Sensor metadata for automated integration of sensor resources into Research Data Infrastructure

Enoc Martínez, Universitat Politecnica de Catalunya (Spain), enoc.martinez@upc.edu
Daniel M. Toma, Universitat Politecnica de Catalunya (Spain), daniel.mihai.toma@upc.edu
Joaquin Del Rio, Universitat Politecnica de Catalunya (Spain), joaquin.del.rio@upc.edu

The study of global phenomena in the marine environment requires the combination of scientific data coming from various sources. Data is usually acquired by different institutions focused on different fields using different formats and procedures. This disparity difficult the data processing and analysis, resulting in information silos.

Fortunately, in the past years significant steps have been taken towards the standardization and interoperability of scientific data across different domains, such as the Open Geospatial Consortium's Sensor Web Enablement Framework [1]. This framework provides a suite of protocols and standards that permit the data and metadata encoding, archival and retrieval in a standardized and interoperable manner.

However, the ocean observing community uses a vast collection of sensor systems (in short: sensors) from different manufacturers, usually with proprietary communication protocols. Moreover sensors are commonly deployed in observation platforms, such as underwater observatories, buoys, underwater gliders, autonomous surface vehicles, profilers, etc. Each platform has its own architecture, with different power and communications constraints. Thus the re-usability of sensor drivers across different platforms is greatly reduced by the diverse nature of observation platforms. Creating an ad-hoc driver for each sensor-platform combination is a time-consuming task that requires in-depth knowledge of both sensor's protocol and the observation platform's architecture [2].

Moreover once a sensor data is acquired in an observation platform it is required to register or publish the acquired data into existing Research Data Infrastructures (RDIs) in order to make it available to the scientific community.

Nonetheless, it is possible to ease the sensor operation (integration a sensor into an observation platform) and the integration of sensor data into existing RDIs by using metadata structured and coherent format, i.e. Sensor Model Language (SensorML) [3]. Using this standard it is possible to generate machine-readable metadata files that comprehend extensive information about a sensor.

In general terms, sensor metadata can be classified in 4 main sections according to its purpose:

- Sensor Description: identifiers, capabilities, characteristics, etc.
- Sensor Deployment: position of deployment, platform where it is deployed, time of deployment, etc.
- Sensor History: calibrations, past deployments, maintenance operations, etc. Improves the sensor traceability.

- Sensor Interface: communication interface, data streams encoding, modes of operation, etc. Provides the information for sensor drivers to automatically detect, interface and operate the sensor.

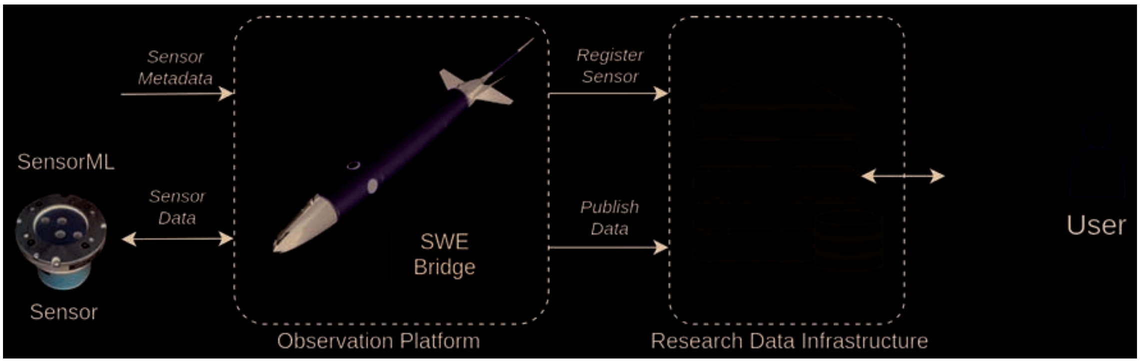

Fig. 1 - Automated Integration of a sensor based on SensorML metadata file into Research Data Infrastructure.

A SensorML metadata file describing a particular sensor deployment (or any other metadata format) can be manually linked to the sensor by the operator, or can be embedded within the sensor itself using the OGC PUCK Protocol [4].

Once all the sensor metadata has been stored into a structured file, it is possible to develop software that interpret this metadata file to automate the integration and operation processes, i.e. the SWE Bridge universal driver [5]. In figure 1, the automatic integration of a sensor into a RDI based on SensorML and the SWE Bridge software is depicted.

The SWE Bridge is a software component that decodes a SensorML file, takes the sensor interface metadata and automatically operates sensor without any a-priori knowledge. Furthermore, the SWE Bridge also takes the deployment, description metadata and automatically generates the necessary registration transactions for Sensor Observation Services [6].

References

[1] Bröring A. *et al.*, *"New generation sensor web enablement,"* Sensors, vol. 11, no. 3, pp. 2652–2699, 2011.

[2] Del Rio J. *et al.*, *"Standards-based plug & work for instruments in ocean observing systems,"* IEEE J. Ocean. Eng., vol. 39, no. 3, pp. 430–443, 2014.

[3] Botts M. and Robin A., *"OGC SensorML: Model and XML Encoding Standard,"* Wayland, MA, 01778, USA, 2014.

[4] "OGC®PUCK Protocol Standard Version 1.4," no. OGC 09-127r2. Wayland, MA, 01778, USA, 2012.

[5] Martínez E., Toma D.M., Jirka S., and Del Río J., *"Middleware for plug and play integration of heterogeneous sensor resources into the sensor web,"* Sensors (Switzerland), vol. 17, no. 12, pp. 1–28, 2017.

[6] Bröring A., Stasch C., and Echterhoff J., *"OGC Sensor Observation Service,"* Open Geospatial Consortium, Wayland, MA, 01778, USA, 2012.