Networks Canada Scalar Data

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Abstract – **The Digital Infrastructure group at Ocean Networks Canada (ONC) is in charge of the development and maintenance of the Organization's Data Management and Archiving System (DMAS), also referred to as "Oceans 2.0". The group has been successful in setting up a software system that acquires data from large sensor networks, archives them and makes them available to a varied audience of scientists, the public as wells as government and non-governmental agencies. Oceans 2.0 relies on its Service-Oriented Architecture to acquire data and has extended it to support data distribution to a wider range of customers using web services. More recently following a funding opportunity with CANARIE Inc. to deliver portable, re-usable middleware, OGC SWE-compliant web services were implemented. The new services offer the ability to OGC-ready clients to obtain ONC scalar data in a self-descriptive and effective way.**

Keywords -- Open Geospatial Consortium; Sensor Web Enablement; Sensor Observation Service; Ocean Networks Canada; scalar sensor data; interoperability

I. INTRODUCTION

The Digital Infrastructure group at Ocean Networks Canada (ONC) is in charge of the development and maintenance of the Organization's Data Management and Archiving System (DMAS), also known as Oceans 2.0. The group has been successful in setting up a software system that acquires data from large sensor networks, archives them and makes them available to a varied audience of scientists, the public and various government and non-governmental agencies.

Presently, data from over 160 instruments are available from the NEPTUNE Canada and VENUS networks in quasi real-time to the public at large with no proprietary period. Data can be previewed through a number of tools such as video search interfaces and web services. Data is available in a variety of formats and can be subjected to a number of pre-processing steps on behalf of the user. Formats are often specific to the scientific disciplines of our users. Oceans 2.0 has deployed a fairly complete instrument vs. data products/data formats matrix to translate and deliver data to suit user needs.

ONC has now implemented another data access method that extends our data product matrix for scalar sensors. The goal was to provide an OGC (Open Geospatial Consortium) compliant interface to access data using web services. This method is also known as Sensor Web Enablement (SWE). SWE is a family of protocols to request, transmit and receive both sensor data and their metadata.

OGC, as an organization, is a most vocal advocate of SWE and is actively lobbying for its expanded use. Other groups the world over are promoting and generalizing SWE use as well.

In this paper, we are describing the implementation of key basic functionality of the OGC SWE family of protocols (in particular those in the Sensor Observations Service – SOS) to provide data access to a significant portion of the ONC observatory's scalar sensors.

II. FEATURES OF THE SERVICES

A. The OCG suite of interoperability services

Web service standards used to foster interoperability typically include three different services:

- a "discovery" service that, upon invocation, returns the capabilities of the service provider i.e., the list of sensors available,
- a "metadata" service that returns detailed information about a specific sensor and
- a data access service that returns the actual data available from a specific sensor and matching certain

The OGC SWE can be depicted as in Fig. 1. It represents a family of protocol, of which we have implemented the Sensor Observation Services. SensorML is the selected encoding in our case.

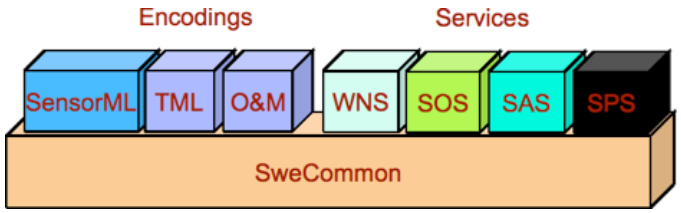

Fig. 1: Sensor Web Enablement family of protocols. This project proposes to implement the SOS data access services for a large subset of ONC Observatory's scalar sensors. Those sensors will be described using the SensorML markup language. Graphic courtesy of Simon Jirka, University of Münster.

B. Terms and definitions

Specific terminology is used in the context of OGC standards. It can be summarized as follows (definitions from the Open Geospatial Consortium):

- *Sensor*: An entity capable of observing a phenomenon and returning an observed value. In SensorML, it is modeled as a specific type of System representing a complete Sensor. This could be for example a complete airborne scanner which includes several Detectors (one for each band).
- *Observable, Observable Property*: A parameter or a characteristic of a phenomenon subject to observation.
- *Observation*: An act of observing a property or phenomenon, with the goal of producing an estimate of the value of the property. A specialized event whose result is a data value.
- *Phenomenon*: A physical property that can be observed and measured, such as temperature, gravity, chemical concentration, orientation, number-of-individuals. A characteristic of one or more feature types, the value for which must be estimated by application of some procedure in an observation.
- *Position*: The location and orientation of an object relative to a coordinate system.
- *Process*: A process that takes one or more inputs, and based on parameters and methodologies, generates one or more outputs.
- *Result*: an estimate of the value of some property generated by a known procedure

C. Features implemented at ONC

- Discover and describe scalar sensors and data resources available at ONC
- Access data from any of the sensors discovered and describe above

The three services actually implemented in support of the hundreds of sensors deployed on the Ocean Networks Canada observatories include:

- discover sensors and sensor data, providing in return information such as location, observables, quality, ...
- obtain sensor information in a standard encoding that is understandable by users and their software
- access sensor observations (or values) in a common manner, and in a form specific to user needs

A summary of the services names is provided in Table 1. They all assume a base URL, currently referred to as "http://dmas.uvic.ca/sos".

TABLE I. SERVICES IMPLEMENTED

Service name	**Method**		
	Description	***Service Type***	***Parameters***
GetCapabilities	Provides the means to access SOS service metadata	HTTP-GET, -POST	Service, request, sections
DescribeSensor	Retrieves detailed information about the sensors and processes generating those measurements	HTTP-POST	OutputFormat, SensorId, service, version
GetObservation	Provides access to sensor observations and measurement data via a spatio-temporal query that can be filtered by phenomena	HTTP-POST	Service, version, offering, observedProperty, responseFormat, eventTime

III. RESULTS

The implementation was successful and will be made publicly available to users in September, after a beta-testing phase. The tools will also be used to implement interoperability between Ocean Networks Canada and the U.S. Ocean Observatory Initiative (OOI) operated by the Consortium for Ocean Leadership. Clearly, the services described here are limited to scalar data. Complex data exchanged between COL and ONC will use OpeNDAP.

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Finally and most importantly, we would like to recognize the entire ONC Digital Infrastructure group and in particular Jonathan Cheng, Tony Lin and Yingsong Zheng for their direct contribution to this project.

There is a large body of documentation and reference material related to OGC's Sensor Web Enablement. The most important ones are:

[1] OGC Sensor Observation Service: http://www.opengeospatial.org/standards/sos.

[2] Oceans 2.0 API documentation for the new services: http://wiki.neptunecanada.ca/display/help/API

[3] OpeNDAP: see http://www.opendap.org