



Communications
Research Centre
Canada

An Agency of
Industry Canada

Centre de recherches
sur les communications
Canada

Un organisme
d'Industrie Canada

HIGHLIGHTS

1998-1999

Canada

CRC

Partnerships

The [National Research Council of Canada](#) (NRC) and the Communications Research Centre (CRC) signed an agreement to enhance collaboration in microelectronics, optoelectronics and semiconductor processing, network applications and commercialisation processes. The agreement provides a framework to maximize complementary capabilities and promote the early adoption and commercialisation of technologies.

Collaboration with NRC's Institute for Microstructural Science (IMS) will highlight semiconductor materials and process technologies for modern telecommunications devices, photonics, thin-film technologies and photonic and optoelectronic devices.

NRC's Institute for Information Technology (IIT) will be collaborating with CRC in artificial intelligence, advanced search engines and seamless personal information networking. CRC will provide expertise on asynchronous transfer mode (ATM) networking, audio and video compression techniques, and access to various transmission test facilities.

CRC signed a Memorandum of Understanding (MOU) with the [Canadian Science and Technology Growth Fund](#) which opens a door to the use of private venture capital funds for the commercialisation of high technology laboratory developments.

An MOU was signed with [LGS Group](#), a Canadian company undertaking collaborative work with General Motors of Canada in support of defence projects.

In supporting Industry Canada, CRC embarked on the [Canada/India Telecommunication Framework](#) project supported by the Canadian International Development Agency (CIDA). CRC and its Indian counterpart, Centre for Development of Telematics (C-DOT), will collaborate on R & D of communications technology. This will create opportunities to commercialize technologies in both Canada and India.

A \$1.25 M agreement signed with [Harris Canada](#) establishes a framework for collaboration on broadband wireless access products with the Montreal division, and on third-generation cellular/PCS fixed wireless local loop work with the Calgary division.

CRC signed research contracts and agreements with various Canadian and foreign companies such as CDTV, Newbridge, NAB in the USA and ETRI in Korea to carry out research and field tests in digital broadband and broadcast transmission systems.

A four-year collaborative program on mobile radio propagation research was initiated with the [Universities of Eindhoven and Delft](#) and included a contract to deliver a CRC-designed and -built channel sounder. Dr. Robert Bultitude spent a year in the Netherlands under the first project agreement.

CRC and the [Defence Research Establishment Ottawa](#) (DREO), signed a specific MOU in April 1998 for joint research activities on military communications. The MOU provides \$2.7 million annually for cost recovery of CRC salaries. It is an annex to an umbrella cooperative R&D agreement signed in October 1997 by Industry Canada and the Department of National Defence.

Awards

CRC and Innovative Fibers Inc. received a Federal Partners in Technology Transfer ([FPTT](#)) Award for the transfer and commercialisation of technology related to Fibre Bragg Gratings.

CRC received an award for international cooperation from The Technical Cooperation Program ([TTCP](#)), which sponsors collaborative research between Australia, Canada, New Zealand, the UK and US. CRC contributed to the development and implementation of a broadband testbed within the framework of ACCORD (Advanced Command and Control R&D).

Dr. Robert Bultitude won the IEEE Vehicular Technology Society [Neal Shephard Memorial Award](#) for the best propagation-related research paper published during 1997.

R&D Activities

- CRC is collaborating with Contact North and TecNorth in the submission of a proposal to the Ontario Government to conduct a field trial of the MILTON (Microwave-Light Organized Network) technology in Northern Ontario. MILTON will provide the last mile wireless solution to bring high speed multimedia internet to the home using directional, high capacity point to multi-point technologies developed at CRC. In a collaborative project with OCRI, a wireless link (presently at 8 Mb/s) has been set up to connect the Glebe High School to the Media Centre in Ottawa as part of Industry Canada's SchoolNet program.
- CRC has expanded the distributed broadband terrestrial wireless testbed announced by Minister Manley in the fall of 1997. Special resources have been allocated to expand the testbed to support the testing of

complete wireless systems as well as modular subsystems in a plug-and-play fashion. The testbed has been made available to Industry Canada for studying various technology options before policies, standards, and regulations are developed, and to the Canadian radio industry for testing products before introducing them to the market.

- CRC has upgraded the wafer prober facility in the MMIC laboratory. This prober accommodates wafers up to 8 in. diameter and allows measurements to be conducted over a temperature range from -65C to +200C. The facility is a key component in the development of a virtual microwave test laboratory that will allow researchers, involved in integrated circuit technologies across the country, to be linked together by CANARIE through cooperation between CRC, CMC and OCRI.
- In a collaborative project with CresTech, DND, US DoD and NASA, CRC led the radio-based measurement campaign to assess the potential hazards of the November 1998 Leonids meteor storm on spacecraft. The multi-frequency multi-antenna array developed by a CRC scientist for the measurements produced valuable results.
- Research on noise cancellation for Search and Rescue operations has led to a field trial at 8 Wing Trenton involving all SAR HF radios. Plans are being formulated for outfitting other SAR installations. Two licence agreements, one for the 2.4 kbps vocoder and another for the helium speech descrambler, have also been signed.
- CRC's advances in high-data-rate HF communications are gaining world-wide exposure and recognition. Defence agencies in Australia, the US and the UK have asked CRC to provide them with modem prototypes for evaluation and for use in international communications trials. HF modem manufacturers are planning to introduce products based on the high-data-rate HF modem standard developed by CRC.
- In 1999 CRC turbo coding products were made available to PC owners and other clients by means of the Internet. The new website at <http://www.crc.ca/fec> describes the ultra fast forward error-correction (FEC) products and allows buyers to order the software on a CD (produced in house) direct from CRC.
- CRC chaired the Video Quality Expert Group (VQEG), a joint ITU-R/ITU-T ad-hoc group which is evaluating and standardizing objective measures of subjective picture quality.
- CRC performed original studies of coding techniques for the efficient transmission and storage of stereoscopic or 3D video. These included bit allocation and spatio-temporal resolution trade-offs, psycho-visual studies related to depth perception with different display sizes and visibility of various coding artifacts.
- CRC developed a unique object-based image sequence interpolation algorithm for applications to video format conversion, video compression and 3D-TV. A patent application is under way.
- CRC's expertise in Digital Television transmission as developed over the years was sought from: Korea, Taiwan, China, USA, Brazil, Australia, and the UK. In particular, CRC's work on the comparison of the two modulation schemes proposed, ATSC 8-VSB and DVB COFDM, attracted a lot of attention as many countries are now making a choice or looking for support for their position. CRC also completed two contracts on DTV for ETRI in Korea and for the Telecommunication Laboratories in Taiwan.
- CRC experimentation with the distributed emission system concept at L-band has resulted in the installation of a third transmitter, extensive field testing and preparation of ITU-R contributions.
- CRC Multimedia mobile datacasting studies started in 1997 have resulted in the development and public demonstration of an experimental interactive system. Successful demonstrations at wireless, broadcast and Intelligent Transportation Systems conferences caught the interest of equipment developers, potential users, such as provincial and regional police forces, and the broadcasting and wireless communities. This concept brings several new aspects including interactivity of a traditionally unidirectional service; data services added to a traditional voice/music services; and convergence with services that are now isolated: wireless telecom, internet, GPS, ITS, broadcasting.
- A new advanced coverage simulation and prediction software framework will serve as the foundation of a platform-independent software for digital broadcasting and military communication systems.
- CRC's coverage prediction software which also serves as a research tool for CRC is in demand by those who must plan such new services as DAB, DTV, MMDS and PCS. DND has asked CRC to develop a military version of the CRC-COV software. Northwood Geoscience sold approximately 140 copies of a software product that uses CRC Predict as the main propagation prediction engine.

- ▶ CRC has developed advanced demodulation techniques for COFDM. These techniques allow the use of Mode IV at L-band with the Eureka 147 DAB system being used in Canada for Digital Radio Broadcasting. Mode IV allows Canadian broadcasters to provide coverage with fewer on-channel transmitters. The use of multiple low power transmitters is more spectrum-efficient. A first method based on multiple symbol differential detection has been developed and shown, through computer simulations, to accommodate vehicle speeds up to 120 km/h.
- ▶ Subjective evaluation of five state-of-the-art audio codecs revealed that one recently standardized codec, namely the MPEG-2 AAC, can provide the same audio quality as the Dolby AC-3 used in ATV and MPEG-1 Layer 2 used in DRB, at a fraction of the bit rate. MPEG-2 AAC is therefore making more efficient use of the spectrum.
- ▶ CRC jointly developed with six other research laboratories a methodology to measure objectively and automatically the subjective quality of audio signals. The method has been standardized by the ITU-R and is being marketed and licenced by CRC. The technology can be crucial in monitoring the quality of audio signals transmitted over networks or broadcast over the air.
- ▶ CRC undertook subjective assessment of the speech intelligibility of Voice Communications Systems for DND using the Modified Rhyme Test (MRT).
- ▶ A novel subjective CRC-developed test method to assess the effect of delay in packet-based military voice communications systems was proposed as a standard to a NATO committee.
- ▶ CRC developed a new statistics-based methodology to help improve standards for the design and operation of electronic equipment in harsh electromagnetic environments.
- ▶ CRC completed for the first time, three-component, near-field measurements around simulated cellular radio configurations; the results will aid the establishment of immunity limits.
- ▶ CRC developed a 20-30 GHz, dual frequency, Cassegrain reflectarray antenna (a world's first for millimeter wave) for a portable satellite communications terminal and successfully demonstrated it to the United States military.
- ▶ CRC developed a first-of-its-kind, scanning dielectric resonator antenna for National Defence and patented the technology.
- ▶ CRC developed a low-cost, low elevation-angle coverage antenna for L-band mobile applications for Skywave Mobile. This design allowed the firm to secure new terminal contracts.
- ▶ A collaborative research project with Spectrum Engineering Branch will develop a second-generation Digital Analysis System for the Integrated Spectrum Observation Centre.
- ▶ CRC developed a wideband direction finding, capable of determining the direction-of-arrival of thousands of radio transmissions per second, on the Digital Analysis System (DAS) for spectrum monitoring. This technology is of great interest to DND as well as to civilian clients.
- ▶ The Remote Communities Services Telecentre Project is now in full operation providing a variety of enhanced services via satellite to remote communities in Newfoundland and Labrador in collaboration with Telesat and several Newfoundland-based SMEs.
- ▶ Methodology to analyze non-GSO system interference was developed under the sponsorship of Industry Canada. This methodology has been accepted as a draft new ITU recommendation.
- ▶ Nortel Networks won the ground segment (gateway and terminals) contract for the Ka-band SES Astra Return Channel System (ARCS), in no small way because of the work they have done and are doing under the Advanced Satellite Communications Program. Consequently, the Advanced Satcom Program is aligning the ground terminals, gateway and test and demonstration network being developed under contracts with Nortel and Telesat to the ARCS system.
- ▶ The proof-of-concept multi-rate multimedia satellite receiver, including a novel I&Q regeneration technique and 5-port direct receiver technology, was completed and is receiving significant interest from Canadian industry.
- ▶ CRC won a design contract for a generic turbo-codec software for satellite services. International Maritime Satellite Organization (Inmarsat) requires the codec software for low and medium data rate services, to improve the power efficiency of its data transmissions.

Events

The VirtualClassroom is a collaboration under the G7 Global Interoperability for Broadband Networks (GIBN) initiative, providing students, researchers and teachers with opportunities for international partnerships using multi-media broadband tools to communicate and learn globally.

Students from three Ottawa area high schools met with students and APEC ministers from Singapore. The virtual event was held during the Third APEC Ministerial Conference on Telecommunications and Information Industry. Students on both sides prepared presentations exploring the topic "Globalization and its Impact on Culture". In another demonstration students in Canada were linked with students in Switzerland and Austria at the Information Society Technologies (IST) Conference in Vienna.

CRC hosted the URSI Commission F conference on climatic parameters in propagation prediction and meetings of two ITU-R Working Parties on radiowave propagation were hosted.

CRC participated in a Tele-health Link with Red Lake, Ontario at which the University of Ottawa Heart Institute demonstrated medical imagery and diagnostics.

CRC Innovation Centre

CRC supports Industry Canada's commitment to assist small and medium-sized enterprises to help make a stronger economy. CRC's Innovation Centre offers special opportunities to start-up companies interested in accessing its technologies, R&D expertise and unique facilities and testbeds. Automatic membership in CATA and OCRI are offered. The following were clients in 1998-99:

- Adaptive Antenna Technologies
- Callisto Media Systems
- Gandec Systems Ltd.
- InfoMagnetics Technologies Corp.
- MeetingSoft Inc.
- Square Peg Communications Inc.
- Trican Multimedia Solutions Inc.
- WIC Connexus Ltd.
- Skywave Mobile Communications Inc.

Construction of a new building at the front of CRC's campus began in spring '99. It will house Industry Canada's Certification and Engineering Bureau. In the near future it will also house the National Capital Institute of Telecommunications headquarters on a temporary basis pending construction of a second phase. The building was intended to provide expanded Innovation Centre office space but this use will be delivered at a later date

Contracting-In and Revenue Generation

Each year CRC engages in a number of contracts and collaborative agreements to provide research services to a wider variety of clients. There were 80 new contracting-in agreements (contracts and purchase orders), 120 new IP agreements (licences, non-disclosures, MOAs, MOUs), and 18 new patent applications and five patents issued.

The IP Portfolio consists of 208 active patents covering 92 inventions. CRC inventors were awarded \$312,000, on 25% of the revenues received for their licences. The inventor award proportion was increased from 15% to 25% this year.

There were 330 active IP agreements this year. Twenty-six technologies brought in IP revenue. IP revenue earned in a given fiscal year is received the following year. Of the \$.93 million IP revenue generated in 1998-99, CRC will receive \$500,000 from licence fees and \$430,000 from royalties next year. Some examples:

- The joint CRC/UTC patents for Fibre Grating Technologies alone generated \$375,000.
- CRC-COV software: \$152,000
- CRC Predict software: \$60,000
- Tap and Combiner: \$46,000
- High Speed Data Rate Modem: \$94,000
- Optical Coupler: \$40,000, and
- Turbo Codec Software: \$6,000

I N F O R M A T I O N

Communications Research Centre

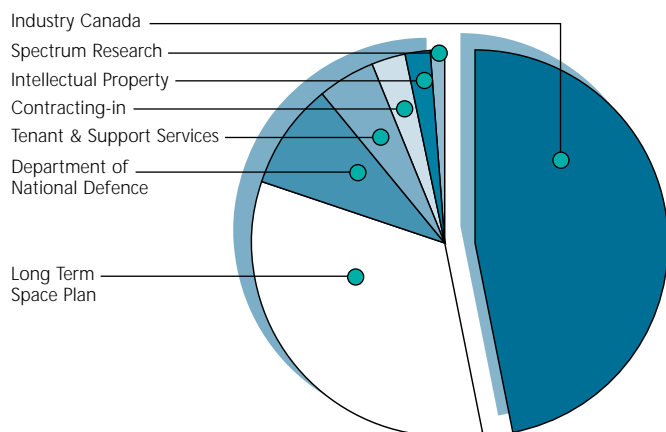
P. O. Box 11490, Station H
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General Inquiries: (613) 991-3313

Web Site: <http://www.crc.ca>

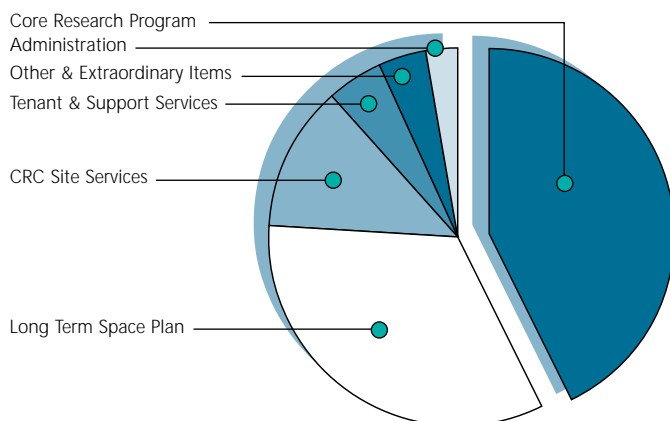
FINANCIAL REPORT

FOR THE FISCAL YEAR 1998 - 99



Revenues (\$000s)

Industry Canada	\$29,099.2
Long Term Space Plan	20,673.0
Department of National Defence	5,527.2
Spectrum Research	750.0
Contracting-In	1,767.7
Intellectual Property	1,296.9
Tenant & Support Services	2,981.9
<i>Total:</i>	<i>\$62,095.9</i>



Expenses (\$000s)

Core Research Program	
Broadcast Technology	\$3,639.2
Broadband Networks	6,000.4
Radio Science	3,586.3
Satellite Communications	4,489.0
Terrestrial Wireless Systems	5,108.6
Research Support	3,671.7
<i>Sub-Total Research Program</i>	<i>26,495.2</i>
Long Term Space Plan	20,673.0
<i>Total Research Program</i>	<i>47,168.2</i>
CRC Site Services	7,717.0
Tenant & Support Services	2,981.9
Administration	1,685.2
Other & Extraordinary Items	2,543.6
<i>Total:</i>	<i>\$62,095.9</i>

T H E B O A R D *

Alan Winter
(Chairman of the CRC Board)
President
Space Group
COM DEV

Michael Binder
Assistant Deputy Minister
Spectrum, Information Technologies
and Telecommunications Sector
Industry Canada

Andrew K. Bjerring
President & CEO
Canarie Inc.

L.J. (Larry) Boisvert
President & CEO
Telesat Canada

Dorothy Byrne
Vice-President
Legal and Corporate Affairs
BC Telecom

Arthur Carty
President
National Research Council Canada

Jocelyne Côté-O'Hara
Consultant

Gilles Delisle
Department of Electrical Engineering and
Computer Sciences
Université Laval

William A. Dunbar
President & CEO
WIC Connexus

W.M.(Mac) Evans
President
Canadian Space Agency

Cheryl M. Knebel, FCA
Chief Financial Officer
AltaSpec Telecom Corporation

Tom Hope
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Telecom Applications Research Alliance (TARA)

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Nortel

Bill Stanley
Chairman and Chief Executive Officer
Fundy Communications Inc.

André Tremblay
President and CEO
Microcell Telecom

Gerry Turcotte
President
Communications Research Centre

* A new Chairman of the CRC Board was appointed this year. Alan Winter who has served on the Board since its inception succeeds William Dunbar.