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SeCoGIS 2010

A Sensor Observation Service Based on OGC Specifications for a Meteorological SDI in Galicia

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Outline

- MOTIVATION
- OBJECTIVE
- SOS DATA MODEL
- PROTOTYPE IMPLEMENTATION
- CONCLUSIONS AND FURTHER WORK

MOTIVATION

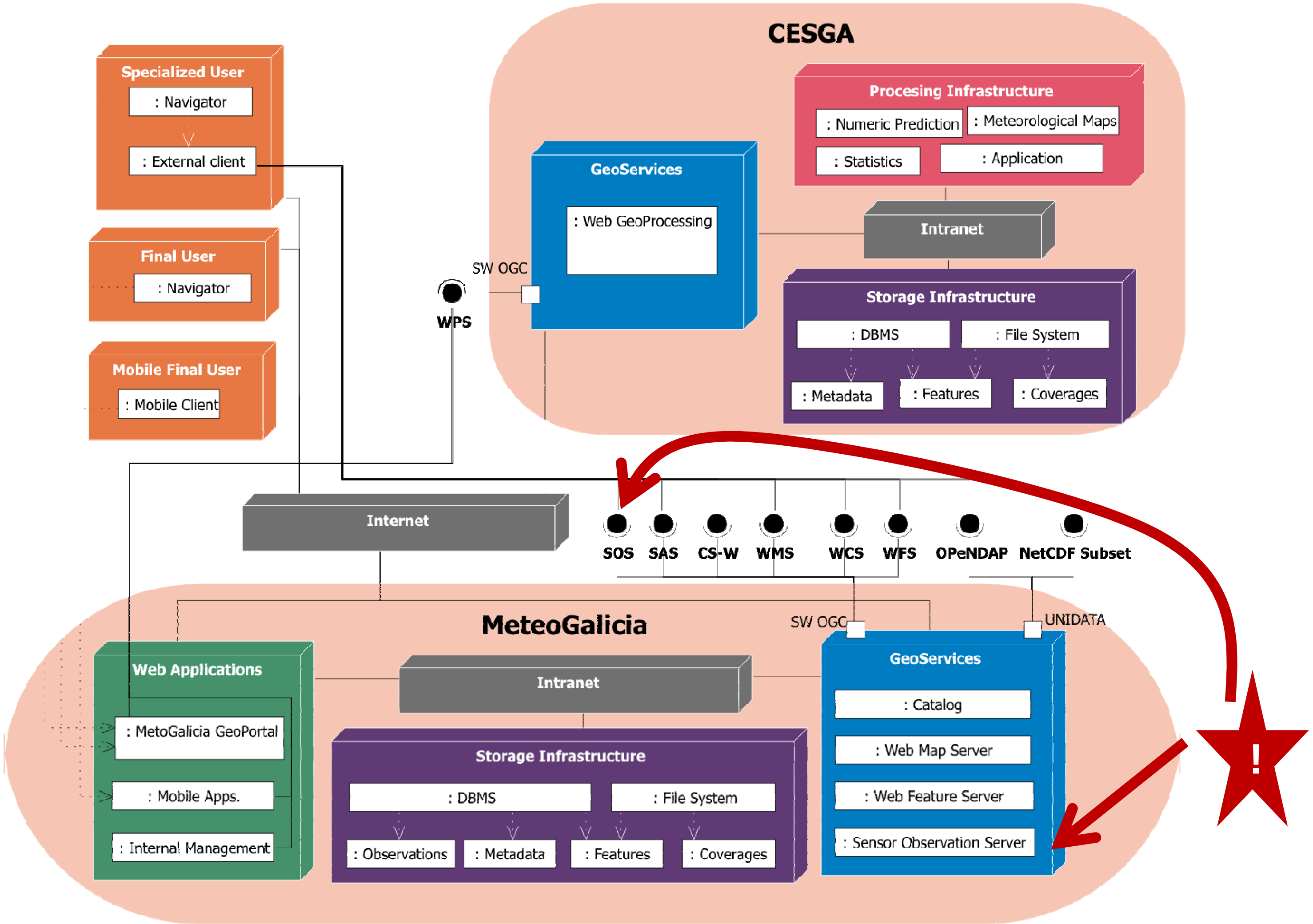
- **INSPIRE**
  - Development of SDI in Spain
  - Public access to meteorological and oceanographic data
- **OGC - Sensor Web Enablement (SWE)**
  - **Sensor Observation Service (SOS)**
    - GetCapabilities
    - DescribeSensor
    - GetObservation

MOTIVATION

- **The MetoSIX Project**
  - "Geographic Information System for the Management and Dissemination of the Meteorological and Oceanographic Information of Galicia"
  - Founded by Galician regional government
    - Xunta de Galicia – INCITE – 09MDS034522PR
  - Participants
    - MeteoGalicia
    - CESGA
    - Computer Architecture Group UDC
    - Systems Laboratory USC

- Motivation
- Objective
- SOS Data Model
- Prototype Implement.
- Conclusions and Further Work

The MetoSIX Project



OBJECTIVE

- **Development of a Sensor Observation Server in the context of the MeteoSIX Project**
  - Restrict to three mandatory operations of the SOS interface
  - Meteorological and oceanographic phenomena measured by sensors of various types
    - Static sensors with in-situ observations
    - Static sensors with remote observations
    - Mobile sensors with in-situ observations
    - Mobile sensors with remote observations

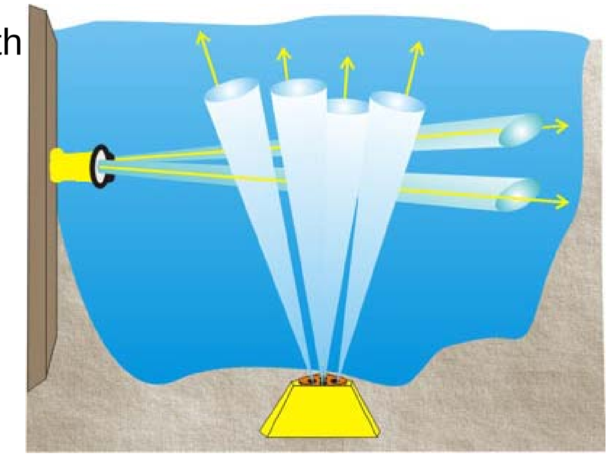
Available Sensor Data

- Meteorological Stations
  (Static – In Situ)
  - About 80 automatic meteorological stations
  - Sensors located at various elevations in each station
  - Primitive Phenomena
    - ✓ Temperature (Air, 10 cm below and above ground)
    - ✓ Average relative humidity
    - ✓ Solar radiation
    - ✓ Rainfall
    - ✓ Barometric pressure
    - ✓ Etc.
  - Derived Phenomena
    - ✓ Evapotranspiration
    - ✓ Aggregates (daily, monthly)

SOS DATA MODEL

Available Sensor Data

- Oceanographic Stations
  (Static and mobile – In Situ and Remote)
  - 4 oceanographic stations
  - In situ sensors
    - ✓ Meteorological Phenomena at some elevation (Static)
      - ➢ Air temperature, Humidity, etc.
    - ✓ Oceanographic Phenomena at various depths (mobile)
      - ➢ Water temperature, salinity, pressure, conductivity, etc.
  - Remote sensors
    - ✓ Sea currents at various depths along a path
    - ✓ Vertical or Horizontal Acoustic Doppler Current Profiler (VADCP, HADCP)

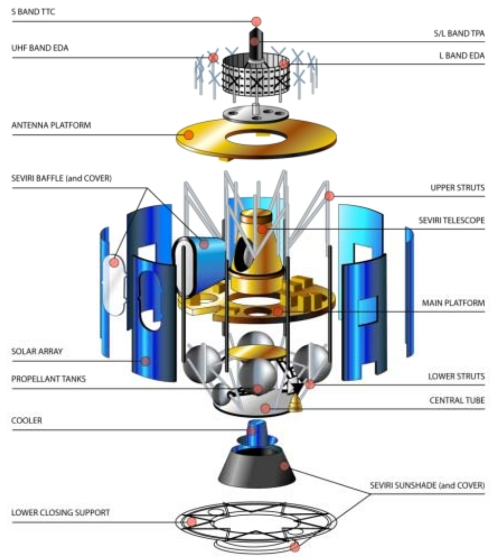


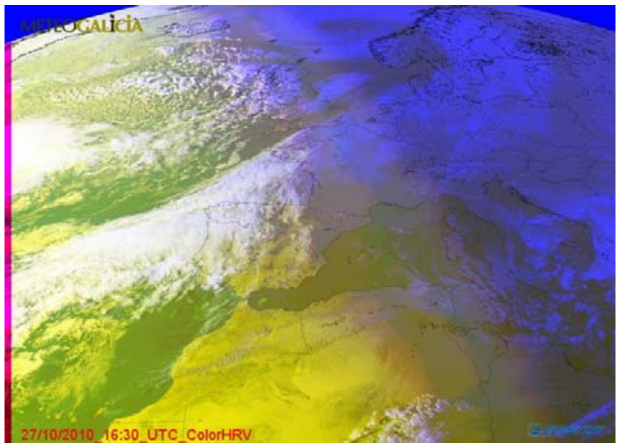
- **Available Sensor Data**
  - Radio sounding (Mobile – In Situ)
    - Mobile platform attached to a weather balloon
    - Sensors
      - ✓ GPS Data
      - ✓ Meteorological Phenomena
        - ✓ Temperature, pressure, humidity, wind direction and speed, etc.

SOS DATA MODEL

Available Sensor Data

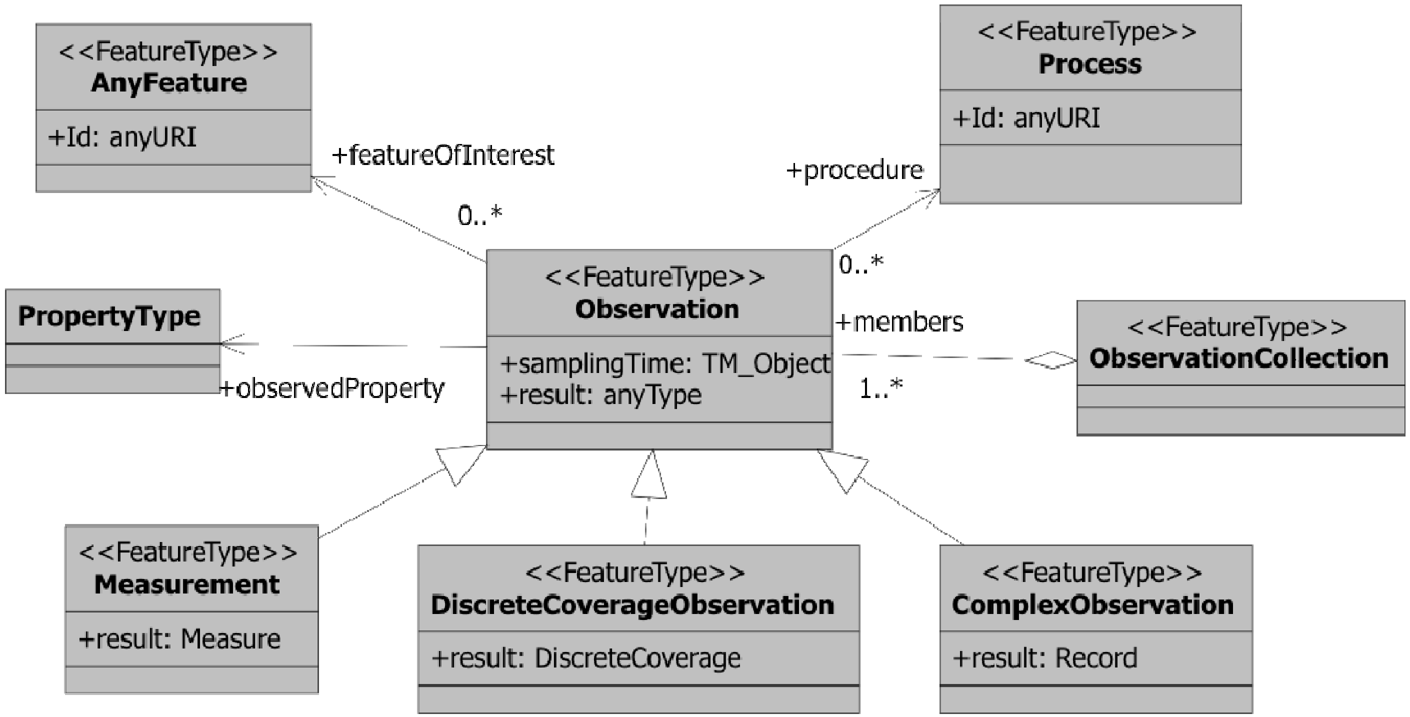
- Satellite Data (Mobile – Remote)
  - Data provided by *European Organisation for the Exploitation of Meteorological Satellites* (EUMETSAT)
  - Platform: Meteosat (Second Generation)
  - Sensors (Radiometers)
    - ✓ Geostationary Earth Radiation Budget experiment (GERB)
    - ✓ Spinning Enhanced Visible and InfraRed Imager (SEVIRI)
      - ➢ 12 Spectral channels
        - ➢ Infrared and visible
        - ➢ Detection of water vapour, ozone and carbon dioxide
      - ➢ Measures every 15 minutes
      - ➢ Spatial resolution at nadir of 3 Km (1km for channel HRV)





In Memory Observations Data Model

- Specialization of the one adopted by OGC



Motivation

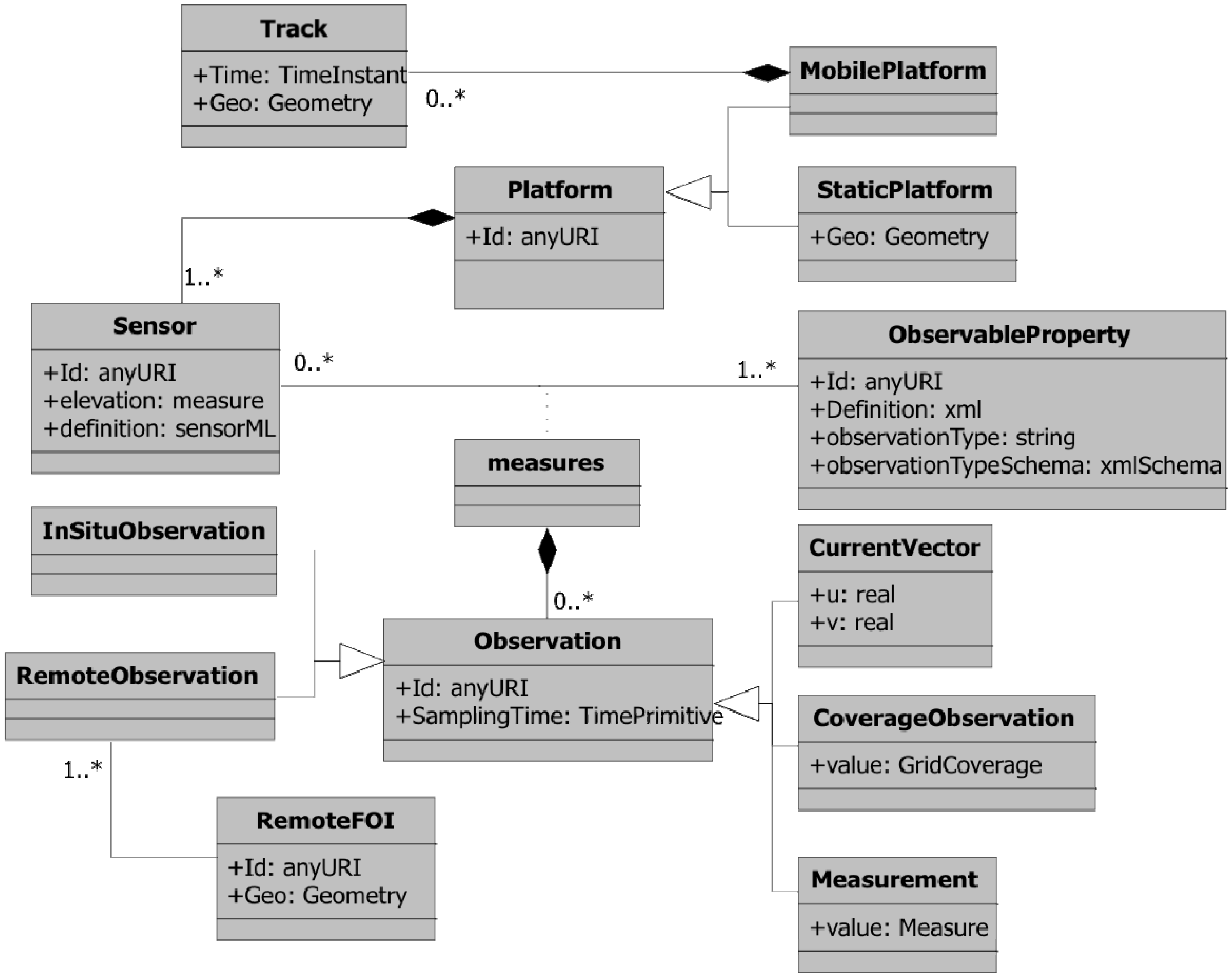
Objective

SOS Data Model

Prototype Implement.

Conclusions and Further Work

- ## Persistent Observations Data Model



PROTOTYPE IMPLEMENTATION

- **Limited Functionality**
  - Only in-situ sensors on board of static platforms (meteo stations)
    - Implementation for mobile platforms in the scope of another project
- **Implementation technologies**
  - PostgreSQL + PostGIS
  - W3C Web Services Distributed Platform
    - SOAP for communication of request and response
    - WSDL for description of the service interface
    - Implementation with Apache Axis 1.0

PROTOTYPE IMPLEMENTATION

- **Compact representation for observation collections**
  - Collections with constant procedure (sensor), observed property and Feature of interest. Variable Time
    - Use Time aggregates to represent observation time.
    - Use measure list to represent the observed value at each time


```
<?xml version="1.0" encoding="UTF-8"?>
<om:ObservationCollection . . .>
<om:member>
  <om:Observation>
     <om:samplingTime>
      <gml:MultiTime>
        <gml:timeMembers>
          <gml:TimeInstant><gml:timePosition>2010-01-15T12:00:00</gml:timePosition></gml:TimeInstant>
          <gml:TimeInstant><gml:timePosition>2010-01-15T12:10:00</gml:timePosition></gml:TimeInstant>
          <gml:TimeInstant><gml:timePosition>2010-01-15T12:20:00</gml:timePosition></gml:TimeInstant>
        </gml:timeMembers>
      </gml:MultiTime>
    </om:samplingTime>
    <om:procedure xlink:href="urn:lbssos:sensor:1"/>
    <om:observedProperty xlink:href="urn:lbssos:AirTemperature"/>
    <om:featureOfInterest xlink:href="urn:lbssos:AutomaticStation45"/>
    <om:result uom="degree Celsius">15.17 15.20 16.04</om:result>
  </om:Observation>
</om:member>
</om:ObservationCollection>
```

PROTOTYPE IMPLEMENTATION

- **Design and implementation of a SOS for 4 main types of sensors**
  - In-situ / Remote, Static / Mobile
- **Only Limited Prototype Implementation ➡ Much Further Work**
  - Recording of satellite data (spatial coverages)
    - Lack of uniform data model for spatial objects and coverages in the context of spatial databases
  - Efficient encoding and transmission of spatial coverages
    - Use of out-of-band mode with well known formats (netCDF)
  - Evolution of spatial data with respect to time
    - Many data modeling approaches (lack of efficient and widely used tools)
    - Only moving points in the scope, thus trivial solution may be adopted
  - Evolution with respect to time of spatial coverages
    - Complex problem (more than spatial coverages + temporal types

PROTOTYPE IMPLEMENTATION

- Motivation
- Objective
- SOS Data Model
- Prototype Implement.
- **Conclusions and Further Work**

- **Final Implemenation. Analyse possible use of 52 North SOS (currently undergoing)**
  - 52 North: International Open Source initiative. Work on Geoinformatics (SWE, Web-based Geoprocessing, etc.)
  - Initial problems
    - Observation types in 52 North restrict to: numeric, text and spatial objects
      - Current vectors? Spatial coverages?
    - 52 North model for persistent observations is too generic
      - Inconsistencies may appear (associate an in-situ sensor of a meteo station with the position of an oceanographic station or with the location of a remote position obtained by a VADCP

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