OGC Sensor Web Enablement (SWE)

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OGC Overview
OGC Sensor Web Enablement
Discussion
Open Geospatial Consortium
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Data come from different sources
Data come from different organizations/countries
Common Issues / Challenges

“We can't share maps on the Web.”

“We can't deliver data to different systems easily.”

“We don't have a common language to speak about our geospatial data or our services.”

“We can't find and pull together data from our automated sensors.”
Sensors are everywhere

And .. 4 billion mobile devices can act as sensors

http://research.ict.csiro.au/conferences/ssn/ssn11
... disconnected
Standalone Sensors

- Deployed for single purpose or function
- Integration Difficulties
  - Heterogeneous platforms
  - Disparate data sets
  - Organisationally bound
- Isolated observations
Networked Sensors

- Allows remote access to sensors for:
  - data collection
  - responsiveness
  - tasking
- Observe phenomena more completely
Challenges

- How do I access the data
- Where is the existing data (Discovery)
- I need to create new sensor data
- What's the lineage of data (Provenance)
Challenges

- Error bars associated with data
- Integration of data
  - Different formats
  - Little known formats
- Real time access to data
Challenges

- Not enough data (*Sparse*)
- Too much data (*Overload*)
  - Subsetting
  - Filtering
- Push the data to me when its becomes available
OGC Sensor Web Enablement (SWE)
Wireless Sensor Networks (WNS) Focus

- Application Layer
  - Sensor Web Applications
  - Sensor Web Portals
- Sensor Web Layer
  - Sensor & Sensor Data Services
- Sensor Layer
  - WSN
    - Communication
    - Routing
    - Energy optimization
    - Coverage optimization

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Sensor Web Requirements

Discover
Describe
Get Data
Task
Subscribe

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Building Blocks: OGC SWE 2.0

Services
- Observation
- Tasking
- Alerting
- Analysis

Encodings, Registries & Dictionaries
- Sensor Description Language
- Phenomenon Description Language
Building Blocks: OGC SWE 2.0

SWE CDM

SensorML CS-W O&M

Encodings, Registries & Dictionaries

SWE CSM

SOS SPS SAS WNS

Services

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SWE Services

- XML/SOAP over HTTP
- RESTful in discussion
- Early: Provide rich data - trust users to filter
- Now: Start thinking about pre-organization of data
- All services are “self-descriptive”
  - SOS/SPS: Spatio/temporal features, observed feature, phenomenon, sensor…
SOS & SPS: Data Access & Control
Sensor Observation Service

- register sensor
- insert Observation

SOS

get capabilities
- List Sensors
- List Observation Offerings
  - Phenomena
  - Process
  - Feature of interest

describe sensor
- Physical characteristics
- Interfaces, inputs and outputs
- Constraints
- Calibration and accuracy...

get observation
Data (O&M, image, etc..)
System Observation Service

- register sensor
- insert Observation

get capabilities
- List Sensors
- List Observation Offerings
  - Phenomena
  - Process
  - Feature of interest

describe sensor
- Physical characteristics
- Interfaces, inputs and outputs
- Constraints
- Calibration and accuracy...

get observation
- Data (O&M, image, etc..)
Observation Model (O&M)

Procedure

Feature of Interest = Monterey Bay

Estimation value of a property

Salinity = property related to the feature of interest
SensorML

- Sensor and Process description language
- Uses SWE Common
- Very generic
SWE Common for encoding data

```xml
<wse:elementType name="weather_data">
  <wse:DataRecord>
    <!-- -->
    <wse:field name="time">
      <wse:Time definition="http://www.opengis.net/def/property/OGC/0/SamplingTime">
        <wse:label>Sampling Time</wse:label>
      </wse:Time>
    </wse:field>
    <!-- -->
    <wse:field name="temperature">
      <wse:Quantity definition="http://mmisw.org/ont/cf/parameter/air_temperature">
        <wse:label>Air Temperature</wse:label>
        <wse:uom xlink:href="Cel"/>
        <wse:constraint>
          <wse:AllowedValues>
            <wse:value>1</wse:value>
            <wse:value>2</wse:value>
            <wse:value interval="-50 +50" insignificant Figures/>
          </wse:AllowedValues>
          <wse:constraint>
            <wse:values>
              2009-01-01T10:00:25Z, 25.3, 1098, 5, 56
              2009-01-01T10:00:35Z, 25.4, 1098, 15, 59
              2009-01-01T10:00:45Z, 25.4, 1098, 12, 42
              2009-01-01T10:00:55Z, 25.4, 1098, 5, 40
              2009-01-01T10:01:05Z, 25.3, 1098, 5, 66
            </wse:values>
          </wse:constraint>
        </wse:constraint>
      </wse:Quantity>
    </wse:field>
    <!-- -->
    <wse:field name="pressure">
      <wse:Quantity definition="http://www.opengis.net/def/property/OGC/0/AtmosphericPressure">
        <wse:label>Atmospheric Pressure</wse:label>
        <wse:constraint>
          <wse:values>
            2009-01-01T10:00:25Z, 1098, 5, 56
            2009-01-01T10:00:35Z, 1098, 15, 59
            2009-01-01T10:00:45Z, 1098, 12, 42
            2009-01-01T10:00:55Z, 1098, 5, 40
            2009-01-01T10:01:05Z, 1098, 5, 66
          </wse:values>
        </wse:constraint>
      </wse:Quantity>
    </wse:field>
  </wse:DataRecord>
</wse:elementType>
```
Main Concepts SWE

Feature of Interest → has Property → Property → Estimated By → Procedure

- Speed
- Model
- Number of Passengers
- Laser speed gun
- System: Super video camera with model car image recognition
- System: Senior Expert passenger counter following procedure p1345 with 8x42 mm binoculars
Procedure = sensor or platform or system

Procedure has inputs and outputs
Systems are procedures

- Each **system** has its own offering (if too big then group by regions)
- One system per offering
- SensorML describes the composition
O&M contains general structure, but needs community semantics
SPS: Tasking Sensors/Actuators

Client -> SPS
- GetCapabilities: Capabilities
- DescribeTasking: Tasking Parameters
- GetFeasibility: Feasibility Study Result
- Submit
- Update/GetStatus/Cancel
- DescribeResultAccess: Data Service(s) endpoint(s)
  - send notification message
  - access data

SPS -> Sensor Logic
- Sensor1 Logic
- Sensor2 Logic

Data Service
- send data
SWE Services

SWE Encodings

* Interoperability Adapter is not a CE deliverable. It is vendor built, if needed
** SDK is an optional CE deliverable, if need warrants and funding allows
Current Status

Current standards
- SensorML – 1.0.1 approved in 2007 (V2.0 anticipated by September 2011)
- SWE Common Data – V2.0 approved
- SWE Common Services – V2.0 approved
- Observations & Measurement – V2.0 approved
- SOS – V2.0 approved
- SPS – V2.0 approved
- SAS – being folded into Pub Sub (based on OASIS WS-N)
- PUCK – on voting process – end in November

Approved SWE standards can be downloaded:
- Specification Documents: http://www.opengeospatial.org/standards
- Specification Schema: http://schemas.opengis.net/
DLR: Tsunami Early Warning & Mitigation Center

Seismic Monitoring  
GPS  
Tide Gauges  
Ocean Bottom Units  
Buoys  
EO Data

Observations

Simulation

Risk- & Vulnerability Modelling

Geospatial Data Repository

BMG 5in1 / 6in1 System

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Application: NASA Sensor Web

NASA SensorWeb Vision

Manage complexity via simplicity using Internet methodology
1. Access via URI
2. Easy discovery
3. Easy upscale
4. Resource Oriented Architecture
5. Goal-oriented or theme based tasking
6. User/Event Driven

Software-driven Antenna Sensitivity Patterns - Software tunes reception to targeted satellite

Plug-and-Play Flight Software

Plug-and-Play Ground Software

INTERNET

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PULSENet™ Applications: Atmospheric/Air Quality – Fire Monitoring/Smoke Forecasting

- Hazard Mapping
- Fire Detections
- Fire Detection Analysis Service
- Initiate Model
- Smoke Forecast Services
- Re-task Sensors for
  - Updated Fires
  - Model Validation
  - Air Quality Impacts

NOAA NESDIS
EO-1 Satellite
NGC
EO-1 Satellite
NASA Ames
NASA Goddard

Charlie Neuman, San Diego Union-Tribune/Zuma Press
SAIC Global SensorWeb

- Defense/Intelligence implementation of OGC SWE standards
- SWE support for UGS and other ISR sensors
- Prominent participant in Empire Challenge since 2005
SWE in the Oceans Community

Real-Time Data from an OGC Sensor Web

This interoperability demonstration represents an effort to develop a Web Services Architecture for Ocean Observing that is enabling observing systems to move closer to the vision of 'network as platform'. We are seeking participants who would like to serve their in-situ observation data via SOS based Web Services. To learn more, visit the OOSTethys.org website.
The image explains the PUCK - IEEE 1451 - SOS system. It shows how various components interact, starting from the SOS client, which communicates with other SOS servers through the SWE protocol. The 1451.0 client connects to the Observatory-1451.0 server using the STWS protocol, which in turn communicates with other servers using the 1451.0 protocol. The Observatory node contains drivers, SensorML, and TEDS, which are loaded from PUCK-enabled instruments. The diagram is lead by Tom O'Reilly (MBARI).
Example Implementations

- From: http://www.opengeospatial.org/resource/products/byspec
- 1Spatial Group Ltd
- 52 North
- Compusult Limited
- Feng Chia U.
- Geomatycs
- Inha University
- IST-SUPSI
- Lat/Ion GmbH
- Northrop Grumman IT TASC
- SAIC
- UAH
Where SWE activities are going

- GeoWeb Mobile Internet
- Augmented Reality
- Open GeoSMS

Photo courtesy of http://www.artisthenewreligion.com
The emerging Internet of things:
-- indoor/outdoor location
-- sensor webs
-- building information models
-- location apps
-- location marketing
-- smart grid
Augmented Reality

OGC ARML 2.0 Standards Working Group (SWG)
http://maps.google.com/maps?q=38.9985,-77.030275&GeoSMS
I am here for OGC TC Meeting.

Usuarios no se preocupan por la plataforma o el servicio de navegación
Semantic Sensor Web: Linked Sensor Data

RESTful SOS Proxy for Linked Sensor Data

http://foo.bar/myRESTfulSOS/Muenster/thermometer_123/RDF

RESTful SOS

SOS: O&M

<Observation>
  <procedure>
    thermometer_123
  </procedure>
  <featureOfInterest>
    Muenster
  </featureOfInterest>
  <result>23</result>
</Observation>

translation between RDF and O&M / SensorML

Arne Broering - broering@52north.org

http://www.slideshare.net/arneb/meaningful-ur-isforlinkedsensordataforpublic
Conclusions

SOS, SensorML, O&M, SweCommon, SPS are there waiting for you..

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