# Pioneering Technology at Shirleys Bay

## Improving Communications for Canadians

### Communications and Canada's Natural Surroundings

**1957**

Scientists and engineers from 66 nations mark the "International Geophysical Year" by making simultaneous studies of the Earth's magnetic field, ionosphere, weather, cosmic radiation, solar magnetic field and solar features.

**1959**

The Canadian Black Brant Rocket takes its first flight from Churchill, Manitoba. It is used to launch scientific instruments to explore the upper atmosphere.

**1970s**

DRDC works on the Seasat Remote Sensing Project, which is focused on providing data for ocean studies. Seasat produces the world's first full-resolution digital Synthetic Aperture Radar Images at Shirleys Bay.

**1971**

Defence scientists conduct large-scale ice movement experiments and collect wind data using anemometers on the ice floes of the Robeson Channel.

**1972**

U.S. launches Landsat 1, the first environment-monitoring satellite. A ground station in Prince Albert, Saskatchewan, receives the satellite's first transmitted image and the Canadian-made Quick-Look system allows the Canadians to display and use the images before the Americans.

**1975-1985**

CRC develops a Synthetic Aperture Receiving Array (SARA) to study propagation effects on the direction of arrival of a HF signal propagated over a long ionospheric path. The SARA is unique.

### Bringing Communications Home

**1954**

The innovative Janet System demonstrates the feasibility of communication via VHF signals reflected from meteor trails.

**1959-1960**

Canada conducts its first satellite communications experiment, using the moon as a reflector. Pioneering communications experiments use the first human-made satellite, the U.S. Echo 1, a giant reflective balloon. The radar station in Prince Albert, Saskachewan, is the ground station for both experiments.

**1970**

Feasibility of mobile communications for military use with U.S. satellites operating in the UHF band for land, sea and air vehicles is demonstrated. A world's first occurs on May 16, 1970, when air-to-air communications via satellite is achieved.

**1976**

Hermes, the Communications Technology Satellite, is launched. Built at Shirleys Bay, Hermes is the first high-power satellite and the first to operate at the higher frequency Ku-band. It is designed to last for two years, but remains operational for almost four – used extensively to demonstrate the use of high-power satellites for broadcasting, tele-education, tele-health and community communications.

**1978**

The world's first direct-to-home satellite television broadcast carries a Stanley Cup hockey game from Canada to the home of a Canadian diplomat in Lima, Peru, via the Hermes satellite.

**1978**

CRC gives its first public demonstration of Telidon, the Canadian videotex/teletext system that contributes to the development of international standards for the World Wide Web.


**1978**

Telesat launches Anik B, the first commercial satellite to operate in two frequency bands. Its purpose is to improve communications for Canadians living in remote areas and CRC uses it to further develop the applications of high-power satellites.

**1978-1986**

Studies on the effects of re-radiation from high-rise buildings and HV power lines on the directional pattern of medium frequency AM broadcast stations lead to the development of methods to minimize these effects. Subsequently, several case studies have validated these studies.

**1979-1984**

The technical feasibility of providing integrated telecommunications services to homes, including telephony, television and data communication service, over a broadband fibre optic distribution system is demonstrated by CRC and partners in Elie, Manitoba. These trials are a world first.

**1980**

The Synchronized Compressor and Expander System (Syncompex) is designed to improve noise and speech quality of HF radio. It is later added to the Radiotelephone with Automatic Channel Evaluation (RACE) System to improve its performance.



**1980-1999**

CRC alerts industry and government of the impending evolution of radio broadcasting and demonstrates a digital radio broadcasting (DRB) system. Further research secures spectrum in the L-band and CRC helps develop an international standard. In 1999, commercial DRB is officially launched in Canada and to this date, it is the only country in the Americas that provides commercial DRB broadcasting.



**1983**

The first permanent international connection to the Internet, known as ARPANet, is set up at Shirleys Bay to support the new computer network research program.

**1985**

The RACE System is installed in Labrador, Newfoundland. Designed to produce and improve operation of HF radio-telephone systems in Northern Canada, RACE allows automatic connections to domestic telephone systems and eliminates the need for skilled operators.

**1987**

The Department of Communications and NASA win an Emmy Award for their role in developing the Ku-band technology of the Hermes satellite.

**1992**

CRC helps create a repository of official government documents (including the Charlottetown Accord) on the Internet. This is the first time a collection of official Canadian government documents is made available to the public via the Internet.

**1993**

CRC creates a Web site for CBC Radio to distribute their audio programs directly to the public on demand. This is the first time that a radio broadcaster uses the Web for international audio broadcasting.


**1996**

MSAT's M1 is launched though its technical feasibility was demonstrated by CRC many years before. Designed to serve mobile users, it allows people in the most remote areas of North America to send or receive voice and data transmissions.

**1997**

The Advanced Satellite Communications Program, funded by CSA and managed by CRC, awards contracts for technology development that successfully position the industry for future broadband, multimedia satellite markets.

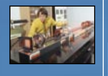
**2000**

The Payload Flight Demonstration Program, funded by CSA and managed by CRC begins, with Canadian industry developing and building Ka-band multimedia payloads to fly on Telesat Canada's Anik F2 satellite (in 2003). This will become an important part of Canada's telecommunications infrastructure, particularly for rural and remote communities.

## Other Achievements in Technology

**1970**

Fibre optic research begins at CRC. This technology is later licensed in Canada and around the world.

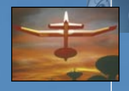


**1973**

CRC helps build a Space Qualified Gallium Arsenide Field Effect Transistor (GaAs-FET) amplifier to fly on the Hermes satellite. This experiment opens the door to next-generation satellites with GaAs-FET low-noise amplifiers.

**1987**

The Stationary High Altitude Relay Platform (SHARP) makes history by flying for 20 minutes using microwave power from a transmitting antenna.



**1990s**

CRC-Predict™, a software program that predicts propagation of radio signals in the VHF/UHF bands, is developed. Later versions of this program are a standard in Canadian broadcast licensing decisions and this technology is later transferred to industry through a series of licence agreements.

**1994**

A natural language computer program developed at Shirleys Bay wins the third-annual international Lobner Prize Competition for the most "human-like" program for its ability to converse in ordinary English.

**1994-2001**

Original methodologies for the subjective and objective evaluation of the quality of audio systems are developed and incorporated into three international standards and into CRC-SEAQ – a commercial software that is licensed to several major corporations around the world.

**2002**

CRC and its American partner, United Technologies Corporation, won a patent interference case at the U.S. patent office against two large multinationals – a first for the Canadian government. The dispute was over the patent rights to the phase mask used to fabricate fiber Bragg gratings, invented at CRC in 1992. The patents relating to Bragg gratings are major money-makers for CRC and the Government of Canada, generating a record $3 million in 2001-2002.

### 40th Anniversary – Alouette

- The launch of Alouette 1 in 1962 makes Canada the third country in the world to have a satellite in space. This ionospheric studies satellite operates for 10 years and sets several space records. In 1965, Canada launches Alouette 2 in California.
- Canada launches ISIS 1 (International Satellite for Ionospheric Studies) in 1969, and ISIS 2 in 1971, to study the physical processes of the upper atmosphere and ionosphere. As a result, Canadians become leaders in sounding, imaging from space and particle measurements. CRC operates the ISIS satellites until 1984 and Japan continues to collect data until 1990.
- In 1987, the Alouette-ISIS Program is designated one of the 10 most outstanding achievements in the first 100 years of engineering in Canada. In 1993, the program is recognized as an International Milestone of Electrical Engineering by the Institute of Electrical and Electronic Engineers (IEEE).

### 20th Anniversary – Cospas-Sarsat

- In the late 1970s, Canada conducts experiments with the space agencies of the U.S. (NASA) and France (CNES) that lead to the creation of a search-and-rescue satellite-aided tracking system (SARSAT). The then-U.S.S.R. joins the trio in 1979 and Cospas-Sarsat is formed.
- In 1982, only nine days after the satellites become operational, the ground station at Shirleys Bay detects a distress signal from an airplane crash in northern British Columbia that is relayed by a Cospas satellite. Searchers find the airplane and rescue three people.
- Key individuals and Canadian organizations involved in the SARSAT project, including those from CRC and DRDC, win the Alouette Award in 1995.
- Cospas-Sarsat celebrates its 20th anniversary in 2002, having helped save more than 14,000 lives worldwide.

### Campus Milestones

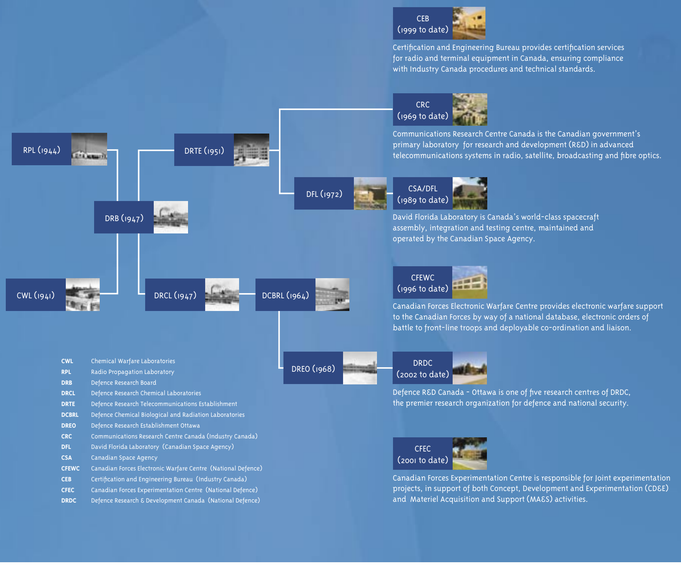
Landmark developments in advanced communications research and development (R&D) occurring on the Shirleys Bay Campus have changed the way Canadians communicate with each other and with the world.

The campus has grown considerably in size and research scope, its dedicated researchers and technicians staying one step ahead of rapid developments on the global information technology scene.

Today, the Shirleys Bay Campus is home to six Government of Canada organizations:

- Communications Research Centre Canada
- Defence R&D Canada – Ottawa
- Canadian Space Agency
- Canadian Forces Experimentation Centre
- Canadian Forces Electronic Warfare Centre
- Industry Canada's Certification and Engineering Bureau

For over 50 years, the campus' federal labs have performed world-class R&D. Working independently, with other government departments or with private-sector partners, they continue to develop leading-edge technologies that advance innovation in Canada and abroad.




## Safety and Defence for Canada and the World

### Helping Save Lives

**1950s-1960s**

Development of new equipment that protects Canadian military personnel against chemical and biological agents: gas masks, protective clothing, and spectacles and fibres for gas mask filters.

**1960s**

Protective masks are developed with greatly improved canisters and at one quarter of the cost of previous models.

**1980s**

Radiation biology research by Canadian defence scientists facilitates the development of anti-nausea drugs for military personnel exposed to radiation. Today, this same research benefits cancer patients who use anti-nausea drugs while undergoing radiation therapy.

**1980s**

Special sleeping bags, tents and other protective materials are developed for Canadian military personnel working in sub-zero temperatures.

**1988**

The world's first commercial aeronautical satellite voice service uses CRC technology installed in an Ontario Air Ambulance. Paramedics are linked to doctors in hospitals via an Inmarsat satellite.

**1987**

A new C4 Protective Face Mask is developed. It features improved vision, greater comfort, better agent resistance, water-drinking capability, improved speech transmission and lower manufacturing costs. Distributed to the Canadian Forces, the C4 Mask is later modified for use by aircrew and becomes the AC-4.

**1990s**

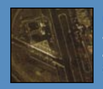
Digital radio frequency memory, the key innovation of the Canadian Advanced Radar Deception System (CARDS), allows a jammer to store and transmit an exact replica of radar waveforms.

**1990s**

In co-operation with Raytheon Canada, two HF Surface Wave Radars successfully demonstrate an inexpensive way to provide 24/7 surveillance of Canada's 200-mile economic zone off the east coast where valued oil, fisheries and other resources are located.

**1990s**

Technology for adding imaging radar capability for land and ocean surveillance from Canada's long-range patrol aircraft is developed in the SpotSAR Project.



**1990s**

A multi-sensor, tele-operated mine detector, designed for soldiers clearing mines from roads and other areas, greatly improves the reliability and speed of mine detection over previous methods used by the Canadian Forces.



DRDC-Ottawa supplies the thermal neutron activation detector.

### Protecting the Nation and Strengthening our Forces

**1955**

Early defence electronics research leads to the development of the proximity fuse for the Velvet Glove, an air-to-air missile designed to detonate when it reaches a certain proximity to its target.

**1960s**

Development of the Canadian Three-Way Detection Paper that detects the presence of G-nerve agents, V-nerve agents and mustard gas. Still in service some 40 years after its development, this is now a standard in all NATO, American, British, Australian and Canadian armed forces.

**Mid-1960s**

New microcomputers are applied to electronic warfare receivers in Project Zander, a forerunner to the Canadian Naval Electronic Warfare System (CANEWS) system, in use today on all Canadian warships.



**2002**

CFEWC personnel travel to the Persian Gulf region to provide electronic warfare support for Operation Apollo.



**2002**

CFEC conducts its first live Uninhabited Aerial Vehicle (UAV) experiment. Increasing Canadian Forces expertise in these operations, the experiment also helps define data fusion requirements for Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) and Intelligence, Surveillance and Reconnaissance (ISR).





## Space Qualification

*Working with the private sector, government agencies and international partners, the Canadian Space Agency's David Florida Laboratory (DFL) has played an integral role in the assembly, testing (environmental and/or functional) and/or integration of some of the world's most powerful space hardware and communications and Earth-observation satellites. DFL had a hand in the spacecraft below – many of which were "firsts."*

**1977 to date** Canadarm

Testing of the Shuttle Remote Manipulator System (SRMS) known as the Canadarm, a robotic arm used during shuttle missions to handle and retrieve space hardware, such as satellites.



**1980-1982** Anik C2

This is Canada's first satellite dedicated to offering point-to-point commercial services.



**1981-1982** Anik D1 and D2

Telesat Canada's Anik D1 provides Canadians with live coverage capability, cable television and other television services while Anik D2 carries voice and data traffic. This is the first prime contract awarded to a Canadian company.

**1983-1986** Brasilsat S1 and S2

Brazil's Sistema Brasileiro de Telecomunicacoes por Satellite (SBTS) – Brasilsat S1 and S2 – is SPAR Aerospace's first international prime contract. This series of satellites gives Brazil the ability to communicate within the entire country by satellite for the first time.



**1985-1989** Olympus

The European Space Agency (ESA) multipayload communications satellite, Olympus (also know as L SAT), is the largest civilian telecommunications satellite.



**1988-1992** Anik E1 and E2

Replacements for the Anik C and D satellites, these are fifth-generation Anik satellites. With the ability to carry 56 television channels (compared to the standard 16), they become the most powerful satellites in commercial use in all of North America.



**1992-1995** RADARSAT 1

Canada's first Earth-observation satellite, RADARSAT 1 is a remote-sensing satellite that takes high-resolution images of the Earth for use in agriculture, oceanography, forestry, hydrology, geology, cartography and/or meteorology.

**1992-1996** MSAT M1 and M2

Commercial mobile communications satellites of the MSAT program, a major part of the Government of Canada's space plan.



**1995 to date** Mobile Servicing System (MSS)

Canada's contribution to the International Space Station (ISS), MSS consists of the Special Purpose Dextrous Manipulator (SPDM), Space Station Remote Manipulator System (Canadarm2) and the Mobile Base System (MBS). This robotic system plays a key role in space station assembly and maintenance.



**2002** SCISAT 1

The first Canadian scientific satellite in 30 years. It will be used to measure and understand the chemical processes that control the distribution of ozone in the Earth's atmosphere.



**2002 to date** RADARSAT 2

Canada's next-generation Earth-observation satellite.









Canada