Providing Observations in a Standardized Way – The OGC Sensor Observation Service

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About myself

- Member of 52° North community since about 8 years
  - Leading developer of 52N SOS up to version 3.1.0
- Did my PhD at the Institute for Geoinformatics (IfGI) at the University of Muenster
  - Web-based spatio-temporal aggregation of observation considering semantics and uncertainties
- Co-chair of SOS SWG at OGC, co-editor of SOS Implementation Specification 2.0
- Several projects/activities:
  - UncertWeb, SoKNOS, OSIRIS, GEOSS, etc.
- Recently joined 52° North staff as researcher/consultant, SOS architect
Overview

- Intro Sensor Web
- SOS Overview
- SOS Deployment Strategies
- SOS Application Examples
Why Standards?
A world full of sensors
Sensor Web – Definitions?

Wikipedia:

A Sensor Web is a type of sensor network or geographic information system (GIS) that is especially well suited for environmental monitoring.

OGC:

A Sensor Web refers to web accessible sensor networks and archived sensor data that can be discovered and accessed using standard protocols and application program interfaces (APIs). (OGC 07-165)
Heterogeneous sensor network
- Airborne
- Satellite
- In-Situ monitors
- Surveillance
- Bio/Chem/Rad Detectors

- sparse
- disparate
- mobile/in-situ
- extensible

Models and Simulations
- nested
- national, regional, urban
- adaptable
- data assimilation

Sensor Web Enablement
- discovery
- access
- tasking
- alert notification

web services and encodings based on Open Standards (OGC, ISO, OASIS, IEEE)

Source: OGC 07-165, p. 6
Sensor Web Basics

- Interoperability
- Reduce the integration efforts of new data sources
- Enhancement of Spatial Data Infrastructures (SDIs) to handle sensor data
- Sensor Web Enablement (SWE): A suite of standards of the OGC for building the Sensor Web
SWE Building Blocks

Sensor Web Enablement

Data Models and Encodings
- SWE Common
  - O&M
  - SensorML
  - TML

Interfaces
- SWE Service Model
  - SOS
  - SAS/SES
  - WNS

- SPS
SOS Overview

- Pull-based access to sensor data
- Consistent interface and data format for all kinds of sensors
- Returns O&M
  - Contrast to WFS: no generic schemas
  - Interoperability
  - A priori-knowledge
- Official OGC implementation specification v2.0 available at http://www.opengeospatial.org/standards/sos
SOS Introduction

- Goals of the SOS (1):
  - Pull-based access to observations in a standard way
  - Mediator between:
    - client \(\leftrightarrow\) data archive / simulation / real-time sensor system
SOS Introduction

- Goals of the SOS (2):
  - Hides the heterogeneous structure of proprietary sensor data formats and protocols
  - Data formats:
    • O&M – to encode requested sensor observations
    • SensorML – to encode sensor metadata
  - Generic character supports:
    • stationary & mobile
    • in-situ & remote
Observations & Measurements

- Used for encoding data observed by sensors
- Observation comprises
  - Timestamp
  - Value (if applicable including unit of measurement)
  - Observed property
  - Feature of interest
- O&M 2.0 data model approved as an ISO standard
- O&M 2.0 XML encoding approved as an OGC standard
- JSON available, not officially standardized yet
SensorML

- Sensor Model Language
- Used for encoding metadata about sensors
  - Which phenomenon is observed?
  - Which output is generated and how is it encoded?
  - Which sensor transfer function is used?
  - Additional metadata: calibration, etc.
- Output encoding defined by SWE Common
- XML-Encoding
SOS Operations

**Transactional Extension**
- **SensorInsertion**
  - `insertSensor()`
- **ObservationInsertion**
  - `insertObservation()`
- **SensorDeletion**
  - `deleteSensor()`

**SOS Core**
- **Core**
  - `getCapabilities()`
  - `getObservation()`

**Get Data Availability Extension**
- **AvailabilityInvestigator**
  - `getDataAvailability()`

**Result Handling Extension**
- **ResultInsertion**
  - `insertResultTemplate()`
  - `insertResult()`
- **ResultRetrieval**
  - `getResultTemplate()`
  - `getResult()`

**Enhanced Operations Extension**
- **FeatureOfInterestRetrieval**
  - `getFeatureOfInterest()`
- **ObservationRetrievalByID**
  - `getObservationById()`
SOS – Consumer Perspective
SOS – Provider Perspective
Typical Set Ups

Existing database via Hibernate

- SOS Client
  - GetObservation
  - SOS Server
    - Hibernate
      - Database
        (e.g. PostgreSQL, MySQL, Oracle)
  - O&M
Typical Set Ups

Existing database via Database Views

SOS Client

GetObservation

SOS Server

O&M

Database Views

Database (e.g. PostgreSQL, MySQL, Oracle)
Typical Set Ups

Existing database with customised SOS

- SOS Client
- SOS Server
- Database
  - (e.g. PostgreSQL, MySQL, Oracle)
- GetObservation
- O&M
Typical Set Ups

Default SOS database, standardised feeding (transactional operations)

- SOS Client
- Data Feeder
- SOS Server
- Default DB

GetObservation → O&M → InsertObservation (O&M)
Typical Set Ups

Default SOS database, data feeding by SQL script

SOS Client

GetObservation

SOS Server

Data Feeder

SQL

Default DB

O&M
Typical Set Ups

**SOS as proxy for proprietary data access service**

- **SOS Client**
- **GetObservation**
- **SOS Server (Translator)**
- **O&M**
- **Proprietary Service**
Example 1

European Environment Agency (EEA)
Architecture
Set-Up

- ArcGIS Server SOS Extension
- Supports SOS 2.0 Standard
- Enhancement to support the e-Reporting O&M-Schema
- Deployment on top of a dedicated database
Example 2

Deployment at IRCEL-CELINE
Set-Up

- 52°North Sensor Observation Service 3.x
- Set-up on top of an existing database (Postgres/PostGIS)
- Usage of database views → presenting the available data in the default model of the 52°North SOS 3.x
- e-Reporting O&M-Schemas are not yet supported
- Currently in development: Web Client
Thank you for your attention!

Any questions? Comments?

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Other SOS examples

- IOOS Tethys project
- British Arctic Survey
- Federal Administration of German Waterways
52N SWE Thin Client Demo

http://sensorweb.demo.52north.org/jsClient/