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SatCom Today in Canada: Canadian Space Agency

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Satcom Programs

General

Since its creation in 1989, the Canadian Space Agency (CSA) has set out to ensure that all Canadians learn and benefit from the innovations of space science and technology to the greatest extent possible. Its objectives are to support and promote a highly competitive space industry and address the needs of Canadian society. With almost half of Canada's GDP growth in the knowledge-intensive sectors of the economy, the Canadian Space Program is a key driver behind continued leadership on the world stage, new opportunities for industry and scientists, and long-term social and economic benefits for all Canadians.

Mission

The Canadian Space Agency is committed to leading the development and application of space knowledge for the benefit of Canadians and humanity.

Mandate

The legislated mandate of the CSA, from the Canadian Space Agency Act, SC. 1990, c. 13, is: "To promote the peaceful use and development of space, to advance the knowledge of space through science and to ensure that space science and technology provide social and economic benefits for Canadians."

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The Advanced Satcom Program

Established in 1997 and continuing through summer 2001, the Advanced Satcom Program was a component of the Canadian Space Agency's (CSA) overall satellite communications effort. The program was designed to support new Canadian developed technologies and enhance the capacity of Canadian industry to secure market niches in the area of multi-media/broadband satellite communications.

The new technologies developed under the program were specifically aimed at expanding the capacity of satellites to handle the rapidly growing market demands for the delivery of vast amounts of data at high speeds. At the same time, the program was aimed at assisting Canadian companies in the development of new ground-based equipment to allow the next generation of advanced satellite communications services to fall within the financial reach of the average business and residential consumer. Projects have included innovative research and development work in the areas of Optical Inter-Satellite Links (OISL), Ka-band space payload technologies, Multimedia Satellite Interactive Terminals (SITs), antennas and RF technologies, gateway and hub design and the development of multimedia applications and trials.

The overall coordination responsibility and accountability for the program has rested with the Canadian Space Agency (CSA), with the Communications Research Centre (CRC) taking responsibility for program management, based on the technical knowledge residing in the Centre for satellite communications. The four-year program leveraged $50 million worth of development work for a combined investment of approximately $65 million under the 75/25 cost sharing arrangement with industry. Projects ranged in size from $4 million to $20 million and involved technology development, prototype development and trials in both the ground and space segments.

Table 1: Overview of Advanced SatCom Projects

Prime Contractor	Project	Gov't ($M)	Industry ($M)	Total ($M)	Start Date	End Date
ComDev (Space)	Multi-media payload technology	9.2	3	12.2	Nov 97	Oct 01
EMS-CAL (Space)	OISL front end	2.8	0.9	3.7	Nov 97	Jul 01
EMS-SPAR (Space)	Ka-band payload technology	14.9	5	19.9	Nov 97	Apr 01
Nortel/EMS-Spar* (Ground)	User terminals & hub	12.4	4.1	16.5	Nov 97	Apr 01

Telesat (Ground)	Networks, applications gateway and trials	7.8	2.6	10.4	Jan 98	Jul 01
Other	CRC program management	2.9	0	2.9	Nov 97	Jul 01
Total Funding		50	15.6	65.6		

*Nortel withdrew from the program in Dec/99 and EMS took over prime responsibilities. EMS-Spar, EMS-CAL and ComDev also received co-funding from the European Space Agency (ESA). Note: All figures taken from a CRC presentation to CSA dated February 6, 1998 with updates taken from a presentation dated January 26, 2001.

The Advanced Satcom Program has allowed Canada to play an important role in leveraging investment, furthering satellite technologies and applications development. The program has improved understanding and advancement of satellite technologies in priority areas, primarily multimedia and Ka-band payload technology, optical inter-satellite links, user terminals and networks and application. It has increased R&D capabilities, international sales/contracts (over $200 million in sales), facilitated new partnerships/joint ventures/alliances, and has significantly enhanced employment/development of highly-skilled workforce.

International Mobile Satellite Program

The International Mobile Satellite Communications Program was established in 1995 as a component of the Canadian Space Program (CSP) to support innovative research, development and implementation of a new generation of products and technologies for the expanding world market for mobile satellite communications. In designing the program, the Canadian Space Agency (CSA) recognized that satellite communications is the most mature area of the space applications market with the greatest potential for immediate economic return. The programs overall mandate was to forge a successful private sector partnership capable of planning, managing, funding and implementing the IMSCP in order to maximize the technical, economic and social benefits to Canada. Specific objectives were to:

- Favourably position Canadian industry in the fast growing international market for mobile/personal satellite communication services; and
- Contribute to the research, development and implementation of the new generation of mobile satcom systems and services.

The overall coordination responsibility and accountability for the program rested with the Canadian Space Agency (CSA), with the Communications Research Centre (CRC) taking responsibility for program management.

Over the five-year duration of the program, the IMSCP program funded 28 projects with 13 Canadian companies.

A study that was commisioned to look at the results of the program indicated that the IMSCP had achieved an excellent commercial success rate and, as such, has favourably positioned Canadian industry in the MSS market and contributed to development and implementation of a new generation of mobile systems and services.

Anik F2

Due to its morphology, climate and immensity, Canada has always provided great challenges to its peoples. Just as, yesterday, the railways contributed to the birth of this country by rendering the transport of good and people possible from one coast to another, broadband satellites are bringing, today, Canadians even closer together by facilitating the flow of information possible from coast to coast to coast.

The telecommunications sector, telecommunications service providers, including telephone, cable, and satellite companies, are making efforts to help pave the way for building the Information Superhighway and, with the assistance of the government of Canada, are making this country one of the most connected in the world. The ultimate aim is to ensure that everyone has high-speed access to Internet, anytime, anywhere, at reasonable cost. To this end, satellites are uniquely qualified to extend the reach of the Internet to areas un-served or under-served by terrestrial digital broadband networks, where the cost of terrestrial networks would be prohibitive.

Supporting this initiative, the Anik F2 Ka-band satellite-based system will offer two-way, high-speed digital connections to off-net users throughout Canada and North America. The Anik F2 Ka-band system will provide service to a large user base through small, low-cost terminals at reduced rates, while meeting the high performance requirements needed for high-speed interactive multimedia and Internet applications.

Telesat's advanced Anik F2 satellite is currently under construction and will be launched in 2003. This satellite incorporates a number of innovations in satellite design that are stretching our understanding of the state-of-the-art. Anik F2 will be the world's largest communications satellite. Weighing over 5900 kg with over 15 kW of power, the satellite will carry 114 TWT amplifiers to service a triple band payload consisting of C, Ku and Ka-band. The satellite will include a complex triple band antenna farm comprising 12 antennas. The payload mass alone will be over 1000 kg. While the sheer enormity of the overall communications payload has led to a number of innovations in order to fit it onto an advanced state-of-the-art satellite bus, the most impressive innovations relate to the Ka-band communications payload design and the associated multimedia applications development and testing.

In preparation for this new satellite platform, Telesat is undertaking a series of R&D field trials involving a host of new, innovative multimedia applications that have captured the imagination of users. In addition, the Canadian Space Agency is sponsoring a project promoting the implementation of a Ka-band multimedia demonstration network on the satellite. Telesat's Nimiq 2 satellite was launched in December 2002 and is the first Canadian satellite with a Ka-band communication payload. The work related to Nimiq 2 will serve as a research and development platform and will be extremely helpful for successful implementation of similar services on Anik F2, when the Anik F2 Ka-band communications payload is brought on line in late fall 2003.Developed in partnership with COM DEV Space of Cambridge, Ontario, Canada, the BEAM*LINK, processor is an on-board traffic management subsystem that provides a means to increase the capacity of multi-beam satellites through the use of finer bandwidth channelisation and independent routing of channels. It actually divides transponders into multiple subchannels that can be independently routed on multi-beam systems. BEAM*LINK, is used on multi-beam satellites to efficiently manage the routing of narrowband traffic. Systems leasing video, data, telephony and other multi-media traffic concurrently benefit significantly. The fill factors of multi-beam FSS satellites approach those of broad beam satellites. The flexibility also allows for new services previously not possible with conventional equipment.

In a conventional bent-pipe satellite, users uplinked together in the same transponder must be downlinked together since beam-to-beam switching is conducted at the transponder level. In order to fill the transponder, sufficient users desiring the identical link must be found. This implies either long delay in filling the transponder or not filling it at all. Either way, significant revenue is lost. BEAM*LINK, alleviates this problem by creating subchannels that can independently be routed and permitting the gain of each channel to be adjusted independently to optimize lifetime performance. In short, BEAM*LINK, is a high-tech switchboard that separates thousands of individual transmissions from a wireless signal, and matches each of them with its intended destination.

ESA

In the mid-seventies, the Canadian government began forging closer ties with Europe to reduce Canada's economic and space policy dependence on the U.S. With this aim in mind, Canadian government officials initiated talks with their counterparts from the European Space Research Organization (ESRO), a precursor to the European Space Agency. The relative size of Europe's space program compared advantageously with that of Canada's, which made the rapprochement much more attractive to the Canadian government who was looking for a partner with whom it could deal on a more equitable basis and with whom it could influence broad policies.

Canada held observer status in the European Space Conference (ESC), a ministerial-level organization set up to determine future European space activities, and it continued in this limited role after ESA was created in 1975. Shortly after ESA's creation, Canadian officials began pursuing more formal ties with the new European institution, cumulating in a five-year cooperation agreement with ESA in January 1979. Since then, as an Associate-Member and later a Cooperating State, Canada has participated in a myriad of ESA programs at different levels. Among the most important ESA satcom-related programs, there were Olympus, ARTES, Artemis and REMSAT.

Olympus

Olympus, one of the largest telecommunications satellite ever built, was an experimental satellite designed to test advanced technologies to enhance the power and transmission capabilities of future commercial communications satellites.

In 1980, Canada joined the project, which was building on the work done on Canada's Anik-B satellite. In doing so, Canada became the third largest participant with an 11 percent share of the budget. Canadian companies supplied several components, including solar panels and amplifiers. The primary Canadian participants were COM DEV Ltd., EMS Technologies (taking over projects from Spar Aerospace Ltd.) and the government's Communications Research Centre. Assembly, integration and testing were done at the CSA's David Florida Laboratory, in Ottawa.

Advanced Research in Telecommunications (ARTES)

ESA's ARTES program is based upon the joint CSA, ESA and EC satellite communications objectives and the development of suitable payloads to meet them. It is carried out under five program lines. The ARTES program is designed to be a flexible, long-term program, with elements being created and terminated according to current needs.

Canada's participation to the ARTES program is concentrated in ARTES elements 1, 3 and 5. Canada has been particularly active in ARTES 3. It is the focus for future satcom strategy in ESA, and is most relevant to Canada's national strategic objectives. ARTES 5 is the core satcom technology development program at ESA. It represents a window on European technology for Canadian Industry. ESA also places a great deal of emphasis on the user segment, including user terminals, the ground network, and applications. This activity will also be supported under ARTES 5. In addition to the user segment activities, ARTES 5 will support a broad range of technologies of interest to Canadian firms, e.g., OBP, ISL, multiplexers, and ground segment signal-processing techniques.

Recently, ESA's telecom sector has redefined the organization of the ARTES program to better reflect the programmatic areas addressed. While the original nomenclature of ARTES continues to be used principally because of the financial authorities obtained and consequential reporting practices, the following link shows the new program name and the mapping to the various ARTES elements (or program lines) http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=511

The ARTES program will also promote the development of satellite-based tele-education and telehealth applications, two fields in which Canada, with its many remote communities, already has considerable experience. Three Canadian demonstration projects are part of the ARTES program:

- Remote Communities Services Telecentre (RCST): Starting in 1998, Telesat Canada and the Canadian Space Agency established satellite telecentres in nine remote rural communities in Newfoundland and Labrador linking them to urban centres. This enabled the use of high-speed Internet access, videoconferencing and digital imaging to deliver health, education and government services.
- Integrated Emergency Medicine Network (IEMN): Building on the RCST infrastructure, this project was started in 1999 to provide high-speed communications to assist emergency workers treating patients in remote locations by providing real-time links with medical experts in urban centres. The service has been used to provide cardiac care and to send X-rays to be interpreted by specialists. It also enables doctors to remotely monitor patients' vital signs while they're being transported by land or air ambulances.
- Marine Interactive Satellite Technologies (MIST): This project, started in 2001, extends satellite-based communications to marine vessels in Canadian waters. High-speed terminals will link patients or the ships' medical staff with doctors on shore. Passengers can also use the terminals can for non-medical purposes, such as accessing email.

Artemis

Artemis is an experimental satellite designed to test new telecommunications services that will improve mobile voice and data communications services for vehicles on earth, improve global navigation services and allow direct satellite-to-satellite communications. It is intended to improve the flow of data from remote sensing satellites, which now depend on ground receiving stations to relay the information they gather. Artemis carries advanced technology, including a unique relay system that uses lasers, which will permit these satellites to talk directly to each other. It's expected that this will improve the efficiency of delivering environmental data to end-users. Two Canadian companies, COM DEV and EG&G Canada Ltd., are participating.

Real Time Emergency Management via Satellite (REMSAT)

REMSAT is a project that combines several types of satellites-telecommunications, navigation and remote sensing-to fight forest fires. In 1998, ESA gave a C$1.6-million contract to MDA and the British Columbia Forest Service to run tests demonstrating the use of satellites for emergency planning and managing forests fires in British Columbia, which experiences about 2800 wildfires a year. The project could showcase the value of using space-based technologies to deal with disaster situations.

The REMSAT system can provide telephone, fax and Internet access in remote locations, as well as near real-time remote sensing images, weather and land use data, topographical models and GPS navigation. This enables firefighters to more accurately map the perimeter of the fire, predict how it will spread and how much damage it will cause and decide where firefighting resources can be most effectively deployed.