OGC
Open Geospatial Consortium

# OWS-3 SWE (OGC Web Services, Phase 3 Sensor Web Enablement): Overview & Information Model Drilldown

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# OWS-3 SWE Overview

- SWE Conop
- OWS-3 SWE Project Description
- SWE Information Model
- SWE Service Model

# Sensor Web Enablement (SWE) Concept

**Sensor Webs are characterized by:**

- **Constellations of heterogeneous sensors**
- **Distributed self-describing sensor systems and services**
- **Sensors linked to networks and network-centric applications and services**
- **Common XML encodings, information models, and metadata for sensors and observations**
- **Access to observation data for value added processing and decision support applications**
- **Broad range of users and applications with exploitation workstations, web browsers, and mobile devices**

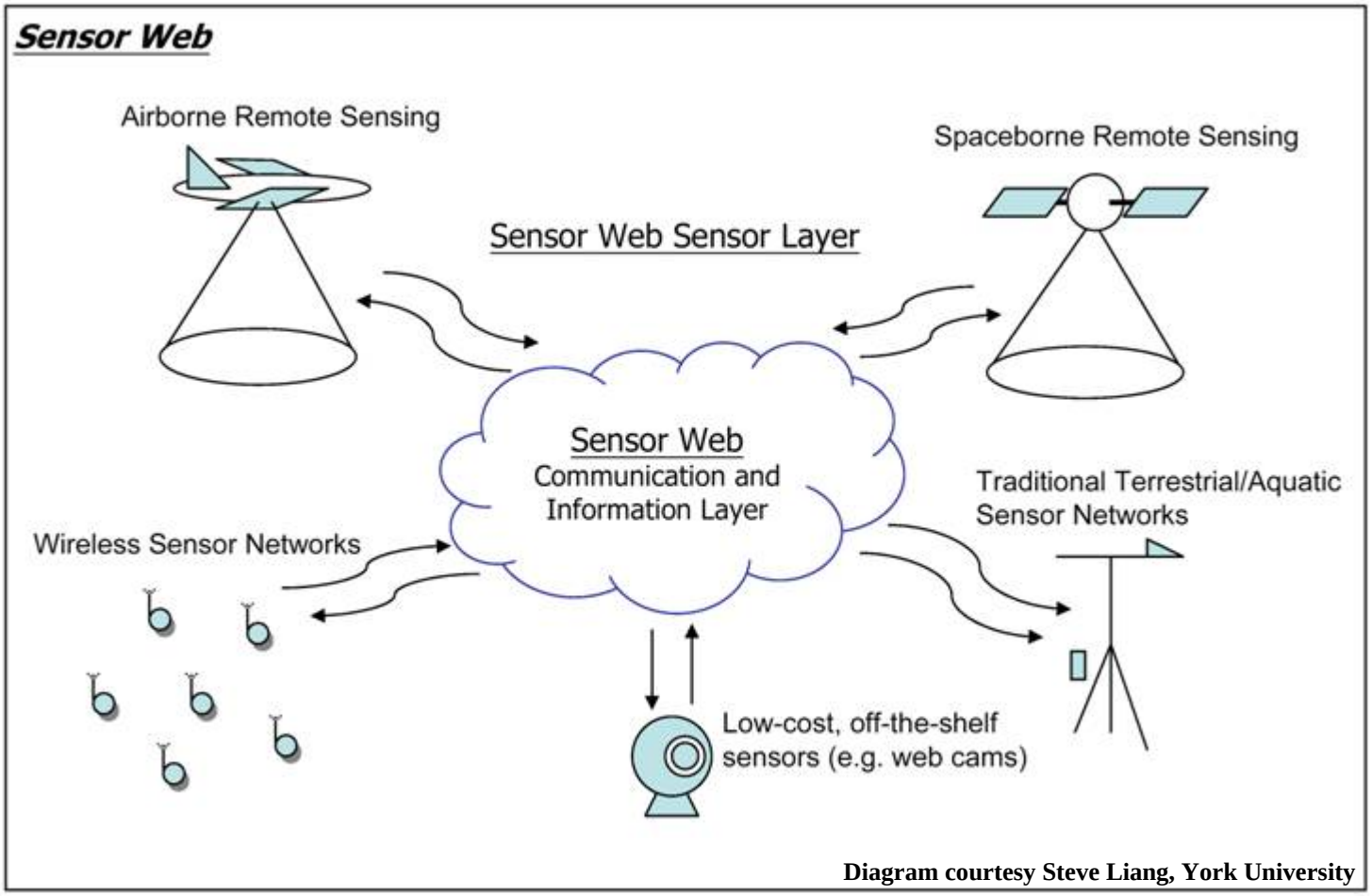



**Diagram courtesy Steve Liang, York University**

# OWS-3 SWE Project Objectives

1. Integrate multiple, independent sensor and sensor support systems, allowing users to reach-out, access and use any sensor and any system.
   a) Quickly discover sensors and sensor data (secure or public) that can meet the users needs – location, observables, quality, ability to task
   b) Task sensors, when possible, to meet the users' specific needs
   c) Obtain sensor information in a standard encoding that is understandable by the user and their software
   d) Readily access sensor observations in a common manner, and in a form specific to the users' needs

2. Enable a standards-based "plug-and-play" sensor framework based on existing specifications (including integration of IEEE 1451 and TransducerML into the SWE framework).

# OWS-3 SWE Participants and Work items

- **SWE Information Engineering**
  - 3eTI (IEEE 1451)
  - CSIRO (GML, O&M, ISO 19130)
  - IRIS (TML)
  - Univ. Alabama Huntsville (UAH), (SensorML, ISO 19130)
  - Univ. Muenster IFGI (SPS messages)
  - ESA/Spot: in-kind
  - NGA: in-kind
  - NASA Ames: in-kind

- **Sensor Planning Service (SPS)**
  - Univ. Muenster/IFGI
  - NASA Ames: in-kind
  - Spot/ESA: in-kind

- **Sensor Observation Service (SOS)**
  - 3eTI
  - IRIS
  - UAH
  - IFGI

- **SWE Client**
  - York Univ./GeoTango
  - Univ. Alabama Huntsville (UAH)

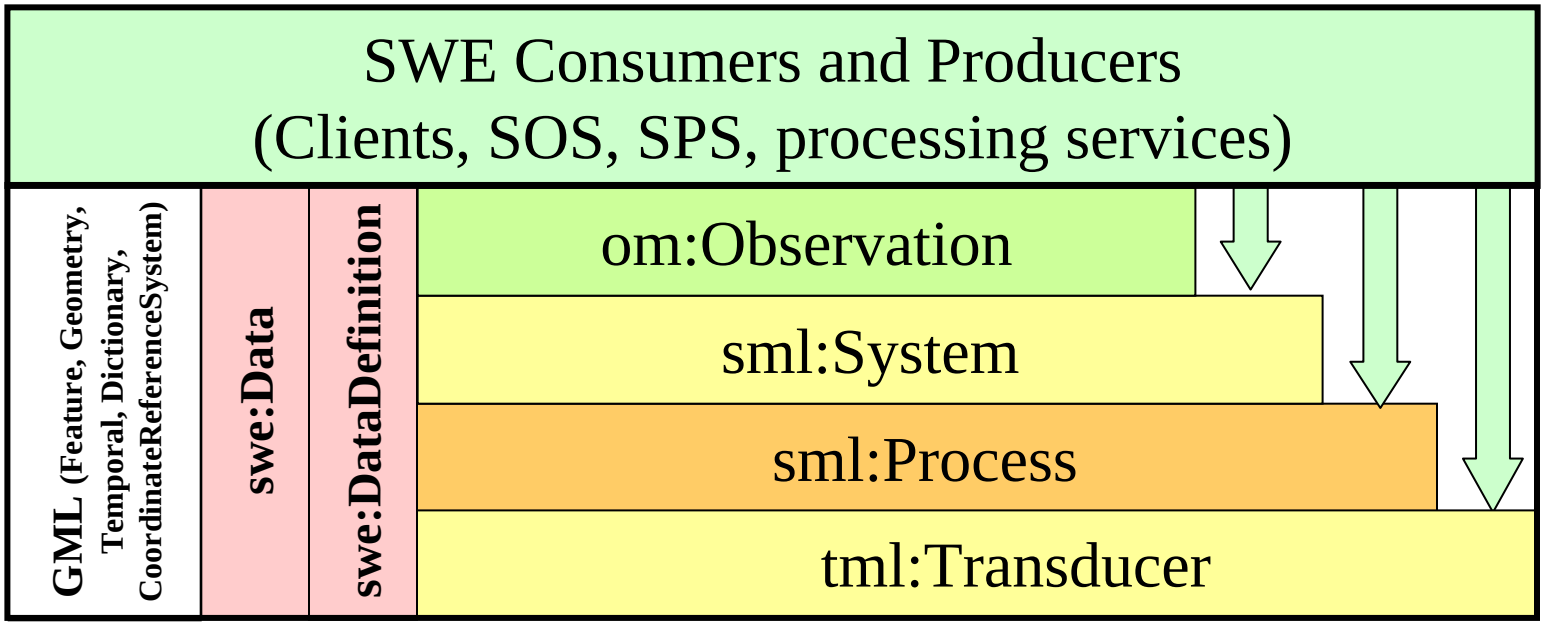
- **SWE Demonstration**
  - York
  - Intergraph
  - 3eTI
  - UAH
  - IRIS
  - IFGI
  - NASA Ames: in-kind
  - ESA/Spot: in-kind
  - SAS IE coordination

# OWS-3 SWE Project Deliverables

- Software and Schema
  - Schema Repository in “Subversion”
  - Client Implementations
  - SOS and SPS Implementations
  - Demonstration of Client and Server Components

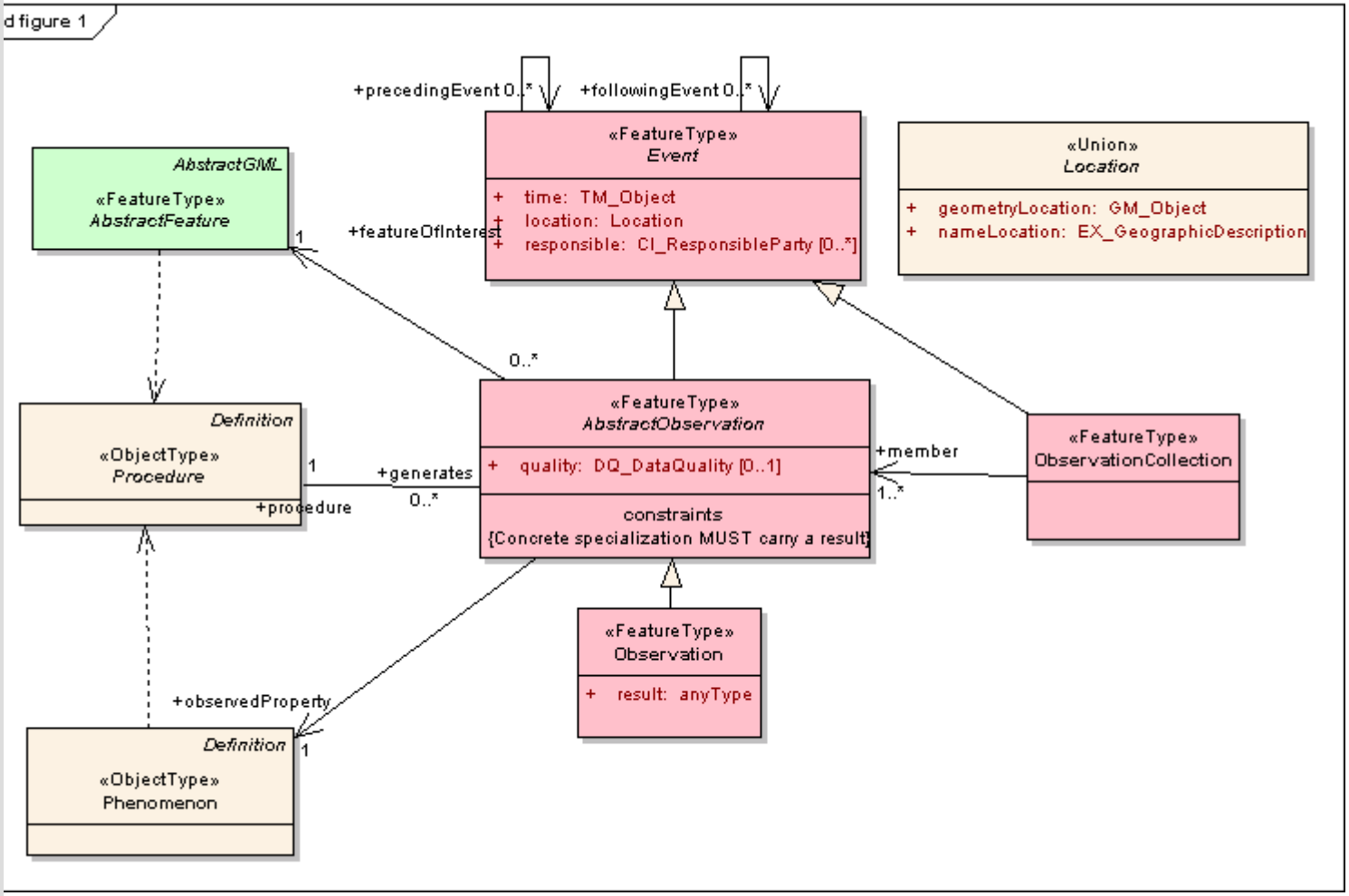
- Interoperability Program Reports
  - **Observations & Measurements (OM) IPR** (05-087) - describes updates to the O&M discussion paper for submission to the Specification Program.
  - **Sensor Model Language (SensorML) IPR** (05-086) - describes updates to the SensorML discussion paper for submission to the Specification Program.
  - **Transducer Markup Language (TML) IPR** (05-085) - describes the TML schema for submission to the Specification Program.
  - **Sensor Observation Service (SOS) IPR** (05-088r1) - describes the SOS interface using XML Schema and XML examples; includes interaction diagrams showing example uses of the SOS; for submission to the Specification Program as a candidate RFC.
  - **Sensor Planning Service (SPS) IPR** (05-089r1) - describes the SPS interface using XML Schema and XML examples; includes interaction diagrams showing example uses of the SPS; for submission to the Specification Program as a candidate RFC.
  - Change proposal for URN ‘def’ (05-091r1) -. Extend OGC def URN scheme: a change proposal to 05-010.
  - Change proposal for URN ‘category.label’ (05-092) - Extend OGC category.label URN scheme: a change proposal to 04-013r4.

# SWE Information Model Layers



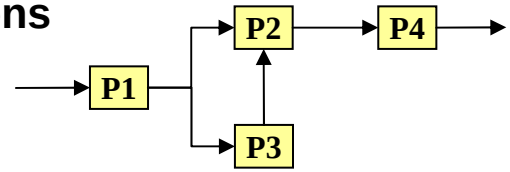
# Observation and Measurement (OGC 05-087)

- Observation → Act of estimating a value of a phenomenon, involving a procedure, instrument or algorithm
- Defines the information model for SWE
- Consistent with Measurement Theory
- Consistent with OGC GML and Feature Model

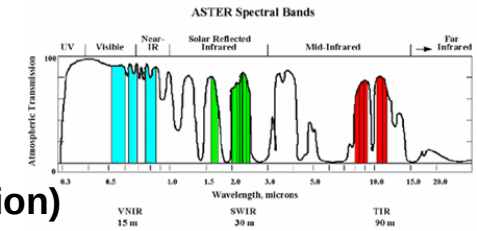


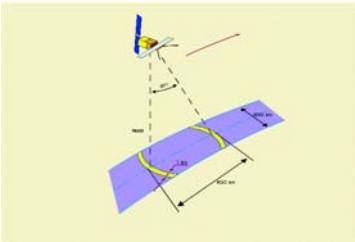
# Sensor Model Language (SensorML) (OGC 05-086)

- Process Model and Process Chains
  - **Framework for process models and chains as serializations of executable components.**
  - **All processes include inputs, outputs, and parameters**



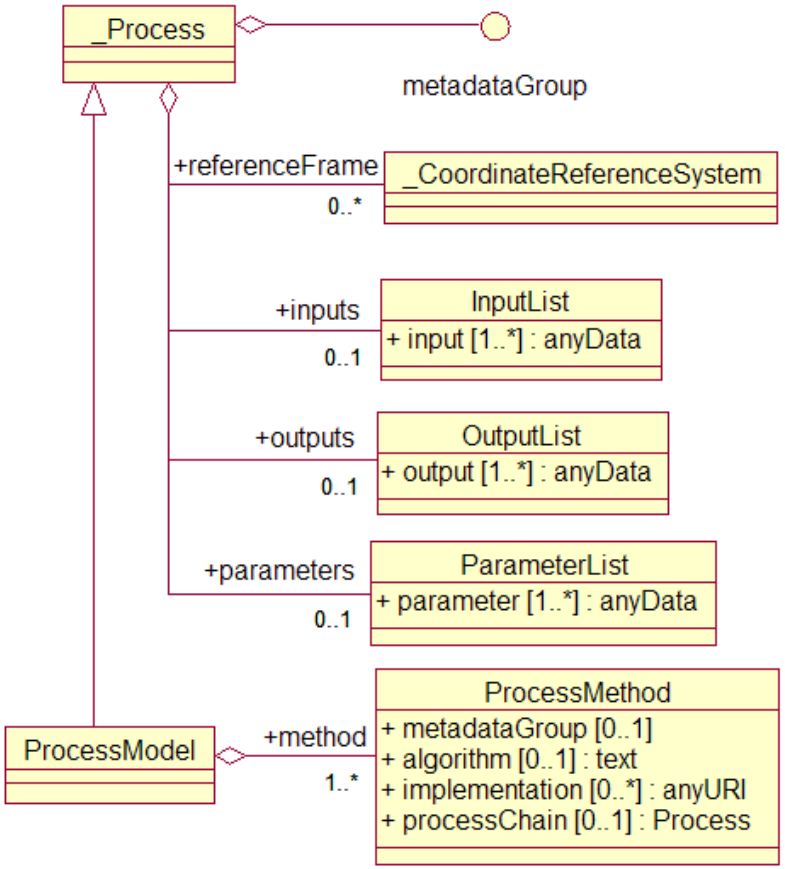

- System Description
  - **System provides connectivity of a process chain to the real-world by including position information.**
  - Geometry Characteristics
    - **Size, shape, spatial weight function (e.g. point spread function) of individual samples**
    - **Geometric and temporal characteristics of sample collections (e.g. scans or arrays)**
  - Documentation
    - **Overall information about the system**
    - **History and reference information**

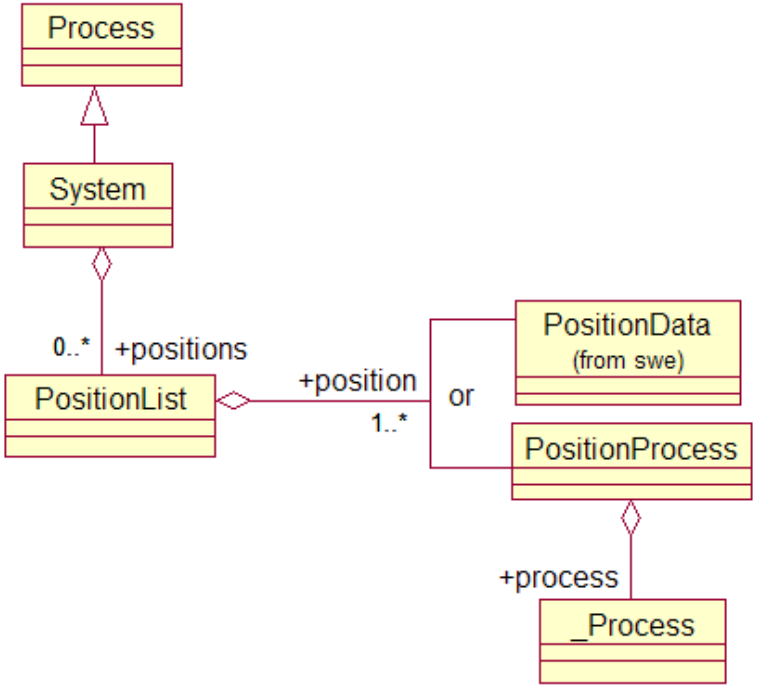


- Observation characteristics
  - **Physical properties measured (e.g. radiometry, temperature, concentration, position, etc.)**
  - **Quality characteristics (e.g. accuracy, precision)**
  - **Response characteristics (e.g. spectral curve, temporal response, etc.)**

# SensorML Process and System Models

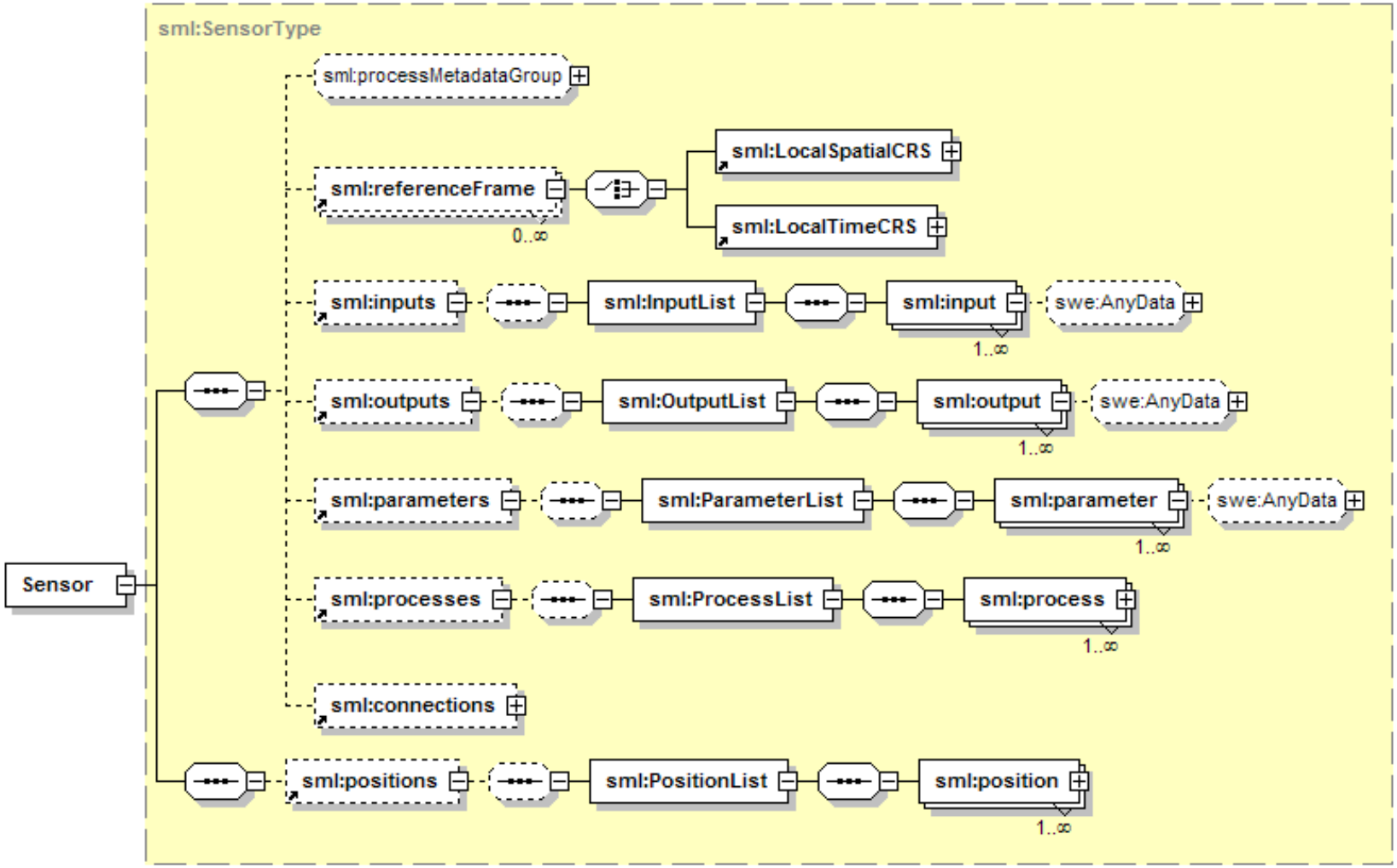



A *process* is a serialization of an executable component… describing the inputs, outputs, parameters and methods of linkable chains of processing steps.

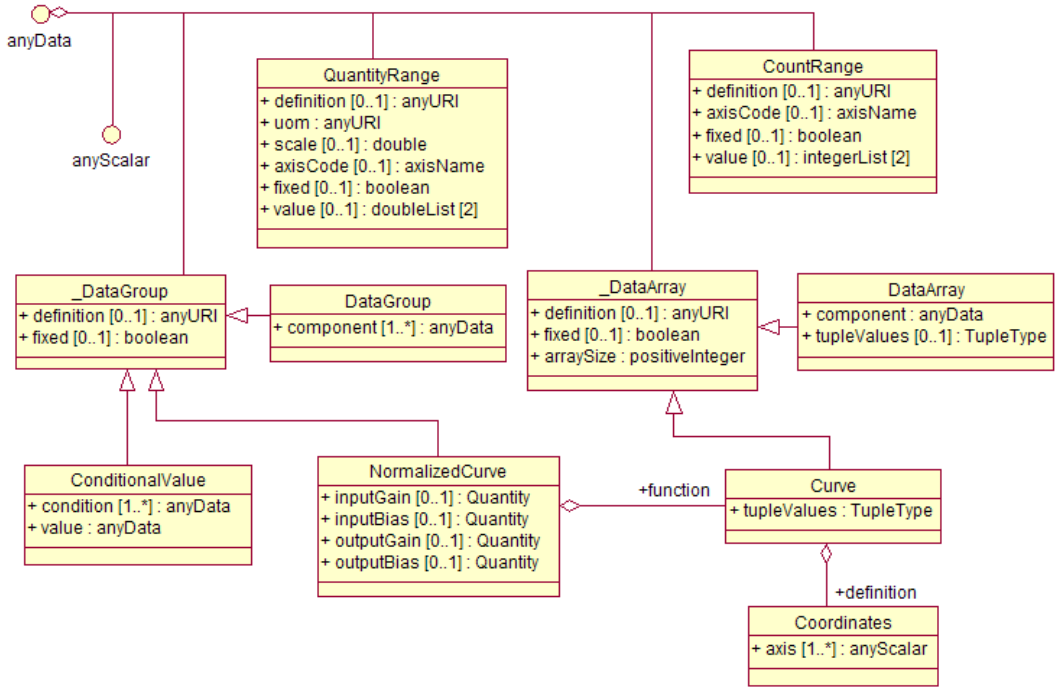
*System* derives from process and connects a process chain to the real-world through position

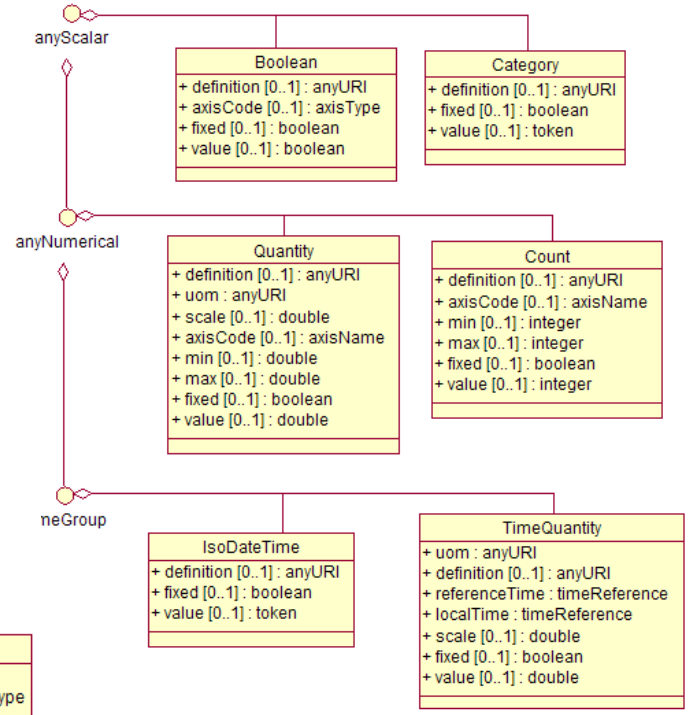
# sml:Sensor Modeled as a Process



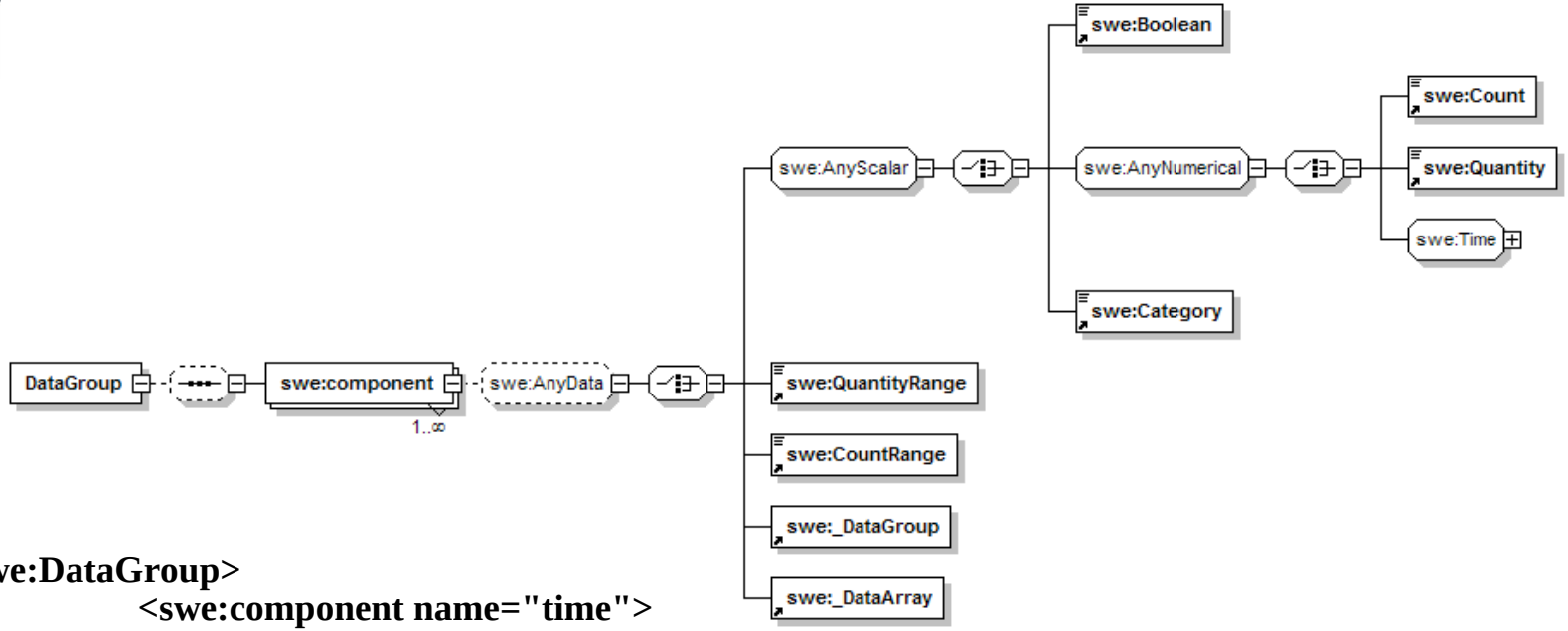
# SWE Common Data Elements

- Data Component Description
- Data Encoding Description
- Encoded Data Values



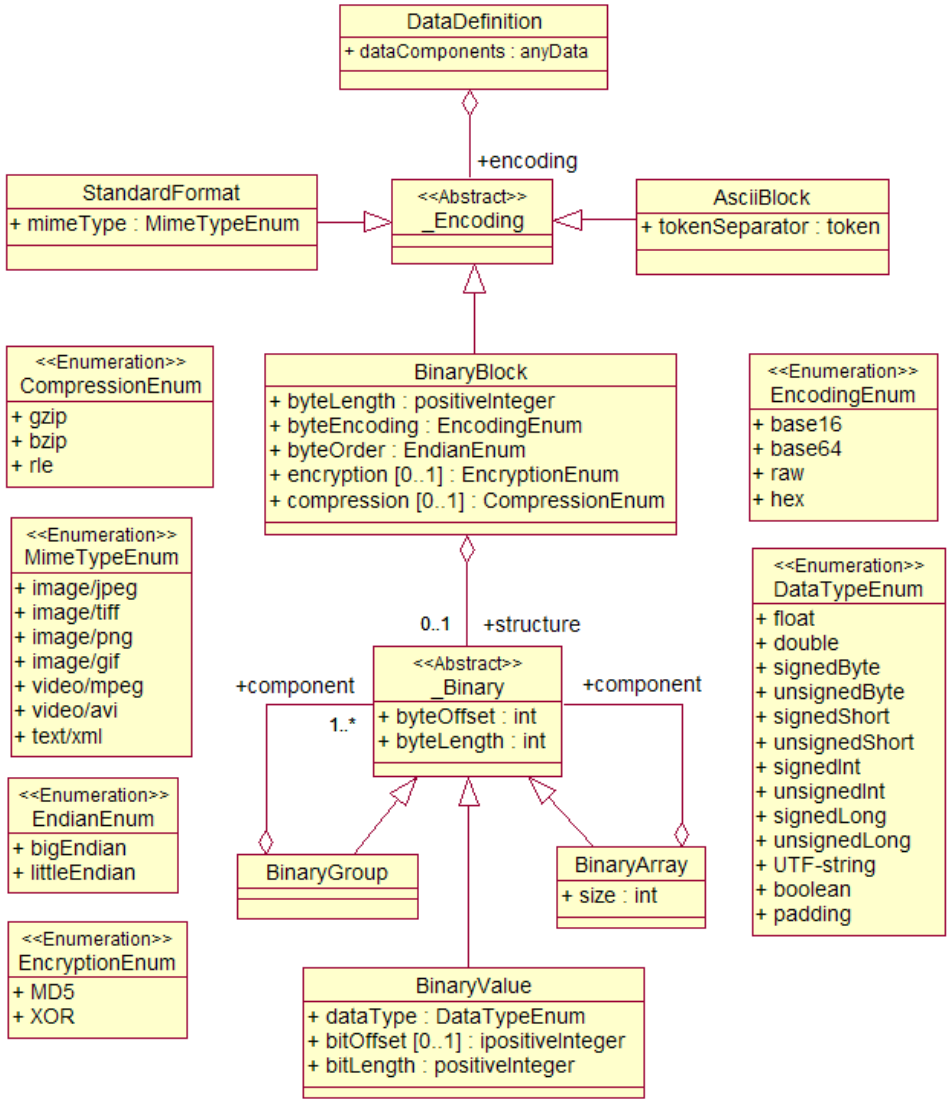



# Data Description with swe:DataGroup




```
<swe:DataGroup>
        <swe:component name="time">
                <swe:Time definition="urn:ogc:def:phenomenon:ogc:1.0.3:time“
referenceTime="1970-01-01T00:00:00Z" uom="urn:ogc:unit:second"/>
        </swe:component>
        <swe:component name="latitude">
                <swe:Quantity definition="urn:ogc:def:phenomenon:ogc:1.0.3:angle”
uom="urn:ogc:def:unit:ogc:1.0:degree"/>
        </swe:component>
        <swe:component name="longitude">
                <swe:Quantity definition="urn:ogc:def:phenomenon:ogc:1.0.3:angle“
uom="urn:ogc:def:unit:ogc:1.0:degree"/>
        </swe:component>
        <swe:component name="altitude">
                <swe:Quantity definition="urn:ogc:def:phenomenon:ogc:1.0.3:distance“
uom="urn:ogc:def:unit:ogc:1.0:foot"/>
        </swe:component>
        …
```

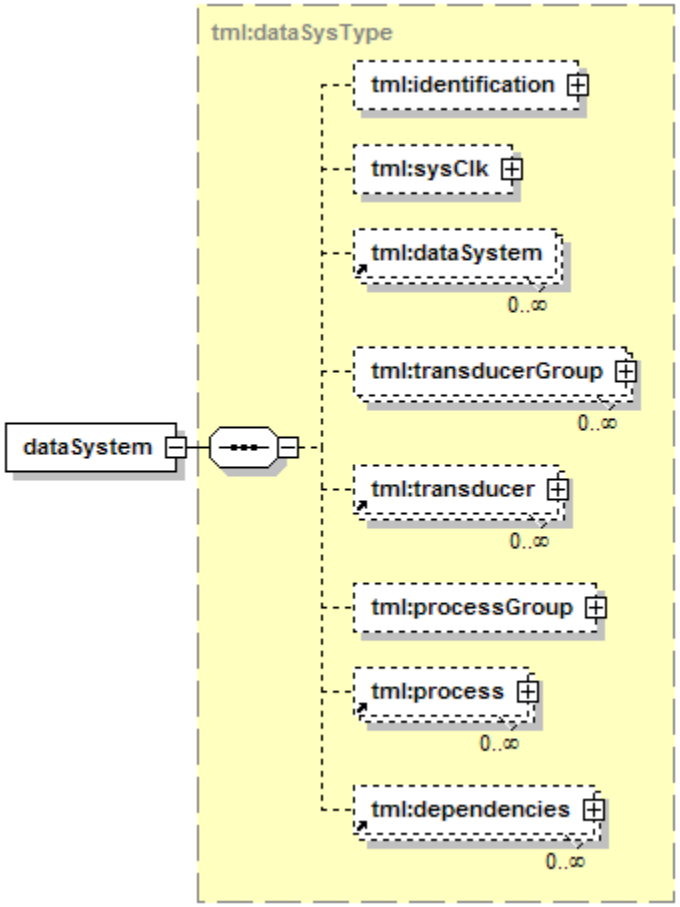
# SWE Common Data Encoding Types

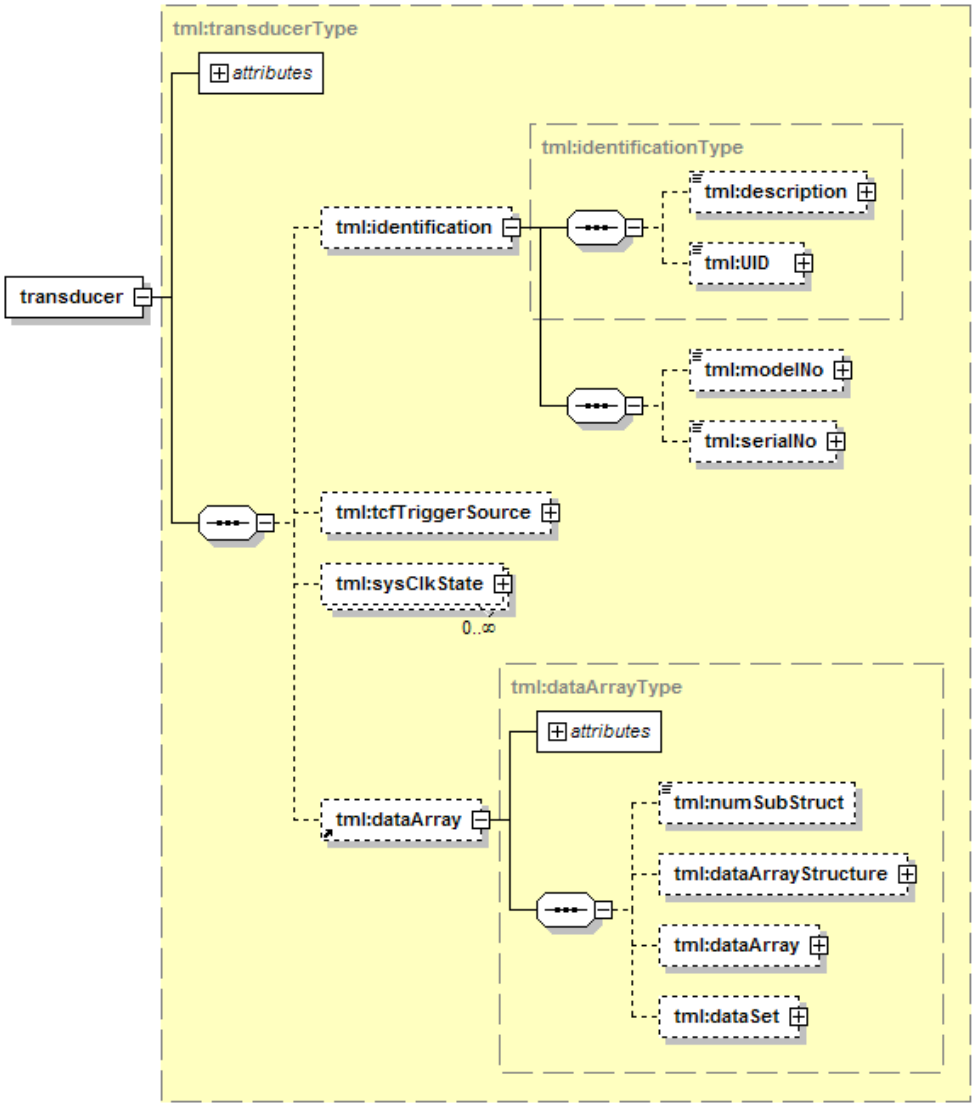


# TransducerML (TML) Components (OGC 05-085)

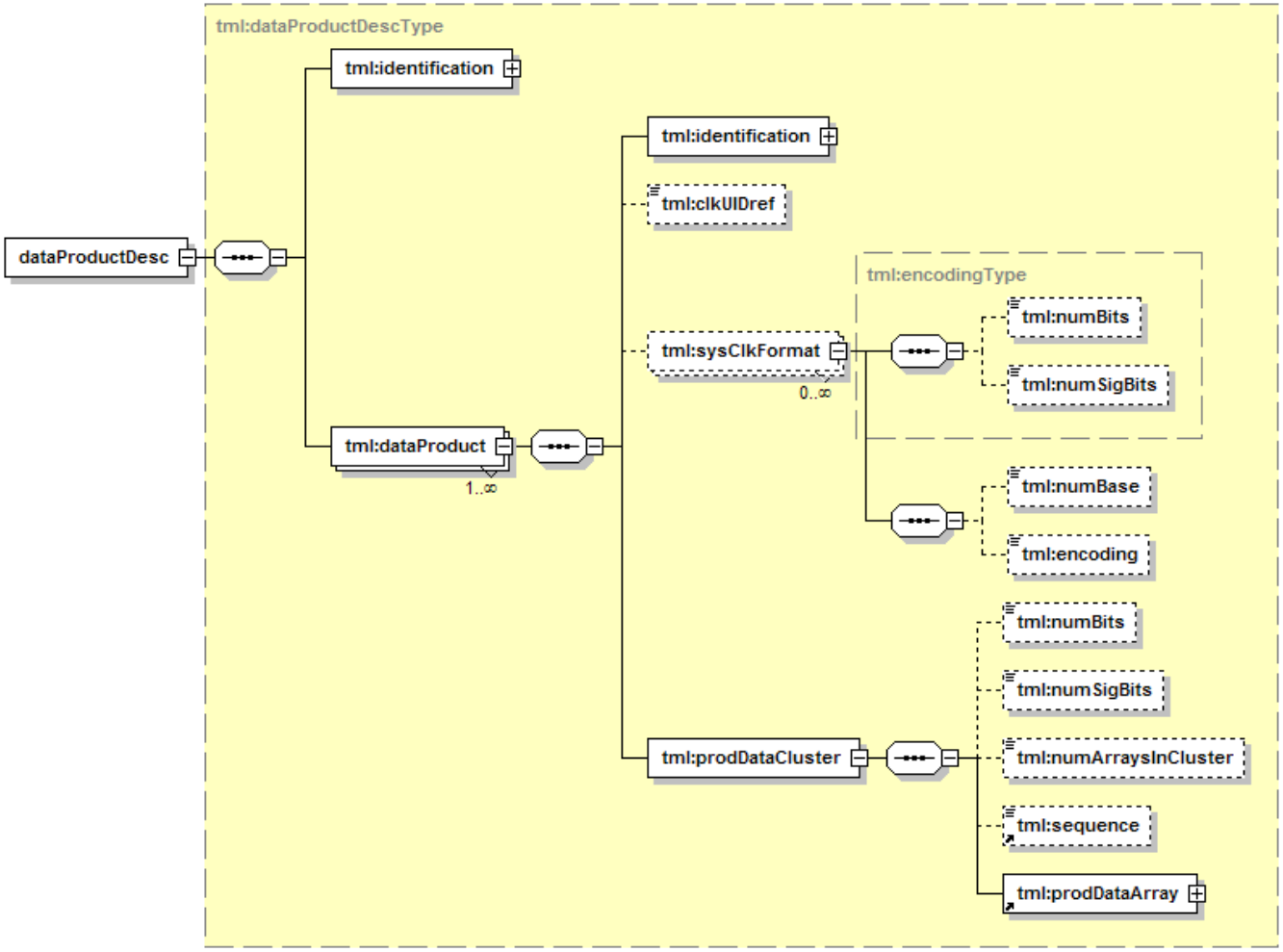
- Physical System Description
  - Physical properties of transducer system
  - Relates data to physical features (matter or energy)
- Data System Description
  - common system clock
  - data structure, encoding and transport info
  - response and geometric characteristics
  - time, space and value of transducer data (what, when and where)
  - pre- and post-processing of data
  - external relationships of transducers and processes within a system
- Data Product Description
  - Describes how to parse, sequence and decode the data cluster sent
- Data Stream

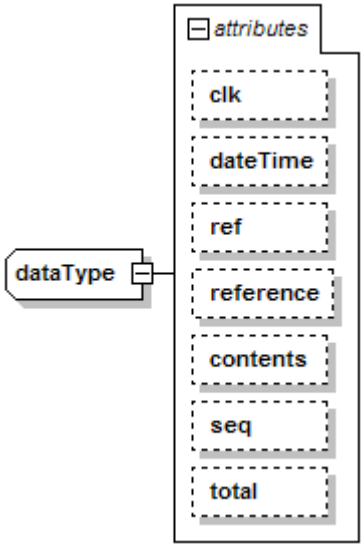
# TML Data System and Transducer



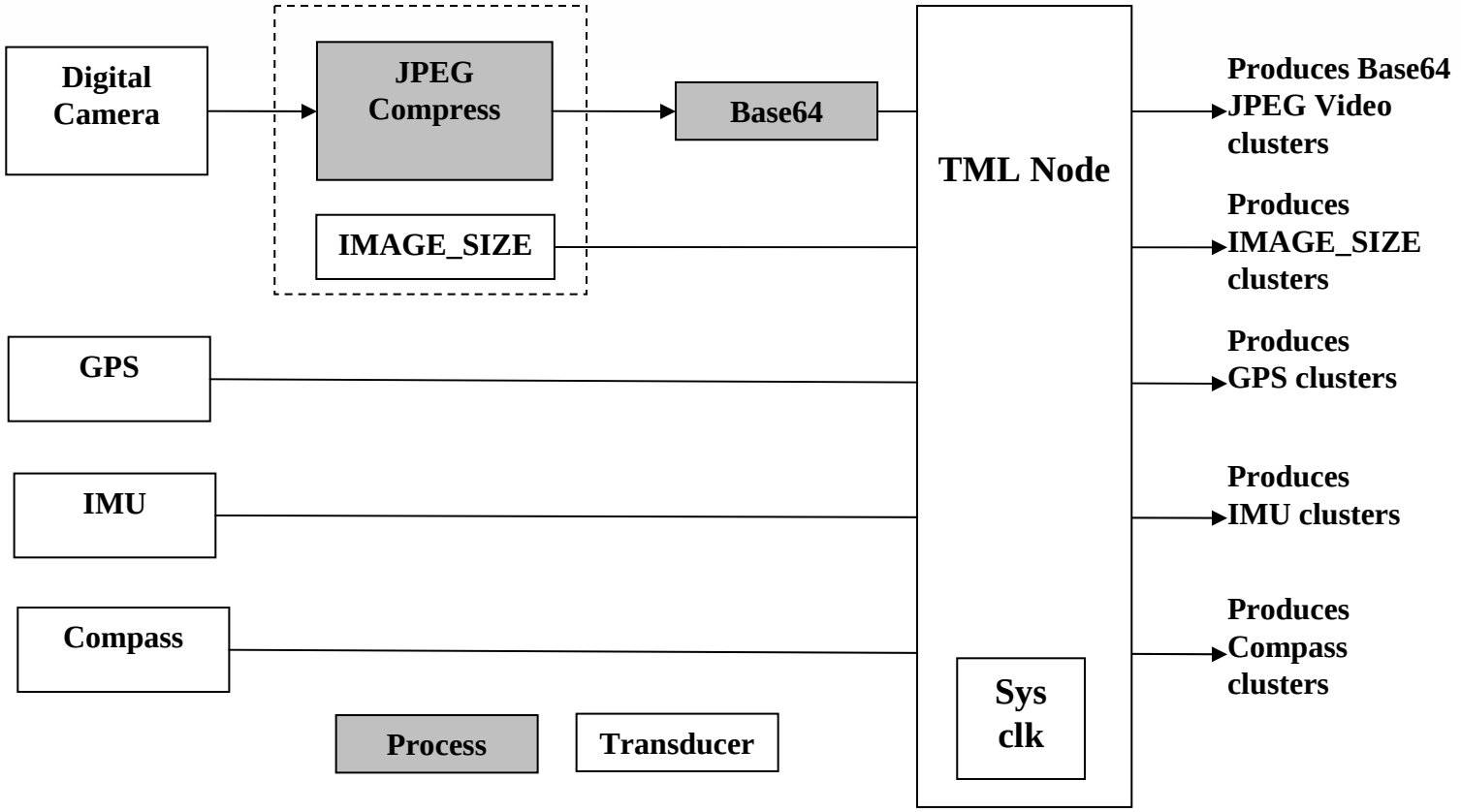



# TML Data Product Description and Data



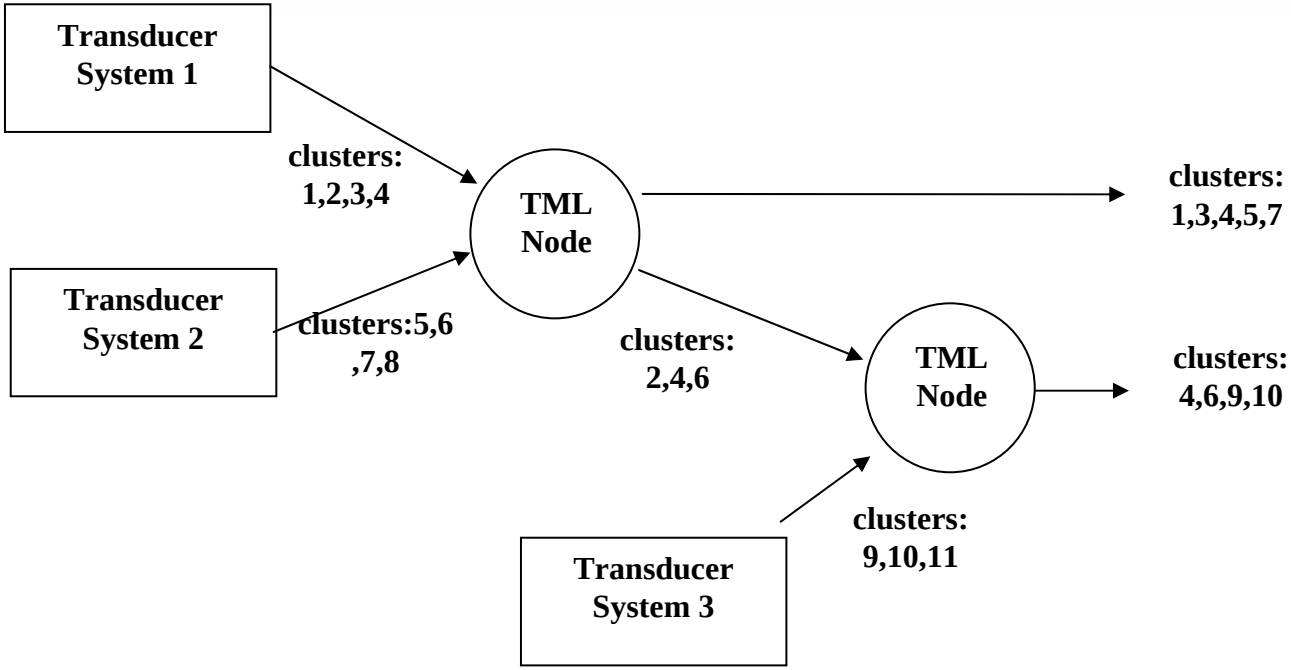



# An Example TML System and Data Stream




<data clk='28118774' ref='IMU'>22.8,1.1,3.4</data> <!—IMU: true heading, pitch roll-->
<data clk='28118792' ref='COMPASS'>21.1</data> <!—COMPASS: mag heading-->
<data clk='28118795' ref='GPS'>516866,-4702126,4264297.2005-08-26T16:31:49Z</data>
<!--GPS: X, Y, Z, Time-->
<data clk='28118800' ref='IMAGE_SIZE'>49094</data>
<data clk='28118800' ref='CAM'>...base64 JPEG video...</data>
<data clk='28118874' ref='IMU'>23.9,2.7,-1.1</data> …

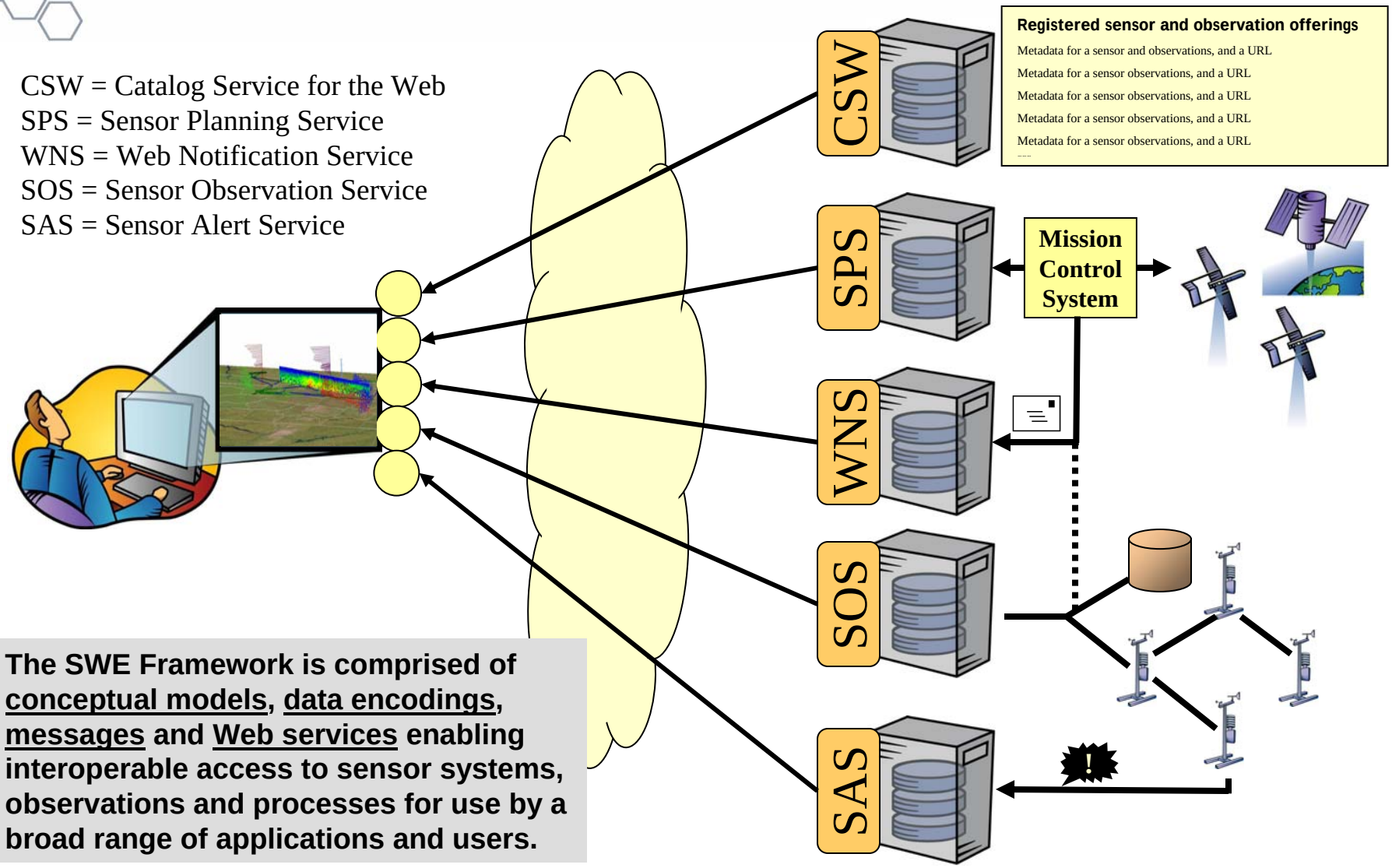
# Processing TML Data Clusters




Data are time-tagged to enable sequencing of multi-channel and asynchronous samples and interpolation between updates.

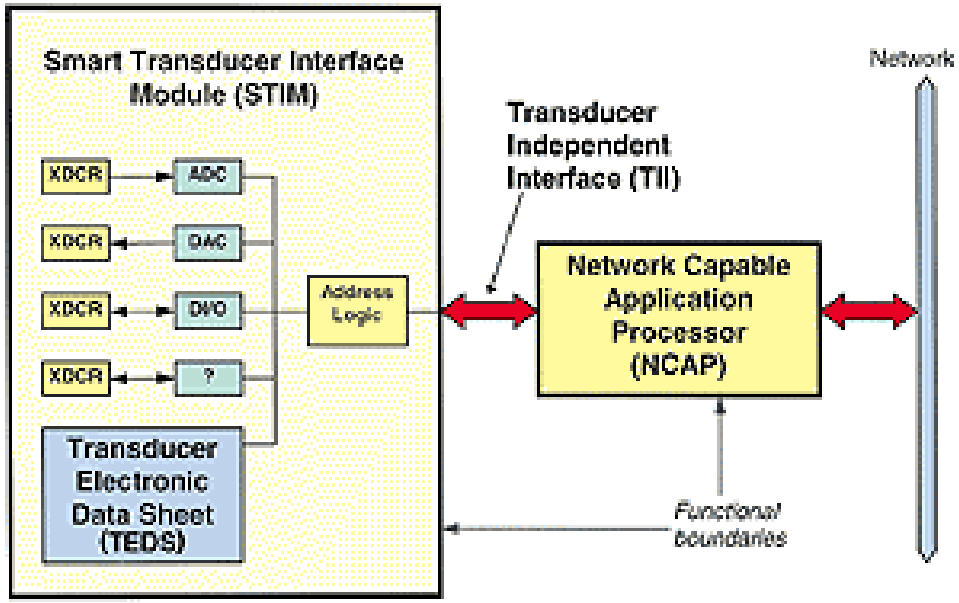
# SWE Service Model

CSW = Catalog Service for the Web
SPS = Sensor Planning Service
WNS = Web Notification Service
SOS = Sensor Observation Service
SAS = Sensor Alert Service



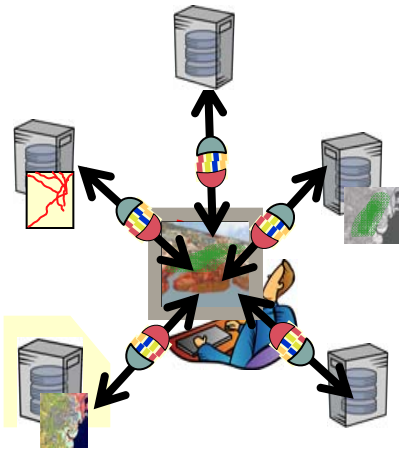

**The SWE Framework is comprised of <u>conceptual models</u>, <u>data encodings</u>, <u>messages</u> and <u>Web services</u> enabling interoperable access to sensor systems, observations and processes for use by a broad range of applications and users.**

# IEEE 1451 – OGC - OASIS Stack




**OGC Sensor Web Enablement Standards**

**OASIS Common Alert Protocol**



**Decision Maker/ Analyst**