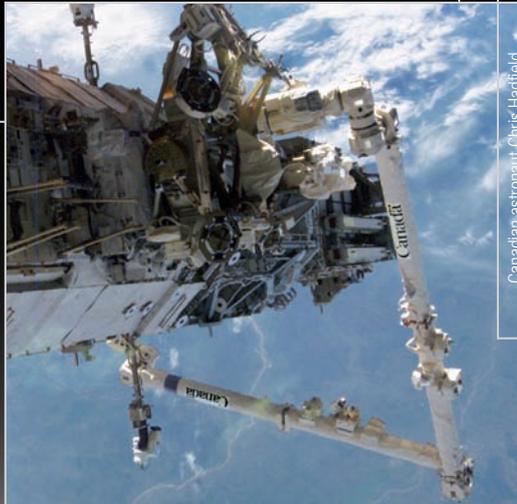




# CANADA'S SPACE SECTOR



Canadarm2 and the Mobile Base System

Credit: NASA



Canadian astronaut Chris Hadfield

Credit: Canadian Space Agency (CSA)

Leading the development of new knowledge and cutting-edge technologies



Microvariability and Oscillations of Stars (MOST) microsatellite

Credit: Canadian Space Agency (CSA)

## Canada's space sector at a glance

- Canada's space sector consists of over 200 private sector companies, research organizations, universities, and governmental departments and agencies.
- Over 8200 professionals work in Canada's space sector, over half of which are considered highly qualified personnel.
- Over \$3.4 billion in revenues are generated annually by this sector, 50% originating from export sales.

Source: State of the Canadian space sector 2010



Wetland characterization, Quebec, GRIP

Credit: RADARSAT-2 data and products © MacDonald, Dettwiler and Associates Ltd. (2009) - all rights reserved

Canada has an enviable record of innovation in space science and technology, as well as in reaching the marketplace with new developments in niche areas.

Canada's space sector develops and uses space innovation to respond to national priorities like sovereignty, security and safety, resource management, and environmental monitoring. Its approach focuses on a vibrant interaction between industry, academia and government in order to develop new knowledge, and targeted technologies in niche areas. Canada's long-held lead in Earth observation, space robotics, space science and exploration, and satellite communications technologies has helped to give it the edge needed to generate global revenues, as well as to contribute to resolving national issues.

A key tenet of Canada's space strategy is the use of international collaborations, with many space-faring nations to carry out projects and programs. These mutually beneficial collaborations bring synergies in space expertise, innovation, scientific and technological activities, and enable risk and cost reductions. Of note, Canada has developed dynamic relationships, primarily through the Canadian Space Agency (CSA), with NASA and the European Space Agency (ESA). These have led to long-lasting and profitable partnerships for Canadian industry and academia.

# CANADIAN EXPERTISE

Canada's space sector has established a world-class reputation in areas of Earth observation, space robotics, space science and exploration, and satellite communications.



RADARSAT-2

Credit: MacDonald, Dettwiler and Associates (MDA) Ltd.

## Earth Observation

Observing the Earth from space is of strategic importance in order to understand and monitor Canada's resources, land mass, coastal waters and atmosphere throughout the country. The Canadian space sector also focuses its approach on the delivery of important environmental and disaster management applications and services.

### RADARSAT

RADARSAT-1 and -2 are remote sensing satellites, each carrying a sophisticated Synthetic Aperture Radar (SAR) antenna that images the surface of the Earth and its oceans on a continuing basis, including through all weather conditions and darkness. The two satellites provide timely and critical data that improve maritime surveillance, ice monitoring, resource management, and mapping. A three-satellite RADARSAT Constellation Mission is currently in development. It will increase revisit time as well as ensure data reliability and continuity.

### SCISAT-1

Canada's most recent small satellite includes an innovative Canadian designed and built instrument to observe the Earth's atmosphere, providing fundamental information for studies on climate change and the protective ozone layer.

## Space Robotics

Canada has become a leader in robotics engineering and innovation, thanks to its contribution to the International Space Station.

### Mobile Servicing System (MSS)

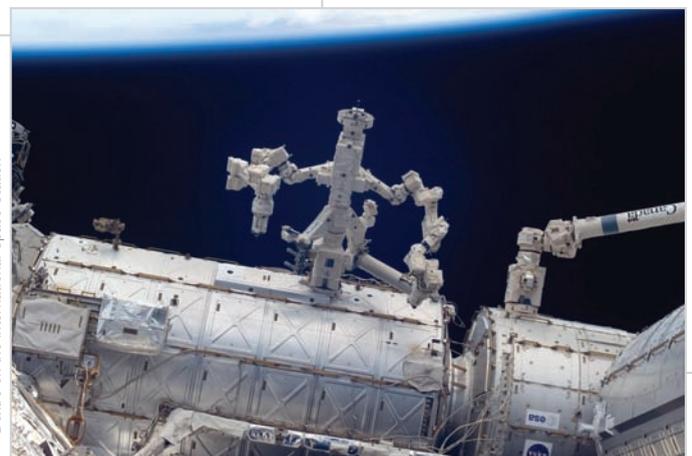
This sophisticated robotics system is made up of the Canadarm2, an advanced version of the first Canadarm, the Mobile Base, a moveable work platform, and Dextre, a highly advanced two-armed robot which performs finer tasks. Canada's space robotics are essential to the assembly and maintenance of the Station and are used on every mission. Astronauts from around the world are trained to operate the MSS at a state-of-the-art training facility located at the CSA's headquarters.

### Space Vision System

This Canadian laser camera system is used both on the Space Shuttle and on the International Space Station to perform on-orbit inspection of the Shuttle, providing astronauts with critical views that were impossible to see from inside the vehicle in the past.

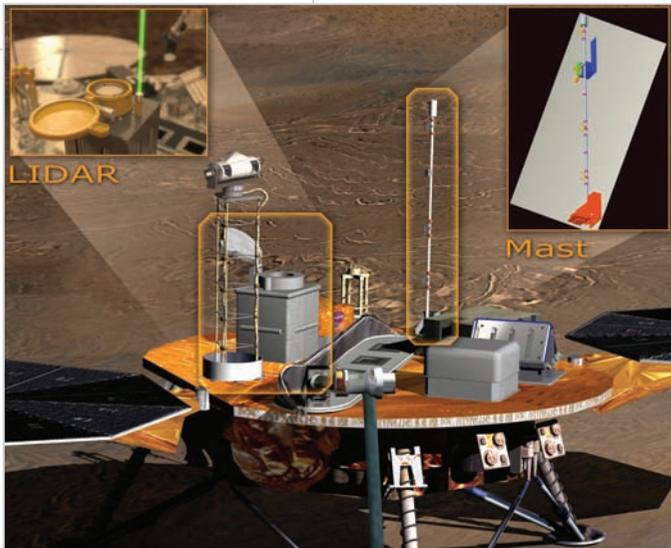
### Next Generation Canadarm

Canada is investing in new technologies in order to remain a leader in space robotics. The Next Generation Canadarm aims to develop ground prototypes that provide the necessary leadership to be able to service space exploration missions or next-generation satellites in the future.



Dextre on the International Space Station

Credit: NASA



Credit: Canadian Space Agency (CSA) and University of Arizona

## Space Science and Exploration

Canada's space sector is renowned for building exceptional scientific instrumentation. These instruments are helping scientists understand the origin, formation, structure and evolution of celestial bodies, and the Universe. For example, Canada has built MOST, the world's smallest astronomical space telescope capable of measuring the age of stars.

### Phoenix Mars Mission

University and industry scientists across Canada worked with the CSA to build the Meteorological Station for NASA's Phoenix Mars Lander. The Station was used to record the daily weather at Phoenix's landing site on Mars, using a meteorology mast and a Light Detection and Ranging (LIDAR) instrument. It was these Canadian instruments that detected snow on Mars. Phoenix was the first mission to explore the Arctic region of Mars at ground level.

### James Webb Space Telescope (JWST)

Canadian scientists and industries are currently building the Fine Guidance Sensor and Tuneable Filter Imager cameras for NASA's next-generation space telescope. The cameras will provide astronomers with unprecedented information on the origin and structure of our Universe. The JWST is part of collaboration between NASA, CSA and ESA.

## Satellite Communications

Leading-edge Canadian technologies enable the delivery of broadband services, multimedia telecommunications, distance learning, telemedicine, e-commerce and marine navigation, including search and rescue. In parallel, Canada has developed a strong expertise in operating ground stations that are used for satellite tasking and data downlink.

As a world leader in satellite communications, Canada is home to the fourth largest fixed satellite service provider worldwide. Canadian technology is also used in over 80% of all commercial communications satellites launched internationally.

### Anik F2

An innovative high-speed Ka-band multimedia system, that serves both remote communities and the rapidly growing satellite-based broadband market in North America, was built by Canadian industry and flies onboard the Anik F2 satellite.

### Micro and Small Satellite Projects

Maritime Monitoring and Messaging Micro-Satellite (M3MSat) will allow the optimization of the Automatic Identification System (AIS) payload. AIS technology will provide several monitoring solutions, including maritime surveillance. Cascade Small Satellite Demonstrator and Ionospheric Polar Explorer (CASSIOPE) is a Canadian multi-purpose small satellite. It will provide the very first digital broadband courier service for commercial use and carry the ePOP probe, a suite of scientific instruments.

### Deep Space Antenna

Canada provided ESA with two of the world's largest and most advanced deep space antenna systems for its scientific and exploration mission. A third antenna is under development that will ensure full communication during missions and that will enhance the return of scientific data.



Deep Space Antenna

Credit: SED Systems

## Key technologies, products and services

### Platform Technologies

- Small/micro satellite bus
- Spacecraft guidance, navigation and control
- Thermal protection and control
- Advanced and deployable structures
- Power generation, conversion, storage and distribution
- Computing/processing hardware and software

### Communication Technologies

- Antenna and transponders
- Radio Frequency (RF) systems, switches and multiplexers
- Digital electronics

### Sensor Systems

- Passive and active optical, infra-red and ultra-violet sensors
- Active space-based radar and SAR
- Passive RF detectors and imaging

### Space Robotics

- Manipulators and vehicles
- Active vision systems
- Robot guidance, navigation and control

### Scientific Instruments/Research

- Spectrometer and interferometer
- Laser instrument
- Ozone, pollutants and green house gases monitoring
- Solar-terrestrial sciences
- Solar system planetology
- Space astronomy
- Human space flights
- Cardiovascular, bone and muscle physiology
- Neuroscience
- Material sciences in space

### Ground Segment

- Satellite navigation receivers
- Mission planning, control and operations
- Data analysis and applications

### System Analysis, Design, Assembly, Integration and Testing

### Space Laws and Policies

## Need more information on the Canadian space sector?

*The Canadian Space Directory provides more information on Canadian space organizations and their sectors of activities, capabilities and expertise.*

[www.asc-csa.gc.ca/csd](http://www.asc-csa.gc.ca/csd)

## Other links

### Canadian Space Agency

*Canada's presence in space*

[www.asc-csa.gc.ca](http://www.asc-csa.gc.ca)

### Industry Canada

*Support to the space sector*

[www.ic.gc.ca/space](http://www.ic.gc.ca/space)

### Foreign Affairs and International Trade Canada

*Trading service and information*

[www.tradecommissioner.gc.ca](http://www.tradecommissioner.gc.ca)

### Canadian Commercial Corporation

*Space procurement and contract services with NASA*

[www.ccc.ca/ExpSpace](http://www.ccc.ca/ExpSpace)



An astronaut at the tip of Canada's arm

Credit: NASA

## Produced in collaboration with:

Canadian Space Agency, Industry Canada, Foreign Affairs and International Trade Canada, and Canadian Commercial Corporation.



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IC: 60729  
lu44-80/2012E-PDF  
978-1-100-20940-1