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LETTER OF INTEREST
LETTRE D'INTÉRÊT

Title - Sujet Spectrum Monitoring Evolution initi	
Solicitation No. - N° de l'invitation UT255-153306/C	**Date** 2017-01-06
Client Reference No. - N° de référence du client UT255-153306	**GETS Ref. No. - N° de réf. de SEAG** PW-$$ZL-107-30694
File No. - N° de dossier 107zl.UT255-153306	**CCC No./N° CCC - FMS No./N° VME**
Solicitation Closes - L'invitation prend fin **at - à** 02:00 PM **on - le** 2017-02-17	**Time Zone** **Fuseau horaire** Eastern Standard Time EST
F.O.B. - F.A.B. **Plant-Usine:** ☐ **Destination:** ☐ **Other-Autre:** ☐	
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Canada

Request for Information
For
Spectrum Monitoring Systems, Radio Frequency Sensors, and "Big Data" Analytics and Visualization Solutions
in Support of
Government Spectrum Management Functions

January 2016

Table of Contents

Respondents are requested to complete the following:

Full corporate name	
Full address of head office	
Full address of the sale and service office closest to Ottawa, Canada and number of employees at that office. As well please provide the location of other sale and service offices in Canada.	
Full address of any implementation partners with offices in Canada, if applicable	
Total number of worldwide employees	
Total number of worldwide employees dedicated to Spectrum Monitoring solutions	
Total number of worldwide employees dedicated to "big data", analytics, and visualization solutions	
Name of products. For each component product you are proposing, please provide the year that the product was first made commercially available and the year of the latest physical or software change.	

1.0 Overview of the Request for Information

This Request for Information (RFI) has been issued by the Spectrum, Information Technologies and Telecommunications (SITT) Sector of Innovation, Science and Economic Development Canada (ISED).

This RFI is related to the previous RFI (UT255-153306/A) that closed July 14, 2015 that focused exclusively on Spectrum Monitoring Systems. Since that time, the spectrum management landscape has evolved and ISED is investigating new methods and tools to support their evolving regulatory roles in Spectrum Management.

Specifically, ISED has launched the Promoting Regulatory Innovation for Spectrum Management (PRISM) initiative that will redefine and implement the future of Spectrum Management in Canada.

1.1 Background

With every passing year, the global economy is becoming increasingly reliant on wireless communication. Wireless is at the heart of many of the biggest innovations happening today – from products like the latest smartphones and wearable devices, to services like planning your trip on your device to avoid traffic. And its importance promises to explode as the next generation of innovations like virtual reality, autonomous cars, “the smart home”, and the broader Internet of Things (IoT) create even more demand for ubiquitous, reliable, and faster wireless communication.

In their 2016 Global Traffic Forecast Update, Cisco notes that global wireless data traffic has grown 4,000 fold over the past 10 years and will increase another eightfold between 2015 and 2020 with an annual compound growth rate of 53%. By 2020 they forecast 11.6 billion wirelessly-connected devices on the planet (for only 7.8 billion people). In Canada alone, the wireless industry contributes an estimated $50 billion to the economy, supports some 280,000 jobs, and inspires the homegrown innovation of new products and services.

5G is the next wireless phase and is projected to be deployed commercially in 2020 and beyond. It is expected to exacerbate the issues affecting spectrum management and availability, given the needs for high and low bandwidth, wide and local coverage, and ultra-low and non-real time latency that the innovations of the future will all require at the same time.

All of this innovation relies on the continued supply of radio frequency spectrum - a limited and constrained resource. Current radio technology and spectrum management approaches do not optimize the use of spectrum enough to meet the growing demands. On the current path, innovation will be stifled by a “spectrum crisis”.

The Spectrum Management Program within ISED is responsible for facilitating access to the radio frequency spectrum by issuing authorities for its use, securing Canada’s access to it through international negotiations, and by ensuring its continued health, in Canada, through well planned allocation of spectrum, enforcement of standards and the ability to detect and find radio interference or inappropriate spectrum use.

Much of the Program's policy development and operational work requires an intimate understanding of how the radio spectrum in a given geographic location is actually being used compared to how it is planned and authorized to be used. The data about how spectrum is actually being used is currently gathered by spectrum monitoring infrastructure which consists of approximately 78 fixed sites (towers), 50 mobile monitoring vehicles (Minivan or SUVs), 2 specialty monitoring vehicles (Cube and Sprinter type), 8 monitoring trailers, and 10 lightweight portable monitoring systems. This infrastructure has evolved over the years in support of operational requirements that focused primarily around the lower frequencies (under 1GHz) that support AM/FM, TV, Air Traffic Control and Land Mobile Radio uses such as emergency services and taxi dispatch. Historically, frequencies above 1GHz have had specialized uses or been licenced on such an exclusive basis within a given geography that the program has not had a significant requirement to monitor the actual use of those frequencies.

Looking ahead there will be much more policy and operational focus on the "super high frequencies (SHF)" and millimeter wave frequencies above 3GHz and solving the "spectrum crisis" will require more sharing of those frequencies between different providers, more use of unlicensed frequency bands (e.g. WiFi at 5GHz and above), and innovative use of much higher frequencies that were previously thought to be impractical for widespread wireless communication because of their much shorter ranges (e.g. 15-70GHz and above). Like most global spectrum regulators, ISED currently has very little monitoring capability in these frequencies.

1.2 Overview of the PRISM Initiative

The goal of the PRISM initiative is to maintain Canada's position as a world leader in spectrum monitoring and leverage that capability in deploying world first approaches for spectrum management to address the inherent challenges coming with IoT, 5G, and other technology advances.

PRISM will address these challenges through three key inter-related and parallel initiatives, as follows:

1) A comprehensive modernization of the ISED spectrum monitoring infrastructure that will focus on adding capability in the "super high frequencies" that will underpin the coming advances in wireless communication. This will allow for much more effective and agile policy development, regulatory action, and operational function. This will include the acquisition and roll-out of a new optimized mix of fixed sites, monitoring vehicles, transportable monitoring systems, mobile sensing platforms, and crowdsourcing mobile applications that better address the activities and frequencies that will likely be a focus of ISED regulatory responsibilities for years to come.

2) ISED will acquire and implement a "Spectrum Environment Awareness" solution that uses "big data" storage, analytics, and visualization capabilities to leverage the data provided by the new spectrum monitoring infrastructure to provide real-time data and tools for our spectrum managers and identify trends and issues in spectrum usage across the country. As well, this will create the opportunity to offer portions of this data – though

the government's commitment to Open Data – to Canadian citizens and businesses that can uncover additional innovative uses for it. Annex B describes the rationale and work done to date in piloting this new approach to spectrum management.

3) Lastly, the two previous elements will facilitate ISED's ability to be a world leader in optimizing the limited resource of spectrum and allow it to fast track industry consultations, liaison with other regulators, and the development and trial of innovative regulatory approaches including dynamic spectrum access.

While initiative (3), above, is primarily a policy and consultation exercise that will be executed internally, initiatives (1) and (2) require the acquisition and deployment of hardware and software solutions that will be procured via a competitive process.

ISED is planning on investing a significant amount of money to re-invent our monitoring and sensing infrastructure and developing a Spectrum Management toolset of the future based on the concepts of "big data", analytics, and visualization.

ISED recognizes that these requirements involve very different technologies and skill sets but given their significant level of dependency and overlap we feel that it would be beneficial to procure both through a single Request For Proposal (RFP) process. ISED also hopes that the vendor community sees an opportunity to design and deploy an innovative integrated hardware and software solution that might be marketed to other spectrum regulators, other government organizations, operators, and other potential clients.

1.3 RFI Purpose

The purpose of this RFI is:

1) to inform vendors of the new expanded scope of ISED's requirement for monitoring and "big data" hardware and software solutions to support Spectrum Management;
2) to understand the level of interest and experience of the marketplace in delivering part or all of such an integrated requirement;
3) to help ISED develop a procurement and implementation strategy for acquiring and implementing such an integrated requirement; and,
4) to refine planning and cost estimates.

ISED may release a Request for Proposal (RFP) for such an integrated requirement (or any subset thereof) depending on a number of factors, including availability and viability of solutions and funding approvals.

1.4 RFI Timeline

The planned process and timeline for this Request for Information (RFI) process is as follows:

1) January, 2016: Issue RFI document through BuyAndSell.gc.ca

2) No later than January 18, 2017: Vendors register their intent to attend the Vendor Conference by e-mailing the name(s) of expected attendees to jeff.campbell@tpsgc-pwgsc.gc.ca. Please indicate if each individual plans to attend in person or by WebEx. This pre-registration will allow ISED to arrange access for visitors to the secure facilities at which the Vendor Conference will take place and to distribute WebEx access information to all interested participants.
3) January 25, 2017: ISED hosts a Vendor Conference to present and demonstrate key elements of the target integrated requirement and solicit clarification questions from attendees. The Vendor Conference will start at 1:30 PM (Eastern Time) at the ISED's Communications Research Centre (CRC) facilities located at 3701 Carling Avenue, Ottawa, Ontario and will also be broadcast via WebEx for those vendors unable to attend in person.
4) February , 2017: ISED will publish responses to any questions generated from the Vendor Conference
5) February 17, 2017: Closing date for responses to the RFI

2.0 Primary Questions of Interest

The RFI document outlines a number of areas where information is being requested. To provide a focus for the type of information required, specific questions are being asked to help focus the attention on core areas of interest for ISED. Any and all related information, particularly related to the RFI questions, is appreciated.

Primary Questions of Interest

Primary Question 1.1	Given the information provided in Section 1, please provide any opinions on the ways in which spectrum management and regulation will likely change in the next five to ten years to accommodate the changing telecommunications and technology landscapes. This information might be based on your research, experience with telecommunications operators, experience with regulators in other jurisdictions, or other sources. What equipment and tools do you see national spectrum regulators using in the future to manage spectrum?
Primary Question 1.2	ISED is looking to issue a single RFP seeking a solution for the entire PRISM vision. Given the disparate technologies and skill sets required to implement the vision (e.g. traditional spectrum monitoring equipment and software, mobile sensing platforms, crowdsourcing mobile applications, and "big data" analytics and visualization) what advantages or disadvantages do you see for this approach?
Primary Question 1.3	With the coming shift of importance in telecommunications to higher frequency bands and smaller low power cells, what changes in monitoring/sensing equipment and approaches do you see coming and that should be included in ISED's plans? Do you have any recommendations in terms of the optimal mix of traditional monitoring and next generation sensor equipment to meet ISED's future requirements?
Primary Question 1.4	Given the Requirements outlined in Section 3, please provide an indicative cost estimate for the up-front and ongoing costs associated with purchase and licensing of any or all of the products/modules that might make up a hardware and software solution that meets as many of ISED's requirements as possible. *

**** Note that cost estimates should be provided in Canadian dollars, FOB Ottawa, exclusive of taxes. Cost estimates are for the purposes of this Request for Information only and will not affect any potential future Request for Proposal pricing proposals.***

3.0 Background Information

3.1 The Organization

The **Spectrum, Information Technologies and Telecommunications** (SITT) Sector of Innovation, Science and Economic Development (ISED) Canada facilitates access to the radio frequency spectrum by issuing authorities for its use, securing Canada's access to it through international negotiations and by ensuring its continued health, in Canada, through well planned allocation of the spectrum, enforcement of standards and the ability to detect and find radio interference or inappropriate spectrum use.

Within this Sector, the **Spectrum Management Operations Branch (DGSO)** provides national leadership and program direction for the delivery of the Spectrum/Telecom Program across Canada. Under the authority of the *Radiocommunication Act* and the *Broadcasting Act*, the Branch:

- Develops spectrum management regulatory and operational policies and procedures;
- Plans, authorizes and manages radio spectrum use by Canadian operators and license holders, and certifies broadcasting facilities;
- Ensures appropriate access to the radio frequency spectrum by as many users and for as many uses as possible and have the ability to determine and find interference issues or inappropriate use of the radio spectrum;
- Facilitates the restoration of telecommunications during times of emergency to maintain reliable communications for Canadians; and
- Provides fair return to the government for the use of the radio frequency spectrum.

3.2 Scope of Procurement

The full scope of the ISED's PRISM implementation may include any or all of the following elements:

- Traditional monitoring hardware including:
    - Spectrum and signal analyzers
    - Communication analyzers
    - Receivers
    - Radio direction finding equipment including fixed, mobile and transportable DF antenna arrays
    - Variety of monitoring antennas (I.E. Broadband, directional, omni…etc.)
    - Antenna rotator systems
    - RF antenna switch matrix

- Traditional monitoring software including:
    - Remote hardware control, system networking and multi-user interface software for remote fixed station control and vehicle system operation
    - Data gathering, reporting and analysis tools
    - Monitoring software and equipment drivers compatible with a MS Windows, Win7, 64 bit operating system environment (present standard for ISED)

    - Interface and data support capabilities with ISED’s spectrum management system (I.E. LS telcom, Spectra Spectrum Management Software Suite)

- Mobile sensing platforms
    - To augment the capabilities of traditional monitoring solutions, ISED has been trialing the use of lower-cost dedicated spectrum-monitoring devices that could be installed on specialized vehicles or vehicles owned by parties working in partnership with the regulator (e.g., city buses, Canada Post vehicles or garbage trucks). Benefits include increased coverage in urban areas and extended coverage in suburban and rural areas.
    - As a pilot, these sensors have been used in both fixed locations and mounted on taxis in the Ottawa area and communicate their data to a cloud-based data repository.

- Crowdsourcing applications
    - ISED has trialed the use of a crowdsourcing mobile application that uses smart phones sensing capabilities for Wi-Fi and cellular. In addition, The crowdsourcing application can be used on mobile phones, tablets and laptops by installing a dedicated software application that collects information on the user’s experience with the wireless service provided at the device location. This is an efficient, low-cost approach that produces the large number of reports needed to derive meaningful statistics.
    - The operating model of how to distribute, manage, and encourage use of such an application have not yet been determined.

- Cloud-based “Big Data” repository, analytics, and visualization platform
    - A cloud-based data repository for very large amounts of data sourced from all of the components outlined above.
    - A “big data” analytics and visualization platform that is customized to enable the evolving mandate of “spectrum management” including day-to-day operations, licensing, compliance/enforcement, and reporting that might feed policy development.
    - The analytics and visualization platform would likely require an interface to the existing ISED licensing database (LS telcom’s SPECTRA software solution) to enable analysis of occupied spectrum versus authorized spectrum.

- Professional services including:
    - Project strategy development and planning
    - System configuration, integration and implementation
    - System installation and maintenance
    - Project management
    - Enhanced system developments for future monitoring requirements, including the potential to collaborate with the Department’s Communication Research Centre (CRC) in the development of future required monitoring capabilities

3.3 Metrics

While future requirements will vary, key metrics of today's Spectrum Monitoring infrastructure used by ISED includes the following:

- 78 fixed monitoring sites
- 50 monitoring vehicles (Minivan or SUV type)
- 2 specialty monitoring vehicles (Cube and Sprinter type)
- 8 monitoring trailers
- 12 light weight portable monitoring systems

The Spectrum Monitoring infrastructure is primarily used by approximately 200 regional Spectrum Management Officers distributed among 25 offices across the country. Typical concurrent usage is between 1-10 users with some peak periods of 20-30 concurrent users.

3.4 Budget and Timeline

The budget and timeline for this project has not yet been set and definition of such along with a project strategy will be developed from the results of this Request for Information (RFI), results of ongoing Environmental Scan efforts with other national spectrum regulators, and internal discussions.

3.5 Current Monitoring Infrastructure

ISED's current spectrum monitoring systems are comprised of the following hardware with varied distribution and installation:

<u>Fixed sites</u>

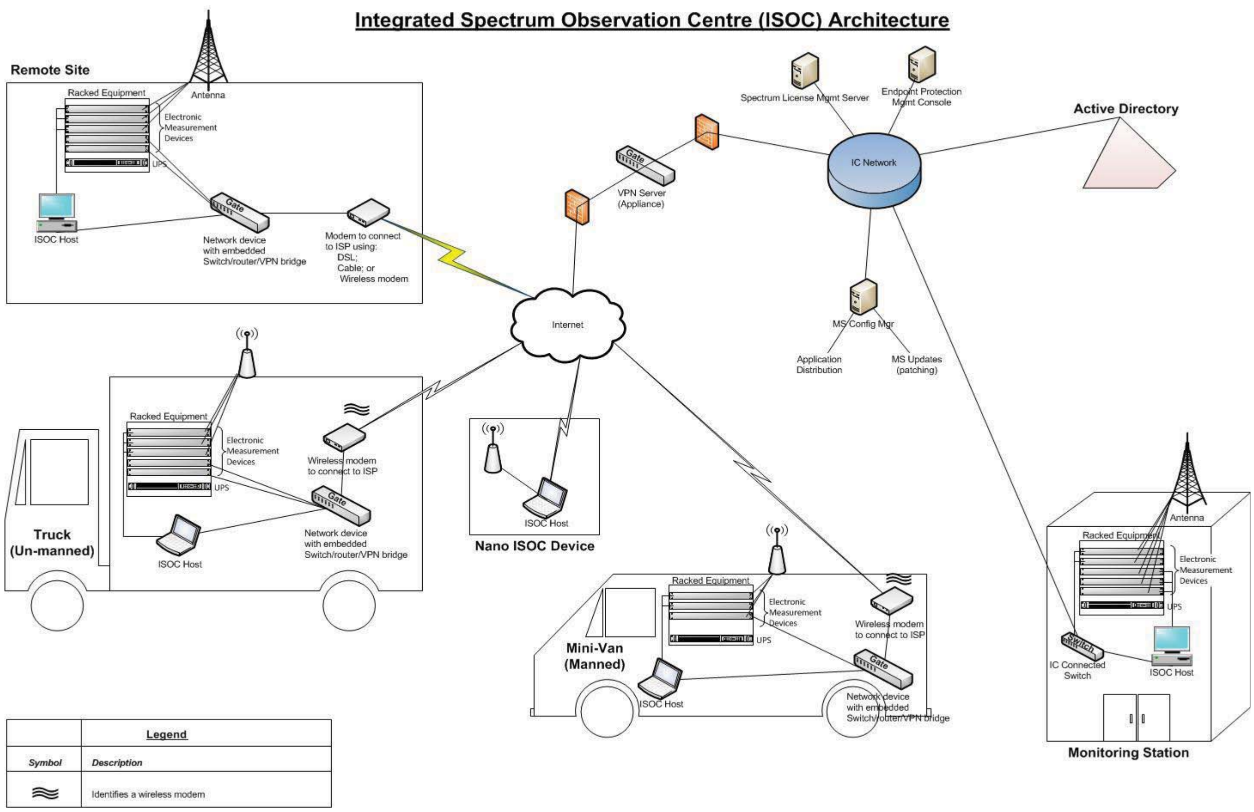
Spectrum Analyzer	– Rohde & Schwarz, Model FSx series (L/P/V); Agilent, Model 8594E series
Direction Finding	– Doppler Systems, Model DDF6000/6001/7000; Cubic, Model 4006R; CRC, Spectrum Explorer system utilizing DRS WJ8621/SI9136c tuners.
Receivers	– Icom, Model R-9000/8500/9500
Antenna Rotator	– Model EV 800 DX
RF switch matrix	– Aerosystems, Model ASI-100 RF Matrix

<u>Vehicles</u>

Spectrum Analyzer	– Rohde & Schwarz, Model FSx series (L/P/V); Tektronix, Model SA2500
Direction Finding	– Cubic, Model 4400 DF; CRC, Spectrum Explorer system utilizing DRS WJ8621/SI9144/SI9136c tuners.
Receivers	– Icom, Model 8500; Rohde & Schwarz, Model EB200

The majority of existing systems are controlled through custom control and multi user interface software (Integrated Spectrum Observation Centre - ISOC) to remotely control equipment through customized drivers, to manage measurement tasks for spectrum utilization data, audio recording sessions, networked direction finding control (multi-site triangulation) including mapping overlay, and to manage site audio, power, RF switching and other system controls.

The following diagram illustrates an example of the present spectrum monitoring system architecture used by ISED (For reference only).



ISED has recently implemented a commercial software solution for the majority of their integrated Spectrum Management requirements outside of spectrum monitoring. That software solution is centered on the LS telcom SPECTRA suite of products and the ISED licence includes entity licencing for their MONITORplus product.

3.6 Pilot "Spectrum Environment Awareness (SEA)" Infrastructure

While there will be no requirement to re-use any or all of the technologies or architectures developed as part of their SEA pilot implementation, a detailed understanding of what has been developed is likely good context for vendors.

Details of the pilot infrastructure can be found in Annex B. Additionally, ISED will have experts available to answer any questions about the pilot development efforts that arise at the Vendor's Conference and during the RFI Question and Answer period.

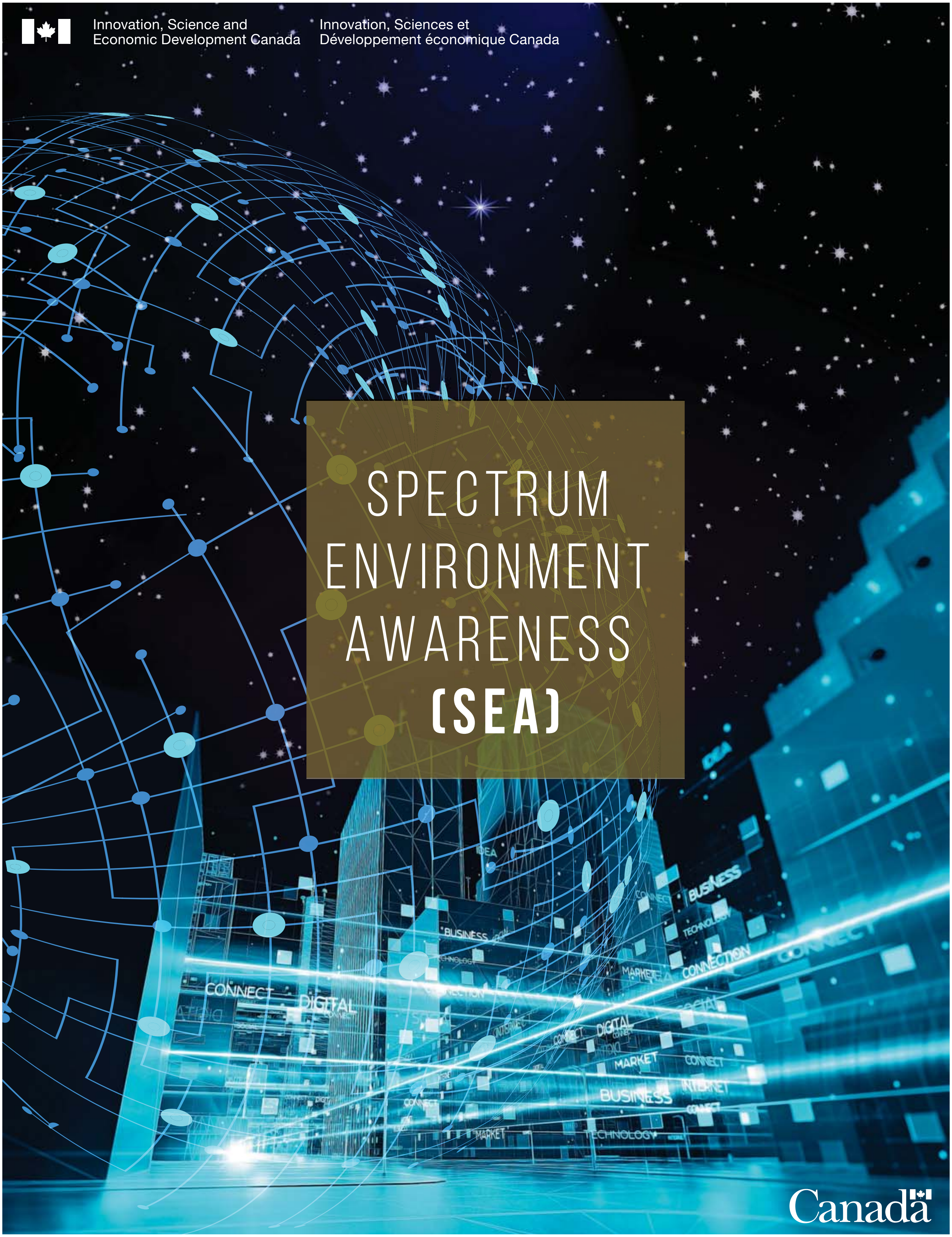
Annex A: Glossary of Acronyms

This glossary provides an explanation of various acronyms used in this document.

Acronym	Meaning
CRC	Communications Research Centre
DF	Direction Finding
DGSO	Spectrum Management Operations Branch
FOB	Free on Board
ISED	Innovation, Science and Economic Development Canada
ISOC	Integrated Spectrum Observation Centre
MS	Microsoft
PRISM	Promoting Regulatory Innovation in Spectrum Management
RF	Radio Frequency
RFI	Request for Information
RFP	Request for Proposal
SITT	Spectrum, Information Technologies and Telecommunications Sector of Innovation, Science and Economic Development Canada
SUV	Sport Utility Vehicle

Annex B: Spectrum Environment Awareness (SEA) Details

Innovation, Science and Economic Development Canada
Innovation, Sciences et Développement économique Canada



SPECTRUM ENVIRONMENT AWARENESS (SEA)

The demand for spectrum is growing daily as we transition to an increasingly wireless world. This rapid evolution demands a new regulatory environment that is based on the continuous collection and analysis of spectrum data through a network of sensing devices providing comprehensive coverage of the entire spectrum environment.

Canada has been a world leader in spectrum monitoring but the emergence and evolution of wireless communication requires changes to both the techniques and systems for monitoring. Canada has currently a relatively small number of high-end fixed and mobile monitoring stations covering large geographical areas.

Figure 1
Integrated Spectrum Observation Centre in Richmond (Québec)

In this environment, Integrated Spectrum Observation Centres (ISOCs) collect usage data from locations across the country. Typically, spectrum data are only collected when issues are brought to the regulator's attention. Since there is no continuous collection of data across bands, it is hard to measure effectively band utilization, identify trends or create a baseline for forecasting.

Given the direction of wireless evolution, these large stations will likely be replaced or augmented by a collection of spectrum sensors covering smaller geographical areas such as city centres, industrial parks, urban corridors, malls, or office buildings. The sensor network of the future will be based on commercial technology and should offer multiple monitoring capabilities at a level of granularity necessary to profile spectrum usage at all frequencies, for all services, and in all types of network deployments.

THE SPECTRUM ENVIRONMENT AWARENESS (SEA) pilot is a mix of high- and medium-performance sensors that cover a wide frequency range. Advanced sensors include enhanced processing capabilities to enable remote tasking and local processing of data. The sensors are networked and report to a cloud-based processing entity. Sensor types include permanent fixed, transportable fixed and mobile installations. Fixed and transportable units are installed in specific locations of interest or used in an area of interest as needed (e.g., for interference detection). Mobile sensing platforms, meanwhile, are installed on specialized vehicles or vehicles owned by parties working in partnership with the regulator. In addition, a crowdsourced mobile application uses smartphone sensing capabilities to monitor Wi-Fi and cellular bands. Finally, Wi-Fi sensors are used for collecting network control data in the 2.4 GHz and 5 GHz bands.

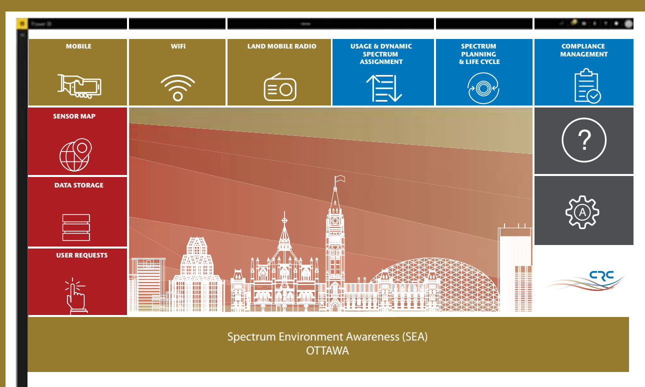


Figure 2. SEA main portal

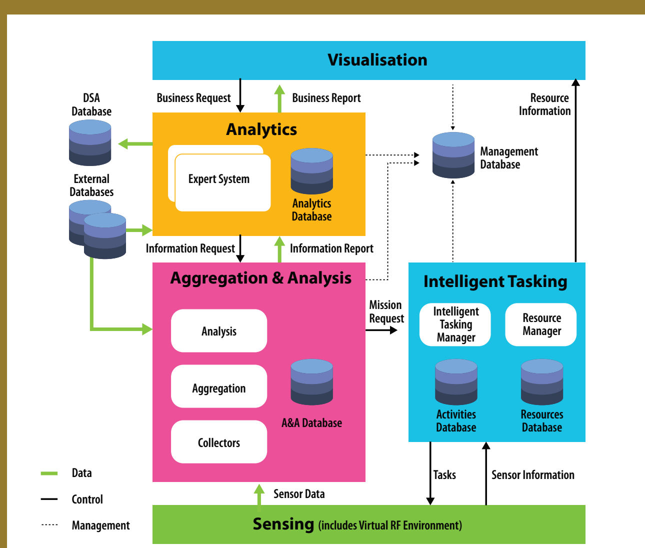


Figure 3. SEA functional architecture

The SEA system user interface is implemented as a portal (see Figure 2), which provides access to the cloud-based system with analysis and reports generated for specific cases such as showing active and inactive portions of the spectrum. The SEA system can also gather focused spectrum data in near real time by sending instructions to specific sensors, for example during special events (e.g., outdoor concerts, festivals or sport events), or during security or public emergency situations

The SEA concept embodies five major functional subsystems: sensing, intelligent tasking, aggregation and analysis, analytics and visualization as illustrated in Figure 3. Except for sensing and visualization, the subsystems are implemented in a cloud infrastructure.

THE SENSING SUBSYSTEM is a collection of sensors responsible for monitoring the environment of interest and capturing data about electromagnetic energies, location and propagation conditions. Some sensing platforms are able to perform varying degrees of processing to help reduce the amount of data sent to the cloud.

THE INTELLIGENT TASKING SUBSYSTEM maps user requests into actionable tasks for the sensing subsystem (e.g., what to sense, where to sense, when to sense, which sensors to use) based on available sensing resources. The resource manager component of this subsystem maintains real-time knowledge of available sensing resources, gathers information such as sensor type and capabilities, geographical location and status, and makes this knowledge available to the system.

THE AGGREGATION & ANALYSIS SUBSYSTEM collects data from the sensing subsystem and other sources, including internal and external databases. The data is then aggregated to extract, transform and prepare it for storage. It is also processed and analyzed to generate statistical reports.

THE ANALYTICS SUBSYSTEM understands and interprets user requests, responding with actionable reports. If more information or analysis is needed, the system can be queried for it. The results are then captured in a user-friendly report. Machine learning, expert systems or other analytical techniques are used to analyze data for spectrum usage trends, anomalies and insights.

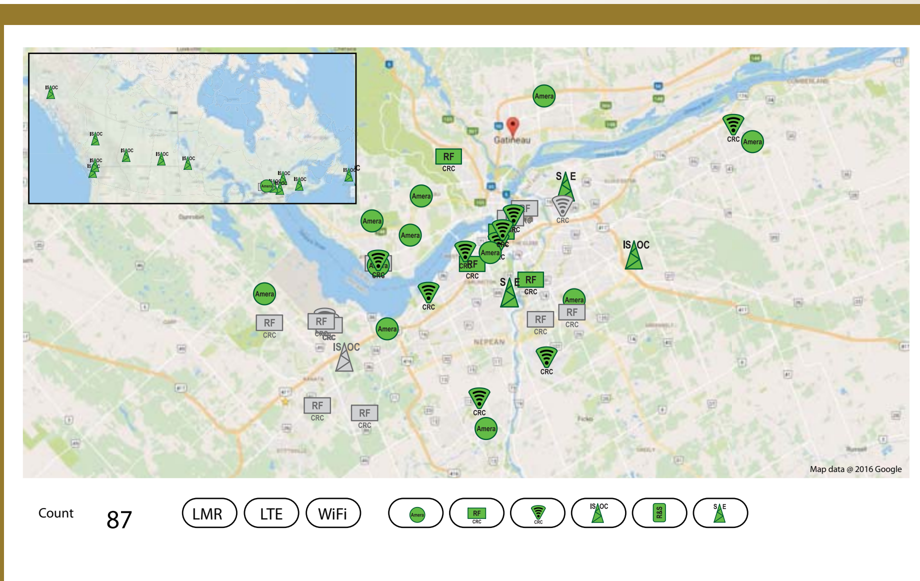


Figure 4
Nationwide SensorDeployment and smaller window shows the Ottawa-Gatineau area

THE VISUALIZATION SUBSYSTEM provides the user interface and interaction through which users can define specific use cases, graphically or otherwise. Visualization also displays results in the form of business application dashboards to enable and support spectrum management activities. Different types of visualization platforms can be used for end users and field operatives such as smart phones and tablets. A spectrum monitoring and data analytics center will be able to use large-scale wall displays and networked terminals as shown in Figure 5. The design also allows for distributed or centralized implementations as subsystems represent separate networks in the cloud infrastructure.

Figure 5 Spectrum Visualizing Platform (Source: Christie Digital)