Geospace Observatory Canada (GO Canada) Program
Operations, Maintenance, and Engineering Services

Statement of Work

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Table of content

STATEMENT OF WORK 2

1. PURPOSE 2

2. LANGUAGE REQUIREMENTS 2

3. DESCRIPTION OF THE CGSM PROGRAM 2

3.1 Background 2

3.2 CGSM core sites 3

3.3 Software/applications for monitoring and control 6

3.4 GO Canada Scientific elements 7

3.5 Description of the instruments 9

3.6 Government Furnished Equipment 12

4. IMPLEMENTATION PLAN 13

5. SCOPE 13

6. MEETINGS 16

7. DELIVERABLES 17

APPENDIX 1 CORE SITES LAYOUT DIAGRAM 18

APPENDIX 2 ITI BUILD DOCUMENTS 19

APPENDIX 3 MATERIAL LIST 20

Statement of Work

1. Purpose

The Canadian Space Agency (CSA) has the requirement to provide operations, maintenance, and engineering (OM&E) services to the ongoing Geospace Observatory (GO) Canada program. In particular, the core sites contain crown-owned computer infrastructure and instruments that will be maintained by this contract.

The GO Canada program was originally known as the CANOPUS program, and then the Canadian GeoSpace Monitoring (CGSM) program. It is motivated by the need for greater fundamental understanding of the planetary environments that are affected by short- and long-term variability of our star – the Sun. The Sun and Earth form a tightly coupled system, with solar variability driving space weather and climate, the creation of harsh radiation environments, and the generation of the aurora. The GO Canada program seeks to understand this fundamental solar-terrestrial coupling and its influence on our planetary environment.

2. Language requirements

The working language for the work to be performed under this Statement of Work is English.

3. Description of the GO Canada Program

3.1 Background

The GO Canada program is the direct successor of the CGSM program which succeeded to the CANOPUS program and builds on its world-class heritage. The CANOPUS program began in the early 1980s and is described in *CANOPUS: Scientific Objectives and System Description*, *CANOPUS – A ground based instrument array for remote sensing in the high latitude ionosphere during ISTP/GGS program*, and *CANOPUS-2000: A Proposal to the Canadian Space Agency* (references below).

From 2003 to 2007, the CGSM instrument network was composed of the Canadian SuperDARN radars, the CADI digisonde array, the CANOPUS and CANMOS magnetometers, the CANOPUS Meridian Scanning Photometers (MSPs), the CANOPUS riometer array, the NORSTAR All Sky Imager (ASI) array, and the Solar Radio Monitoring Program (SRMP) 10.7 cm solar flux antenna. This phase of the CGSM program was characterized by major deployments of new instrumentation and the hardware and software infrastructure required to manage the resulting data.

The following phase (2008-2012) saw additional deployments to increasingly focus on activities that realize the full potential of the CGSM dataset. The scientific elements of CGSM that received funding for this new phase are enumerated below (see *GO Canada Scientific* elements).

From December 2013 to November 2018, the Geospace Observatory (GO) Canada will support 10 scientific projects funded by the CSA. Some of those projects require the use of core sites and are listed in this document.

This contract will support the shared infrastructure used by the GO Canada projects, maintain the crown owned equipment, and provide telecommunication and power to the core sites and hosted instruments.

CANOPUS Science Team (1986), CANOPUS: Scientific Objectives and System Description, http://www.cgsm.ca/doc/CANOPUS_yellow_book.pdf.

Rostoker, G., J. C. Samson, F. Creutzberg, T. J. Hughes, D. R. McDiarmid, A. G. McNamara, A. Vallance Jones, D. D. Wallis, and L. L. Cogger (1995), CANOPUS – A ground based instrument array for remote sensing in the high latitude ionosphere during ISTP/GGS program, *Space Sci. Rev.*, *71*, 743, doi:10.1007/BF00751349.

Canadian Space Science Community (1999), CANOPUS-2000: A Proposal to the Canadian Space Agency, http://www.cgsm.ca/doc/canopus_2000.pdf.

3.2 GO Canada core sites

A core site is currently defined as a location where more than two scientific groups operate instruments and share a crown-owned IT infrastructure. The previous 13 CANOPUS/CGSM sites are now considered as GO Canada core sites. New core sites should be commissioned during summer 2014 (or later) and are referred to as proposed sites in this section (Table 3). The Contwoyto and Arviat sites are currently not operational and should be subject to relocation in the future.

TABLE 1: CURRENT OPERATIONAL GO CANADA CORE SITES

Name	Code	Lat. (°)	Long. (°)	A	P	F	R	H	HSe/ITI	Dome
Dawson	DAWS	64.05	220.89			✓	✓	⭘	✓	No
Fort Churchill	FCHU	58.76	265.92			✓	✓		✓	No
Fort McMurray	FMCM	56.66	248.79			✓	✓		✓	No
Fort Simpson	FSIM	61.76	238.77	⭘		✓	✓		✓	Yes
Fort Smith	FSMI	60.02	248.05	✓	✓	✓			✓	Yes
Gillam	GILL	56.38	265.36	✓	✓	✓	✓	⭘	✓	Yes
Island Lake	ISLL	53.85	265.33			✓	✓		✓	No
Pinawa	PINA	50.25	263.96	✓	✓	✓	✓		✓	Yes
Rabbit Lake (Mine)	RABB	58.22	256.32	✓		✓	✓		✓	Yes
Rankin Inlet	RANK	62.82	267.89	⭘		✓	✓		✓	No
Taloyoak	TALO	69.54	266.45	⭘		✓	✓	⭘	✓	Yes

CGSM GFE Instruments [A=ASI, P= MSP, F=Fluxgate, R=Riometer, H=HF Receiver, HSe/ITI=IT Infrastructure and RT Data Retrieval System, ✓=deployed**,** ⭘=planned]

TABLE 2: CURRENT NON-OPERATIONAL GO CANADA CORE SITES

Name	Code	Lat. (°)	Long. (°)	A	P	F	R	H	HSe/ITI	Dome
Eskimo Point (Arviat)[1]	ESKI	61.11	265.95			✓	⭘		✓	No
Contwoyto Lake	CONT	65.75	248.75			✓	⭘		✓	No

CGSM GFE Instruments [A=ASI, P= MSP, F=Fluxgate, R=Riometer, H=HF Receiver, HSe/ITI=IT Infrastructure and RT Data Retrieval System, ✓=deployed**,** ⭘=planned]

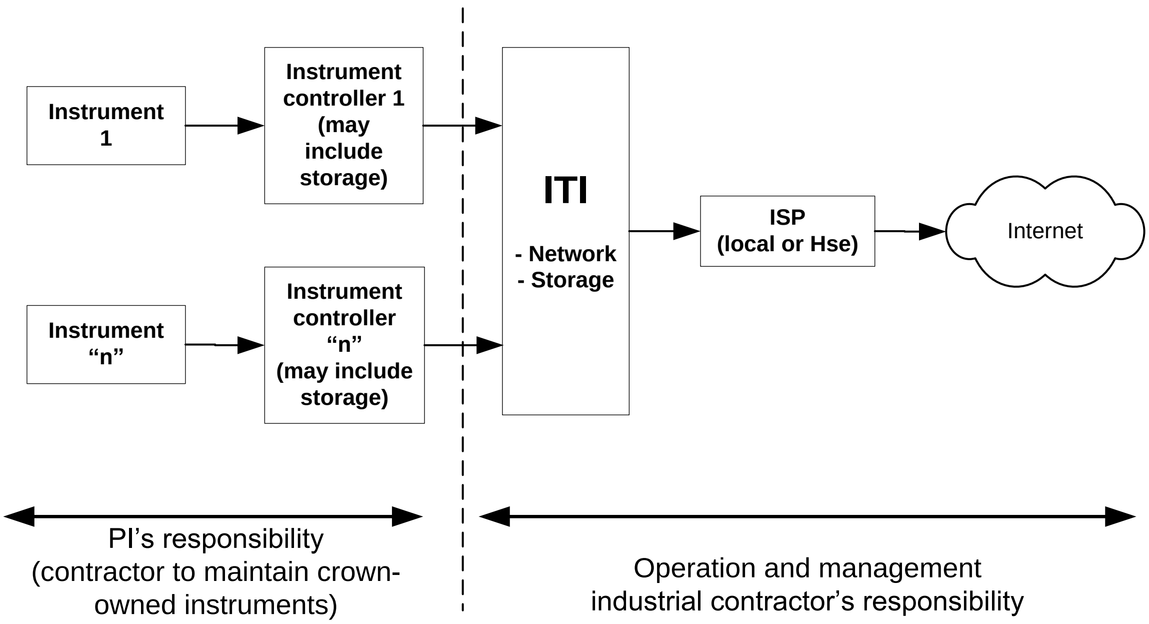
[1] Although originally a core site, the location of the core site will be moved to another location.

TABLE 3: PROPOSED GO CANADA CORE SITES

Name	Code	Lat. (°)	Long. (°)	A	P	F	R	H	HSe/ITI	Dome
Nain[2]	NAIN	56.54	298.31					⭘	⭘	
Qikiqtarjuaq[2]	QIKI	67.56	295.98					⭘	⭘	
Sachs Harbor	SACHS	71.98	234.77	⭘			⭘	⭘	⭘	Yes *

CGSM GFE Instruments [A=ASI, P= MSP, F=Fluxgate, R=Riometer, H=HF Receiver, HSe/ITI=IT Infrastructure and RT Data Retrieval System, ✓=deployed**,** ⭘=planned].

* **-** Placeholder for dome exists. Dome yet to be installed. Supplied by the UofC



A core site is usually composed of the following:

- Instruments and their controllers;
- Information Technology Infrastructure (ITI);
- Ka-band internet connection;
- Building and its utility;

A. **Instruments**

At each core site, the scientific Principal Investigators are responsible for the instruments (operation and maintenance), up to the point where each instrument connects to the Information Technology Infrastructure (ITI). Section 3.4 of this Annex provides a list of the contract holders for scientific operation and maintenance of instruments in the context of GO Canada.

[2] Nain and Qikiqtarjuaq will be maintained as GO Canada Core sites for the 3-year duration of the HF Receiver experiment, but may or may not be retained as GO Canada Core sites after the completion of this experiment.

B. **Information Technology Infrastructure (ITI) / Ka-band internet connection**

The ITI and the internet connection are the responsibility of the Contractor. A shelter is also provided to host the electronics.

The IT infrastructure provides basic network services, shared storage, and serial data acquisition capabilities at each GO Canada core site. It is capable of autonomous operation under non-ideal conditions such as dusty environments, poor power quality, and potentially extreme temperatures.

The primary design goal for the ITI is to simplify the requirements for operating scientific instruments at remote field sites. This is done by providing a core set of required services coordinated over standard internet connections.

Internal Network

Communication at each field site is via standard internet protocols (e.g. TCP/IP). The primary "bus" is a 24- port 10/100 Mbps Ethernet switch with an additional bank of surge protection modules. All connectors are standard RJ-45; all cables are Cat5. All networked devices can communicate with each other directly through the switch without any intervention by the ITI computer.

The main internal network is configured to allow up to 249 devices in addition to the core ITI computer and four power related elements (see below). Several network addresses have been set aside for automatic (DHCP) allocation to temporary (e.g. short-term campaign) clients. Addition of each new permanent network devices requires some minor configuration file changes.

Internal Services

The core ITI computer provides several services to clients on the internal network.

- DHCP - dynamic host configuration protocol;
- DNS - domain name services;
- NTP - a network time protocol reference is available to all internal clients. The primary standard is provided by a GPS (Trimble Accutime 2000), which should be accurate to less than 1 millisecond. Additional time sources can be obtained over the internet, but satellite travel time delays introduce significant and variable inaccuracies (e.g. 0.1 to 1 seconds).

Internet Connection

Each GO Canada core site has a single connection to the internet provided by a satellite link where no local ISP is available. Current utilization for most sites (except those with all-sky imagers and scanning photometers) is typically 2.2 kbps.

External Services

The ITI computer acts as the primary gateway for the internal network. It provides multiplexing capabilities so that multiple internal clients can share a single external IP-address.

- SNAT - source network address translation allows internal clients to initiate network connections with external systems. This is accomplished automatically for all internal clients.
- DNAT - destination network address translation allows external devices to initiate network connections with internal clients. This requires minor configuration file changes for each additional client.

Power Management

Two American Power Corporation AP7900 switch PDU devices are provided for clients. Both of these are network-enabled, allowing for remote monitoring and control. All plugs and outlets are standard NEMA 5-15. UPS 1 is dedicated to providing power to the ITI computer and associated equipment. UPS 2 is dedicated to providing power to the instruments at site.

- UPS - uninterruptible power supply filters line power and provides short duration (>30 minutes for the ITI UPS and less for the instrument UPS) battery backup.
- PDU - power distribution unit has 8 individually switchable outlets and a total current monitor.

Other

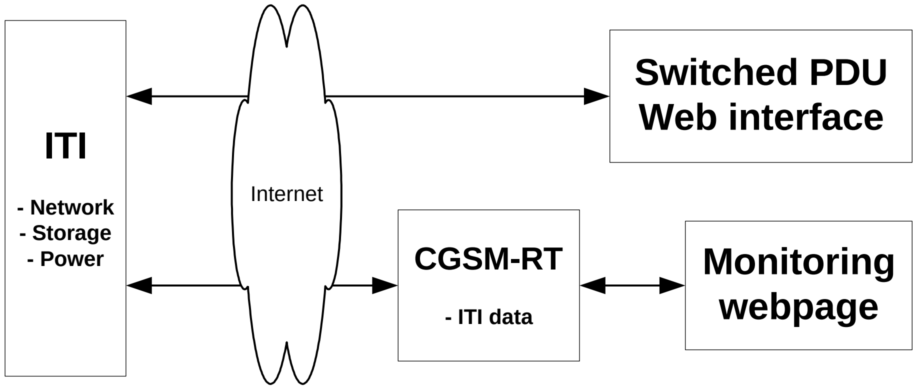
- Temperature sensors for monitoring.
- KVM - an 8-port keyboard/video/mouse switch allows clients to share the site LCD display and keyboard/mouse input devices.
- Rack- Some legacy equipment is still used in the current operation of the site. Additional rack space for new client devices with rack mount form factor is available.RS232 - as legacy serial devices are decommissioned, more ports will become available
- Storage - roughly 50 GBytes of disk space are available for client data. No interface is currently configured for this purpose, but it would be easy to provide multiple access methods (e.g. NFS, SMB, RSync, HTTP)

C. Building and site maintenance

The infrastructure for each core site (operation and maintenance of building, utilities, custodian, etc) is the responsibility of the Contractor. A legacy temperature control system of heaters and ventilation should automatically maintain the building temperature within the 10 °C to 30 °C range. The building is approximately 8 feet long by 12 feet wide, and 8 feet of height.

3.3 Software/applications for monitoring and control

In addition to the software related to the instrument data acquisition, the ITI makes use of several routines/scripts related to configuration, monitoring and control. All software, routines and scripts are used under a GNU General Public License.



A. **ITI system monitoring tool**
Each ITI is running an identical script to gather housekeeping information, while the GO Canada/CGSM-IT machine, currently located at SED Systems in Saskatoon, is running a program that monitors incoming ITI operational data. Both programs use common libraries and modules. The final product is a monitoring webpage were ITI parameters can be visualised at http://142.165.130.79/dataflow/monitor.

B. **ITI configuration files**
Each ITI has its configuration file and the addition of instruments necessitate the modification of the firewall configuration.

C. **ITI remote control**
The power distribution unit can be monitored and controlled via a specific web interface. The description of the unit and remote capabilities can be found at the following website:

http://www.apc.com/resource/include/techspec_index.cfm?base_sku=AP7900

D. **Trac Trouble Ticket System**

Trouble ticket software by "TRAC" is located on the RT system server. This software allows authorized users to log in and register a problem that they may see related to the ITI network or the site itself. Any time a ticket is initiated or updated, the ticket summary is emailed out to the registered users to allow the group to keep up to date to changes and resolutions to problems that affect the core sites.

This software is located at the following website: http://142.165.130.79/trac/cgsm

3.4 GO Canada Scientific elements

This section lists the projects that require the use of core sites. The following table lists the instruments that are or are planned to be deployed at core sites:

Core Sites	AGO	REGO	MSP	VLF	IRIS	Riometer	GPS	ICM	FGM	HFR	Grand Total
Arviat/Eskimo point						√	√				2
Contwoyto						√			√		2
Dawson City						√		√	√	√	4
Fort Churchill						√	√	√	√		4
Fort McMurray						√	√		√		3
Fort Simpson	√					√	√		√		4
Fort Smith	√	√	√		√	√	√	√	√		8
Gillam	√	√	√		√	√	√		√	√	8
Island Lake						√		√	√		3
Nain										√	1
Pinawa		√	√	√	√	√		√	√		7
Qikiqtarjuaq										√	1
Rabbit Lake (Mine)	√					√	√	√	√		5
Rankin Inlet						√	√		√		3
Sachs Harbour		√				√				√	3
Taloyoak		√				√	√		√	√	5
Grand Total	**4**	**5**	**3**	**1**	**3**	**13**	**9**	**6**	**13**	**6**	**63**

The instruments are operated by the following Principal Investigators:

Instrument	Full name	Principal Investigator	Affiliation
FGM	Fluxgate Magnetometer	Ian Mann	University of Alberta
ICM	Induction Coil Magnetometer	David Milling	University of Alberta
AGO	Aurora Geospace Observatory	Eric Donovan	University of Calgary
MSP	MultiSpectral Photometer	Brian Jackel	University of Calgary
IRIS	Imaging Riometer Information System	Emma Spanswick	University of Calgary
REGO	Red Line Geospace Observatory	Eric Donovan	University of Calgary
Riometer	Riometer	Emma Spanswick	University of Calgary
VLF	Very Low Frequency Antenna	Christopher Cully	University of Calgary
GPS	Global Positioning System	P.T. Jayachandran	University of New Brunswick
HFR	High Frequency Receiver	Ryan Riddolls	Defence R&D Canada

The contractor will coordinate with the PI to accommodate his instrument on the ITI.

3.5 Description of the instruments

A. *FGM: Scientific Operation of Fluxgate Magnetometers in the Expanded Canadian Array for Real-time Investigations of Magnetic Activity (CARISMA)*

This project covers the continued operation of an array of fluxgate magnetometers in the CARISMA array. These instruments monitor the magnetic perturbations arising from currents flowing in the ionosphere, a region of Earth's atmosphere above around 110 km altitude which is perturbed by currents and energetic particles from space. The magnetometers operating at the existing CGSM core sites are the S100 series ringcore fluxgates manufactured by the Canadian company Narod Geophysics Ltd. (NGL).

At the core GO Canada sites the magnetometer data logger interfaces with the networking, GPS timing and power supply infrastructure provided by the ITI. At the University of Alberta sites the function of the ITI is replicated by a similar set of infrastructure components.

B. *ICM: Scientific Operation of Induction Coil Magnetometers in the Canadian Array for Real-time Investigations of Magnetic Activity (CARISMA)*

This project proposes to operate an IC network as a complement to the CARISMA network of fluxgate magnetometers. IC magnetometers monitor the AC magnetic perturbations arising from currents flowing in the ionosphere, a region of Earth's atmosphere above around 110 km altitude which is perturbed by currents and energetic particles from space. These induction coils are based on the LEMI–117 induction coil, manufactured by Lviv Centre of Institute of Space Research [sic] (LCISR), Ukraine.

At the core sites the magnetometer data logger interfaces with the networking, GPS timing and power supply infrastructure provided by the ITI.

C. *GPS: Expanded Canadian High Arctic Ionospheric Network (ECHAIN)*

This project proposes to expand the existing CHAIN array and measure the ionospheric electron density. The Arctic is a unique natural laboratory to study the fundamentals of Solar Terrestrial interaction and its impact on modern technological systems such as Global Navigation Satellite Systems (GNSS) and radio communication systems. Observations from this network will facilitate better understanding of the fundamental processes of the Solar-Terrestrial interactions.

The CHAIN GPS receivers are GPS Ionospheric Scintillation and TEC Monitor units (GSV 4004B) made by GPS Silicon Valley, Los Altos, CA, USA. These receivers, NovAtel Euro-3M dual frequency receivers with special firmware, comprise the major component of a GPS signal monitor system, specifically configured to measure amplitude and phase scintillation using the L1 frequency GPS signals, and TEC using the L1 and L2 frequency GPS signals.

Each driver computer has a Linux operating system (Ubuntu 12.0) and a 500-gigabyte (GB) internal hard drive for the temporary local storage of the data. Each computer is also equipped with an external USB storage device for storing a back-up copy of the data that can be mailed to UNB in the event of an extended communication outage. Each system will be connected to a 1500W UPS unit, which will power the system up to 30 minutes in the case of power failure. Power consumption of the total system under nominal operating conditions is 4.75 kWh/day.

This project includes the installation and operation of fifteen Global Positioning System (GPS) receivers, eight of them at GO Canada core sites. The bandwidth requirement of ~62 Kb/s for data acquisition and 5 Kb/s for command and control can be easily handled by the existing connection. Larger data transfers shall be scheduled to run during off-peak times wherein bandwidth is unrestricted.

D. *AGO: Auroral Geospace Observatory*

The Auroral Geospace Observatory (AGO) is a multispectral imaging array that collects high time resolution true colour imagery of the Aurora. Leveraging the expertise of the international space physics community, and engaging the public in geospace science, AGO will enhance understanding of the dynamics surrounding our planet. This will be accomplished through a crowd-sourced classification of auroral forms, study of spectral information, and collaboration with other international projects and outreach programs.

The data collection and transmission process is completely self-contained and the system requires very little from the "site interface". What is required from site is: a building which has an optically viable dome installed on the roof, a quasi-stable 110VAC power supply (maximum power draw = 400W), and an internet connection to the outside world. A standard rainbow imager installation includes: a GPS for time stamping accuracy, a power distribution unit (PDU) which allows independent power cycling of system components, and a Uninterrupted Power Supply (UPS) to ensure instrument operations continue through power brown out conditions and controlled shutdowns during blackout conditions. At core sites the instrument installations leverage existing infrastructure by using the onsite GPS and UPS rather than deploying redundant equipment.

E. *REGO: Red Line Geospace Observatory*

Redline auroral Geospace Observatory (REGO) will focus in on one specific wavelength of the aurora: the sub-visual "red-line". REGO will be comprised of an array of narrow band (or single channel/colour) imagers that incorporate advanced "all-sky" optics and an enhanced detector.

Data from this array will be used by the Canadian and international space physics community to further understand how this particular phenomenon reflects the interactions in geospace.

The data collection and transmission process is completely self-contained and the system requires very little from the "site interface". What is required from site is: a building which has an optically viable dome installed on the roof, a quasi-stable 110VAC power supply (maximum power draw = 800W), and an internet connection to the outside world. A standard Redline imager installation includes: a GPS for time stamping accuracy, a power distribution unit (PDU) which allows independent power cycling of system components, and an Uninterrupted Power Supply (UPS) to ensure instrument operations continue through power brown out conditions and controlled shutdowns during blackout conditions. At the core sites the instrument installations leverage existing infrastructure by using the onsite GPS and UPS rather than deploying redundant equipment.

F. *Rio: Geospace Observatory Riometer Network*

This project operates a Canada-wide Riometer network, and to produce high quality data for space science and space weather purposes. Riometers passively monitor radio "noise" from extraterrestrial sources and have been shown to be an effective way of monitoring high-energy electron populations in the region of space around the Earth. These high-energy electrons are scientifically interesting because they are produced by fundamental physical processes that are not currently well understood.

Each GO Canada riometer is a La Jolla Sciences solid state riometer operating at 30 MHz with a zenith oriented 4-element yagi antenna. The riometers have two main components: the receiver and the antenna. The antenna is installed in a manner that is open to the elements while the receiver is deployed in an underground "silo" (near to the antenna) so it is out of the elements. The site building provides quasi-stable power and satellite or telephone-based internet. The riometers are controlled through acquisition scripts running on an ITI which appends a GPS time and site information. The ITI also provides the riometers with stable power (UPS buffered).

G. *IRIS: Imaging Riometer Instruments System*

GO-IRIS will be the world's only network of riometers that will image this high energy precipitation with high spatial resolution over a large geographical region. This network, called the Geospace Observatory for Imaging Riometer Information Systems (GO-IRIS), will span much of Manitoba, Saskatchewan and Alberta, from the US border and up into the North West Territories.

GO-IRIS will be unprecedented in terms of its ability to remote sense high-energy particles and their relationship with geospace dynamics. The overlapping fields of view of its ten imaging riometers will form a super-image, giving us our first-ever view of high-energy auroral processes that unfold over many hundreds of kilometers. This array will be built on the innovation of researchers at UCalgary and Siena College, take advantage of Canada's unique geography, and have capabilities unique in the world. GO-IRIS will be a true example of Canadian technological and scientific leadership on the world stage.

An IRIS has four main components: the A-D converter interface, the receiver matrix, the 5V, 12V, 16V and 24V power supply vault, and the antenna. The antenna is installed in a manner that is open to the elements while the converter, the vault, and the receiver matrix are deployed in a thermally controlled environment (inside a building) so they are out of the elements. The site building provides quasi-stable power and satellite or telephone-based internet. The imaging riometers are controlled through acquisition scripts running on a site computer (a standard linux computer will be used for the nine new systems installed at both GO-core and non-GO core sites) which appends a GPS time and site information. The ITI also provides the riometer vault with stable AC power (UPS buffered).

H. *MSP: Quantitative Multi-Spectral Auroral Photometry for CGSM*

This project is aimed at operating a newly enhanced network of Meridian Scanning Photometers (MSPs) located in the Arctic Archipelago, along the west coast of Hudson Bay, and as far south as Pinawa and Athabasca.

The original CSA owned CANOPUS meridian scanning photometer array (MPA) consisted of four instruments built by an industrial Contractor (BOMEM Inc.) in the mid 1980's. The MPA measures night sky radiant intensity inside a 4 degrees swath that is carved out by the instrument field of view (FoV) along a path that extends from 10 degrees above the northern horizon to 10 degrees above the southern horizon. The meridian scanning photometer is a single pixel imaging device. To form the image region (also referred to as an "MSP scan") a rotating fold mirror is systematically stepped in 0.225° increments from north to south using a predefined stepping table. A scan is completed once every thirty seconds. Within each discrete scan head step, light that passes through the instrument aperture is directed down an optical train, through an interference filter, and focused onto the photocathode of the MSPs photomultiplier tube (PMT). Eight different interference filters are rotated through the PMT field of view before the MSP executes the next mirror move dictated to the step table. The filters are rotated through the field of view by a filter wheel spinning at 1200 rpm in order to approximate simultaneity between signal and background channels.

These systems have been deployed and operated continuously at remote field sites for two decades. The operational goal of the project is to maintain the legacy systems for the next few years to provide enough time to complete the first refurbishment prototype under an existing contract, and provide for the retrofit of the remaining three MPA subject to an upcoming RFP.

The MSP installation requires a building housing the collection hardware (ITI or instrument computer), a quasi-stable 110VAC power supply (maximum power draw: FESO = 850W, MSP = 2200W), and an internet connection to the outside world, and the onsite GPS, PDU and UPS.

I. *VLF: Very Low Frequency antennas*

The Array for Broadband Observations of VLF/ELF Emissions (ABOVE) is a project funded by the Canada Foundation for Innovation (CFI) and Alberta Enterprise and Advanced Education (AEAE) to deploy an array of ground-based radio receivers operating in the Extremely Low and Very Low Frequency (ELF and VLF) bands. These receivers will be able to simultaneously monitor both precipitating electrons absorbed in the ionosphere and thermosphere as well as electromagnetic waves that cause this precipitation. Deployment of the array is beginning in the summer of 2013.

The Geospace Observatory for ABOVE (GO-ABOVE) project will provide instrument operations and reliable information infrastructure designed to maximize the connectivity of the ABOVE data to scientists working on the radiation belts and space weather. By providing targeted, high-quality data and increased collaborative opportunities, GO-ABOVE will significantly augment the Geospace Observatory's ability to engage in the scientific exploration of the radiation belts.

The VLS antennas require: a quasi-stable 110VAC power supply (maximum power draw = 800W), and an internet connection to the outside world. A standard installation would include: a power distribution unit (PDU) which allows independent power cycling of system components, and an Uninterrupted Power Supply (UPS) to ensure instrument operations continue through power brown out conditions and controlled shutdowns during blackout conditions. At GO core sites the instrument installations leverage existing infrastructure by using the onsite UPS rather than deploying redundant equipment. The VLF antenna will interface with the ITI computer through a wireless card.

J. *HFR: High Frequency Receiver*

The High Frequency Receiver (HFR) is radio receiver that collects signals from two beacons in the Canadian Arctic. The first beacon is a swept-frequency oblique sounder, whose reception is used to determine the range of carrier frequencies that are supported along the oblique path between the beacon and the HFR. The second beacon is a fixed-frequency Doppler probe, which is used to determine the frequency spreading of a monochromatic radio signal during propagation through the ionosphere. The information related to frequency support and spread are used to determine the performance of Department of National Defence (DND) HF radio systems.

The HFR requires a quasi-stable 110 VAC power supply (maximum power draw = 1200 W), and a local custodian to swap out data hard drives approximately once per month and place in the mail. The HFR contains its own UPS, GPS, data storage, and communications equipment, and does not require the corresponding systems provided by the GO Canada Core site. The HFR occupies 15 rack units (RU), which includes the integrated UPS, GPS, drive array, and modems. The HFR includes the following antennas that must be mounted external to the shelter: (1) a 6-m tall HF monopole receive antenna with 16 x 6-m radial ground wires, (2) a dedicated GPS antenna, and (3) a dedicated satellite communications antenna (either Iridium or Ka-band, depending on station latitude).

3.6 Government Furnished Equipment

Some of the above mentioned instruments namely the Multispectral Photometers, Fluxgate Magnetometers, and riometers are government owned. These instruments are under the care of the contractor.

The contractor will perform routine maintenance to these instruments as required. The contractor will ensure the principal investigator of these instruments has access to the data collected by their instrument. The contractor will coordinate with the principal investigator to facilitate their access to the sites in case they need to perform maintenance trips.

If required, the contractor may enter in a loan agreement with the principal investigators or his institution for the use the Government Furnished Equipment, as this material is under his care through this contract. The contractor may not willingly allow the use of this Government Furnished Equipment by a third party who was not selected to operate it by the Canadian Government.

4. Implementation plan

Work assignments will be covered by Task Authorizations (TAs) issued by the Technical Authority. TAs will describe the work to be done, the required schedule and the required deliverables. The Contractor may be required to perform duties outlined in the Work Packages below at any GO Canada core site at any time.

5. Scope

The following is the scope of work foreseen at this time:

WP1000	**Project management**
WP1100	Produce reports and plans, project control
WP1200	Participate in GO Canada science team meetings
WP2000	**Configuration Management**
WP2100	Maintain Material Inventory Control
WP2200	Maintain System Configuration Control
WP3000	**Scientific instruments**
WP3100	Provide assistance in development of ground-based instruments
WP3200	Provide assistance in deployment of ground-based instruments
WP3300	Provide assistance in maintenance of ground-based instruments
WP4000	**GO Canada Core Sites**
WP4100	Provide support to build, modify, refurbish, or electronically connect remote physical sites; and to decommission and dispose remote physical sites
WP4200	Operate and maintain remote physical sites
WP5000	**Information Technology**
WP5100	Maintain and develop the ITI system monitoring tool
WP5200	Maintain and develop the ITI configuration tool
WP5300	Integrate ITI systems

WP1000 Project management

WP1100 Produce reports and plans, project control

The Contractor shall provide monthly progress reports to the Technical and Contractual Authorities. It shall cover, but not limited to, the progress made on each active work packages and tasks during the period, and provides project control details on cost and schedule. It shall also give the operational status of each core sites.

WP1200 Participate in GO Canada **science team meetings**

The core of the GO Canada science team will be composed of the members of the various project scientific teams. The GO Canada science team will meet at least twice annually (once to consider scientific issues, once to address programmatic issues).

The Contractor shall attend the GO Canada science team meeting related to programmatic issues via teleconference, or in person depending of the location and availability.

WP2000 Configuration management

WP2100 Create and Maintain Material and Equipment Inventory Control

The Contractor shall create, perform and maintain a rigorous inventory of all Government Property to ensure efficient use of assets. This includes Government Property at the Core Sites and at the Contractor facility. During planned site maintenance visits, the Contractor shall make an inventory of equipment, material and assets to either confirm or populate such information.

WP2200 Create and Maintain System Configuration Control

The GO Canada infrastructure system includes hardware and software that requires maintenance work and updates. The Contractor shall create and maintain a system configuration control for the operations, hardware and software components of the GO Canada infrastructure. The Contractor shall document and maintain the history of maintenance work on each unit, operational settings and changes performed for each sites. The Contractor shall maintain under configuration control through appropriate mechanism the ITI system monitoring tool (open-source) and ITI configuration files. The Contractor may be required to implement the configuration control system on a web-accessible format.

WP3000 Scientific instruments

WP3100 Provide assistance in development of ground-based instruments

The development of ground-based instruments for the observation, monitoring, and study of the solar-terrestrial space environment is the responsibility of the GO Canada Scientific elements contract holders.

The Contractor may be required to provide technical assistance in the development of ground-based instruments. The approved work may include engineering design, procurement, manufacturing, assembly, testing and documentation.

WP3200 Provide assistance in deployment of ground-based instruments

The deployment of ground-based instruments for the observation, monitoring, and study of the solar-terrestrial space environment is the responsibility of the GO Canada Scientific elements contract holders.

The Contractor may be required to provide technical and logistical assistance in the deployment of ground-based instruments. The approved work may include travel, installation and testing. It may also include remote configuration of the ITI for the addition of new instruments at core sites.

WP3300 Provide assistance in operation and maintenance of ground-based instruments

The operation and maintenance of ground-based instruments for the observation, monitoring, and study of the solar-terrestrial space environment are the responsibility of the GO Canada Scientific elements contract holders.

The Contractor may be required to provide technical and logistical assistance in the operation and maintenance of ground-based instruments.

WP4000 GO Canada Core Sites

WP4100 Provide support to build, modify, refurbish, or electronically connect remote physical sites; and to decommission and dispose remote physical sites

The GO Canada program is an evolving entity and the establishment of new core sites is planned for the near future.

The Contractor may be required to provide all support required to build, modify, refurbish, or electronically connect remote physical sites; and commissioned, relocated or decommissioned core sites. The approved work may include travel, engineering design, procurement, manufacturing, assembly, testing and documentation. The approved work may also include providing advices and documentations to appropriate Government entity to secure appropriate local or territorial permits and licenses.

WP4200 Operate and maintain remote physical sites

A crucial part of this contract is to ensure proper operation of the Core sites infrastructure. To do so, the Contractor shall perform the following work:

WP4210 Provide for utility and Internet services

All core site buildings have heating (fuel or electricity), ventilation, power systems, and Internet services providers. Some sites also have telephone lines. The Contractor shall provide for utility and Internet services, and manage and charge to this contract all utility services.

WP4220 Monitor and remotely operate Core sites infrastructure

The GO Canada core site infrastructure can be monitored through a webpage where several specific parameters can be assessed. Limited remote operation can be performed through the network enabled Power Distribution Unit (PDU).

The Contractor shall monitor and remotely operate Core sites infrastructure through the GO Canada system monitoring software and remote accessible PDU.

WP4230 Provide for local custodians

The GO Canada core site infrastructures are situated near inhabited locations. Locals, under the request of the Contractor, could fix malfunctioning systems that do not require expert skills. GO Canada Scientific elements contract holders, with prior authorization from the Contractor, could also contact the local custodian to perform basic instruments related actions. The Contractor shall have at least one custodian per core site to perform such actions and perform basic maintenance on the site.

WP4240 Perform regular maintenance of Core sites infrastructure

The Contractor shall perform an on-site maintenance of all core site infrastructures once a year.

WP4250 Perform emergency maintenance of Core sites infrastructure

Upon malfunction of a core site as monitored by WP4220 or through other means, the concerned GO Canada Science team member, the Technical Authority and the Contractor shall assess the level of urgency and provide adequate response as determined. As such, the Contractor shall provide a methodology of intervention depending on the urgency of the repair and shall perform emergency maintenance of Core sites infrastructure as required.

WP5000 Information Technology

WP5100 Maintain and develop the ITI system monitoring tool

The core sites are monitored via the web-based ITI system monitoring tool.

The Contractor may be required to maintain and provide improvement to the ITI system monitoring tool and associated documentation. The approved work may include writing, documenting, validating and testing of computer software written in the C and Tcl languages.

WP5200 Maintain and develop the ITI configuration scheme

The ITI is configured via different set of files.

The Contractor may be required to provide improvement to the ITI configuration scheme and associated documentation. The approved work may include writing, documenting, validating and testing of computer software written in the C and Tcl languages.

WP5300 Integrate ITI systems

The ITI is an integration of commercial off-the-shelf equipment.

The Contractor may be required to integrate additional ITI systems. The approved work may include engineering design, procurement, manufacturing, assembly, testing and documentation.

6. Meetings

The Contractor is requested to attend the following meeting, in person or teleconference, depending on the location of the meeting:

Meetings	Frequency	Location
GO Canada Operations and Maintenance Services kick-off meeting	Only one	Contractor’s facilities
GO Canada Science Team Meeting – Programmatic issues	Once a year	TBD

7. Deliverables

The following are the deliverables foreseen at this time:

- GO Canada Operations and Maintenance Services kick-off meeting (no later than 1 month after start of contract);
- Science team meetings (one per year, TBD);
- Material and Equipment Inventory List (updated every year)
- Annual GO Canada Core Site status Report (every year, synchronized with the Science team meeting)
- Monthly Progress reports;
- Deliverables resulting and agreed upon related to authorised tasks;
- Final report (end of contract period).

Appendix 1
Core sites layout diagram

(For technical reasons, this Appendix is only provided in English.)

Appendices 1 and 2 to the Statement of Work are being distributed in electronic format (PDF) by Public Works and Government Services Canada to all Canadian bidders who request the RFP and submit a signed CONFIDENTIALITY AGREEMENT, as outlined in Attachment 3. It is to be inserted at this point into the RFP, and forms part of this RFP.

Appendix 2
ITI build documents

(For technical reasons, this Appendix is only provided in English.)

Appendices 1 and 2 to the Statement of Work are being distributed in electronic format (PDF) by Public Works and Government Services Canada to all Canadian bidders who request the RFP and submit a signed CONFIDENTIALITY AGREEMENT, as outlined in Attachment 3. It is to be inserted at this point into the RFP, and forms part of this RFP.

Appendix 3
Material list

(For technical reasons, this Appendix is only provided in English.)