Smart Applications for the Maintenance of Large Buildings: How to Achieve Ontology-based Interoperability at the Information Level

Alfredo D'Elia

Riccione – June 22, 2010

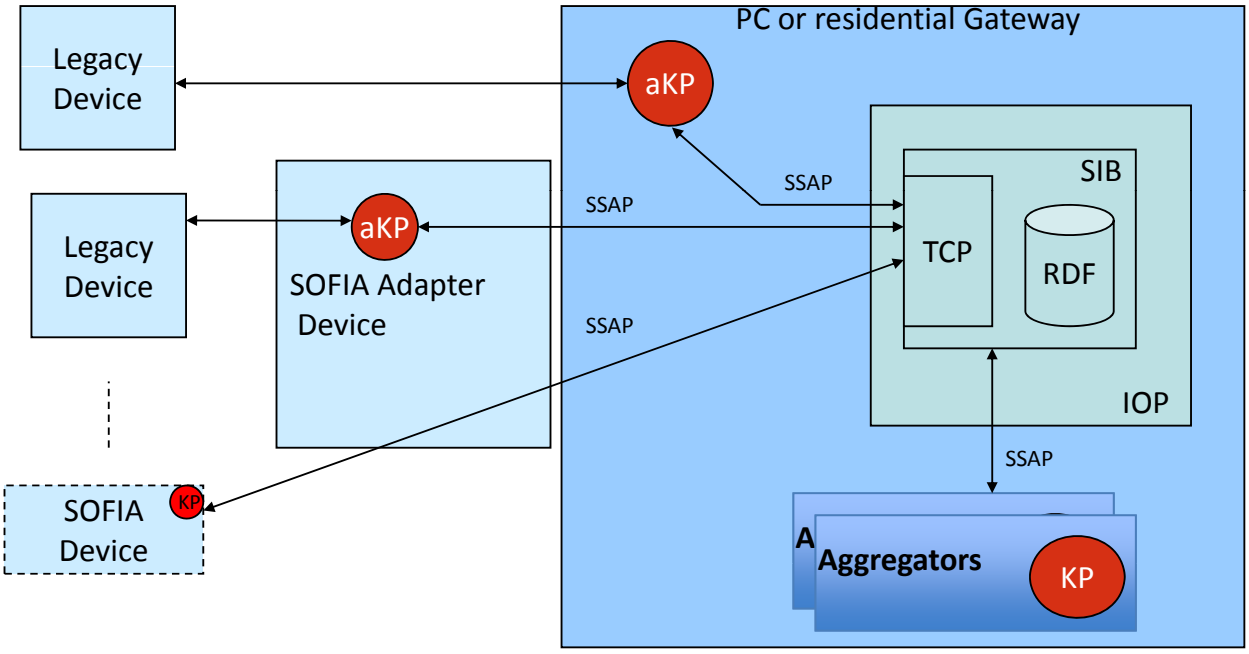
ARTEMIS JU SP3 / 100017: Smart Objects For Intelligent Applications

ARTEMIS JU SP3 / 100017: Smart Objects For Intelligent Applications

Smart Environment Objectives

- **Connect physical world with information world**
- **Cross-industry interoperability**
- **Maintain value of existing legacy**
- **Innovative user interaction with embedded devices**

SOFIA Architecture (a view)

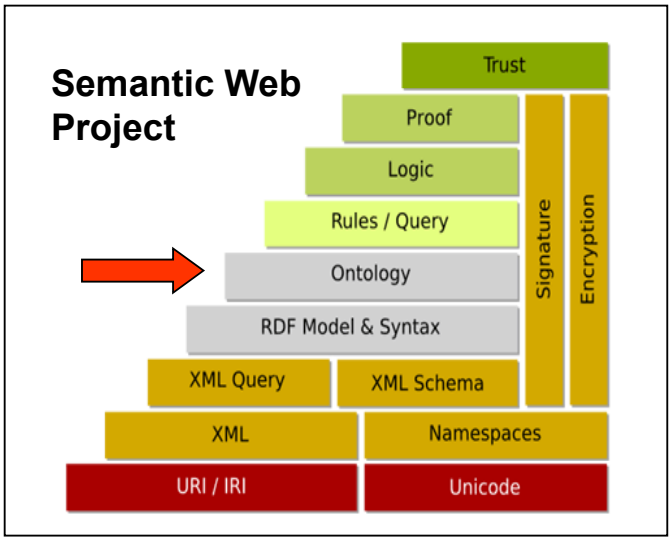


Ontology driven KPs → **Information level interoperability**

ARTEMIS JU SP3 / 100017: Smart Objects For Intelligent Applications

Ontologies

- **Built on existing standards**
- **Specify information semantics**
- **Machine interpretable**
- **Support reasoning**
- **Extendible**



Once a certain domain has been specified using an ontology, software agents based on the same ontology are interoperable and so may communicate and cooperate

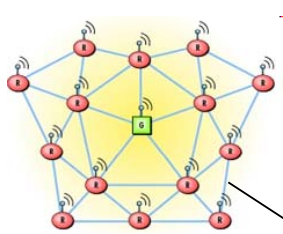
Generic Approach to Interoperability

- Scenario analysis and application requirements
- Ontology as a formal representation of the detected concepts and properties
- HW/SW architecture
- Implementation and testing

Maintenance Domain

- Sensor networks provide data about environment
- Rules and normatives specify limits over which fault are detected
- Faults are signaled and communicated to maintenance companies and operators
- Maintenance interventions are scheduled and performed
- Office tenants are informed of faults and intervetion which happens in their office to have a less intrusive intervention
- Maintenance operators are guided to fault location and signal start and end of operation

Building Maintenance Scenario



WSN

Contextualized Observations

Normatives
Business rules
Aggregators

Contextualized Observations

Contextualized Faults and corrective interventions

Knowledge Base

corrective interventions details

Contextualized Faults and corrective interventions

corrective interventions details

Maintenance company and operator

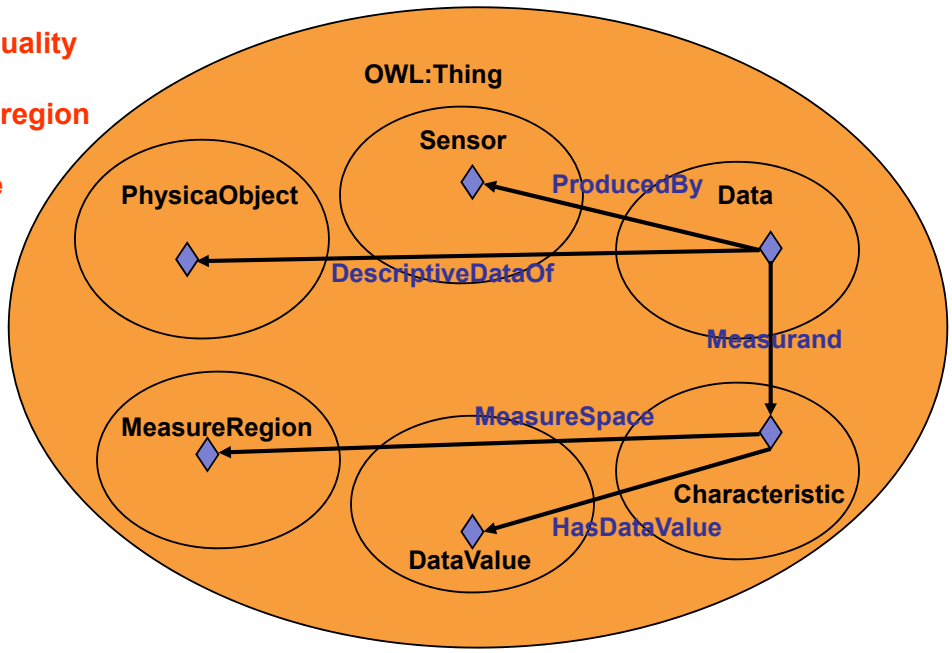
Sensor Network adaptation

- Dolce: high abstraction level entities
- Sensor Ontology: entities related to sensors and data

Characteristic ≡ Dolce:Quality

MeasureRegion ≡ Dolce:region

DataValue ≡ Dolce:Quale



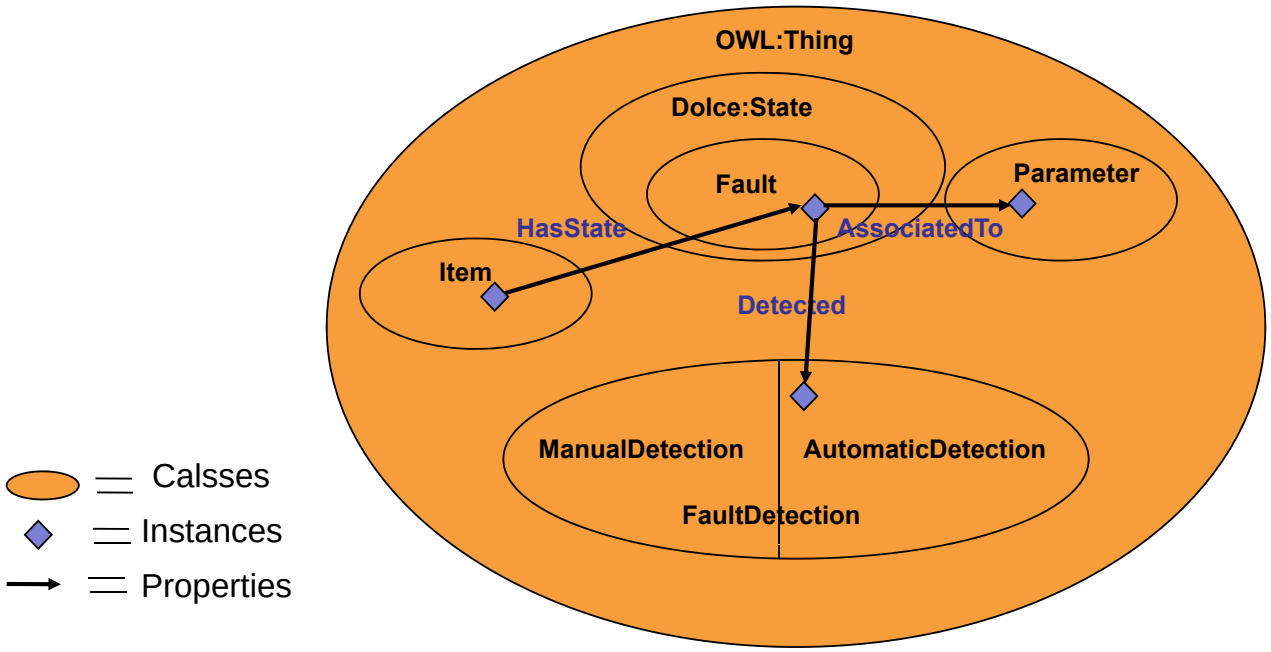
Calsses

Instances

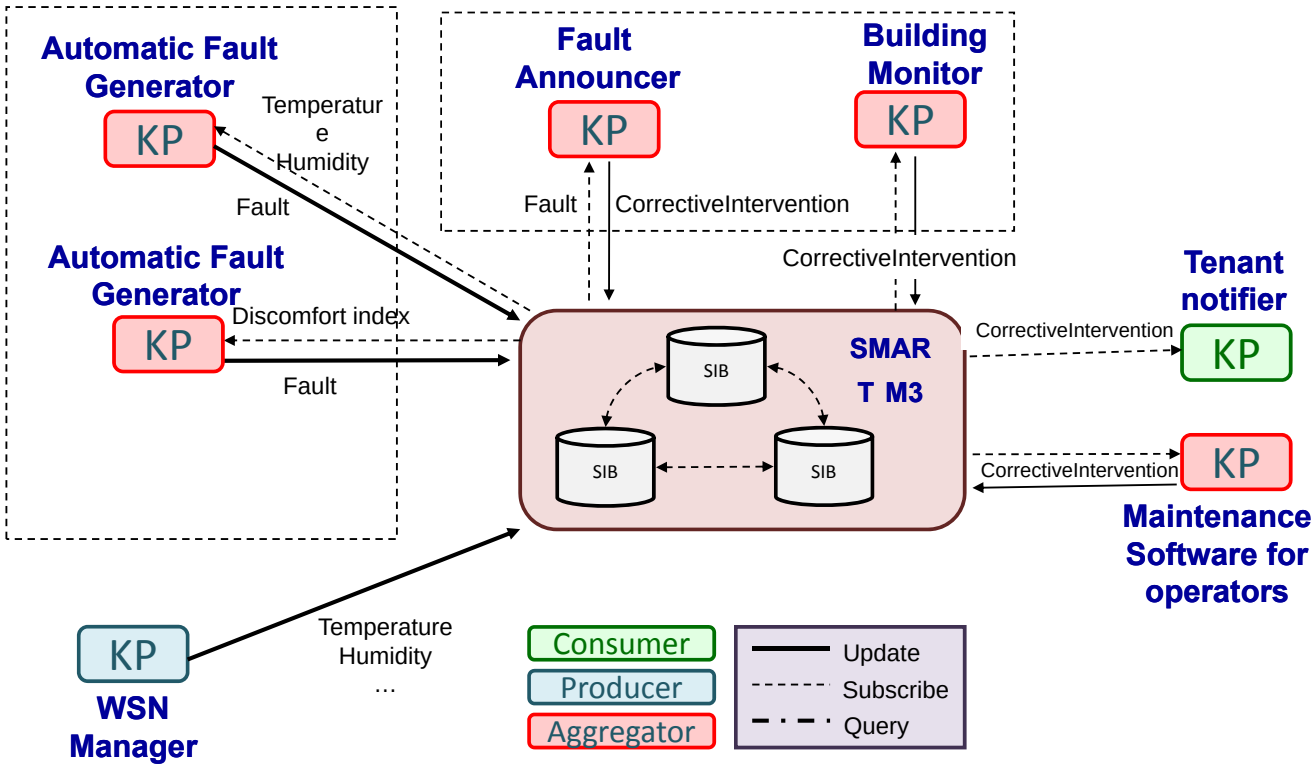
Properties

Faults and Corrective interventions

Fault definition from EN 13306:
state of an item (e.g., an A/C unit) or a building element (e.g., the HVAC system) characterized by its inability to perform a required function"



Maintenance: software infrastructure



Building monitoring GUI

							Intervention			
Place	**Fault**	**Urgency**	**Parameter**	**Value**	**Measurement unit**	**Detection time**	**start time**	**stop time**	**Operator**	**Comment**
Room1	Temperature-out-of-range	low	temperature	18,5	°C	2010-06-18 09:30:10	2010-06-22 10:30:34	2010-06-22 13:28:10	Mario Rossi	
Room2	anomalous-water-presence	high	Water presence	YES	YES/NO	2010-06-18 11:44:22	2010-05-20 14:30:10		Maria Bianchi	
Room1	Humidy-out-of-range	medium	Relative humidity	70	%	2010-05-20 22:12:55				
…	…	…				…	…	…	…	…

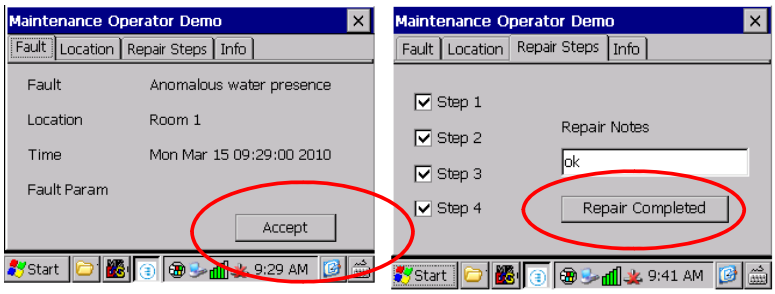
Real time indoor space parameters monitor

Place	Temperature (°C)	Relative humidity (%)	Water on the floor (YES/NO)
Room1	18.5	70	NO
Room2	27.5	63	YES

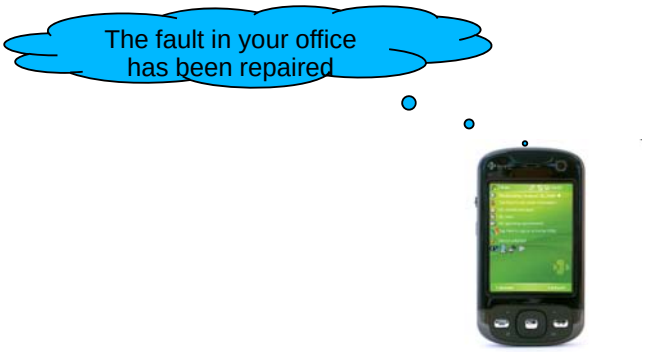
ARTEMIS JU SP3 / 100017: Smart Objects For Intelligent Applications

Operator GUI

- Acceptation by only one of the pool of appropriately skilled operators
- Synchronization of multiple acceptations



- Fault info to help the operator
- Buttons to interact with the SIB



- Notification of all processes interested in the modified fault instances => Tenant GUI

Conclusions and future works

- **Evaluation of ontology based approach in a real scenario**
- **Work with domain experts for conceptualization of the domain**
- **HW/SW architecture to support the desired behaviour**
- **Software implementation on multiple platforms**
- **Intrinsic extendibility and interoperability**