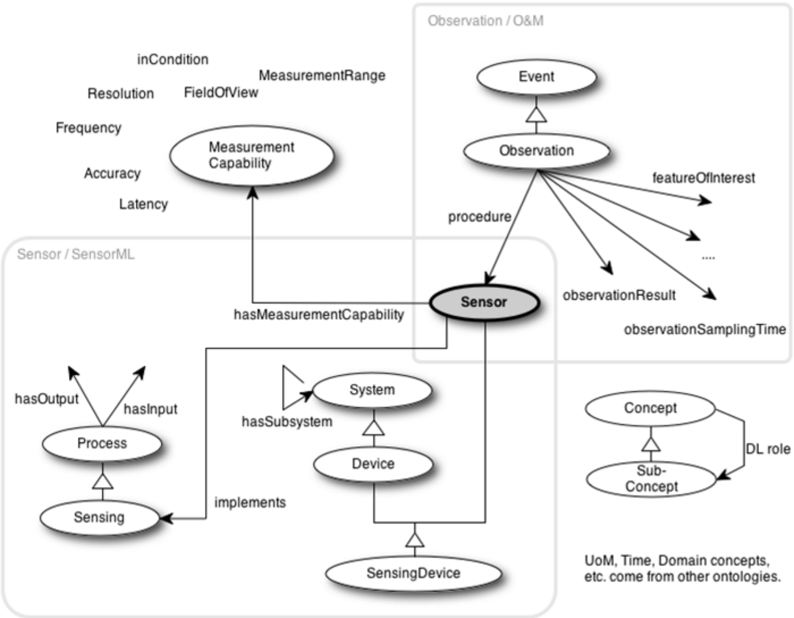
Ontology Summit 2015: Internet of Things: Toward Smart Networked Systems and Societies

Semantic Sensor Network Ontology:

Past, Present, and Future



Cory Henson

Sr. Research Scientist
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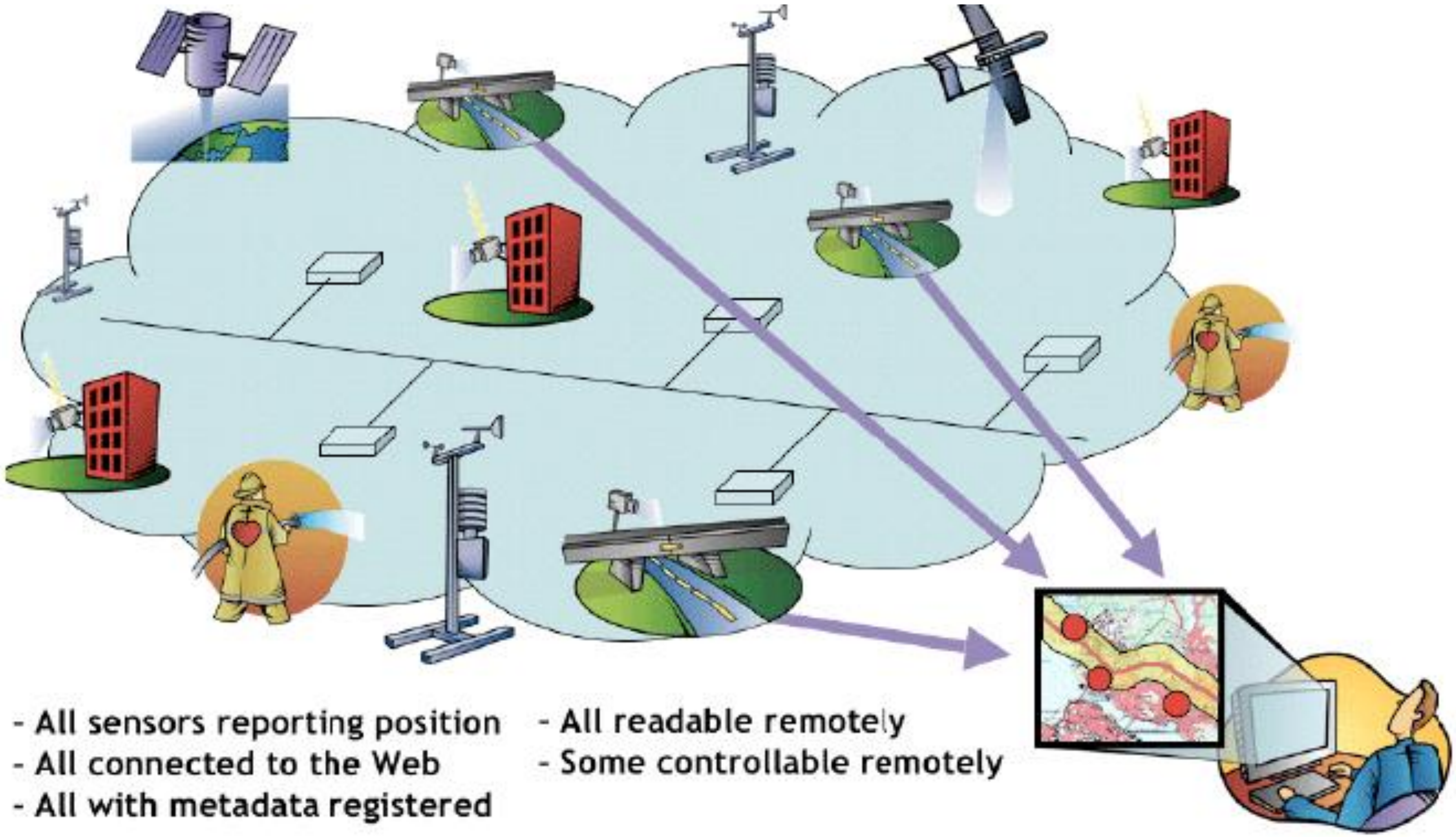
Sensor Web



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Sensor systems are too often stove-piped

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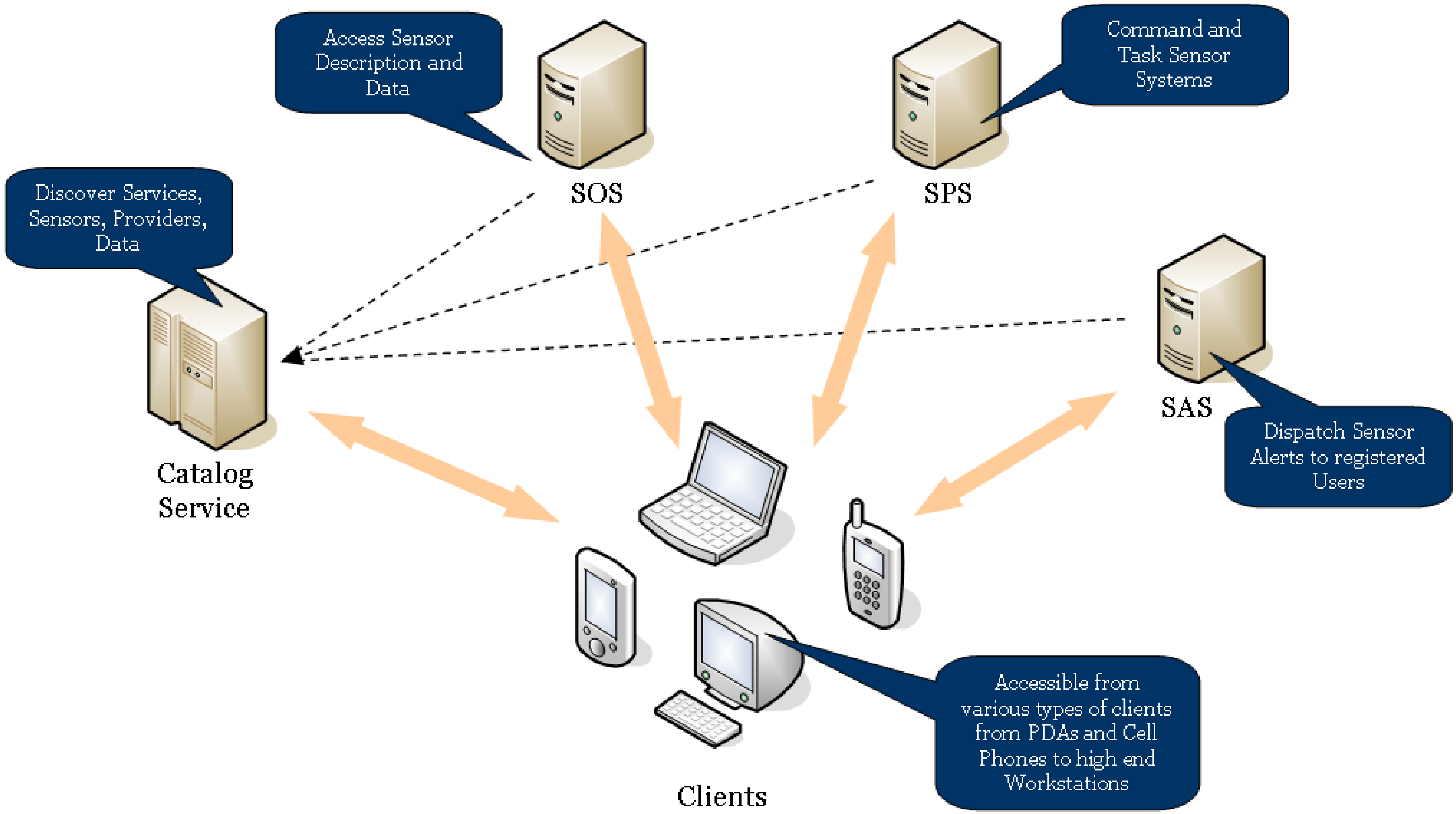
We want to set this data free

With freedom comes responsibility

1. discovery, access, and search
2. integration and interpretation

OGC Sensor Web Enablement (SWE)



We want to set this data free

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1. ~~discovery, access, and search~~
2. integration and interpretation

How are machines to integrate and interpret data?

Semantic Web

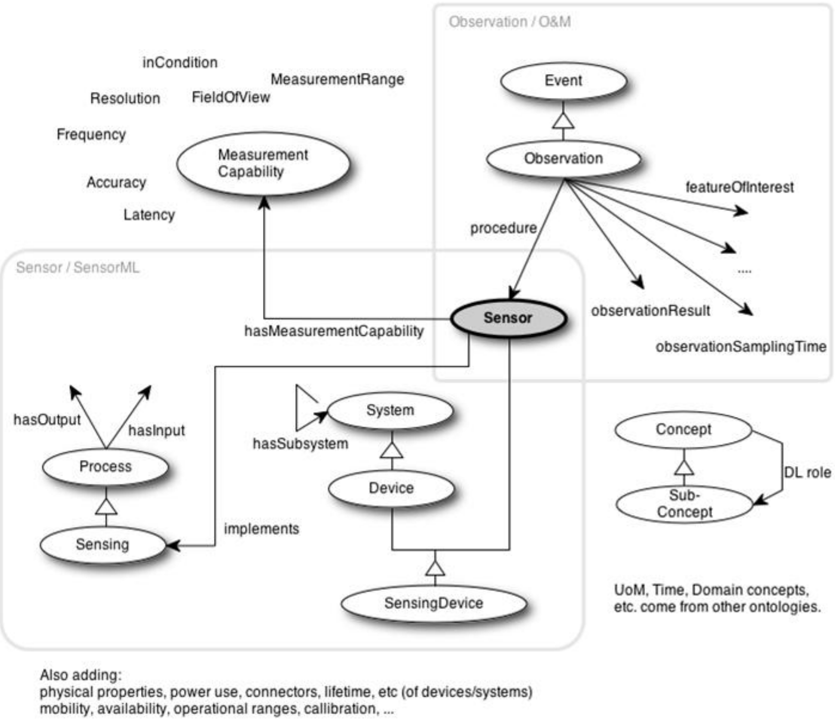
RDF

OWL

W3C

Semantic Sensor Networks (SSN)

Semantic Sensor Network Ontology



- OWL 2 DL ontology
- Developed by W3C SSN-XG (2011)
- Driven by Use Cases
- To be standardized by OGC/W3C Spatial Data on the Web WG (~2016)
  http://www.w3.org/2015/spatial/

SSN Report: http://www.w3.org/2005/Incubator/ssn/XGR-ssn-20110628/
SSN *Ontology:* http://purl.oclc.org/NET/ssnx/ssn

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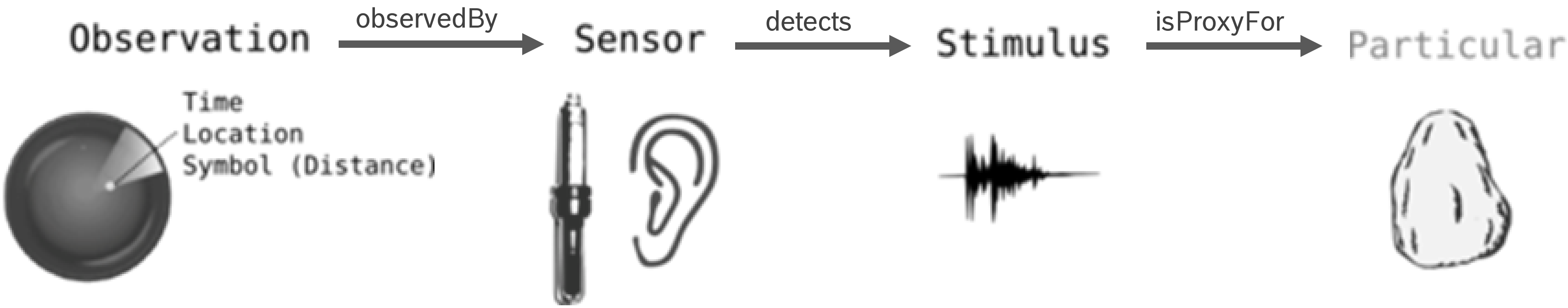
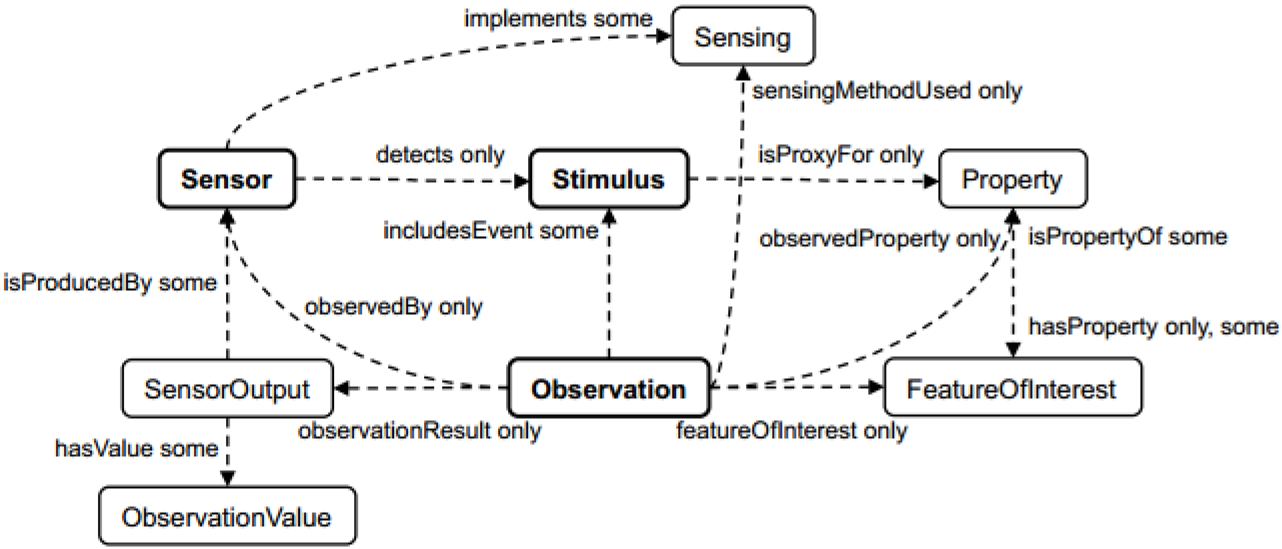
Stimulus-Sensor-Observation Design Pattern



- Introduces a minimal set of classes and relations centered around the notions of *stimuli, sensor, and observations*.

http://www.w3.org/2005/Incubator/ssn/XGR-ssn-20110628/

Stimulus-Sensor-Observation Design Pattern



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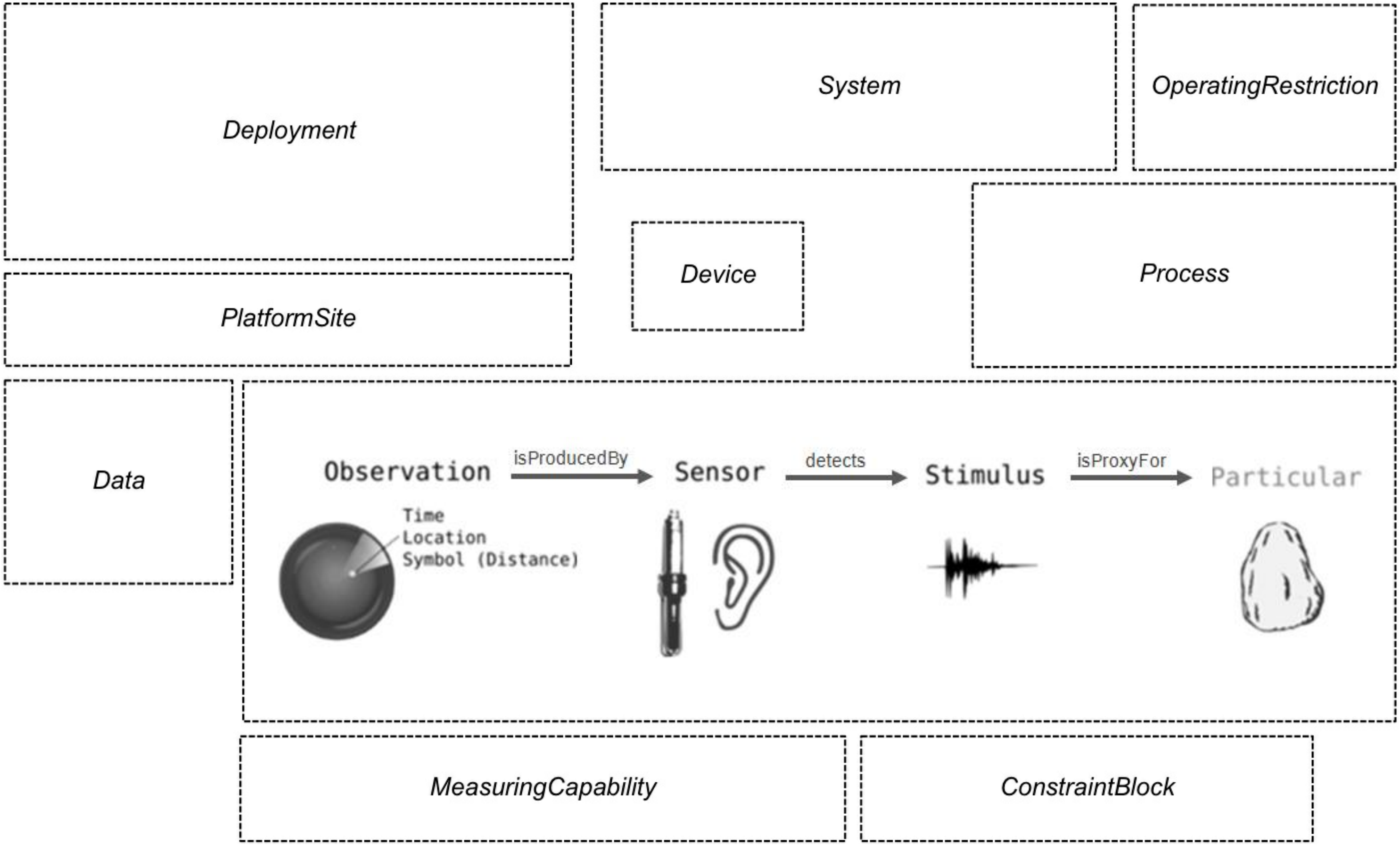
SSNO Modules



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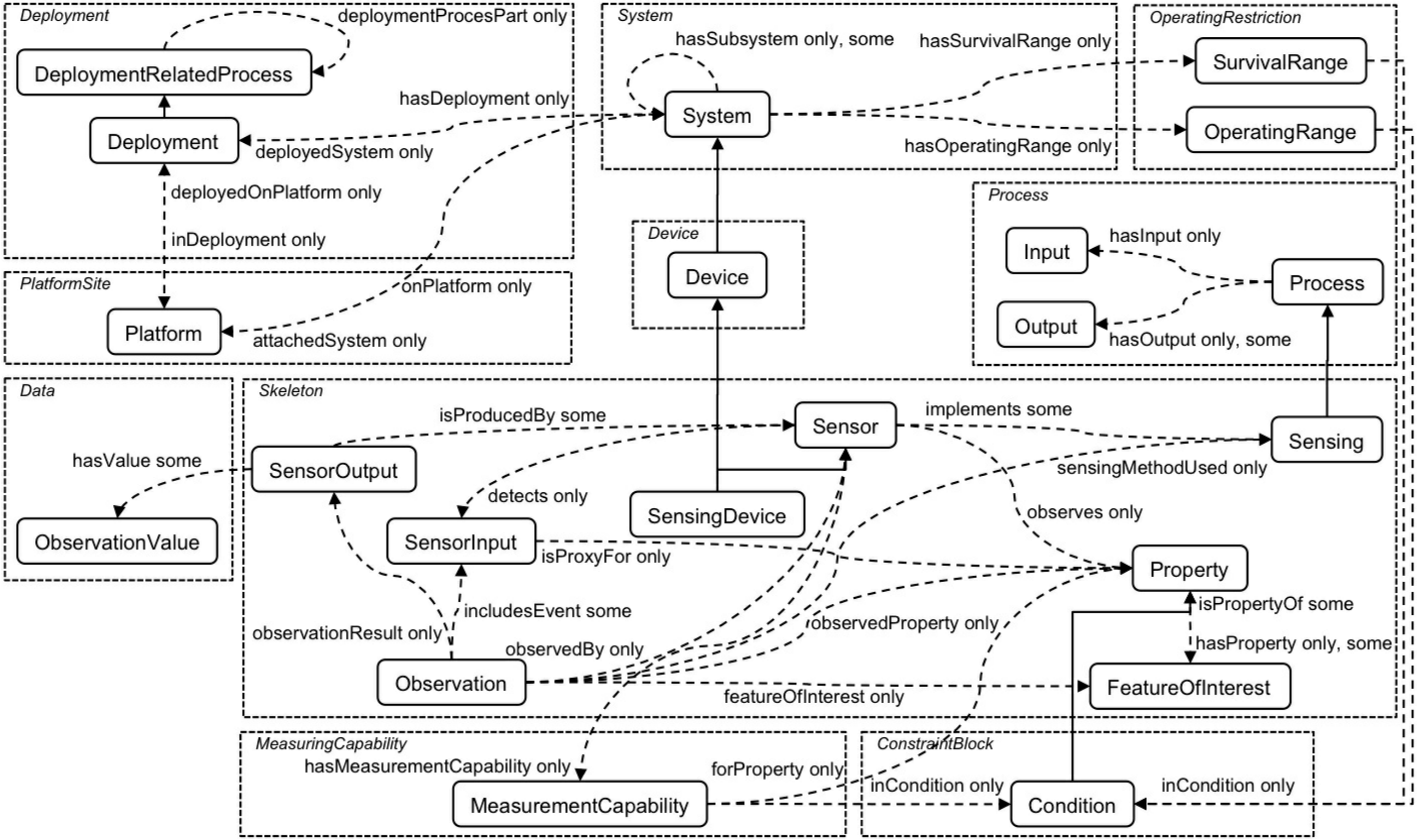

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SSNO Example: Wind Sensor

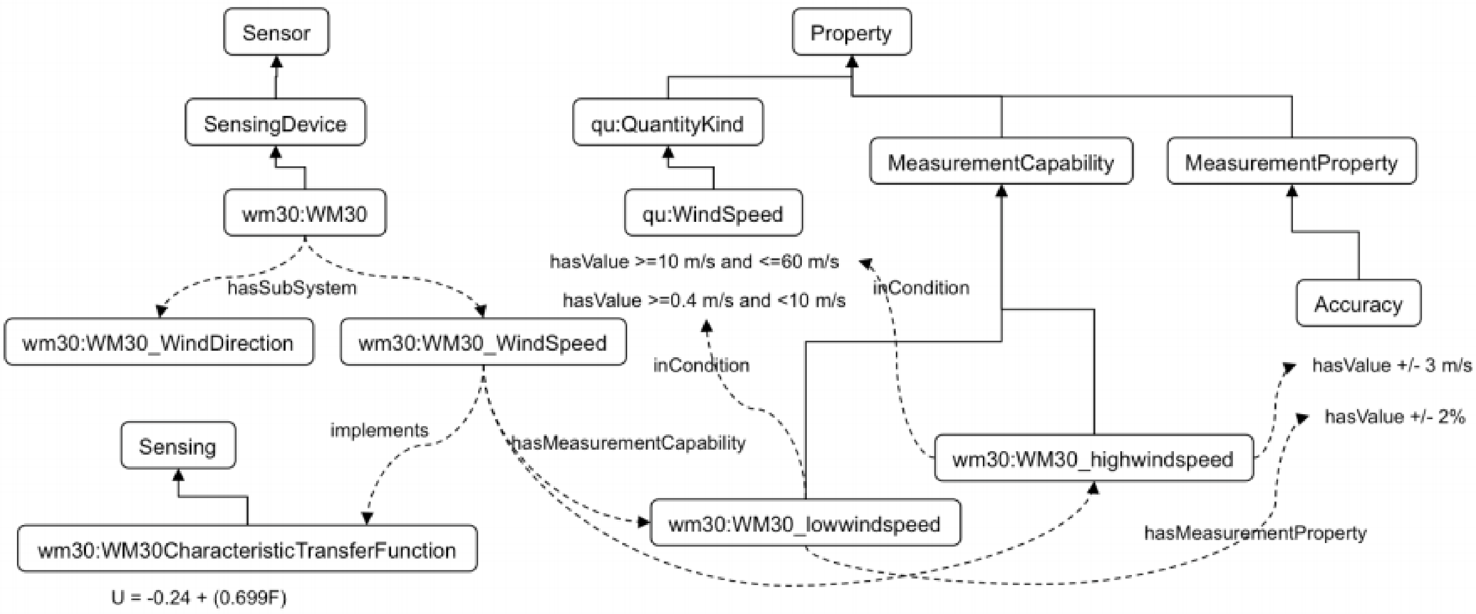

Figure 5: Simplified view of wind sensor example. The wind speed sensor has accuracy dependent on wind conditions. Not shown in the figure are the operating and survival ranges and the specification of the wind direction sensor, which comes with options for 355° and 360° measurement ranges. The sources of new concepts are shown with wm30: and qu: namespaces. Values incorporate DUL regions and QU units.

http://www.w3.org/2005/Incubator/ssn/XGR-ssn-20110628/

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Applications of SSNO

1. Discovery and query of sensor data
   - SSN-XG use-cases #1 and #2

2. Interpretation of sensor data
   - Translating data to knowledge

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SSNO Application #1: Discovery and query of data

GraphOfThings.org provides real-time access to sensor data streams across the globe, through both SPARQL query and Pub/Sub.

http://challenge.semanticweb.org/2014/submissions/swc2014_submission_8.pdf

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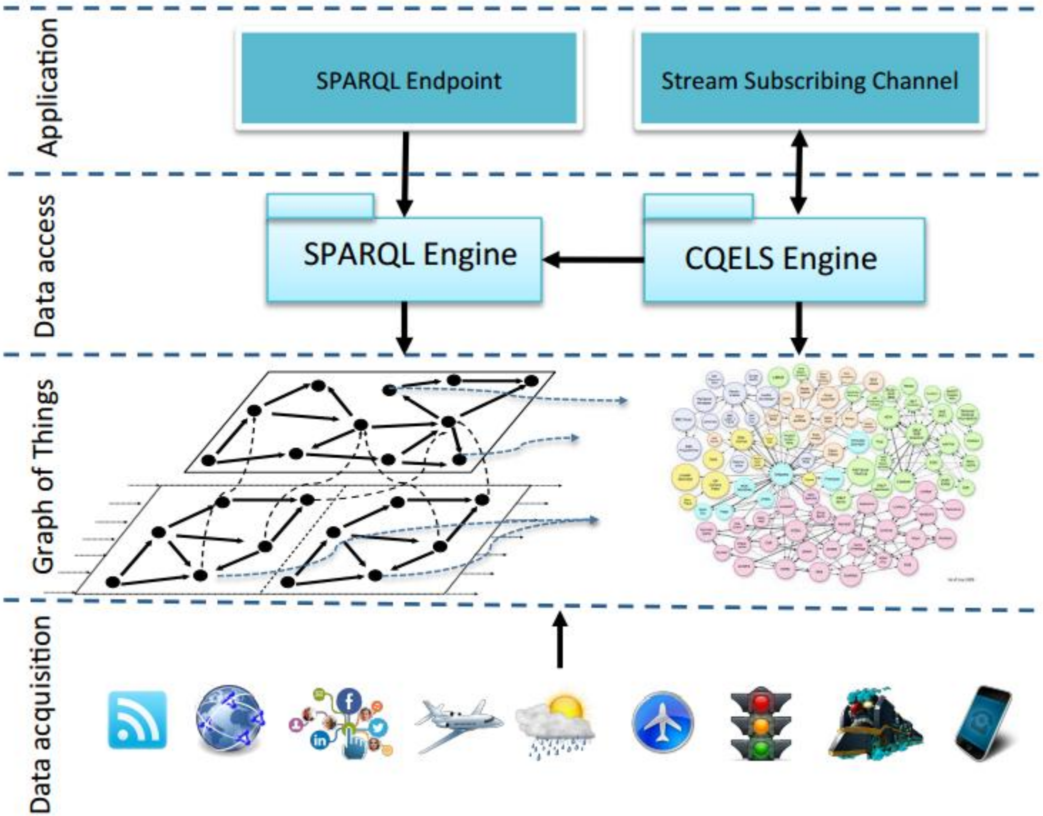

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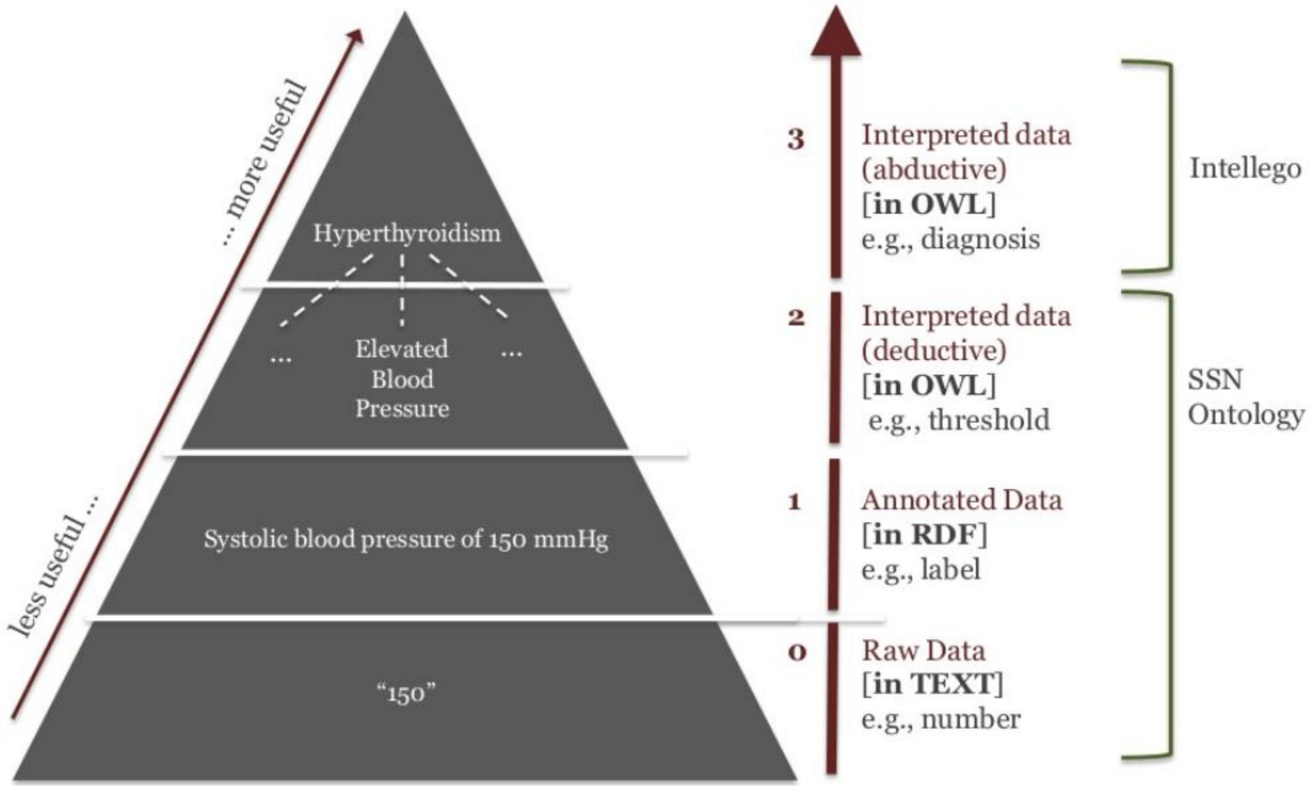
SSNO Application #2: Interpretation of sensor data

Intellego provides a framework for interpreting sensor data, loosely based on cognitive models of perception.



http://knoesis.wright.edu/library/resource.php?id=1948

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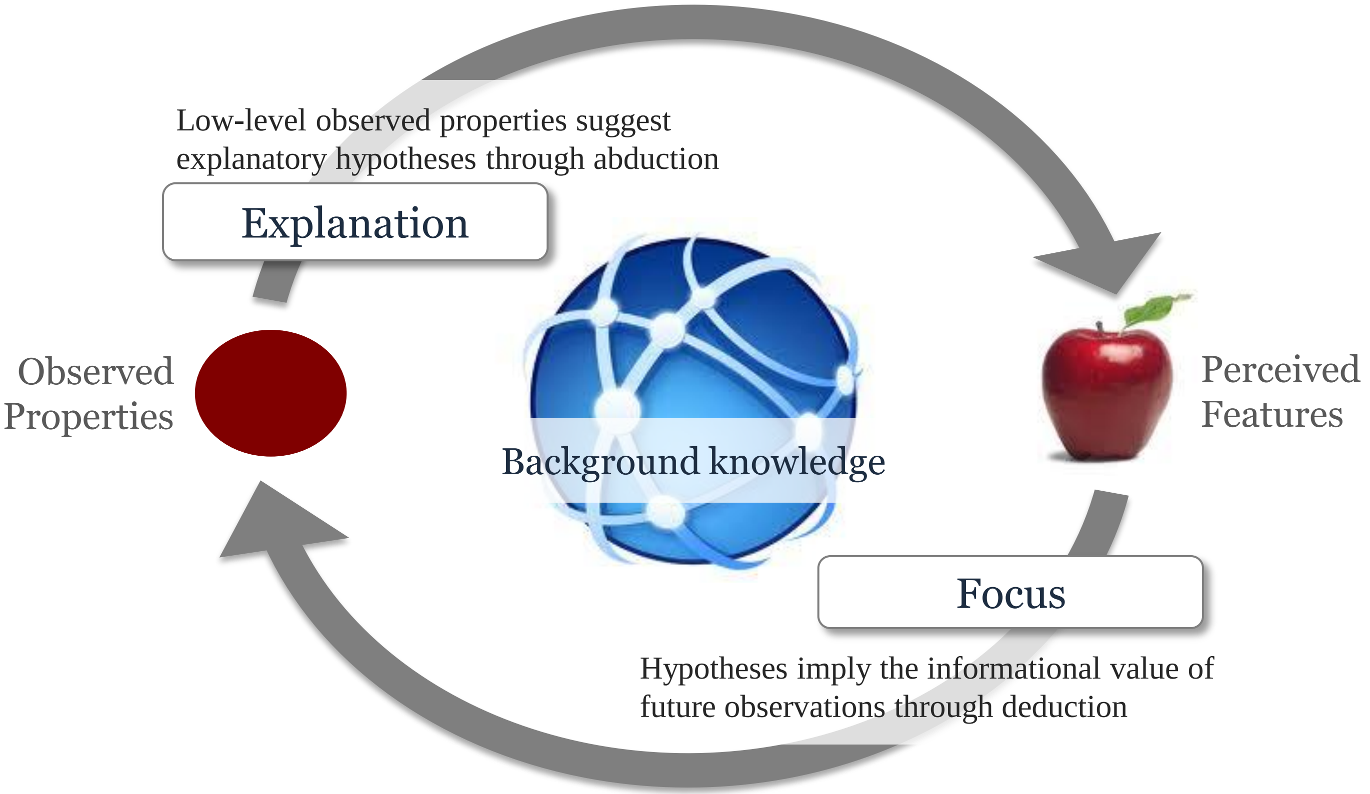

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Integrating SSNO with other Web Standards

SSNO + PROV-O

Sensor Data Provenance: SSNO and PROV-O Together at Last

Michael Compton[1], David Corsar[2], and Kerry Taylor[1,3]

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[2] University of Aberdeen, Aberdeen, UK dcorsar@abdn.ac.uk
[3] Australian National University

SSNO + CoAP

A logic-based CoAP extension for resource discovery in semantic sensor networks

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SSNO + RDF Data Cube Vocab

A Linked Sensor Data Cube for a 100 Year Homogenised daily temperature dataset

Laurent Lefort[1], Josh Bobruk[1], Armin Haller[1], Kerry Taylor[1] and Andrew Woolf[2]

[1] CSIRO ICT Centre, GPO Box 664, Canberra, Australia, {firstname.lastname}@csiro.au
[2] Australian Bureau of Meteorology, Canberra, Australia, A.Woolf@bom.gov.au

Internet of Things

Consumers care consequences of technical decisions

Obama Approval Rating Drops After NSA Surveillance News: Poll

The Huffington Post | By Luke Johnson
Posted: 06/17/2013 8:47 am EDT | Updated: 06/17/2013 11:17 am EDT

President Barack Obama's approval rating dropped eight points from last month, according to a CNN poll released Monday.

Consumer *sensor* data

our claim	There is nothing wrong with **ubiquitous** cameras and sensors: the problem is the **software architecture** behind them.

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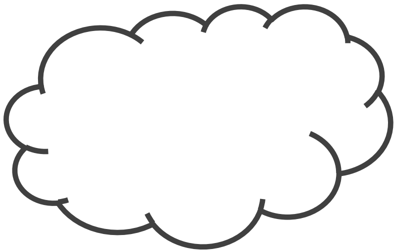
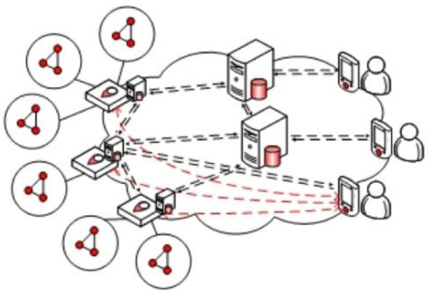
Future Directions: IoT



Approach 1: Semantics in the Cloud
Send all sensor observations to the cloud for semantic annotation and processing.



Approach 2: Semantics at the Edge
Downscale semantic representation and reasoning for local processing.

http://www.knoesis.org/library/resource.php?id=1772

Future Directions: IoT

An Efficient Bit Vector Approach to Semantics-based Machine Perception in Resource-Constrained Devices

Cory Henson, Krishnaprasad Thirunarayan, Amit Sheth

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OWL-DL

Use *bit vector encodings and their operations* to encode background knowledge and execute semantic (OWL-DL) reasoning

http://www.knoesis.org/library/resource.php?id=1772

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Thank You.

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