OGC Sensor Web Enablement (SWE)

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- OGC Overview
- OGC Sensor Web Enablement
- Discussion

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Open Geospatial Consortium
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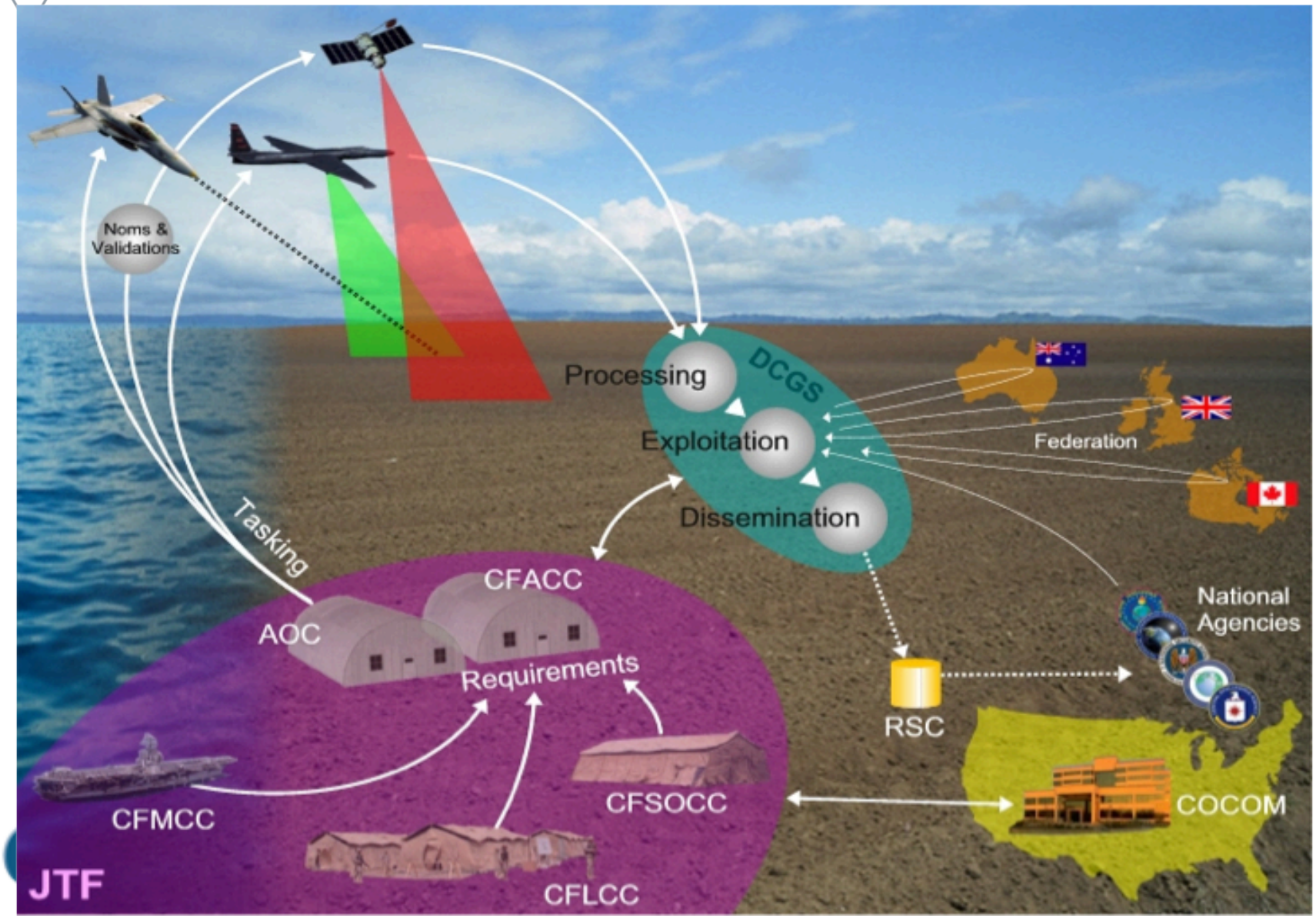
Data come from different sources

Data come from different organizations/ countries



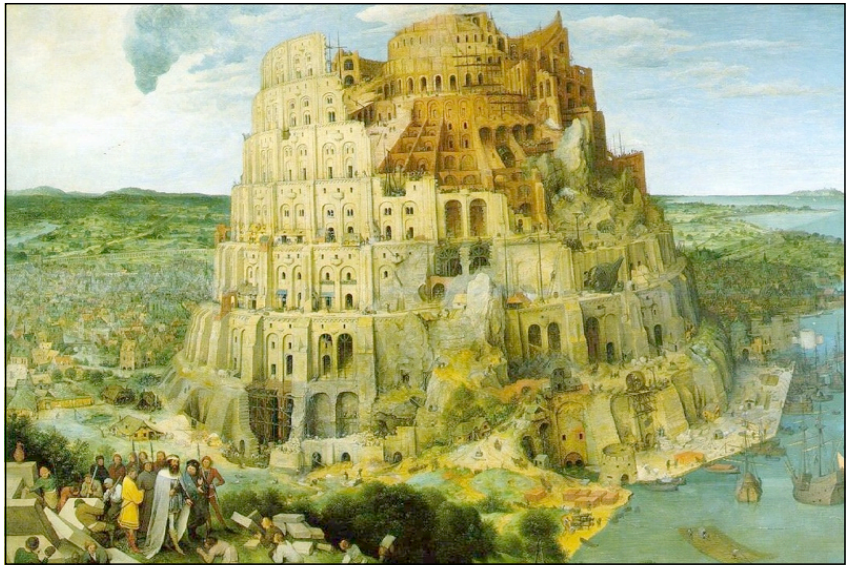
Common Issues / Challenges

"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."



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Sensors are everywhere

And .. 4 billion mobile devices can act as sensors
http://research.ict.csiro.au/conferences/ssn/ssn11

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… disconnected

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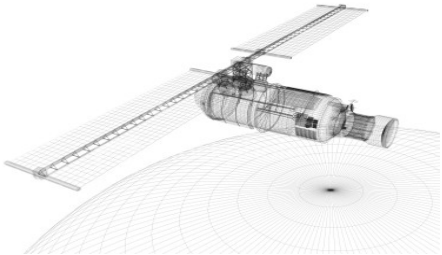
Standalone Sensors

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



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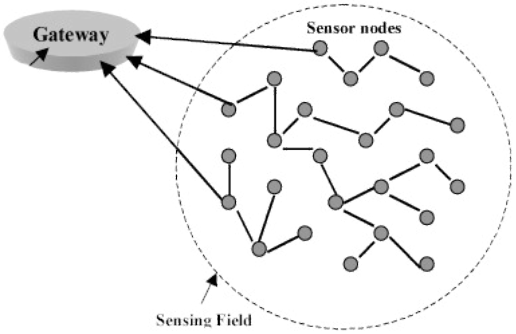
Networked Sensors

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



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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)

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Challenges

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

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Challenges

- Not enough data (Sparse)
- Too much data (Overload)
  - Subsetting
  - Filtering
- Push the data to me when its becomes available

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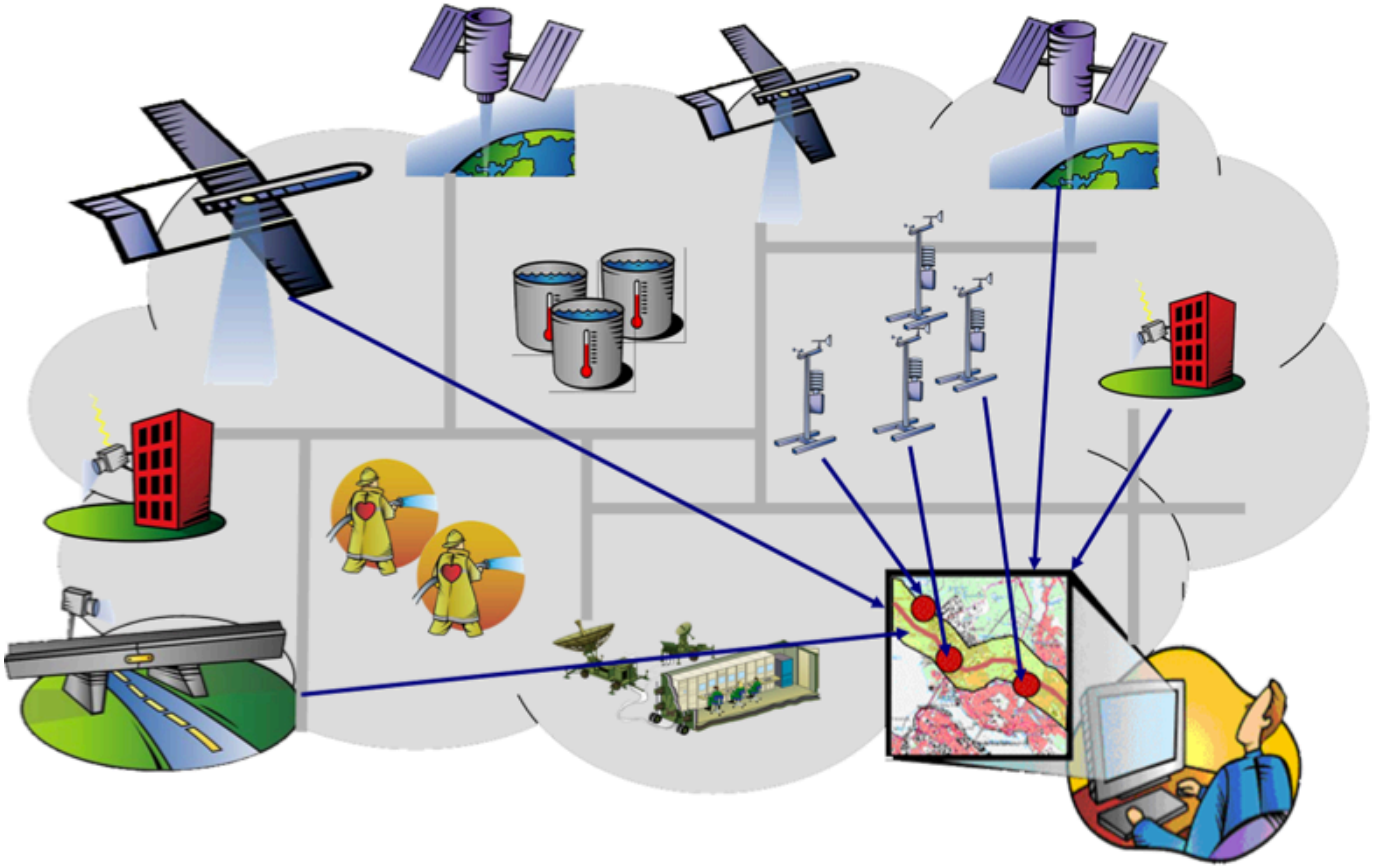
OGC Sensor Web Enablement (SWE)



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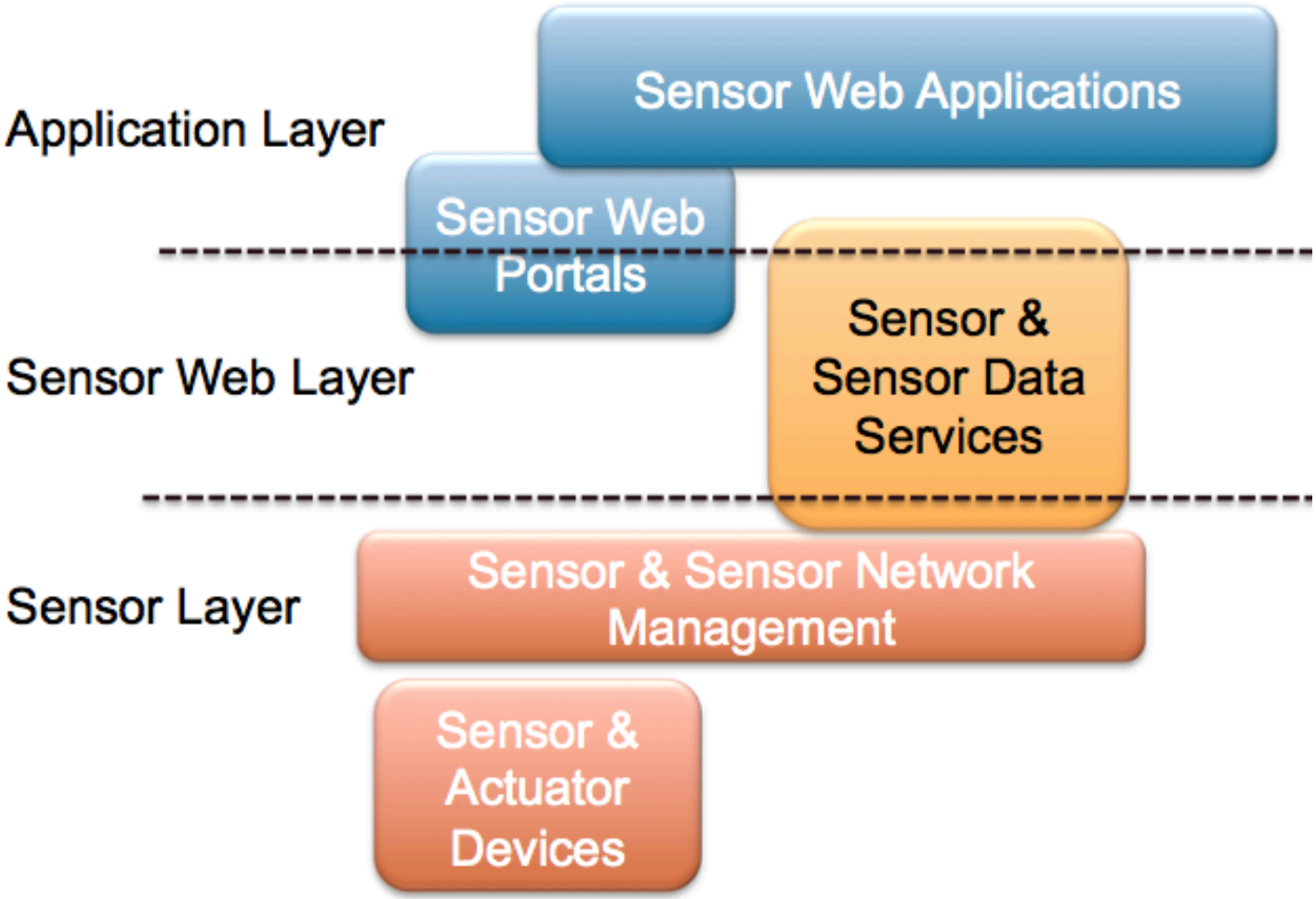
From Sensors to Applications



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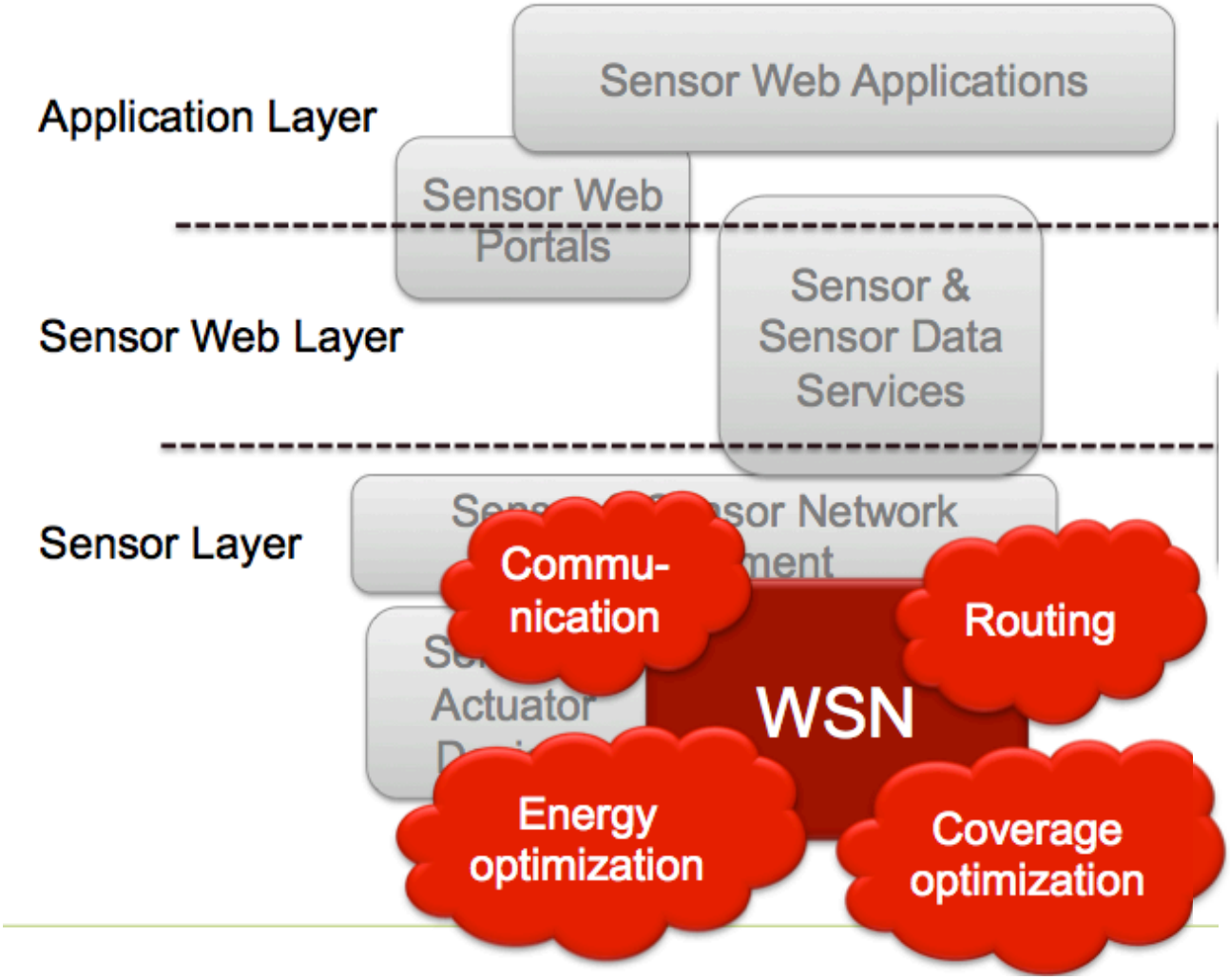
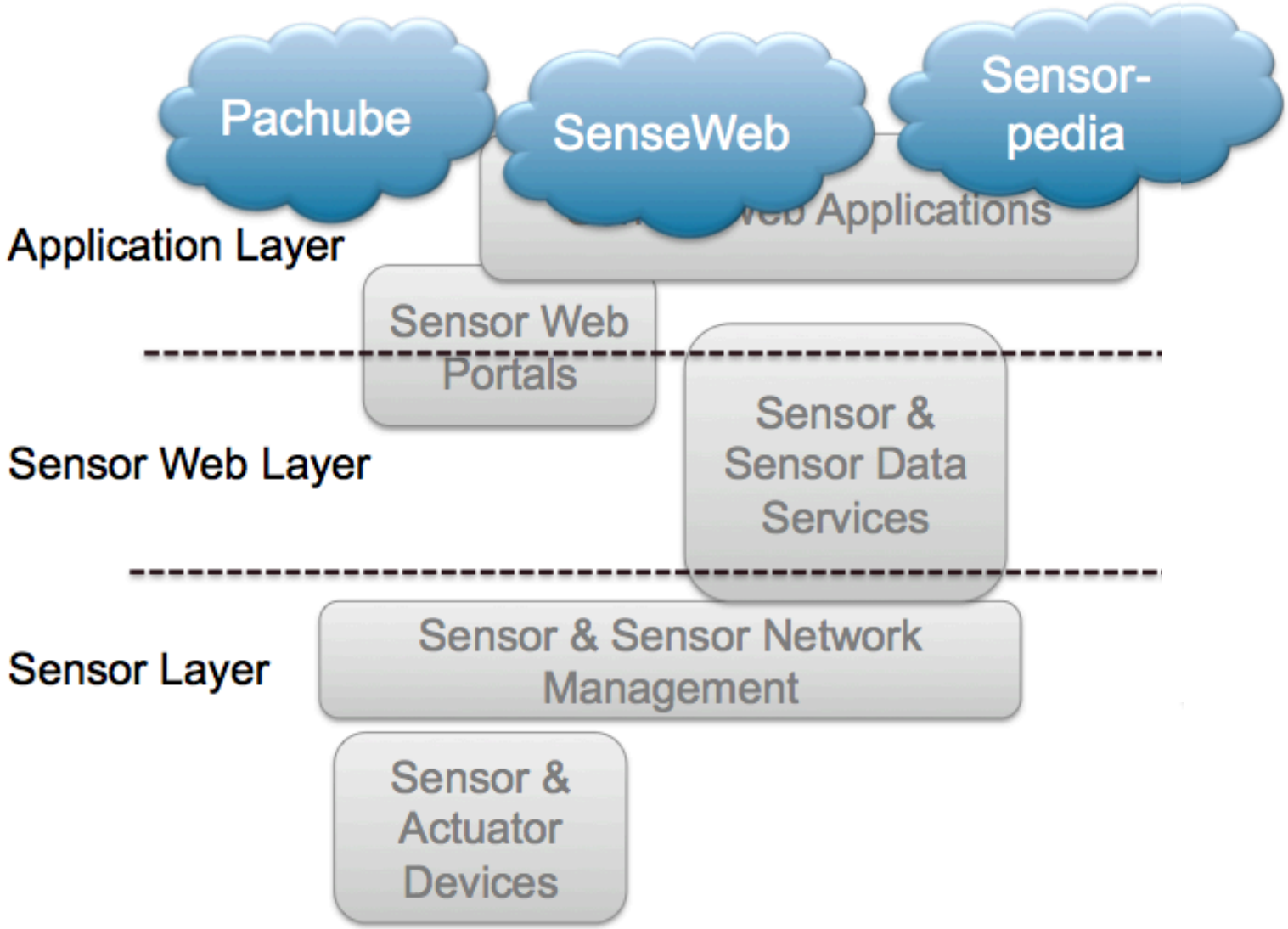
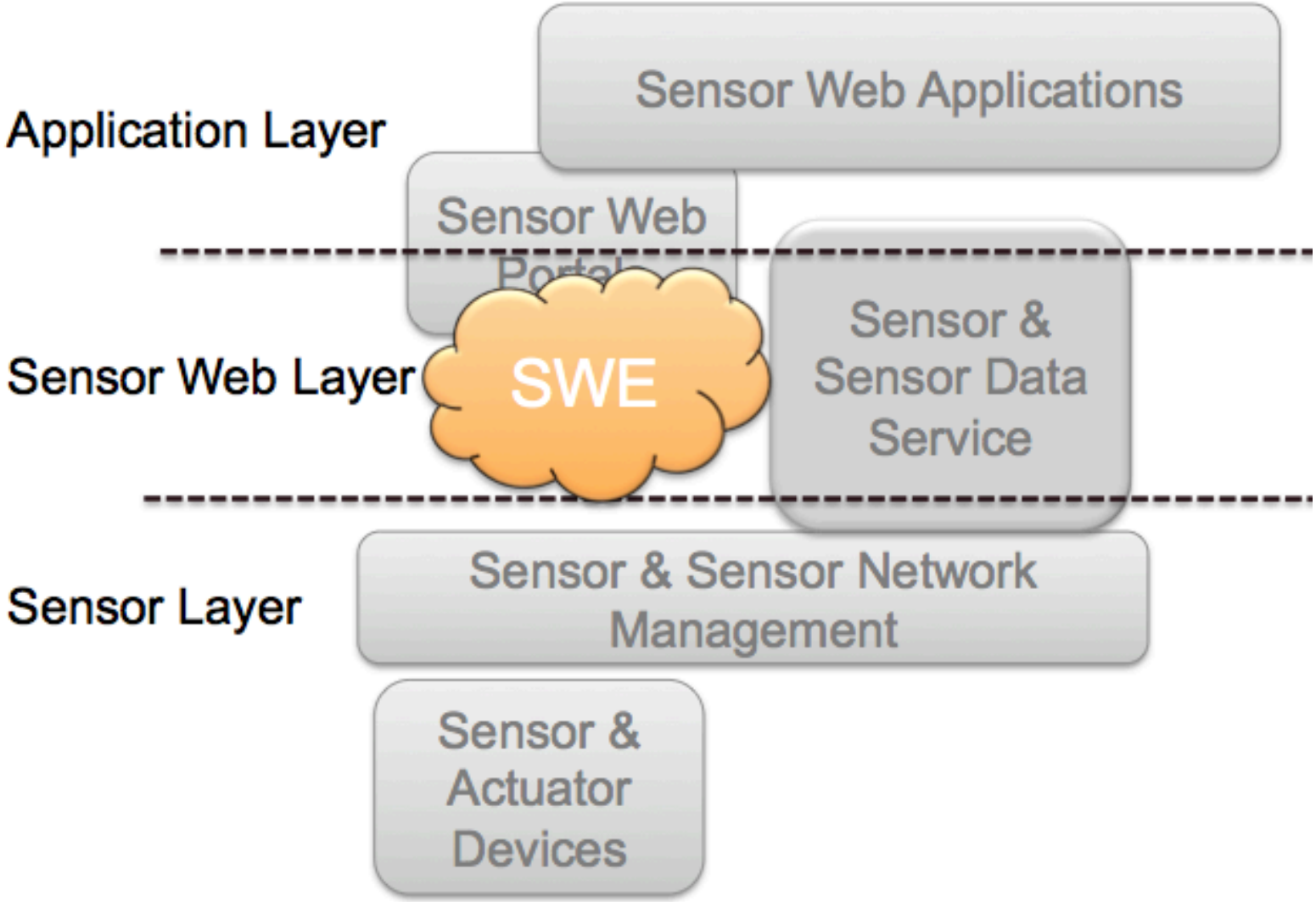
Wireless Sensor Networks (WNS) Focus



Portal Focus



Sensor Web Layer Focus



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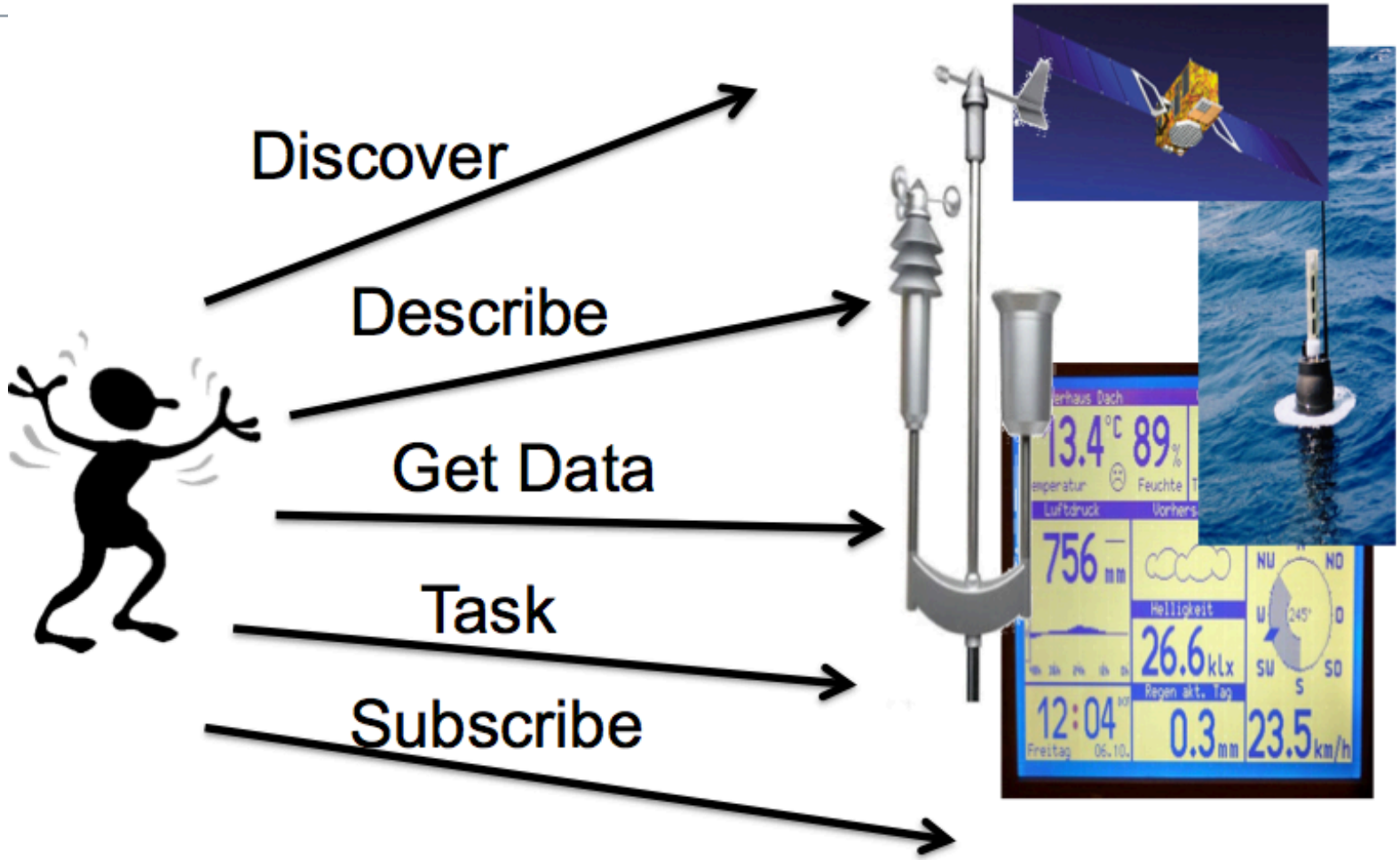
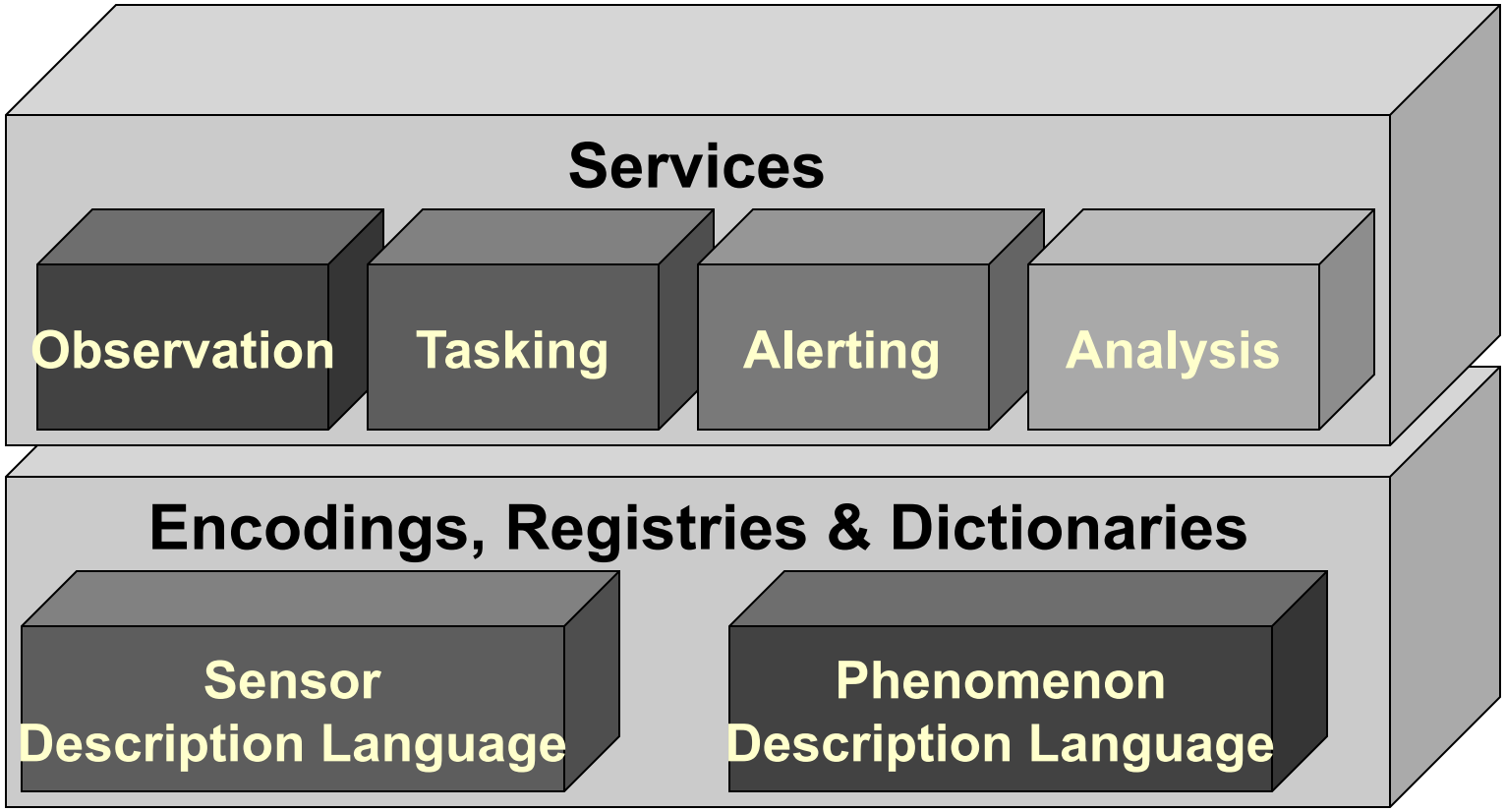
Sensor Web Requirements



Building Blocks: OGC SWE 2.0



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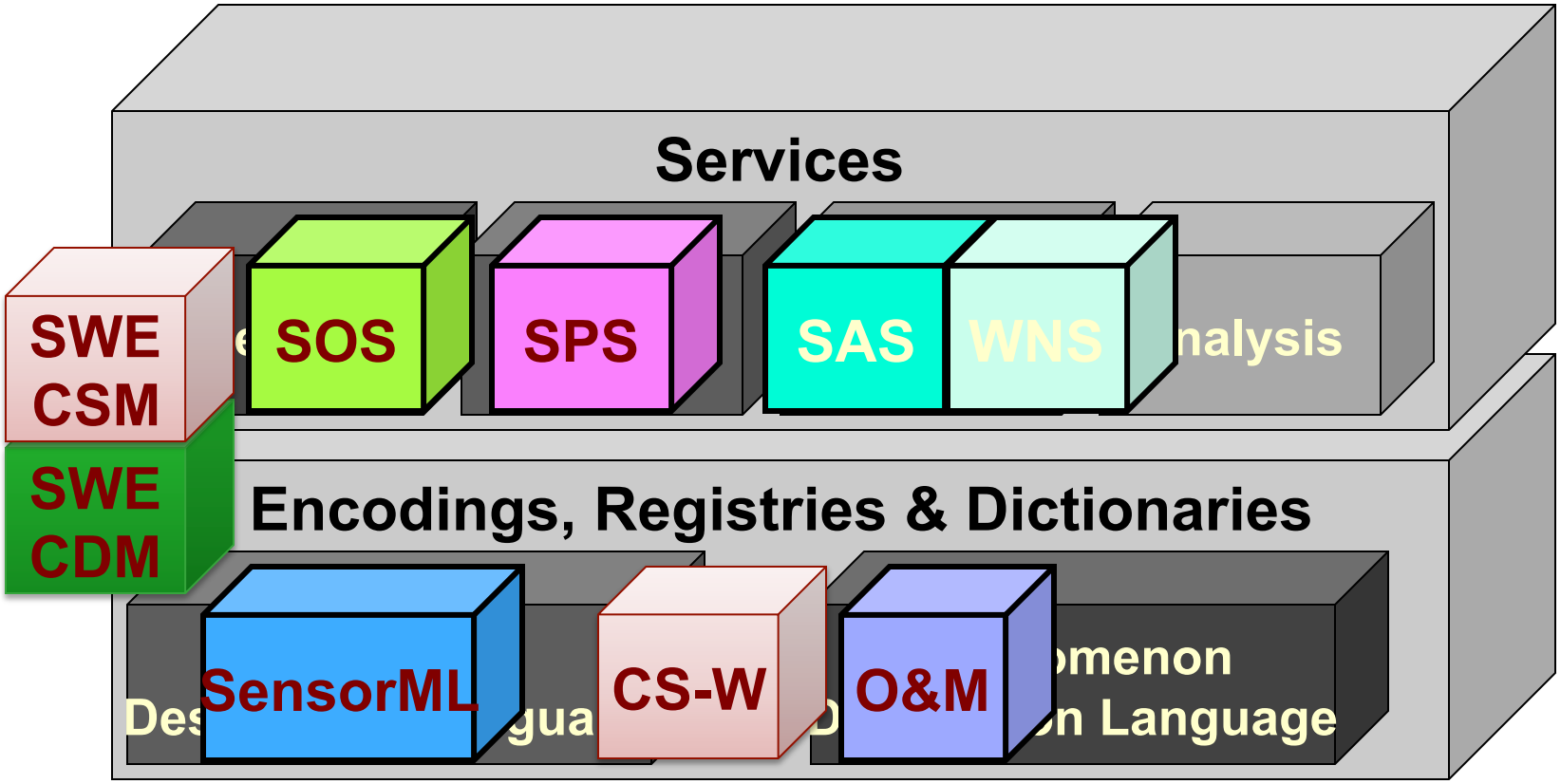
Building Blocks: OGC SWE **2.0**



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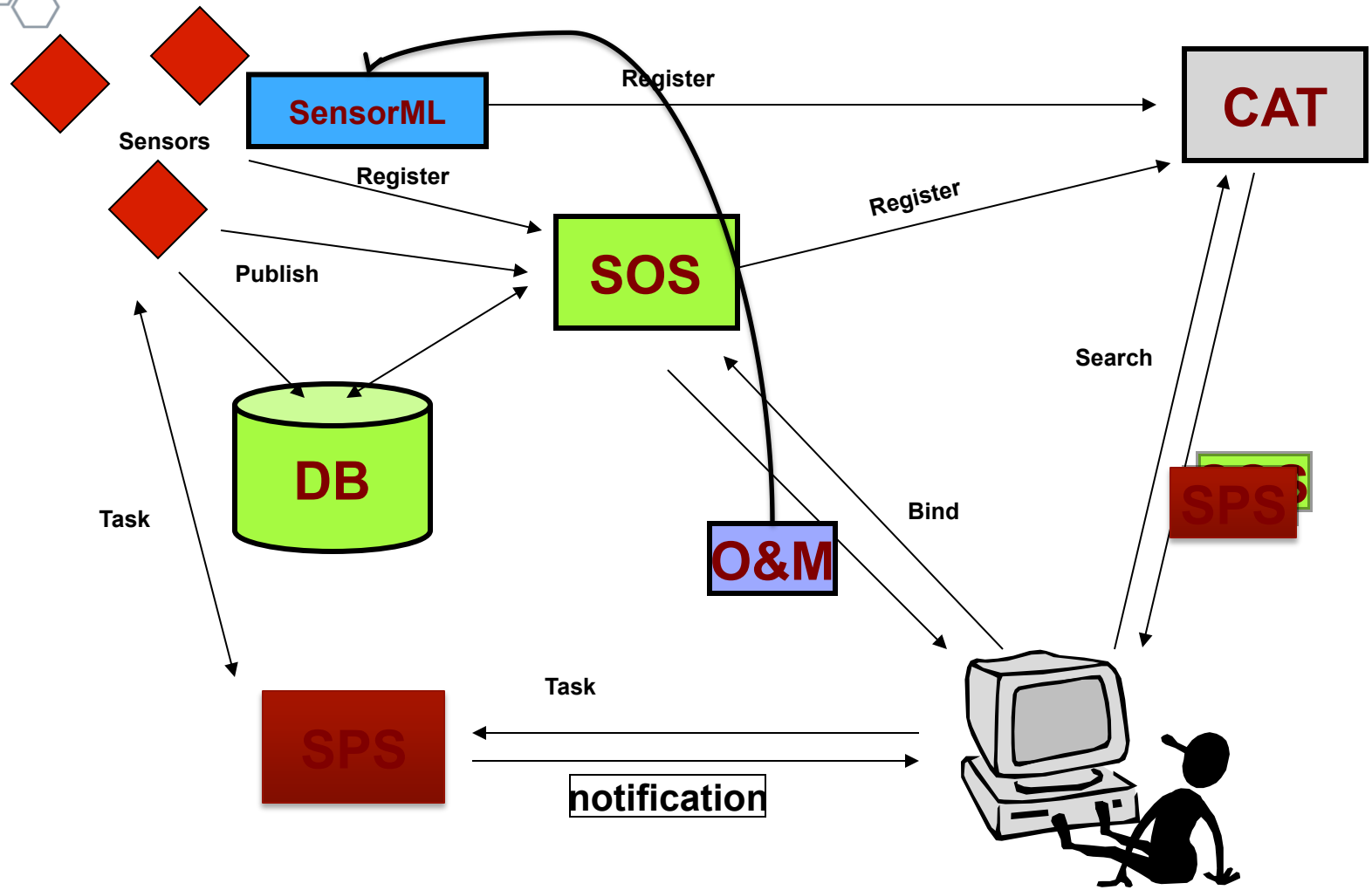
SWE


Sensors
SensorML
Register
CAT
Register
Register
SOS
Publish
Search
DB
Task
Bind
O&M
SPS
Task
SPS
notification

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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…

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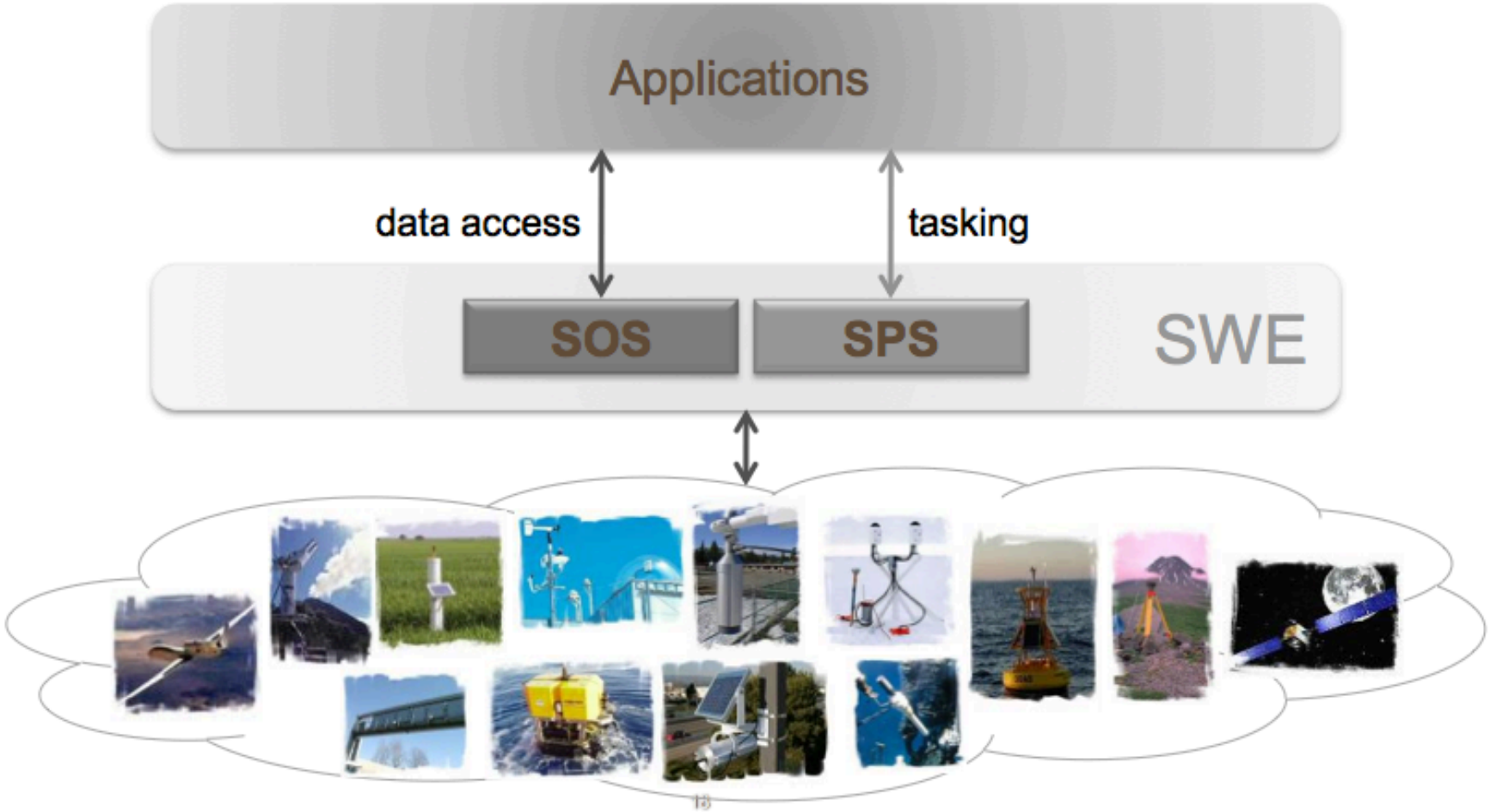
SOS & SPS: Data Access & Control



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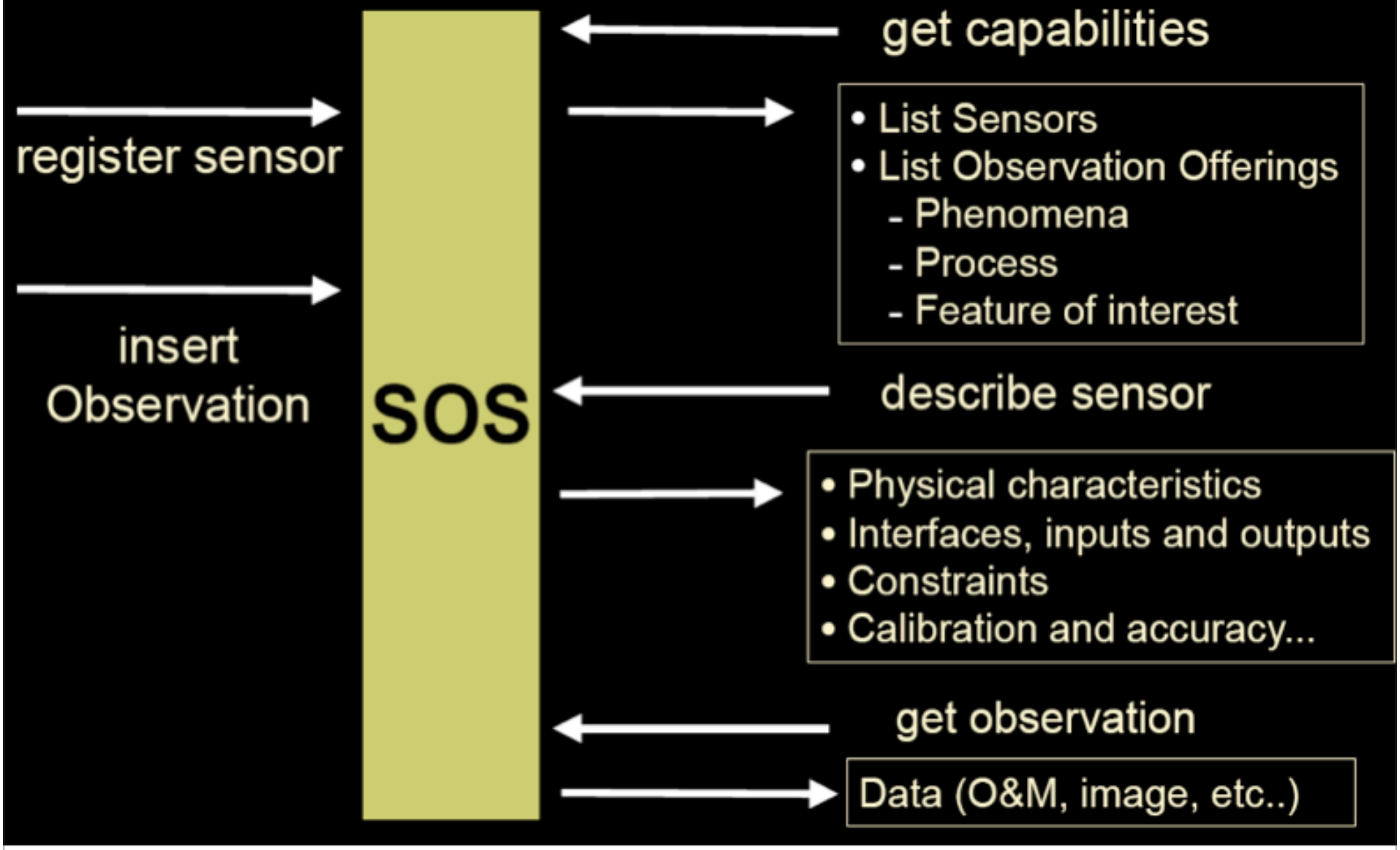
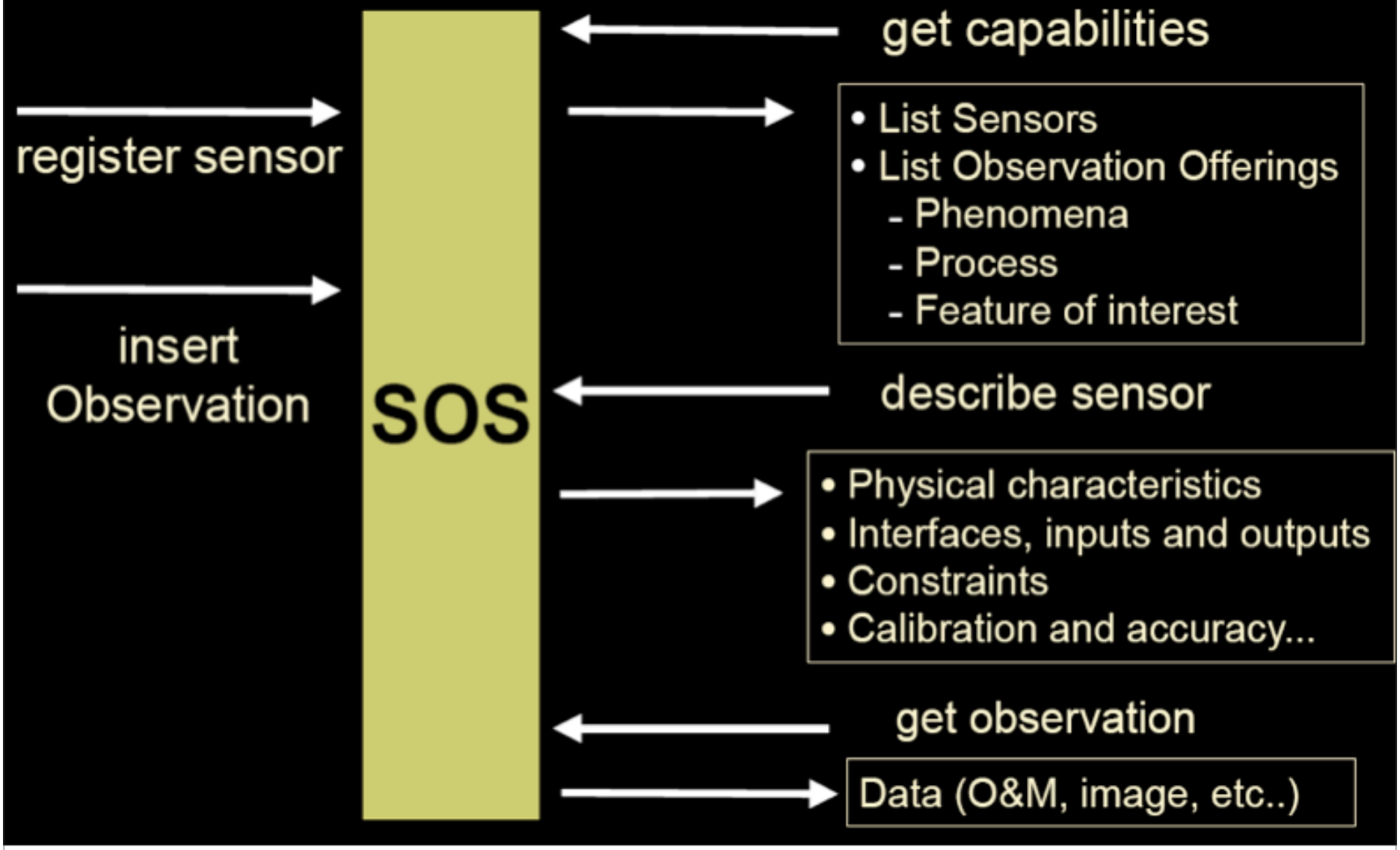
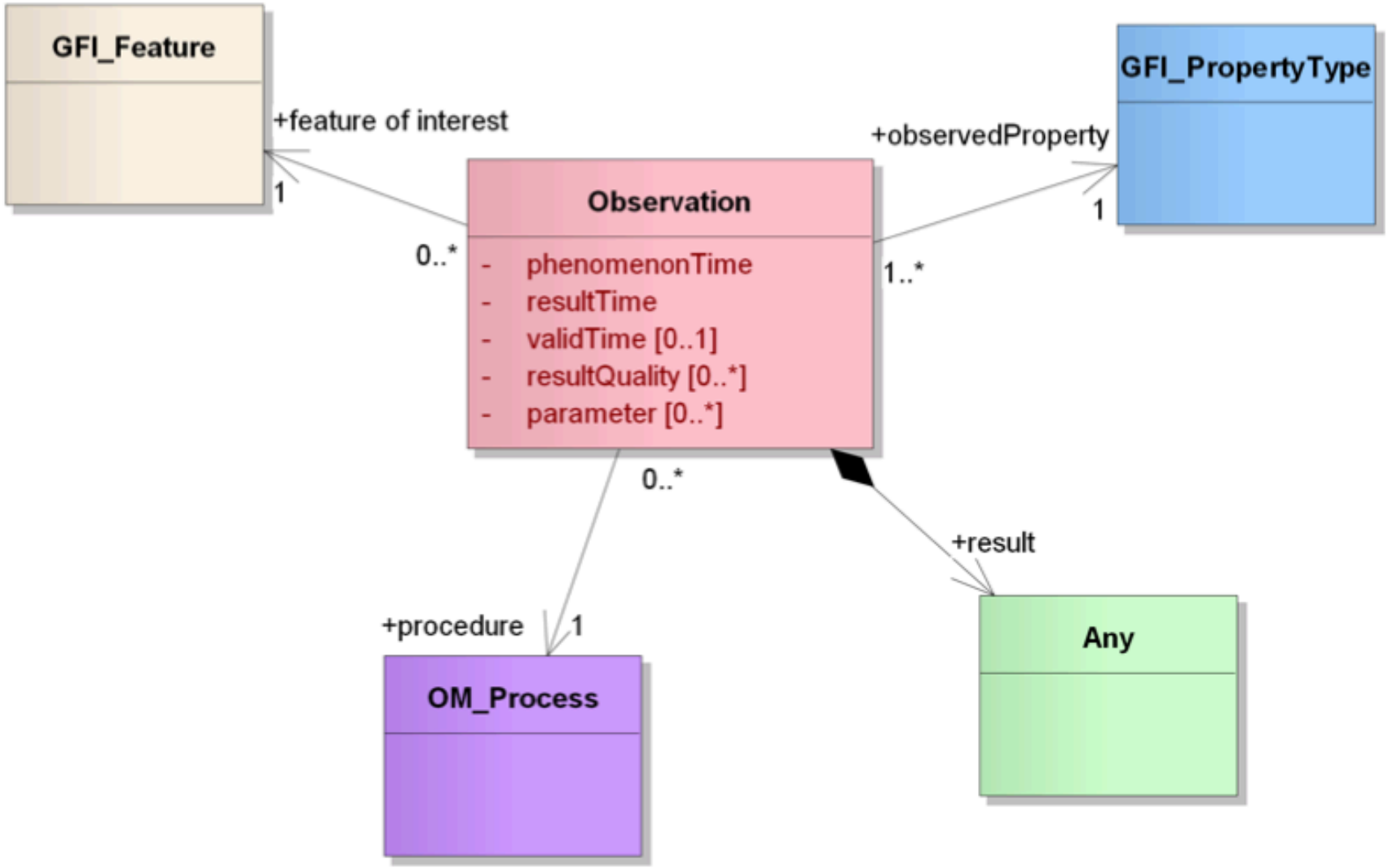
Sensor Observation Service



System Observation Service

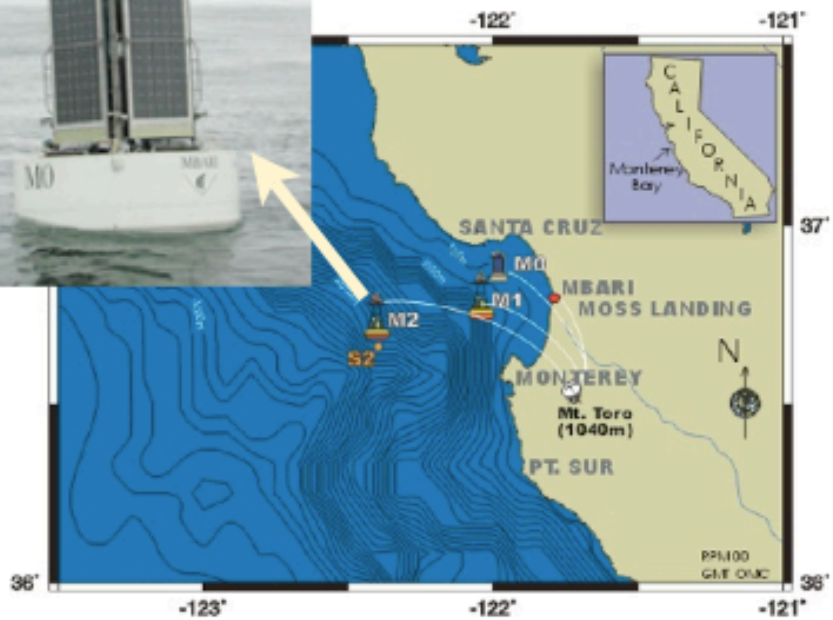


Observations and Measurement (O&M)

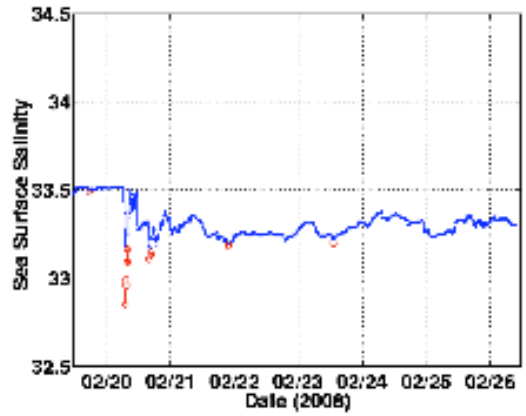


Observation Model (O&M)

Procedure



Feature of Interest = Monterey Bay

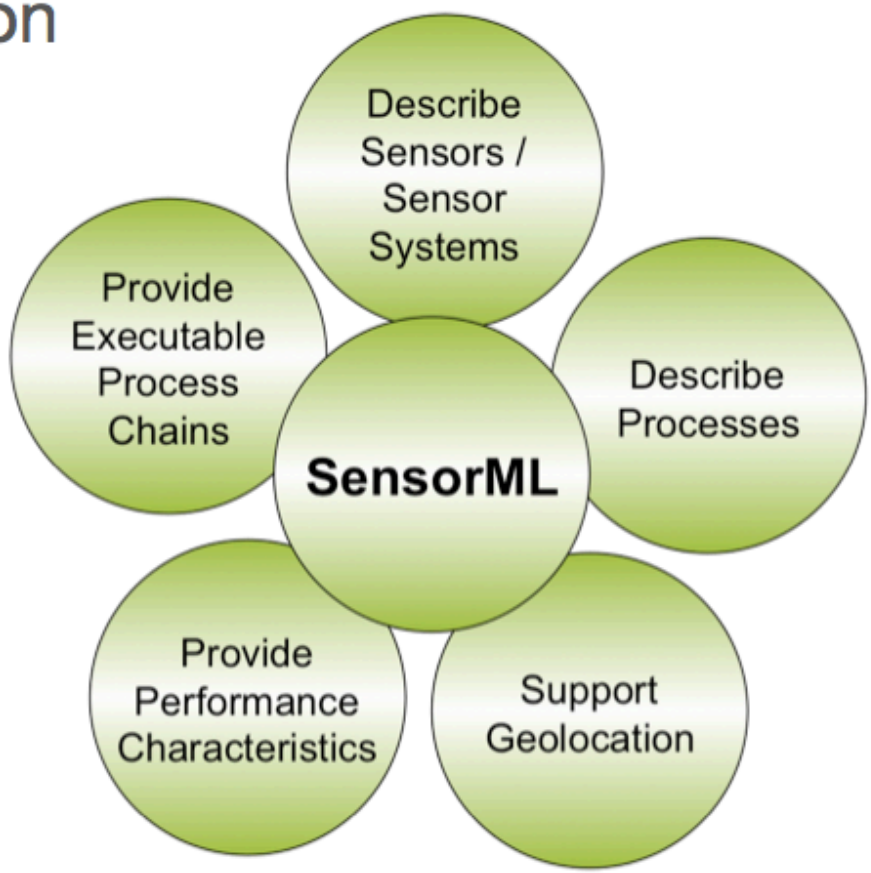


Estimation value of a property

Salinity = property related to the feature of interest

SensorML

- Sensor and Process description language
- Uses SWE Common
- Very generic



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SWE Common for encoding data

```
<swe:elementType name="weather_data">
   <swe:DataRecord>
      <!-- -->
      <swe:field name="time">
         <swe:Time definition="http://www.opengis.net/def/property/OGC/0/SamplingTime">
            <swe:label>Sampling Time</swe:label>
            <swe:uom xlink:href="http://www.opengis.net/def/uom/ISO-8601/0/Gregorian"/>
         </swe:Time>
      </swe:field>
      <!-- -->
      <swe:field name="temperature">
         <swe:Quantity definition="http://mmisw.org/ont/cf/parameter/air_temperature">
            <swe:label>Air Temperature</swe:label>
            <swe:uom xlink:href="Cel"/>
            <swe:constraint>
               <swe:AllowedValues>
                  <swe:value>1</swe:value>
                  <swe:value>2</swe:val
                            <swe:value>
                  <swe:interval>-50 +50
                  <swe:significantFigur
               </swe:AllowedValues>
            </swe:constraint>
         </swe:Quantity>
      </swe:field>
      <!-- -->
      <swe:field name="pressure">
         <swe:Quantity definition="http
            <swe:label>Atmospheric Pres
```

```
<swe:encoding>
   <swe:TextEncoding tokenSeparator="," blockSeparator="&#32;"
   decimalSeparator="."/>
</swe:encoding>
<!-- -->
<swe: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
</swe:values>
```

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Main Concepts SWE

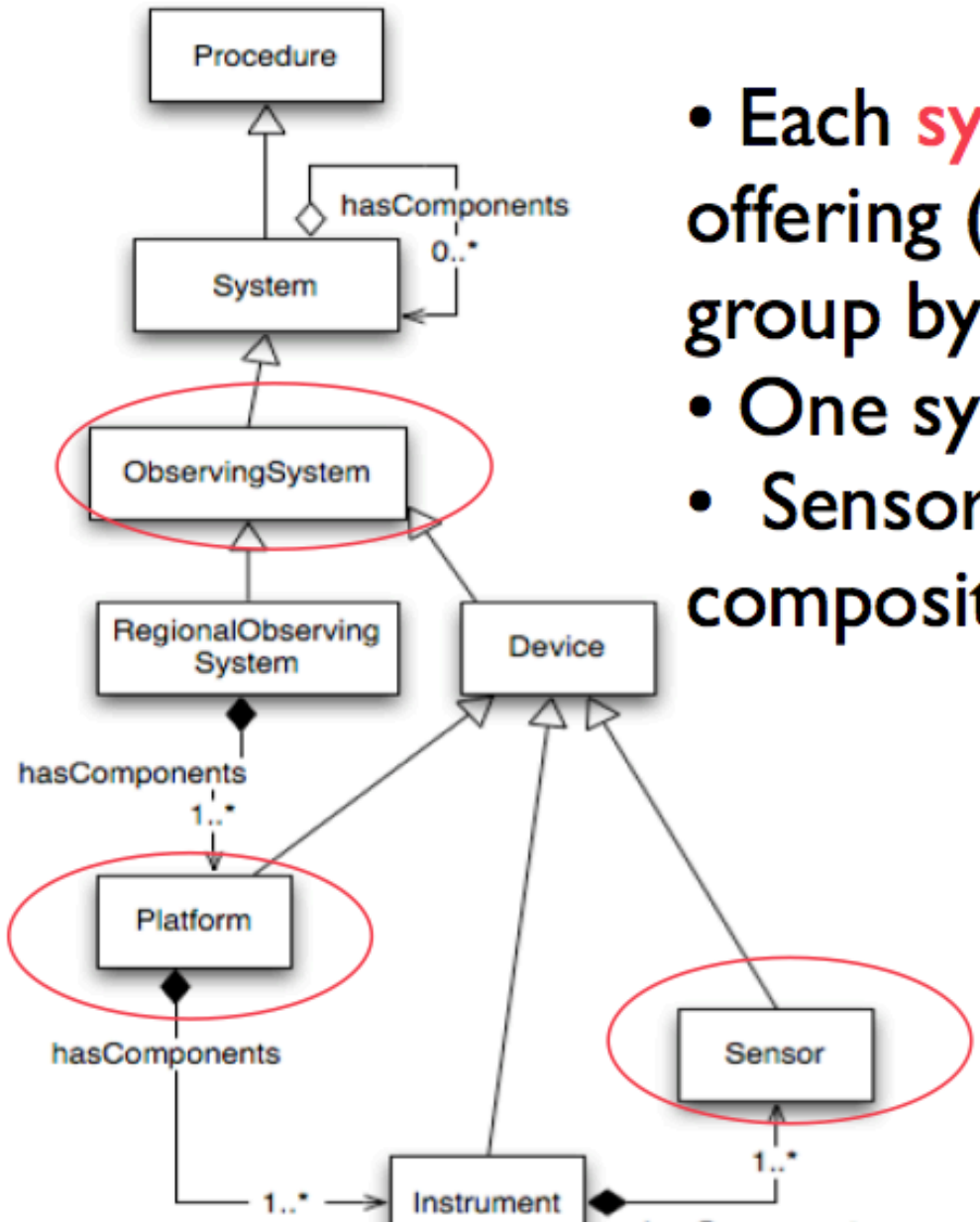
Feature of Interest — has Property → Property — Estimated By → Procedure

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

Procedure = sensor or platform or system

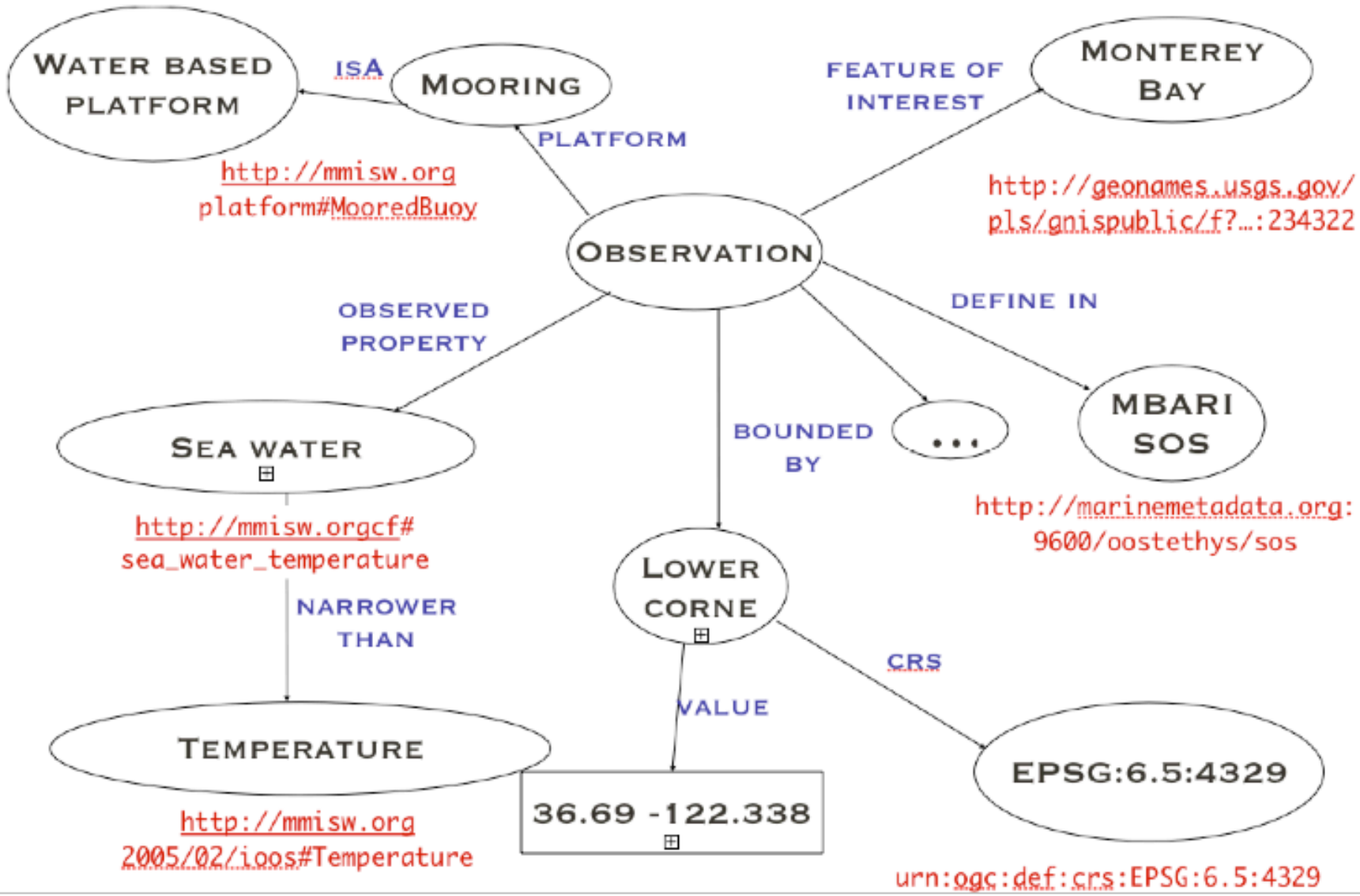
Procedure has inputs and **outputs**

Systems are procedures

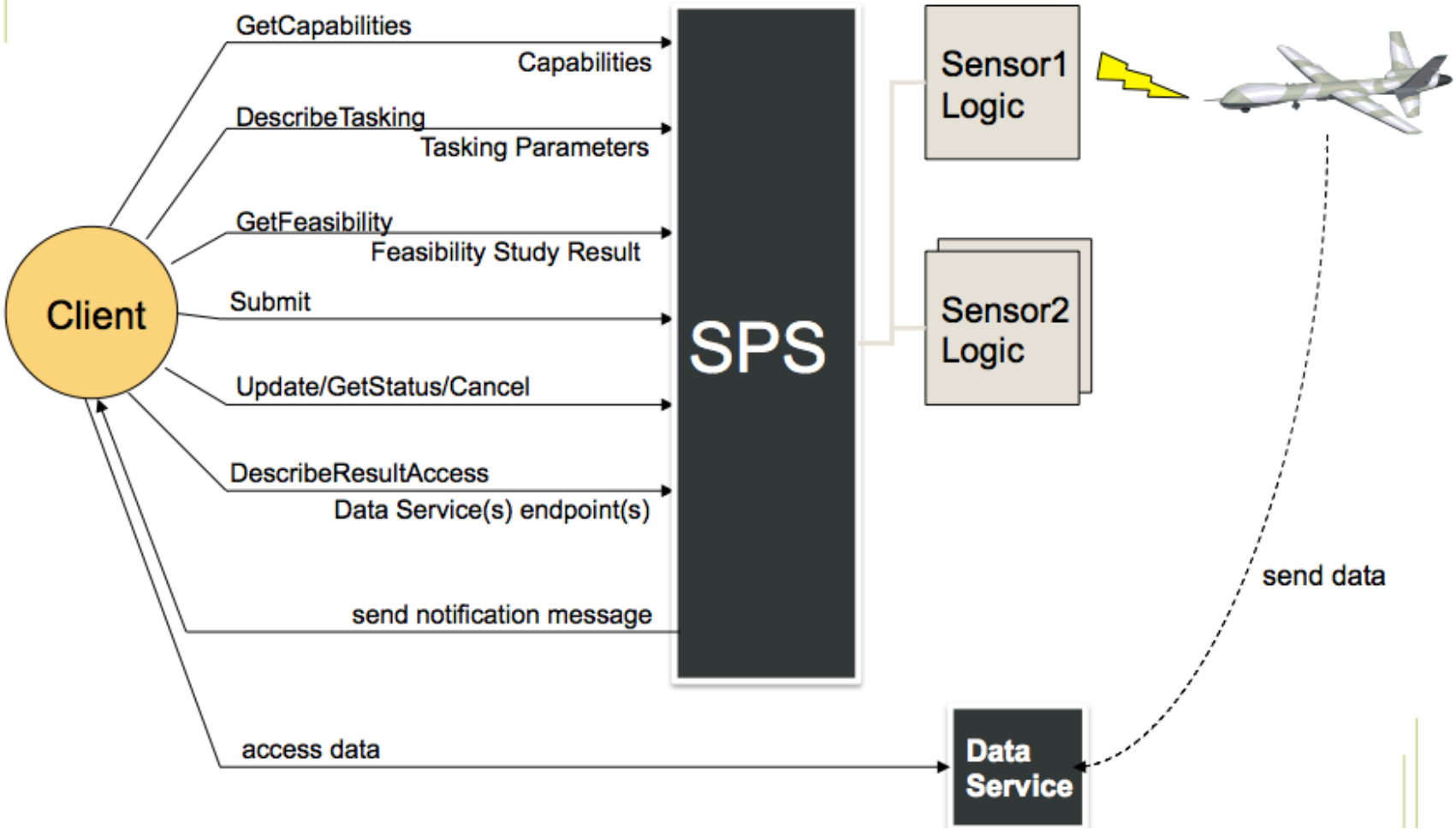


- Each system has its own offering (if too big then group by regions)
- One system per offering
- SensorML describes the composition

O&M contains general structure, but needs community semantics



SPS: Tasking Sensors/Actuators



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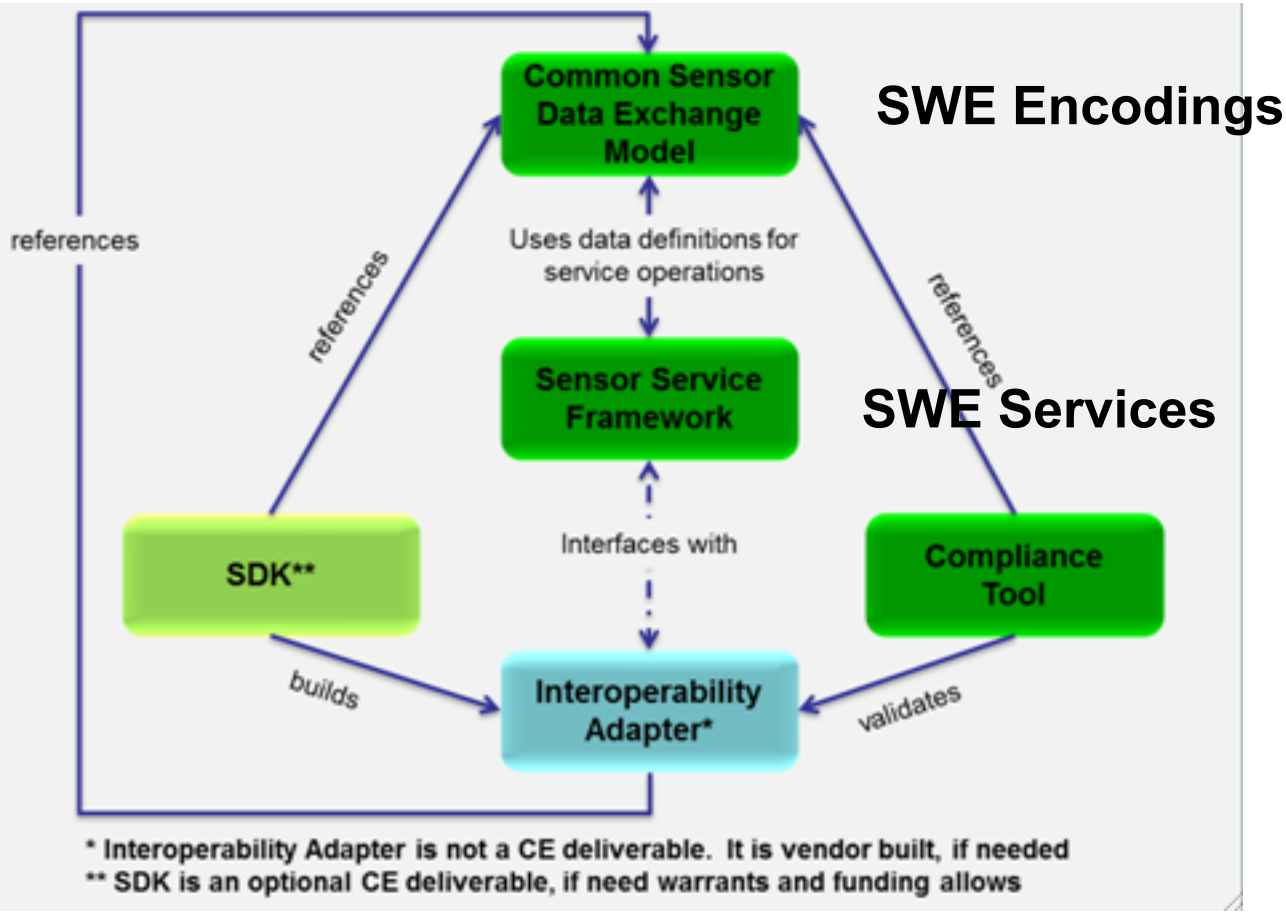

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Current Status

- 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/

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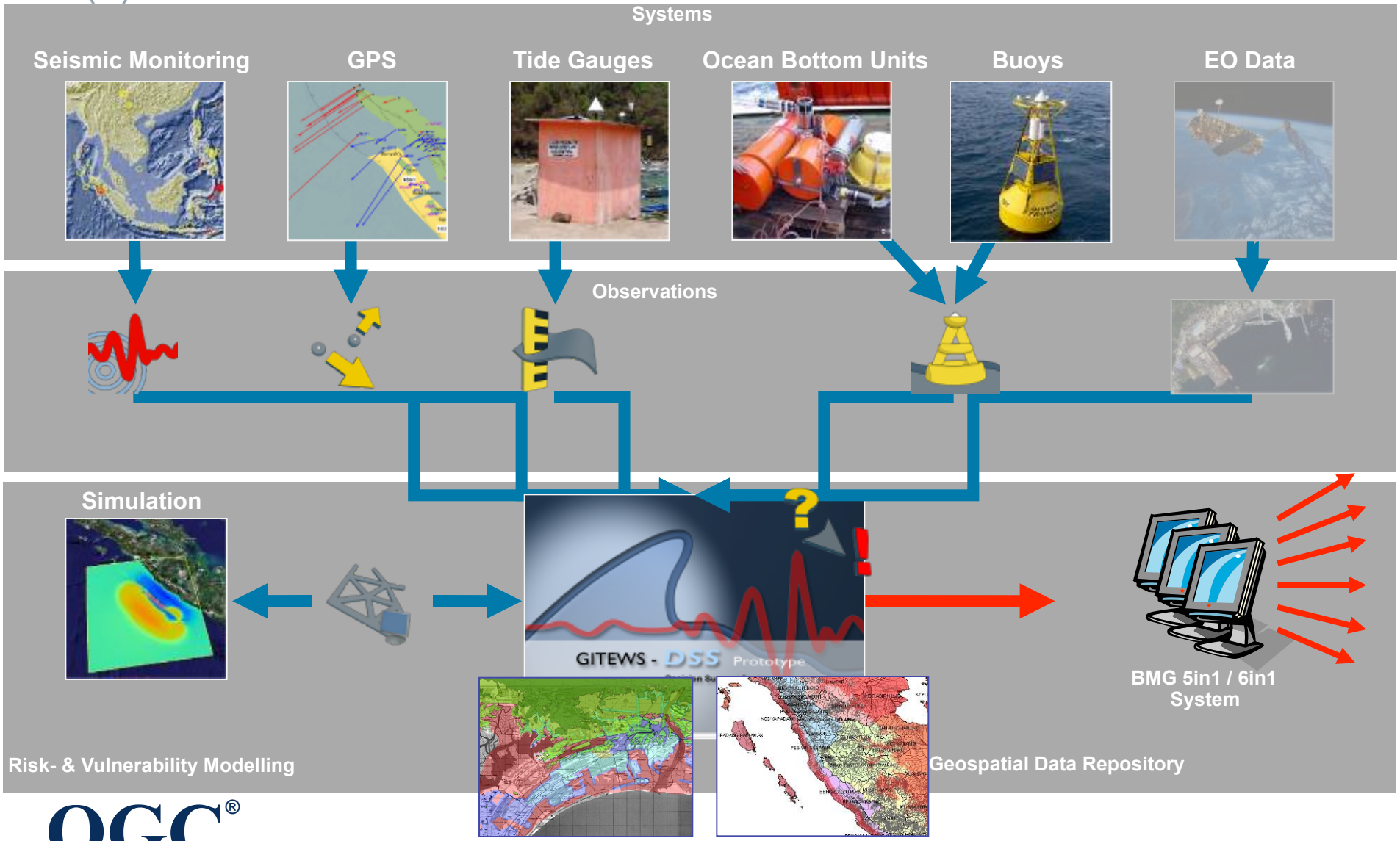
DLR: Tsunami Early Warning & Mitigation Center



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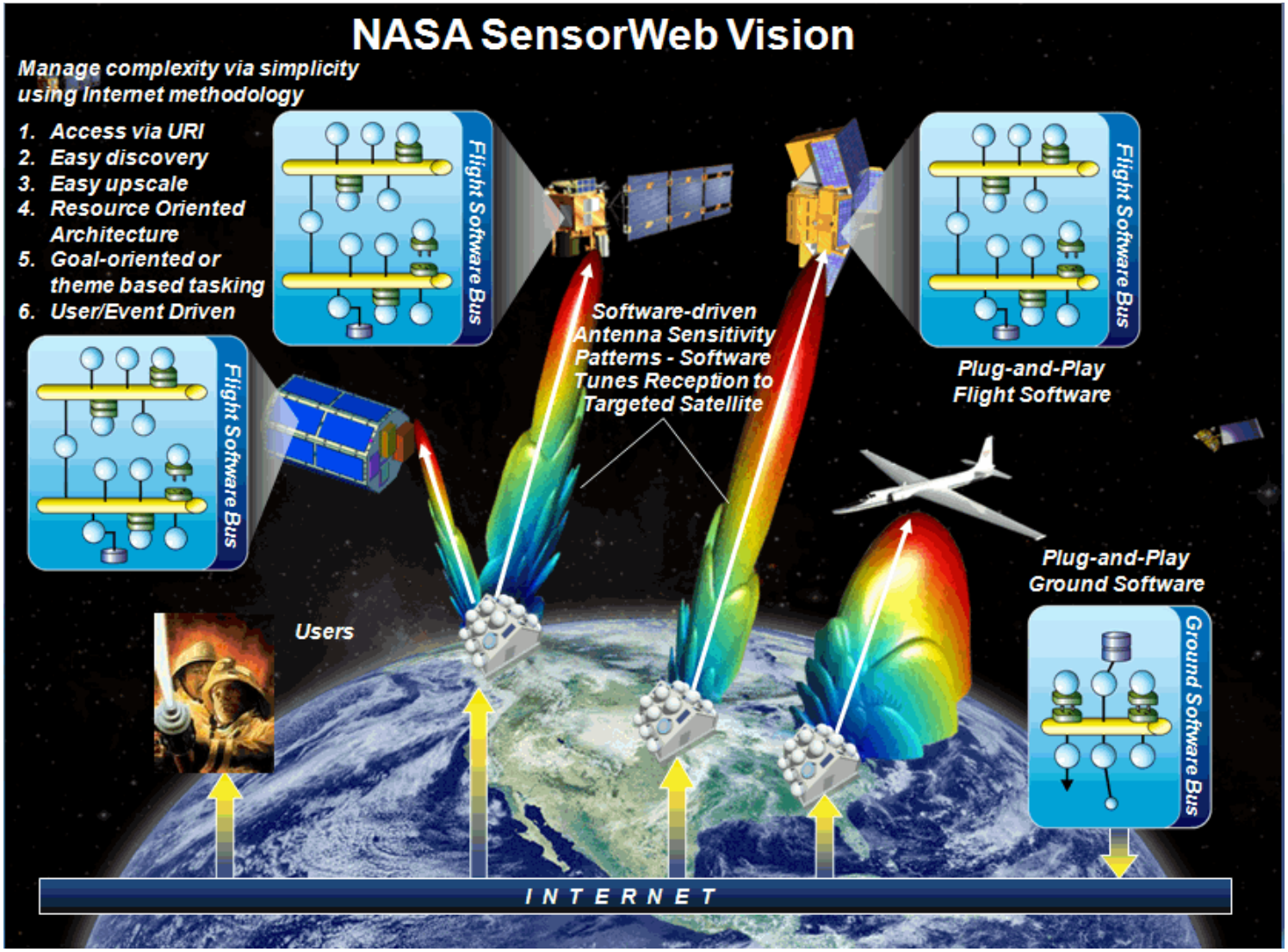
Application: NASA Sensor Web



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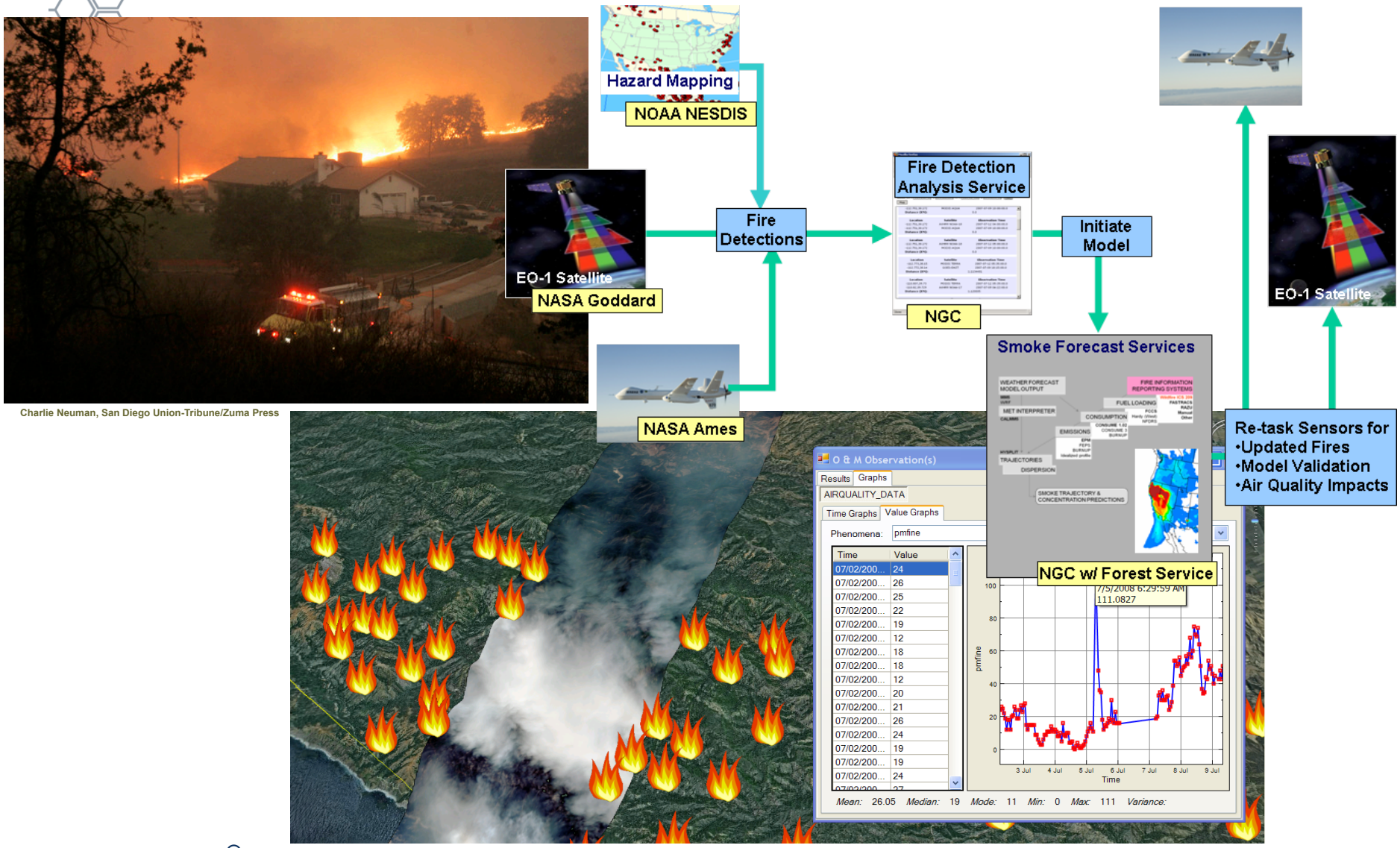
PULSENet™ Applications: Atmospheric/Air Quality – Fire Monitoring/Smoke Forecasting



Charlie Neuman, San Diego Union-Tribune/Zuma Press

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SAIC Global SensorWeb

SensorWeb

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

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SWE in the Oceans Community

WITH FUNDING FROM

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

OFFICE OF NAVAL RESEARCH

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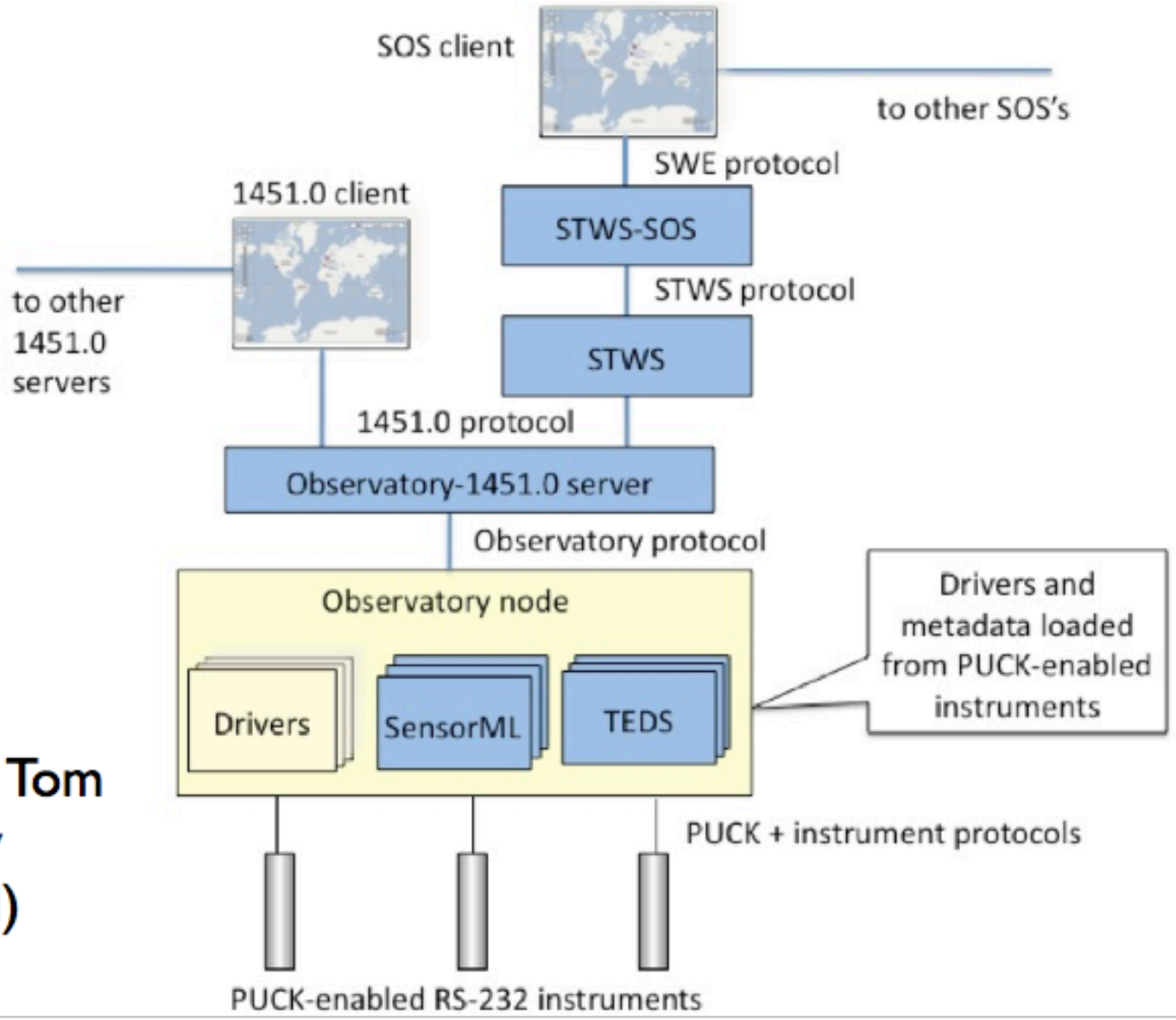
PUCK - IEEE 1451 - SOS



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/lon GmbH**
- Northrop Grumman IT TASC
- SAIC
- UAH

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Where SWE activities are going

- **GeoWeb Mobile Internet**
- **Augmented Reality**
- **Open GeoSMS**

Photo courtesy of http://www.artisthenewreligion.com

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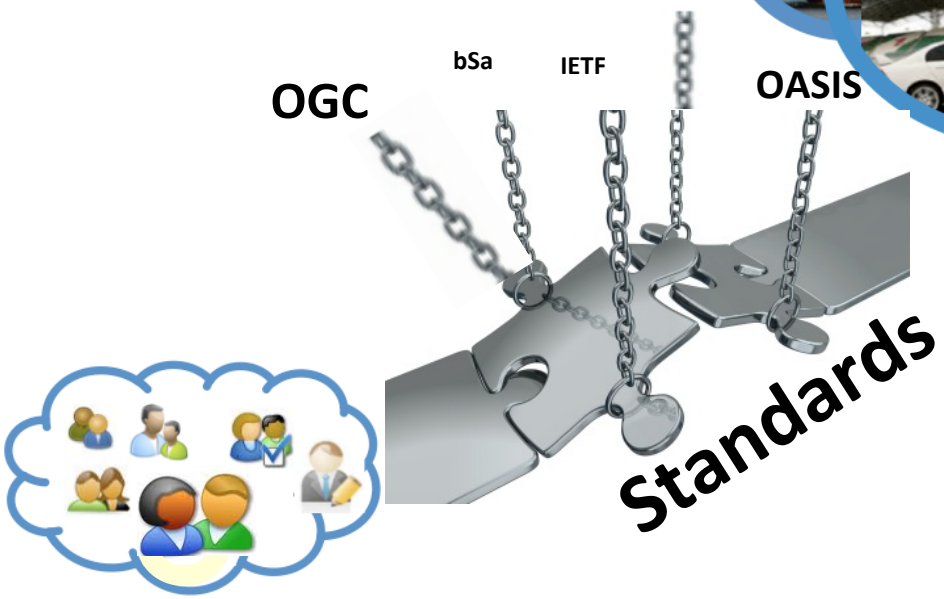
GeoWeb e Internet Mobil



Today's Internet

The emerging Internet of things:
-- indoor/outdoor location
-- sensor webs
-- building information models
-- location apps
-- location marketing
-- smart grid

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Augmented Reality

OGC ARML 2.0 Standards Working Group (SWG)

Open GeoSMS

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

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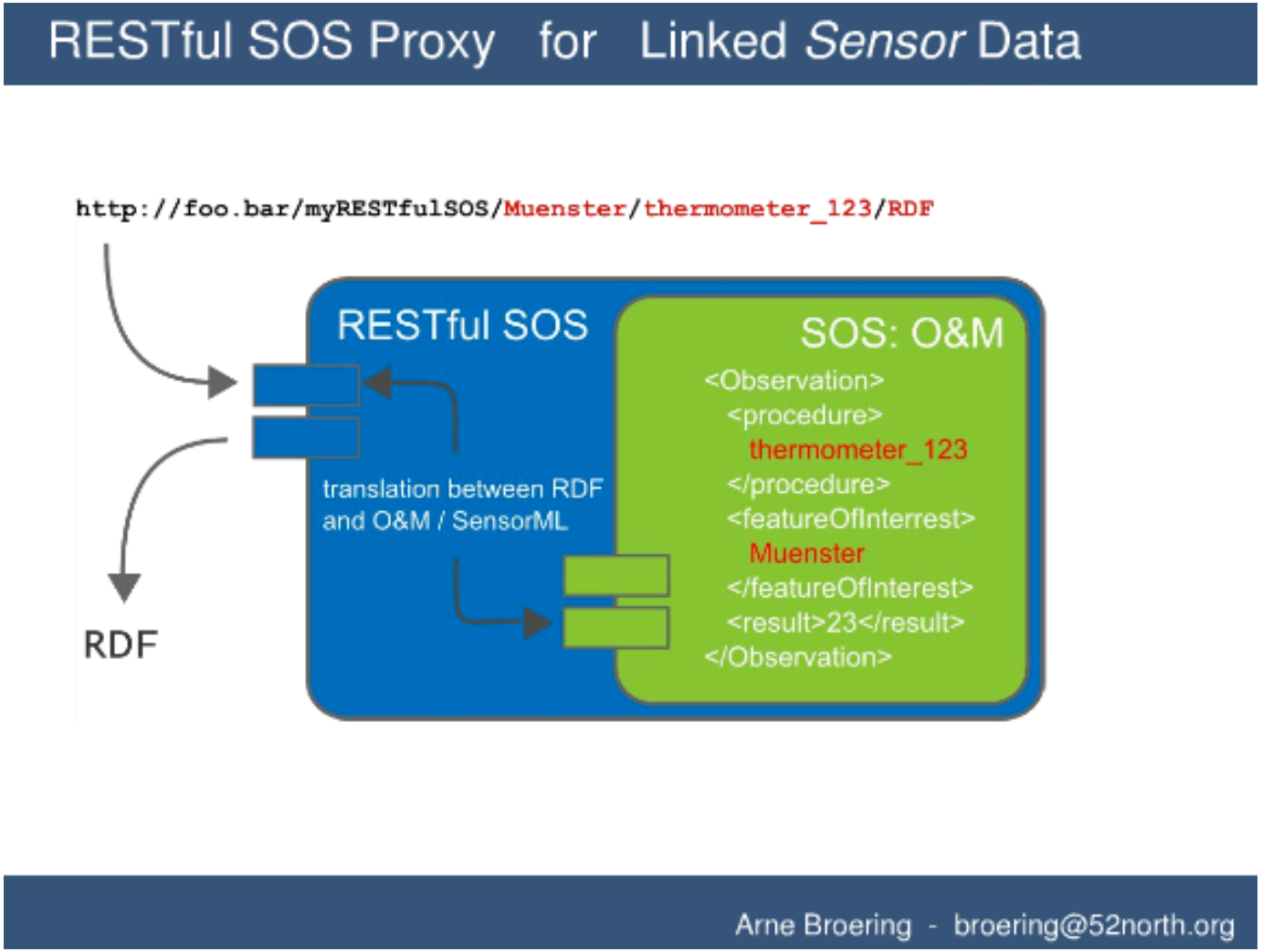
Semantic Sensor Web: Linked Sensor Data



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

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Conclusions

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

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