Review Of Existing Ontologies

The usual auto captured minutes are at
http://www.w3.org/2009/07/01-ssn-minutes.html

Quick mark up of my notes from the meeting. The list of ontologies is at

http://www.w3.org/2005/Incubator/ssn/wiki/SSN_Key_Ontologies_Reference_List

Most of this is probably covered by

http://www.w3.org/2005/Incubator/ssn/wiki/SSN_Ontologies_Attributes

but some of it not. Between the irc notes, the presenters notes and this, we should have most of it

CSIRO Ontology

Presenter : Michael

For describing and reasoning about sensors, observations and scientific models, and use in semantic workflows. Not yet complete but being actively worked on.

The ability to do composition is an important feature (I don't think present in other models, MMI excepted). Also, doesn't provide a hierarchy of sensors, but should be able to auto classify into this, given definitions of the hierarchy in terms of the capabilities.

OntoSensor

Presenter : Danh

Created as a knowledge base for sensors, not currently active, can't load in protege.

(Michael : it can be loaded in Protege 3.3.1, but have to manual resolve sumo, not sure how well this works)

Focussed mainly on crossbow sensors and attributes related to them. Agrees with Laurent: instances good, but there seems to be many properties, some of which are unrelated, makes it hard to use/extend.

SWAMO

Presenter : John

For autonomous agents, work in progress. Seems reasonably sophisticated, with a focus on sensors and processes. Compatible with SWE. Organised around everything being a component. Some things didn't seem to be where expected. Need to contact developers to check current status.

MCRLab SUMO

Presenter : Raul

For heterogeneous sensor networks. Not sure if actively maintained. Difficult to tell about this one, because there isn't enough in the papers and ontology not available.

(Michael : I have written to the authors)

WISNO

Presenter : Oscar

From a poster/demo, has written to authors for ontology. Not to consider - not enough detail etc.

SensorML Process

Presenter : Luis

Developed to encode the process part of SensorML into OWL. Not actively maintained. Shouldn't be considered.

MMI Device

Presenter : Luis

Originally for oceanographic sensors, but also more broadly applicable. See use cases

http://marinemetadata.org/community/teams/ontdevices/usecases

Actively developed - MMI meeting every 2 weeks. Organised around System/Process. Has hierarchy, properties and restrictions. Can be used as a basis.

OOSTethys

Presenter : Luis

For SWE observation model. Not finished, actively worked on. (Note: diagram is not current). Focusses making observations. Observation and the hierarchy of systems worth considering.

A3ME

Presenter : Arthur

For description and discovery in heterogeneous sensor networks. Simple, but stable and complete (is a hierarchy of concepts). Could build a more sophisticated version from this.

CESN

Presenter : Holger

Part of CESN reasoner project - a paper on this has been discussed on the mailing list (I think that's : John G., 21/5/2009, 'another relevant bit of ontology'). Paper indicates ontology is work in progress

Sensor is treated as a black box. The rules and use are probably interesting, but out of scope.

(John and Oscar : sensor measuring only one property probably indicates that sensor = transducer in this case)

Stimulus-Centric

Presenter : Krzysztof

Haskell (not OWL), bridge between SensorML and O&M. About observing and observations, not sensors so much. Actively worked on.

Should allow a very rich semantics because it's Haskell, not limited to OWL. Could be used (or an OWL version used) for an ontology of observations, that works with an ontology of sensors.

General Discussion

what's hard/easy to add incorporate?

Michael : Given an existing ontology...

Individual concepts are probably pretty easy to add in most cases (provided there isn't a clash with some existing part of the ontology). In many cases it is a matter of finding the right name and place in the hierarchy.

Structural issues are probably going to be harder to work out. For example, if the way composition works in two different ontologies is different enough then it's harder to reconcile them.

Composition is a pretty big structural issue (i.e. at what point does it occur), other things include, observations, time, sensors as stimulus as per Krzysztof's talk.

Observations

krp : need to make sure that data can be traced to sensors and use data too.

Michael : Data/Observations and Sensors are fairly tightly coupled and so should probably both be first class objects. i.e. you can view it from a data or a sensor perspective.

Luis : yes, see Sonet. Also SWE common, which serves as the common elements repeated through a number of SWE standards.

Danh : we have an ontology from SensorML observation model, can talk about the kind of sensors that can provide particular types of data.

Cory : us too, didn't mention cause not sure of scope of discussion.

Members with an observations model

- Cory
- Danh
- Krystoff

Michael : I have the references that Laurent mentioned in his email, and have written to some of the authors for access to their ontologies.

Kerry : Has reviewed liu2005 - wanted to provide summary, but the meeting technology didn't seem to be working for her (Kerry to put review on wiki).

Outcome

John : What direction do we take now. One is to start working with the CSIRO ontology and work with the others to include the relevant concepts.

Krzysztof : Start working on the sensor ontology, but keep the observation part in mind.

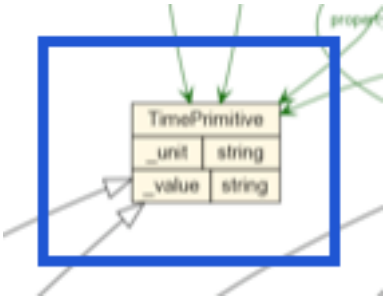
John : So start with CSIRO ontology and build content from others into that. Keep track of conflicts and structural issues.

Analysis of Ontologies
(vs. CSIRO ontology)

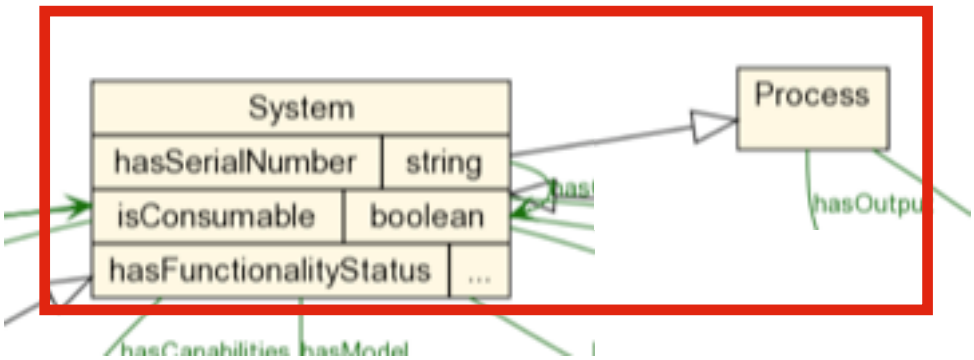
Since we are starting with the CSIRO ontology, and I'm very familiar with it, I went though the most relevant ontologies that were discussed at the meeting (just the pictures, though for some the ontologies as well) and indicated bits that I think are missing from the CSIRO ontology (not including domain concepts) and also places where there might be conflicts if we attempt to merge.

I've probably missed things, got things wrong etc, so please feel free to disagree, say that something's not important etc. I'm not 100% familiar with some of these, so I may also have missed 'the point' in a few cases.

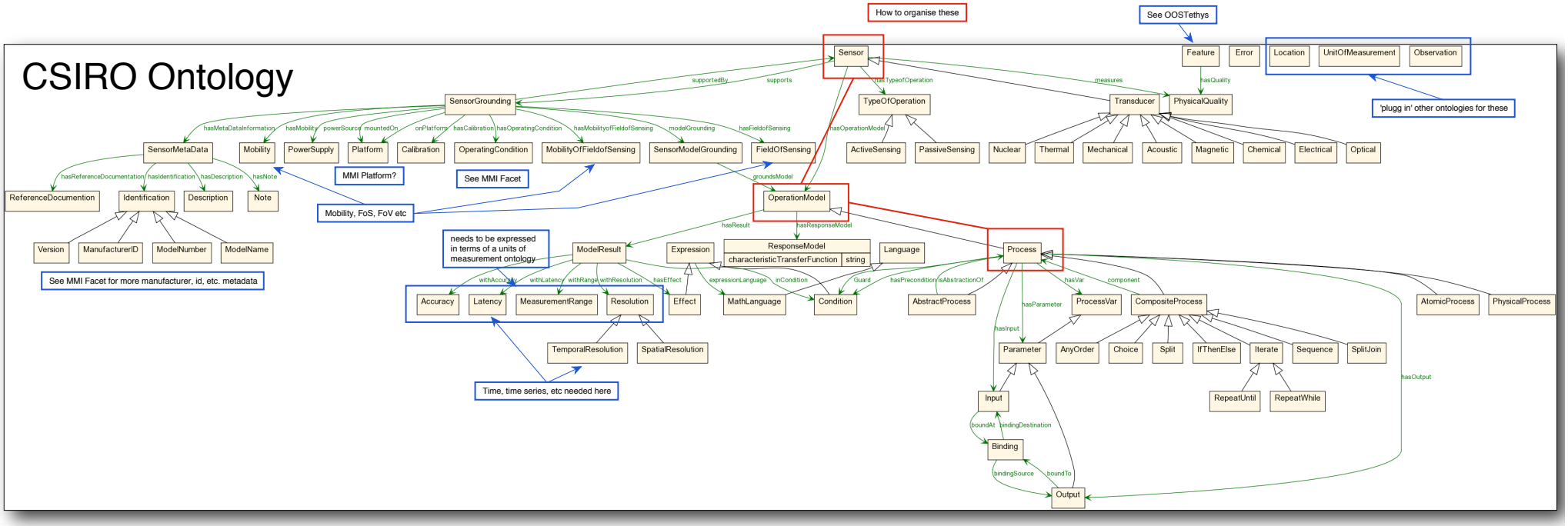
I'm not suggesting that all these things need to be merged into the ontology, that they are relevant, or expressed the right way. I'm just trying to indicate differences - I guess the key problem after this is to work out what to do with these, and what else is missing / not quite right.



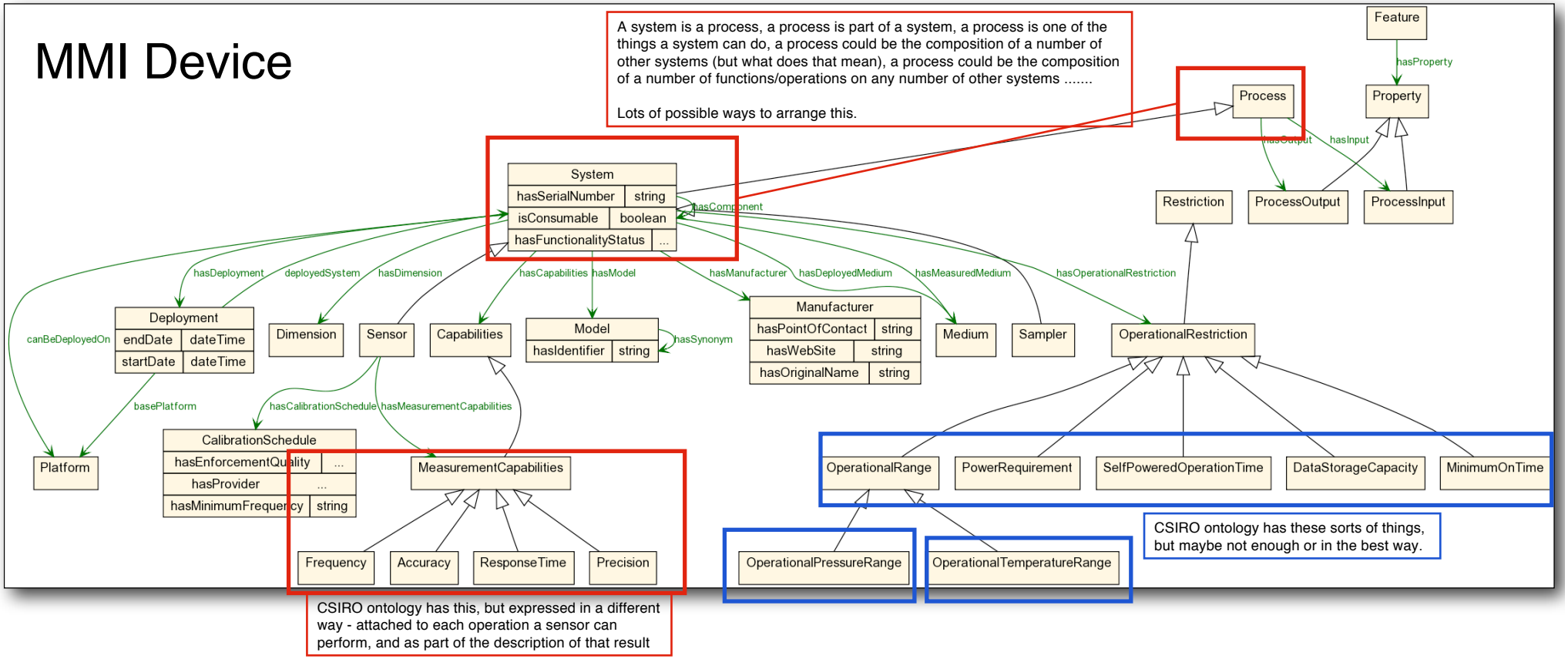
Indicates a concept in this ontology, but not CSIRO ontology



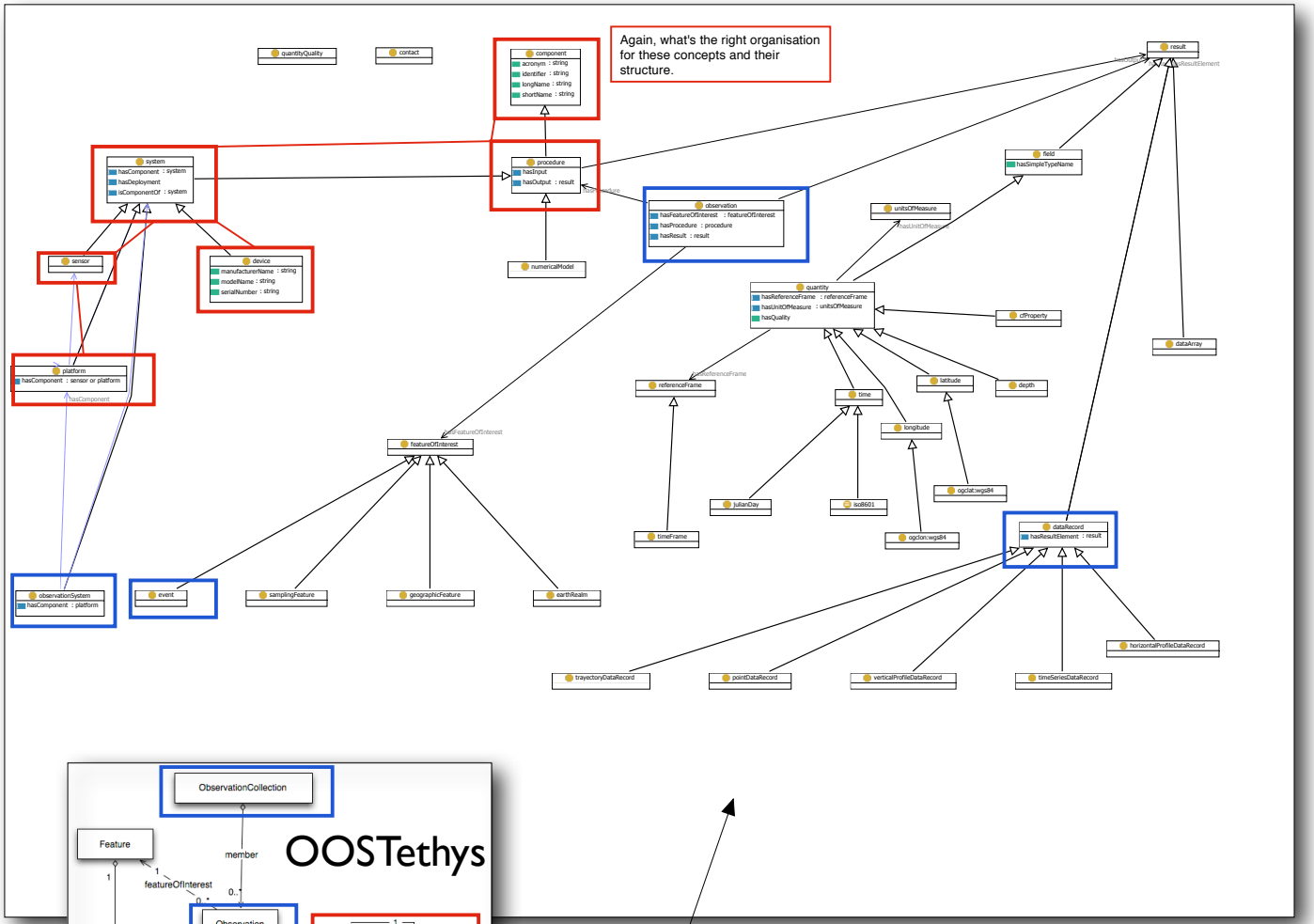
Indicates a concept or structure for which there might be a conflict in merging into the CSIRO ontology.

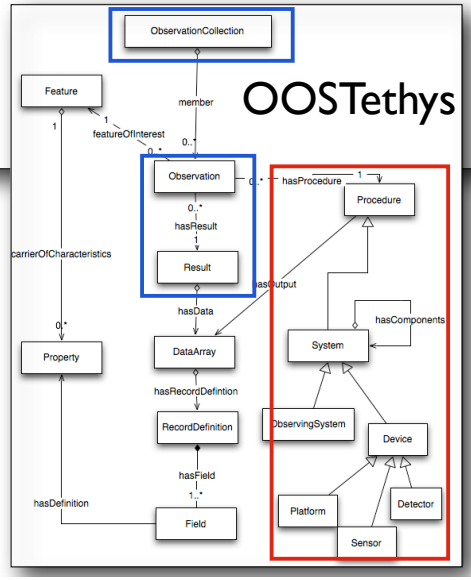

CSIRO Ontology
How to organise these
See OOSTethys
Sensor
Feature
Error
Location
UnitOfMeasurement
Observation
'plugg in' other ontologies for these
supportedBy
supports
hasTypeofOperation
measures
hasQuality
SensorGrounding
TypeOfOperation
Transducer
PhysicalQuality
hasMetaDataInformation
hasMobility
powerSource
mountedOn
onPlatform
hasCalibration
hasOperatingCondition
hasMobilityofFieldofSensing
modelGrounding
hasFieldofSensing
hasOperationModel
SensorMetaData
Mobility
PowerSupply
Platform
Calibration
OperatingCondition
MobilityOfFieldofSensing
SensorModelGrounding
FieldOfSensing
ActiveSensing
PassiveSensing
Nuclear
Thermal
Mechanical
Acoustic
Magnetic
Chemical
Electrical
Optical
MMI Platform?
See MMI Facet
hasReferenceDocumentation
hasIdentification
hasDescription
hasNote
groundsModel
ReferenceDocumention
Identification
Description
Note
Mobility, FoS, FoV etc
OperationModel
hasResult
hasResponseModel
needs to be expressed in terms of a units of measurement ontology
ModelResult
Expression
ResponseModel
characteristicTransferFunction
string
Language
Process
Version
ManufacturerID
ModelNumber
ModelName
See MMI Facet for more manufacturer, id, etc. metadata
withAccuracy
withLatency
withRange
withResolution
hasEffect
expressionLanguage
inCondition
Guard
hasPrecondition
isAbstractionOf
hasVar
component
Accuracy
Latency
MeasurementRange
Resolution
Effect
MathLanguage
Condition
AbstractProcess
hasParameter
ProcessVar
CompositeProcess
AtomicProcess
PhysicalProcess
hasInput
TemporalResolution
SpatialResolution
Parameter
AnyOrder
Choice
Split
IfThenElse
Iterate
Sequence
SplitJoin
hasOutput
Time, time series, etc needed here
Input
RepeatUntil
RepeatWhile
boundAt
bindingDestination
Binding
bindingSource
boundTo
Output

MMI Device


A system is a process, a process is part of a system, a process is one of the things a system can do, a process could be the composition of a number of other systems (but what does that mean), a process could be the composition of a number of functions/operations on any number of other systems .....
Lots of possible ways to arrange this.
Feature
hasProperty
Process
Property
hasOutput
hasInput
System
hasSerialNumber string
isConsumable boolean
hasFunctionalityStatus ...
hasComponent
Restriction
ProcessOutput
ProcessInput
hasDeployment
deployedSystem
hasDimension
hasCapabilities
hasModel
hasManufacturer
hasDeployedMedium
hasMeasuredMedium
hasOperationalRestriction
canBeDeployedOn
Deployment
endDate dateTime
startDate dateTime
Dimension
Sensor
Capabilities
Model
hasIdentifier string
hasSynonym
Manufacturer
hasPointOfContact string
hasWebSite string
hasOriginalName string
Medium
Sampler
OperationalRestriction
basePlatform
hasCalibrationSchedule
hasMeasurementCapabilities
Platform
CalibrationSchedule
hasEnforcementQuality ...
hasProvider ...
hasMinimumFrequency string
MeasurementCapabilities
OperationalRange
PowerRequirement
SelfPoweredOperationTime
DataStorageCapacity
MinimumOnTime
Frequency
Accuracy
ResponseTime
Precision
OperationalPressureRange
OperationalTemperatureRange
CSIRO ontology has these sorts of things, but maybe not enough or in the best way.
CSIRO ontology has this, but expressed in a different way - attached to each operation a sensor can perform, and as part of the description of that result

Again, what's the right organisation for these concepts and their structure.



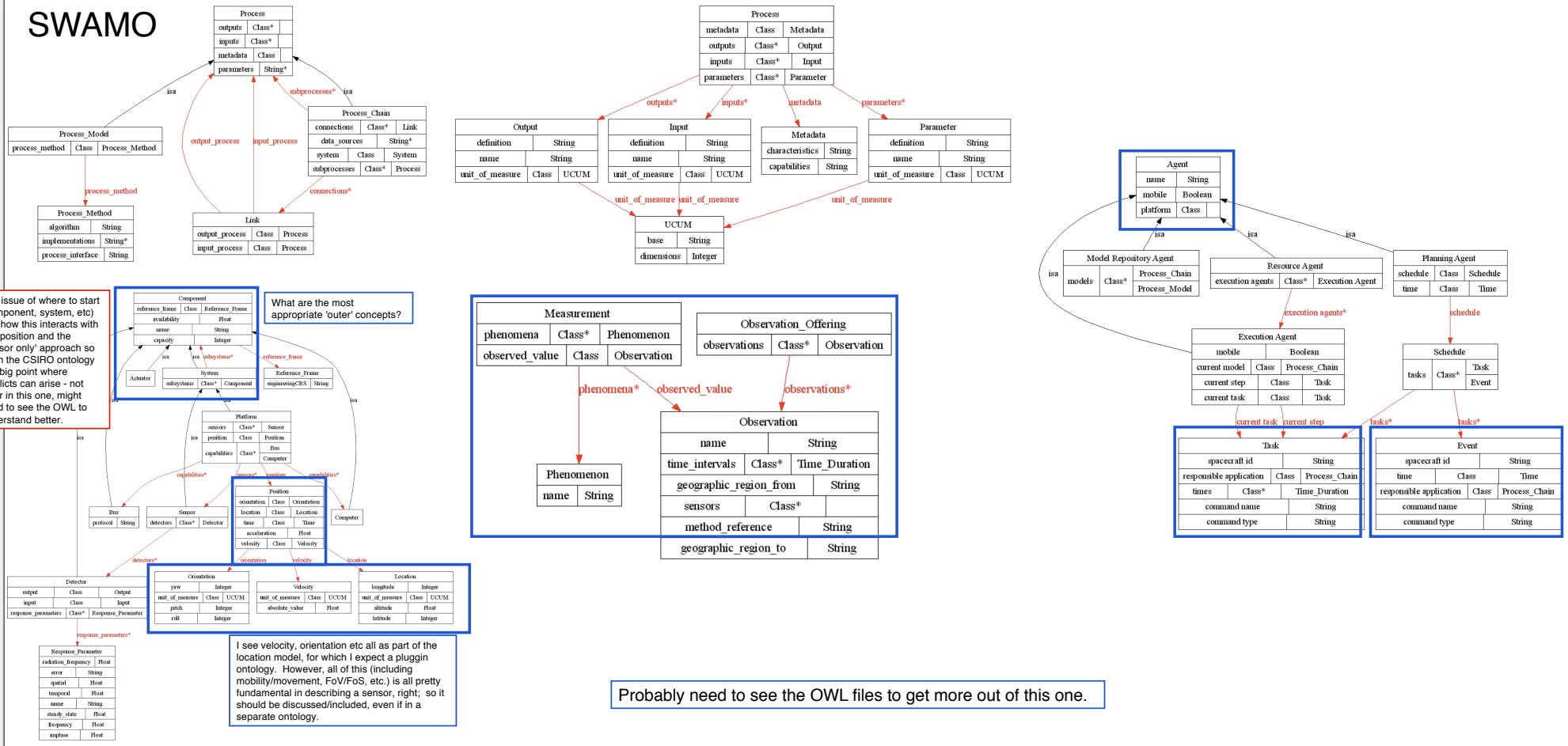


Not same as the ontology.

OOSTethys

Based on SWE common. All about systems composed of other systems

SWAMO

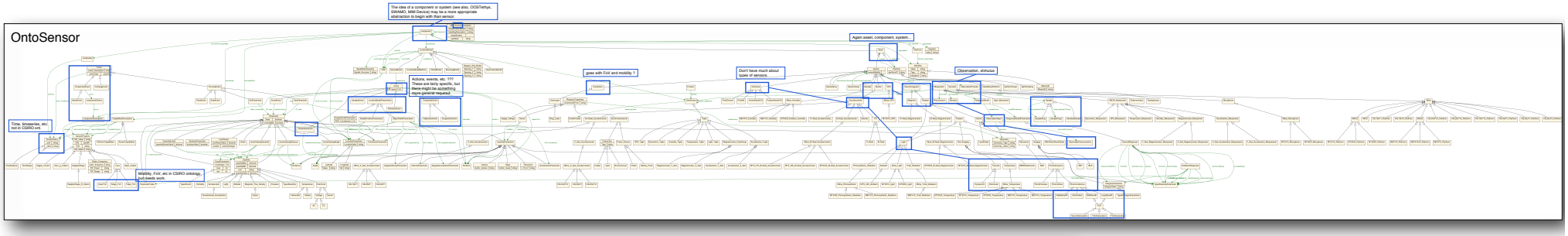


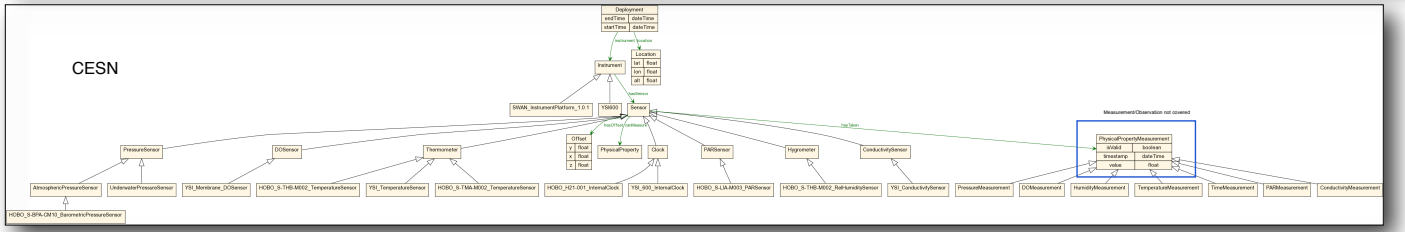
The issue of where to start (component, system, etc) and how this interacts with composition and the 'sensor only' approach so far in the CSIRO ontology is a big point where conflicts can arise - not clear in this one, might need to see the OWL to understand better.

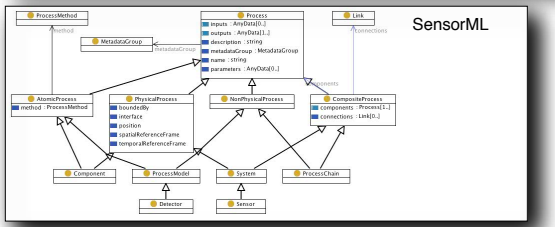
What are the most appropriate 'outer' concepts?

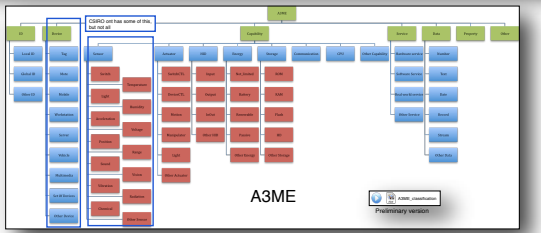
I see velocity, orientation etc all as part of the location model, for which I expect a pluggin ontology. However, all of this (including mobility/movement, FoV/FoS, etc.) is all pretty fundamental in describing a sensor, right; so it should be discussed/included, even if in a separate ontology.

Probably need to see the OWL files to get more out of this one.









(Haven't read this yet) No OWL ontology to grab things from. But the model and ideas seem interesting. As Krzysztof pointed out in his talk, it's more about observations and is in a more expressive language, but it could be a basis for an observation ontology.

HadarEvale

A Stimulus-Centric Algebraic Approach to Sensors and Observations

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Abstract. The understanding of complex environmental phenomena, such as deforestation and epidemics, requires observations at multiple scales. This scale dependency is not handled well by today's earlier technical sensor definitions. Governor networks are normally defined as a set of sensors and actuators connected to a computer system that is to monitor phenomena in geographic space. Such definitions also do not admit animals as sensors. Consequently, they exclude human sensors, such as the use of crowdsourcing platforms and citizen science, and fail to support connections between phenomena observed at multiple scales. We propose definitions of sensors as information sources at multiple aggregation levels and of observations as aggregations of sensor data. Formalizations also claim behavior as well as their aggregations and generalizations. It is intended as a basis for defining consistent application ontologies that can be used to reason about at multiple scales of observations and with different types of sensors.

1 Introduction

Sensor networks have become an important technology for observing physical phenomena. Their application scenarios include environmental and health monitoring, climate management, early warning systems, precision agriculture, as well as home security [1]. Currently, most research is focused on technical issues. This includes tools on hardware, operation systems, and signal processing [2], as well as on communication protocols, such as routing algorithms and communication costs [3]. In contrast, this paper investigates sensors from an ontological perspective.

The understanding of complex phenomena, such as deforestation and epidemics, requires environmental sensor networks [1] observing at multiple scales. This scale dependency is not handled well by today's earlier technical sensor definitions and therefore also in the derived models. For instance, to understand the impact of deforestation on the local biota, it is necessary to track the path of individuals. This requires a sensor that observes movements of individuals in terms of individuals sensed information about change in territory and foraging,

Marine Metadata Interoperability

Published on *Marine Metadata Interoperability* (http://marinemetadata.org)

Ordered Device Facets

The CSIRO ontology can do some of most of this, so here the blue generally means 'some, but not all'.

By *ngalbraith*
Created *01/20/2009 - 23:48*
A sketch of the facets that describe a device

While the ontology itself will not have the hierarchical structure of an outline, it may be useful to view the device facets this way; this is the facet list re-ordered into main categories. Members, please feel free to update this.

In fact, best to ignore my annotations here and simply take this list as a set of requirements to keep checking the XG's ontology against.

The symbols indicate status of inclusion into the ontology:

√√: included and stable
√: provisionally included
+: assigned for inclusion

1. Device Construction
   a. √ Original Manufacturer
      1. official original name of manufacturer
      2. current name/point of contact (i.e., latest company name) for that manufacturer
      3. current web site
   b. √ Model
   c. + Physical
      1. √ Dimensions
      2. Weight
      3. Buoyancy
      4. Materials
   d. Absolute physical limitations/restrictions
      1. Survival pressure range (depth/pressure limits)
      2. Survival temperature range
   e. Component mfgrs, models *(JBG: these fold into sub-device's properties)*

I think what we have is more operating range than survival range

2. Functionality: Parameters, measurements, atomic phenomena
   a. √ Measured medium (liquid, water, saline water, fresh water, air, solid) *(ref: OGC 'feature type')*
   b. Innate attribute measured (temperature, total dissolved salts, water current direction) *(ref: OGC 'phenomenon')*
   c. Measurement taken (temperature, conductivity, acoustic doppler return) *(ref: OGC 'measurement')*
   d. + Output provided: (temperature, salinity, water speed and direction) *(ref: OGC 'observation result')*
   e. + Measurement technique *note: reference OntoSensor for more*
      1. Gross method: sensing or sampling
      2. Engagement: active or passive
      3. Sensing method: In-situ by contact, in-situ at distance or remote
      4. Detailed measurement process:
         1. Process: different processes can be used to obtain measurements; for example, temperature can be measured by contact sensing or by remote infrared sensing
         2. Sample scheme: Does the device take a spot sample (i.e. last, first, or center?), or burst sample, or continuous measurements? Does it do an average, boxcar, running mean on these measurements? Does it control sampling with its own clock (type of clock: a counter, or a "real" clock)?
3. Operational restrictions, capabilities, processes
   a. Usage
      1. √ Deployed Medium (where device must be to perform: liquid, water, air)
      2. √ Deployed Platform (on what can the device be deployed)
   b. Interfaces

1. mounting options (how can I mount it on my platform)
2. master input/output interface(s) (how can I communicate with it?)
    1. connector attributes
        1. form factor
        2. pin out (wiring)
        3. protocol
        4. communication throughput capacity
    2. Control: commands available
        1. during setup
        2. during operation
        3. during shutdown/offline
3. slave Input/output/physical interfaces (what else can I attach to it, and how)
    1. mechanical form factor (bolt holes, etc.)
    2. connector attributes
        1. form factor
        2. pin out (wiring)
        3. protocol
        4. communication throughput capacity

c. + Operational Restrictions
    1. √ Operational pressure range (depth/pressure limits)
    2. √ Operational temperature range
    3. √ Power requirements
    4. √ Data storage capacity
    5. √ Available self-powered operation time
    6. √ Minimum on-time (before sampling)
    7. Water or wave tolerance, RF tolerance, other interference problems

d. √ Measurement Capabilities *(may vary between sensor components and device)*
    1. √ Measurement frequency
    2. √ Accuracy
    3. √ Precision
    4. √ Response time

e. + Data processing requirements
    1. Processing: highest data level produced (NASA level 0, 1, 2, 3) *(note: per parameter? JBG)*
    2. Processing software required to access data (none, existing public software, existing public algorithm, proprietary)
    3. Quality control procedures defined/available

4. + Physical Processing
    a. Quality assurance procedures
    b. Calibration procedures
    c. Required/suggested calibration schedule
    d. Handling requirements
    e. Maintenance procedures
5. Logistics
    a. Availability status
        1. currently manufactured
        2. currently sold (retail, used)
            1. cost range
    b. √ Is itself consumable
    c. √ Has consumable components
6. Manufacturer Documentation
    a. Manual(s) location
        1. Users, Programmers, Installation, Operation, Software
7. Instance
    a. Identification
        1. √ Serial Number
        2. Unique Identifier
        3. Owner
        4. Point of Contact
        5. Date/location of manufacture
        6. Firmware version
        7. Software version
    b. Transaction
        1. Purchase metadata (date, location, reference materials, price, purchaser)
        2. Shipment metadata
    c. Operational availability
        1. Available in-house?
        2. √ Functionality status (unknown, operational, verified, calibrated, broken)
        3. Current deployment status
    d. History
        1. Current Location

Some of this seems more about assets and purchases than sensors

History seems important for reasoning - i.e when reasoning about data, where has a sensor been, etc

http://marinemetadata.org/community/teams/ontdevices/facetoutline