

SWE

Introduction to Sensor Web Enablement

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Agenda

- Background
 - SDI
- Why do we need SWE?
- What are the required functions?
- SWE building blocks
 - Information model
 - Service model
- Scenario

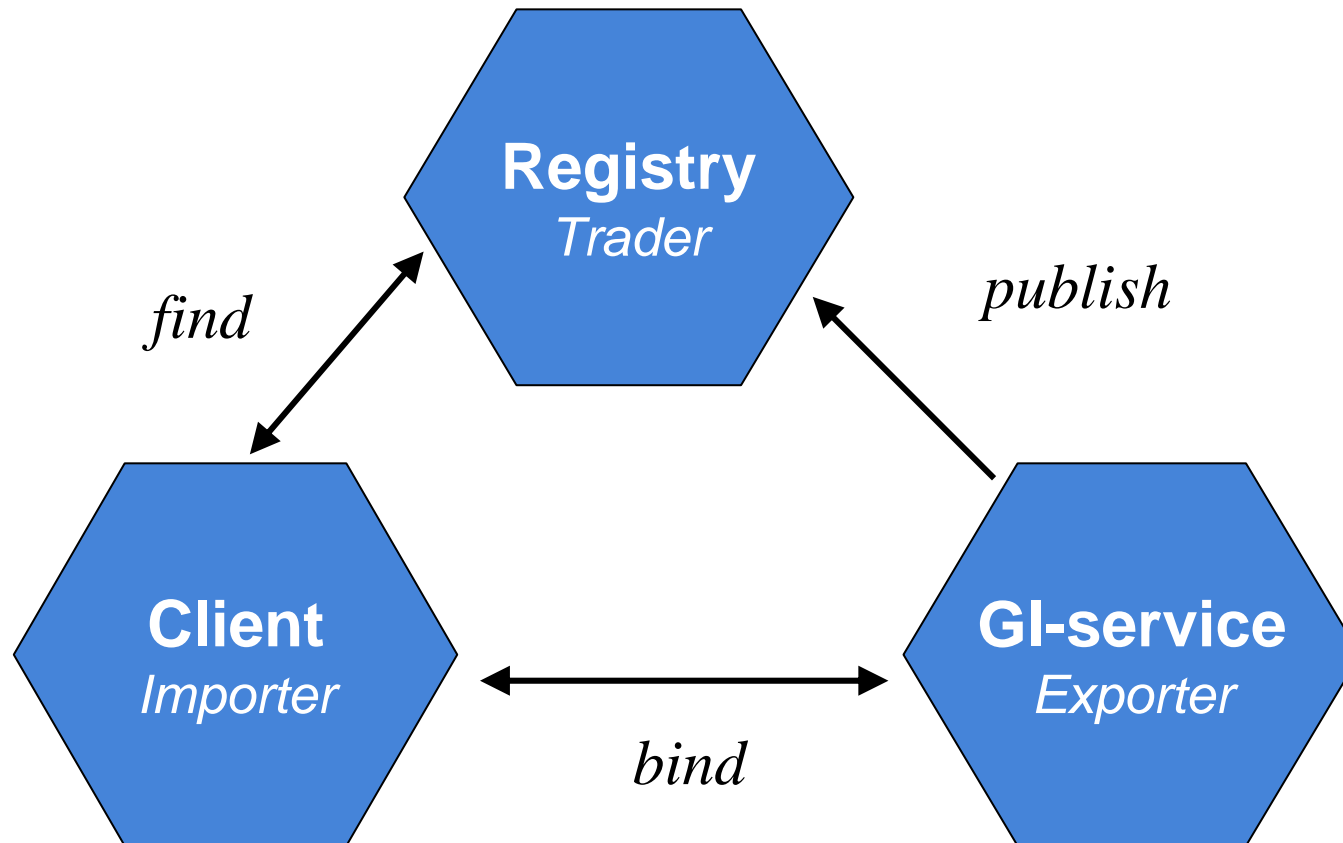
SDI – What is it?

- “[...] base collection of technologies, policies, and institutional arrangements that facilitate the availability of and access to spatial data.” (Nebert 2001)
- “[...] encompasses the sources, systems, network linkages, standards, and institutional issues involved in delivering spatially related data form many different sources to the widest possible group of potential users at affordable costs” (Groot & McLaughlin 2000)

Spatial Data Infrastructure

- Cooperatively usable, interoperable and Web-based geo information services (GI-services)
 - Improvement of the availability of geoinformation
 - Pool of ad hoc usable geodata
 - Common platform for users & providers
 - More efficient use of geodata
 - Avoid data conversions
 - Higher actuality
- networking across boundaries of systems and organizations
 - Requires interoperability

Service Trading



- Ad hoc chaining of services

Motivation for SWE

- Traditional services allowed to
 - request for maps (image)
 - Web Mapping Service
 - request for (binary) raster data
 - Web Coverage Service
 - request for vector data
 - Web Feature Service
- Lack of a generic framework for sensor data integration into SDIs

Objective

- Make all kind of sensors via the WWW
 - Discoverable
 - Accessible
 - Controllable
- Framework for a WWW-based sensor web
- Foundation for “plug-and-play” web-based sensor networks

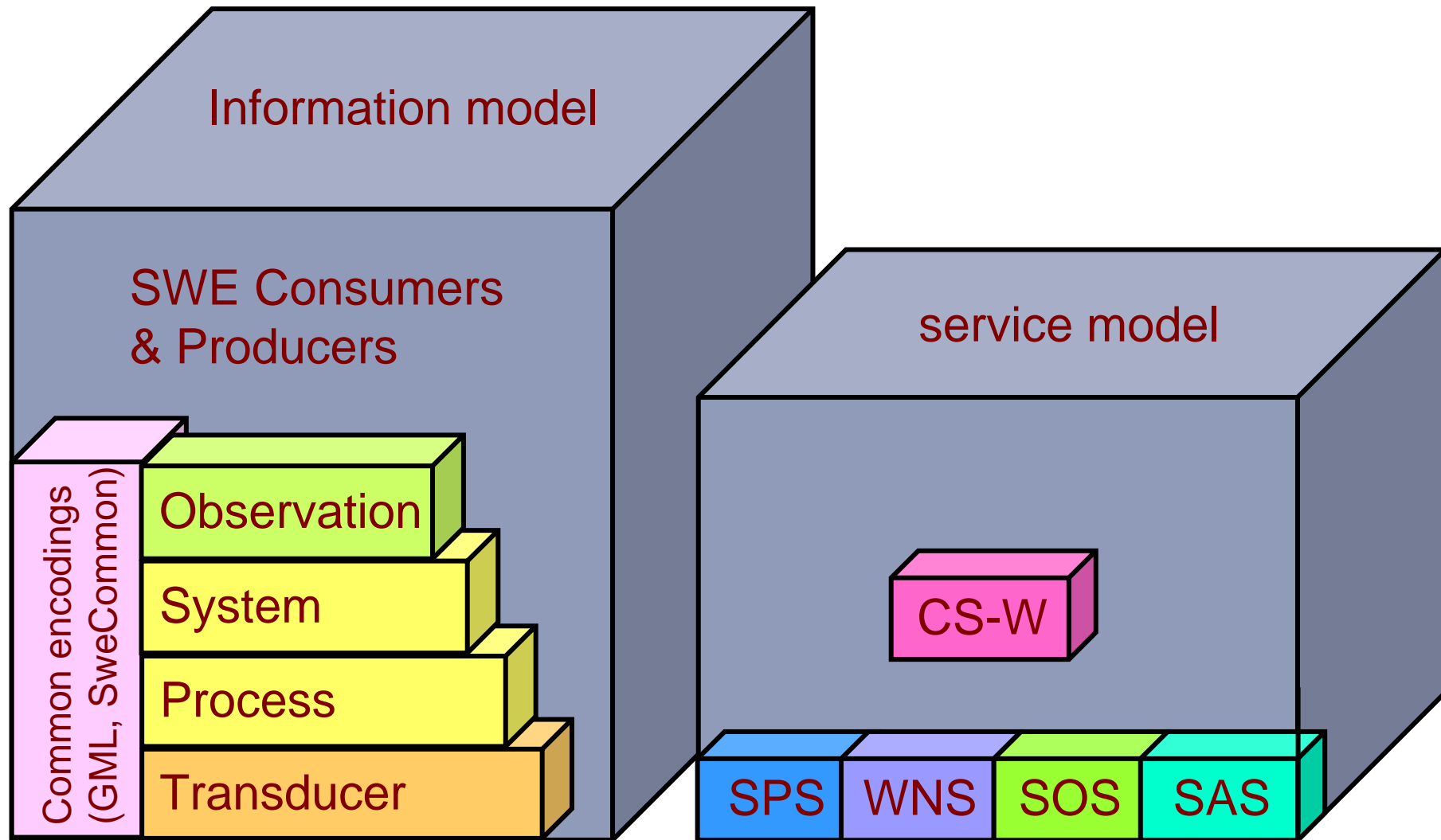
Required functionality I

- Discovery
 - of sensor systems, observations and processes
- Determination
 - of sensor's capabilities and quality of measurements
- Access
 - to sensor parameters

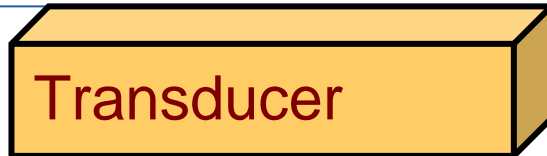
Required functionality II

- Retrieval
 - of real-time or time-series observations in standard encodings
- Tasking
 - of sensors to acquire observations of interest
- Subscription & publishing
 - to/of alerts to be issued by sensors

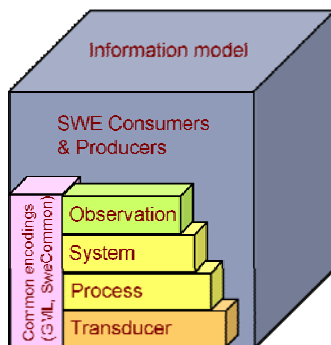
SWE building blocks



Information model I

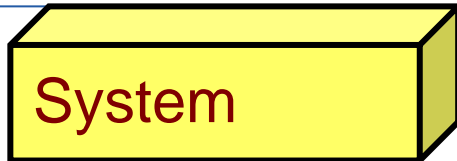


- Interface between the digital and the real world
- Actuator
 - Translates electronic signals to phenomenon
- Sensor
 - Translates phenomenon to data

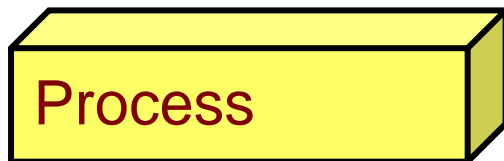


➤ link: [Transducer Model Language \(TML\)](#)

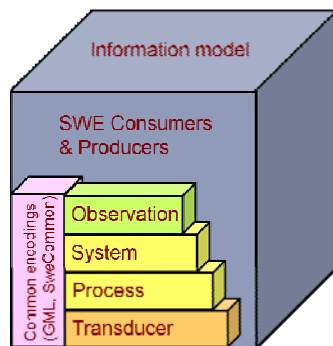
Information model II



- Composite model of transducers and/or subsystems
- Enables the geo-location of comprising parts



- Transforms one or more inputs based on a given methodology to one or more outputs

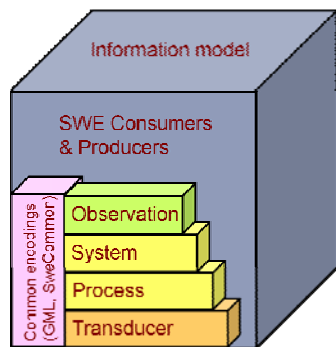


➤ link: [Sensor Model Language](#)

Information model III

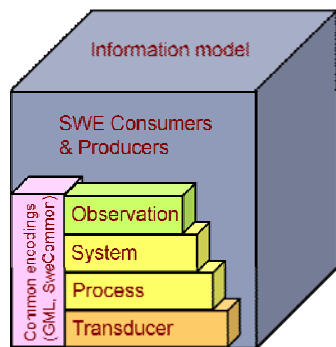
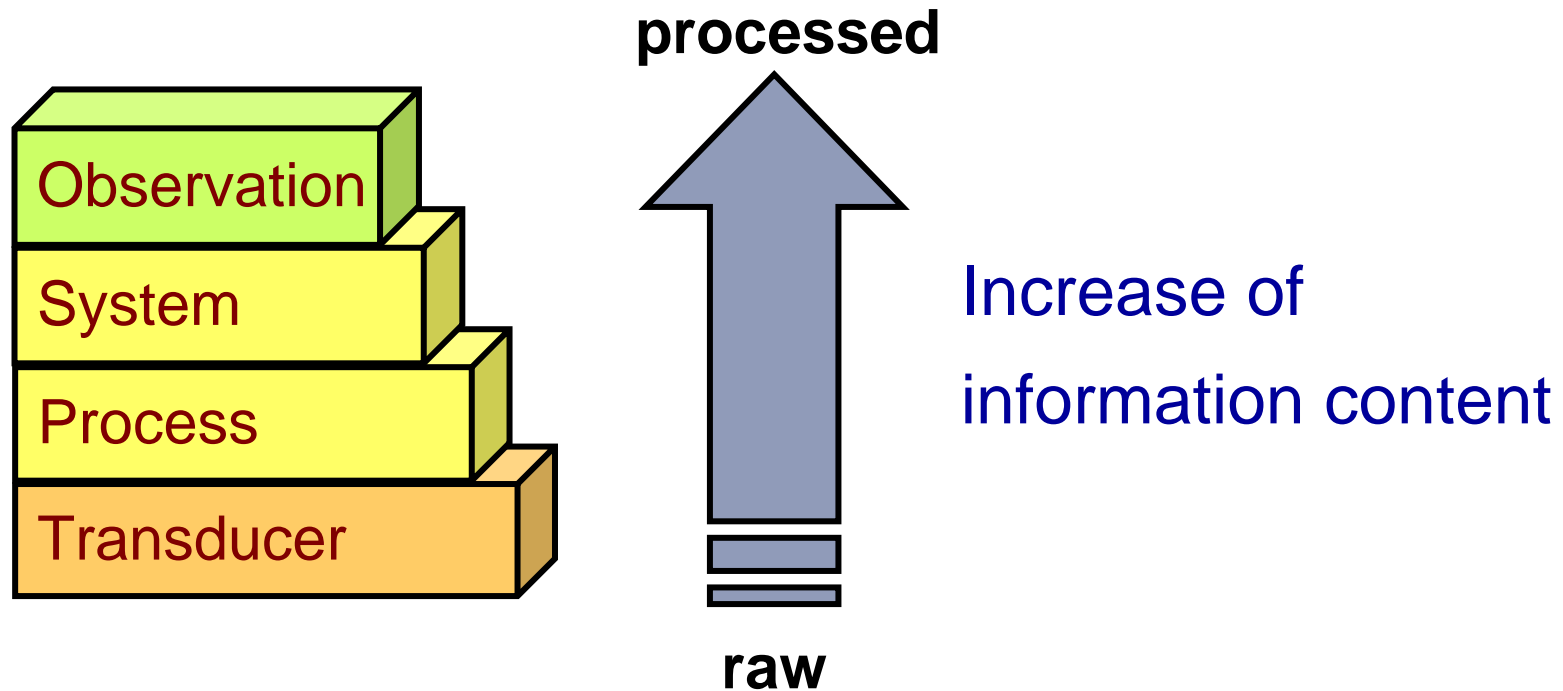


- Act of observing a phenomenon
- Produces an estimate of the value of the property
- Is an event
- Observable is a characteristic of a phenomenon subject to observation

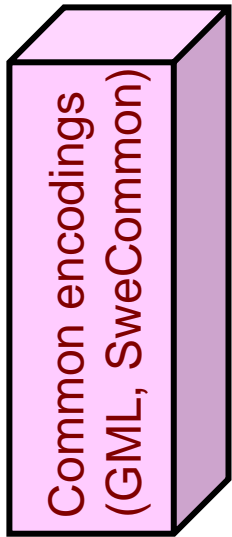


➤ link: [Observation and Measurements \(O&M\)](#)

Information model IV

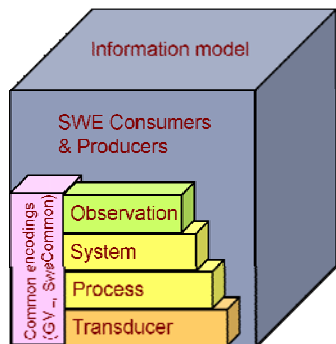


Information model V



- SWE data stack uses common encodings
- SweCommon specifies
 - Description of data values
 - Encoding of data
 - Use of process inputs
 - Encoding of parameters
 - Observation results

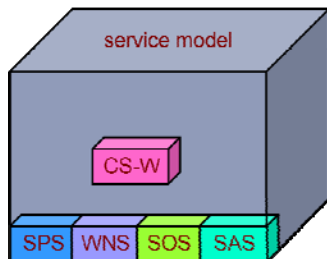
- is based on GML



Service model



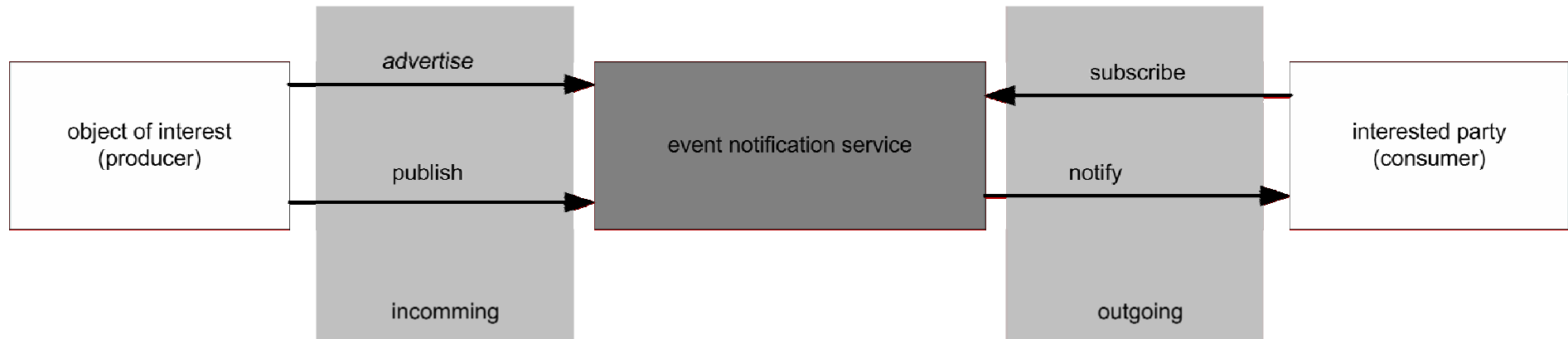
- Access to observation from sensors
 - Pull-based time-series
- Leverages
 - O&M for modeling sensor observations
 - SensorML for modeling sensor metadata
- Observation Offering
 - Analogous to WMS layer
 - Grouping of related observations
 - Geographical region
 - Sensor system
 - Phenomena being sensed
 - link: Sensor Observation Service



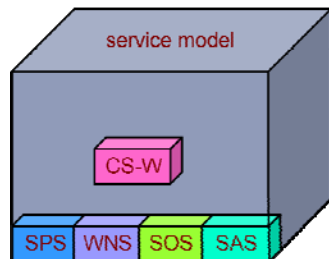
Service model



- Similar to event notification system



- Event-based real-time alerts
- Instead of regular request/response protocols such as HTTP, the XMPP protocol is used

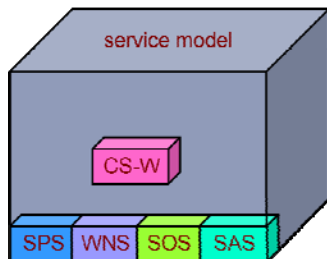


➤ link: [Sensor Alert Service](#)

Service model



- Tasking of web resident sensors
 - Parameterization of:
 - sensors
 - simulations
 - Planning and executing of:
 - UAV
 - probe
 - robot
 - ...
- allows defining, checking, modifying and cancelling tasks
- does not archive the data itself → points to where the data can be accessed
- asynchronous communication with task client via WNS

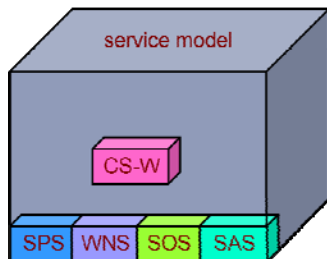


- link: Sensor Planning Service

Service model

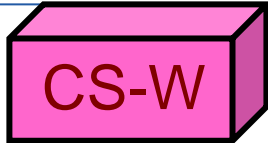


- Long-term actions require asynchronous communications between a user and corresponding service
- Protocol transducer HTTP →
 - E-mail
 - SMS
 - Instant message
 - Phone call
 - ...

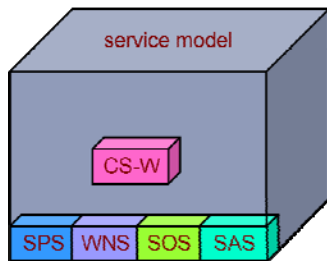


➤ link: [Web Notification Service](#)

Service model



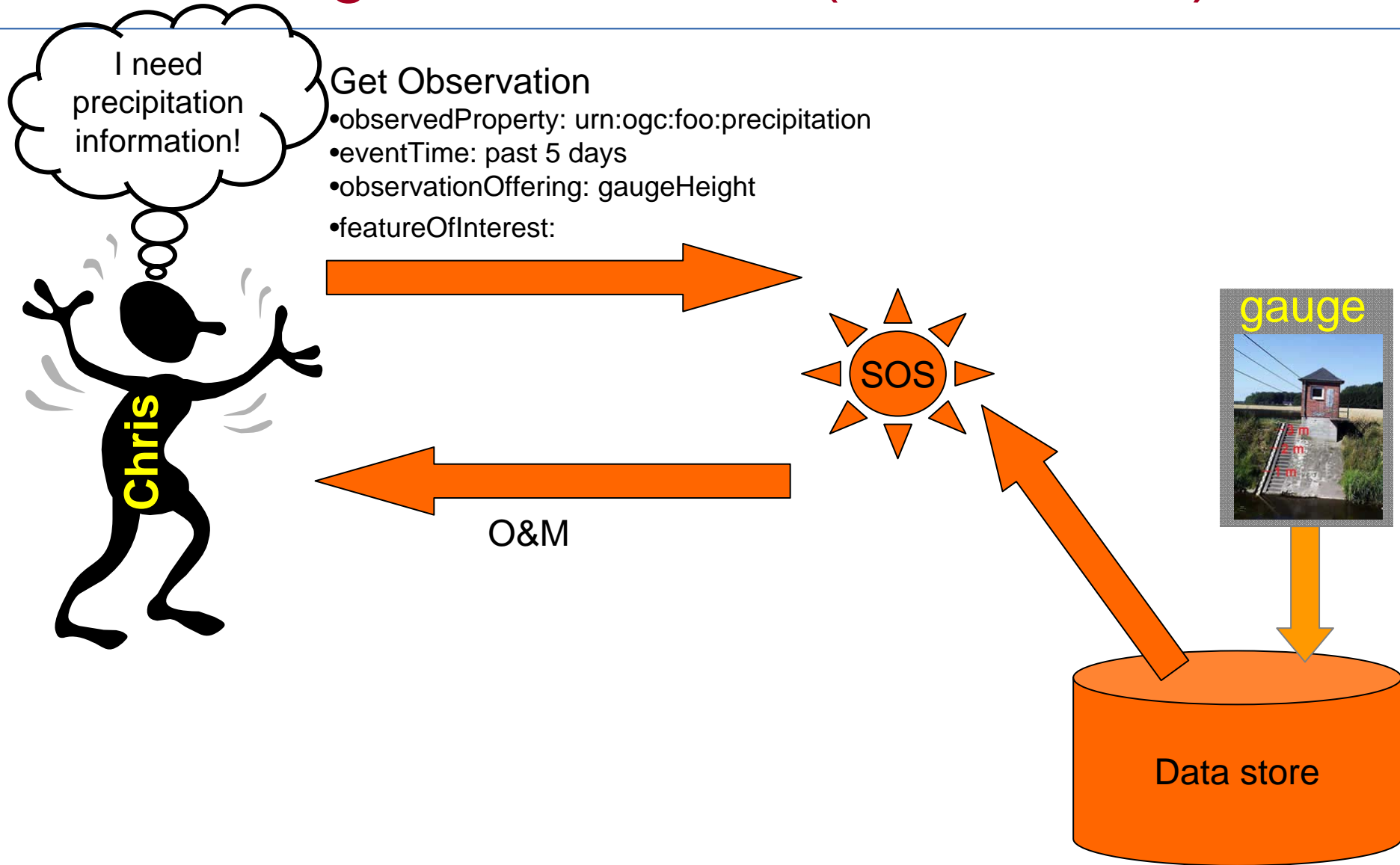
- Catalog for discovery of
 - Sensors
 - Phenomena
 - Services
 - Units of measure



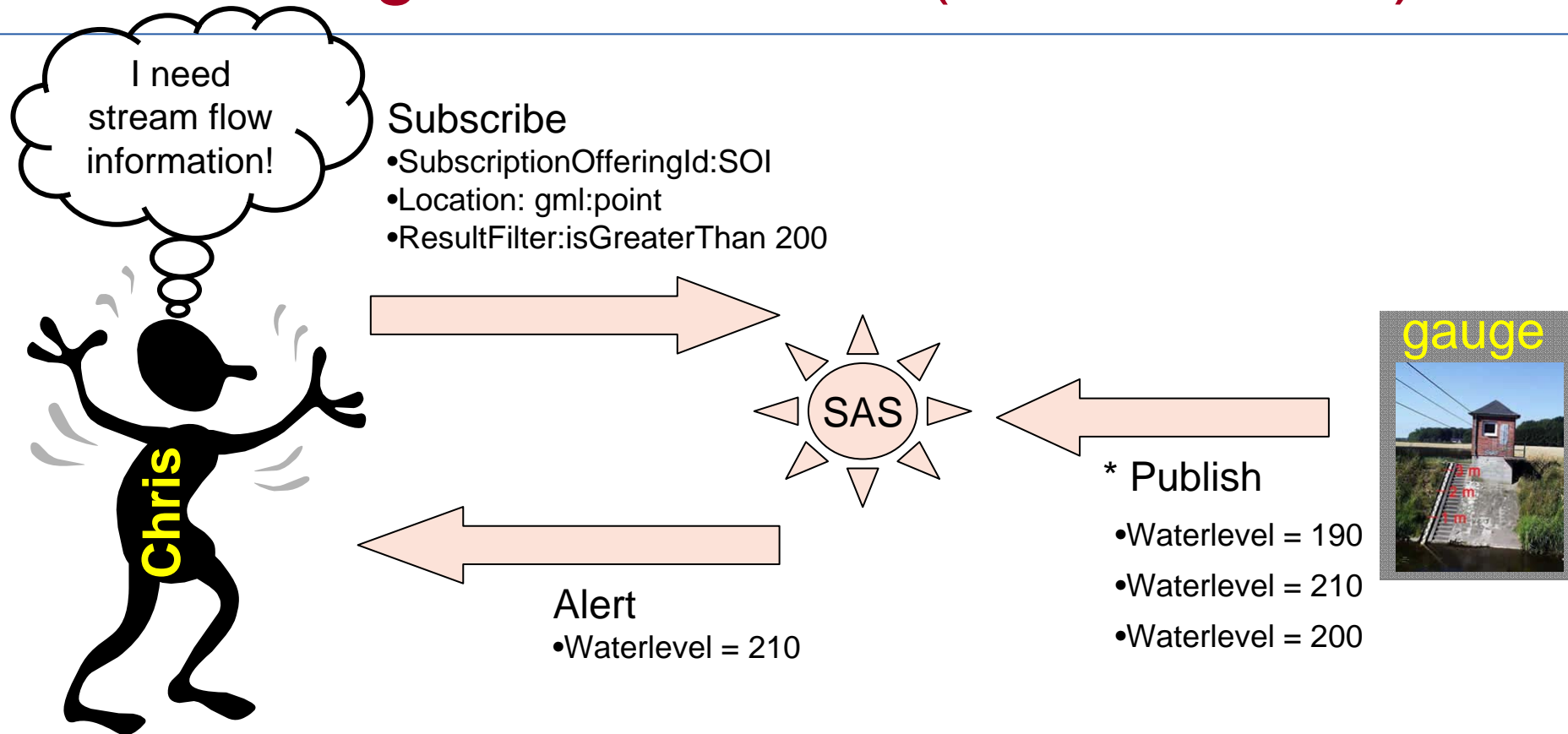
Scenario

- *Chris works in an environmental agency. His task is to monitor the discharge of a water catchement during a flood event.*
 - *Which parcels will be affected?*
 - *What provisions have to be implemented?*
- Chris needs the following information:
 - Past precipitation
 - Hydrograph curve of the last month
 - Up to date water level & stream flow information
 - Real time notification
 - if threshold value (water level, stream flow) is crossed

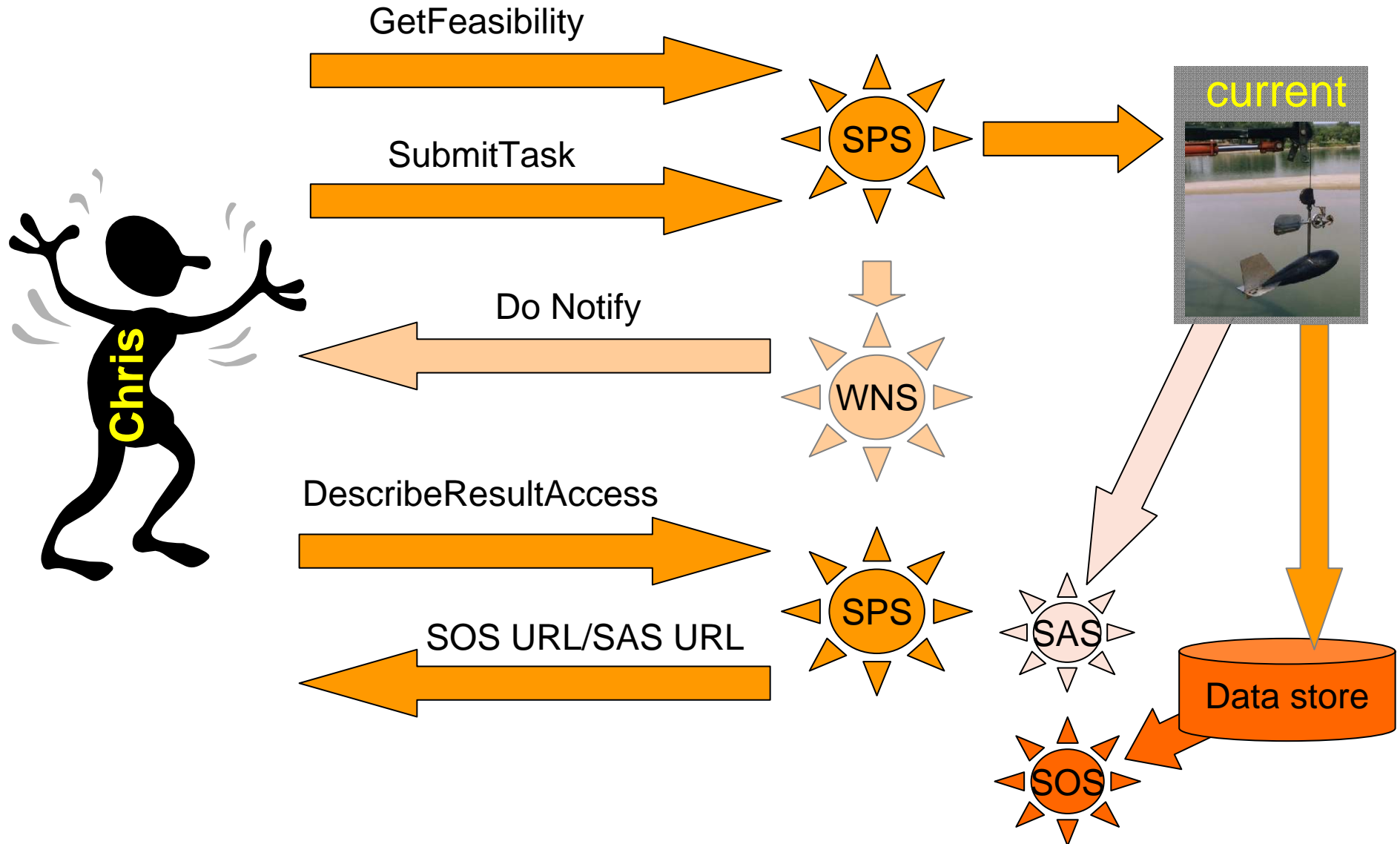
Accessing observations (time-series)



Accessing observations (event based)

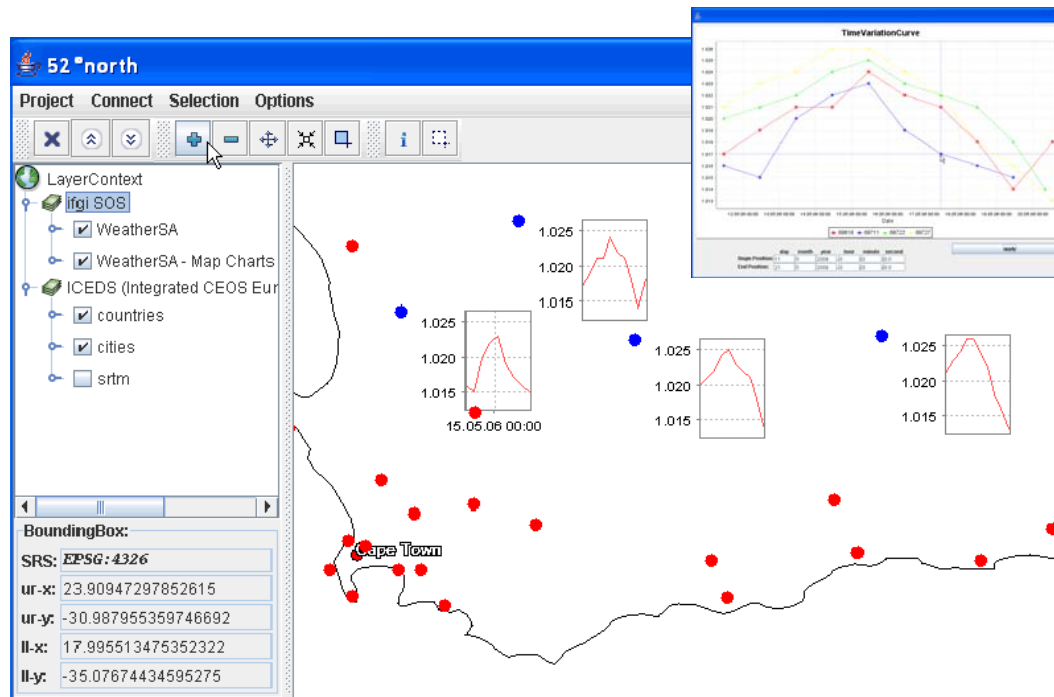


Sensor Tasking



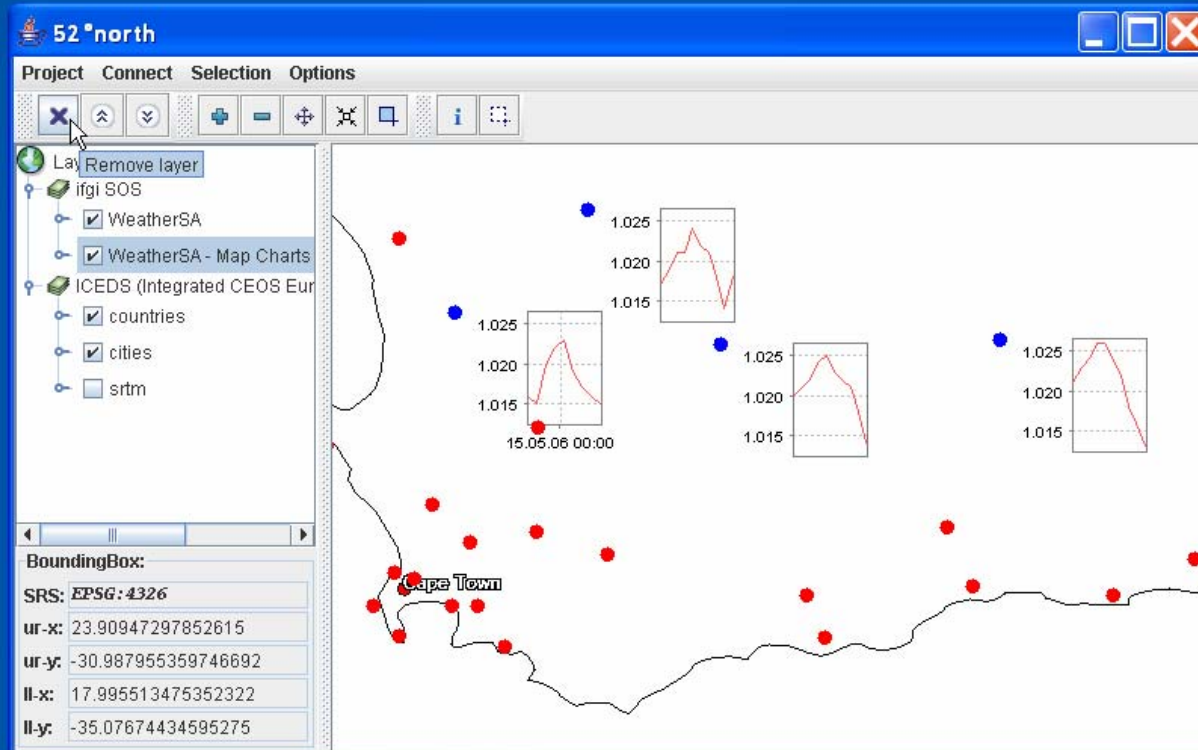
Plug & Play

- Integration of all kind of sensors
 - analysis
 - control



The screenshot shows the "IFGI OWS3 Sensor Planning Service client" window. It displays the service URL: `http://mars.uni-muenster.de:8080/52nSPSv1/SPS` and the sensor ID: `urn:ogc:object:feature:Sensor:IFGI:AXISPTZ_C:1:i`. Under the "basic operations" section, there are three buttons: "GetCapabilities", "DescribeTasking", and "DescribeResultAccess", each with a "show request" button next to it. The "GetFeasibility / Submit parameters" section includes a "speed:" input field and a "gotoserverpresetname:" dropdown menu set to "watersystem".

Producing animated map charts



Connect WMS

Service-URL:

WMS Version:
1.0.0
1.1.0
1.1.1

GetCapabilities GetMap

Connect SOS

Service-URL:

Show Capabilities Document

Show DescribeSensor Document

Add Features of Interest to Map

animated map charts

The screenshot shows a GIS application window titled "52°north". The main map area displays a map of Cape Town with several red dots representing data points. A 3D bar chart is overlaid on the map, showing two bars for the date "11.5.2006 11:00:00". The first bar has a value of 1025.0, and the second bar has a value of 1022.5. The chart's vertical axis ranges from 1015.0 to 1025.0. The map includes a layer list on the left with the following items: LayerContext, ifgi SOS (expanded), WeatherSA (checked), WeatherSA - Animated M (checked), ICEDS (Integrated CEOS Eur (expanded), countries (checked), cities (checked), and srtm (unchecked). Below the layer list is a BoundingBox section with the following information: SRS: EPSG:4326, ur-x: 23.90947297852615, ur-y: -30.987955359746692, ll-x: 17.995513475352322, and ll-y: -35.07674434595275. At the bottom of the window, there are two dialog boxes: "Connect WMS" and "Connect SOS". The "Connect WMS" dialog box has a Service-URL field with the value "http://iceds.ge.ucl.ac.uk/cgi-bin/icedswms" and a WMS Version dropdown menu with options 1.0.0, 1.1.0, and 1.1.1. The "Connect SOS" dialog box has a Service-URL field with the value "http://localhost:8080/52nSOSv2_weatherSA/sos" and three buttons: "Show Capabilities Document", "Show DescribeSensor Document", and "Add Features of Interest to Map".

Summary

- What is the concept behind SDI and SWE?
 - Service oriented architecture
 - Publish, find, bind
- Why do we need SWE?
 - generic framework for sensor data integration into SDIs
- What are the required functions?
 - Discovery, determination, access, tasking, subscription
- SWE building blocks
 - Information model
 - Modeling and encoding
 - Service model
 - Service interface specification

Thank you ...

for your attention!



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