Third Interim Report
The Smart Appliances REFerence ontology (SAREF)
SMART 2013/0077

10 February 2015
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Part 1 - Background:
WP3 tasks, approach and results
WP3 - where did we start? (1/3)

Results of WP2

- The *D-S2 Second Interim study report* covered
  - **Task 2.1**: Translation -> translation of semantic assets in the short list to OWL ontologies
  - **Task 2.2**: Mapping -> an initial mapping between the various ontologies

- The *D-O1 OWL-files semantic assets* deliverable consisted of all OWL files created during WP2
  - available at the smart appliances website
    https://sites.google.com/site/smartappliancesproject/ontologies
WP3 - where did we start? (2/3)

Mapping

› In D-S2 we proposed an initial mapping of the ontologies by means of a number of concepts that we have identified as most relevant as basis for the reference ontology
WP3 - where did we start? (3/3)

Core concepts

- Device
- Device category
- Function
- Function category
- Service
- Command
- Parameter
- Mode/Status
- Energy profile
- Energy
- Power
- Time/Duration
- Building
- Sensor
- Actuator
- Meter
- Load
- Storage
- Generator
- Unit of Measure
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<th>DEVICE CATEGORY</th>
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In WP3 we started from the results of WP2 with the goal of proposing a reference ontology and documenting it into the ETSI M2M architecture.

- **Task 3.1**: Smart appliances reference ontology
  - presented here
- **Task 3.2**: Documentation of the ontology into the ETSI M2M architecture
  - presented by Frank den Hartog
WP3 results

- The *D-S3 Third Interim study report* covers the definition of the Smart appliances REFerence (SAREF) ontology and a description of this ontology within the ETSI M2M architecture.
  - The report is available at [https://docs.google.com/file/d/0B2nnxMhTMGh4VINzT01ydnNqazQ/edit](https://docs.google.com/file/d/0B2nnxMhTMGh4VINzT01ydnNqazQ/edit)

- The *D-O2 Smart Appliances unified ontology* deliverable consists of an OWL file of the smart appliances reference ontology.
  - The ontology file is available at [http://ontology.tno.nl/saref.ttl](http://ontology.tno.nl/saref.ttl)
  - The ontology documentation is available at [http://ontology.tno.nl/saref](http://ontology.tno.nl/saref)
How to open an ontology

› Web Protégé (online tool)
  http://webprotege.stanford.edu/#List:coll=Home

› Protégé
  http://protege.stanford.edu/

› TopBraid Composer
  http://www.topquadrant.com/downloads/

› The .ttl ontologies can also be opened as textual files using a text editor (e.g., Notepad) or a web browser
WP3 approach - principles (1/2)

- **Reuse and alignment** of concepts and relationships defined in existing assets
  - Not re-inventing the wheel, but harmonizing existing work
  - Despite heterogeneity, we identified 3 main trends: *function-related*, *energy-related* and *building-related devices*

- **Modularity** to allow separation and recombination of (parts of) the ontology
  - Building blocks, starting point is the concept of *device*
  - *Functions*, *commands*, *states* and *properties* are also offered as building blocks
WP3 approach - principles (2/2)

- *Extensibility* to allow further growth of the ontology
  - Different stakeholders can specialize SAREF concepts and create new concepts, as long as they link to SAREF

- *Maintainability* to facilitate the process of identifying and correcting defects, accommodate new requirements, and cope with changes in SAREF
  - Stakeholders can create new modules based on SAREF and are responsible for maintenance and versioning (distributed)
  - A single entity (e.g., TNO and/or ETSI) is responsible for the maintenance and versioning of SAREF (centralized)
  - A single entity (e.g., TNO and/or ETSI) is responsible for the extension of SAREF based on stakeholders input (mixed)
WP3 approach – ontology creation process (1/2)

- Assessment of additional assets suggested during the stakeholders’ workshops
  - CENELEC, ZigBeeHA and Adapt4EE also considered in the creation of SAREF
  - CENELEC has no OWL version

- (Qualitative) validation of the usability of our modular approach based building blocks with some stakeholders
  - Representatives of CENELEC, ETSI M2M and HGI

- Experiment on automated matching to validate our initial mappings
  - In collaboration with Jerome Euzenat (INRIA institute, France) – member of our expert group
  - Using dedicated software for ontology matching
WP3 approach – ontology creation process (2/2)

- Creation of SAREF starting from the core concepts presented in D-S2
  - Creation of explicit definitions for concepts
  - Organization of concepts in hierarchical (vertical) relationships
  - Definition of (horizontal) relationships between concepts
  - Change of some names in the core concepts presented in D-S2 and refinement of these concepts in subclasses (more details in D-S3)

- Iterative check of intermediate results against short-list assets
  - Especially relevant:
    - DogOnt, OSGi DAL and CENELEC for creating function-related part of SAREF
    - SSN ontology for sensing function and observation of properties
    - Fiemser for building-related part
    - Fanfpai, Mirabel, PowerOnt and CENELEC for energy-related part
  - Not neglecting other assets, all valuable and contributing to SAREF in one way or another
Part 2 - SAREF:
Smart Appliances REFerence ontology
The Smart Appliances REFerence (SAREF) ontology

- The ontology file is available at [http://ontology.tno.nl/saref.ttl](http://ontology.tno.nl/saref.ttl)
- The ontology documentation is available at [http://ontology.tno.nl/saref](http://ontology.tno.nl/saref)

- See D-S3 report for detailed description of SAREF

- In this part of the presentation:
  - Some important definitions
  - A close look at SAREF using Top Braid Composer (live)
<table>
<thead>
<tr>
<th>CONCEPT</th>
<th>DEFINITION</th>
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<tbody>
<tr>
<td>Building Object</td>
<td>A building object is an object in the building that can be controlled by devices, such as a door or a window that can be automatically opened or closed by an actuator.</td>
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<tr>
<td>Building Space</td>
<td>According to FEIMSER, a building space in SAREF defines the physical spaces of the building. A building space contains devices or building objects.</td>
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<tr>
<td>Command</td>
<td>A Command is a directive that a device must support to perform a certain function. A command may act upon a state, but does not necessarily act upon a state. For example, the ON command acts upon the ON/OFF state, but the GET command does not act upon any state, since it gives a directive to retrieve a certain value with no consequences on states.</td>
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<tr>
<td>Commodity</td>
<td>A commodity is a marketable item for which there is demand, but which is supplied without qualitative differentiation across a market. SAREF refers to energy commodities such as electricity, gas, coal and oil.</td>
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<td>Device</td>
<td>A device in the context of the Smart Appliances study is a tangible object designed to accomplish a particular task in households, common public buildings or offices. In order to accomplish this task, the device performs one or more functions. For example, a washing machine is designed to wash (task) and to accomplish this task it performs the start and stop function.</td>
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<td>Device Category</td>
<td>A Device Category provides a way to classify devices according to a certain point of view, for example, the point of view of the user of the device vs. the device's manufacturer, or the domain in which the device is used (e.g., smart appliances vs. building domain vs. smart grid domain), etc.</td>
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<td>Function</td>
<td>A Function represents the particular use for which a Device is designed. A device can be designed to perform more than one function.</td>
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<tr>
<td>Function Category</td>
<td>A Function Category provides a way to classify functions according to a certain point of view, for example, considering the specific application area for which a function can be used (e.g., light, temperature, motion, heat, power, etc.), or the capability that a function can support (e.g., receive, reply, notify, etc.), and so forth.</td>
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<td>Profile</td>
<td>A profile caracterizes a device for the purpose to optimize the energy efficiency in the home or office in which the device is located. The saref:Profile class allows to describe the energy (or power) production and consumption of a certain device using the saref:hasProduction and saref:hasConsumption properties. This production and consumption can be calculated over a time span (the saref:hasTime property) and, eventually, associated to some costs (the saref:hasPrice property).</td>
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<td>Property</td>
<td>Anything that can be sensed, measured or controlled in households, common public buildings or offices.</td>
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<td>Service</td>
<td>A service is a representation of a function to a network that makes the function discoverable, registerable, remotely controllable by other devices in the network. A service can represent one or more functions. A Service is offered by a device that wants (a certain set of) its function(s) to be discoverable, registerable, remotely controllable by other devices in the network. A Service must specify the device that is offering the service, the function(s) to be represented, and the (input and output) parameters necessary to operate the service.</td>
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<td>State</td>
<td>It represents the state in which a device can be found, e.g., ON/OFF/STANDBY, or ONLINE/OFFLINE, etc.</td>
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<td>Task</td>
<td>A task represents the goal for which a device is designed (from a user perspective). For example, a washing machine is designed for the task of cleaning.</td>
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<td>Unit of Measure</td>
<td>The unit of measure is a standard for measurement of a quantity, such as a Property. For example, Power is a property and Watt is a unit of power that represents a definite predetermined power: when we say 10 Watt, we actually mean 10 times the definite predetermined power called &quot;watt&quot;. Our definition is based on the definition of unit of measure in the Ontology of units of Measure (OM). We propose here a list of some units of measure that are relevant for the purpose of the Smart Appliances ontology, but this list can be extended.</td>
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SAREF ontology using Top Braid Composer (live)
What’s next?

- The *D-S4 Study report* is the final report of the Smart Appliances study. It will be used as basis to create an ETSI technical specification.

- The *D-S4 Study report* includes:
  - Results described in the previous reports D-S1, D-S2, and D-S3
  - Updates generated from stakeholders’ feedback during the entire study
  - Feedback from expert group

- The *D-S4 Study report* will be presented in the final stakeholders workshop on the 1st of April in Brussels
Part 3 - Discussion:
Smart Appliances REFERENCE ontology