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SmartM2M;
Guidelines for consolidating SAREF with new reference ontology patterns, based on the experience from the ITEA SEAS project

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Smart Machine-to-Machine communications (SmartM2M).

Modal verbs terminology

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1 Scope

The present document specifies the functional requirements for a set of reference ontology patterns for the SAREF semantic model, along with guidelines for developing extensions to this semantic model for multiple engineering-related verticals. The present document has been developed leveraging the experience of the EUREKA ITEA 12004 SEAS (Smart Energy Aware Systems) project, and the development of the OGC&W3C SSN (Semantic Sensor Network) ontology. It illustrates the applications of the guidelines with use cases for Smart Energy, Smart Building, and Industry of the Future/Industry 4.0 verticals. The associated ETSI TS 103 548 [i.1] will define the update to SAREF and its extensions based on the requirements and guidelines specified in the present document.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TS 103 548: "SmartM2M; SAREF consolidation with new reference ontology patterns, based on the experience from the SEAS project".

[i.2] ETSI TS 103 264 (V2.1.1): "SmartM2M; Smart Appliances; Reference Ontology and oneM2M Mapping".

[i.3] ETSI TS 103 410-1 (V1.1.1): "SmartM2M; Smart Appliances Extension to SAREF; Part 1: Energy Domain".

[i.4] ETSI TS 103 410-2 (V1.1.1): "SmartM2M; Smart Appliances Extension to SAREF; Part 2: Environment Domain".

[i.5] ETSI TS 103 410-3 (V1.1.1): "SmartM2M; Smart Appliances Extension to SAREF; Part 3: Building Domain".

[i.6] ETSI TS 103 410-4 (V1.1.1): "SmartM2M; Extension to SAREF; Part 4: Smart Cities Domain".

[i.7] ETSI TS 103 410-5 (V1.1.1): "SmartM2M; Extension to SAREF; Part 5: Industry and Manufacturing Domains".

[i.8] ETSI TS 103 410-6 (V1.1.1): "SmartM2M; Extension to SAREF; Part 6: Smart Agriculture and Food Chain Domain".

[i.9] ETSI TR 103 411 (V1.1.1): "SmartM2M; Smart Appliances; SAREF extension investigation".

[i.10] A. Haller, K. Janowicz, S. Cox, D. Le Phuoc, K. Taylor, M. Lefrançois, R. Atkinson, R. García-Castro, J. Lieberman, C. Stadler: "Semantic Sensor Network Ontology". W3C Recommendation, 19 October 2017.

NOTE: Available at https://www.w3.org/TR/vocab-ssn/.

[i.11] M. Lefrançois, J. Kalaoja, T. Ghariani, A. Zimmerman: "The SEAS Knowledge Model", ITEA2 12004 Smart Energy Aware Systems Deliverable 2.2, January 2017.

NOTE: Available at http://w3id.org/seas/.

[i.12] M. Lefrançois, A. Zimmermann, N. Bakerally: "A SPARQL extension for generating RDF from heterogeneous formats", in Proc. Extended Semantic Web Conference, 2017.

NOTE: Available at http://w3id.org/sparql-generate.

[i.13] H. Rijgersberg, M.F.J. van Assem, J.L. Top: "Ontology of Units of Measure and Related Concepts." Semantic Web, 4, 1, 2013, pp. 3-13.

NOTE: Available at http://www.ontology-of-units-of-measure.org/page/om-2.

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

ontology: formal specification of a conceptualization, used to explicitly capture the semantics of a certain reality

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CHE	Concept Hierarchy Extension
CS	Concept Specialization
EMSE	École des Mines de Saint-Étienne, France
FOI	Feature Of Interest
FOIPD	Feature Of Interest, Properties and Devices
GECAD/ISEP	Knowledge Engineering and Decision-Support Research Center, School of Engineering, Polytechnic of Porto, Portugal
IoT	Internet of Things
IRI	Internationalized Resource Identifier
ITEA	Information Technology for European Advancement
OGC	Open Geospatial Consortium
OM	Ontology of Measurements
OWL	Web Ontology Language
PEP	Procedure Execution Ontology
PSD	Platform, System and Deployment
QUDT	Quantities, Units, and DataTypes
RDF	Resource Description Framework
RG	Research Group
RMS	Root Mean Square amplitude
RN	Phase R to Neutral
SAREF	Smart Appliances REFerence ontology
SEAS	Smart Energy Aware Systems
SN	Phase S to Neutral
SOSA	Sensor, Observation, Sample, and Actuator
SPARQL	SPARQL Protocol And RDF Query Language
SSN	Semantic Sensor Networks
STF	ETSI Specialist Task Force

TB	Technical Body
THD	Total Harmonic Distortion
TN	Phase T to Neutral
TR	Technical Report
TS	Technical Specification
URI	Universal Resource Identifier
URL	Universal Resource Locator
W3C	World Wide Web Consortium

4 Consolidation of SAREF using ontology patterns

SAREF (V2.1.1) (ETSI TS 103 548 [i.2]) is a reference ontology for the IoT developed by ETSI SmartM2M in close interaction with the industry. SAREF contains core concepts that are common to several IoT domains and, to be able to handle specific data elements for a certain domain, dedicated extensions of SAREF have been created, for example SAREF4ENER (ETSI TS 103 410-1 [i.3]), SAREF4ENVI (ETSI TS 103 410-2 [i.4]), SAREF4BLDG (ETSI TS 103 410-3 [i.5]), and SAREF4CITY (ETSI TS 103 410-4 [i.6]), SAREF4INMA (ETSI TS 103 410-5 [i.7]), SAREF4AGRI (ETSI TS 103 410-6) [i.8]. Each domain can have one or more extensions, depending on the complexity of the domain. As a reference ontology, SAREF serves as the means to connect the extensions in different domains. The earlier document ETSI TR 103 411 [i.9] specifies the rationale and methodology used to create, publish and maintain the SAREF extensions.

Ontology patterns are like design patterns in object oriented programming. They describe structural, logical, naming, or documentation best practices that one can consider when building an ontology.

The present document provides an analysis of the potential of modularization and factorization of the SAREF core ontology (V2.1.1) (ETSI TS 103 548 [i.2]) as patterns.

Then, the present document specifies a set of ontology patterns for the modelling and the description of any kind of engineering-related data/information/systems; that may be used to consolidate SAREF.

Finally, the present document lists a set of issues that are identified in the current version of SAREF, and proposes changes to consolidate SAREF.

The present document has been developed in the context of the STF 556 (https://portal.etsi.org/STF/STFs/STFHomePages/STF556.aspx), which was established with the goal to consolidate SAREF and its community of industrial users based on the experience of the EUREKA ITEA 12004 SEAS (Smart Energy Aware Systems) project. The present document specifies requirements for an initial set of SAREF extensions instantiating the defined ontology patterns, for some use cases taken from SEAS project, therefore filling some of the representational gaps that were identified during this project.

5 Related initiatives

In this clause, some of the main related initiatives in terms of modelling reference ontology patterns for the IoT, and using these ontology patterns to develop ontologies, are reviewed.

- **Joint OGC and W3C Spatial Data on the Web working group:** the SSN (Semantic Sensor Network) ontology [i.10] is a modular ontology using some design patterns that were instantiated manually. One of these design patterns involves different kinds of systems and the procedures they execute: Sensors, Actuators and Samplers, execute Observation, Actuation and Sampling activities.

- **OntologyDesignPatterns.org:** This website references ontology design patterns, which are classified in different categories such as Content, Logical, or Lexico-Syntactic patterns.

- **EUREKA ITEA 12004 SEAS:** The SEAS ontology [i.11] is a modular and versioned ontology with all the terms it defines having the same namespace (https://w3id.org/seas/). It contains a core of SEAS reference ontology patterns that can be instantiated to create the SEAS ontology itself with a homogeneous and predictable structure for the modelling and the description of any kind of engineering-related data/information/systems. These design patterns and some of their instances fill some of the representational gaps that were identified in SAREF.

6 Use cases

6.1 Introduction

The SEAS (Smart Energy Aware Systems) project was a 35 partners and 13 500 000 € project that ran from February 2014 to December 2016 (https://itea3.org/project/seas.html), and received the ITEA Award of Excellence 2017. Its goal was to design and develop an eco-system of smart things and services, collectively capable of optimizing the energy efficiency within the future Smart Grid. 100 use cases were defined by 35 partners, from which some identified gaps not yet covered by SAREF to be filled in the SEAS knowledge model. SAREF focuses on the notion of Device, while industry use cases often require some description of the physical systems and their connections, value association for their properties, and the activities by which such value association is done. The SEAS ontology development was initiated during a workshop that gathered 45 participants during 3 days and continued with close collaborations between ontology engineering experts, domain experts, and industry software architects.

6.2 Use case 1: Smart Energy

6.2.0 Introduction

New SAREF ontology patterns can be used to homogeneously represent knowledge that is relevant for use cases in the Smart Energy domain.

6.2.1 Types, topology and properties of the Features Of Interest

- An Actuator Switch acts on the state of a specific device. Given a device, one should be able to know what are the switches that can act on it.
- A Smart-Meter measures the energy consumption of the energy grid at a certain point of the energy grid.
- Electric power systems can exchange electricity with other electric power systems. The electric energy can flow both ways in some cases (from the Public Grid to a Prosumer), or in only one way (from the Public Grid to a Load). Electric power systems can be made up of different sub-systems. Generic sub-types of electric power systems include producers, consumers, storage systems, transmission systems. The properties that are relevant for these systems include power production, consumption, energy stored. These properties may be measured or acted on by IoT devices.
- Electric power systems may be connected one to another through electrical connection points. An Electric power system may have multiple connection points (Multiple Winding Transformer generally have one single primary winding with two or more secondary windings). Generic sub-types of electrical connection points include plugs, sockets, direct-current, single-phase, three-phase, connection points. The properties that are relevant for these connection points include Voltage, Resistance, Conductance, Reactance, Susceptance, and can be measured between two wires of the connection points.
- An Electrical connection may exist between two Electric power systems at two of their respective connection points. Generic sub-types of electrical connections include Single-phase Buses, Three-phase Buses. A single-phase electric power system can be connected using different configurations at a three-phase bus (RN, SN, TN types). The properties that are relevant for a three-phase electric bus include voltage between the different wires R, S, T, N (R-to-N, S-to-N, R-to-S, etc.). IoT devices can be used to measure and control this voltage at different points of the grid.

6.2.2 Kinds of measures

- Every electric power device potentially consumes and produces electric power, and stores electric energy. Over a given period of time, different Smart Meters may measure different aggregated values for these quantities. E.g. cumulative (sum), maximum, minimum, average.
- Quantities that evolve periodically are usually described in terms of their frequency, the peak, RMS amplitude, THD of the quantity value. Smart Meters may measure different aspects of a direct current, single-phase alternating current, or three-phase alternating electric current.

- Some properties are controllable, such as the consumption or production of electric power systems. The reduction, augmentation, cut, move flexibility, of a specific controllable property can be evaluated (and valuated).

6.3 Use case 2: Smart Building

6.3.0 Introduction

New SAREF ontology patterns can be used to homogeneously represent knowledge that is relevant for use cases in the Smart Building domain.

6.3.1 Types, topology, and properties, of the Features Of Interest

- A light switch acts on the luminosity of a specific room. Given a room, one should be able to know what light switch may be used to change the luminosity in this room.

- Temperature Sensors, Heaters, Coolers, observe or act on a specific zone of a building. Given a zone, one should be able to know what are the devices that observe or act on the temperature in this zone.

- Buildings, Storeys, Spaces, are different sub-types of Zones. Zones can contain sub-zones. Zones can be adjacent or intersect with other zones. The properties that are relevant for these systems include temperature, luminosity, humidity, pressure, population. These properties may be measured or acted on by IoT devices.

- Two zones may share one or more connections. For example some fresh air may be a created inside a storey if it has two controllable openings to the exterior at different cardinal points. Different properties may be relevant depending on the connection between zones. Observing and controlling the flow of humans or animals, total heat transfer, pressure difference, wind speed, may be relevant for controllable openings.

6.3.2 Kinds of measures

- Temperature, pressure, humidity, can be observed or acted upon by dedicated IoT devices. An observation may be instantaneous, or aggregated over a period of time: maximum, minimum, average. Derived properties may be evaluated, like the number of occurrences for a certain temperature rising above a threshold.

- Depending on the quantity, derived quantities may be observed such as the sum (interesting for properties like flows of humans/animals, or rain precipitation), or the growth rate (important for controlling the pressure in specific zones like planes or cleanrooms).

7 Analysis of the modularization and factorization potential of SAREF

7.1 Introduction

This clause provides an analysis of the potential of modularization and factorization of the SAREF core ontology (V2.1.1) (ETSI TS 103 548 [i.2]). It highlights inter-dependent parts of the ontology, parts that are more or less *central*, and parts that are repeated homogeneously for different concepts (patterns). The result of this analysis is illustrated on Figure 1, and detailed in the next clauses.

7.2 Modularization

In Figure 1, a box illustrates a module constituted by a subset of concept declarations and axioms of SAREF core (V2.1.1) (ETSI TS 103 548 [i.2]). Each module has a label in bold font, and the lower part of the box lists the concept declarations that belong to this module. Axioms are not shown in Figure 1. For example, the box labelled **Service-core** contains the concept declarations and axioms related to the terms `saref:Service`, `saref:isOfferedBy`, `saref:offers`, `saref:represents`. The terms `saref:Function` and `saref:hasFunction` will also be grouped in one single module because they share a similar name.

A directed link between two boxes illustrate a dependency between the two modules. The label of a link explicits the rationale, and potentially the condition, for this dependency. For example, the module **Service-core** depends on the module **Functions and Commands** because there exists an axiom in SAREF stating that every `saref:Service` represents some `saref:Function`. Therefore, `saref:Service` cannot be defined without the `saref:Function`. In general, restrictions such as existential cardinality restrictions and minimal cardinality restrictions are used to decide on the direction of a dependency.

The grouping of concept declaration and axioms of SAREF in modules and the orientation of the dependencies between modules is partly made by choosing to view SAREF according to a certain perspective, and partly for intuitive reasons. For example, it makes sense to consider that `saref:Property` can be defined independently of `saref:Measurement`, but not the other way around. Therefore, the dependency link will be oriented from **Measurement-core** to **Property-core**.

It is necessary to group the concepts and axioms related to functions and commands into one single module **Functions and Commands**, because there exists axioms in SAREF stating that every `saref:Function` is associated to at least one `saref:Command`, and vice versa.

This analysis can be used to discuss conceptual issues in the axiomatization of SAREF. For example, SAREF (V2.1.1) (ETSI TS 103 548 [i.2]) contains an axiom that specifies that every `saref:Task` is accomplished by at least one `saref:Device`. This results in the module **Task-core** depending on the module **Device-core**, which is odd. In fact, tasks should be defined independently of devices.

Second, this analysis can be used to modularize SAREF core (V2.1.1) (ETSI TS 103 548 [i.2]): modules or group of modules with no incoming dependencies are not required for other modules. They could be safely filtered out in the documentation on the portal or in some embedded implementation of SAREF, without impacting the rest of the documentation or application. For example, the two modules **Service-core** and **specific Service** have no incoming dependency, therefore they are not essential to the specification of the rest of the ontology.

7.3 Factorization

In Figure 1, a box with an underlined label represents a pattern which can be applied to different concepts. For example, the pattern **specific Sensor** can be instantiated for `saref:SmokeSensor` and `saref:TemperatureSensor`. The pattern **specific Function** can be instantiated for `saref:ActuatingFunction`, `saref:OpenCloseFunction`, etc.

These instantiated patterns have dependency links with other modules, and potentially other patterns. The latter are to be understood as dependencies between two specific pattern instances. For example, the instance of pattern **specific Function** for `saref:OpenCloseFunction` has a dependency to instance of pattern **specific Command** for `saref:OpenCommand` and `saref:CloseCommand`, because they are the types of commands this function can have.

This factorization analysis is used to extract the existing ontology patterns in SAREF core (V2.1.1) (ETSI TS 103 548 [i.2]). Future evolutions of SAREF may progressively migrate to using languages and tools to generate the ontology from patterns and some description of the instances of these patterns. A proof of concept of such a pattern instantiation mechanism for SAREF is implemented using the SPARQL-Generate RDF transformation language [i.12].

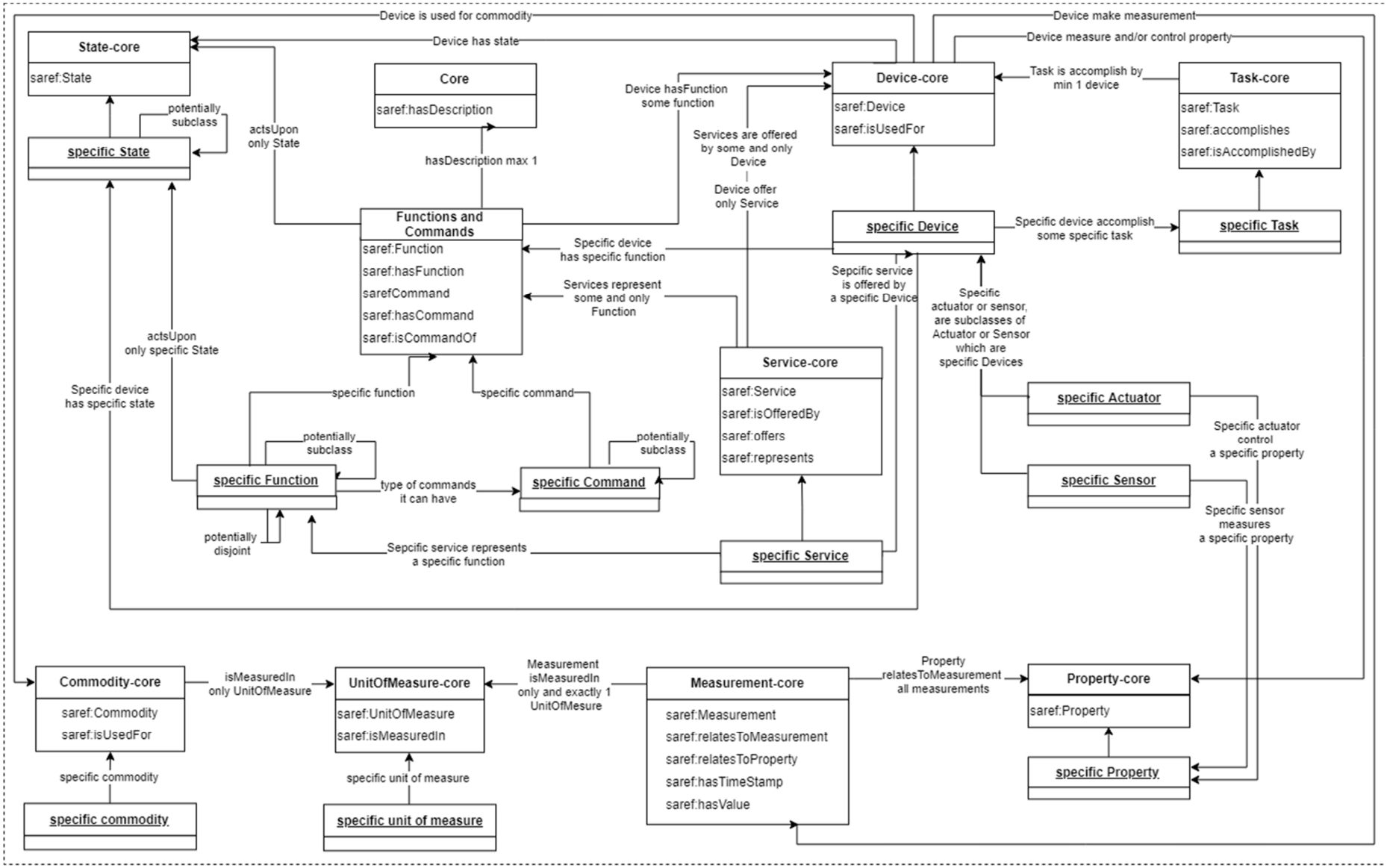

Figure 1: Analysis of the modularization and factorization potential of SAREF-Core (V2.1.1)

8 Ontology patterns

8.1 Introduction

This clause presents the ontology patterns for SAREF resulting from:

- the incorporation of SEAS and SSN core ontology patterns, resolving any incompatibility that could arise with SAREF in the process;
- the specification of the common patterns that form the backbone of the SAREF family of ontologies.

8.2 Functions, commands, states, services

In SAREF, sensing, actuating, metering, are kinds of functions. Usually, a function (e.g. `saref:StartStopFunction`) has one or more commands to trigger it (e.g. for `saref:StartStopFuncton`, this should be either a `saref:StartCommand` or a `saref:StopCommand`). Some commands act upon some state (`saref:StartStopCommand` acts upon some `saref:StartStopState`).

There is an implicit ontology pattern that is used for functions, commands, states, in SAREF. This clause will explicit this pattern.

NOTE 1: Some `saref:Commands` have a "generic" instance.

NOTE 2: `saref:StepUpCommand` and `saref:StepDownCommands` could be defined as specific kinds of `saref:SetRelativeLevelCommand`.

NOTE 3: SAREF also has a command named `saref:PauseCommand`, which is associated with no Function.

The meaning of Commands in SAREF is different from the meaning of Commands in SEAS. Instead, it is very close to the meaning of the SEAS Sensing, Actuating, Forecasting, Planning, Metering, are Procedures. SEAS specifies that an input and output of the procedures can be described. Devices can "implement" and "execute" these procedures. The Executions of these procedures have commands and results (see Figure 2).

The ontology pattern for functions, commands, states, in SAREF, should be augmented with the input, output, and the description of the executions of these commands.

NOTE 4: In SAREF, a device may implement all the commands of a function it has, as "a package". It may be interesting to link a device directly to a specific command.

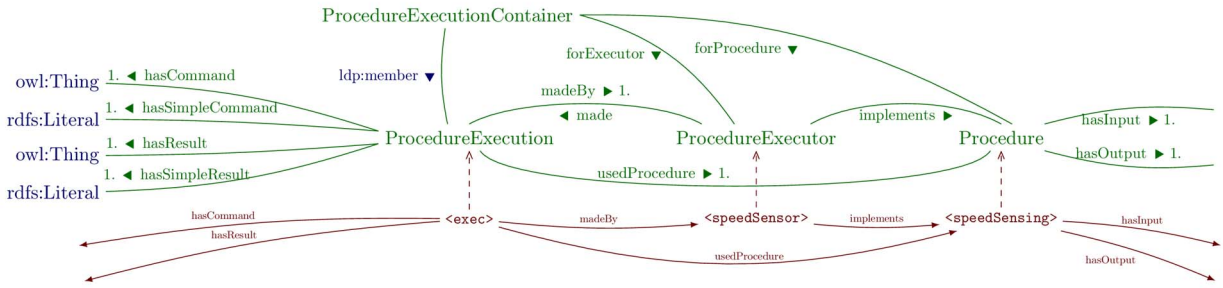

Figure 2: The PEP pattern: IoT Devices implement procedures and make executions of these procedures (activities)

In SAREF, Service is defined as 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. […]"*. Although multiple commands are defined (on, off, start, stop, …) only one type of service is defined: `saref:SwitchOnService`. Other such services should be defined for each of the other kind of commands.

Table 1 list generic requirements for ontology patterns related to functions, commands, states, services.

Table 1: Guidelines to write requirements for instantiations of the "Functions, commands, states, services" ontology patterns

Id	Requirement
F-1	**A {#Device} that implements a function {#Function} has commands for {#list of possible Commands}.**
Example	A window opener that implements an open/close function does implement commands for opening and closing the window. A heater that implements an on/off function does implement commands for turning on or off the heater.
F-2	**A {#ActuationFunction} of a {#actuator} acts on a {#State or Property} of a {#Feature of Interest}.**
Example	An *open/close* function of a window opener acts on the open/close state of a window. A level control function of a heater acts on the temperature of a space.
F-3	**A {#SensingFunction} of a {#sensor} observes the {#State or Property} of a {#Feature of Interest}.**
Example	A *sensing* function of a temperature sensor measures the temperature of a room.
F-3	**A {#EventFunction} of a {#sensor} watches the {#State or Property} of a {#Feature of Interest}.**
F-3	**A {#MeteringFunction} of a {#meter} provides measures about the {#State or Property} of a {#Feature of Interest}.**
Example	A *metering function* of a smart meter measures the RMS amplitude, THD, peak value for the voltage and current between every pairs of R, S, T, N wires of an electrical connection point, and the cumulative consumption of the associated electric power system.

8.3 Features Of Interest, states and properties

Features Of Interest are of high relevance for the IoT domain. Measurements and actuations are made for properties of specific Features Of Interest. Features Of Interest may also have states. For example, not only devices can be in Open and Close state, but also a Door or a Window.

The meaning of `seas:Property` generalizes the concepts of `saref:State` and `saref:Property`. A `seas:Property` is specific to a feature of interest and can be observed, acted on, forecasted, planned, estimated.

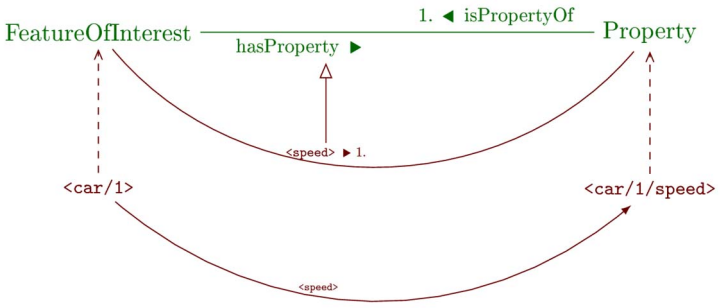

Figure 3: Illustration of the FOI pattern from SEAS

The SAREF saref:Property as defined in SAREF may be aligned with the SEAS seas:Property concept. In addition, SEAS proposes a mechanism to avoid artificially duplicate properties such as saref:InactiveDurationMin, saref:InactiveDurationMax, saref:ActiveDurationMax, saref:ActiveDurationMin, saref:ActiveDurationSumMax, saref:ActiveDurationSumMin, etc. These artificially duplicated properties raise issues such as: which of them is the one a sensor observes, or an actuator acts upon. The SEAS approach consists in linking a Feature of interest to only one instance of the Property class through a relationship named seas:activeDuration. Then this instance of a property can be of a generic type seas:DurationProperty, and be observed by a sensor or be acted on by an actuator. SEAS also assumes that sub-classes of seas:Property hold the information about the *quantity kind* of the property such as seas:PowerProperty, seas:PercentProperty, seas:OpenCloseStatus, whereas the relationships that link the feature of interest to the instances of properties would be named seas:electricConsumption, seas:humidity, or seas:windowOpenCloseStatus. There is no distinction among the properties regarding the way they are qualified or quantified. A property may be quantified using literals having any datatype, or also using named individuals that may be further qualified elsewhere. It is therefore possible to define a property such as seas:operator of a machine, provided that there is only one such seas:operator at any point in time. A face recognition sensor may observe this property, and detect who the current operator is (a person identified by his/her own IRI). The way one may associate actual values with a property or state is defined in clause 8.4.

Therefore, the proposal for SAREF is:

- to introduce the concept saref:FeatureOfInterest, which has e.g. saref:Device as a sub-class;
- to make saref:State a sub-class of saref:Property;
- to define three intricated patterns for extending the saref:FeatureOfInterest, and saref:Property classes, and the saref:hasProperty relationship;
- keep the state instances.

Table 2 lists generic requirements for ontology patterns related to Features Of Interest, States, Properties.

Table 2: Guidelines to write requirements for instantiations of the "Feature Of Interest, states and Properties" ontology patterns

Id	Requirement
FOI-1	**A {#Feature Of Interest} is either in {#possible values for State} states.**
Example	A door is either in Open or Closed state. A heater is either in On or Off state.
FOI-2	**A {#Feature Of Interest} has a {#Property}, of kind {#Super-Property}.**
Example	A *hydraulic cylinder* has a unique, of kind *length.* A room has a temperature, of kind temperature.
FOI-3	**A {#Sensor} observes the {#State of PropertyKind} of a {#Feature Of Interest}**
Example	A temperature sensor observes the Temperature property of a room.
FOI-4	**A {#Actuator} acts on the {#State of PropertyKind} of a {#Feature Of Interest}**
Example	An heater acts on the temperature property of a room. A window opener acts on the open or close state of a window.
FOI-5	**All those Features Of Interest that have a {?property} are of type {?featureOfInterest}**
Example	All those Features Of Interest that have a *speed* are of type *mobile object.* All those Features Of Interest that have a *position* are of type *geolocated object.*
FOI-3	**The {?property} of any feature of interest is a {?propertyKind}**
	The consumedElectricalPower of any feature of interest is a PowerProperty.

8.4 Characterizing states and properties

SEAS defines the class seas:Evaluation as a means to assign a value to a property or a state. This seas:Evaluation class may be aligned to the saref:Measurement class in SAREF. Integrating the seas:Evaluation in SAREF adds interesting representational capabilities on top of the saref:Measurement. SEAS defines different patterns that can be instantiated in different verticals.

The evaluation is true when each of its validity contexts are true. A validity context may be a temporal context, described with the OWL Time ontology, it may also be a spatial context described with geoSPARQL (the temperature in a certain part of the city), or any other condition (e.g. other evaluations of other properties). Again, SEAS decouples the sub-class of evaluations and the sub-classes of properties. Sub-classes of Evaluation describe the aspect of the evaluation of the property over the given context that is given a value to. For example, considering the property `seas:speed` of a car (an instance of the type `seas:CelerityProperty` which is specific to a certain car), evaluations of the car may be a diverse as follows:

- the average speed of the car on a certain portion or road;
- the current speed of the car;
- the maximum operating speed of the car (in any context);
- the number of times the car speeded above 100 km/h during the past hour;
- the duration during which the car was speeding above 100 km/h during the past hour;
- the maximum derivative value of the speed of the car (an acceleration value) during the past hour;
- a multi-valued state (very-slow, slow, fairly-fast, fast, very-fast).

The actual value (a literal or a named individual) is linked through the relation `seas:evaluatedSimpleValue` (for literals) and `seas:evaluatedValue` (for named individuals). Literals may be of any datatype, such as `cdt:ucum` for quantities, `xsd:int` or `xsd:boolean`, or any other datatype. Named individuals may be instances of states (On, Off), an instance of `qudt:QuantityValue` or `om:Measure` (with a unit of measure and a float or a double), or anything else.

Comparatively, the concept `saref:Measurement` is:

- only for properties (not states);
- mandatorily for `xsd:float` values, with a unit of measures (no integer or boolean);
- valid at a certain time stamp (not in a more general context such as time interval and geolocation);
- not linked to the actual feature of interest whose property is quantified;
- not heavily specialized in SAREF extensions (only a flat list of quantities is defined).

Therefore, the proposal is to deprecate the `saref:Measurement` class and use instead the `seas:Evaluation` pattern.

Figure 4 illustrates the SEAS pattern for characterizing states and properties, and the way it may enrich the concept of SAREF `saref:Measurement`, illustrated on Figure 5.

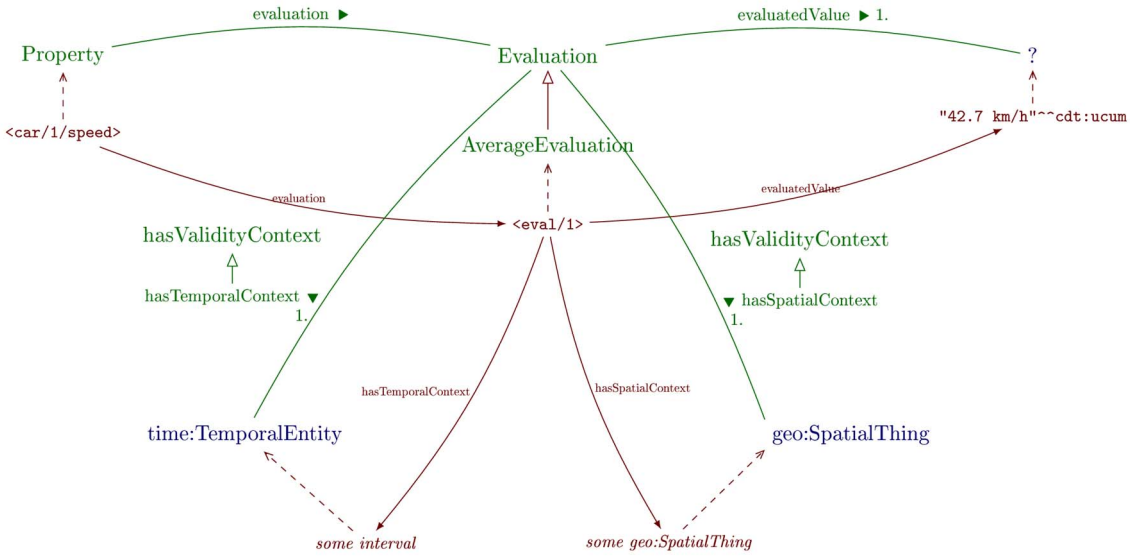

Figure 4: Illustration of the Evaluation pattern from SEAS

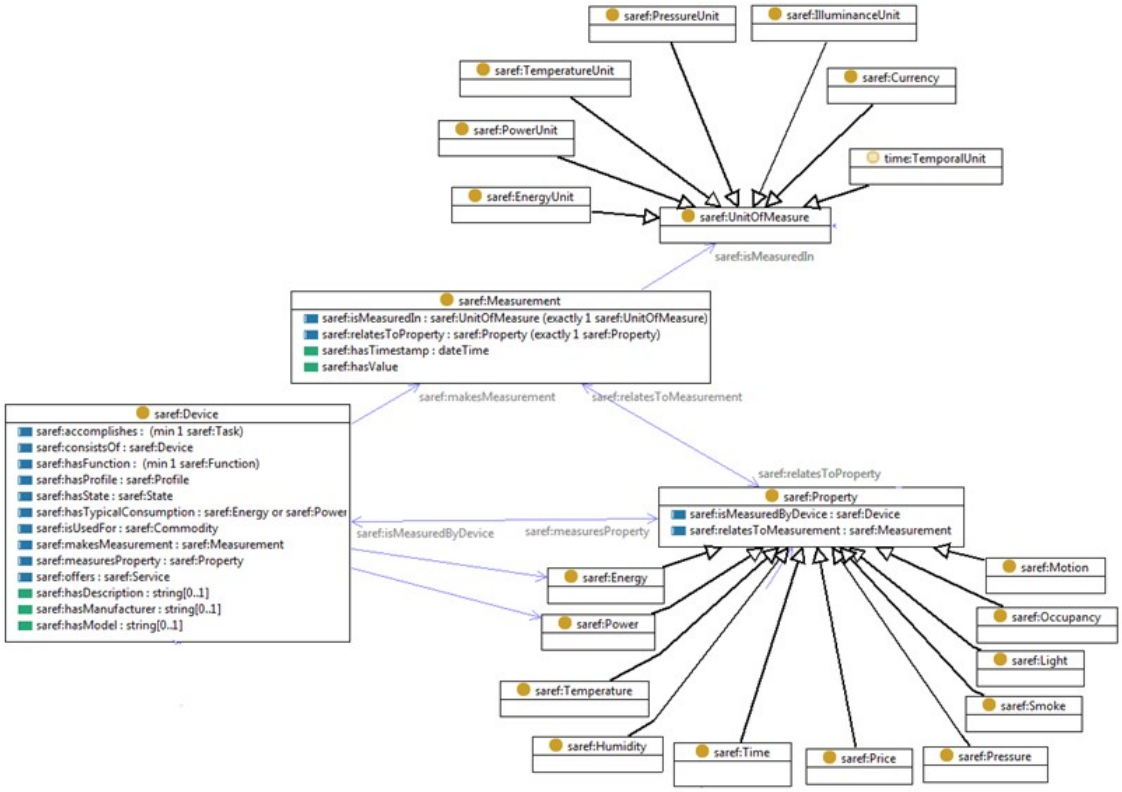

Figure 5: Illustration of the Measurement class in SAREF (V2.1.1)

8.5 Features Of Interest, properties and devices

Features Of Interest (FOIs) are of high relevance for the IoT domain including also sub-domains as Smart Cities and Smart Agriculture. For example, when generating KPIs as city indicators, such indicators might be related to a given feature of interest in the city. In addition, FOIs might have one or more properties to be observed, for example, one can measure the average speed or the CO_2 level of a road or the moisture level or the type of soil of a crop.

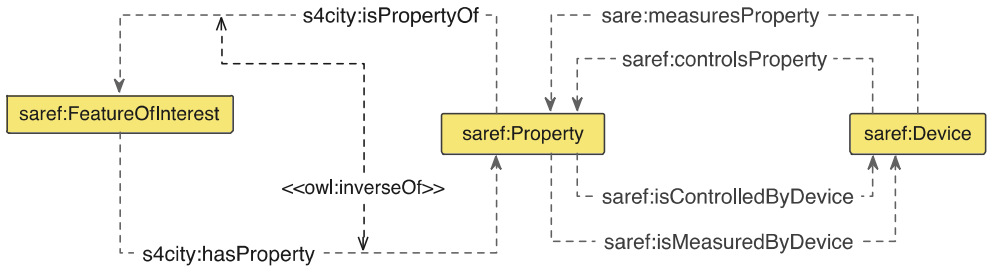

Figure 6: The FoIPD Pattern: Feature of Interests their properties and devices controlling them

Table 3 lists generic requirements for ontology patterns related to Features of Interest, Properties and Devices.

Table 3: Guidelines to write requirements for instantiations of the "Feature Of Interest, Properties and Devices" ontology pattern

Id	Requirement
FOIPD-1	**A {#FeatureOfInterest} has one or more {# Property}.**
Example	A road has average speed and CO_2 level. A crop has moisture level and a certain type of soil.
FOIPD -2	**A {#Device} controls a {#Property}.**
Example	A watering gun controls the soil moisture.
FOIPD -3	**A {#Device} measures a {#Property}.**
Example	A CO_2 sensor measures the CO_2 level.

8.6 Platform, system and deployment

In some situations, it is needed to represent systems and their deployments within IoT broader systems. This deployment might also include the platform. For example, when modelling a Smart Irrigation set up, it is needed to represent the whole system including its devices and the platform that hosts the system and in which the system is deployed.

These needs are aligned with the SSN/SOSA ontology in which the core model for representing platforms, systems and deployments is included. Some additional information might be plugged into the SSN/SOSA modelling as for example temporal or spatial information about a given deployment.

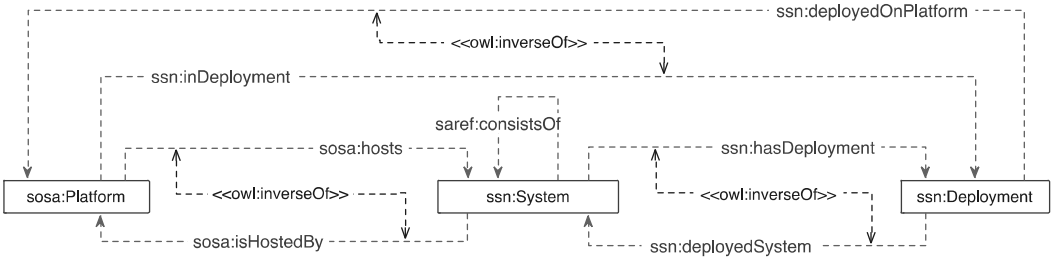

Figure 7: The PSD pattern: platforms host systems in deployments

Table 4 lists generic requirements for ontology patterns related to Platforms, Systems and Deployments taken from the SSN/SOSA ontology. The modelling of these requirements is not included in the SAREF ontology; however, the SSN/SOSA ontology can be reused for that task.

Table 4: Guidelines to write requirements for instantiations of the "Platform, system and deployment" ontology pattern

Id	Requirement
PSD-1	**A {#System} consists of one or more {#System}.**
Example	A smart irrigation system consists on a mobile pluviometer, a weather station, one or more tensiometers, and a rain gun.
PSD-2	**A {#Platform} hosts a {#System}.**
Example	A field hosts a smart irrigation system.
PSD-3	**A {#System} has a {#Deployment}.**
Example	A smart irrigation system is deployed in a given piece of land in a given period of time.
PSD-4	**A {#Deployment} is deployed on a {#Platform}.**
Example	A smart irrigation system specific deployment is deployed on a given field.

8.7 Systems, connections and connection points

8.7.0 Introduction

The topology of the Features Of Interest is highly important in many use cases. If a room holds a lighting device, and if it is adjacent with an open window to a room whose luminosity is low, then by turning on the lighting device in the former room one may expect that the luminosity in the latter room will rise. SEAS defines `seas:Systems`, `seas:Connections` between systems, and `seas:ConnectionPoints` at which systems may be connected. These core concepts can be used generically to define the topology of Features Of Interest, and are specialized for multiple domains.

8.7.1 Systems

A `seas:System` is defined as a part of the universe that is virtually isolated from the environment. The system properties are typically state variables (e.g. consumed or stored energy, agent population, temperature, volume, humidity). Figure 8 illustrates classes and properties that can be used to define connected `seas:systems` and their sub-systems.

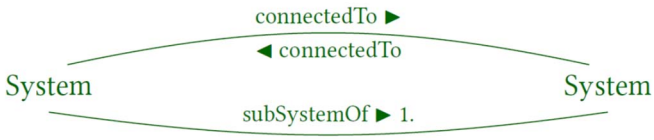

Figure 8: Illustration of systems and their connections in SEAS

A `seas:System` may be connected to other `seas:systems` that are part of its environment. This is modelled by a property named `seas:connectedTo`, which is symmetric. For example:

```
<electric_vehicle> :connectedTo <electric_vehicle_service_equipment>.
```

Connected systems interact in some ways. The exact meaning of interact is defined by sub properties of `seas:connectedTo`. For example, for the electricity to directly flow between an electric vehicle service equipment `<electric_vehicle_service_equipment>` and an electric vehicle `<electric_vehicle>`, then they should be linked by property `seas:exchangesElectricityWith`.

```
<electric_vehicle> seas:exchangesElectricityWith
<electric_vehicle_service_equipment>.
```

A `seas:system` can be a sub-system of a unique other `seas:system`. This is modelled using property `seas:subSystemOf`, which is asymmetric and functional. For example:

```
<battery> seas:subSystemOf <electric_vehicle>.
```

Properties of subsystems somehow contribute to the properties of the super system. The exact meaning of this contribution is defined by sub properties of `seas:subSystemOf`. For example, if one wants to model the fact that the consumption power of a fridge `saref:<fridge/1>` contributes to the consumption power of the kitchen, `<kitchen/1>`, then one may use a sub-property of `seas:subSystemOf` named `seas:subElectricPowerSystemOf`:

```
<fridge/1> seas:subElectricPowerSystemOf <kitchen/1>.
```

8.7.2 Connections

A connection between two systems, modelled by `seas:connectedTo`, describes the potential interactions between connected systems. A connection can be qualified using class `seas:Connection`. For example, one can then associate this connection with properties that describe the interactions between the connected systems (e.g. population flow, exchange surface, contact temperature). Figure 9 illustrates classes and properties that can be used to qualify connections between systems.

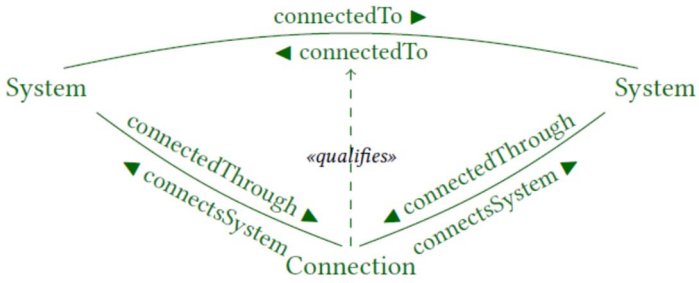

Figure 9: Illustration of Systems and Connections in SEAS

For example, a power connection between power systems describes the fact that these systems may exchange electricity.

```
<connection> seas:connectsSystem <electric_vehicle>,
<electric_vehicle_service_equipment>.
<electric_vehicle> seas:connectedThrough <connection>.
<electric_vehicle_service_equipment> seas:connectedThrough <connection>.
```

8.7.3 Connection points

A system connects to other systems at connection points. A connection point belongs to one and only one system, and can be described using the class `seas:ConnectionPoint`. Figure 10 illustrates the classes and the properties that can be used to describe connection points of a system.

For example, an electric vehicle charging station may have three connection points: two plugs of different kind to which electric vehicles can connect, and a three phase connection point to the public grid:

```
<electric_vehicle> seas:connectsAt <plug_high_voltage>, <normal_plug>,
<three_phase_connection_point>.
```

One can then associate a connection point with properties that describe it (e.g. position and speed, voltage and intensity, thermic transmission coefficient).

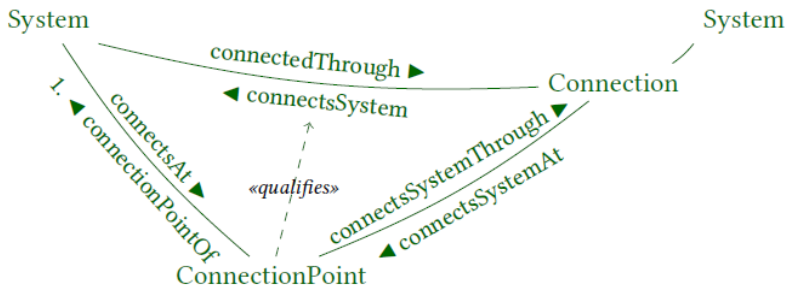

Figure 10: Illustration of systems, connections and connection points in SEAS

8.7.4 Instances of the ontology pattern

This ontology pattern can be instantiated for different domains. For example to describe zones inside a building (systems), that share a frontier (connections). Properties of systems are typically state variables (e.g. agent population, temperature), whereas properties of connections are typically flows (e.g. heat flow).

Currently 173 subclasses of `seas:System`, 42 subclasses of `seas:Connection`, and 32 subclasses of `seas:ConnectionPoint`, may be integrated in SAREF. The use cases that are covered are:

- `seas:ThermodynamicSystemOntology` defines thermodynamic systems that can exchange heat with one another, and that have sub-thermodynamic systems.
- `seas:CommunicationOntology` defines communication devices that can have multiple communication connection points with various protocols, and exchange information when they are connected through a communication connection.
- `seas:ZoneLightingOntology` defines light sources that can illuminate illuminable zones, which can then transmit light to other illuminable zones.
- `seas:TradingOntology` defines electricity traders that can trade electricity with one another, or trade electricity on various electricity markets.
- `seas:ElectricPowerSystemOntology` defines electric power systems that can exchange electricity with other electric power systems via electric power connection points. This module is the biggest and most detailed SEAS module. It has been developed in collaboration with researchers from EMSE and GECAD/ISEP in August 2016, and allows to describe precisely the typology of electric grids, the electric power systems that compose it (transmission systems, transformers, producers, consumers, storage systems), and the configuration in which they are connected via power buses they can share that depend on the current type of the connected system.

8.8 Concept hierarchy extension

In most of the SAREF extensions, it has been observed the need for extending concepts in order to represent domain-specific knowledge. The simplest case is the need for representing domain-specific devices. For example, in SAREF4ENVI [i.4] there are lampposts and photometers included as subclasses of `saref:Device` and in SAREF4BLDG [i.5] there is a hierarchy of 61 devices under `saref:Device`. But this is not the only case in which a concept defined in SAREF needs to be extended in an extension, the following examples use concepts from the SAREF4ENVI extension:

- `saref:Measurement` extended by `s4envi:FequencyMeasurment`; `s4envi:HeightMeasurement` and `s4envi:PeriodMeasurement`;
- `saref:UnitOfMeasure` extended by `s4envi:FrequencyUnit`;
- `saref:Property` extended by `s4envi:LightProperty`.

It should be mentioned that the SAREF ontology also presents specializations of some concepts such as:

- saref:Device (extended by saref:BuildingRelated, saref:EnergyRelated; and
- saref:FunctionRelated) or saref:Function (extended by saref:ActuatingFunction;
- saref:EventFunction, saref:MeteringFunction and saref:SensingFunction).

Some examples of this pattern taken from SAREF4ENVI and SAREF4BLDG are shown in Figure 11.

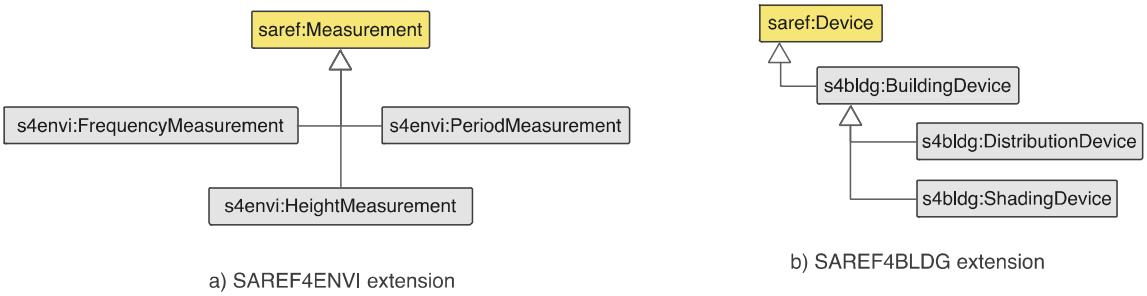

Figure 11: "Concept hierarchy extension" pattern examples in SAREF4ENVI and SAREF4BLDG

Table 5 lists generic requirements for ontology patterns related to extending concept hierarchies taken from SAREF, SAREF4ENVI and SAREF4BLDG ontologies.

Table 5: Guidelines to write requirements for instantiations of the "Concept hierarchy extension" ontology pattern

Id	Requirement
CHE-1	**A {#SpecificConcept} is a type of {#Concept}.**
Example	A lamppost is a type of device.
Example	A photometer is a type of sensor.
CHE-2	**There are different types of {#Concept}: {#SpecificConcept1}, {#SpecificConcept2}...**
Example	There are different types of building devices: distribution devices, shading devices, etc.
CHE-3	**The {#Concept} can be classified into {#SpecificConcept1}, {#SpecificConcept2}...**
Example	The devices can be classified into categories: function related, energy related and building related.

8.9 Concept specialization

A specific case of concept extension occurs when the concept to be extended is not extended by a restricted version of itself. That is, in the CHE pattern (see clause 8.8) a concept is extended by a hyponym, that is, device is extended by photometer. In the concept specialization pattern the extended concept is the concept itself together with a number of local axioms that restrict the semantics of the concept in a given domain. For example, in the SAREF4ENVI (ETSI TS 103 410-2 [i.4]) ontology the concept `saref:Device` is extended by `s4envi:Device` which includes local axioms for the properties `s4envi:hasTransmissionPeriod`, `s4envi:hasVersion`, `s4envi:hasRevisionNumber`, among others. Figure 12 presents an example of this pattern.

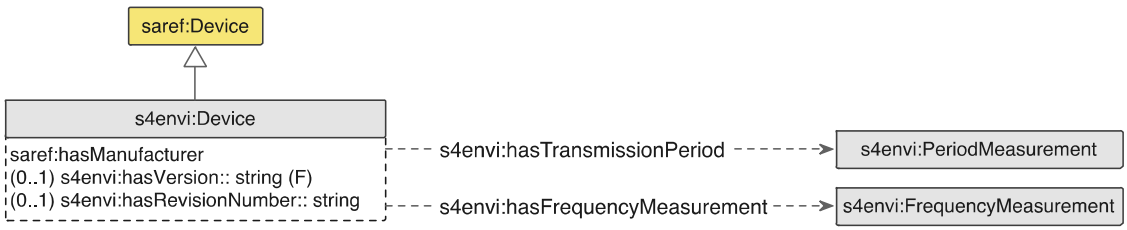

Figure 12: "Concept specialization" pattern example in SAREF4ENVI

Table 6 lists generic requirements for ontology patterns related to concept specialization taken from the SAREF4ENVI ontology.

Table 6: Guidelines to write requirements for instantiations of the "Concept specialization" ontology pattern

Id	Requirement
CS-1	**A {#ExistingConcept} {#property} {#AuxConcept}.**
Example	A device has a transmission period.

8.10 Concept instantiation

It has been observed, through SAREF and its extensions, the need for defining specific instances of some classes included in the modelling. For example, the class `saref:Task` includes in the SAREF ontology instances like `saref:Cleaning`, `saref:Drying`, `saref:Lighting`, etc. This pattern also appears in the SAREF4ENVI extension in different ways, namely, for providing instances of the subclasses of `saref:UnitOfMeasure` or by including instances of `saref:Property` and its subclasses.

Figure 13 depicts two examples of this pattern in the SAREF4ENVI ontology. As it can be observed, for the case of instances of properties, the individuals representing particular properties have been defined in the SAREF4ENVI namespace. However, for the case of unit of measure, the instances have been reused from existing ontologies, in this case the Unit of Measure ontology [i.13].

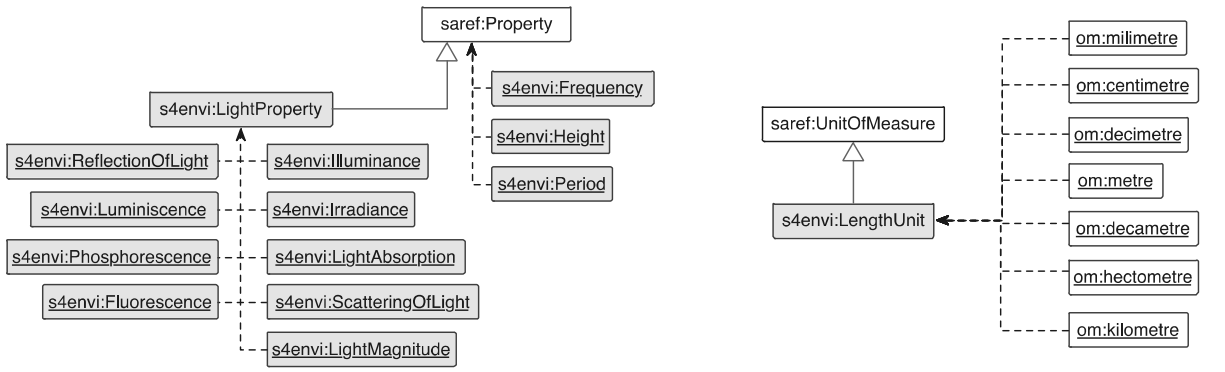

Figure 13: "Concept instantiation" pattern example in SAREF4ENVI

Table 7 lists generic requirements for ontology patterns related to instantiation taken from the SAREF4ENVI ontology.

Table 7: Guidelines to write requirements for instantiations of the "Instantiation" ontology pattern

Id	Requirement
Inst-1	**A {#Concept} may be {#individual1}, {#individual2}...**
Example	A property may be frequency, height or period.
Inst-2	**Examples of {#Concept} are {#individual1}, {#individual2}...**
Example	Examples of light properties are illuminance, irradiance or luminescence.
Inst-3	**{#individual1} or {#individual2} are examples of {#Concept}.**
Example	Phosphorescence or fluorescence are examples of light properties.

9 Issues and recommended resolution in SAREF

This clause lists proposed resolutions for identified issues in SAREF (V2.1.1) [i.2]. Reasons for adopting these resolutions are categorized as follows:

- BEST_PRACTICE: the identified issue contravenes best practices. Adopting best practices encourages the adoption of SAREF.
- CLARIFICATION: the identified issue makes SAREF misleading, or ambiguous, which may lead to mis-interpretations, and therefore interoperability issues.
- CRITICAL: the identified issue may cause bugs in systems that implement SAREF (e.g. inconsistent knowledge graph).
- NOT_USED: the identified feature is not used elsewhere in SAREF core or its extensions. It may have been added to SAREF core only for the purpose of illustrating a concept. Illustrating concepts should be moved to a separate document about examples.
- PERFORMANCE: the identified feature unnecessarily complexifies the semantics of SAREF, which may lead to performance issues.

There is a total of 36 proposals, some with multiple reasons. 9 issues are considered critical and could lead to inconsistencies in knowledge graphs. 23 issues are clarifications. 6 identified issues are proposed to be removed or changed because they are not documented in the SAREF Technical Specification, nor are they used in any of the SAREF extensions. 3 proposals relate to best practices that should be adopted to enhance the SAREF ontology.

These proposals are input for the development of SAREF v3. They have been discussed during online SmartM2M meetings, added on the ETSI forge of the group https://forge.etsi.org/gitlab/SAREF/ and are being progressively implemented.

Proposal 1. Change ranges of datatype properties to `rdfs:Literal`
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/1
Category: CRITICAL
Affects: SAREF and its extensions
Situation: Right now, the range of datatype properties is defined as `xsd:string`. This does not include strings with language tags (`rdf:langString`).
Proposal: To change the ranges of datatype properties to `rdfs:Literal`.
Status: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08

Proposal 2. Remove strong cardinality restriction in `saref:hasDescription`
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/2
Category: CRITICAL
Affects: SAREF
Situation: `saref:Command` has max 1 `saref:hasDescription`. This may cause a critical bug (inconsistent knowledge graph) if one defines more than one description.
Proposal: To remove the maximum cardinality axiom in `saref:hasDescription`.
Status: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08

Proposal 3. Review terms not used in the SAREF extensions
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/3
Category: NOT_USED
Affects: SAREF
Situation: Some terms are not used in the SAREF extensions, but may be used by users of SAREF:
- `saref:hasDescription`
- `saref:hasName` (hasName is now actually encoded inside the URI of the class)
- EnergyRelated, FunctionRelated, BuildingRelated

Proposal: To delete these terms.
anywhere in the spec where `saref:description` is used, recommend the use of `dcterms:description` instead
Status: `saref:hasDescription` and `saref:hasName`: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08

Status: other classes: agreed during SmartM2M-2nd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-06

Proposal 4. Review terms not mentioned in the SAREF TS
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/4
Category: NOT_USED
Affects: SAREF
Situation: Some terms appear in the ontology implementation but are not mentioned in the SAREF TS:

- `saref:hasThresholdMeasurement`
- `saref:hasMeterReading`
- `saref:hasMeterReadingType`
- `saref:hasSensingRange`
- `saref:hasSensorType`

Proposal: To review these terms and to analyse whether to mention them in the TS (giving a proper motivation) or to remove them without affecting others, or we make in a section of the TS that sometimes in the ontology file there are concepts that are there just for examples, and can be used.
Status: discussed during SmartM2M-3rd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-09

Proposal 5. Clarify descriptions of some terms
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/5
Category: CLARIFICATION
Affects: SAREF
Situation: Some term definitions can be clarified to avoid misunderstandings:

- (The definition of `saref:EventFunction` is too strict compared to what the name suggests):
  - `saref:EventFunction` - A function that allows to notify another device that a certain threshold value has been exceeded
  - **Proposal:** change definition to: A function that allows to notify another device that some event occurred, for example that a certain threshold value has been exceeded
- (`saref:isUsedFor` is used to link devices to commodities. Not to control function or command):
  - `saref:isUsedFor` - A relationship specifying the purpose for which a device is used for (e.g. controlling a `saref:Commodity`)
  - **Proposal:** change definition to: A relationship specifying the commodity for which a device is used for
- (Only properties can be measured in Profiles. Also, no record of usage of `saref:Profiles` for `saref:Commodity` in SAREF4ENER the only use of `saref:Profile` is for the property `saref:Power`):
  - `saref:Profile` - about a certain `saref:Property` (e.g. `saref:Energy`) or `saref:Commodity` (e.g. `saref:Water`)
  - **Proposal:** change definition to: about a certain `saref:Property` (e.g. `saref:Energy`)
- (Enforces the consistency of the definitions of the functions):
  - `saref:LevelControlFunction` - An actuating function that allows to do level adjustments of an actuator in a certain range (e.g. 0 %-100 %), such as dimming a light or set the speed of an electric motor.
  - **Proposal:** change definition to: An actuating function that allows to do level adjustments of the property of a device or a feature of interest in a certain range (e.g. 0 %-100 %), such as dimming the light in a room or setting the speed of an electric motor.
- (`saref:hasCommand` and `saref:isCommandOf` are inverse one of another. the subject of a `saref:hasCommand` relationship will most often be automatically classified as a `saref:Function`. This may lead to bugs in systems.):
  - `saref:hasCommand` - A relationship between an entity (such as a `saref:function`) and a `saref:command`
  - `saref:isCommandOf` - A relationship between a `saref:command` and a `saref:function`.
  - **Proposal:** change definition of `saref:hasCommand` to: A relationship between a `saref:function` and a `saref:command`
- `saref:Device` instances will be linked to `saref:function` instances. Not `saref:function` types. If some SAREF user uses them differently, it may lead to interoperability issues:
  - `saref:hasFunction` - A relationship identifying the type of `saref:function` of a `saref:device`

  - **Proposal:** change definition to: A relationship identifying the `saref:function` of a `saref:device`
- (only `saref:Device` can be associated with `saref:profiles`):
  - `saref:hasProfile` - A relationship associating a `saref:profile` to a certain entity (e.g. a device)
  - **Proposal:** change definition to: A relationship associating a `saref:profile` to a certain `saref:device` or feature of interest
- (This is misleading as this is a class, not an instance. There is usually more than one unit of measure for a quantity kind):
  - `saref:Currency` - The unit of measure for `saref:price`
  - **Proposal:** change definition to: The class of units of measures for `saref:price`
  - **Proposal:** to update the term definitions.

Status: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08

Proposal 6. To use `rdfs:comment` instead of `saref:hasDescription`
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/6
Category: BEST_PRACTICE
Affects: SAREF
Situation: There exists `rdfs:comment`, which is the recommended property to add a description to a concept. However, there is people already using the property (e.g. https://innoweb.mondragon.edu/ontologies/dabgeo/application_context/application_type/home_appliances_dr/appliance phase/1.1/index-en.html).
Proposal: To use `rdfs:comment` instead of `saref:hasDescription` and deprecate `saref:hasDescription`.
Status: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08

Proposal 7. Use language tags in labels and comments
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/7
Category: BEST_PRACTICE
Affects: SAREF and its extensions
Situation: this is a best practice, and translations in other languages may be provided in the future
Proposal: To use language tags @en instead of the `xsd:string` datatype for all labels and comments.
Status: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08

Proposal 8. Think of naming patterns Command / Device / command
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/8
Category: BEST_PRACTICE
Affects: SAREF and its extensions
Situation: instances of patterns may be identified in SAREF, but sometimes only partially, and with naming heterogeneities

procedure	act	obs	notif	meter
name of the command	ActuatingCommand	SensingCommand	NotifyingCommand	MeteringCommand
name of the device	Actuator	Sensor	Notifier	Meter
link between device and property	actsUpon	observes	notifiesAbout	measures

Proposal: There should be a clear classification/hierarchy that is common to `saref:Command`, `saref:Device`, `saref:Function`. And `saref:Property`. The current relation between commands and devices is partial and misleading.
Status: discussed

Proposal 9. Clarify link between service and command

URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/9
Category: CLARIFICATION
Affects: SAREF
Situation: there is no clear relationship between concepts switchOnService and OnCommand, although their name suggests there is. There is nothing specific about "On" in the description.
Proposal: Clarify/document the relationships between services, functions and commands in the documentation.Explain the link is in oneM2M.
Status: agreed during SmartM2M-2nd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-06. Open question: keep service in SAREF, or just import oneM2M , or just reuse a subset of oneM2M terms, without importing it ?

Proposal 10. Add a relationship between a function and the state or property it acts upon ?
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/10
Category: CLARIFICATION
Affects: SAREF
Situation: Only a `saref:command` can be linked to the state it acts upon. There is no relationship between a `saref:Function` and the `saref:State` or `saref:Property` it acts upon. There is no relationship between an `saref:Actuator` and the `saref:State` or `saref:Property` it acts upon.
(`saref:ControlsProperty` exists already). *Markus Maass: state belongs to properties, because devices consists of lots of properties*
Proposal: Discuss if these relationships need to be introduced.
Status: discussed during SmartM2M-2nd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-06 . Should be discussed further.

Proposal 11.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/11
Category: CLARIFICATION, CRITICAL
Affects: SAREF
Situation: From the combination of the two axioms below, a SAREF user may induce that there are two distinct switches. This would lead to wrong classification, and potentially make a knowledge graph inconsistent.
Axiom subClassOf(`saref:DoorSwitch saref:Switch`)
Axiom subClassOf(`saref:DoorSwitch` someValuesFrom(`saref:consistsOf saref:Switch`))Other concepts have the same situation: `saref:EnergyMeter` is asserted to be both a `saref:Meter` and some `saref:Device` that consists of a `saref:Meter`
Proposal: Remove the second axiom, for each of the impacted concepts
Status: agreed during SmartM2M-2nd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-06

Proposal 12.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/12
Category: CRITICAL
Affects: SAREF
Situation: A `saref:LightSwitch` is classified as an actuator. It does not measure light. But SAREF contains the following axiom:
Axiom subClassOf(`saref:LightSwitch` SomeValuesFrom(`saref:measuresProperty saref:Light`))
Proposal: Replace with `saref:controlsProperty`.
Status: agreed during SmartM2M-2nd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-06

Proposal 13.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/13
Category: BUG
Affects: SAREF
Situation: there exists temperature sensors who are not meant to accomplish comfort. But SAREF contains the following axiom:
Axiom subClassOf(`saref:TemperatureSensor` HasValue(`saref:accomplishes saref:Comfort`))
This happens in other places too, where the axiom was meant to provide examples, but has unwanted logical implications.
Proposal: Delete these axioms, and add a sentence at the end of the definitions to give an example of the task they can accomplish

Status: agreed during SmartM2M-2nd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-06

Proposal 14.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/14
Category: BUG
Affects: SAREF
Situation: The axiom below states that each and every task is accomplished by at least one device. This restriction is too strong and not necessary. One should be able to describe a task even if no device accomplishes it.
Axiom subClassOf(`saref:Task` ObjectMinCardinality (1 `saref:isAccomplishedBy` `saref:Device`))
Proposal: To remove these axioms.
Status: agreed during SmartM2M-2nd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-06

Proposal 15.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/15
Category: CLARIFICATION
Affects: SAREF
Situation: It is clear from some definitions of properties what the subject and/or the object is. If some SAREF user uses them differently, it may lead to interoperability issues:

- `saref:accomplishes`: A relationship between a certain entity (e.g. a device) and the task it accomplishes

From this definition, it is unambiguous that the object of a `saref:accomplishes` relationship is always a task.

- `saref:accomplishes` - A relationship between a certain entity (e.g. a device) and the task it accomplishes
  - domain is `saref:Command` and range is `saref:State`
- `saref:actsUpon` - A relationship between a command and a state
  - domain `saref:Command`, range `saref:State`
- `saref:controlsProperty` - A relationship specifying the Property that can be controlled by a certain Device
  - domain `saref:Device`, range `saref:Property`
- `saref:hasCommand` - A relationship between an entity (such as a function) and a command
  - domain `saref:Function` and range `saref:Command`
- `saref:hasFunction` - A relationship identifying the type of function of a device
  - domain `saref:Device` and range `saref:Function`
- `saref:hasMeterReading` - A relationship between a metering function and the measurement of the reading
  - domain `saref:MeteringFunction` and range `saref:Measurement`
- `saref:hasMeterReadingType` - A relationship identifying the reading type of a measurement (e.g. Water, Gas, Pressure , Energy , Power, etc.)
  - domain `saref:Measurement` and range `saref:Property`
- `saref:hasPrice` - A relationships identifying the price associated to an entity
  - range `saref:Price`
- `saref:hasProfile` - A relationship associating a profile to a certain entity (e.g. a device)
  - domain `saref:Device` and range `saref:Profile`
- `saref:hasSensingRange` - A relationship between a sensing function and a measurement identifying the range of a sensor detection
  - domain `saref:SensingFunction` and range `saref:Measurement`
- `saref:hasSensorType` - A relationship identifying the sensing type of a sensor detection (i.e. Temperature, Occupancy, Humidity, Motion , Smoke, Pressure, etc.)
  - domain `saref:SensingFunction` and range `saref:Property`
- `saref:hasState` - A relationship identifying the type of state of a device
  - domain `saref:Device` and range `saref:State`
- `saref:hasThresholdMeasurement` - A relationship associated with an event function to notify that a certain threshold measurement has been exceeded
  - domain `saref:EventFunction` and range `saref:Measurement`
- `saref:hasTime` - A relationship to associate time information to an entity
  - range `saref:Time`

- saref:isAccomplishedBy - A relationship identifying the task accomplished by a certain entity (e.g. a device)
  - domain saref:Task
- saref:isCommandOf - A relationship between a command and a function.
  - domain saref:Command and range saref:Function
- saref:isControlledByDevice - A relationship specifying the devices that can control a certain property
  - domain saref:Property and range saref:Device
- saref:isMeasuredByDevice - A relationship specifying the devices that can measure a certain property
  - domain saref:Property and range saref:Device
- saref:isMeasuredIn - A relationship identifying the unit of measure used for a certain entity
  - domain saref:Measurement and range saref:UnitOfMeasure
- saref:isOfferedBy - A relationship between a service and a device that offers the service
  - domain saref:Service and range saref:Device
- saref:makesMeasurement - A relation between a device and the measurements it makes. Such measurement will link together the value of the measurement, its unit of measure and the property to which it relates.
  - domain saref:Device and range saref:Measurement
- saref:measuresProperty - A relationship specifying the Property that can be measured by a certain Device
  - domain saref:Device and range saref:Property
- saref:offers - A relationship between a device and a service
  - domain saref:Device and range saref:Service
- saref:relatesToMeasurement - A relationship between a property and the measurements it relates to
  - domain saref:Property and range saref:Measurement
- saref:relatesToProperty - A relationship between a measurement and the property it relates to
  - domain saref:Measurement and range saref:Property
- saref:represents - A relationship between a service and a function
  - domain saref:Service and range saref:Function

Proposal: To add ObjectPropertyDomain and ObjectPropertyRange axioms wherever the definition of a property unambiguously identifies the domain or the range of a property.
Status: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08

Proposal 16. Reading Type of measurements cannot be commodities
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/16
Category: CLARIFICATION
Affects: SAREF
Situation: The definition of saref:hasMeterReadingType is "A relationship identifying the reading type of a measurement (e.g. Water, Gas, Pressure , Energy , Power, etc.)". And SAREF contains the axiom:
subClassOf(Device AllValuesFrom(saref:hasMeterReadingType UnionOf (saref:Commodity saref:Property))
However, it is ambiguous to assert that a metering function measures water, electricity, or other commodities, which intrinsically have no unit of measure. It is better to assert that a metering function measures some property.
Proposal: change the definition of saref:hasMeterReadingType to: A relationship that links a Metering Function to the property that it can make measurement of (e.g. Pressure , Energy , Power, etc.). And change the axiom to:
subClassOf(saref:Device AllValuesFrom(saref:hasMeterReadingType saref:Property)

Proposal 17.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/17
Category: CLARIFICATION
Affects: SAREF
Situation: the definition of saref:hasSensorType is: A relationship identifying the sensing type of a sensor detection (i.e. Temperature, Occupancy, Humidity, Motion , Smoke, Pressure, etc.). Yet sensors may also detect statuses of features of interest, such as open/close or hot/cold
Proposal: assert that states are sub-types of properties and add the following two axioms:
saref:State a subclass of saref:Property
saref:hasState a subproperty of saref:hasProperty

Proposal 18. definition of EventFunction is too restrictive
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/18
Category: CLARIFICATION
Affects: SAREF
Situation: the definition of `saref:EventFunction` is "A function that allows to notify another device that a certain threshold value has been exceeded". However, there may be other kind of event functions such as to detect when a person passes through a door.
Proposal: to rewrite the definition
Status: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08

Proposal 19. cannot associate other typical consumption than power and energy
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/19
Category: CLARIFICATION, CRITICAL
Affects: SAREF
Situation: SAREF contains the axiom SubClassOf(`saref:Device` AllValuesFrom(`saref:hasTypicalConsumption` UnionOf (`saref:Energy saref:Power`). However, Energy and Power are coupled. If a SAREF user associates some other property to the device, the knowledge base would become inconsistent.
Proposal: to delete the axiom
Status: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08

Proposal 20. Commodities cannot be measured using unit of measure
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/20
Category: CLARIFICATION
Affects: SAREF
Situation: SAREF contains the axiom: subClassOf(`saref:Commodity` AllValuesFrom(`saref:isMeasuredIn saref:UnitOfMeasure`). However, examples of commodities like Water or Electricity cannot be measured using any unit of measure. `saref:isMeasuredIn` should only be used for Measurements.
Proposal: to delete the axiom
Status: agreed during SmartM2M-3rd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-09

Proposal 21. relatesToMeasurement and relatesToProperty should be inverse one of another
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/21
Category: CLARIFICATION
Affects: SAREF
Situation: from the definitions of `saref:relatesToMeasurement` and `saref:relatesToProperty`, it should be clear that these two properties are inverse one of another.
`saref:relatesToMeasurement` - A relationship between a property and the measurements it relates to
`saref:relatesToProperty` - A relationship between a measurement and the property it relates to
Proposal: Add the axiom: inverseOf(`saref:relatesToMeasurement saref:relatesToProperty`).
Status: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08

Proposal 22. units of measure are just examples
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/22
Category: CLARIFICATION
Affects: SAREF
Situation: SAREF contains the axiom
`saref:UnitOfMeasure rdfs:isDefinedBy` <http://www.wurvoc.org/vocabularies/om-1.6/Unit_of_measure> and all the instances of units of measures that serve as examples are from OM v 1.8. However, these instances and this annotation are not present in the SAREF TS. The SAREF core ontology should not take one ontology of units of measure specifically. Examples may be provided in a separate document. OM had a v 1.8, now v 2.0 is under development. Alternatives include QUDT or the `cdt:ucum` datatype.
Proposal: The specification is agnostic of the way of representing units. The ontology file should also be agnostic. Examples of the use of OM will be moved to specific instance files using the ontology under consideration and that people can download to understand how SAREF can be used.
Status: agreed during SmartM2M-2nd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-06
updated during SmartM2M-3rd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-09

Proposal 23. Examples should be moved away from SAREF-core
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/23
Category: CLARIFICATION, NOT_USED
Affects: SAREF
Situation: The SAREF ontology contains many examples of devices like `saref:WashingMachine`
However, these instances and their annotation are not present in the SAREF TS. There is no evidence of usage of these concepts in other SAREF extensions
Proposal: Move the examples to additional resources/documentation and not in the ontology. Only keep `saref:Actuator saref:Appliance saref:Sensor saref:Meter`, keep `saref:HVAC` (maybe remove it in the future, add in the comment that there is a link with SAREF4BLDG). Remove `saref:LightingDevice`, remove `saref:MicroRenewable`, remove `saref:Multimedia` but create an example about `saref:Multimedia`. remove `saref:Network`.
Status: agreed during SmartM2M-2nd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-06

Proposal 24. range of hasValue should not be `xsd:float`.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/24
Category: CLARIFICATION
Affects: SAREF
Situation: SAREF contains axiom Rangesaref:(`saref:hasValue xsd:float`). However, there are other datatypes for measurements. Some domains require the precision of doubles. One may use the `cdt:ucum` datatype to associate a value. The number of persons in a building would be an integer. Other types of property may be thought about, like vectors (x, y, z acceleration), matrices (strain in deformable solids)
Proposal: remove the axiom. Update the definition of `saref:hasValue` to specify that numeric values are expected to enable reasoning
Status: agreed during SmartM2M-2nd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-06

Proposal 25. measurements could be more complex than that
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/25
Category: CLARIFICATION
Affects: SAREF
Situation: SAREF contains axioms
Axiom SubClassOf (`saref:Measurement` ObjectExactCardinality(`saref:isMeasuredIn 1 saref:UnitOfMeasure`)
Axiom SubClassOf (`saref:Measurement` ObjectExactCardinality(`saref:relatesToProperty 1 saref:Property`)
However a Measurement may be about more than one property, and use more than one unit of measure. For example the measurement of strain in deformable solids outpus both force (N) and torque (N.m).
Proposal: remove the two axioms.
Status: discussed during SmartM2M-2nd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-06 : need simple means to link to a numeric value. Maybe introduce an ObjectProperty `saref:hasValueObject` (to link to measurement ontologies for example), provide example on how to do so. For example, SAREF4health: the output of a sensor may be a timeseries, which needs to be represented as an individual and not a literal.

Proposal 26.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/26
Category: CLARIFICATION, NOT_USED
Affects: SAREF
Situation: SAREF contains the classes `saref:IlluminanceUnit`, `saref:PowerUnit`, `saref:PressureUnit`, `saref:TemperatureUnit`, `saref:EnergyUnit`. However, they are not mentioned in the SAREF TS document. There are classes for these units in OM, QUDT, or even a datatype for this in `cdt:ucum`. Also, their definition is "The unit of measure for { ?label }". This is misleading as this is a class, not an instance. There is usually more than one unit of measure for a quantity kind
Proposal: delete these classes, moved to specific instance files using the ontology under consideration and that people can download to understand how SAREF can be used

Proposal 27.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/27
Category: CLARIFICATION, NOT_USED
Affects: SAREF
Situation: SAREF contains axiom `saref:Time saref:consistsOf time:TemporalEntity`. However, this is not specified in SAREF TS. Also, the relation `saref:consistsOf` has a different meaning elsewhere in the ontology
Proposal: delete the axiom

Proposal 28. a metering function may have other commands than the three currently specified
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/28
Category: CRITICAL
Affects: SAREF
Situation: Some axioms are too restrictive in SAREF:

- axiom SubClassOf(MeteringFunction AllValuesFrom(hasCommand UnionOf (`saref:GetCurrentMeterValueCommand saref:GetMeterDataCommand saref:GetMeterHistoryCommand`))), which means that if a metering function has a command, then this command is a `saref:GetCurrentMeterValueCommand` , a `saref:GetMeterDataCommand` , or a `saref:GetMeterHistoryCommand`. However, a metering function may have other commands than these three (ex. `saref-ext:GetLast10MeterValueCommand`) . If a SAREF user adds such a command, then it would be wrongly classified as one of the three. This may lead to knowledge base inconsistencies.
  - **Proposal:** change the axiom to
  - subClassOf(`saref:GetCurrentMeterValueCommand` AllValuesFrom(`saref:isCommandOf saref:MeteringFunction`)), which means: the command `saref:GetCurrentMeterValueCommand` is a command of the function `saref:MeteringFunction`
- axiom subClassOf(`saref:EventFunction` AllValuesFrom(`saref:hasCommand saref:NotifyCommand`). However, an event function may have other commands than the notify command (ex. `saref-ext:SetMaxRateCommand saref-ext:SetBurstValueCommand`). If a SAREF user adds such a command, then it would be wrongly classified. This may lead to knowledge base inconsistencies. At least, the `saref:NotifyCommand` is always a command of the `saref:EventFunction` function
  - **Proposal:** change the axiom to
  - subClassOf(`saref:NotifyCommand` AllValuesFrom(`saref:isCommandOf saref:EventFunction`).
- axiom subClassOf(`saref:SensingFunction` AllValuesFrom(`saref:hasCommand saref:GetSensingDataCommand`). However, a sensing function may have other commands than the get sensing data command. If a SAREF user adds such a command, then it would be wrongly classified. This may lead to knowledge base inconsistencies
  - **Proposal:** change the axiom to
  - subClassOf(`saref:GetSensingDataCommand` SomeValuesFrom(`saref:isCommandOf saref:SensingFunction`)
- axiom subClassOf(`saref:OnOffFunction` AllValuesFrom(`saref:hasCommand` UnionOf(`saref:OffCommand saref:OnCommand saref:ToggleCommand`)). Same problem as above.
  - **Proposal:** change the axioms, except for `saref:Toggle`, which may be a command for other functions, like saref-ext:HotColdFunction.
  - Axiom subClassOf(`saref:OffCommand` AllValuesFrom(`saref:isCommandOf saref:OnOffFunction`)
  - Axiom subClassOf(`saref:OnCommand` AllValuesFrom(`saref:isCommandOf saref:OnOffFunction`)
  - Axiom subClassOf(`saref:ToggleCommand` AllValuesFrom(`saref:isCommandOf saref:OnOffFunction`)
- This also applies to:
  - `saref:OpenCloseFunction` and the commands `saref:OpenCommand` and `saref:CloseCommand`.
  - `saref:StartStopFunctionand` and the commands `saref:StartCommandand saref:StopCommand`.

- `saref:LevelControlFunction` and the commands `saref:SetAbsoluteLevel` `saref:SetRelativeLevelCommand` `saref:StepDownCommand` `saref:StepUpCommand`.

Proposal: rewrite the axioms
Status: agreed during SmartM2M-3rd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-09

Proposal 29.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/29
Category: CLARIFICATION
Affects: SAREF
Situation: SAREF contains `saref:ToggleCommand`, which can be used indifferently for on/off, or open/close. However, it would be easier to identify that toggle has different meanings depending on the function.
Proposal: improve the description of `saref:ToggleCommand`, maybe add classes `saref:OnOffToggleCommand`, `saref:OpenCloseToggleCommand`, etc., potentially make them sub-classes of `saref:ToggleCommand`
Status: discussed during SmartM2M-3rd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-09. Further discussion is needed.

Proposal 30.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/30
Category: CLARIFICATION
Affects: SAREF
Situation: The definition of `saref:OnOffFunction` is "switch on and off an actuator". `saref:OpenCloseFunction` is "open or close an actuator" However, other devices or even features of interest may be on or off, open or close.
Proposal: generalize the definitions to `saref:OnOffFunction` - switch on or off a feature of interest `saref:OpenOrCloseFunction` - open or close a feature of interest
Status: Rejected during SmartM2M-3rd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-09.

Proposal 31.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/31
Category: CRITICAL
Affects: SAREF
Situation: SAREF contains axioms subClassOf(?someCommand AllValuesFrom(`saref:actsUpon` ?someState)). However, for example, an actuating function may act on other states by transitivity (e.g. a heater `saref:actsUpon` temperature *and* humidity, as temperature and humidity are coupled). If a user asserts that an actuating function acts on two distinct properties, then the knowledge base will be inconsistent. Other example: an actuating function should also be capable of changing the property of a feature of interest (ex. the temperature of the heater, which may be linked to a state of the heater cold or hot).
Proposal: change the axioms to subClassOf(?someCommand SomeValuesFrom(`saref:actsUpon` ?someState))
Status: agreed during SmartM2M-3rd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-09

Proposal 32. remove the instances of the command classes
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/32
Category: NOT_USED, CRITICAL
Affects: SAREF
Situation: instances of the command classes are provided in the ontology. However, if `saref:SetAbsoluteLevel` is "the" instance of the `saref:SetAbsoluteLevelCommand` class, and if one uses it to define two different commands (one with value 20 and one with value 22), then there is no way to identify which command has what value, because the same identifier is used for two commands. Also, some of these are both instances of State and command, which are conceptually distinct. Finally, they are not mentioned in the SAREF TS document.
Proposal: remove these instances, and add a section in the TS where we provide very clear examples on how commands can be instantiated
Status: agreed during SmartM2M-3rd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-09

Proposal 33.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/33
Category: CLARIFICATION
Affects: SAREF
Situation: The definition of State is "The state of a device that is […]". However not only devices have states. A door, too, can be open or closed.
Proposal: change the definition of State to: "The state of a device or a feature of interest that is […]"
Status: discussed during SmartM2M-3rd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-09. Further discussion is needed.

Proposal 34.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/34
Category: CLARIFICATION
Affects: SAREF
Situation: SAREF contains axioms
SubClassOf(`saref:Command` AllValuesFrom(`saref:isCommandOf saref:Function`)).
SubClassOf(`saref:Function` AllValuesFrom(`saref:hasCommand saref:Command`))
If `saref:isCommandOf` and `saref:hasCommand` only applies to `saref:Command`, and the domains and ranges are specified, then these axioms are useless.
Proposal: delete the axioms **if** the domain and range is specified
Status: dependent on the resolution of proposal 15 during SmartM2M-3rd RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-05-09.

Proposal 35.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/35
Category: IMPROVEMENT
Affects: SAREF
Situation: The TS document contains an alignment to oneM2M base ontology, but not to SOSA/SSN.
Proposal: Discuss the alignment with SOSA/SSN and add in a section after the oneM2M alignment
Status: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08 SAREF4Indus and SAREF4Agri already propose mappings, they may be used as starting points

Proposal 36.
URL: http://forge.etsi.org/rep/SAREF/SAREF-core/issues/36
Category: IMPROVEMENT
Affects: SAREF
Situation: the OWL Time ontology has an axiom that make it inconsistent. If SAREF imports it directly, then SAREF is inconsistent.
Proposal: do not import the OWL Time ontology, but add a section in the TS needs to explain to the user how this can be done
Status: agreed during SmartM2M-RG Meeting about 2 NWIs SAREFv3 and SAREF Com Framework V2 2019-04-08 SAREF4Indus and SAREF4Agri already propose mappings, they may be used as starting points

10 Conclusions

The present document described the use cases taken into account for the consolidation of SAREF using ontology patterns that are instantiated for different engineering-related verticals.

The present document also provided an analysis of the potential of modularization and factorization of the SAREF core ontology (V2.1.1) (ETSI TS 103 264 [i.2]) as patterns. This helped identifying issues. An updated version of this analysis should be made for the future version of SAREF v3, and used as a starting point to rewrite SAREF as modules and patterns.

Then, the present document specified a set of ontology patterns for the modelling and the description of any kind of engineering-related data/information/systems. The pattern Feature Of Interest and Properties will be included in SAREF v3. The pattern for Evaluations should be included first in a future version of SAREF4ENER (ETSI TS 103 410-1 [i.3]). The pattern for Systems Connections and Connection Points will be specified in ETSI TS 103 548 [i.1]. The other patterns may be used to consolidate SAREF in future versions.

Finally, the present document listed a set of issues that are identified in the current version of SAREF, and proposes changes to consolidate SAREF. These proposals for changes have been discussed during online SmartM2M meetings, added on the ETSI forge of the group https://forge.etsi.org/gitlab/SAREF/ and are being progressively implemented.

History

Document history		
V1.1.1	July 2019	Publication