

**CANADIAN SPACE AGENCY**  
**2014–15 REPORT ON PLANS AND PRIORITIES**  
**SUB-PROGRAM PLANNING HIGHLIGHTS**

**March 4, 2014**

## 1.1. Program: Space Data, Information and Services

**Description:** This Program includes the provision of space-based solutions (data, information and services) and the progression of their utilization. It also serves to install and run ground infrastructure that processes the data and operates satellites. This Program utilizes space-based solutions to assist Government of Canada (GoC) organizations in delivering growing, diversified or cost-effective programs and services within their mandate, which is related to key national priorities, such as sovereignty, defence, safety and security, resource management, environmental monitoring and the North. It also provides academia with data required to perform its own research. The services delivered through this Program are rendered, and the data and information are generated and processed, with the participation of the Canadian space industry, academia, GoC organizations, national and international organizations, such as: foreign space agencies, not-for-profit organizations, as well as provincial and municipal governments. This collaborative effort is formalized under national and international partnership agreements, contracts. This Program is also funded through the Class Grant and Contribution Program.

### - 2014-15 EXPECTED ACCOMPLISHMENTS -

#### 1.1.1 Sub-Program: Earth Orbit Satellite Missions and Technology

- The CSA will continue the implementation phase of the RADARSAT Constellation Mission (RCM) initiated at the end of fiscal year 2012-2013. This phase will include multiple intermediary deliverables throughout its duration, which is planned to last a little less than 6 years (69 months) with a launch of the three satellites in 2018. While ensuring continuity of space data from its predecessors RADARSAT-1 and -2 for many government departments, the RCM will enhance Canada's ability to use space-based solutions for operational maritime surveillance, disaster management and ecosystem monitoring and will support the strategic objectives of Canada on security and sovereignty, particularly in the Arctic.
- The CSA will continue to support its partner Department of National Defence (DND) in post launch activities of the M3MSAT joint micro-satellite project which will demonstrate and further develop a multi-mission bus capability; allow optimization of the Automatic Identification System (AIS) payload in maritime traffic identification; and significantly support Canadian industry business development strategies in a global market context. This complement to the CSA's RADARSAT Constellation and DND's Polar Epsilon missions is scheduled to launch in March 2014.
- The CSA will continue to develop Canadian participation in the Surface Water and Ocean Topography (SWOT) demonstration mission led by NASA and CNES (French space agency) for launch in 2020. SWOT will allow global measurement of lake level and ocean circulation features. SWOT data will be of great utility to Environment Canada for hydrological and meteorological monitoring and forecasting, and to Fisheries and Oceans Canada for ocean science and forecasting.

- The CSA will continue to develop promising mission concepts to demonstrate innovative space-based solutions in Earth Observation and Satellite Communications. Implementation approaches to meet users' needs will continue to be studied, notably the use of micro and small satellite platforms. Three concepts will be studied, leading to the announcement of the most promising missions in March 2016.
- The CSA will continue to develop the chemical and aerosol sounding satellite mission concept as a follow on to CSA's successful SCISAT-1 mission, which is now in its 11<sup>th</sup> year of operation, and to OSIRIS on Odin now in its 13<sup>th</sup> year of operation. This Atmospheric Limb Sounding satellite mission will continue making climate quality atmospheric composition measurements; monitor the changes in atmospheric composition that influence ozone recovery; and enable new science on Earth surface climate interaction with the upper troposphere and lower stratosphere. Canadian instruments on foreign as well as on Canadian spacecraft will be considered.
- The CSA will continue collaborating with Environment Canada (EC) to support the development of a Carbon Assimilation System (CAS). This activity will allow EC, in collaboration with Canadian university scientists, to develop the capacity and assess the operational feasibility of using space borne atmospheric CO<sub>2</sub> observations and a transport model to infer surface fluxes. The EC-CAS system will also be useful for assessment of future space-borne greenhouse gas observation requirements.
- The CSA will continue collaborating with Environment Canada (EC) and with Agriculture and Agri-Food Canada (AAFC) to support the Canadian Science and Applications Plan for NASA's Soil Moisture Active Passive (SMAP) mission. Canadian scientists from EC, AAFC and five Canadian universities, are participating in pre- and post-launch data calibration/validation and algorithms development activities as well as testing, demonstration, and implementation of SMAP data and algorithms for Canadian regional products and other related activities. SMAP data will improve the representation of energy, water and carbon cycles in Canadian environmental analysis and prediction systems using soil moisture and freeze/thaw data. SMAP will be launched in November 2014.
- The CSA will continue supporting Canadian university scientists to participate in calibration, validation and analysis of data from the eight-instrument ePOP payload on the CASSIOPE satellite that launched in September 2013. They will use the enhanced Polar Outflow Probe data to help understand particle exchange and energy coupling processes between the Earth's atmosphere and space environment.

### 1.1.2 Sub-Program: Ground Infrastructure

- The CSA will continue to operate SCISAT-1 and to support data production, validation and analysis. SCISAT-1 makes climate quality, vertical profile, measurements of atmospheric composition (over 35 gas species) that help scientists to monitor the atmosphere as it responds to natural and anthropogenic changes, and to improve climate and weather models.
- The CSA will continue to operate the Near Earth Object Surveillance Satellite (NEOSSat) launched in February 2013. The NEOSSat is a microsatellite jointly sponsored by CSA and Defense Research and Development Canada (DRDC) to acquire useful metric (position/time) data on Near Earth-orbiting objects (asteroids) and man-made objects (spacecraft and space debris). The University of Calgary's NEOSSat science operations centre exploits NEOSSat's imagery. Through NEOSSat, Canada is contributing to the international effort to both catalogue the near-Earth population of asteroids producing information crucial to targeting new destinations for future space exploration missions and to maintain the safety of Canadian and international assets, both civilian and military.
- The multi-mission ground infrastructure required to operate the RADARSAT Constellation Mission in 2018 and upcoming demonstration missions are being designed.
- The CSA will keep operating RADARSAT-1 data archives and supply radar imagery data from these archives to the existing client base in Canada and abroad. RADARSAT-1 data archives were accumulated over the 17 years of operations of this satellite and they constitute an important asset for the future.
- The CSA will continue to support observations of the near-Earth space environment (geospace) above Canada and in so doing, better understand the phenomena of space weather to mitigate its impact on the lives of Canadians. Geospace Observatory (GO) Canada contribution agreements with ten Canadian universities will support the operation of arrays of ground-based instruments. GO Canada grants will generate new science knowledge and stimulate entrepreneurial thinking to transform science knowledge into applications that increase Canada's resilience to the impacts of space weather.
- The CSA will continue to take advantage of Canada's favourable northern location. A modern, integrated and coordinated national system of ground infrastructure is required to operate the Canadian space assets and for the timely capture of space data from domestic or foreign satellites. Federal departments are partnering to ensure ground station coverage of the Canadian territory, especially over the Arctic where gaps are still found. The CSA will continue feasibility studies for a new station in the Northeastern part of Canada to provide redundancy and extend the coverage of the existing Canadian antenna network while reducing the need for foreign ground station usage.
- The CSA will pursue discussions for an agreement with the European Commission to ensure access to Sentinel mission through Canadian ground facility in order to receive and process the data.

- Sentinel missions are expected to provide useful data to an array of Canadian users such as the Canadian Ice Service of Environment Canada for ice monitoring using Sentinel-1 as well as Agriculture & Agri-Food Canada and Natural Resources Canada using Sentinel-2 and-3 data for ecosystem monitoring, crop surveillance, land surface characterization and forestry applications to name a few. The Department of Fisheries and Oceans are expecting Sentinel-3 data for ocean colour application of offshore and coastal waters.
- The CSA will continue funding of the operation of the 16 Canadian Ground Based observatories for the THEMIS mission, complementing the observations from the four Alaska based observatories and five NASA spacecrafts to better understand the processes that lead to geomagnetic storms and auroral intensification. Canada is the preferred location for studying space weather processes due to our proximity to the magnetic North Pole and our large landmass under the auroral oval.
- The CSA will continue to safeguard CSA satellites in orbit against space debris by taking operational actions as required. Also, the CSA will collaborate operationally with the Department of National Defence and foreign agencies to ensure latest tools and information are available to protect satellites from the impact of debris in space. The CSA will also continue to participate in international forums concerned with space debris. The CSA will offer its operational expertise in avoiding space debris to Canadian operators of satellites.
- The CSA will continue to support MOPITT and OSIRIS. These two major Canadian science instruments are currently orbiting Earth and collecting atmospheric composition data. MOPITT, on NASA's Terra satellite, measures pollutants in the troposphere, providing a wealth of data on global transport of pollutants while OSIRIS, on the Swedish Odin satellite, measures ozone and aerosols in the stratosphere, providing important data for monitoring trends of these essential climate variables, for assessing the status of the ozone layer and for improving climate models.
- The CSA will continue collaborating with the Canadian Forest Service in developing and testing an active fire product to be derived from radiance measurements made by the NIRST instrument on the SAC-D/Aquarius satellite (launched in 2011). The CSA contributed unique uncooled microbolometers detectors to this instrument that should improve the estimation of biomass fire emissions through the measurement of fire radiative power.
- The CSA will continue supporting Canadian university scientists to participate in the calibration and validation of the Canadian Electric Field Instrument (EFI). The ESA Swarm mission launched in November 2013 is primarily a magnetic surveying mission. But Canadian scientists will use the EFI data obtained from the three Swarm spacecraft, in conjunction with Geospace Observatory Canada ground instruments, to help understand ionospheric plasma convection processes.

### 1.1.3 Sub-Program: Space Data, Imagery and Services Utilization Development

- The CSA will continue managing and optimizing the RADARSAT-2 data allocation to ensure that the needs for Synthetic Aperture Radar (SAR) data by operational Government users are met in a sustainable way. Out of the \$445 million worth of prepaid RADARSAT-2 data, the Canadian government had consumed \$203 million by October 2013. Fourteen departments are taking advantage of RADARSAT many capabilities and making long term investments to develop new capabilities within the departments by either bringing applications closer to an operational status or by finding ways to improve the use of the data in order to better fulfill their mandate. The loss of RADARSAT-1 in March 2013 has put pressure on RADARSAT-2 data ability to meet users' needs. The CSA will continue to work with government users of SAR data to better coordinate their data acquisition plan with the expected benefits of increasing access to their needed SAR data while reducing the average price of data consumed by Government of Canada organizations.
- The CSA will continue to support satellite data applications development and Earth Observation (EO) utilization activities. These activities assist departments with the implementation of space-based solutions and support the growth of capabilities within the service industry. Ten new Applications Development R&D projects will develop EO methods, systems, products and/or services that address Environmental Monitoring or Remediation information needs. Moreover, 19 ongoing projects with 6 departments (Agriculture & Agri-Food Canada, Department of Fisheries and Ocean, Environment Canada, National Resources Canada, Public Safety, and Public Works and Government Services Canada) are aiming at delivering EO information products in support of land, marine and arctic ecosystem management, energy resources development, and disaster management, amongst other.
- The industry will also have the opportunity to bid on other applications development opportunities to provide high-value solutions to the Government of Canada and to increase its capability and competitiveness. For example, the CSA, within the context of its collaboration with the German Space Administration will ensure that the Canadian Industry has the opportunity to develop applications that capitalize on C-band (RADARSAT) and X-band (TerraSAR-X, TANDEM-X) SAR sensors and their capabilities.
- The CSA will continue to leverage international efforts by partnering with international organizations to better serve Canadians:
  - The CSA will continue to participate actively in the International Charter *Space and Major Disasters*, to use Earth Observation (EO) satellites in response to disasters. The CSA continues to regularly provide RADARSAT-2 data and strategic EO-derived information products upon Charter activation, thus contributing to help mitigating the effects of disasters on human life.
  - The CSA will continue to be an active member of the Committee on Earth Observation Satellites (CEOS) by co-chairing the Working Groups on Calibration/Validation and on Disaster Management. CSA will also continue its contribution to the global satellite mapping of the polar ice sheet to ensure historical data continuity through its active participation in the Polar Space Task Group.

- The CSA will also continue to support the implementation of key international initiatives led by the Group on Earth Observation, such as the Joint Experiment for Crop Assessment and Monitoring (JECAM) for space-based monitoring of agriculture, the Forest Carbon Tracking and Global Forest Observation Initiative (GFOI) and Caribbean Flood Pilot Project (CSDP) aiming at improving the capacity for mitigation, management and coordinated response to natural hazards.

To learn more about Earth observation, go to:

<http://www.asc-csa.gc.ca/asc/eng/satellites/default.asp?page=observation>

To learn more about satellite communications, go to:

<http://www.asc-csa.gc.ca/asc/eng/satellites/default.asp>

## 1.2. Program : Space Exploration

**Description:** This Program provides valuable Canadian science, signature technologies and qualified astronauts to international space exploration endeavours. This Program contributes to the Government of Canada's Science and Technology Strategy. It fosters the generation of knowledge as well as technological spin-offs that contribute to a higher quality of life for Canadians. It generates excitement within the population in general and contributes to nation-building. This Program appeals to the science and technology communities. It is targeted mostly towards Canadian academia and international space exploration partnerships. Canadian industry also benefits from the work generated within this Program. This Program is delivered with the participation of foreign space agencies and Government of Canada (GoC) organizations. This collaborative effort is formalized under international partnership agreements and contracts.

### - 2014-15 EXPECTED ACCOMPLISHMENTS -

#### 1.2.1 Sub-Program: International Space Station (ISS)

- The CSA will continue to fulfill its International Space Station obligations by operating the Mobile Servicing System (MSS) until 2020. This involves providing operational and technical support for the MSS hardware and software; repairing failed hardware; replacing obsolete sub-systems; providing MSS training for astronauts, cosmonauts and ground support personnel; planning MSS operations and providing real-time support; and conducting operations in conjunction with the NASA Houston flight control room from the Remote Multi-Purpose Support Room located in Longueuil, Québec. CSA is initiating the procurement of new MSS cameras to replace the obsolete ones which no longer have any spare components available. Most of the operation and maintenance activities are done through contracts to industry for logistic and sustaining engineering or through competitive request for proposal for the MSS Cameras.
- The CSA will continue to maintain MSS operational preparedness to carry out ISS maintenance and operations. This will entail the development and certification of new flight products and operational procedures to support MSS operations. CSA will also continue to monitor the MSS health and put in place mitigation activities to maximize the MSS life.
- The CSA will finalize the negotiation and continue the implementation of the agreement with NASA to provide technologies and services that will offset Canada's share of the ISS Common System Operation Costs to 2020. The objective of this exercise will be to ensure that a potential agreement with NASA not only meets NASA needs but optimizes Canadian industry benefits and provides an opportunity for investments in emerging Canadian technology.



- The CSA will enable Canadians to utilize the ISS through the development and implementation of state-of-the-art scientific research and innovative technology including:
  - CSA will support the industry for the development of state-of-the-art technology for biomedical analysis in space targeting new instruments to be used on board the ISS to support space life science studies.
  - The cardiovascular study BP Reg aims to validate a simple in-flight method to test the risk of fainting on return to Earth after long duration space flight. There are also Earth applications: dizziness and fainting caused by reduced blood flow in the brain account for up to 3% of emergency room visits, especially among older patients who are at greater risk for serious bone injury from falls. Results will improve our understanding of the mechanics behind fainting, and the ability to predict the likelihood of fainting, which will enhance modern health care.
  - Radiation dosimeter technology will be validated through the Radi-N2 payload. In this project performed in collaboration with the Russian Agency Roscosmos, finger-size bubble detectors around the station and on an astronaut will help measure neutron radiation exposure and map radiation patterns within ISS.
  - The Binary Colloid Alloy Test Canadian experiment 1 (BCAT-C1) will be operated on the ISS until March 2015. It is a fluid science experiment using NASA hardware that will further our understanding of the properties of colloids such as paint, pharmaceuticals or food products.
  - The Tomatosphere IV is an educational activity aimed at stimulating the interest of students in biology and space science through exposure of tomato seeds to the space environment. Tomatosphere projects have stimulated students to see the relevance of science, not only in the classroom, but in and out of this world. Since the project began in 2001, over 2 million Canadian children have taken part in Tomatosphere by comparing tomatoes grown from seeds exposed to a space environment with Earth-bound seedlings to learn about exciting world of science, space exploration, food and nutrition.
  - The CSA will continue to supporting data analysis from past and current scientific experiments. Science teams at York University, University of Waterloo, Ryerson University and Simon Fraser University are using unique data generated on the ISS in projects such as Hypersole, BISE and Vascular to further our understanding on human adaptation to space. This knowledge will help inform about health risks of space travel and improve the safety of human space flight, while improving health care on Earth.
  - The CSA will support the development of new scientific studies focusing on bone loss, cardiovascular adaptation, and blood cell production occurring in the space environment, and on the psycho-social adaptations that occur during spaceflight. These studies will have important contributions to the development of novel mitigation strategies against the risks of human spaceflight, and will also have applications on Earth.

### **1.2.2 Sub-Program: Exploration Missions and Technology**

- Canada is participating in the James Webb Space Telescope (JWST), a major facility-class space observatory that is scheduled for launch in 2018. The JWST is a successor to the highly successful Hubble Space Telescope. Canada is responsible for the design and construction of the Fine Guidance Sensor (FGS), a critical element of the mission, which ensures the very precise pointing of the telescope and for the design and construction of a science instrument named NIRISS (Near Infrared Imager and Slitless Spectrograph). Both instruments were delivered in July 2012. The CSA will continue to support the finalization and integration of the flight instruments on board JWST. By virtue of CSA's contribution, Canadian astronomers will have guaranteed access to 5% of the observing time of the James Webb Space Telescope.
- The CSA will complete and deliver an optical metrology system through NEPTEC for participation in JAXA's lead ASTRO-H mission, an X-ray space astronomy telescope, scheduled for launch in 2015. This mission also includes participation from Europe and NASA. The CSA's participation foster Canadian industrial capabilities in optics and will enable Canadian scientists to apply for observation time on the telescope.
- The CSA will support the operations of the Near Earth Object Surveillance Satellite (NEOSSat) that was launched in February 2013. The NEOSSat is a microsatellite jointly sponsored by CSA and Defense Research and Development Canada (DRDC) to acquire useful metric (position/time) data on discovered near-Earth asteroids and man-made objects (spacecraft and space debris). Images are downloaded and analyzed by the University of Calgary's NEOSSat science operations centre. Through NEOSSat, Canada is contributing to the international effort to both catalogue the near-Earth population of asteroids producing information crucial to targeting new destinations for future space exploration missions and to maintain the safety of Canadian and international assets, both civilian and military.
- The CSA will support the integration of the Flight Detector Subsystem for the Ultra Violet Imaging Telescope (UVIT) on board the ASTROSAT satellite of the Indian Space Research Organization (ISRO). The subsystem was delivered to ISRO in February 2010 but the flight has been delayed by India and is now scheduled no earlier than mid-2014. The CSA's participation will guarantee 5% of the observing time for Canadian scientists and access to ASTROSAT's astronomic data.
- With the successful launch of ESA's Herschel and Plank space telescope, in May 2009 to study how galaxies were formed in the early universe and how stars have been created throughout the history of time, CSA will continue to support the Canadian science teams involved in the post on-orbit operations phase of this space observatory and will then support the close-out activities for these missions.
- MOST is a micro-satellite, carrying a space telescope to study Micro-variability and Oscillations of Stars. Since its launch in 2003, MOST has vastly exceeded expectations by observing over ten times as many targets as originally expected during 10 years of operations. CSA has conducted a formal review for further extension of the mission and will implement the approved recommendations in 2014-15.

- The CSA will complete the design and enter the development stage for the OSIRIS-Rex Laser Altimeter (OLA), an advanced scanning LIDAR (Light Detection and Ranging) that will provide global topographic mapping of the target asteroid's surface; assist the mission as a navigation aid; and provide context for images and spectra collected by other instruments on the OSIRIS-Rex mission. The mission is part of the NASA New Frontiers program and will launch in 2016. It will be the first U.S. mission to return samples from an asteroid and it will constitute a first for Canada.
- The CSA will continue to support the operations of the Alpha Particle X-ray Spectrometer (APXS) for Curiosity, the Mars Science Laboratory (MSL) that landed on Mars in August 2012. The Canadian contribution is helping scientists to determine the chemical composition of various soil, dust and rock samples on Mars.
- The CSA will evaluate potential contributions to international space astronomy and planetary exploration missions by initiating phase "0" studies for Moon and Mars exploration and to support space astronomy missions.
- The CSA's Space Exploration Core Program aims at preparing Canadian industry and research organisations for future exploration missions by advancing the readiness of various technologies as well as scientific, medical and operational procedures. The CSA will continue the development of concepts for planetary and space astronomy missions. The CSA will deploy the terrestrial prototypes of the rovers and payloads that were delivered as part of Canada's Economic Action Plan 2009. Through the Advanced Astronaut Medical Support project, the CSA will continue to explore the development of medical Concepts of Operations as well as medical technologies and procedures for human space flight. The CSA will also initiate new prototyping activities and support analogue mission deployments, working in collaboration with industrial and academic partners such as the Canadian Field Robotics Network of the Natural Sciences and Engineering Research Council of Canada.
- The CSA will continue to participate actively to the International Space Exploration Coordination Group (ISECG). This group was created in 2007 to promote coordination of Moon and Mars exploration between 14 space agencies around the world. In 2014, the ISECG will initiate work preparing the third version of the Global Exploration Roadmap for robotics and human exploration of the Moon, Mars and asteroids originally published in 2011 and updated in 2013. The ISECG will furthermore develop a concept for interaction with the science community. It will also support community workshops targeted at stakeholder engagement. The CSA will continue to chair the ISECG until the next Senior Agency Manager meeting planned for 2015.

### 1.2.3 Sub-Program: Human Space Missions and Support

- The CSA will maintain its human space flight expertise to meet the requirements of the CSA's exploration program.
  - The two newest Canadian astronauts continue to be eligible for long-duration space flight assignments to the International Space Station. They continue training on various ISS Partners' segments while assuming collateral duties in support to the ISS Program and CSA priorities.
  - The CSA Medical Operations specialists will maintain their operational skills in collaboration with international partners in order to remain current and be ready to support the next Canadian mission.
- The CSA will continue to actively support the ISS Operational and Medical panels and working groups that are mandated by international agreements.
- In order to maintain astronaut health and performance, it is necessary to identify and characterize the spaceflight risks. These are largely associated with the long-term effects of reduced gravity, radiation, and other aspects of the space environment on systems ranging from the cell to the whole body. CSA will take advantage of the 1-year mission on the ISS in 2015, and plan a radiation health and monitoring activity in collaboration with the Russian Space Agency, the European Space Agency and the Atomic Energy of Canada involving the study of chromosomes in astronauts after their flight. In addition, collaborative work with the same partners will help improve the prediction modeling of mission-related radiation exposure of astronauts.
- The Health and Life Science program managed by CSA will support and initiate several activities including:
  - Consultations of the scientific and medical communities that will provide the opportunity to identify promising mission concepts for future ISS utilization in two areas: studies that can contribute to reduction of health risks of space missions, and studies that will enable to study the response of living organisms to space radiation beyond low Earth orbit. Science teams will perform Science Definition Studies following a Request for Proposals led by CSA Exploration Core team, which will result in definition of scientific requirements in these areas.
  - The CSA and the Canadian Institutes of Health Research will continue their collaboration to support research in space relevant to the aging process. Space provides an interesting model for aging. There are important similarities between the effects of space on astronauts and the process of aging on Earth such as chromosomal changes.
  - The CSA will continue to collaborate in the European Life and Physical Sciences Program (ELIPS). Through this program, Canadians have access to space analogue facilities such as bed rest that are not available in Canada.
  - The CSA will continue to work with the European Space Agency, the Japan Aerospace and Exploration Agency, NASA, the German Space Agency, the French Space Agency and the Italian Space Agency to support Canadian science experiment through by coordinating space life sciences and multinational world-class scientific research.

Participation in this international working group generates, efficiencies through collective peer review, and space hardware and data sharing.

- The CSA will continue to honor its collaborative agreement with the Canadian Institute of Health Research to jointly fund research related to nanotechnology-based diagnostic and treatment systems for health on Earth and in space.

To learn more about space science and exploration, go to:  
<http://www.asc-csa.gc.ca/asc/eng/sciences/default.asp> and,  
<http://www.asc-csa.gc.ca/eng/sciences/astronomy.asp>

### **1.3 Program: Future Canadian Space Capacity**

**Description:** This Program attracts, sustains and enhances the nation's critical mass of Canadian space specialists, fosters Canadian space innovation and know-how, and preserves the nation's space-related facilities capability. In doing so, it encourages private-public collaboration that requires a concerted approach to future space missions. This Program secures the nation's strategic and ongoing presence in space in the future and to preserve Canada's capability to deliver internationally renowned space assets for future generations. It is targeted at Canadian academia, industry and youth, as well as users of Canadian space solutions (Government of Canada (GoC) organizations) and international partners. This Program is conducted with the participation of funding agencies, GoC organizations along with government facilities and infrastructure, foreign space agencies, not-for-profit organizations and provincial governments. This collaborative effort is formalized under contracts or national and international partnership agreements. This Program is funded through the Class Grant and Contribution Program to support research, awareness and learning in Space Science and Technology.

#### **- 2014-15 EXPECTED ACCOMPLISHMENTS -**

##### **1.3.1 Sub-Program: Space Expertise and Proficiency**

- Following the completion of the new stratospheric balloon launch base in Timmins, Ontario and the successful qualification flights in the summer of 2013, CSA will support the next scientific balloon campaign, to be held in Timmins, in August-September 2014. Instruments from several Canadian Universities and organizations will benefit from these flight opportunities during the STRATO-SCIENCE 2014 campaign, here in Canada.
- CSA will continue its efforts to provide a unique platform to perform atmospheric and space sciences as well as for the qualification of new space technologies and for the training of Canada's next generation of scientists and engineers. Flight opportunities on stratospheric balloons to be launched not only from Canada but also from bases located worldwide, are already possible thanks to a collaborative agreement signed between the CSA and the French space agency. Finally, in order to increase the number of Canadian instruments to be flown on balloons, the feasibility of building Canadian generic gondolas will be investigated.
- Ten of the eleven university projects funded through the Flight for the Advancement of Science and Technology (FAST) announcement of opportunity 2011 will fly on suborbital platforms and/or space-related instruments in order to validate their associated technologies or generate scientific data.
- The CSA will complete the Advanced Payload Development activity for the adaptation and integration of the SHOW (Spatial Heterodyne Observation of Water) payload elements in preparation for a stratospheric balloon flight demonstration in late summer 2014.

- The CSA will continue to provide in-kind technical support to four of the eleven FAST announcements of opportunity 2011 grantees to assist them in getting ready to fly their respective payloads on upcoming French space agency's balloon campaigns.
- Through the CSA FAST announcement of opportunity 2013, newly selected grantees from academia will gain access to suborbital platforms including balloons, aircrafts, nanosatellites and sounding rockets. As is the case with the FAST 2011, the FAST 2013 space science and technology development projects will contribute to the development of the next generation of scientists and engineer.
- The two Canadian BRITE nanosatellites are scheduled to be launched in April 2014 from Russia, thereby joining two other nanosatellites already in orbit and respectively owned by an Austrian and Polish academic institutions. These four nanosatellites will be operated by the Space Flight Laboratory from (SFL) of the University of Toronto Institute for Aerospace Studies (UTIAS). Several Canadian scientists and graduate students funded through the FAST 2011 will conduct investigations using scientific data generated by the four BRITE nanosatellites.
- The CSA will continue to provide support to ten research projects already funded through the CLUSTER announcement of opportunity 2011. These projects aim at encouraging data sharing, scientific collaboration and technology development through support for multi-disciplinary and multi-institutional Earth-based research. Each CLUSTER project requires the collaboration of at least three partnering organizations.
- The CSA will continue to support Industrial Research Chair (IRC) partnerships co-funded with the Natural Sciences and Engineering Research Council of Canada (NSERC).
- As part of one of these IRC partnerships, the CSA will continue to provide access to its ground-based installations and laboratories. The intention of the CSA contribution in this IRC is to ensure that CSA's unique space-related ground assets (namely the Mars yard) are incorporated into undergraduate and graduate training in research and development so as to encourage the acquisition of mission-relevant knowledge, skill sets and experience.
- Through a 2014 announcement of opportunity, the CSA plans on funding terrestrial research projects aiming at developing HQP in space-like missions.
- The CSA is planning on conducting an analysis with the chief aim of identifying the nature and magnitude of any gaps that may exist between the students graduating from Canadian universities and the industrial workforce requirements.
- The CSA will identify the existing National organizations providing funding assistance to space-related activities, opportunities and projects aimed at enhancing the Canadian industrial workforce as well as supporting the development of the next generation of scientists and engineers.

- The CSA is continuing, on a best effort basis, the development of the Concurrent Design Facility (CDF). The CDF has reached one third of its capacity and continues to grow steadily as resources are available. This facility is meant as a tool allowing to run feasibility (phase 0/A) studies of future space missions, thereby improving significantly the overall definition of mission cost, schedule and requirements. This improvement is achieved by involving simultaneously the client(s) and a design team composed of multidisciplinary specialists. The CDF also acts as a repository of lessons learned and corporate knowledge coming from past mission / studies, which can further be used to better define future CSA projects by identifying technical risks early-on.



### 1.3.2 Sub-Program: Space Innovation and Market Access

- Through the participation in European Space Agency (ESA) Earth Observation Programs, more specifically the Earth Observation Envelope Program and GMES Space Component, CSA continues to support Canadian companies to be involved in development of advanced space-borne instrument and sub-systems, user-oriented applications, and ensuring access to the data for Canadian uses such as:
  - Active participation by Canadian scientific community exploiting data generated from the Canadian built Electric Field Instrument for study of ionosphere and Earth magnetic field (the satellites were successfully launched on 22 November, 2013);
  - Potential Canadian contribution of an active calibration transponder for P-band Synthetic Aperture Radar of BIOMASS mission which has been selected as the 7<sup>th</sup> Earth Explorer mission;
  - Preparation for call for proposal of 9<sup>th</sup> Earth Explorer mission in the areas of next generation precipitation observation from space for high latitude precipitation measurements;
  - Development of advance payload instrument technology for potential contribution to next generation precipitation mission;
  - The development of applications in the field of aquaculture, forestry and subsidence, oil and gas development, and Polar monitoring;
  - Ensuring access to Sentinel mission data by participating in data policy formulation, program declaration, and coordination with other Government agencies so that adequate Canadian ground infrastructure is established within Canada to receive and process the data.
- Through Canada's partnership with the European Space Agency (ESA), the CSA will continue to position the Canadian industry and scientists in future scientific and technological developments relating to the European Aurora planetary exploration programs. In particular, CSA will monitor closely Canadian industrial participation to the two Exomars missions planned to be launched in 2016 and 2018. The CSA will also continue to position the Canadian industry and scientists in future scientific and technological developments relating to the European Life and Physical Science Program (ELIPS). Canada has participated in the ELIPS Program in the past, and its contribution to the latest ELIPS-4 will provide opportunities to Canadians in Europe and on European assets such as bed rest facilities, sounding rockets and even ISS allocation to advance the Space Life Science mandate.
- Canada's participation in the European Advanced Research in Telecommunications Systems (ARTES) allows our industry to access forward-looking studies on new telecommunications services, and to develop new satellite, technologies, equipments and applications focussing in the area of satellite-based Automatic Identification Systems (AIS) for improved maritime domain awareness in partnership with the European industry.

- The CSA will also continue to support the maturation of Canadian space technologies in view of their potential use in ESA missions and to support Canadian industry's participation to In-orbit technology demonstration missions through its participation to ESA's General Support Technology Program (GSTP). For example, CSA is supporting the development of Canadian Lidar-based Hazard Detection and Avoidance technology for potential use on a Lunar mission and is supporting the development of the Canadian GNC software on the In-Orbit Demo Formation Flying Mission Proba 3 planned to be launched in 2017.
- Through a prioritization process using mission and technology roadmaps as input, the CSA is identifying technology priorities in order to reduce uncertainties of future missions of Canadian interest as well as promising generic technologies that could enhance Canada's capabilities. CSA's Space Technology Development Program (STDP) will therefore continue to ask industry and research organizations to work on these technology priorities through R&D contracts. Examples of projected technology development activities in 2014-2015 include:
  - Development of a DNA-Based Radiological Dosimeter for Space Crew Applications: Experimental research performed to develop a gel-based DNA-based dosimeter. This dosimeter would be eventually used by astronauts to monitor their exposure radiation. It is believed that the full development of the DNA dosimeter technology will place Canada in a leading position for novel and state-of-the-art dosimetry measurement for mixed-field application.
  - Development and prototyping of a compact laser for future space missions: Development, design, optimization, testing and delivery of a compact prototype laser for potential space missions aimed specifically for longer laser ranging, high resolution atmospheric backscatter lidar monitoring, planetary exploration or Earth Observation, remote gas sensing and Raman spectroscopy for solid targets (e.g. Moon or Martian soil).
  - On-board Propulsion System for Micro and Small Satellite Stationkeeping and De-Orbiting: Development will evolve an existing cold gas system into a monopropellant system for improved specific impulse, using an appropriate (i.e. less hazardous) fuel. A second development will evolve the existing cold gas system into an electric propulsion system using the same green, non-toxic fuel that is presently being used.
  - Modular Design for CASS-CATS: This contract follows from a previous collaboration with Sweden where Canada contributed the OSIRIS instrument for the ODIN satellite. The current development of the CATS instrument for the CASS mission is the next generation of the OSIRIS instrument. Development of the CATS instrument will place Canada in a strong position to partner with Sweden once again on the CASS mission.
  - Dexterous Robotic Tools: This contract enables Canada to maintain its leading position as a world leader in on-orbit robotic servicing technology. Development of this technology will enable servicing of unprepared (or lightly prepared) space vehicles, leading to a wide range of new possible robotic missions, including orbital debris cleanup, de-orbit of spacecraft, and satellite servicing.

- Through non-refundable contributions, the Space Technology Development Program will also support Industrial Capacity Building, CSA will award contributions to companies to support industry responsiveness to future market demands and their maintenance of global competitiveness in areas of Canadian strengths: robotics, optics, satellite communications and space-based radar. The work covered by these agreements will include the development of novel concepts, products and improving industrial processes.
- The CSA will continue modifications and risk reduction work on the CSA generic microsatellite bus. Mission options have been proposed to take advantage of the flight opportunity offered by this platform, and activities to confirm its feasibility and target performance have been initiated. Activities to adjust the microsatellite bus to the selected mission will be initiated.
- The CSA will continue to participate actively in the Inter-Agency Space Debris Coordination Committee (IADC) activities and meetings. This committee is an international government forum of 12 Space Agencies, for the global coordination of research activities related to the growing threat from man-made debris in space. CSA access to the latest space debris research activities aims to minimize potential threats to Canadian satellites and other space assets. CSA will foster and leverage this relationship with IADC partnering agencies.
- The CSA will continue to promote technology transfer of space technologies to the Canadian industry via licensing and other activities through its Intellectual Property Management and Technology Transfer Office, enhancing Canada's industrial competitiveness. CSA will contribute to innovation by facilitating research collaborations with academia and industry.

### 1.3.3 Sub-Program: Qualifying and Testing Services

- The David Florida Laboratory (DFL) will continue to provide environmental space qualification services for the assembly, integration and testing of spacecraft systems to CSA's programs as well as national and international clients. Following a year of significant facility and infrastructure modifications including installation of a new spacecraft integration crane, replacement of HVAC systems, refurbishment of DFL's complement of smaller thermal vacuum chambers, and updates to general building electrical and mechanical systems, the DFL is well prepared to return to full operational mode in fiscal year 2014-15. As a result, many priority projects will benefit from DFL support, including:

CSA sponsored programs and projects:

- RADARSAT Constellation Mission including components, subsystems, and SAR antenna panels;
- Mars rover and payload consisting of a robotic drill and sample transfer system;
- Canadian Astro-H Metrology System (CAMS);
- OSIRIS-Rex;
- SWOT-C; and
- Conclusion of DFL's contribution to James Web Space Telescope (JWST).

Commercial/Industry sponsored programs and projects:

- Various antennas and reflector payloads for MDA-M;
- SICRAL 2 UHF TX & RX Antennas for Thales Alenia Space;
- MEOSAR for ComDev;
- TriDAR Cygnus resupply vehicles for Neptec;
- Spacecraft filters DRKO Program for ComDev;
- INMARSAT aeronautical antennas for Honeywell and Tecom Industries;
- METEOSAT Third Generation (MTG) spacecraft panels for Thales Alenia Space;
- Radome antennas (CF-18, L3-MAS, USN) for L3 Communications;
- Extended Interaction Klystron (EIK) for CPI.

To learn more about enabling technology development, go to:

<http://www.asc-csa.gc.ca/eng/programs/default.asp>

To learn more about qualifying and testing services go to:

<http://www.asc-csa.gc.ca/asc/eng/dfl/default.asp>