Semantic approach to services management
Developing an effective method of systems monitoring and management in the Internet of Things

There is a strong trend toward a world of sensors with everyday objects equipped with embedded data and communications capabilities in the Internet of things. In such a world, a semantic web offers a practical framework to provide ways to process the huge amount of data produced. From an end-user point of view, the information provided is only meaningful within the scope of some end-user activity, targeting a defined goal achievable through a dedicated scenario.

The goal of SEMbySEM was the development of generic software allowing aggregation of information from communicating objects – such as radio-frequency identification tags, industrial sensors, servers, simulated objects and devices – and applications such as video acquisition, supervision and computer-system monitoring in an ergonomic form enabling actions by the end-user on these objects and applications.

COHERENT OBJECTS
SEMbySEM defined tools and standards for systems management as a coherent set of objects grounded in a semantic representation. This abstract view isolates the technical issues related to communications with the various sensors in a ‘façade’ layer and works directly on a semantic model of the system.

As the systems to be managed are intrinsically dynamic, a new semantic representation was needed to define the ontology and the business rules. The system needs not only to find out what information is available but also to decide on priorities. And the mechanism needs to be generic to address the situation where lots of objects can communicate and have to be controlled.

SEMbySEM started with the management of computer systems with a summary of

Project Results

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operations in terms of human goals. The resulting system can then manage the human need directly, not the technical issues.

**ONTOLOGICAL APPROACH**
To be certain that it was always possible to compute, SEMbySEM limited the capacity of the language being used to try and address all the possible problems. This resulted in a specific internal approach called Micro Concept using semantics to describe the systems in terms of an ontology so that it is not necessarily to change the vocabulary continuously.

This vocabulary is used to design a living model of the system which is fed at run time with events such as ‘train started’ and ‘train stopped’ in rail transport and all other activities that modify these properties. This live model of the system can then be queried before carrying out an action. The living dynamic reference of the system being managed is analogous with how the brain sees the body and controls its actions. SEMbySEM demonstrated that the semantic approach is the most appropriate and versatile way to describe concepts and rules, with the largest consensus on the terms and their meaning.

It lets different users define their business model in terms of concepts and rules and define their own representation. These concepts are then linked with their real counterpart to manage them by obtaining information from them and acting on them.

**OPEN-SOURCE TOOL**
SEMbySEM proved the efficiency of its approach in a series of demonstrators, including:
- Real-time localisation and tracking of locomotives and goods wagons in rail transport;
- Management of virtual metrology for metal car-panel production; and
- Centralised control of multiple building management systems in a single coherent supervisory control and data acquisition (SCADA) hypervision system.

The software will be published as open-source and the results are already being applied. Thales has demonstrated a systems application for a Spanish metro network. ARC Informatique will use the results in more dynamic generations of its SCADA systems. And Spanish partners will develop virtual metrology systems for the car industry.

### Major project outcomes

**DISSEMINATION**
- 15 publications were provided by the different universities (INRIA Loria, LISSI, LIG Grenoble) and by THALES Services
- 9 presentations were made at conferences, in particular ESWC 2009, KEOD 2009, SCC2010, SEAMS 2011, RTSOAA 2011

**EXPLOITATION**
- THALES will use parts of these results in future Hypervision Tools
- ARC Informatique will use parts of these results in its SCADA product
- CityPassenger is using semantics results in some of its network appliances
- ICBT will incorporate results in its metrology systems

**STANDARDISATION**
- The project has been a real effective use case for multilingual standardisation within ISO’s TC37 “Terminology and other language and content resources” / SC4 “Language Resources Management”.
- Based on work done in SEMbySEM, the MLIF standard (ISO MLIF FDIS 24616) should become an International Standard in July 2011.