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An ontology for sensor networks

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Sensors and networks of sensors are important ways of monitoring and digitizing reality. As the number and size of sensor networks grows, so too does the amount of data collected. Users of such networks typically need to discover the sensors and data that fit their needs without necessarily understanding the complexities of the network itself. The burden on users is eased if the network and its data are expressed in terms of concepts familiar to the users and their job functions, rather than in terms of the network or how it was designed. Furthermore, the task of collecting and combining data from multiple sensor networks is made easier if metadata about the data and the networks is stored in a format and conceptual models that is amenable to machine reasoning and inference.

While the OGC's (Open Geospatial Consortium) SWE (Sensor Web Enablement) standards provide for the description and access to data and metadata for sensors, they do not provide facilities for abstraction, categorization, and reasoning consistent with standard technologies. Once sensors and networks are described using rich semantics (that is, by using logic to describe the sensors, the domain of interest, and the measurements) then reasoning and classification can be used to analyse and categorise data, relate measurements with similar information content, and manage, query and task sensors. This will enable types of automated processing and logical assurance built on OGC standards.

The W3C SSN-XG (Semantic Sensor Networks Incubator Group) is producing a generic ontology to describe sensors, their environment and the measurements they make. The ontology provides definitions for the structure of sensors and observations, leaving the details of the observed domain unspecified. This allows abstract representations of real world entities, which are not observed directly but through their observable qualities. Domain semantics, units of measurement, time and time series, and location and mobility ontologies can be easily attached when instantiating the ontology for any particular sensors in a domain.

After a review of previous work on the specification of sensors, the group is developing the ontology in conjunction with use case development. Part of the difficulty of such work is that relevant concepts from for example OGC standards and other ontologies must be identified and aligned and also placed in a consistent and logically correct way into the ontology. In terms of alignment with OGC's SWE, the ontology is intended to be able to model concepts from SensorML and O&M.

Similar to SensorML and O&M, the ontology is based around concepts of systems, processes, and observations. It supports the description of the physical and processing structure of sensors. Sensors are not constrained to physical sensing devices: rather a sensor is anything that can estimate or calculate the value of a phenomenon, so a device or computational process or combination could play the role of a sensor. The representation of a sensor in the ontology links together what is measured (the domain phenomena), the sensor's physical and other properties and its functions and processing. Parts of the ontology are well aligned with SensorML and O&M, but parts are not, and the group is working to understand how differences from (and alignment with) the OGC standards affect the application of the ontology.