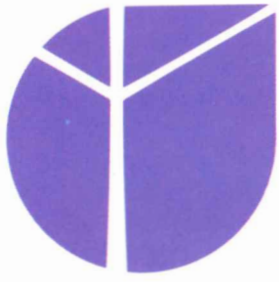
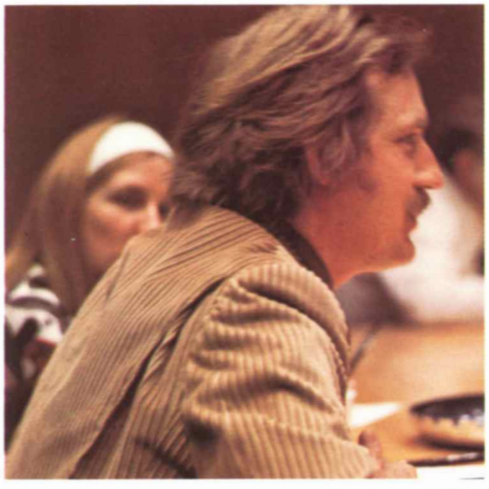
Bell-Northern Research Capability

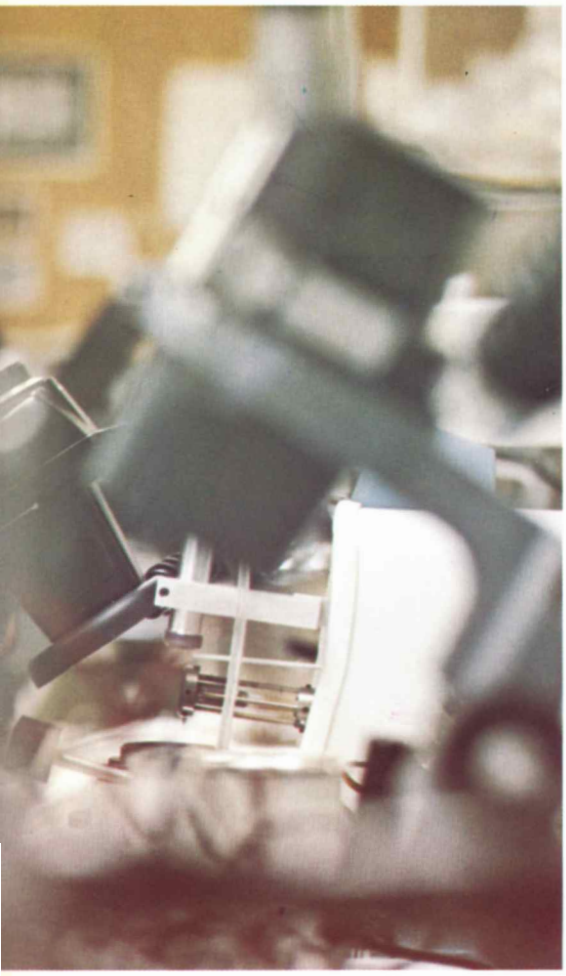


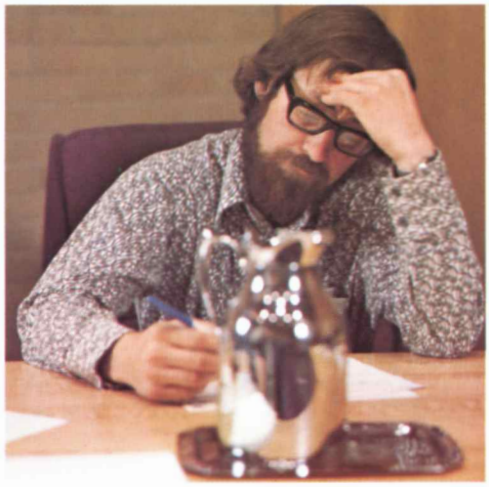
Areas of expertise

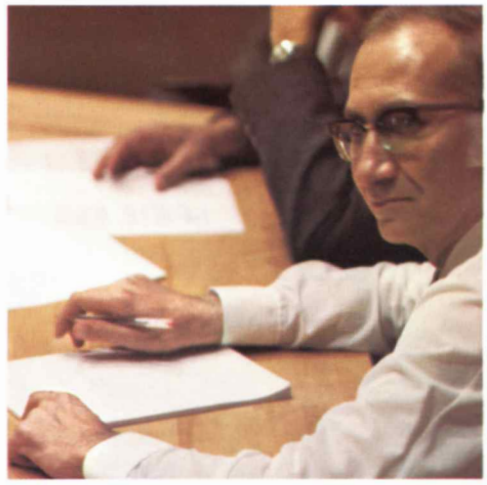


Having operated as a communications and systems engineering group since the turn of the century, and as the Northern Electric Laboratories since 1958, Bell-Northern Research became a corporation in its own right on 1 January 1971: a long tradition of manufacturable designs. Owned by Bell Canada and Northern Electric Company Limited, it has carried out research, design, development, long range planning and systems engineering during the intervening years. It is attacking the problems of today and tomorrow on a broad front and is actively engaged in virtually all areas of technology related to communications and allied fields at several locations.

In the Bell-Northern Research range of activities, special emphasis is placed on such areas as: memory technology, optical communications, computer technology, communications transmission, switching technology, mechanical systems and systems engineering. Recent achievements in these fields include technological advances and products such as: an electronic private automatic branch exchange featuring a time-division multiplex switching system network using pulse amplitude modulation; a medium-size stored program controlled electronic switching system; the first permanently-charged capacitive microphone based on the electret principle; high efficiency light-emitting diode indicator lamps and a whole range of silicon integrated circuits for logic and memory applications.





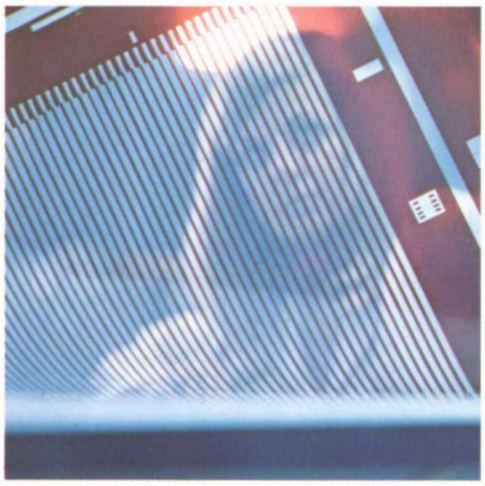


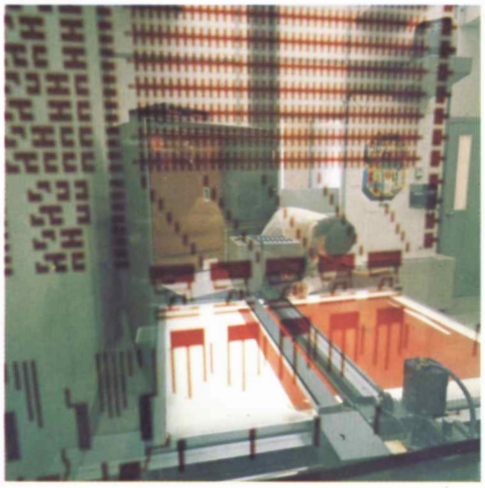
The scientific staff embraces a wide range of disciplines, including electrical, civil and mechanical engineering, physics, chemistry, psychology, metallurgy and mathematics. Many of its scientists are internationally recognized in their fields. Among the company's 1800 employees, 700 hold degrees (65 Doctors, 235 Masters, 400 Bachelors) and 400 are graduates of schools of technology. The balance are skilled support and administration people. To ensure the confidentiality of clients' projects, our security department program includes government clearance of the participating employees.

These resources are now available to carry out advanced research and development for industry and government. Briefly described in the following pages are areas of special expertise of interest to potential users of Bell-Northern Research services:

- semiconductor memories
- optical communications
- advanced digital transmission
- switching development
- communications systems engineering
- transmission media analysis and development
- computer system technology
- Support activities also are briefly described in the final section of this booklet.

Semiconductor memories





A Bell-Northern Research team has made significant progress in the development of charge coupled devices (CCD's) as semiconductor memories. There are many other possible applications, such as a less expensive solid state imaging replacement for existing TV cameras, or filters to improve radar signals.

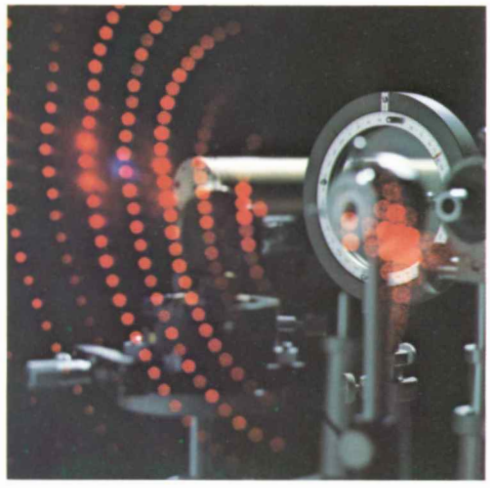
Charge coupled devices operate by transferring increments of charge, representing information, along the surface of a silicon substrate. The main thrust of the present work on CCD's is toward a serial memory system which will be substantially smaller and far faster than current fixed head disks.

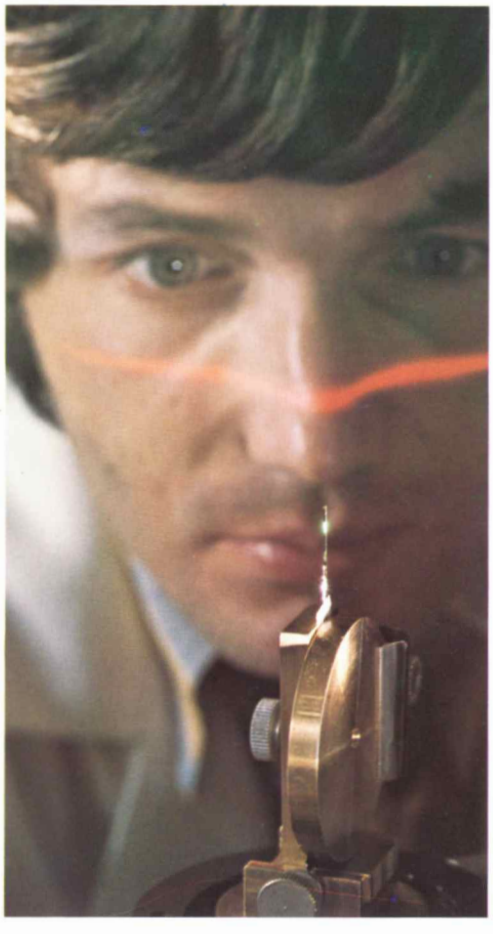
The team has already developed a CCD process that:

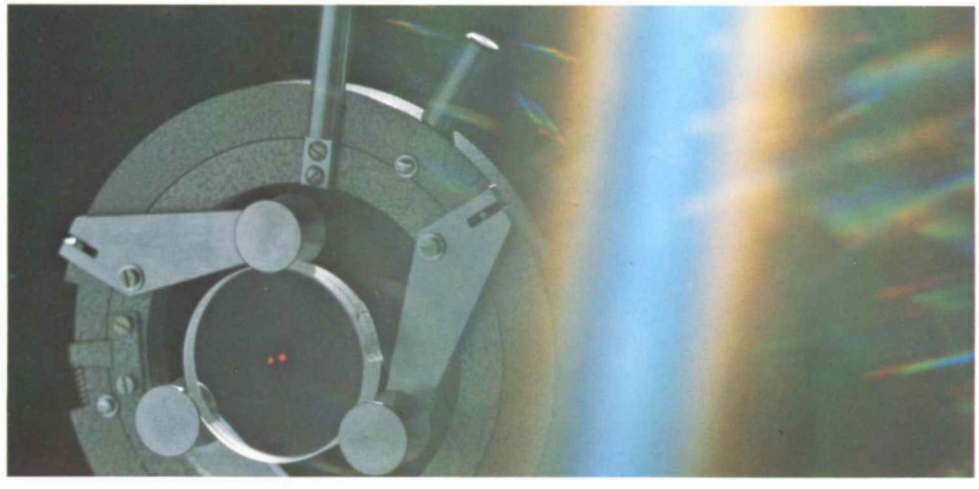
- is compatible with present well established silicon gate process technology and requires minimum deviation from current production techniques
- permits standard metal oxide silicon (MOS) logic on the same chip for refresh and other control circuitry
- uses the Hydrogen Chloride (HCl) passivation method, an effective and well established technique developed at Bell-Northern Research and now widely used by several of the largest semiconductor manufacturers.

Based on this stable process and extensive related circuit design work, developments in the areas of large scale memories, analog filters and large scale imaging devices look very promising. The capabilities developed for Bell-Northern Research are being made available to serve other organizations.

Optical communications







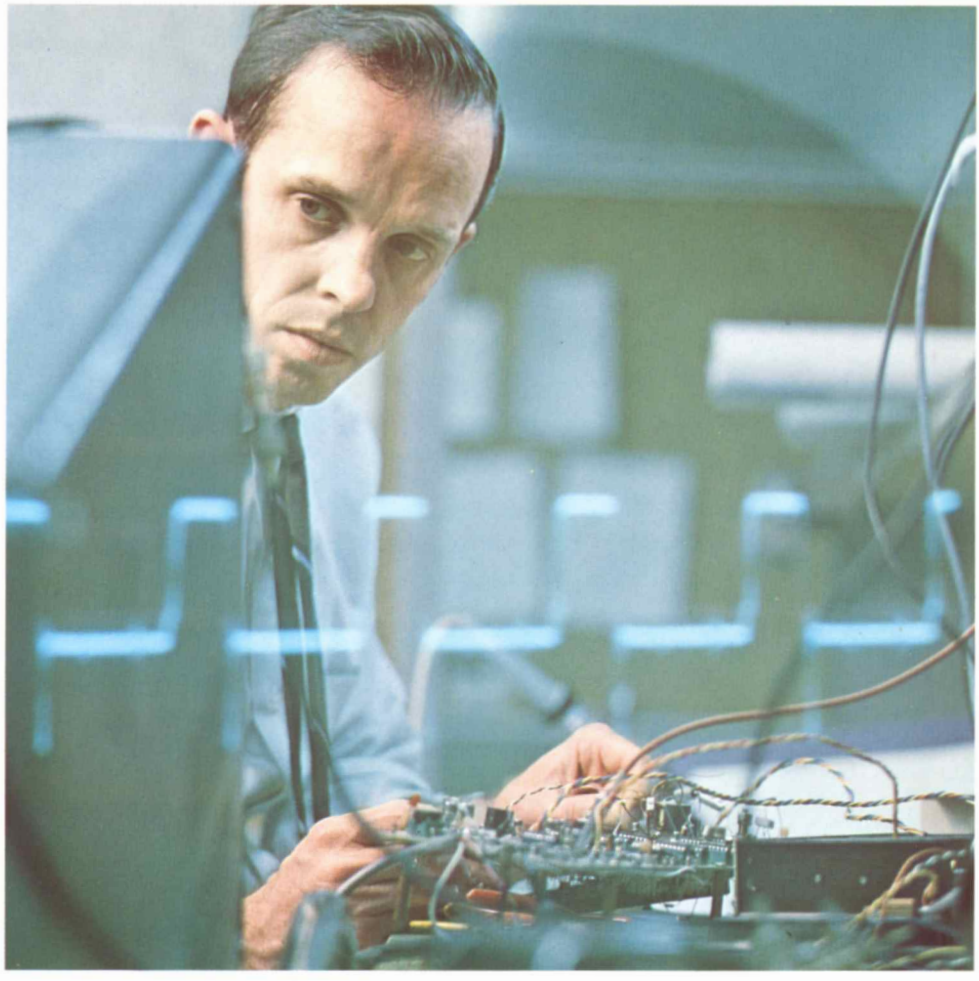
Initially sparked by a growing need in the telecommunications industry for high bandwidth communication links, the continuing research and development program on optical fibre communication systems at Bell-Northern Research has been encouraged by the increasingly apparent possibilities of such systems. Characteristics include lower cost, improved reliability, reduced size and weight, and higher quality communications.

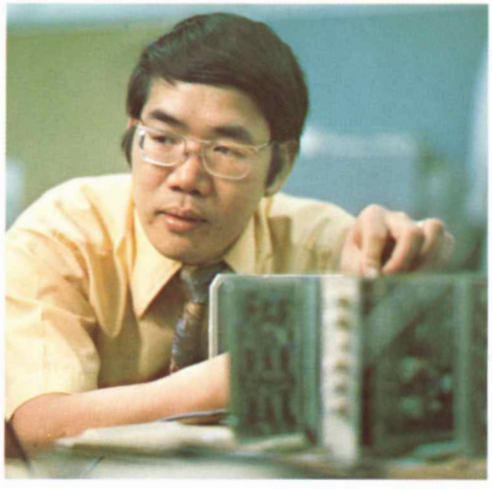
Basically, the program is aimed at providing digital and wideband communications systems whereby high density information can be sent down fine glass fibres, either as streams of light pulses or as analog signals. Work on this project involves the structure and design of solid state laser light sources and their packaging technology. The group is developing thin film optical waveguides to better couple light sources into glass fibres and glass fibre cables which carry the light pulses, silicon photo detectors to change the light back to electrical signals, and repeaters for use in long-link optical fiber transmission systems.

Light emitting diodes developed by this group are already in daily use as indicator lamps in various types of information displays. They incorporate the advantages of a relatively large emitting surface, very low power demand, and great reliability — rigorous life testing has shown that individual lamps will last well over 100 years.

There are many potential applications for optical communications technology, such as in aircraft and ship communications systems, where the vastly reduced weight and size are of paramount importance. A glass fibre carrying light pulses creates no magnetic field, so such systems are particularly attractive in military applications where anti-detection is an important feature. The range of possible applications seems to be as wide as the communications field itself.

Advanced digital transmission



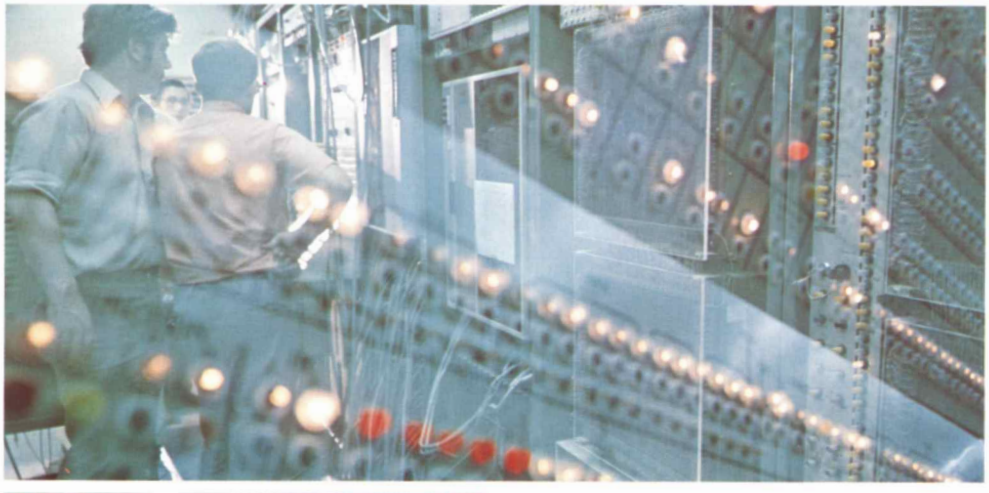


Bell-Northern Research has long been committed to digital communications. This includes the broad fields of digital signal transmission and digital switching systems. Current activity in the area of transmission includes both digital radio and cable systems development.

Activity in digital radio dates back to the mid-1960's with the development of a baseband modem for a low capacity communications satellite experiment. Subsequent programs include a digital radio repeater design and a two-year study, supported by the Canadian Government, on special effects relating to satellite repeaters. An experimental microwave system is presently in development using information from our recently completed study on path fading effects. The digital radio program is backed by design experience in hardware development and a proven history in analog microwave radio systems.

A recent program in digital transmission was the LD-4 long-haul system where a total system approach involved the design and development of all system components, including the outside plant and test apparatus as well as the electronics. This ultra-high-speed system carries communications traffic in digital form, by a technique known as pulse-code modulation, over a special high capacity buried coaxial cable. Designed to operate at a rate of 274 megabits per second, it provides a nominal capacity of more than 20,000 two-way voice equivalent circuits on the 12-tube coaxial cable for route distances extending to 4000 miles.

Switching development



Bell-Northern Research has designed communications switching machines for a wide range of sizes, passbands and features. Control techniques range from electromechanical to wired logic electronic to fully stored program control. Similarly, switching matrices have run the gamut from electromechanical to space division electronic to time division pulse amplitude modulation (PAM).

The depth of our commitment extends to the updating of earlier designs, the active commissioning of current designs and the exploration of switching in digital modes. This is a very broad field including high speed TTL, various MOS logic technologies, and mechanical crossbar.

Our current project in the fully stored program controlled field is the SP-1 family development. This communications switcher is now operational as a two-wire, class five end office in the North American network. Centrex, four wire, combined two wire/four wire and traffic operator position system versions are being developed to meet delivery commitments.

Contracts of interest to us run from short report activities to full developments to meet agreed field service dates.

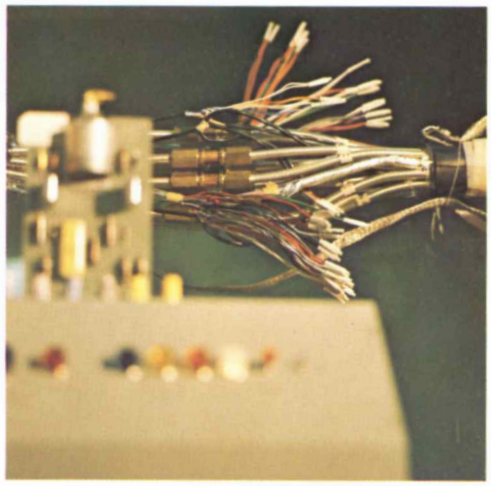
Communications systems engineering

Much of the long range planning at Bell-Northern Research is done by a staff of 130 professionals in the systems engineering group. This group, through its close contact with people engaged in exploratory research, is kept informed on new technological capabilities being developed inside and outside the organization. Continuous dialogue is also maintained with clients and manufacturing companies to ensure a full understanding of their needs and to recommend practical and timely solutions.

The long range planning function, in conjunction with basic research, helps reduce uncertainty to a minimum, thereby improving the chances of success for any project. Factors which must always be considered in planning a program are: objectives, need for the product or service, market potential, state of the art, competition, resources, technical feasibility, economic feasibility and timing. In short, long range planning is the art of deciding what is the right thing to do now in order to meet future requirements.

Systems engineering expertise includes: satellite communications systems, digital and analog radio systems, digital line systems, digital switching systems, digital terminals, outside plant, and data transmission including multiplexing and network synchronization, to name a few. These capabilities, proved at Bell-Northern Research, are now available to other organizations.

Transmission media analysis and development



In Bell-Northern Research there exists a multidisciplinary group which has extensive experience in the analysis of system requirements, proposed product definition, conceptual modeling and the full development of products, with emphasis on the following areas:

Electrical protection — We have made the most comprehensive survey in the world on the nature of lightning interference on communication systems and the effectiveness of various techniques and devices to protect the system and users. Related experience includes the development of fuses, air gap and semiconductor devices to provide appropriate levels of protection.

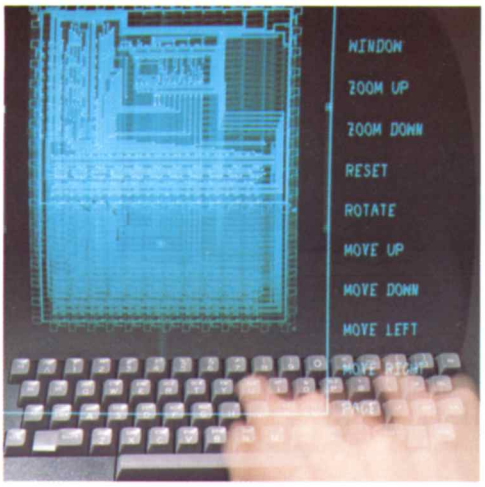
Wire joining and connector design — We are active in the development of highly efficient wire and coaxial cable joining techniques. This involves the development of tools and associated hardware to withstand buried and extreme outdoor environments. By applying human engineering and a knowledge of construction methods, we enable customers to meet system reliability objectives with a minimum of installation skill and time.

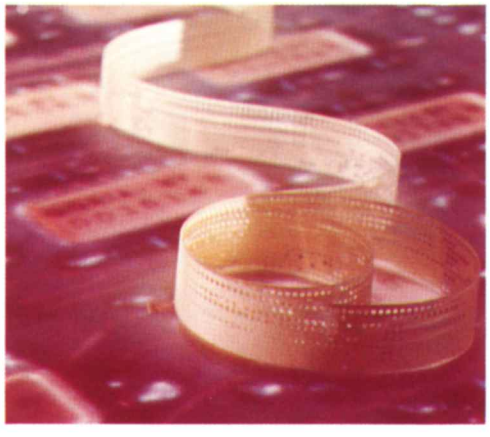
Human engineering — Our development of electric and hydraulic powered prosthetic arm systems has won international recognition. These arms enabled rehabilitation institutes to produce individually customized prostheses. The human engineering and knowledge gained in this program have been applied successfully to the design of methods and tools better suited to the performance of precise tasks under severe conditions.

Mechanical design and electronic packaging — A major capability exists with experience ranging from encapsulation of microcircuits to the development of re-enterable enclosures designed to withstand corrosion, stray current environments and frost action found in manholes and buried cross-country routes. Sub-systems, which monitor gas pressure, have been developed to give advance warning of defects that may cause a service failure.

Construction technology — A special activity is underway to promote the removal of all above-ground utilities to improve the appearance of cities and highways and increase the reliability of service. This program has fostered the development of a novel buried peg locator which may be used to locate installations, survey markers, etc. Improvements have been made to cable plows and new methods are being developed to safeguard services from tampering or premature failure.

Computer system technology



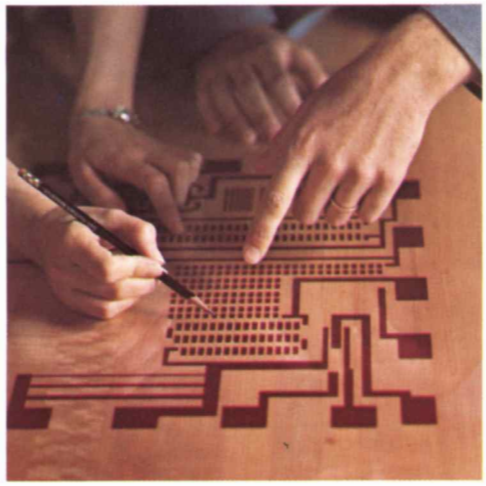


In the area of computer communications, our development team has amassed the kind of system knowledge that is consistent with being masters of one of Canada's largest industrial time shared computer networks. The team has successfully adapted and redesigned software and hardware from a wide variety of manufacturers.

The Computer System Technology team includes highly experienced software experts who are not only capable of developing the most complex and sophisticated computer operating systems but are also creating new programming languages. For example, GRAPPLE (Graphics Application Programming Language) was developed at Bell-Northern Research to make graphical programming techniques easier. It allows people who are not programmers by profession to use a computer directly. Typically, GRAPPLE enables a circuit designer or planner, after a few hours' instruction, to program the requirements of his own project in graphical terms, whether it is electrical circuit design, cartography or office layout.

The company, having designed a stored program controlled electronic switching system, is, quite understandably, fully experienced in software development for such systems. The competence of the staff in this, as in other areas, is such that it welcomes the challenge of new systems and new features, ours or yours.

Support activities



Reliability
Bell-Northern Research has a full capability to deal with all aspects of reliability and standards engineering, and documentation for communications systems, products and devices.

The reliability engineering group supports all development programs within the organization and is prepared to act independently, either as a consultant or directly for you.

This group has the proven capability to manage and implement programs ranging from reliability assessments to full scale activities. These can include systems evaluation and simulations, parts and materials programs, analysis and testing, maintainability and logistics studies. These activities are all supported by a data centre which can gather and process information involved in such problems as the introduction studies for new products. Support facilities exist for the establishment of standards and specifications as well as the generation of manuals, procedures and drawings.

It also has access to an extensive list of specialized test equipment in addition to the company's own facilities. This group is prepared to work to any commercial or military specifications and, where necessary or desired, will create standards and specifications.

The reliability physics department identifies and explains the fundamental phenomena which affect the reliability of microelectronic components. The results of these investigations are used to develop highly reliable circuits and devices in the company's own semiconductor, thick film and thin film pilot lines. At the earliest possible stage, reliability and failure analyses are performed on the devices and circuits to ensure the integrity of sophisticated electronic systems.

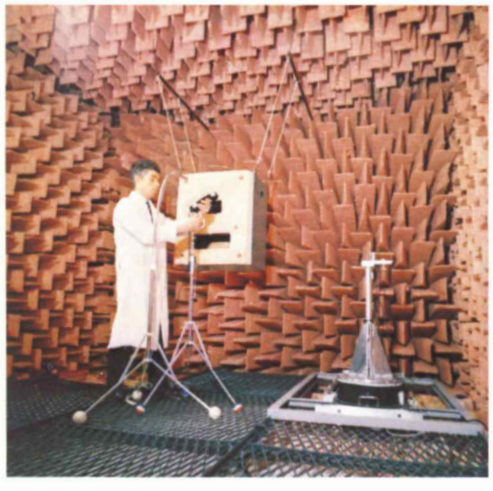
The most prominent tool used in this work is the scanning electron microscope. Integrated circuits, for example, can be examined using magnifications up to 50,000 times to reveal topographical features and the presence of voltage and current. The instrument also detects and displays light emitted by material and electron interactions. Material analysis is performed by energy dispersive X-ray spectrometry, electronic circuit testing, transmission electron microscopy and Auger spectroscopy. X-ray topography as well as environmental and electrical testing are other techniques used within the group to determine the performance of materials and devices.

Hybrid technology
The hybrid technology group uses the pilot line approach to demonstrate the feasibility of the packaging methods conceived by their engineers.

Hybrid technology is a technique of packaging miniature integrated circuits and discrete components on thick or thin film substrates. The program provides prototype circuits in the areas of film circuitry, microcircuit assembly and interconnection.

Accomplishments of this group include a method to beam-lead bond silicon chip arrays, having beams on both top and bottom of the chips, with all beams bonded in one pass although they are separated vertically by eight thousandths of an inch; a plating process for generating microstrip circuits with a metallization thickness of 10 microns and vertical walls; stable tantalum nitride resistors for gyrator circuit applications; and high density circuits produced by intermixing thick and thin film processes on a common substrate.

Facilities and equipment



Bell-Northern Research has approximately $25 million invested in facilities and equipment, at several locations. The central laboratory near Ottawa acts as the administrative centre and conducts work on switching development, systems engineering, research on materials and processes, and apparatus development. Of the other locations, the Kanata Laboratories, also near Ottawa, are mainly concerned with transmission development and reliability and Bramalea, near Toronto, with electromechanical switching systems.

Included in the extensive electronic instrumentation and equipment (over $6 million worth) are:

- scanning and standard electron microscopes,
- one of Canada's finest anechoic chambers,
- IBM 370/145 and 360/67 computers,
- a computerized integrated circuit mask making co-ordinatograph,
- thick and thin film pilot production lines,
- an integrated circuit pilot production line,
- automatic integrated circuit testing facilities,
- a custom quartz and glassware fabrication laboratory,
- digitizers for automated production of printed circuits and schematics,
- high intensity X-ray generators,
- spectrometers,
- environmental testing laboratories,
- two model fabrication shops with numerically-controlled equipment and a scientific standards and calibration laboratory.

Bell-Northern Research has Canada's largest industrial library, with over 26,000 publications on file. Some 450 periodicals, in 40 languages, are received on a regular basis.

Bell-Northern Research, with its full research and development facilities, is prepared to undertake both small and large projects for industry and government. If your requirements relate to any of our capabilities, and you require further information, please contact:

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