Introduction to Sensor Web Enablement

Uetrecht,
2007-02-01

Alexander C. Walkowski

ifgi
Institute for Geoinformatics
University of Münster

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)

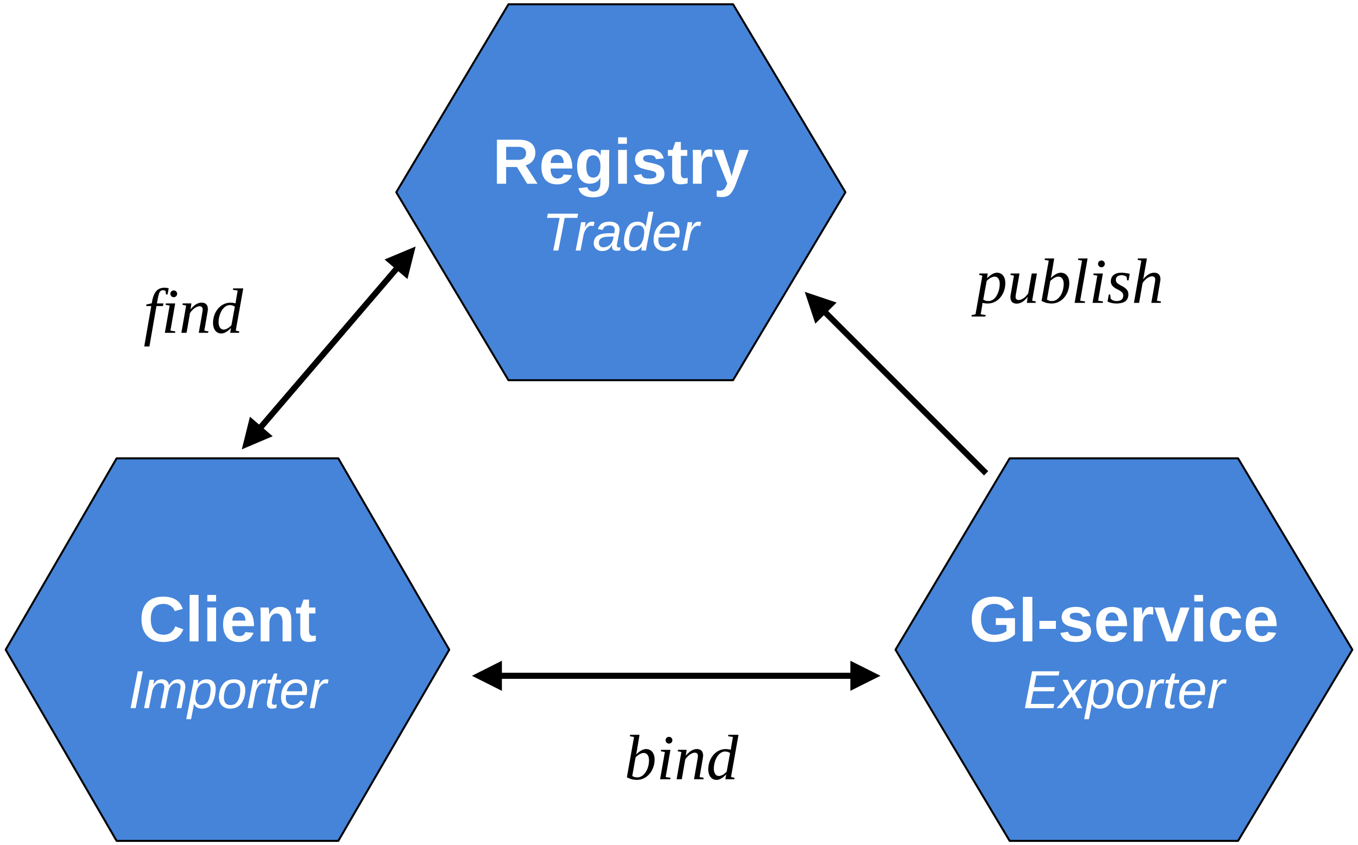
Spatial Data Infrastructure

- 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

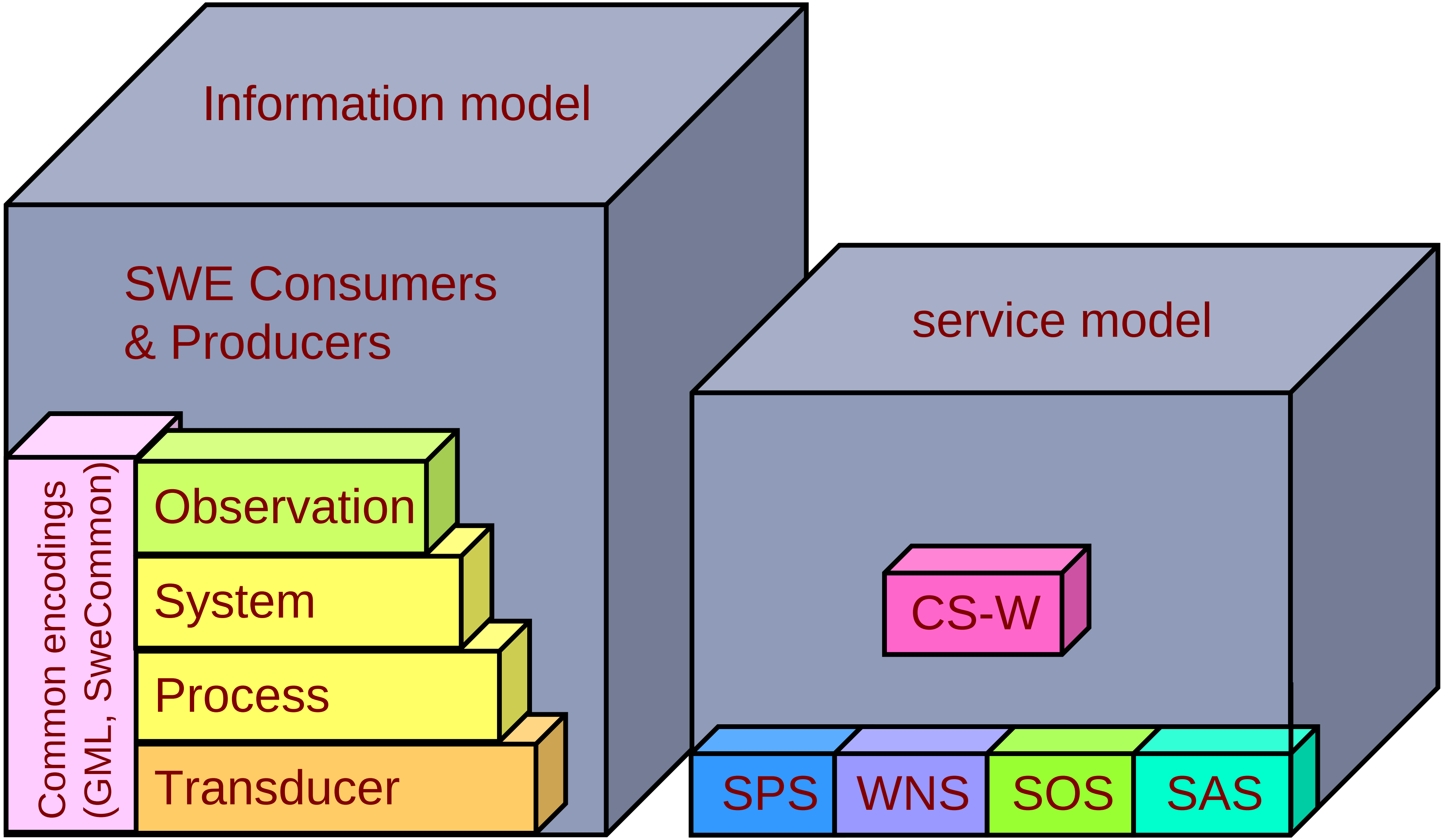
Required functionality II

- 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

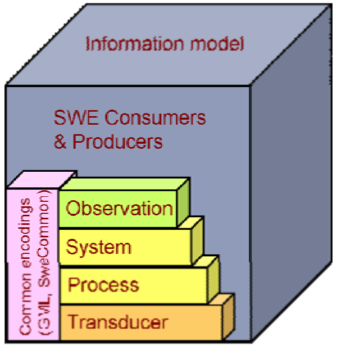
SWE building blocks



Information model I

Transducer

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



➢link: Transducer Model Language (TML)

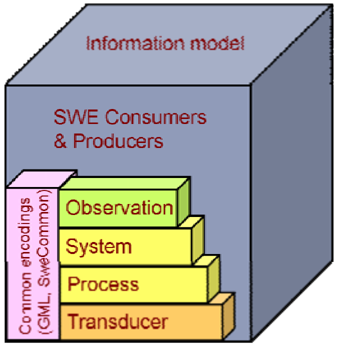
Information model II

System

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

Process

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

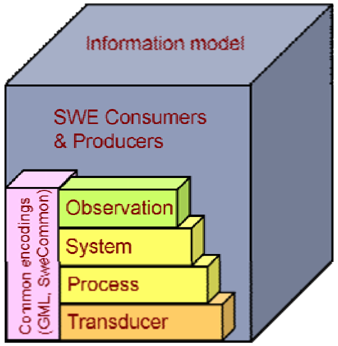


➢link: Sensor Model Language

Information model III

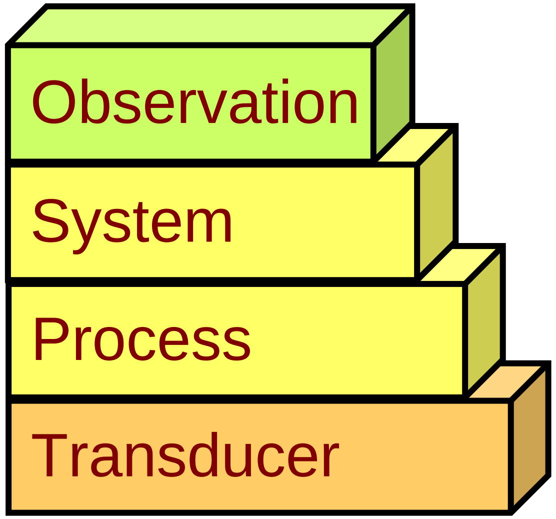
Observation

- 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

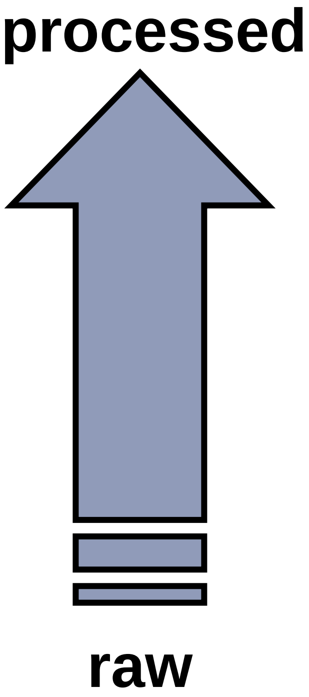


Observation

System

Process

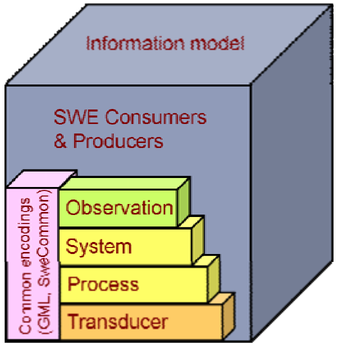
Transducer



processed

raw

Increase of information content



Information model

SWE Consumers & Producers

Common encodings (GML, SweCommon)

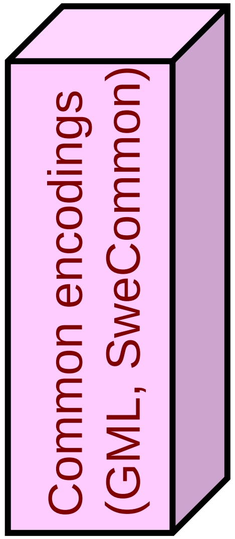
Observation

System

Process

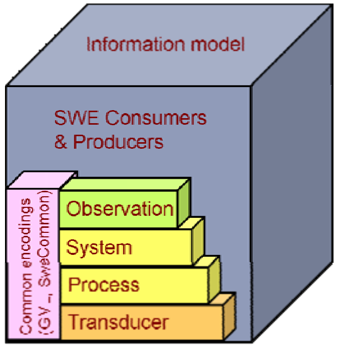
Transducer

Information model V

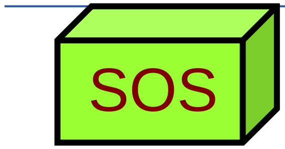


- SWE data stack uses common encodings
- SweCommon specifies
  - ➢Description of data values
  - ➢Encoding of data
  - ➢Use of process inputs
  - ➢Encoding of parameters
  - ➢Observation results

- is based on GML

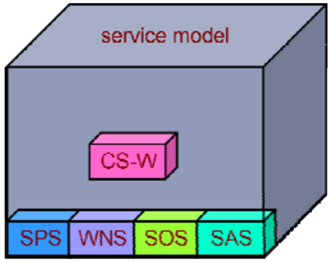


Service model

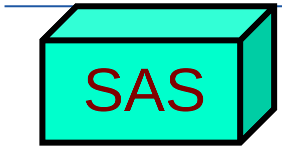


- Access to observation form sensors
  - Pull-based time-series
- Leverages
  - O&M for modeling sensor observations
  - SensorML for modeling sensor metadata
- Observation Offering
  - Analogous to WMS layer
  - Grouping of related observations
    - ➢Geographical region
    - ➢Sensor system
    - ➢Phenomena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

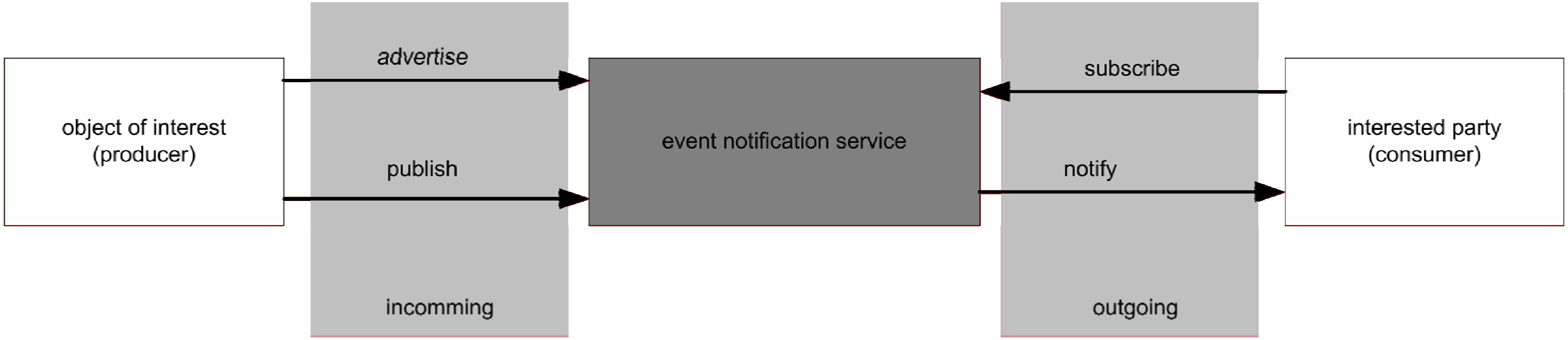
➢link: Sensor Observation Service



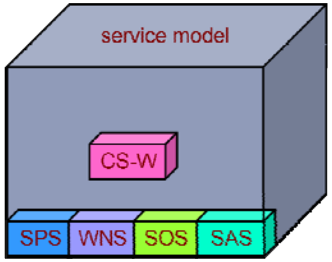
Service model



- Similar to event notification system

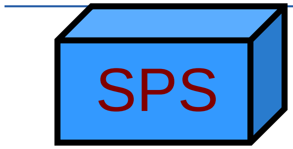


- Event-based real-time alerts
- Instead of regular request/response protocols such as HTTP, the XMPP protocol is used

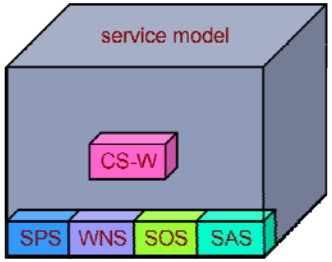


  - ➢ link: Sensor Alert Service

Service model

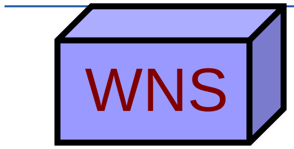


- Tasking of web resident sensors
  - Parameterization of:
    - sensors
    - simulations
  - Planning and executing of:
    - UAV
    - probe
    - robot
    - …
- allows defining, checking, modifying and cancelling tasks
- does not archive the data itself → points to where the data can be accessed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

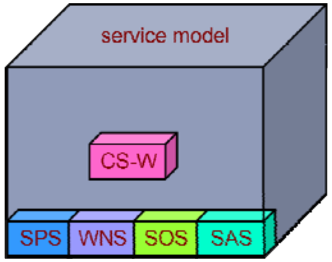


- link: Sensor Planning Service

Service model

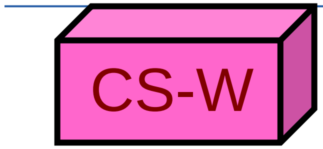


- Long-term actions require asynchronous communications between a user and corresponding service
- Protocol transducer HTTP →
  - E-mail
  - SMS
  - Instant message
  - Phone call
  - …

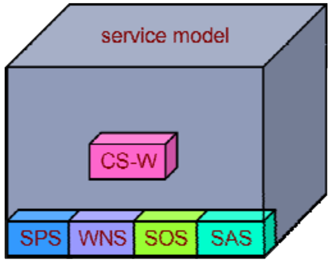


➢link: Web Notification Service

Service model



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

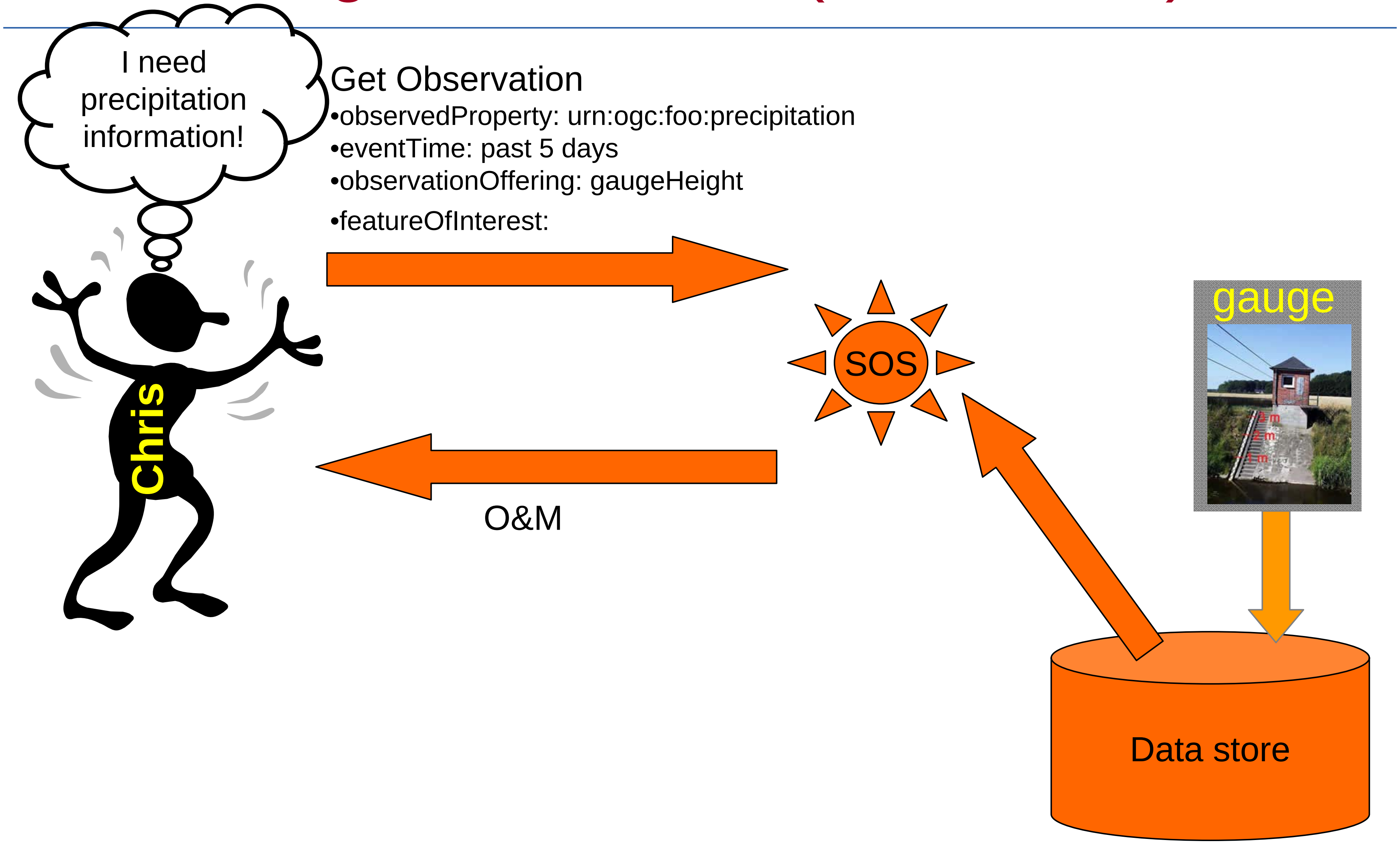


Scenario

- *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)



I need precipitation information!

Get Observation
- •observedProperty: urn:ogc:foo:precipitation
- •eventTime: past 5 days
- •observationOffering: gaugeHeight
- •featureOfInterest:

Chris

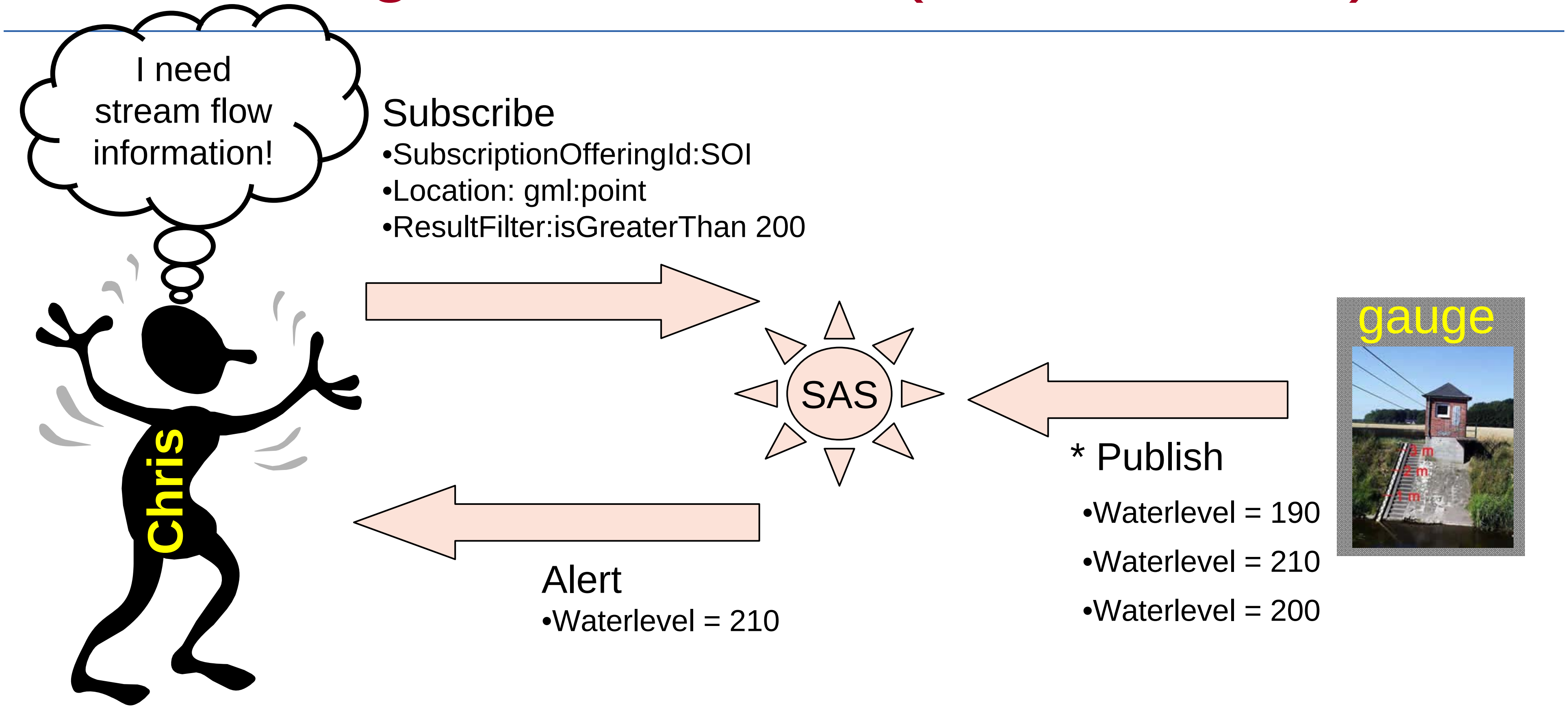
SOS

gauge

O&M

Data store

Accessing observations (event based)



I need stream flow information!

Subscribe

- SubscriptionOfferingId:SOI
- Location: gml:point
- ResultFilter:isGreaterThan 200

SAS

gauge

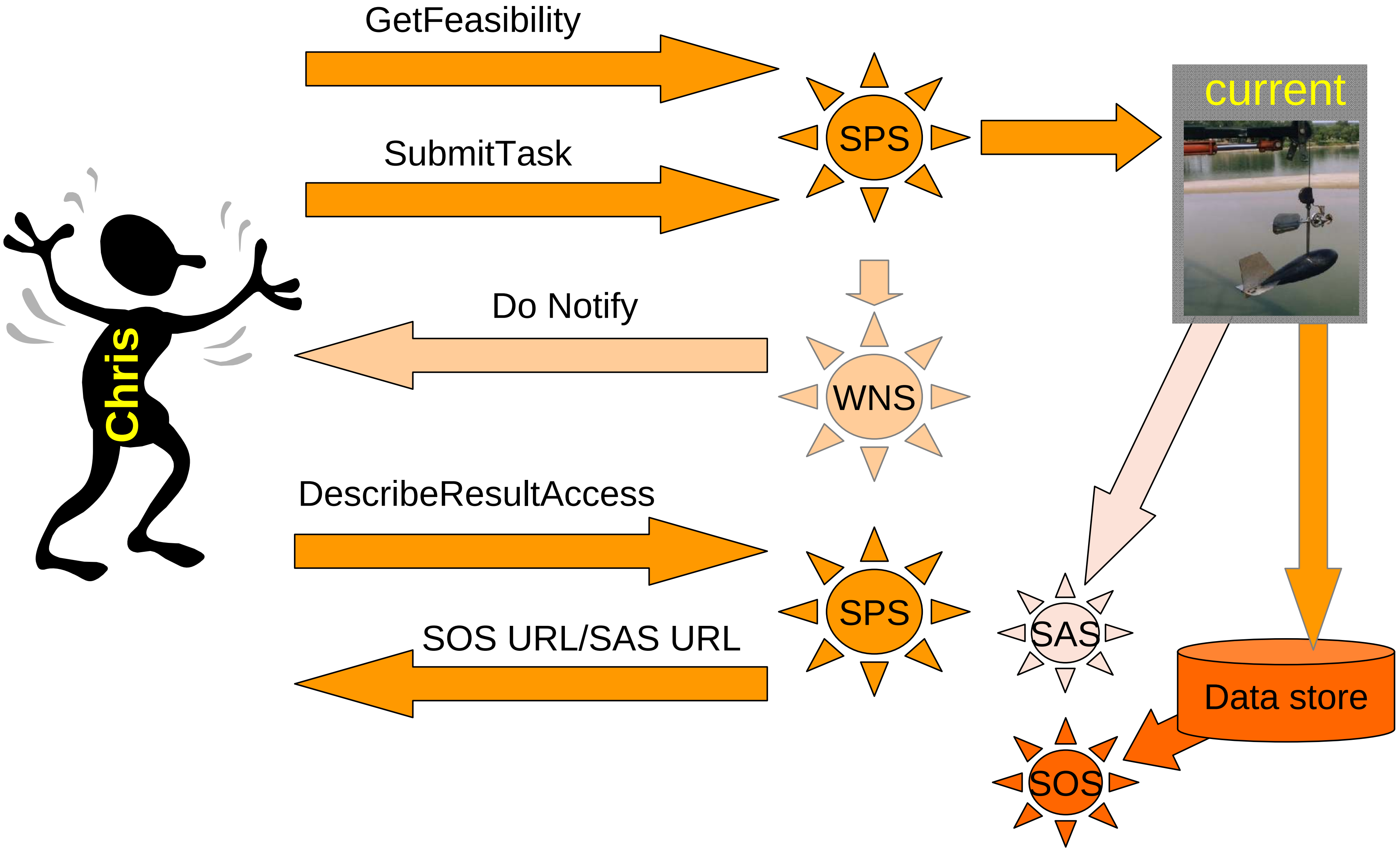
* Publish

- Waterlevel = 190
- Waterlevel = 210
- Waterlevel = 200

Alert

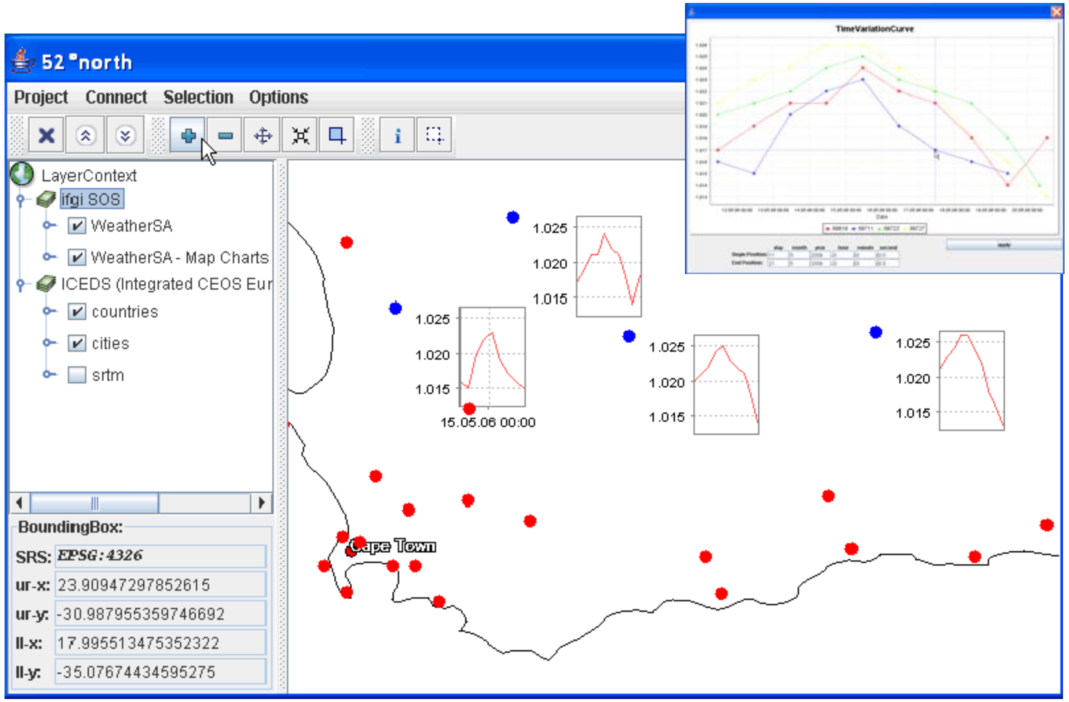
- Waterlevel = 210

Sensor Tasking



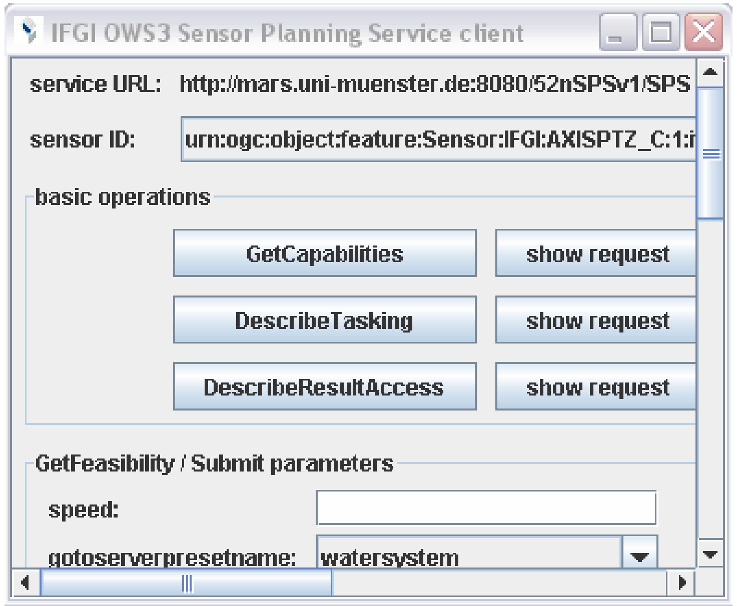
Plug & Play

- Integration of all kind of sensors
    - analysis
    - control



BoundingBox:

SRS:	EPSG:4326
ur-x:	23.90947297852615
ur-y:	-30.987955359746692
ll-x:	17.995513475352322
ll-y:	-35.07674434595275



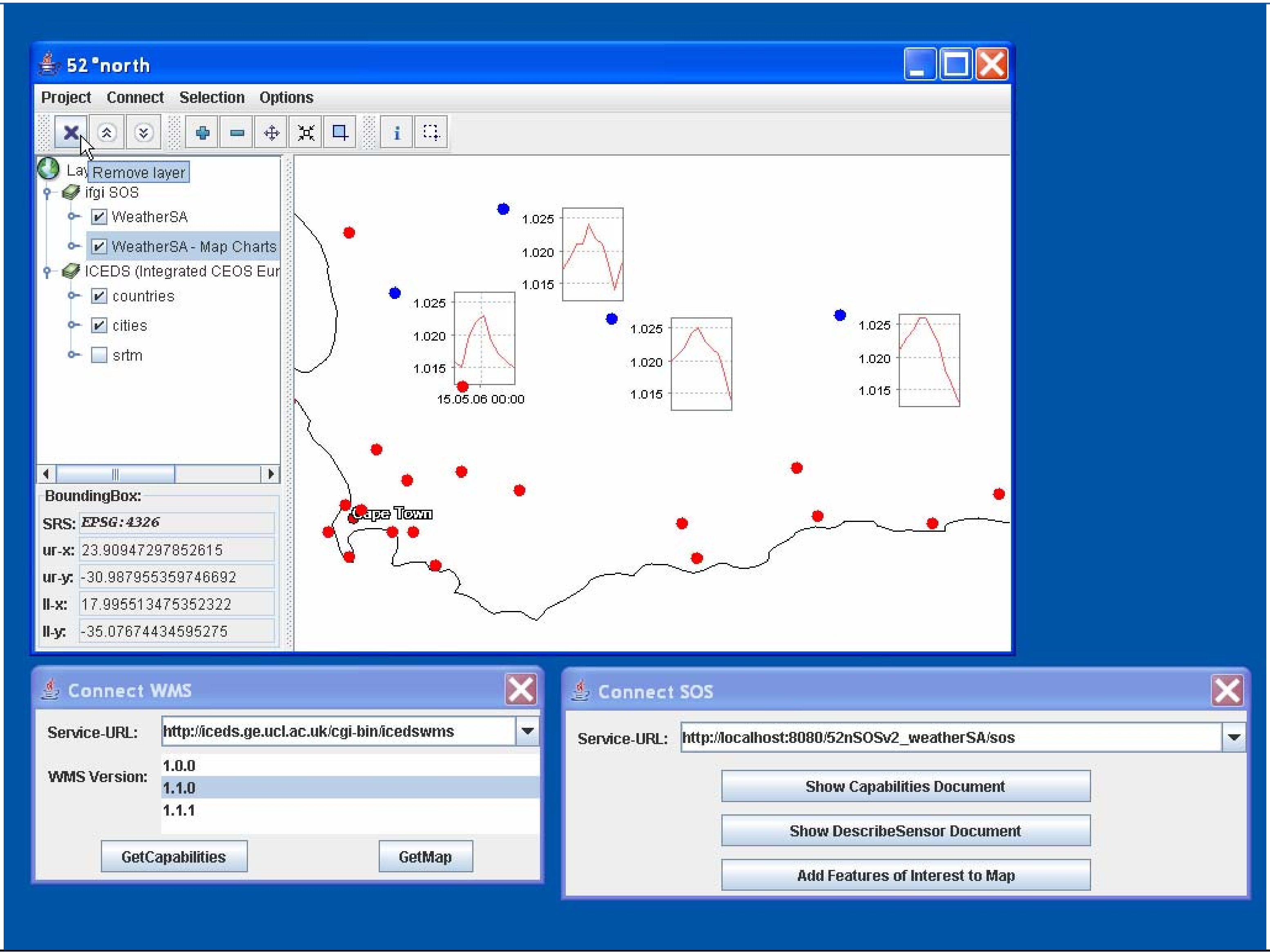
service URL: http://mars.uni-muenster.de:8080/52nSPSv1/SPS

sensor ID: urn:ogc:object:feature:Sensor:IFGI:AXISPTZ_C:1:i

speed:

gotoserverpresetname: watersystem

Producing animated map charts



BoundingBox:

SRS: EPSG:4326

ur-x: 23.90947297852615

ur-y: -30.987955359746692

ll-x: 17.995513475352322

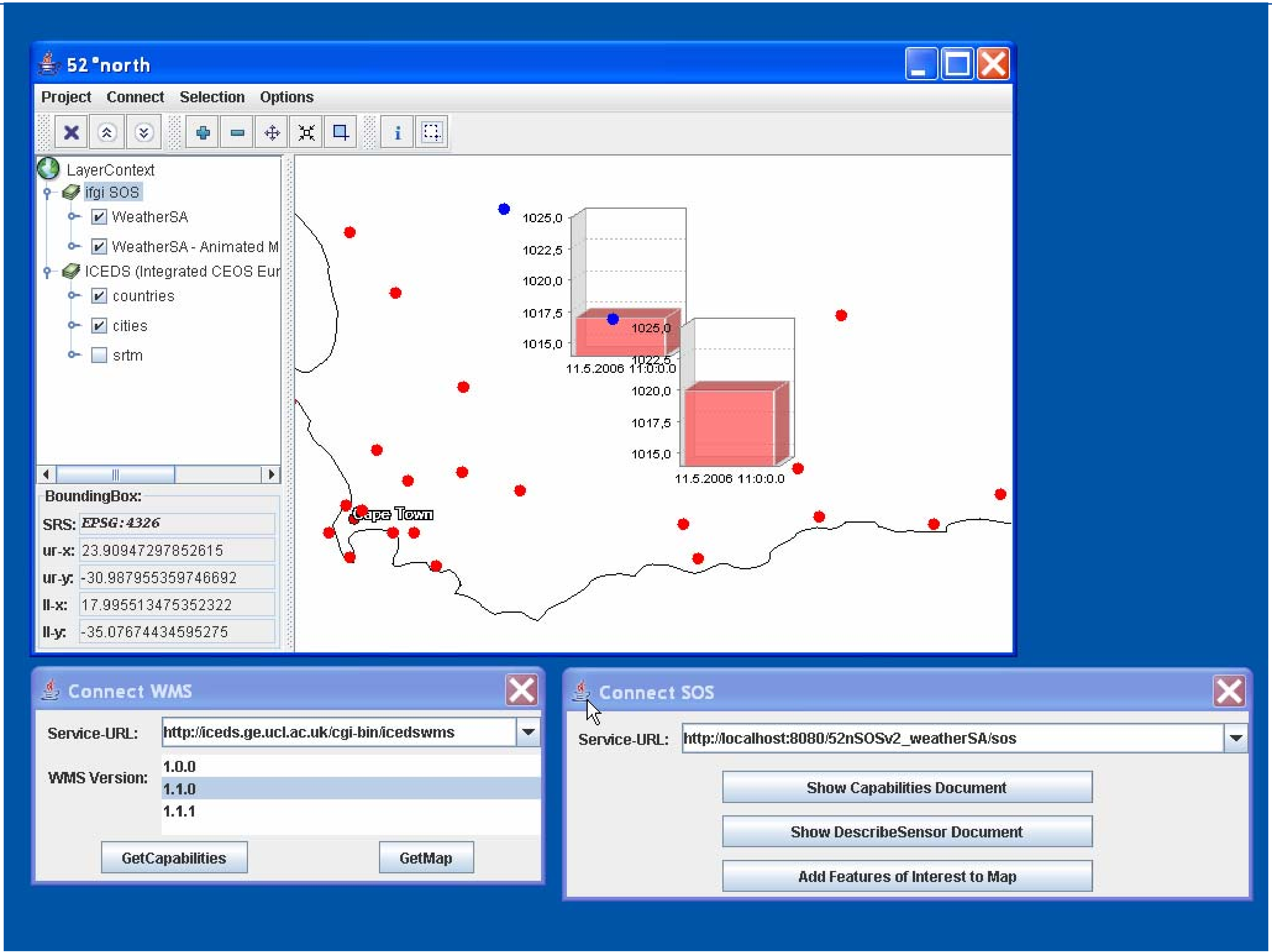
ll-y: -35.07674434595275

Service-URL: http://iceds.ge.ucl.ac.uk/cgi-bin/icedswms

WMS Version: 1.0.0 / 1.1.0 / 1.1.1

Service-URL: http://localhost:8080/52nSOSv2_weatherSA/sos

animated map charts



BoundingBox:

SRS: *EPSG:4326*

ur-x: 23.90947297852615

ur-y: -30.987955359746692

ll-x: 17.995513475352322

ll-y: -35.07674434595275

Service-URL: http://iceds.ge.ucl.ac.uk/cgi-bin/icedswms

WMS Version: 1.0.0 / 1.1.0 / 1.1.1 (1.1.0 selected)

Service-URL: http://localhost:8080/52nSOSv2_weatherSA/sos

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!

ifgi
Institute for Geoinformatics
University of Münster

Alexander C. Walkowski
Diploma Geographer

Robert-Koch-Str. 26-28
D-48149 Münster
Fon:+49(0)251 83 30056

walkowski@uni-muenster.de