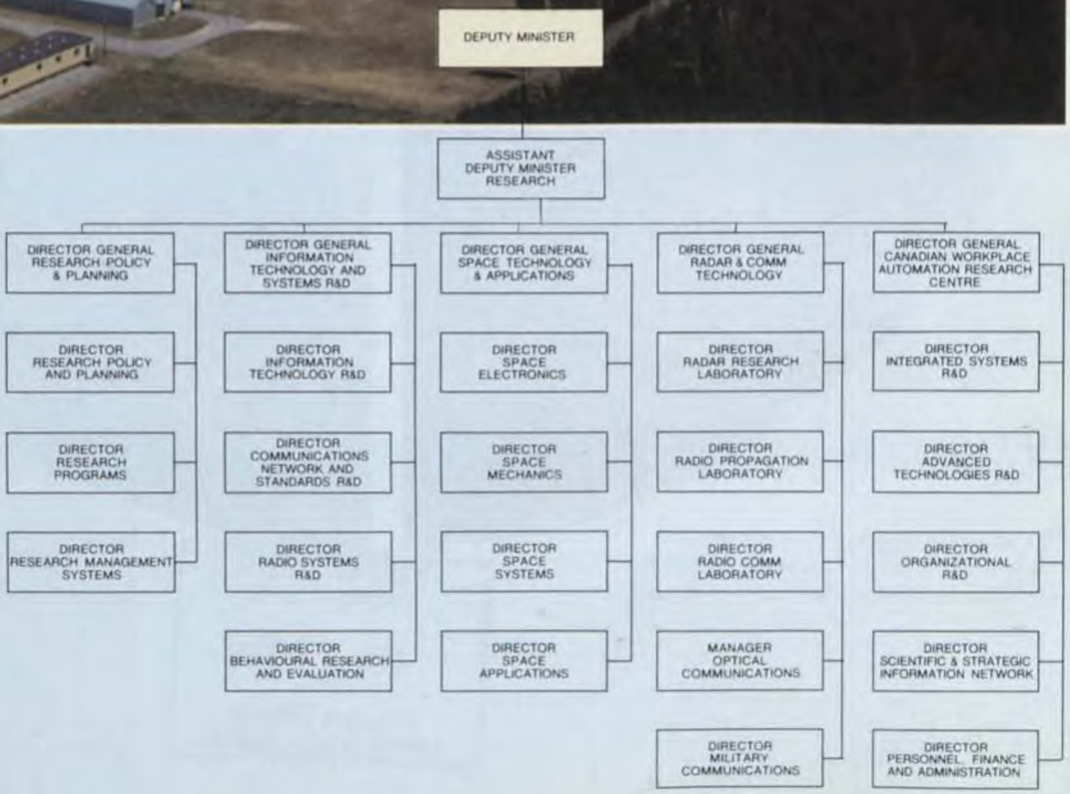
Video tele-conferencing

The Skynet UHF antenna undergoing a Step Relaxation structural response test developed by the Space Mechanics Directorate and DFL

Evaluation of the structural dynamics characteristics of an Astromast under simulated vacuum environment of space

Laying optical fibre cable

CRC at Shirleys Bay



DOC's Research Sector

Where it's happening

The department's main research establishment is the Communications Research Centre (CRC) at Shirleys Bay, about five kilometres west of Ottawa. This includes a computer centre, the David Florida Laboratory and other research facilities, on a site covering 576 hectares.

Some 500 Department of Communications' scientists, engineers and support staff regularly work at this site. With additional personnel working on contract, the total employed there is close to 650.

Four branches of the department's Research Sector are located at CRC: Radar and Communications Technology; Information Technology and Systems R&D; Space Technology and Applications; and Research Policy and Planning. The David Florida Laboratory, also at CRC, is part of the department's Technology and Industry Sector.

The Communications Research Centre grew directly from the facilities of the Defence Research Telecommunications Establishment, developed after the Second World War by the Defence Research Board. In 1969 CRC became part of the newly-created Department of Communications.

CRC's Research Policy and Planning Branch is responsible for the overall planning and administration of the department's whole research effort. At the same time, it administers programs of aid to universities, private companies and other agencies engaged in research.

On Clyde Avenue in Ottawa's west end is the department's Telecommunications Engineering Laboratory, established in 1959. There, some 30 technicians, engineers and support staff design, maintain and calibrate laboratory and field equipment.

This laboratory ensures that radio equipment used in Canada meets the national standards established by the department. Its engineers and technicians also solve technical problems affecting telecommunications and the use of various radio frequencies. Then, too, they make field and laboratory measurements of the ionosphere — a layer of electrically charged particles in the upper atmosphere which reflects radio waves.

The Department of Communications' newest research establishment is the Canadian Workplace Automation Research Centre (CWARC) in Laval, Quebec, northwest of Montreal. Opened early in 1985, this is administratively linked to the Communications Research Centre. Its major task is to study all aspects of the workplace of the future.

CWARC will be a focal point for co-operation between private companies, universities and government agencies involved in communications research. It will concentrate on improving office systems, hardware and software, and on the social and organizational impact of office automation.

CWARC will also develop the knowledge and skills needed to produce new office communications systems and equipment. Working closely with universities and the private sector, it will direct and strengthen Canadian participation in office research. Thus the new centre will act as a catalyst for technological developments in this important sector.

Construction of the centre began in October 1983, and by 1988 it will employ some 120 persons. About half of its scientific and technical staff is expected to come from industry and universities. At its disposal will be the most advanced data processing and telecommunications equipment and software available.

1 Alouette I (1962)
2 Alouette II (1965)
3 Isis I (1969)
4 Isis II (1971)
5 Anik A-1 (1972)
6 Anik A-2 (1973)
7 Anik A-3 (1975)
8 Hermes (1976)
9 Anik B (1978)
10 Anik D-1 (1982)
11 Anik C-3 (1982)
12 Anik C-2 (1983)
13 Anik D-2 (1984)
14 Anik C-1 (1985)
15 MSAT (1989)
16 Direct Broadcast Satellite (1989)
17 Radarsat (1990)

Canada in space

After the Soviet Union and the United States, Canada was the first country to venture into space. With its vast distances and its widely spread population, Canada quickly recognized how space technology could improve domestic communications.

Canada's first satellite, Alouette 1, was launched September 29, 1962, from Vandenberg Air Force Base, California. Like all the other Canadian satellites that followed, it continued to function much longer than expected. For 10 years Alouette 1 sent back useful data on the ionosphere. In 1965 it was followed into orbit by Alouette 2, which extended the program of measurements from the top side of the ionosphere.

Then came two more research satellites — International Satellites for Ionospheric Studies, or ISIS. ISIS 1 was launched in 1969 and ISIS 2 in 1971, and both are still sending back valuable information. Since Canada completed its ISIS program in March 1984, Japan has continued to receive and analyze data from these satellites, by special agreement with the Department of Communications.

Anik A-1, launched in 1972 by Telesat Canada, was the world's first domestic communications satellite in geostationary orbit. This orbit allowed it to remain in the same position over the earth — to bring Canadians continuous, reliable telecommunications services.

Anik A-1 was followed in 1973 by Anik A-2, which served initially as an orbiting spare or backup satellite. Then Anik A-3, launched in 1975, provided additional capacity. Together the Aniks brought network radio, television and improved telephone service to northern Canada and other remote areas.

Hermes, the Communications Technology Satellite launched in 1976, was the world's most powerful communications satellite — the product of combined Canadian and U.S. expertise. Over the next four years both countries successfully tested it for direct broadcasting to remote areas, for use in telemedicine, tele-education and other applications.

Anik B, in orbit since 1978, continues to assist this work, while serving many other experimental and commercial purposes. Through a number of Anik B pilot projects, government, business and special interest groups have explored new applications of space technology.

Anik D-1, launched in 1982, was the first Canadian-made communications satellite, built by Spar Aerospace Limited. Anik D-2, the second in this series, was placed in storage orbit in November 1984, ready for future use. Anik C-3 and Anik C-2 were launched in 1982 and 1983 respectively, and Anik C-1 was expected to join them in spring 1985.

Scheduled for launch in 1989 is MSAT (Mobile Satellite), being developed by Canadian and United States industry in cooperation with the U.S. National Aeronautics and Space Administration (NASA). MSATs over both countries will provide reliable communications for vehicles outside large metropolitan areas, as well as for ships, boats and aircraft. The owner and operator of the MSAT system will be Telesat Canada, a company owned jointly by the Canadian government and Canada's long-distance telephone companies.

Radarsat, to be launched in 1990, will keep track of arctic ice conditions for northern shipping and the Department of Energy, Mines and Resources. From a height of 1000 kilometres, it will also serve a number of other government departments. Unaffected by the weather, it will send back data on sea conditions, oil spills, crops, forests, mineral deposits and other resources, in Canada and around the world.

Radarsat will circle the earth in polar orbit — an orbit that passes over both poles. It will cover every part of the globe in 16 days, while completing a northern hemisphere ice survey every three days.

A proposed Direct Broadcast Satellite (DBS) could beam radio and television broadcasts directly into the homes of people living in remote areas. This could be launched as early as the end of the decade, but no firm plans have yet been made. Meanwhile, the Anik C satellites already have the potential to provide medium power direct-to-home television service.

Another Canadian achievement is the Canadarm, the remote manipulator currently used in the United States space program. Developed by the National Research Council in Ottawa, the Canadarm passed its first space trial in November 1981, when it was used by astronauts aboard the U.S. space shuttle Columbia.

The development of the Canadarm illustrates the close co-operation between the Department of Communications, private industry and other agencies. It was built by Spar Aerospace Limited of Toronto in partnership with the National Research Council, with the help of engineers and technicians at the Communications Research Centre. Testing was carried out in CRC's David Florida Laboratory.

Canadarm

Canadarm in thermal vacuum chamber

David Florida Laboratory

The David Florida Laboratory, a major component of the Communications Research Centre, was named in honor of one of Canada's foremost pioneers in space research. When he died in 1971, C. David Florida was director of the Canadian National Space Telecommunications Laboratory and manager of the ISIS satellite program.

The David Florida Laboratory was built initially to support the development of the Hermes communications satellite, launched in 1976. It has since played a key role in Canada's space program.

The laboratory duplicates conditions during launch and in outer space, for testing satellites and aerospace components. There they must survive an ordeal of vigorous vibration and alternate chilling and heating, as they must do also on an actual space mission. The laboratory also provides a clean, controlled environment in its satellite assembly room, and RF (radio frequency) test facilities which duplicate the communications environment of space.

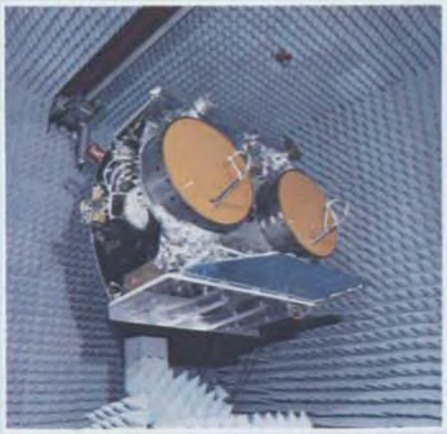
The David Florida Laboratory serves both the private sector and government research. Spar Aerospace used it, for example, to test sections of the Canadarm before its maiden flight. Recently this laboratory was used for testing and assembling Brasilsat, a communications satellite produced for the Brazilian government by the same company.

Together with Canadian Astronautics Limited, Spar is also testing several subsystems of the British defence satellite Skynet 4. Meanwhile the laboratory has a vital test role in the development of a large communications satellite, Olympus, for the European Space Agency.

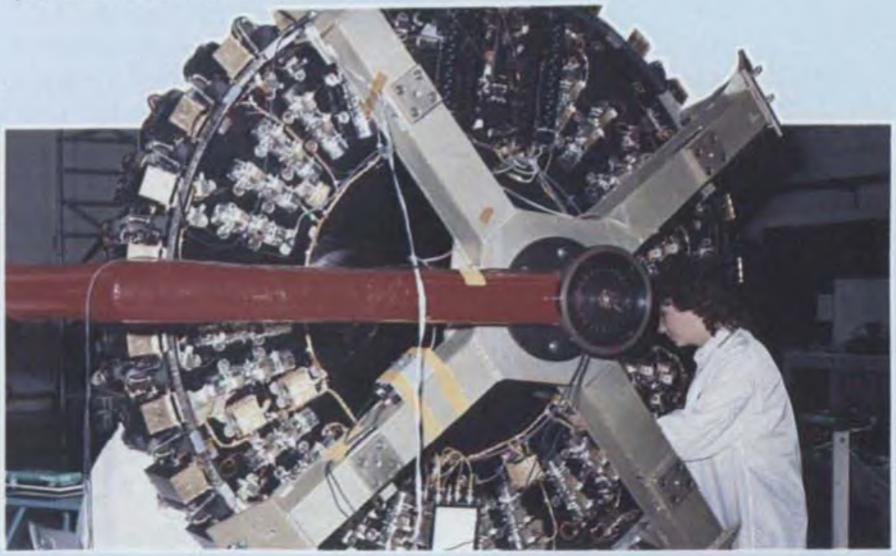
The David Florida Laboratory has seven functional elements:

- Two high-bay spacecraft assembly areas, with appropriate dust and contamination control. A third assembly area is under construction.
- A radio frequency testing facility comprising two anechoic (reflection-free) chambers, two screened rooms, an antenna range with fixed and movable antenna towers, and equipment for testing electromagnetic compatibility and radio frequency interference.
- Vibration tables for testing the response of spacecraft and their components to vibratory stress.
- Five thermal vacuum chambers, to simulate thermal and vacuum conditions in outer space.
- Facilities for displaying, recording and storing test data.
- Systems for balancing spacecraft statically and dynamically, and for measuring their mechanical properties.
- Specialized ground support equipment for handling satellites and aerospace components.

Hermes model in small anechoic chamber



Technicians assembling communications payload for the Brasilsat S1 satellite



The Analysis and Simulation Laboratory

Space Technology and Applications

Space Mechanics

Space Mechanics is concerned with the overall design of a satellite. It specifies the satellite's performance requirements and directs the development of critical spacecraft systems. Space Mechanics includes four major task areas:

- The Analysis and Simulation Laboratory carries out complex computations for analyzing and simulating performance in space.
- The Dynamics Research group develops new methods for analyzing and testing the behaviour of large floppy space structures, such as radio antennas and solar panels, and for determining and predicting low orbits.
- The Control Systems group develops controls and sensors for these large flexible space structures.
- The Applied Mechanics group ensures there is adequate thermal control for the spacecraft, and sponsors the development of the large floppy structures and the mechanisms that deploy and retract them.

The Analysis and Simulation Laboratory forecasts and analyzes the behavior of satellites and their various components in space. It does this with computers which mathematically simulate space conditions, such as weightlessness, difficult to duplicate on earth. It shows how a particular space structure would react to those conditions, and also the effects of possible changes in design.

Thus the laboratory's computers can test a satellite's attitude control system, designed to keep it stable and prevent its wobbling in orbit. They can show, for example, how its attitude would be affected by the deployment of antennas, solar panels or other auxiliary equipment — and how the equipment itself would react. This can be represented not only by numbers and graphs, but also by animated images on a monitor screen.

The Controls Laboratory tests the systems used in controlling a spacecraft's attitude and orbit, along with the gyros, star sensors and other components of these systems. It works closely with the Analysis and Simulation Laboratory, where newly developed hardware for these systems is simulation-tested.

The Thermal Control Laboratory ensures that suitable temperatures can be maintained aboard spacecraft for all equipment sensitive to heat or cold. To do this it tests the efficacy of three different approaches to the problem — active heat production and distribution, the use of insulation to conserve heat, and a combination of both.

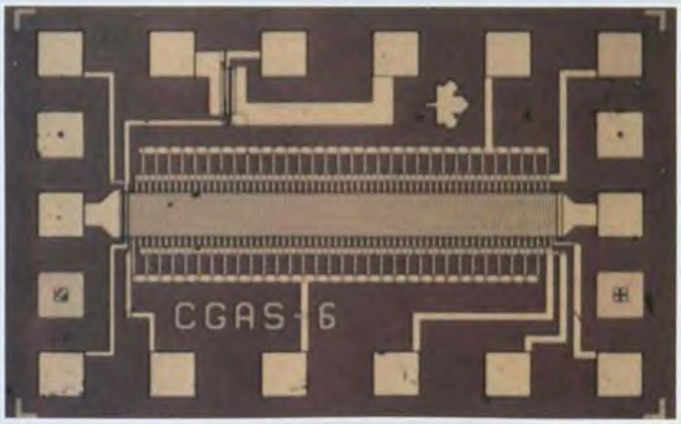
The Space Mechanics Directorate played a vital part in the development and operation of the Hermes satellite. It also provided scientific analysis and personnel for the development of the Canadarm. Currently it is carrying on research in support of MSAT, Radarsat and possible new Canadian initiatives in the U.S. space station program.

These ongoing efforts, along with research by major Canadian universities, are producing new products for the space industry. For example, two advanced composite materials — carbon epoxy and Kevlar — were tested in October 1984 during the flight of the first Canadian in space, Commander Marc Garneau, aboard the U.S. space shuttle Challenger. A similar experiment was expected to end with the retrieval of the Long Duration Exposure Facility, launched from the Challenger in April 1984.

7 × 10 m thermal vacuum chamber

Scanning electron microscope with integral microprobe analyser

Gallium arsenide chip



Space Electronics

Space Electronics develops circuits and other components for space communications systems. These include such vital elements as satellite antennas, components for earth terminals, and electronic circuitry for spacecraft power systems and signal processing systems. The Space Electronics Directorate has helped make Canada a world leader in designing transponders — satellite components that receive signals from earth, change their frequency and amplify them for transmission back to earth.

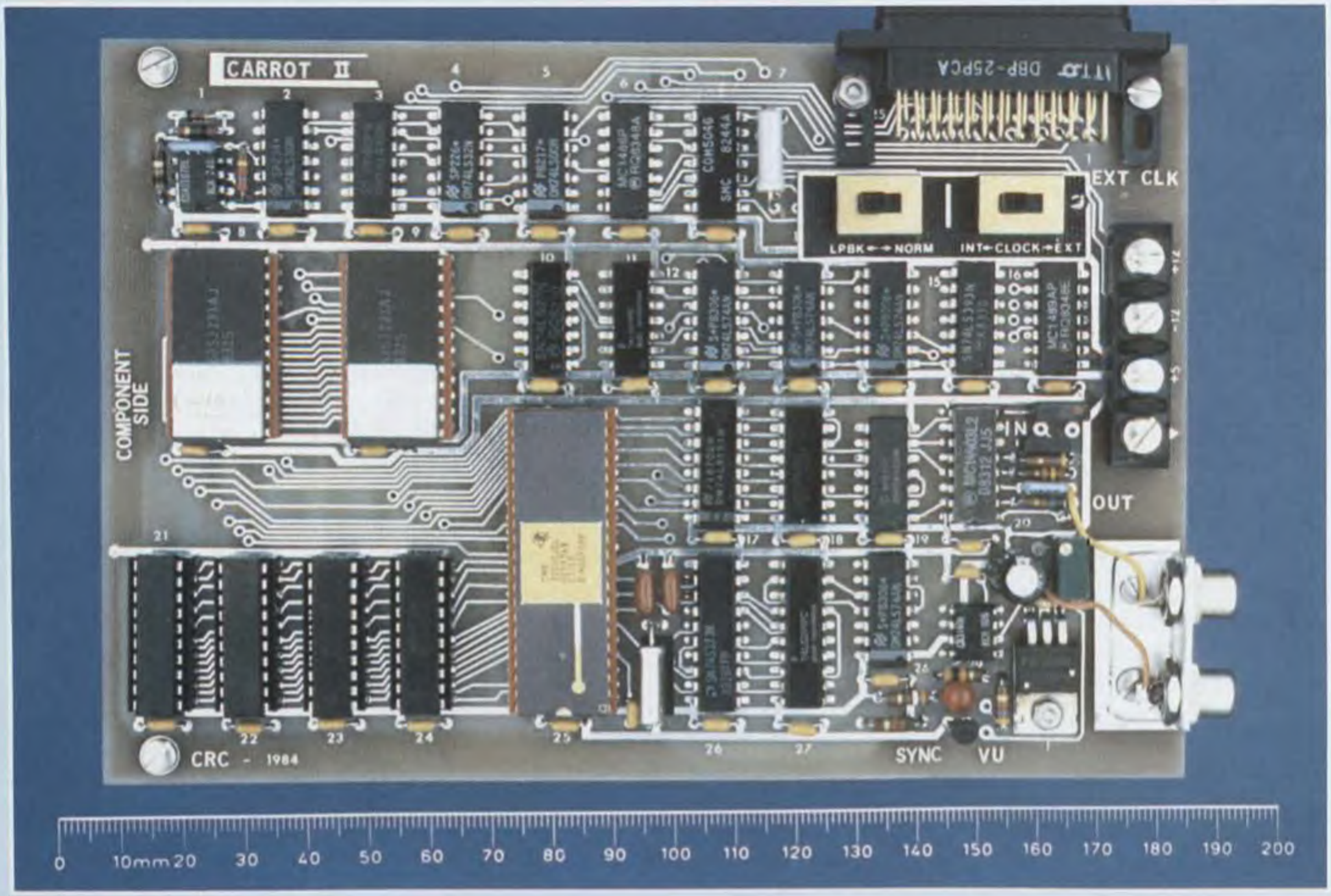
These and other components are tested in the High Reliability Laboratory, along with the materials from which they are made. Its facilities include scanning electron microscopes, several optical microscopes, microprobe analyzers and other non-destructive probing devices. A powerful X-ray unit is used to study the crystal structure and quality of materials used in fabricating electronic equipment.

CRC played a supporting role in the development of gallium arsenide crystals as semiconductors by the National Research Council. Initially developed for the Canadian space program, this technology now enables Canadian industry to produce new products for world markets.

Researchers in the Microelectronics Laboratory provided the technical assistance which enabled Cominco Ltd. of Trail, British Columbia, to become a major supplier of gallium arsenide. Through its aid to other companies, such as Bell Northern Research and Optotek Limited of Ottawa, CRC is helping to establish gallium arsenide technology in Canada.

Gallium arsenide is a compound of arsenic and gallium, a bluish white metal obtained as a byproduct of smelting zinc or extracting aluminum from its ore. Transistors and microchips made of gallium arsenide operate six times as fast as those made of silica — the material normally used — and at much higher frequencies. This is a big advantage in space communications. Starting with Hermes, launched in 1976, gallium arsenide transistors have been used in all Canadian satellites.

12 GHz output multiplexer/transponder



Pitch excited linear predictive codec which works at 2400 bits per second

ELT emergency locator transmitter

B.C. crash, 1982

Space Systems

Space Systems explores and develops new methods of communication using satellites or other space structures. Its main concerns are mobile and military communications, the processing of radio signals and the use of satellites in search-and-rescue operations.

Research on satellite mobile communications has a global as well as a domestic focus. Through an international experimental program, CRC researchers seek ways to improve the international service operated by the London-based International Marine Satellite Organization (INMARSAT). They are also assisting the development of the proposed domestic service to be provided by Telesat Canada, with the expected launch of MSAT in 1989. Current research includes the investigation of the radio propagation environment and the study and development of new techniques for transmitting and receiving radio signals relayed by satellites.

The Communications Processing group examines techniques for modulating radio signals and converting voice communications into digital form. At the same time, it studies methods of ensuring privacy in telecommunications. The group maintains close contact with Canadian industry, which has received licenses for several designs of voice-coding equipment.

SARSAT is an acronym for search and rescue aided by satellite — an international program that uses satellites to locate the victims of air crashes and marine disasters. Space Systems played a key role in implementing this program, which has helped save hundreds of lives.

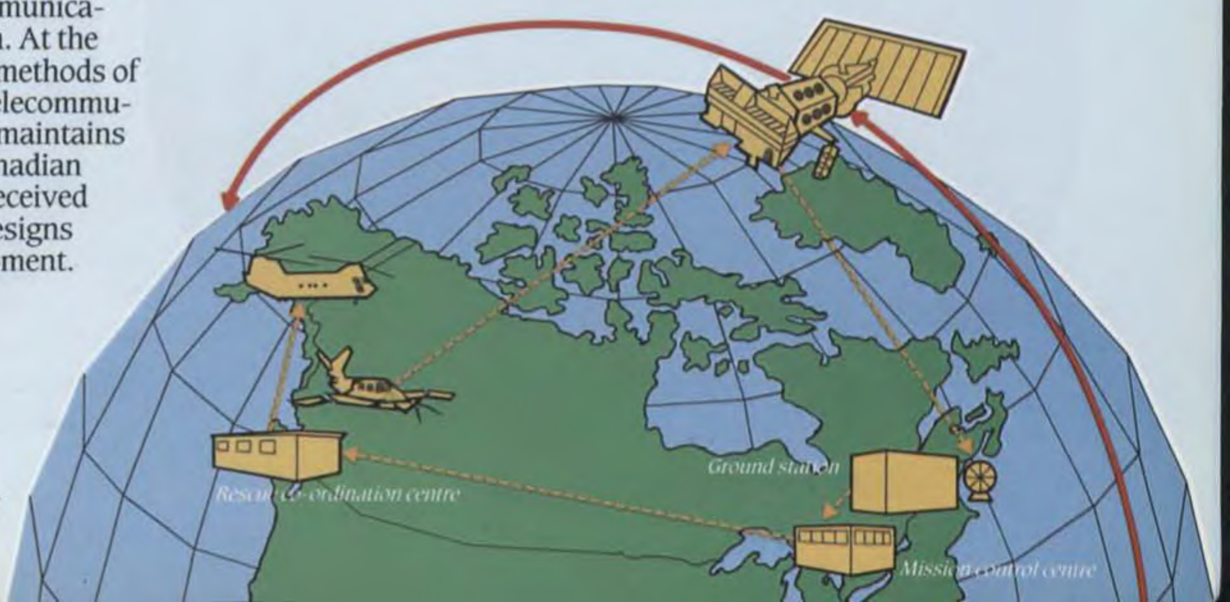
SARSAT is co-ordinated by a working group representing Canada, the United States, Britain, France and Norway. It is closely linked with COSPAS, a similar Soviet program, to form a larger system known as COSPAS-SARSAT. In Canada the program is directed by the Department of National Defence, with technical support from the Department of Communications.

Each of the satellites in the COSPAS-SARSAT system circles the earth in a low polar orbit every 12 hours, detecting distress signals from emergency beacons on ships and aircraft over a large area. In Canada these signals are received at CRC and relayed to the Canadian Forces rescue headquarters in Trenton, Ontario.

With the Department of National Defence, Space Systems is researching the use of satellites in military communications. This research is concerned with such problems as the propagation of radio signals and the design of transmitters, receivers, transponders and antenna systems.

Military research has concentrated on the use of the extremely high frequency (EHF) band, to avoid the congested lower frequency bands. This also permits the use of smaller antennas and highly directional narrow-beam radio transmission, resistant to jamming. Space Systems is currently working with Com Dev Limited of Cambridge, Ontario, to develop on-board signal processing for military aircraft.

With MPB Technologies Inc. of Dorval, Quebec, Space Systems engineers are developing a system of laser communication in free space. At the same time, they are investigating the possibility of laser communications between satellites.



SARSAT in low polar orbit

DOC personnel in the Ottawa Briefing Centre confer with committee members in Quebec City through videoconferencing facilities

Telemedicine

Direct satellite broadcasting

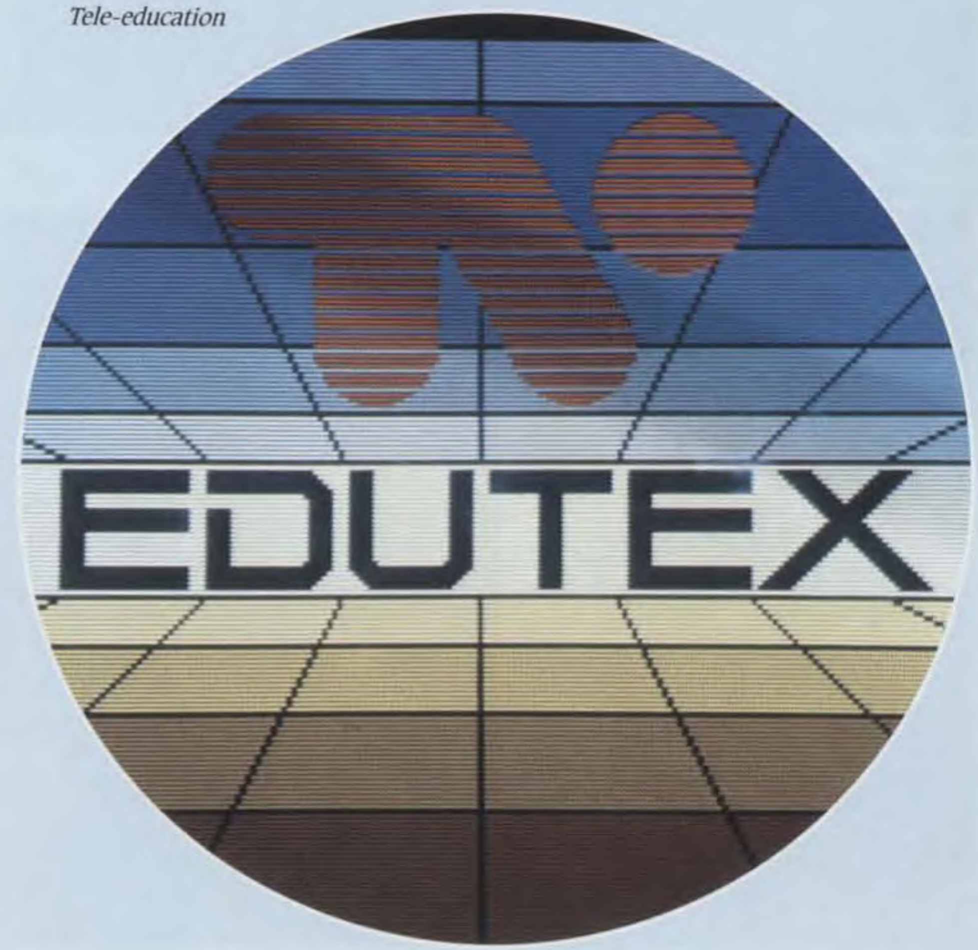
Space Applications

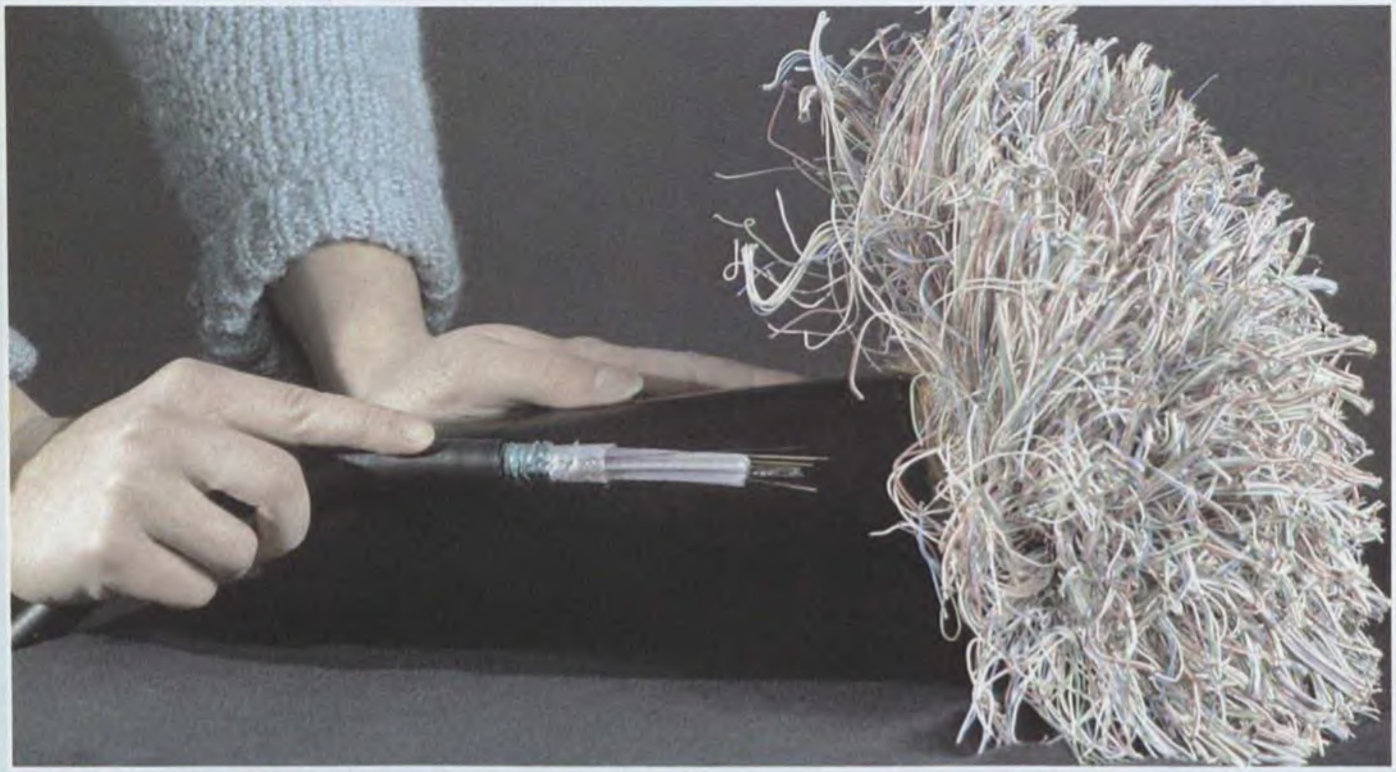
Space Applications brings the space age into our daily lives by working with industry to develop practical uses for satellite communications. Among these applications are teleconferencing, telemedicine, tele-education and low power direct-to-home television. These were developed as a result of trials conducted with Canada's Anik B satellite, launched in 1978.

Telemedicine has proved its worth in remote locations such as offshore oil rigs. It allows a doctor to diagnose the condition of patients hundreds or thousands of kilometres away, with the help of televised X-ray pictures, electrocardiograms and other information sent by satellite. Then, too, it enables the doctor to prescribe and supervise treatment.

Tele-education is a boon to students in isolated communities, and to others who cannot leave home. In one such application the Department of Communications teamed up with TVOntario, a provincial television network, to provide further education for high school students in northern Ontario. This service combines satellite communications technology with Telidon.

Tele-education





The fibre optic cable has more than three times the message-carrying capacity of the much larger copper cable

Optical fibres

Radar and Communications Technology

Optical Communications

The Optical Communications Laboratory conducts advanced research in photonics — a new science and technology based on the smallest units of light, called photons. It studies the emission, transmission, behaviour and harnessing of light, especially for communications and information processing.

One area of this research is fibre optics. Instead of electricity or radio waves, fibre optics technology uses pulses of light to transmit information along fine glass fibres. Besides carrying much more information than copper wires, optical fibres can also be produced more cheaply. This is because they are made from silica — the main ingredient in common sand — one of the most plentiful materials on earth.

Optical cable is much smaller in diameter than copper cable, and therefore easier and cheaper to install. Moreover, because it transmits information more efficiently with practically no leakage, fewer relay stations are needed. As a further bonus, transmissions over optical fibres are free from interference and the risk of interception.

Besides studying fibre transmission, the Optical Communications Laboratory conducts research and development on other components of optical systems. The Department of Communications has obtained basic patents on such devices as opto-electronic switches and optical couplers and splitters — the access points in a fibre optics system.

Optical Communications has pioneered the development of all-fibre local communications networks, without the need for repeaters or amplifiers to deliver a signal. These networks, known as FO-LANs (fibre optics local area networks), are designed to serve large numbers of users at a single location. They can be installed, for example, in office buildings, factories, hospitals, apartment blocks or ships, or serve as traffic control systems.

Optical coupler

Radio Propagation

The Radio Propagation Laboratory investigates the propagation of radio waves under various natural conditions. This research is aimed at improving radio communications of all kinds, including radio and television broadcasting, satellite and mobile communications. At the same time, it seeks to increase the number of channels available for such services. Propagation research is thus an important tool in spectrum management — the allocation of radio frequencies for broadcasting and other uses, both nationally and internationally.

The laboratory has conducted extensive studies of propagation at microwave frequencies — above 3000 MHz. At these frequencies, radio signals can be lost because of rainstorms or other unusual weather conditions. The studies have been used, for example, in designing new satellite systems developed by the department.

Currently, research is largely focused on very high frequency (VHF) and ultra high frequency (UHF) transmissions, used increasingly for mobile radio and other applications. Scientists are studying the characteristics and limitations of these frequencies, so that the best use can be made of them.

A special concern is the obstruction of VHF and UHF signals by heights of land, buildings and other physical obstacles. Such obstacles limit the range of communications, and studies are aimed at making better predictions of television and FM radio coverage patterns.

A related problem is the reflection of these signals to produce ghost images on television screens, and similar interference in other forms of communication. CRC researchers are seeking ways to solve this problem, which can cause havoc with mobile communications in our cities.

In co-operation with the Canadian Coast Guard, CRC scientists recently investigated the uniquely stable propagation conditions in the Canadian arctic. This work is expected to improve communications in the region.

Another co-operative effort is WISP/HF — an abbreviation for Waves in Space Plasmas, High Frequency. This is a planned study of the propagation of high frequency radio waves (3-30 MHz) in the ionosphere, using Canadian equipment carried aboard a U.S. space shuttle — expected to begin in 1988. Co-operating in this project are CRC, the National Research Council (NRC) and NASA. CRC is supplying the principal investigator, who leads the international team of scientists working on this project.

Besides guiding the department in assigning frequencies and designing new communication systems, propagation research at CRC aids telephone companies and other communications carriers. On the basis of this research, the department also advises international bodies on frequency planning and assignment. One such body is the International Radio Consultative Committee (CCIR)*, a committee of the International Telecommunication Union (ITU).

*Comité consultatif international des radiocommunications

FM interference

Communications Technology

The Radio Communications Laboratory investigates interference from competing radio signals, power lines and other artificial sources. Researchers there are developing improved techniques for monitoring the airwaves — useful in managing and policing the radio spectrum. Ultimately they hope to perfect an automated monitoring system, which would be much more efficient than present methods.

Researchers are also seeking ways to reduce the background noise that interferes with mobile communications, such as personal paging systems, car radios and radiotelephones. Meanwhile they are pioneering the use of single sideband radio for mobile communications — a technology that uses less of the spectrum, thus leaving room for many more users.

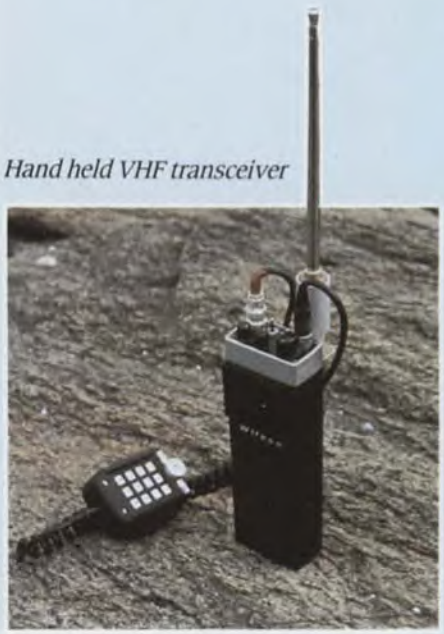
Another concern is AM reradiation — the retransmission of radio signals by power lines erected near broadcast transmitters. This can seriously distort a station's broadcast pattern, blotting out the signal in some places and causing interference in others.

CRC is represented on a special working group on AM reradiation, chaired by the Department of Communications' director of broadcast regulations. Also represented are the Canadian Electrical Association, the Canadian Broadcasting Corporation (CBC), the Canadian Association of Broadcasters and the Canadian Association of Broadcast Consultants.

An important achievement of the Communications Technology group is trail radio, developed initially for the Inuit at Nain in northern Labrador. This is an efficient communications system for hunters, trappers and other people in remote areas, with no access to other reliable communications.

Trail radio combines the advantages of different technologies — the distance of high frequency (HF) radio with the reliability of very high frequency (VHF) radio and telephones. It does this through an interconnect terminal developed for CRC by Baron Communications Ltd. of Vancouver, which integrates these separate systems.

Hand held VHF transceiver



Another project is SHARP — an acronym for Stationary High Altitude Relay Platform. SHARP is a system of pilotless aircraft which the Department of Communications is considering for possible use as high-flying relay stations. These would fly in tight circles less than 21 kilometres above the ground, receiving and retransmitting radio signals across vast stretches of wilderness.

There has been considerable interest outside Canada in developing such a system. But much of the recent research has been done by Canadian industry and the staff of CRC. This includes the adaptation of a rectenna (rectification antenna) for use on the aircraft, to convert microwave transmissions into direct current for powering equipment.

Over a smaller area, SHARP could serve many of the same functions as a communications satellite. Its regional coverage and lower cost could place it within the financial reach of developing countries which cannot afford satellites.

Early test of microwave power transmission to a small airship for SHARP

Landsat imagery courtesy of the Canada Centre for Remote Sensing, EMR

Radar and Military Communications

Canada's main effort in radar research and development is centred in the Radar and Military Communications Laboratories at CRC. Most of this work is done for the Department of National Defence, and is therefore classified for security reasons. But some of this research yields important benefits for civil aviation and other non-military uses.

Researchers at CRC advise National Defence and other government departments on radar procurement and development. They give technical support to such projects as Radarsat, the survey satellite to be operated by the Department of Energy, Mines and Resources. They also give advice to aerial survey companies and other organizations interested in using radar.

The Radar Research group is closely involved in the SHARP project — the proposed use of pilotless aircraft as relay stations. Its responsibility here is to develop ground transmitters capable of sending a narrow beam of microwave radiation to the aircraft, to serve as a power source.

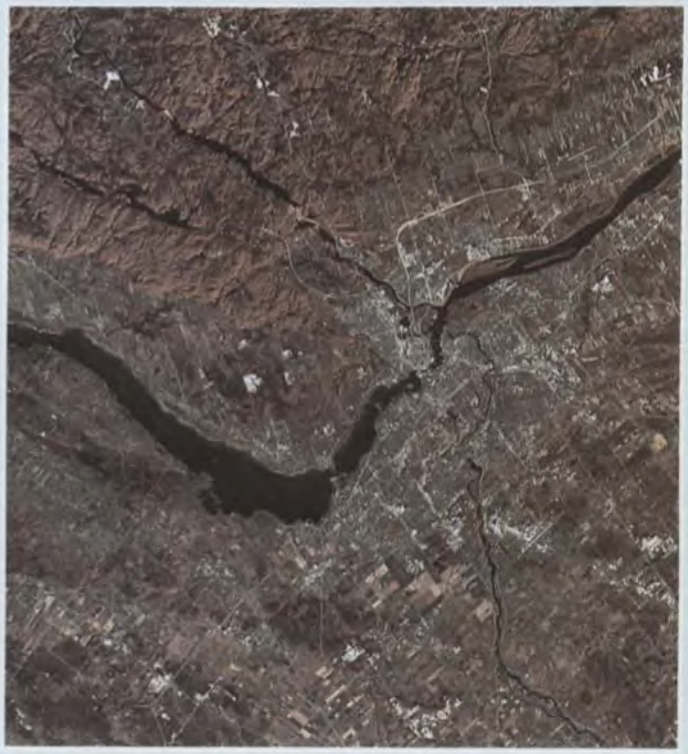
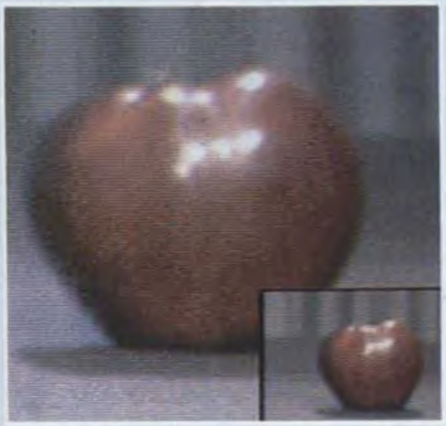



PHOTO TELIDON



Information Technology and Systems

Information Technology

A major Canadian achievement is Telidon, an improved form of teletext and videotex developed at CRC. Like other versions of this technology, Telidon teletext enables users to access and display information on a television screen; and, similarly, Telidon videotex allows them to create and exchange both data and graphics. But Telidon's more realistic graphics are strikingly superior to the crude mosaics used in other systems.

Its superior graphics have made Telidon the basis of the North American standard for teletext and videotex technology. This is the North American Presentation Level Protocol Syntax (NAPLPS), adopted by the American National Standards Institute and the Canadian Standards Association. It has also been approved by the International Consultative Committee on Telegraphy and Telephony (CCITT)* as one of the world's standards.

In just a few years, a whole new industry has grown up around Telidon. Some 200 Canadian companies are engaged in developing, refining and manufacturing Telidon equipment, or in creating electronic information banks and other software for use with Telidon. Many former CRC engineers and scientists have helped to organize and launch these companies.

*Comité consultatif international télégraphique et téléphonique

CRC researchers now are trying to make Telidon talk. They are working on a high-speed digital method of encoding speech, like the NAPLPS system for encoding images and data. Another current project is the refinement of photo-Telidon, a system for reproducing, storing and sending photographs and other pictures by videotex or teletext.

Meanwhile, preliminary studies have started on digital television, an emerging technology to which Telidon can make an important contribution. Digital television may soon give us clearer and more realistic images on our TV screens, with enhanced special effects.

NAPLPS/Telidon development

NAPLPS picture creation

NABTS teletext delivery

Low-cost VLSI decoding

Mobile message terminal

Radio Systems

Radio Systems identifies special technological needs in communications systems, then devises ways to meet those needs. This has resulted, for example, in the development of a new radio-linked data terminal for use in police cars, fire trucks, ambulances, courier cars and other vehicles.

Using such a terminal, police officers can call up detailed information about a suspect on a monitor screen in their cruiser. Firefighters can study building diagrams and hydrant locations on their way to a fire; and ambulance attendants can obtain vital diagnostic information, along with a patient's medical history.

Radio Systems researchers worked with private industry to develop this terminal, now manufactured by Mobile Data International Inc. of Richmond, British Columbia. Close to 90 per cent of the terminals produced are exported for use outside Canada.

Another Radio Systems achievement is RACE, an acronym for radiotelephone with automatic channel evaluation. This is a computerized switchboard for high frequency radiotelephone systems, which automatically selects the best available channel whenever a call is made.

Part of the RACE system is Syncompex (synchronized compressor and expander), a radio voice-processor developed at CRC. This makes spoken communications more intelligible, despite the high noise levels of many transmissions.

RACE is a user-friendly system ideal for small isolated communities, providing more reliable communications without the need for an operator. It is manufactured by the Canadian Marconi Company of Montreal, based on a concept developed by Radio Systems engineers.

Another achievement is a mobile message terminal, the size and weight of a portable typewriter, for high frequency radio systems. Well suited for boats and other small craft, it was specifically designed for use by fisheries inspectors with the Department of Fisheries and Oceans. Complete with a voice transmitter, a keyboard and a small printer, this miniature terminal is produced by Glenayre Electronics of North Vancouver.

Behavioural Research

Technology is useful only if people know how to use it. And the best technology is the kind we can use conveniently, comfortably and easily. This human factor is the concern of Behavioural Research, a team of psychologists working at CRC and department headquarters.

These researchers investigate how people use and react to data terminals, computer programs and other information technology. Their studies are helpful in making this equipment more useful and more user-friendly. At the same time, they are interested in how the new technology affects public attitudes, office and community organization.

Psychologists played a key role in developing Telidon — in making it easily understandable and convenient to use. Studies focused on finding the best methods of inputting and retrieving information, on the effective use of graphics and the design of visual displays, including the size, shape and spacing of letters.

Similar research is continuing in the whole area of telematics — the electronic transmission of data. How do people perform and interact with electronic information systems? How well do they understand their use and operation? And how do these systems affect them as individuals, as members of a work team or their local community?

These are just a few of the problems being explored by Department of Communications' Behavioural Research psychologists. Their findings are used not only by other government scientists and engineers, but also by private industry and other professionals outside government.

Communications Networks

To be useful at all for communication, separate terminals must be integrated into larger systems or networks. Designing such systems is the business of the Department of Communications' Communications Networks group, at the departments' Ottawa headquarters.

Among its achievements is the design of a pilot fibre optics network serving Elie and St. Eustache, two small rural communities near Winnipeg. Transferred to the Manitoba Telephone System in 1984, this network provides 150 families with Telidon, cable television, stereo FM radio and private-line telephone service.

The success of this project proved the practicality of fibre optics systems, even under conditions of extreme heat and cold. Since 1983, Bell Canada has been using optical fibres in all its new and replacement trunk telephone cables. In Saskatchewan, SaskTel has built one of the world's longest fibre optics network, covering some 3200 kilometres, using Northern Telecom equipment.

However, system-building often involves much more than design and construction. Frequently, too, it requires obtaining agreement on what kind of system to use. A major achievement of the department's Communications Networks group is the acceptance of Canada's Telidon technology as the basis of an international videotex standard — the North American Presentation Level Protocol Syntax (NAPLPS).

The Department of Communications is currently involved in another international project, known as Open Systems Interconnection (OSI). This seeks to establish procedures that will enable different computer-based systems to communicate, wherever they might be. Taking part, along with Canada, are the United States, Britain, France, Sweden and Australia.

Fusing optical fibres

Laying optical fibre

Working together

NAPLPS and OSI are just two examples of the co-operation between the Department of Communications and other agencies, organizations and governments. This has proved beneficial both to Canada and to other countries with whom we have shared our expertise.

Canada is a member of the International Telecommunication Union, which co-ordinates the assignment of radio frequencies on an international basis. The department also works closely with the U.S. National Aeronautics and Space Administration (NASA), which has launched all of Canada's communications satellites. It collaborates with other countries on a number of special projects, such as SARSAT — the international satellite search-and-rescue program.

In Canada, the Department of Communications works closely with the National Research Council (NRC) and other federal departments, providing technical support and advice. In March 1985 it concluded field trials of new office systems technology, conducted with the help of four other departments: National Defence, Environment Canada, Revenue Canada, and Energy, Mines and Resources (EMR).

National Defence now manages Canada's participation in SARSAT. But the Department of Communications still provides technical expertise for this life-saving program, while carrying on important defence research.

Satellites have given an enormous boost to Environment Canada's weather and climate service, providing data for more useful and reliable forecasts. With technical assistance from the Department of Communications, they have also enabled Environment Canada to carry out its Canada Land Inventory — used in the management of wildlife, forests and other resources.

The Department of Communications gives technical support to EMR's Canada Centre for Remote Sensing, which also uses satellites to carry out resource surveys. Engineers at the Communications Research Centre are responsible for designing and testing EMR's Radarsat, to be launched in 1990.

Meanwhile, the Department of Communications helps other departments and agencies by providing them with better communications. One example is the mobile terminal used by Fisheries and Oceans aboard its inspection vessels. Similarly, the Canadian Coast Guard will benefit from improved communications made possible by high frequency radio research in the arctic.

Field trials of office systems technology

Working with the private sector

Department of Communications' researchers work with other experts, inside and outside government, in solving common problems. In this survey we have noted just a few examples of their close co-operation with private industry. Besides assisting individual companies, they work with such organizations as the Canadian Association of Broadcasters, the Canadian Association of Broadcast Consultants and the Canadian Electrical Association. Meanwhile they share their expertise with researchers in universities and various provincial agencies.

Recent tests aboard two Atlantic Ocean oil rigs involved the Department of Communications, three oil companies, the Newfoundland Telephone Company and the medical faculty of Memorial University. They demonstrated the value of two low-cost satellite communication terminals aboard the rigs, one of which was used to provide telemedicine.

The department shares the fruits of its research under a number of programs designed to assist private industry. Thus it promotes new enterprises and creates new jobs, while helping to raise our living standards.

Neddrill, Petrocan drill ship, sets out on offshore exploration for oil and gas, carrying telephony terminal for Memorial University telemedicine project

A new, low cost 14/12 GHz stabilized satellite earth terminal (shown here bottom right) on board Sedco 706 oil rig operating off Newfoundland

Opening new doors

The communications revolution is far from over. There are still new doors to be unlocked by continuing research, and the Department of Communications' scientists and engineers are determined to open them.

Many new opportunities await them in space, where they hope to conduct experiments aboard the proposed U.S. space platform. Meanwhile, they are looking for new and improved applications of existing satellite technology. The launching of a proposed direct broadcast satellite would considerably broaden the possibilities of this technology.

Other challenges await them on the ground. An important frontier is the development of new and improved communication devices for the handicapped — for the blind, the deaf, the palsied, the paralyzed and those with other disabilities.

New developments in optical communications, high frequency and ultra high frequency radio will further transform our lives — as also will the growing popularity of home computers. And the behavioural sciences will play a large role in perfecting this technology and helping us to live with it.

MSAT model