OGC Web Services 4 (OWS-4) Testbed

Progress Update - focusing on on Sensor Web Enablement (SWE), IEEE1451, and other complimentary standards

Sensor Standards Harmonization, 12 September 2006

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Sensors Are Everywhere

SWE Basic Objectives

- Quickly discover sensors and sensor data (secure or public) that can meet my needs – location, observables, quality, ability to task
- Obtain sensor information in a standard encoding that is understandable by me and my software
- Readily access sensor observations in a common manner, and in a form specific to my needs
- Task sensors, when possible, to meet my specific needs
- Subscribe to and receive alerts when a sensor measures a particular phenomenon

SWE in OGC Web Services Testbeds

OGC Web Services Testbed 1.1:

- Sponsors: EPA, NASA, NIMA
- Specs: SOS, O&M, SensorML
- Demo: NYC Terrorist
- Sensors: weather stations, water quality

2001

OGC Web Services Testbed 1.2:

- Sponsors: EPA, General Dynamics, NASA, NIMA
- Specs: SOS, O&M, SensorML, SPS, WNS
- Demo: Terrorist, Hazardous Spill and Tornado
- Sensors: weather stations, wind profiler, video, UAV, stream gauges

2002

OGC Web Services Testbed 3.0:

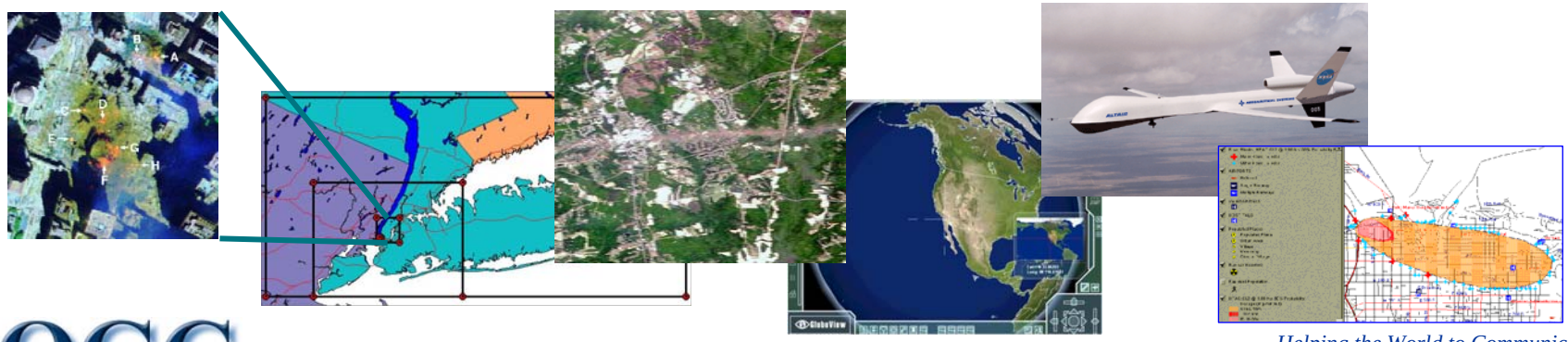
- Sponsors: NGA, ORNL, LMCO, BAE
- Specs: SOS, O&M, SensorML, SPS, TransducerML
- Demo: Forest Fire in Western US
- Sensors: weather stations, wind profiler, video, UAV, satellite

2005

OGC Web Services Testbed 4.0:

- Sponsors: NGA, NASA, ORNL, LMCO
- Specs: SOS, O&M, SensorML, SPS, TransducerML, SAS
- Demo: Emergency Hospital
- Sensors: weather stations, wind profiler, video, UAV, satellite

2006



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SWE Specification Status, September 2006

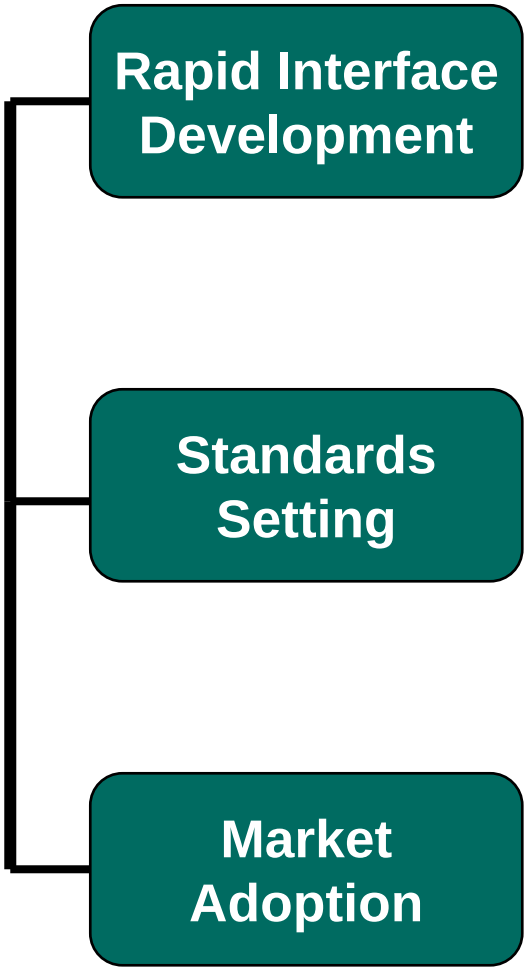
- SensorML
  - Version 0 approved, RWG created, Version 1 (Public) aimed for Nov 06, into DISR January 07 as mandated standard
- TransducerML
  - Version 0 approved, RWG created, Version 1 (Public) aimed for Nov 06, into DISR January 07 as mandated standard
- Observations & Measurement (O&M) specification
  - Approved as a Best Practices paper, June 06
- Sensor Observation Service (SOS)
  - Version 0 approved, RWG created, Version 1 (Public) aimed for Nov 06, into DISR January 07 as mandated standard
- Sensor Planning Service (SPS)
  - Version 0 approved, RWG created, Version 1 (Public) aimed for Dec 06
- Sensor Alert Service (SAS)
  - Approved as a Best Practices paper, June 06

OGC's Approach for Advancing Interoperability

- ***Interoperability Program* (IP)** - global, innovative, prototyping and testing program to accelerate interface development and validation, brings interoperability to the market

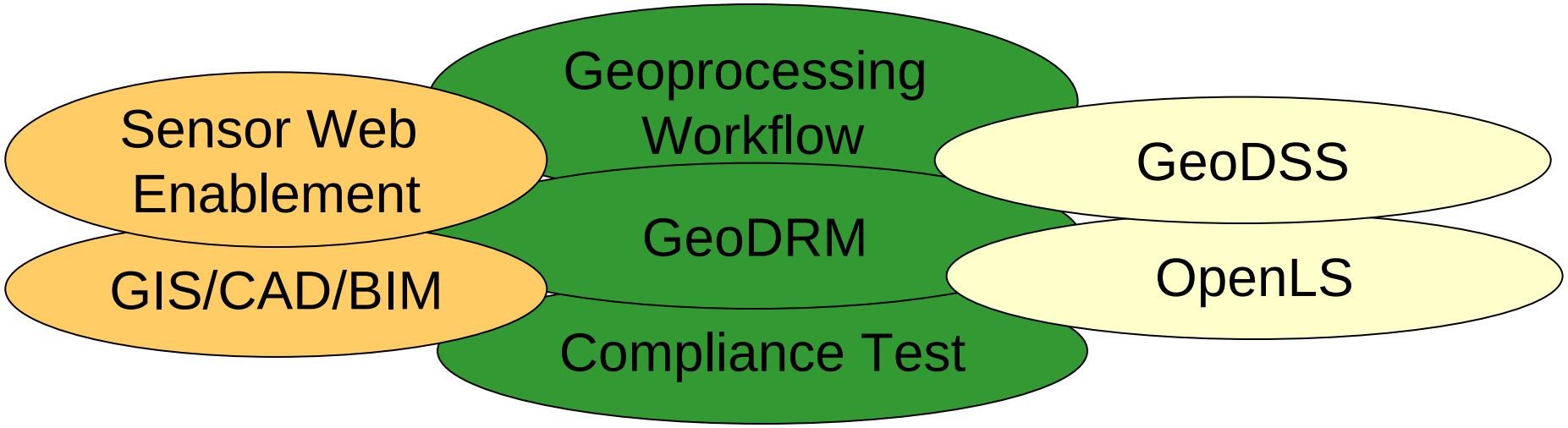
- ***Specification Development Program*** –Consensus processes similar to other Industry consortia (World Wide Web Consortium, OMA, OMG, etc.).

- ***Outreach and Community Adoption Program*** – education and training, encourage take up of OGC specifications, business development, communications programs



OGC Web Services-Phase 4 (OWS-4) Testbed

- Objective: Collaboratively extend and demonstrate OGC baseline for interoperable, multi-source decision support
- June 2006 to December 2006



- 11 Sponsoring organizations
- 66 Participating organizations

As of September 2006

- Sponsorship total $1.8M
- Deliverables
  - 56 Component implementations
  - 36 Reports/draft specifications

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OWS-4 Schedule

January	Call For Sponsors
Jan-March	Sponsor meetings
April	RFQ/CFP Release
May	Participants selected for cost-sharing
June	Kickoff at Oracle, Reston, VA

Six Month development cycle

December	Demo

Organizations in OWS-4

- 3eTi
- ADI
- AEC Infosystems
- AEC3
- Autodesk
- BAE Systems
- Bentley
- Compusult
- con terra
- CSIRO-EM
- CSIRO-ICT
- Cubewerx
- deCarta
- Eco-Systems
- ESRI
- FAO (GeoNetwork)
- Fraunhofer
- Galdos
- General Services Admin
- GeoConnections
- GeoTexel
- GMU
- Harvard
- Image Matters
- IndoorLBS
- Interactive Instruments
- Intergraph
- Ionic
- IRIS (Argon ST)
- ITC
- ITT
- IU Bremen
- Laser-Scan
- Lat-lon
- LizardTech
- LMCo
- MAGIC Services Forum
- MapXperts
- NASA
- NATO C3 Agency
- Navteq
- NGA
- NG-TASC
- NTA
- Oracle
- Ordnance Survey
- ORNL
- PCI Geomatics
- PANYNJ
- COMCARE
- Smart Sensors
- Snowflake
- Spacebel
- Spot Image
- Technical University of Munich
- Tele Atlas
- TOPP
- Traverse Technologies
- UAH
- UniBW – AGIS
- Univ of Bonn
- Univ.Muenster - IFGI
- University of Potsdam
- Vightel
- Washington University, StL
- Thirteen/WNET

66 Organizations as of 1 September

OWS-4 SWE - Objectives

- Progress from design (OWS-3) to refinement/implementation (OWS-4)
  - Refine SWE architecture to clarify design tradeoffs
  - Feed into Geoprocessing Workflow Thread
- SensorML and TransducerML profiles for sensors and applications
  - Specific sensor instances: Quality, uncertainty of derivations
  - Continue deriving/refining Catalog profiles for discovery in SWE
- Refine SWE Service specs and implementations
  - Sensor Observation Service (SOS)
  - Sensor Planning Service (SPS)
  - Sensor Alert Service (SAS)
- Sensor Standards Coordination
  - (See next page)
- Tie into Agency/Sponsor demonstration/exercises

OWS-4 SWE coordination with other standards

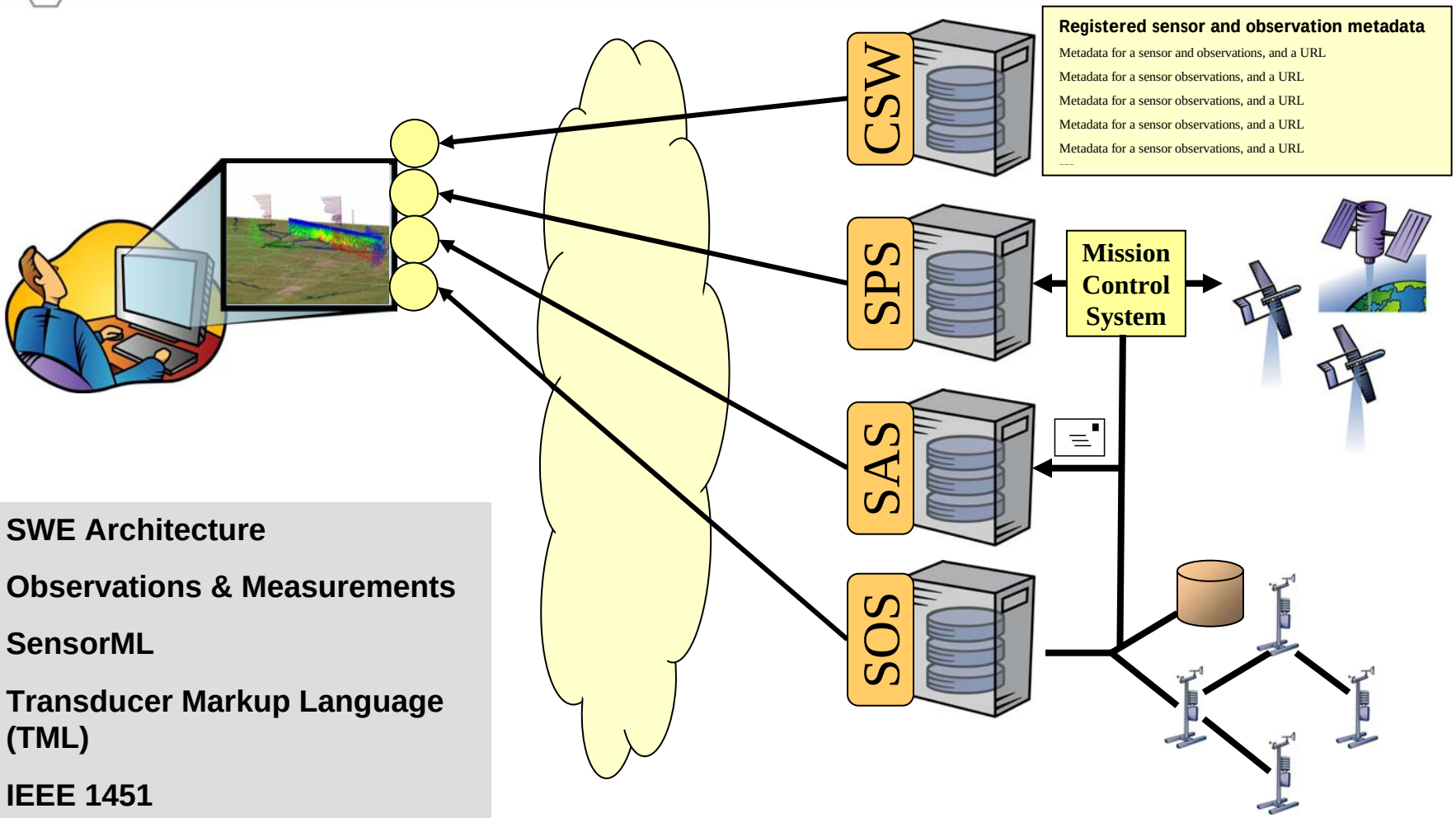
- IEEE 1451
  - TEDS mappings and transformations (under development)
  - 1451-sensors integrated with SWE SOS (under development)

- ANSI 42.42
  - Radiation measurement in SWE O&M
  - Develop GML Application Schema for ANSI 42.42
  - Map SWE to ANSI 42.42 (see “SOA Workflow for Sensor Data” slide)

- OASIS (Future)
  - Develop transforms of SWE O&M and CAP
  - Integrate EDXL-DE with SWE sensor workflows for pub/sub and multicast notification

- GeoRSS - “syndication with location” through SAS

SWE Web Services



SWE Architecture

Observations & Measurements

SensorML

Transducer Markup Language (TML)

IEEE 1451

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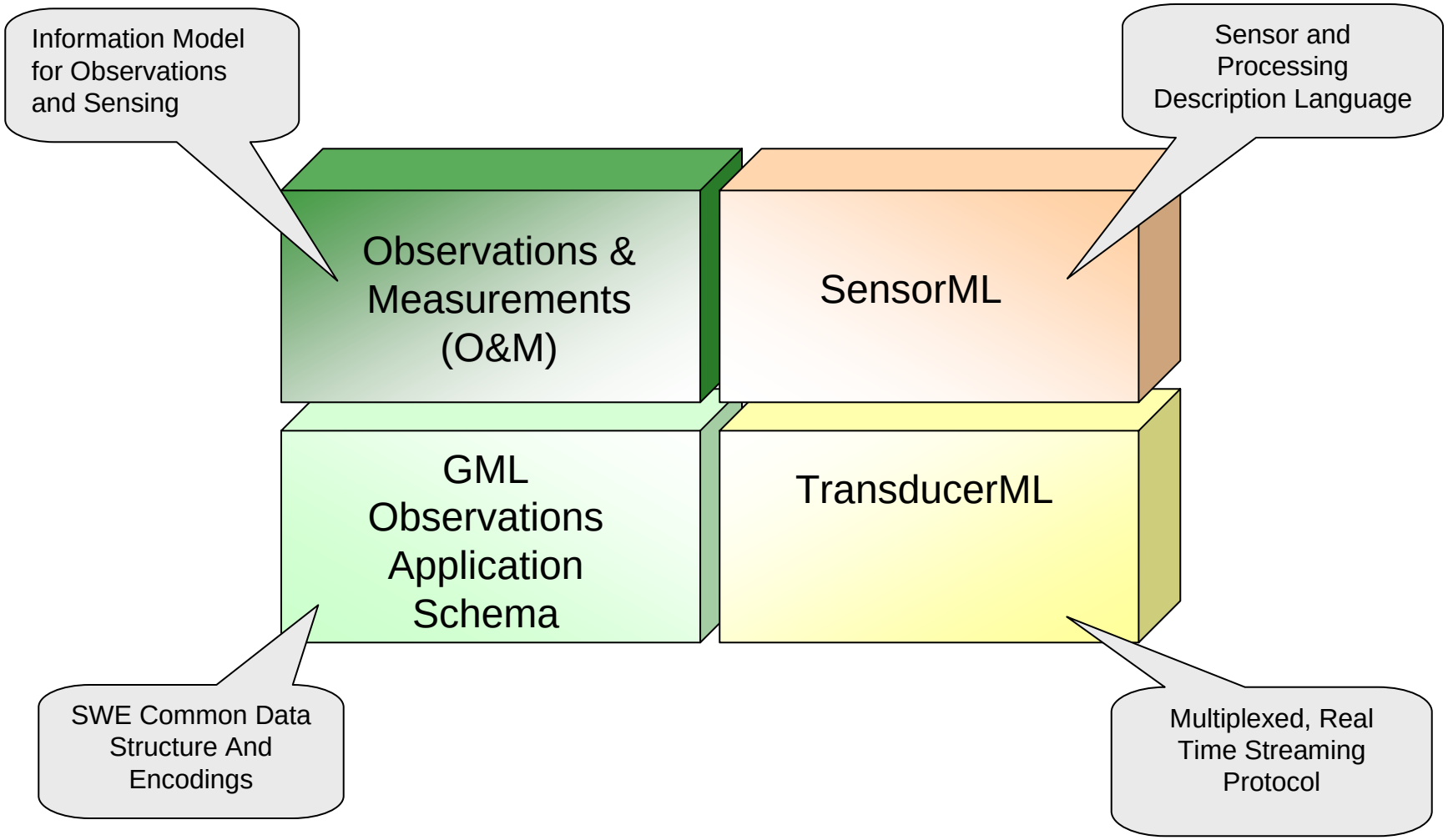
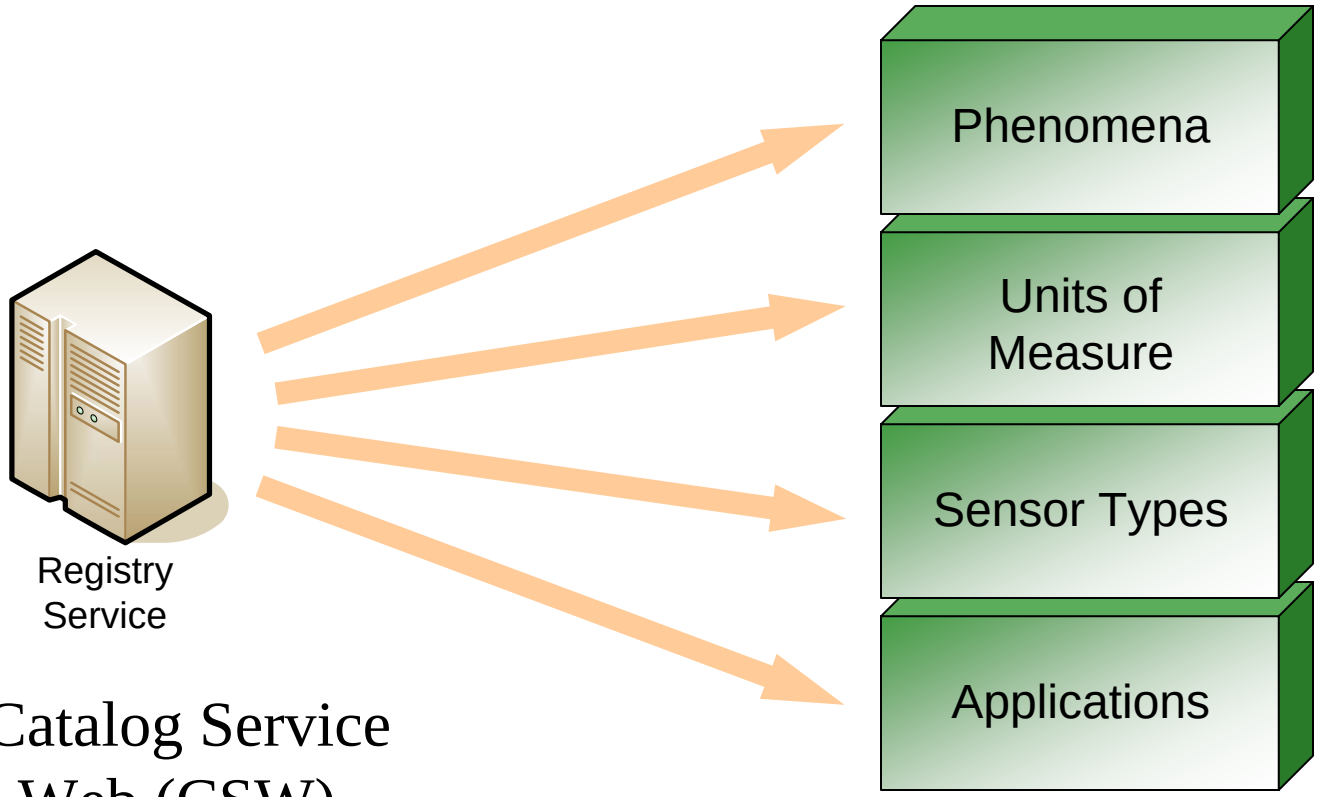
SWE Languages and Encodings



SWE Components - Dictionaries

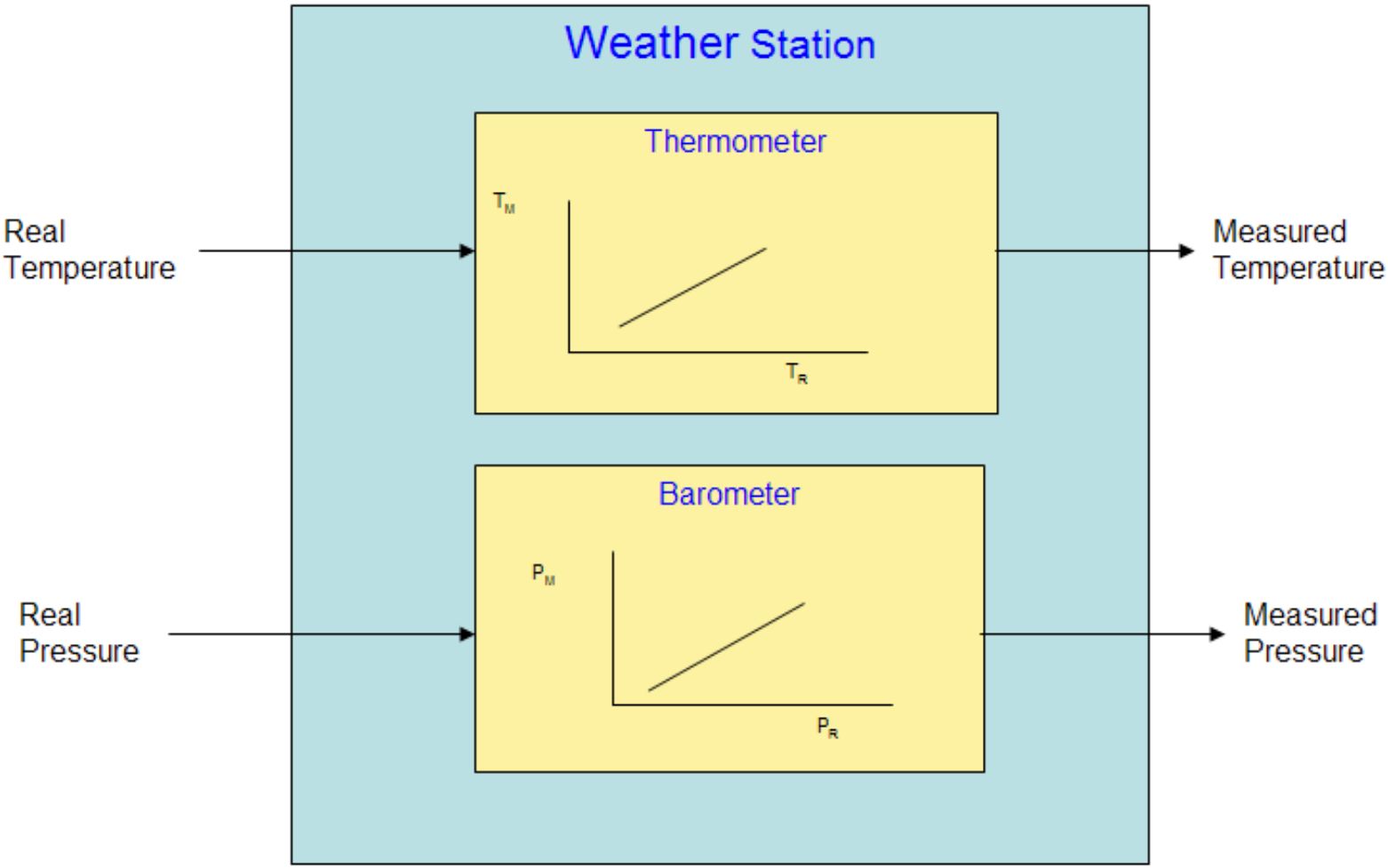


OGC Catalog Service
for the Web (CSW)

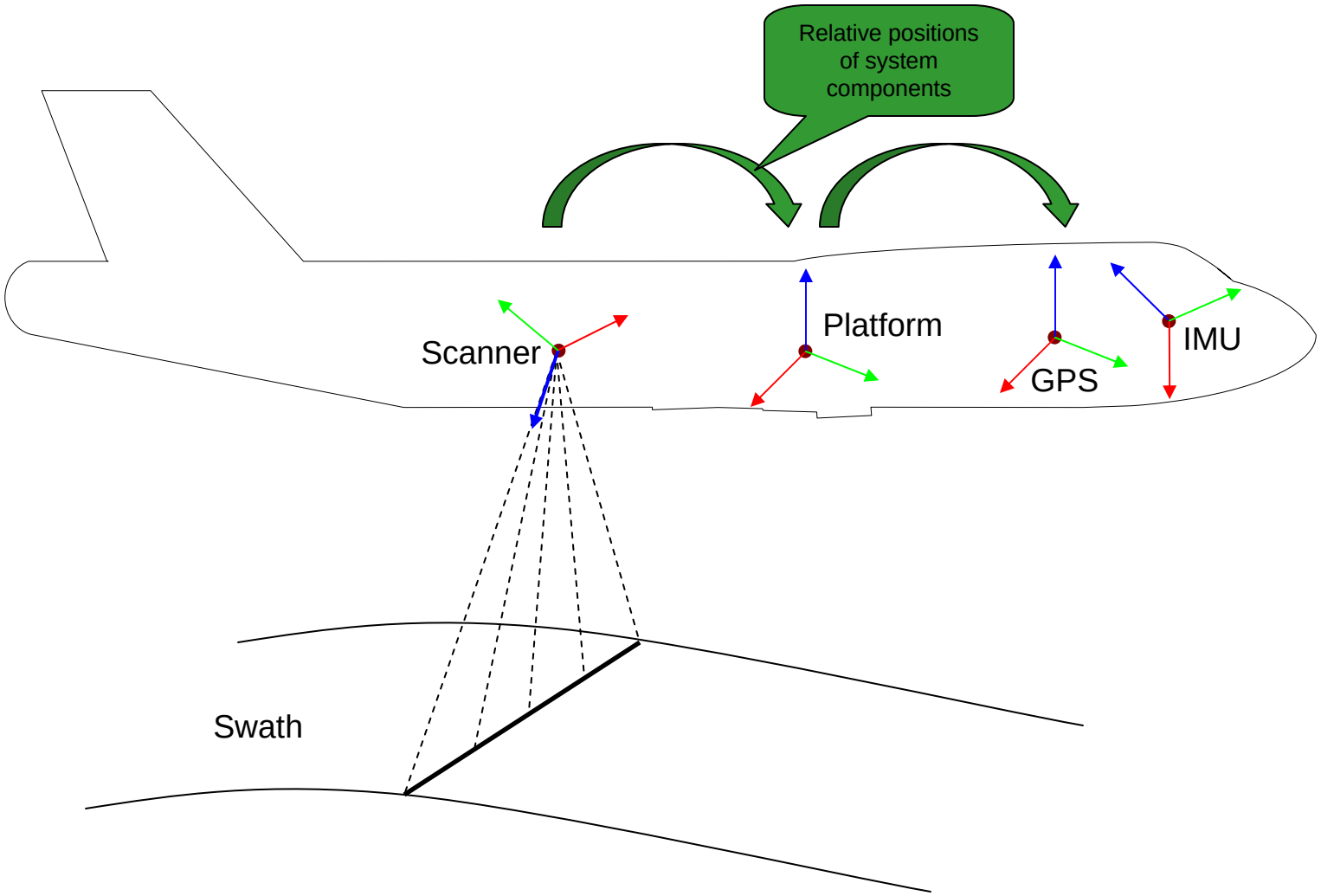
What is SensorML?

- Models and XML encodings for describing processes
  - **Detectors, actuators, etc. are modeled as processes**
  - **Can be used to describe "left-side" processes ("how were these observations obtained?")**
    and "right-side" processes ("what can I derive from these observations?")
- Vision:
  - Discovery of transducers and processes / plug-n-play sensors **– SensorML is the means by which sensors and processes make themselves and their capabilities known**
  - Observation lineage **– SensorML provides sensing and processing history of observations; supports quality knowledge of observations**
  - On-demand processing **– SensorML supports on-demand derivation of higher-level information (e.g. geolocation or products) without a priori knowledge of the sensor system**
  - Extensibility **– SensorML provides easy means for meeting various community needs**

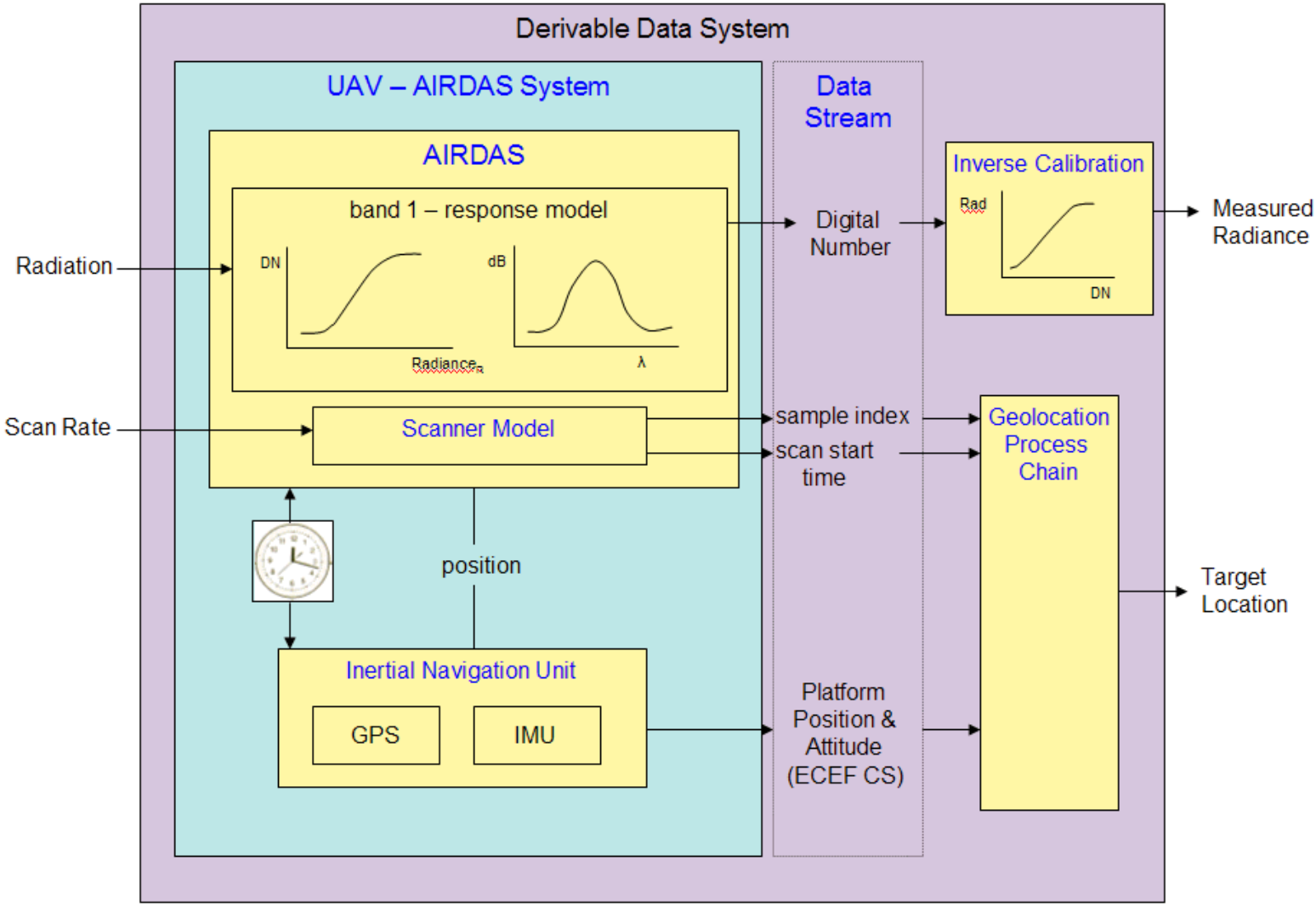
System Example – Simple Weather Station



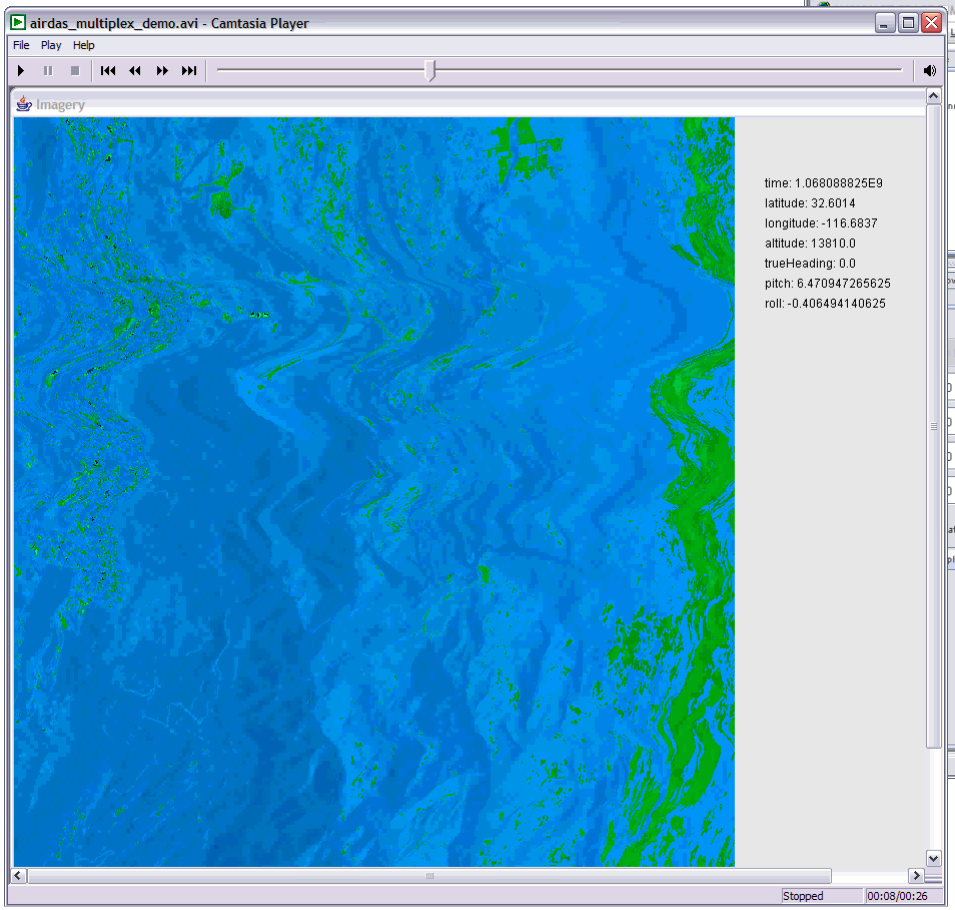
SensorML – Relative Positions



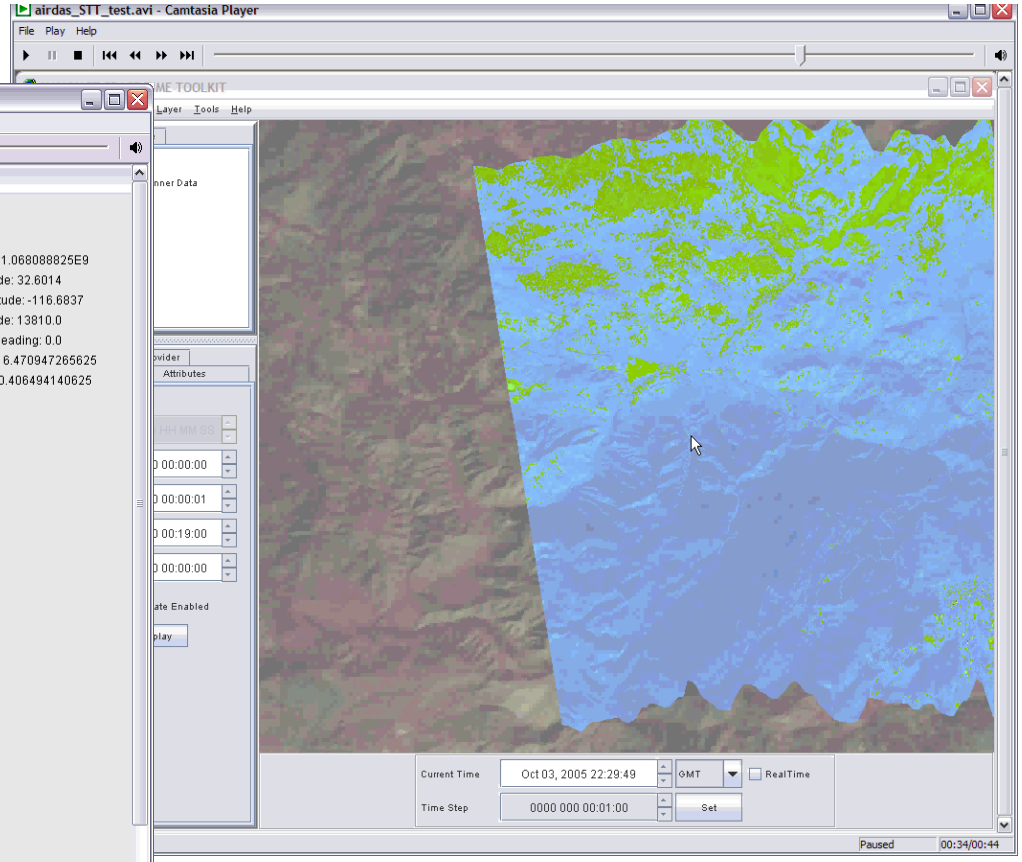
Example – AIRDAS with derivable data



AIRDAS UAV Geolocation Process Chain Demo



AIRDAS data stream (consisting of navigation data and 4-band thermal-IR scanline data)



AIRDAS data stream geolocated using SensorML-defined process chain (software has no a priori knowledge of sensor system)

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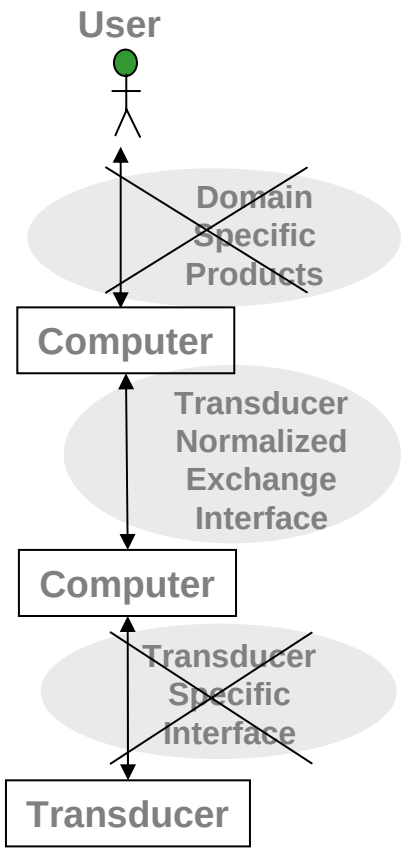
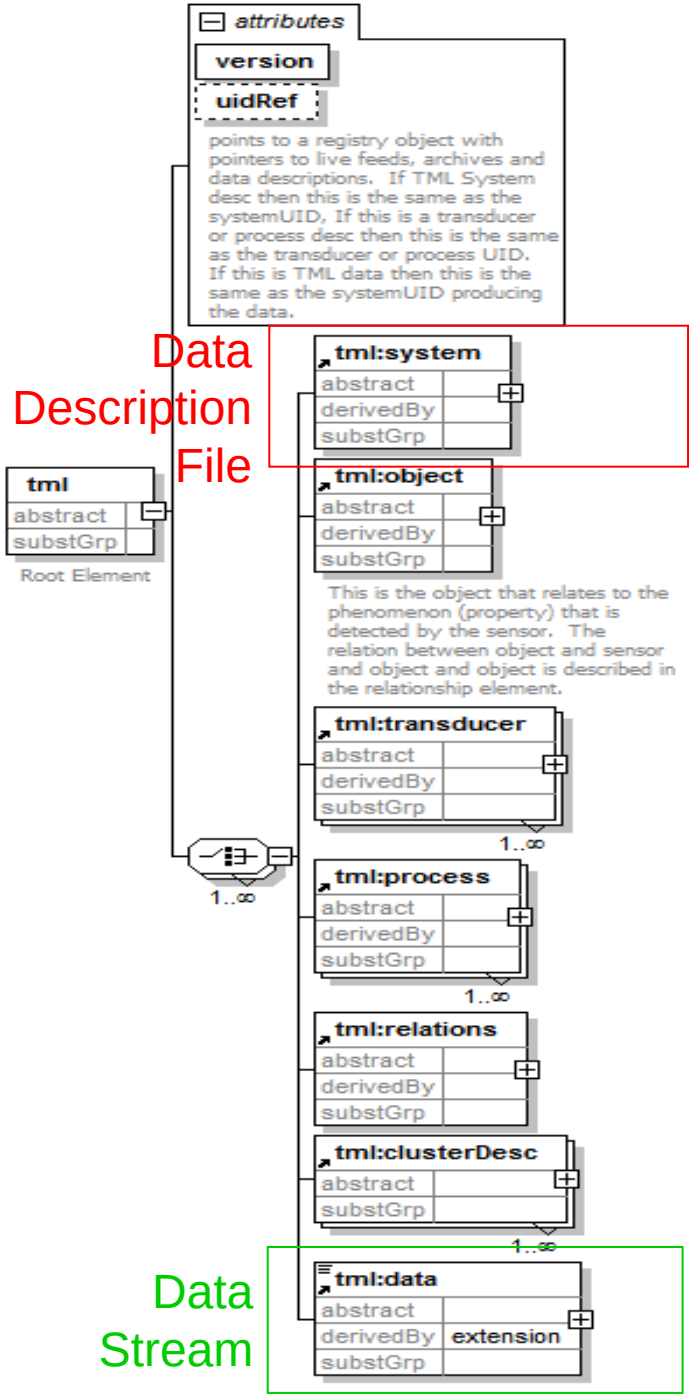
What is Transducer Mark Language (TML)?

- **TML is a language for exchanging streaming transducer command & status data**
  - Between a system of transducers and a transducer processor/service or client
  - Self-describing
  - Based on XML (archive or live data)
- **The language communicates**
  - Streaming Transducer data
  - Transducer metadata
  - Metadata is tightly coupled with data
- **Sensor Metadata characterizes the "What", "When" and "Where" of data**
- **Normalizes data for exchange**
  - Standardized spatial, temporal, phenomenon value, and UOM.
  - Data traceable to an enterprise datum's (space, time, value) with uncertainties
  - Data traceability of processing pedigree and source data
- **TML is Sensor Agnostic**
  - Metadata is Common for all Type Sensors
  - Enables a "Common Sensor Processor"
- **TML is Application Domain Agnostic**
- **TML is for Machine-to-Machine data exchange**
  - Historical, live, and future time precision time tagged messages



***TML role is not to describe how to represent data**
***Relies on other ontologies and taxonomies to carry domain specific data**
***Relies on other services for communication, security, discovery, delivery, representation, etc.**

TML Framework



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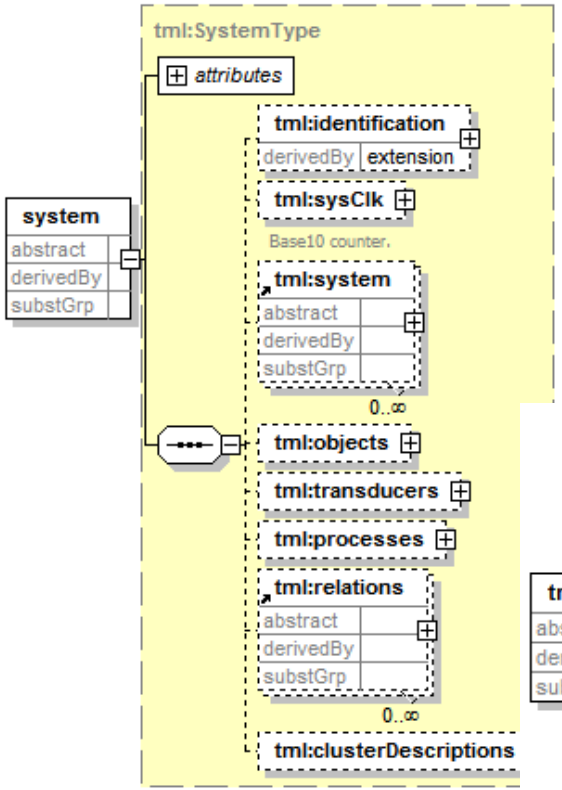

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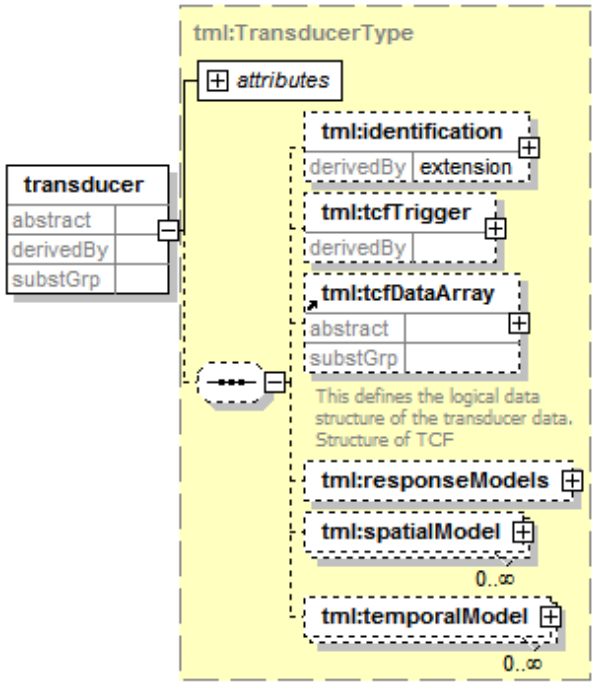

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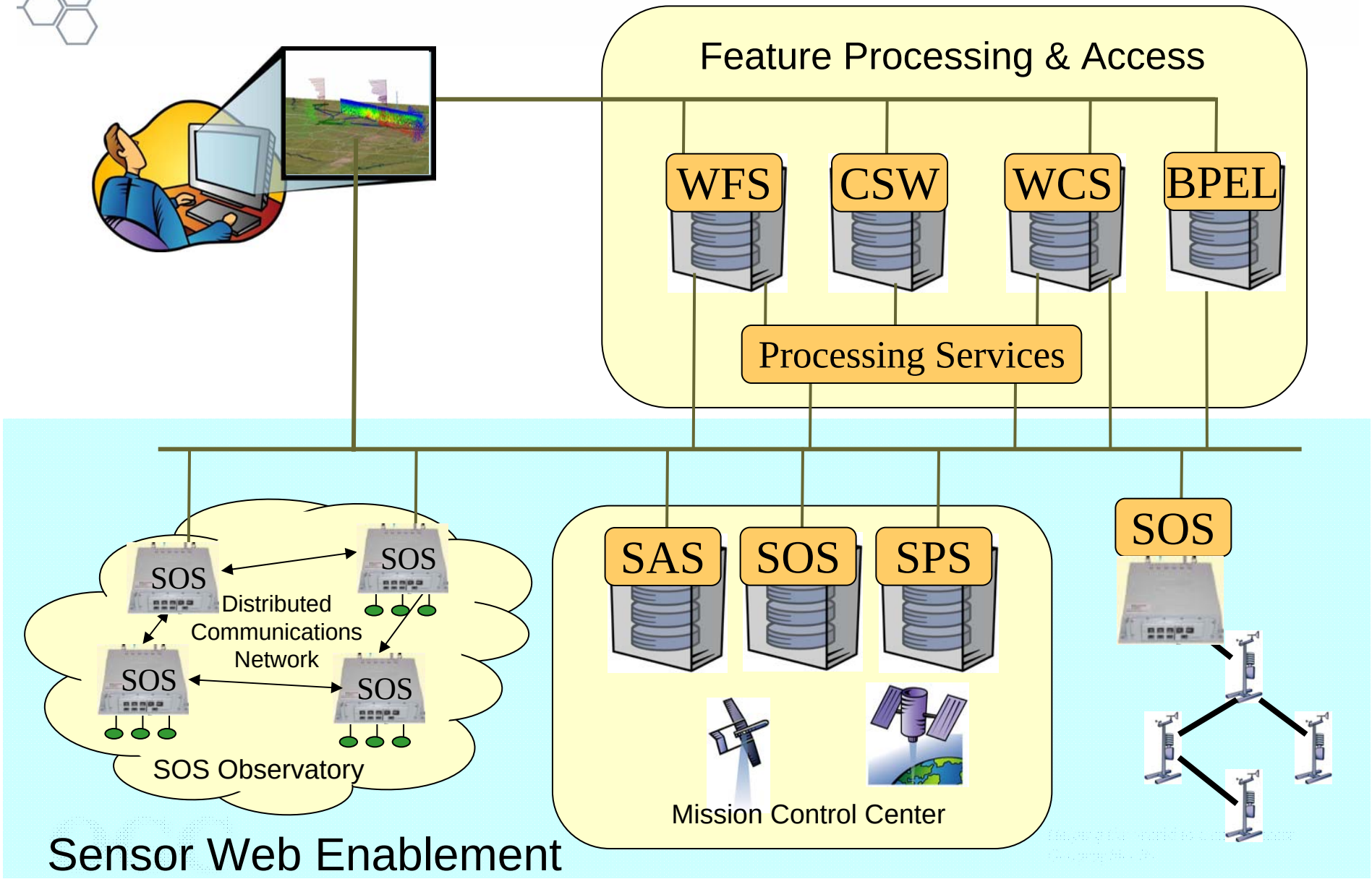
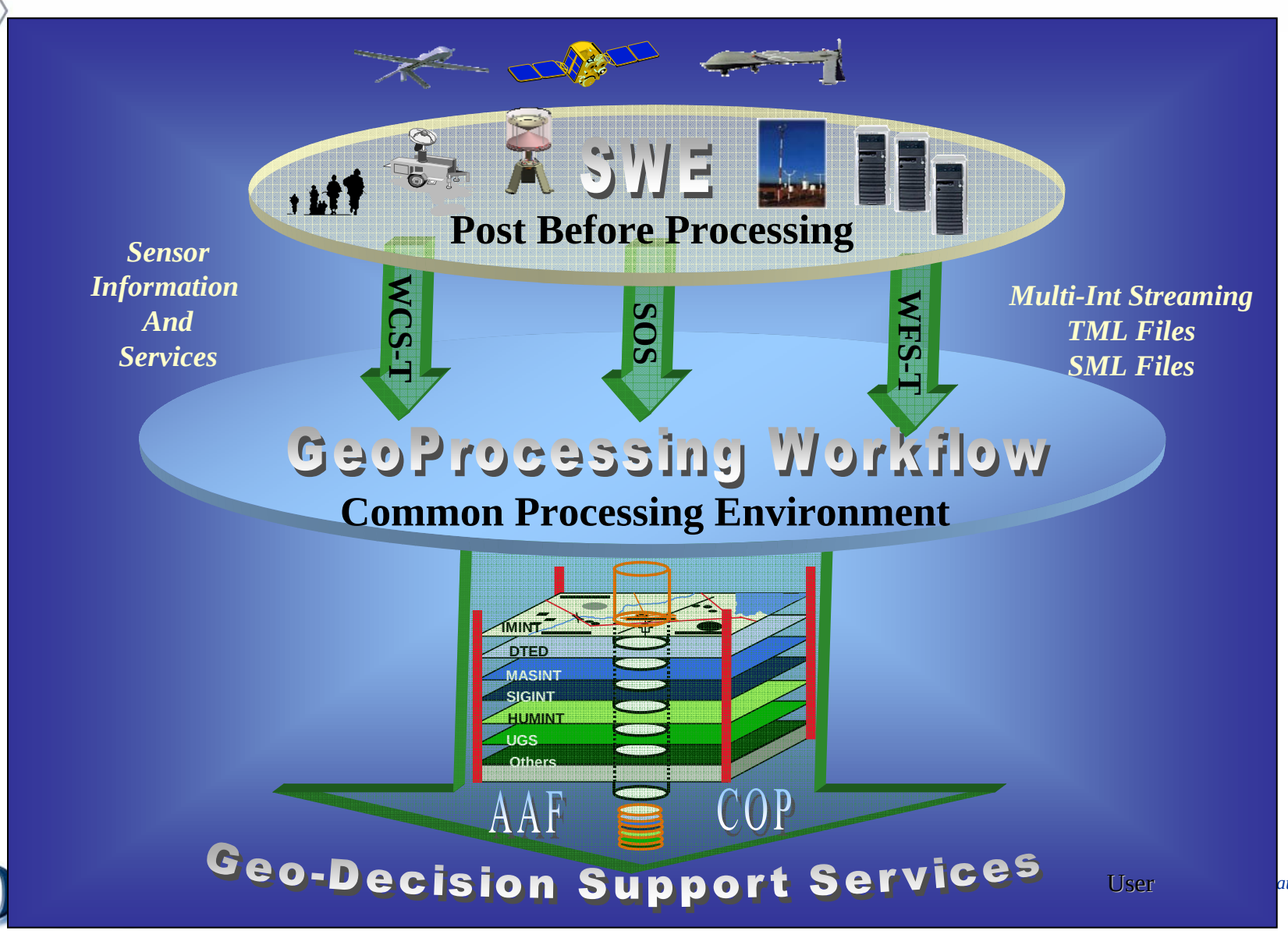
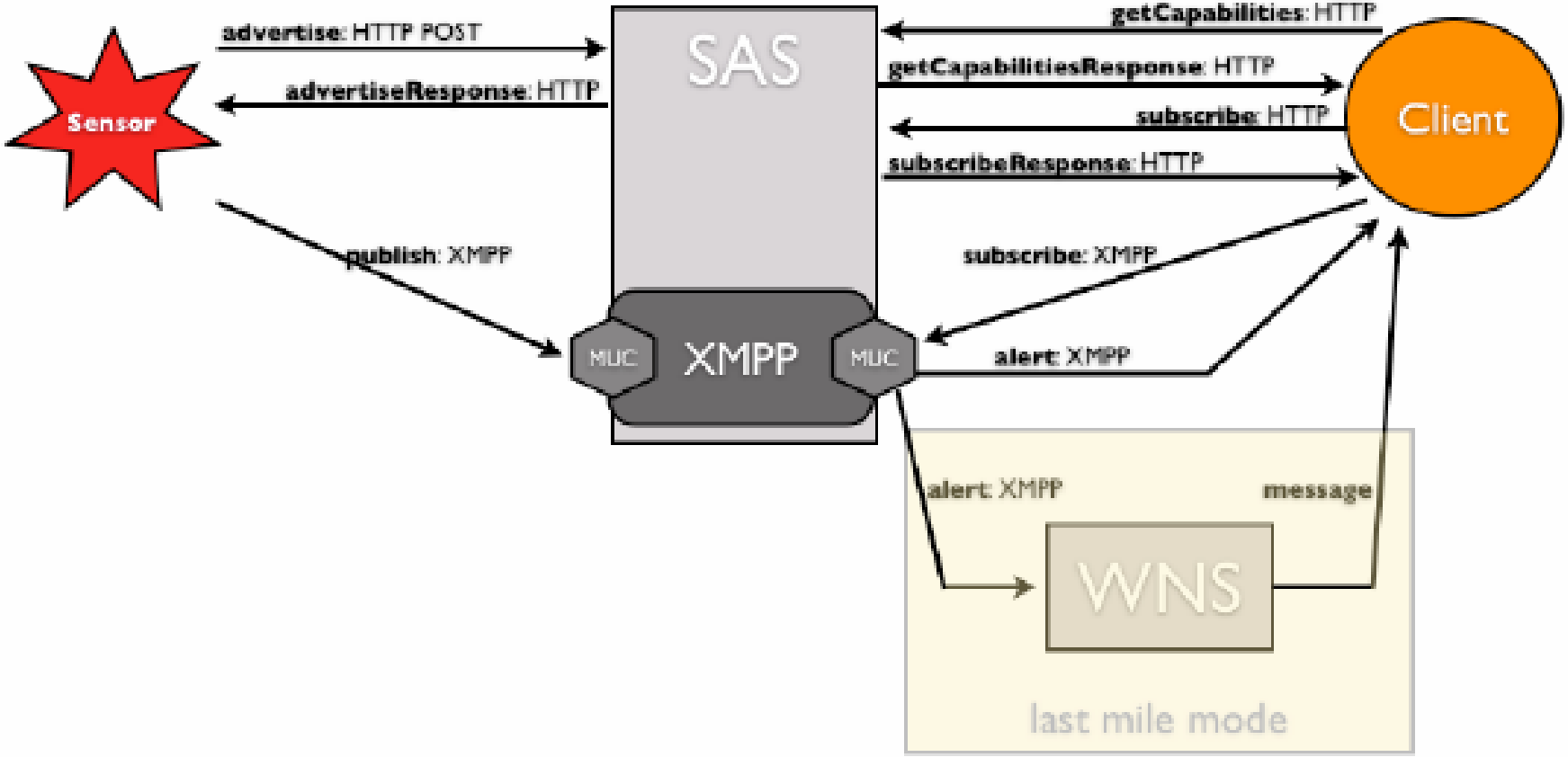
SWE and Geo-Processing Workflow in OWS-4



OWS-4 Data Flow



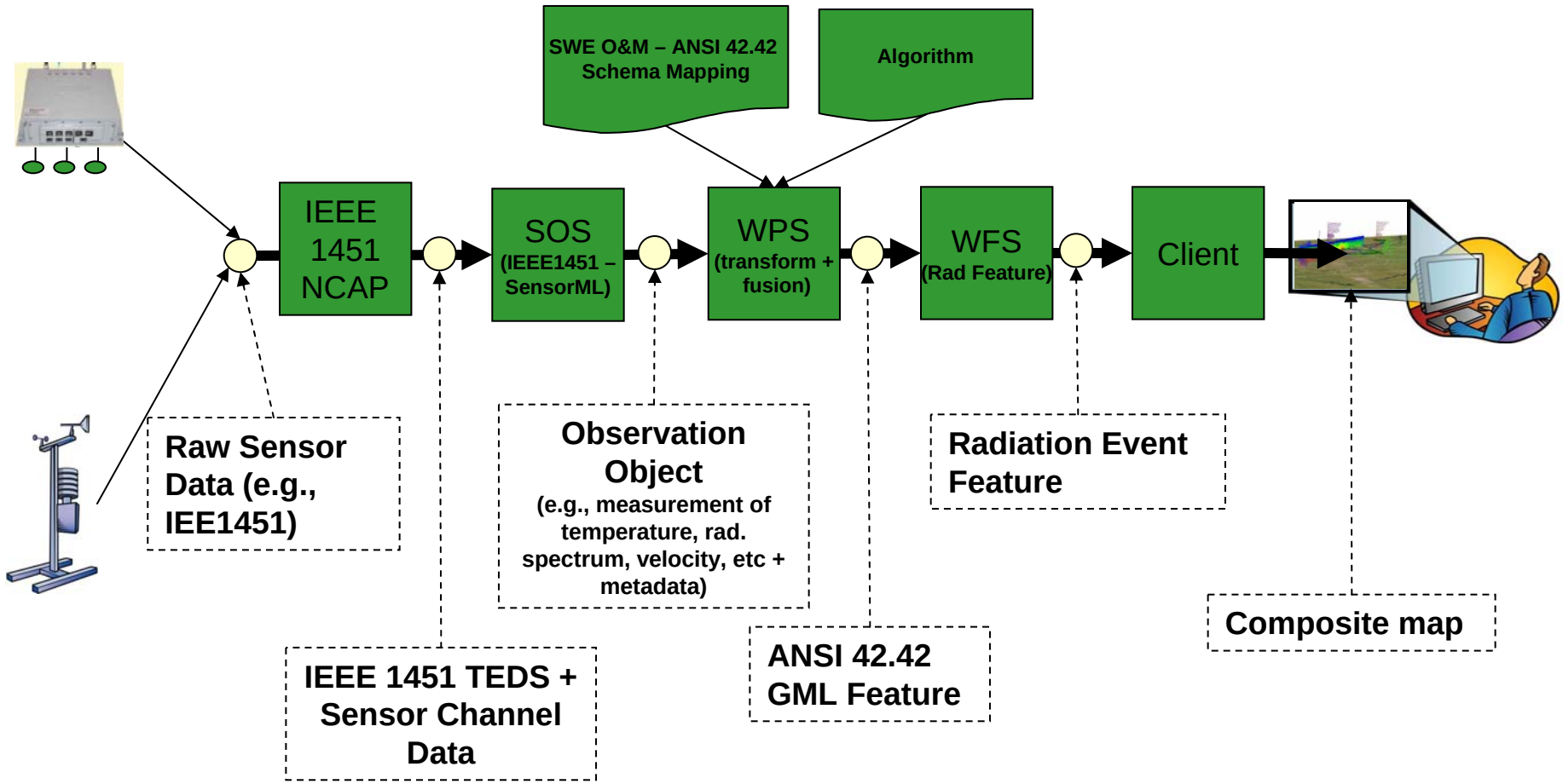
SAS Interactions



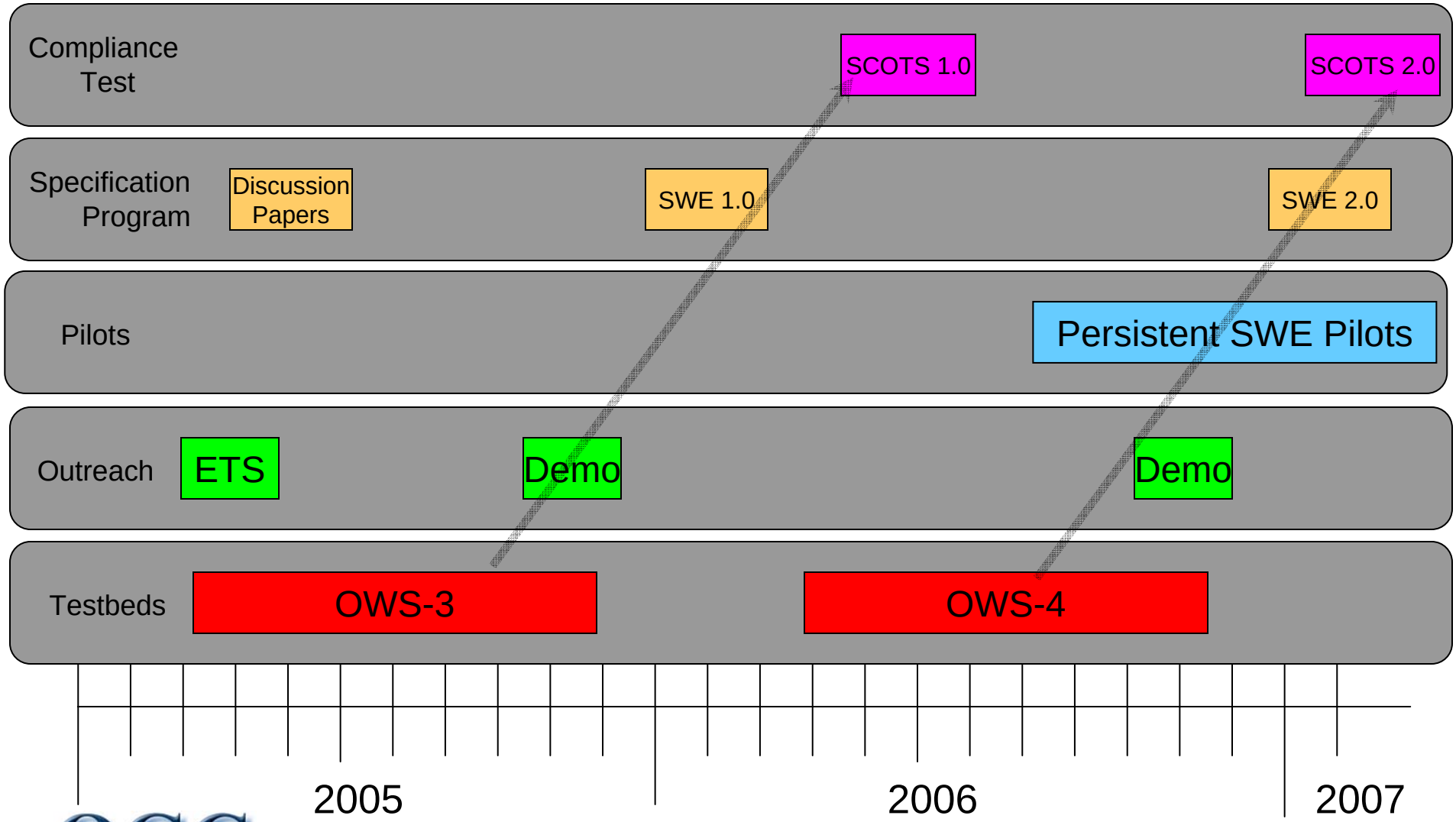
OWS-4 Demonstration Scenario - DRAFT

- Scene 1 - Radiation event
  - SWE radiation sensors triggers additional sensors and workflow
  - Presents summary to EOC operator
  - DHS/FEMA scenario for First responders
- Scene 2 - Preparing Temporary Hospital Site
  - CAD/BIM model of airport building, modified with necessary changes to meet hosptial requirements
  - Develop plan: AIXM, Feature Fusion, Topology Quality, WCS-JPIP
  - Collaboration for approving plan; GeoDRM
- Location - Port Authority of NY and NJ
  - Emergency Operations Center, Jersey City, NJ
  - Radiation site with wireless communications to sensors
  - Temporary Hospital at one of the 4 PANYNJ airports

SOA Workflow for Sensor Data



SWE Development Plan



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Questions & Comments

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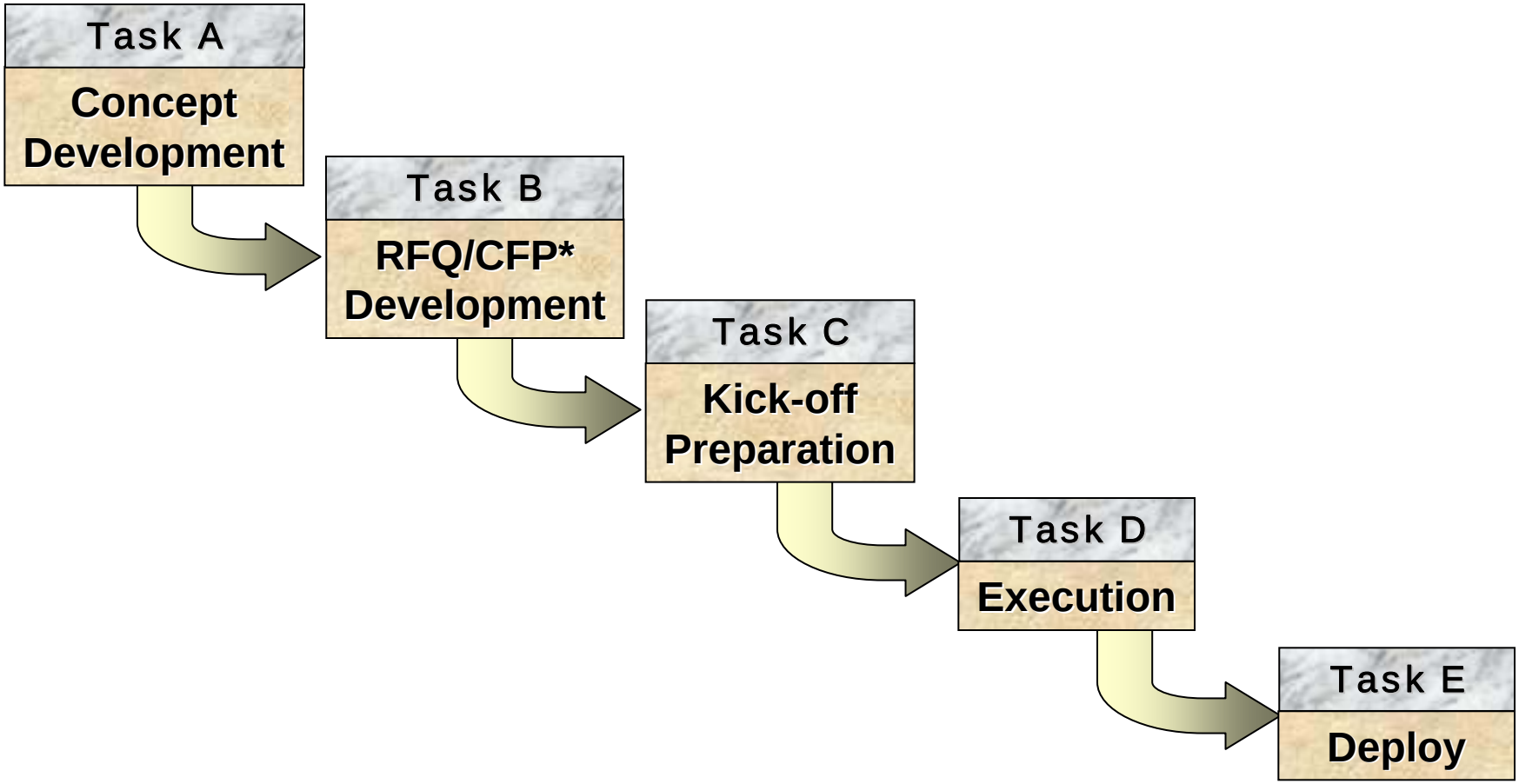
Backup

Testbed Approach



***RFQ/CFP = Request for Quotation/Call for Participation**

SWE Participants and Stakeholders

- Participants
  - 3eTI
  - CSIRO-EM
  - CSIRO-ICT
  - Ecosystems Associates
  - IFGI (Uni. Muenster)
  - IRIS
  - Smart Sensor Systems
  - UAH
  - Vightel
  - Washington University
- Sponsors, Additional Participants and Observers
  - NGA, NASA, ORNL
  - IEEE 1451
  - OASIS (CAP and EDXL)

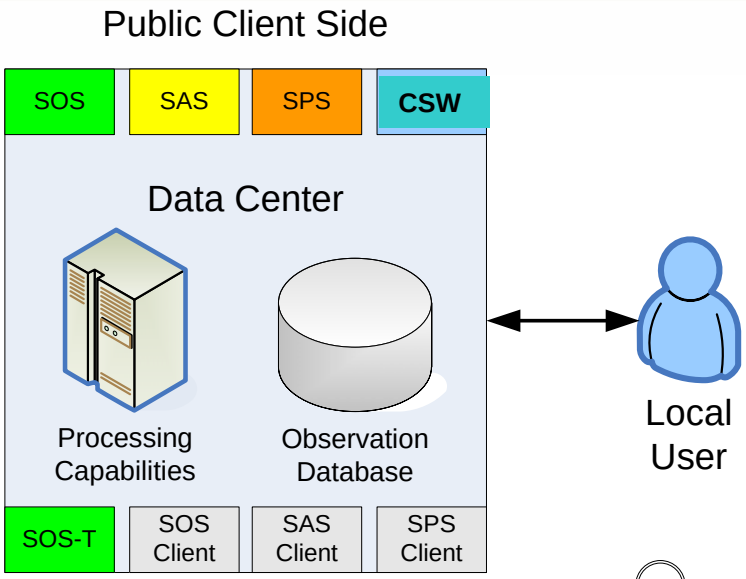
SWE Deliverables

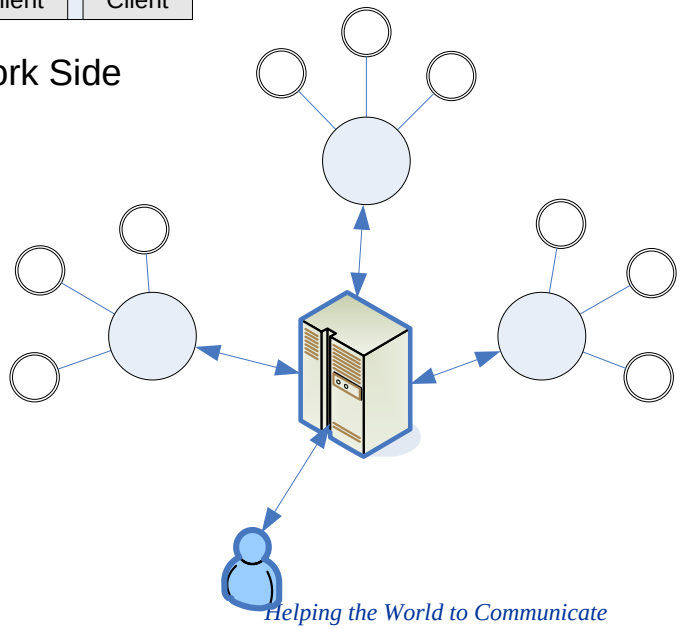
IPR Deliverable	Participant
SWE Architecture IPR (revision)	CSIRO-EM (lead)
O&M IPR (revision)	CSIRO-EM (lead)
SensorML CR	UAH (lead)
SensorML CR (1451 to SML mapping)	Smart Sensors (lead)
TransducerML CR	IRIS (lead)
TransducerML CR (1451 to TML mapping)	Smart Sensors (lead)
SOS CR	3eTi (lead)
SPS CR	Lockheed-Martin, Eco-Systems
SAS CR	IFGI (lead)

Implementation Deliverable	Participant
Sensor Data Center #1	IFGI- SOS, SPS, SAS
Sensor Data Center #2	Vightel – SPS, SAS, GeoRSS
Sensor Data Center #3	CSIRO –ICT
SOS for IEEE 1451 systems	3eTi - SOS
IEEE 1451 sensors	Smart Sensors
TML stream for mobile MPEG-4 video	IRIS
WPS for O&M Observations	Washington Univ.
WPS for NASA models	Washington Univ.
SWE Visualization Client	UAH

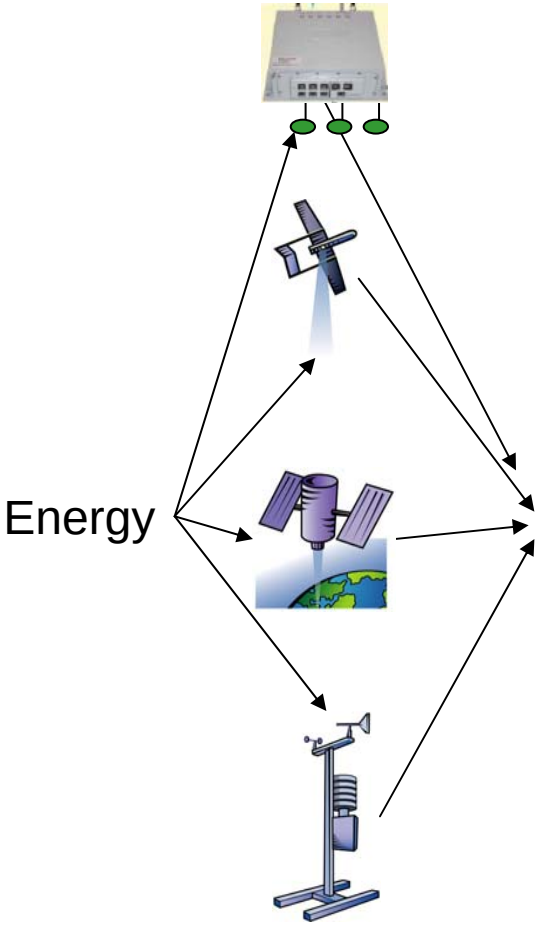
SWE Service Model (Data Center View)

- SWE Data Center
  - Composition of integrated SOS, SPS and SAS service implementations
  - Tasking of sensors, access to sensor system observation data and alerting of sensor system state changes and measurements.
  - Support the requirements for sensor systems and protocols (IEEE1451, MPEG4, ANSI 42.42, XMPP, OASIS CAP/EDXML)
  - Descriptions of the sensors systems, observation offerings and services must be published to CSW implementations





The Energy to Knowledge Value Chain



Utility of the sensor system is measured by the extent to which it supports effective decision making.

Signals → Data → State → Labels → Knowledge