# ONEM2M – PRESENTATION TO W3C

**Omar Elloumi, oneM2M TP Chair**

**oneM2M** www.oneM2M.org

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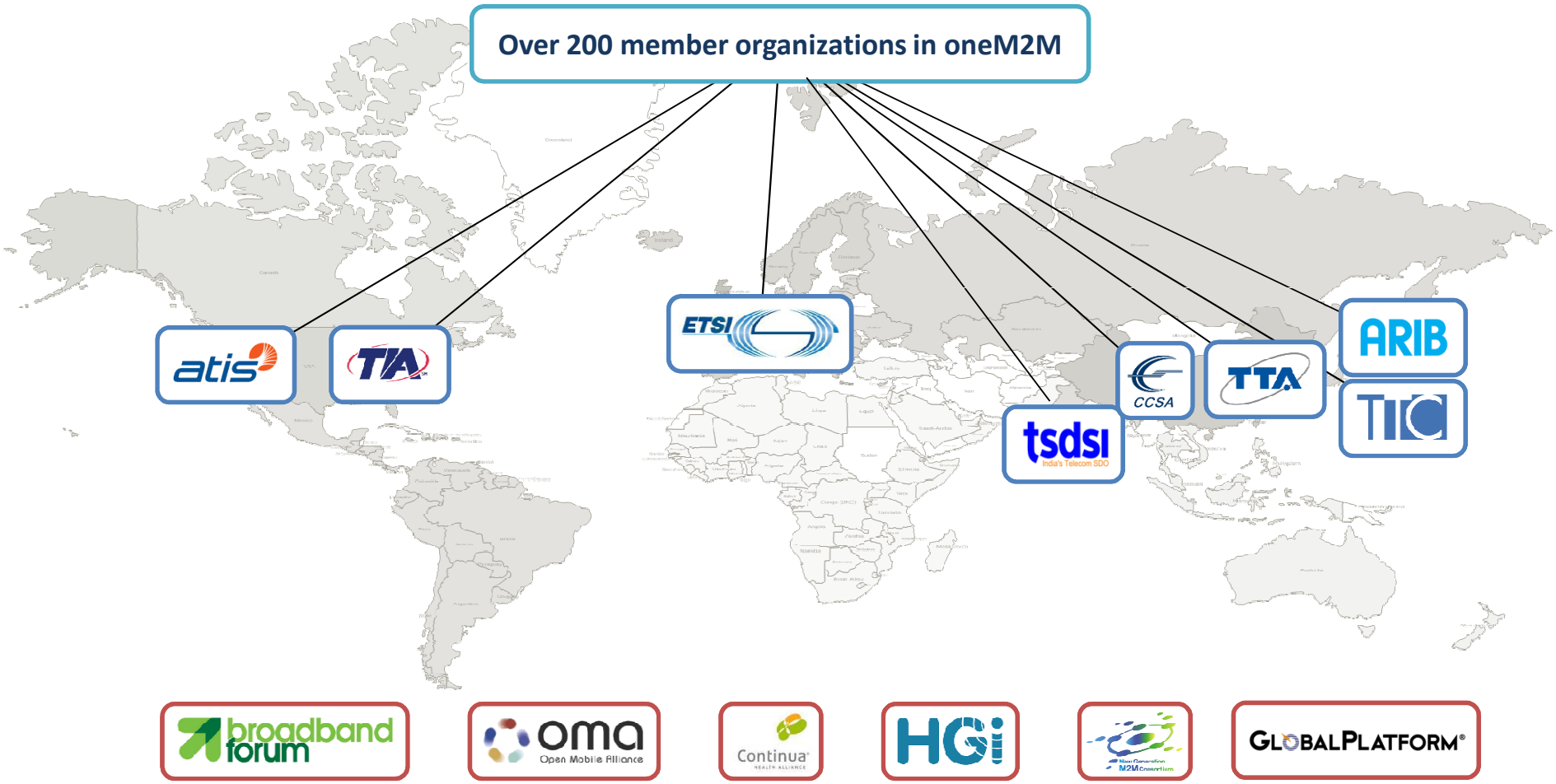
# The Partnership Project



# 200+ members organizations

Some of the 200+ active members of oneM2M

# Purpose & Deliverables

**Purpose**

To specify and promote an

**M2M Common Service Layer**

**Deliverables**

**Technical Reports and Technical Specifications**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# M2M Common Service Layer

- It is a software layer
- It sits between M2M applications and communication HW/SW that provides data transport
- It normally rides on top of IP
- It provides functions that M2M applications across different industry segments commonly need. Those functions are exposed to Applications via developer friendly APIs.
- It allows for distributed intelligence (device, gateway, cloud apps)


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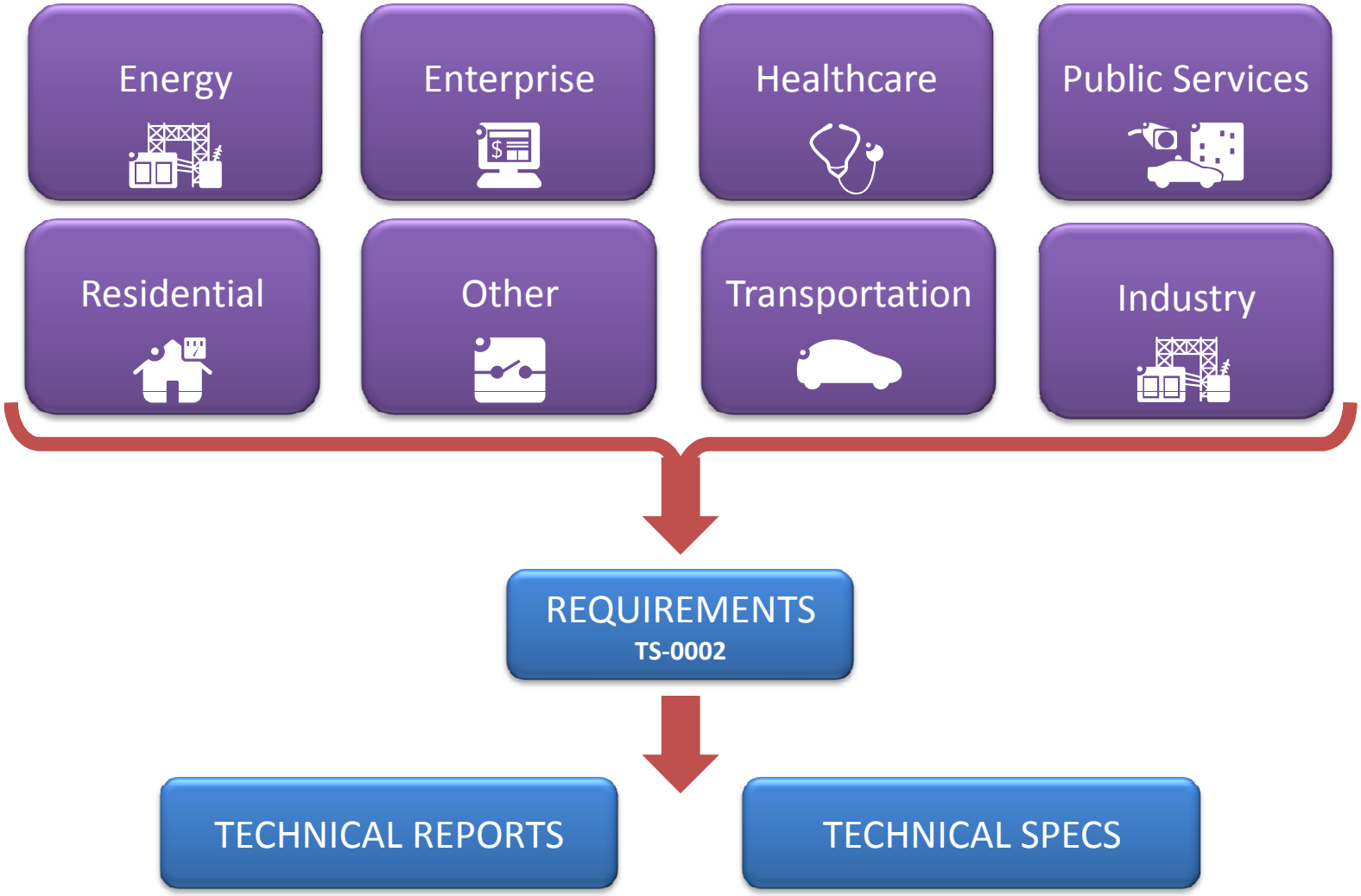
Backup slide

# Work Process





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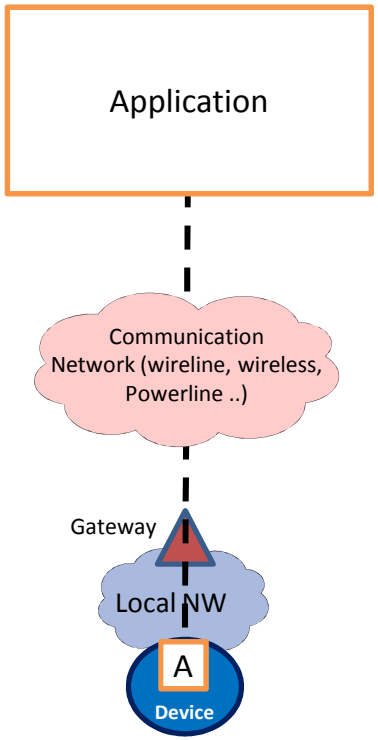
# oneM2M Architecture approach

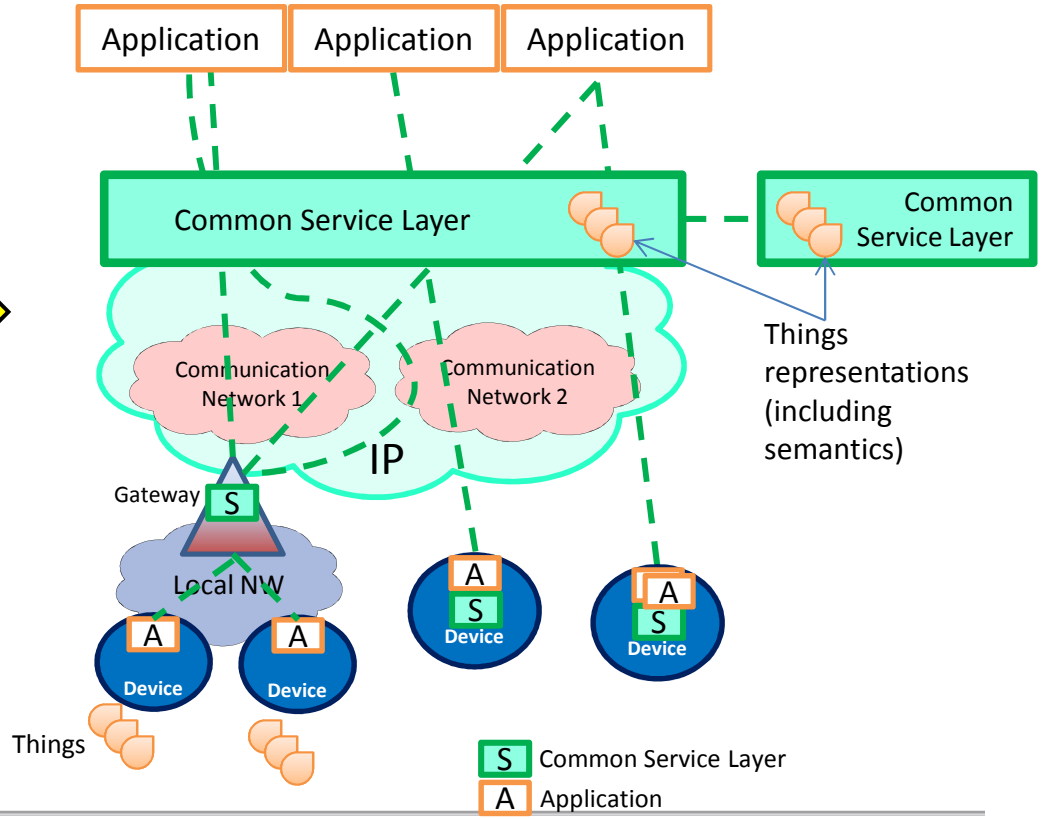
## Pipe (vertical):

1 Application, 1 NW,
1 (or few) type of Device
Point to point communications




## Horizontal (based on common Layer)

Applications share common service and network infrastructure
Multipoint communications





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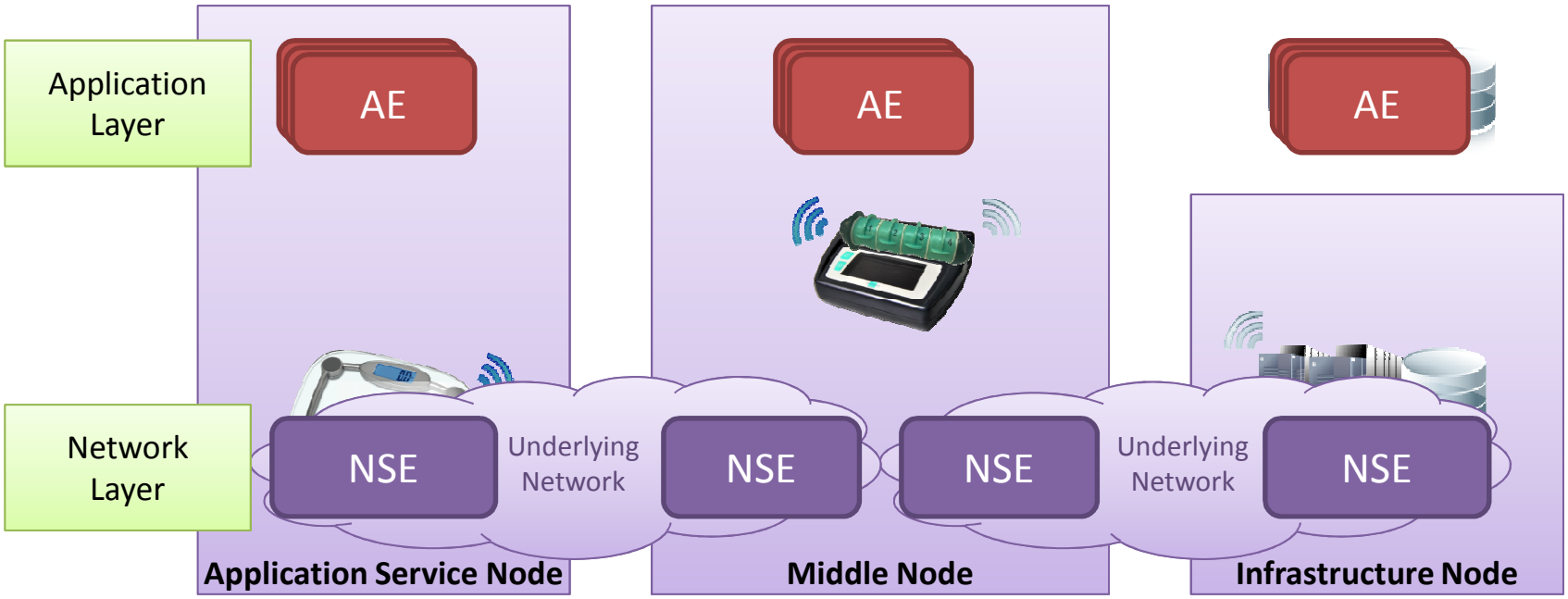
# Architecture

| | |
|---|---|
| **Application Entity** | Provides application logic for the end-to-end M2M solutions |
| **Network Services Entity** | Provides services to the CSEs besides the pure data transport |
| **Node** | Logical equivalent of a physical (or possibly virtualized, especially on the server side) device |





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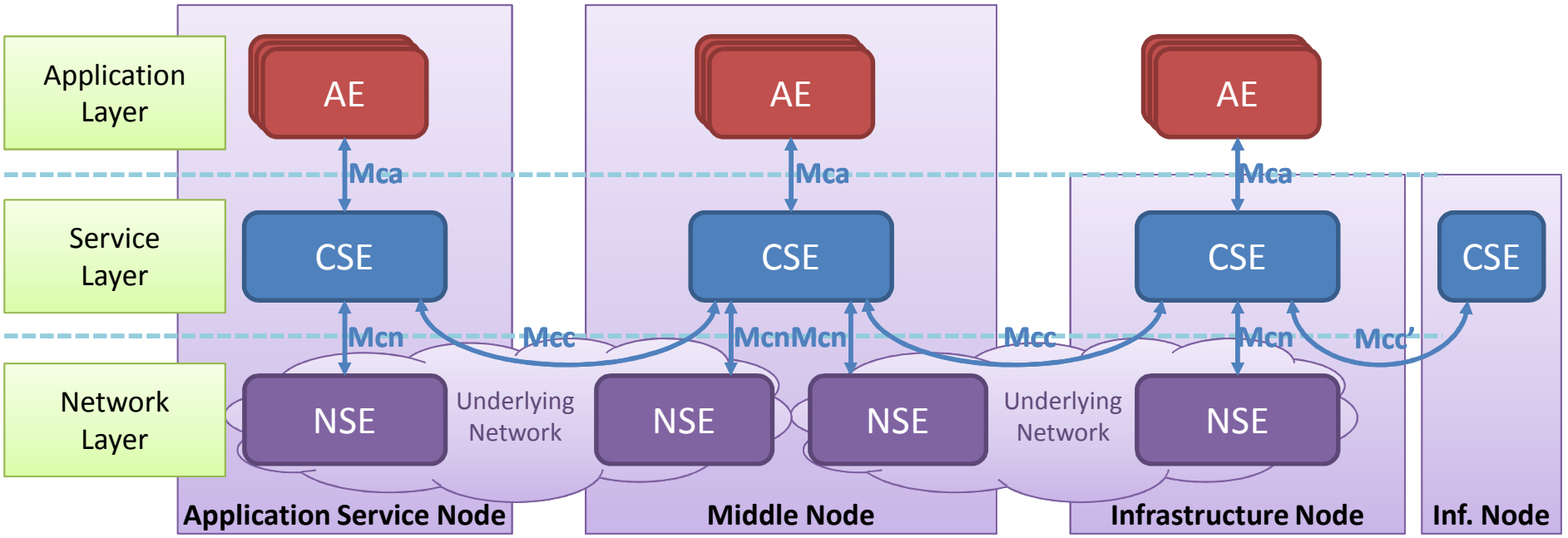
# Architecture

| | |
|---|---|
| **Reference Point** | One or more interfaces - Mca, Mcn, Mcc and Mcc' (between 2 service providers) |
| **Common Services Entity** | Provides the set of "service functions" that are common to the M2M environments |
| **Application Entity** | Provides application logic for the end-to-end M2M solutions |
| **Network Services Entity** | Provides services to the CSEs besides the pure data transport |
| **Node** | Logical equivalent of a physical (or possibly virtualized, especially on the server side) device |





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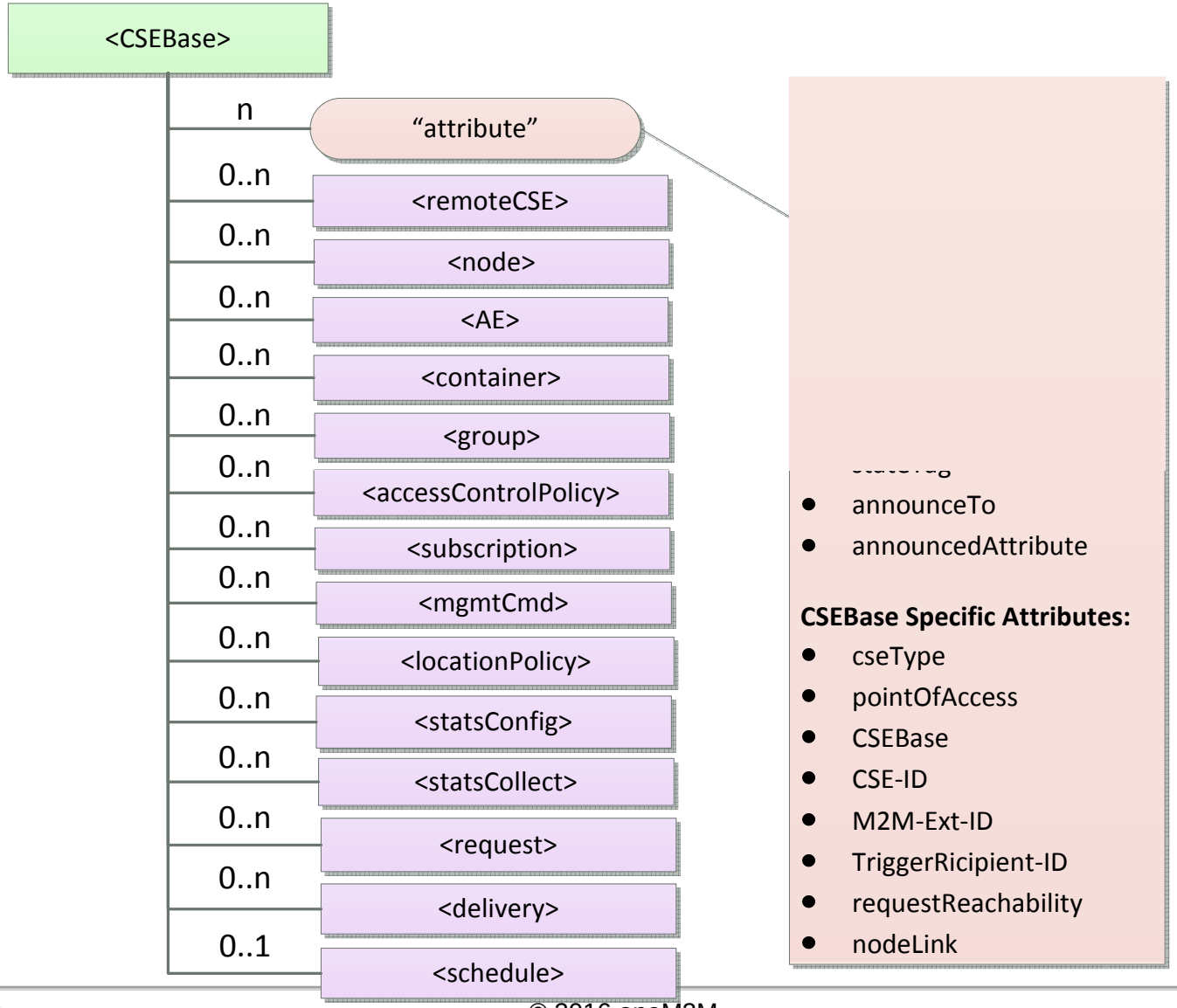
# oneM2M Resource Structure





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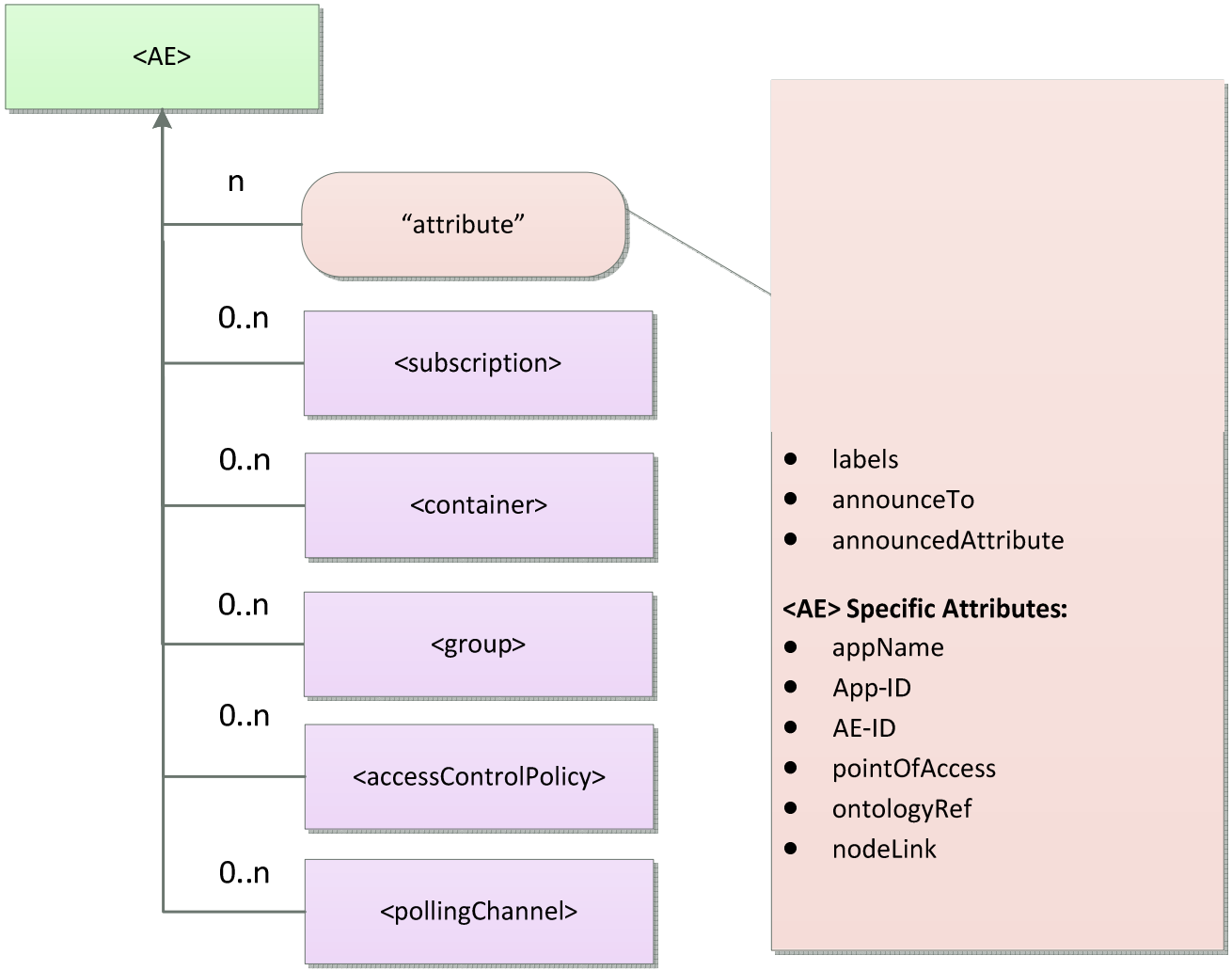
# oneM2M Resource Example





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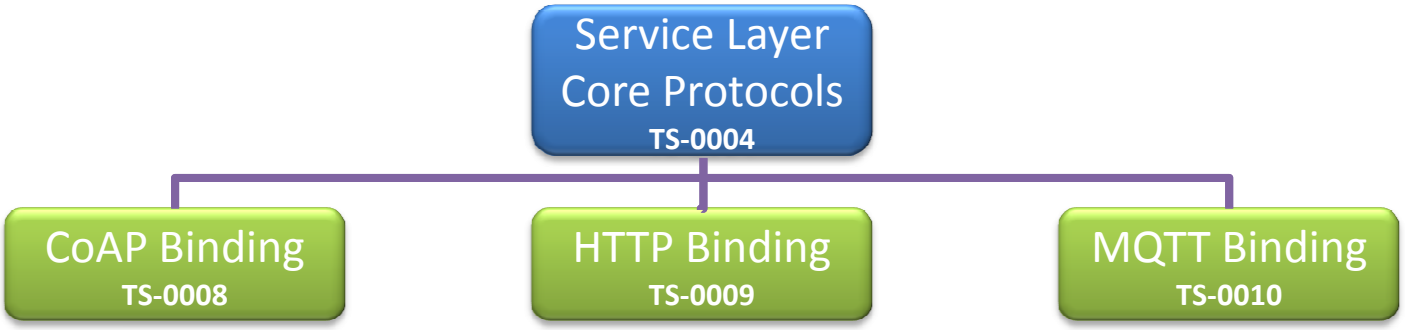
# Communication Protocols

## Reuse IP-based existing protocols




### XML or JSON Content serialization - HTTP Example

REQUEST

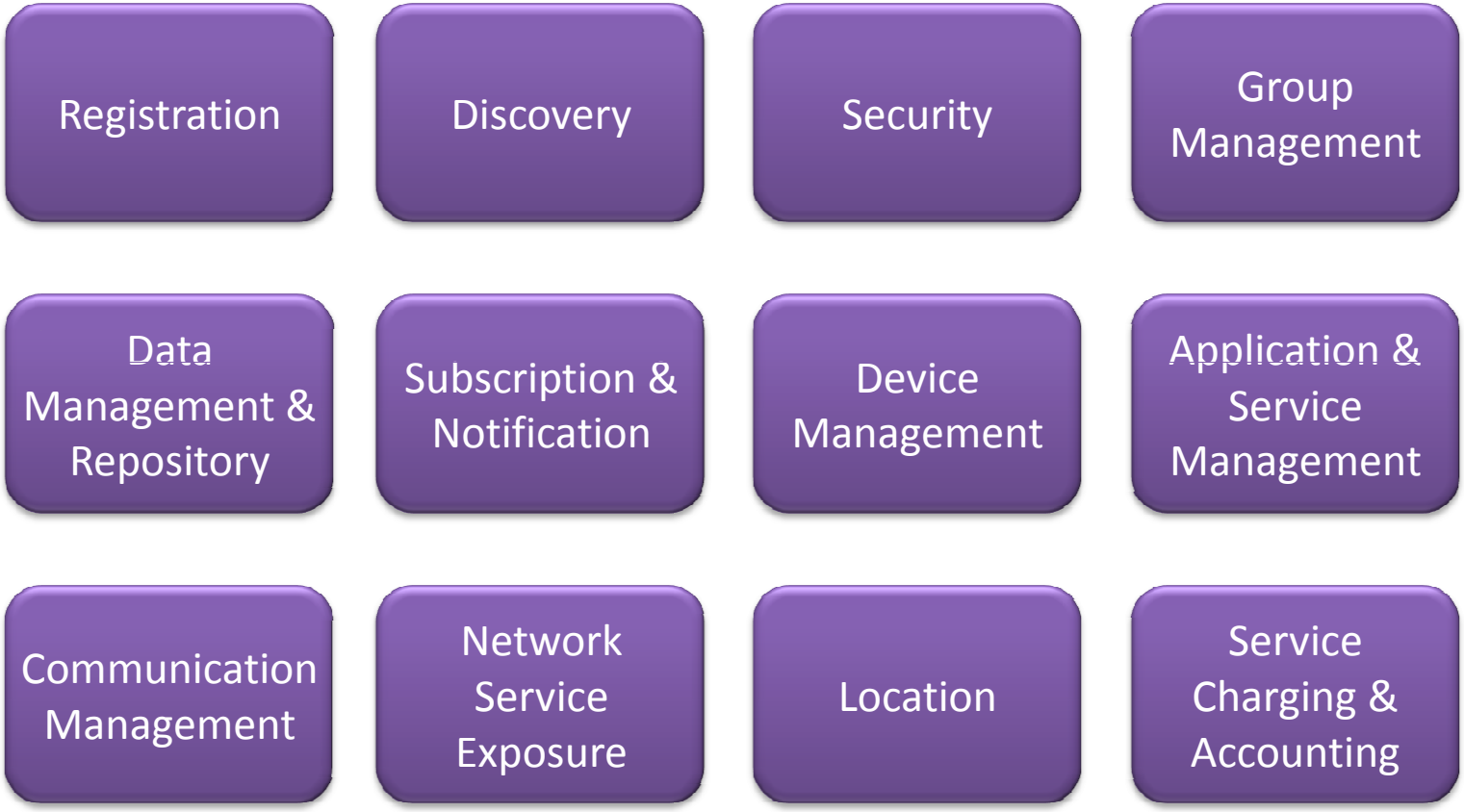
GET /~/CSE-178/CSEBase/home/temperature HTTP/1.1
Host: provider.net
X-M2M-Origin: /CSE-123/WeatherApp42
X-M2M-RI: 56398096
Accept: application/json

RESPONSE

HTTP/1.1 200 OK
X-M2M-RI: 56398096
X-M2M-RSC: 2000
Content-Type: application/vnd.onem2m-res+json
Content-Length: 101
{“m2m:cin”:[
"cnf":"application/json:0",
"con":"{'timestamp':1413405177000,'value':25.32}"]
}

Backup slide

# Common Service Functions





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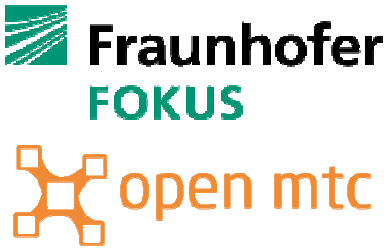
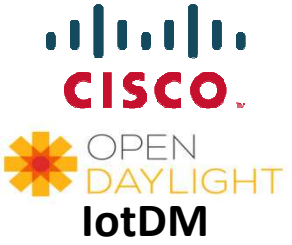
# Strong implementation base

## Industry-driven Open source implementations






## Examples of Commercial implementations /demos

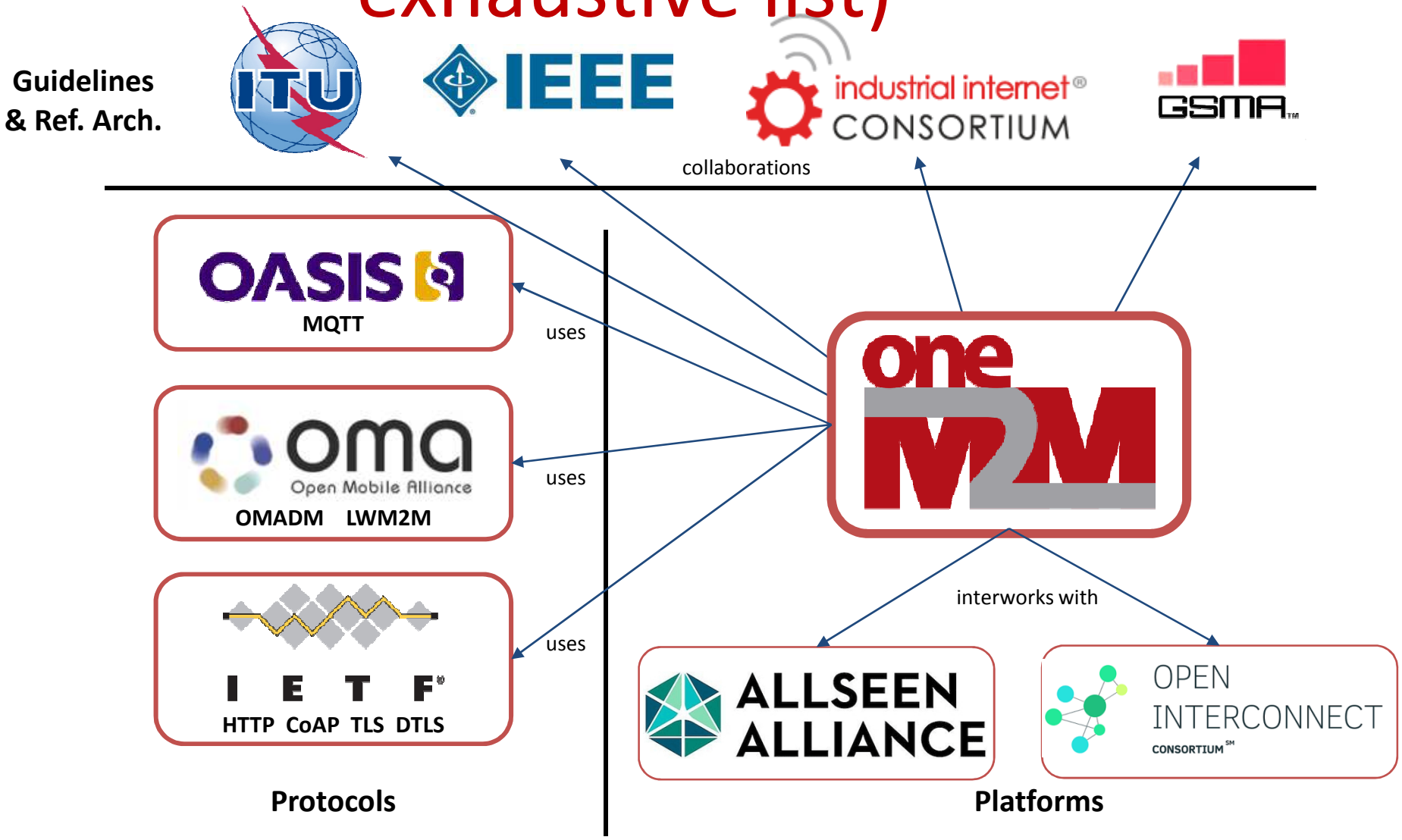
## First interoperability event (Sept 14-16 2015)

With 30 participating organizations and 75 people



Source: N Damour, Sierra wireless

# Ongoing collaborations (not exhaustive list)




Source: N Damour, Sierra Wireless

# Why we are here?

- We see great potential in bringing semantic technologies to IoT
- However, our findings as regards Semantic technologies and IoT show:
  - The business benefits are not always well understood to our stakeholders
  - There is a need to educate the engineers (IoT domain experts)
  - There is a need to provide a venue where we can build consensus around ontologies and their applications in IoT space
- W3C has a strong background in Semantics and we are interested in exploring how we can collaborate in applying this to IoT
- oneM2M and IoT standards can provide IoT domain knowledge and use cases
- oneM2M has some initial framework that is reusing W3C, our aim is to get feedback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# Semantics in oneM2M

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# Overview

- Semantics as new Feature in oneM2M Release 2
  - Example
- Architectural Aspects
  - Semantic Descriptor
  - Semantic Resource Filtering / Discovery
- Semantic Modelling
  - oneM2M Base Ontology
  - Interworking with non-oneM2M devices based on Semantics
  - Example: SAREF Ontology
- Outlook


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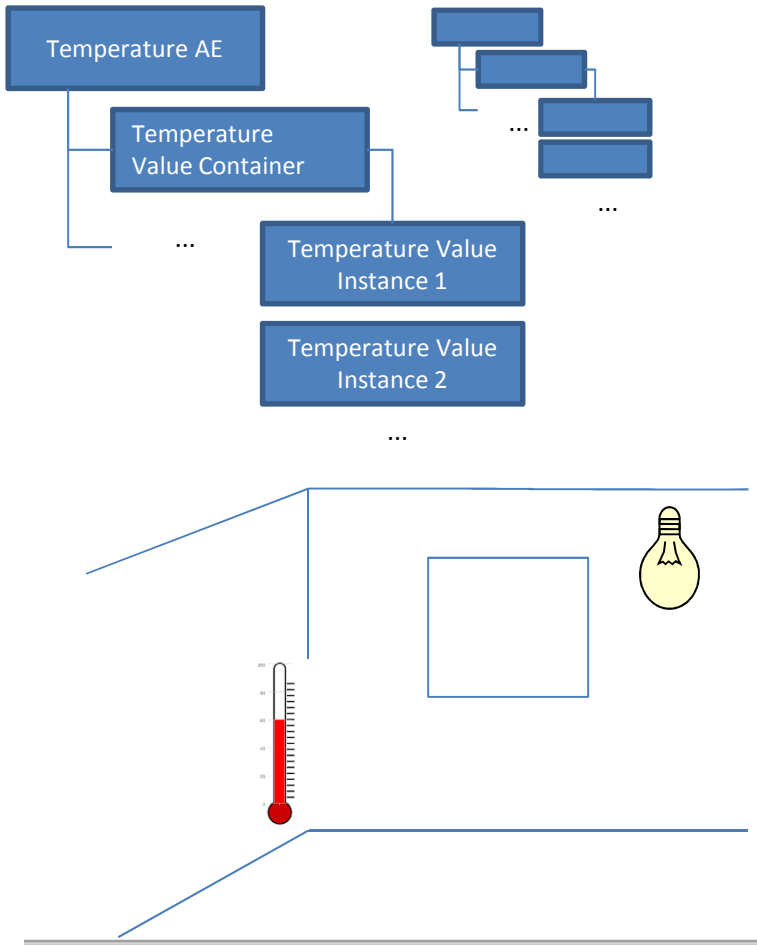
# Example: oneM2M Release 1 without Semantics

## Building Management Application




- oneM2M provides resource structure for sensor applications to provide their information
- Syntax and semantics of information not visible to the platform
  - At best limited support for discovery (explicit tags)
  - No support for efficient access to structured information, creation of mash-ups, support for analytics
- Applications using the information have to a-priori know
  - Resources provided by each sensor applications
  - Syntax and semantics of information

Explicit configuration step for every change in available sensors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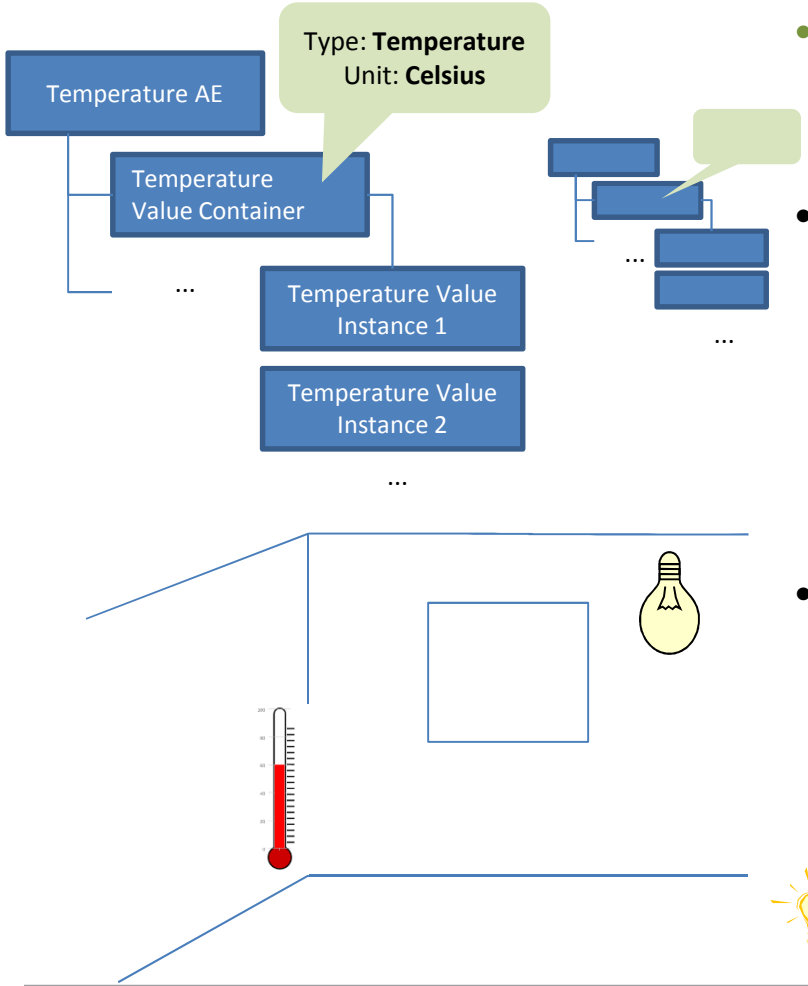
# Example: oneM2M Release 2(+) with Semantics

**Building Management Application**




- oneM2M provides resource structure for sensor applications to provide their information
- oneM2M provides semantic information about resource contents and functionalities making use of it
- Functionalities that can be provided or enhanced using semantics
  - Queries/Discovery based on semantic descriptions
  - *Support for analytics (e.g. efficient access to information, deployment of analytics within the platform)*
  - *Support for creation of mash-ups (e.g. enabling IoT scenarios)*
- Applications using the information can
  - Specify what information they are interested in → be notified in case of relevant changes
  - Syntax and semantics of information is made explicit, so applications can decide whether they can handle it, what module is needed for processing etc.

Automatic configuration for every change in available sensors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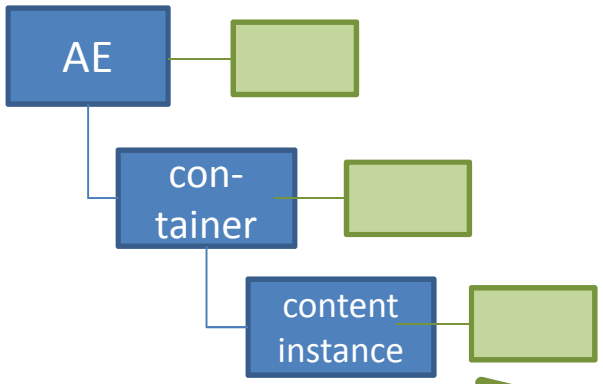
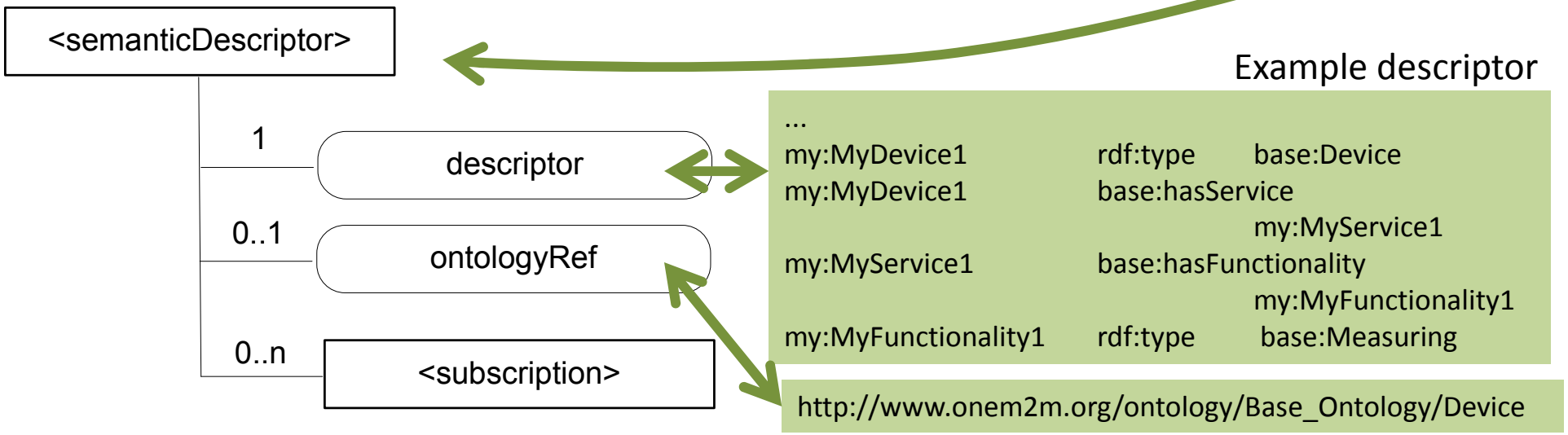
# Architectural Aspects:

## Semantic Descriptor Resource Type

- Key oneM2M resource types can be semantically annotated with a description stored in a semantic descriptor resource





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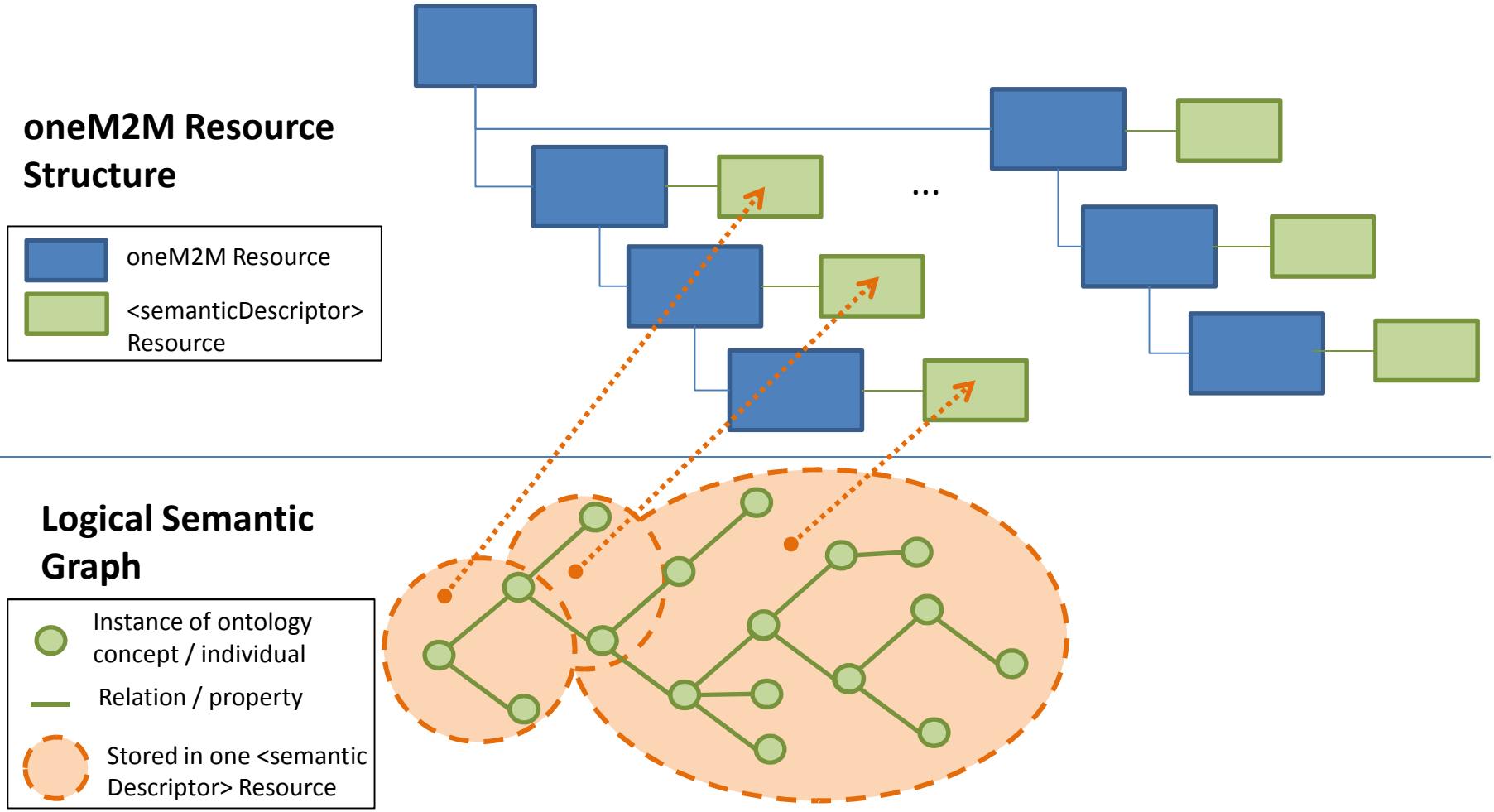
# Relation: Semantic Graph and oneM2M Resource Structure





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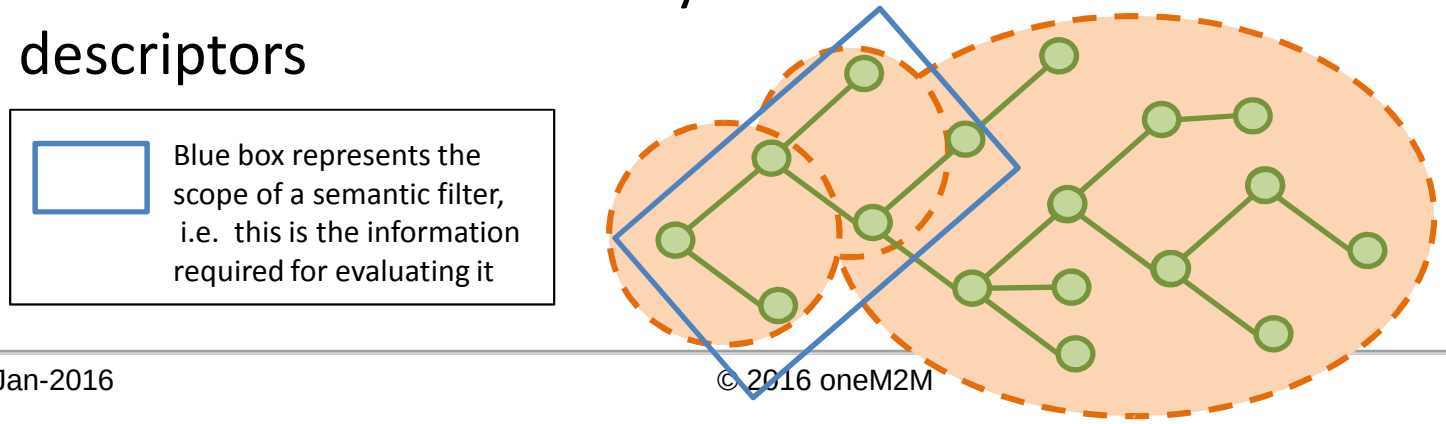
# Architectural Aspects:
## Semantic Filtering / Discovery

- **Filtering / discovering (child) resources: RETRIEVE request** on appropriate oneM2M resource with semantic filter
- **Semantic Filter:** The semantic description contained in one of the <semanticDescriptor> child resources matches the semantic filter that shall be specified in the **SPARQL** query language.

→ **Resource is included in result if semantic filter matches**

- Semantic information may be stored across different semantic descriptors





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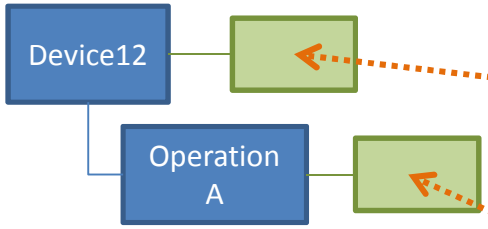
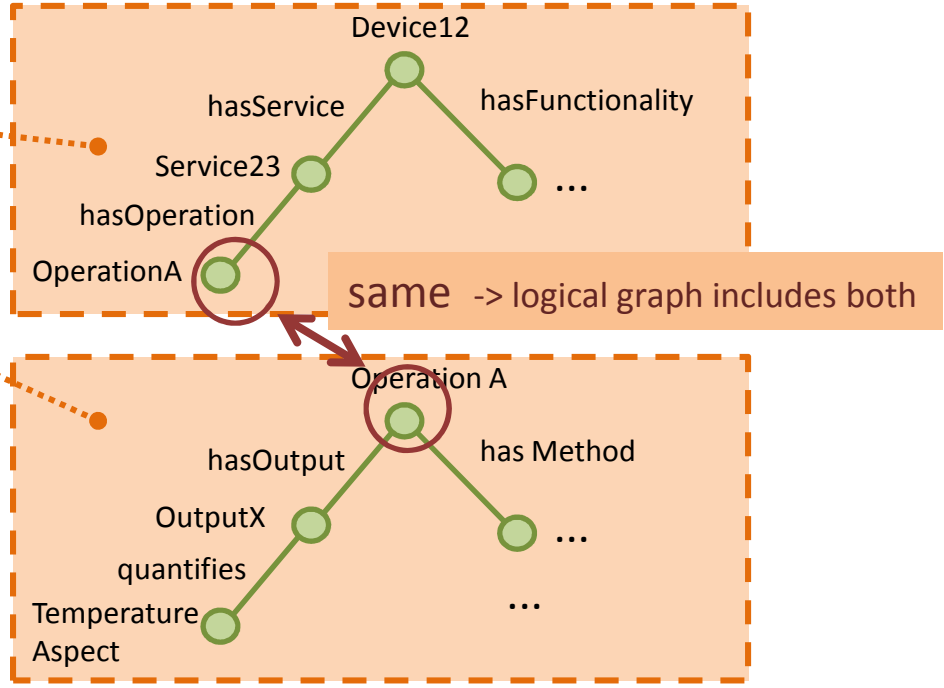
# Concrete Example

oneM2M Resource Structure




Semantic Graphs




**Filter** request: ”Find all AE resources representing devices that have a service that has an operation whose output quantifies a temperature aspect”

**SPARQL** representation of filter:

```
…
SELECT ?device
WHERE { ?device rdf:type base:Device .
        ?device base:hasService ?service .
        ?service base:hasOperation ?operation .
        ?operation base:hasOutput ?output .
        ?output base:quantifies
                temp:TemperatureAspect
}
```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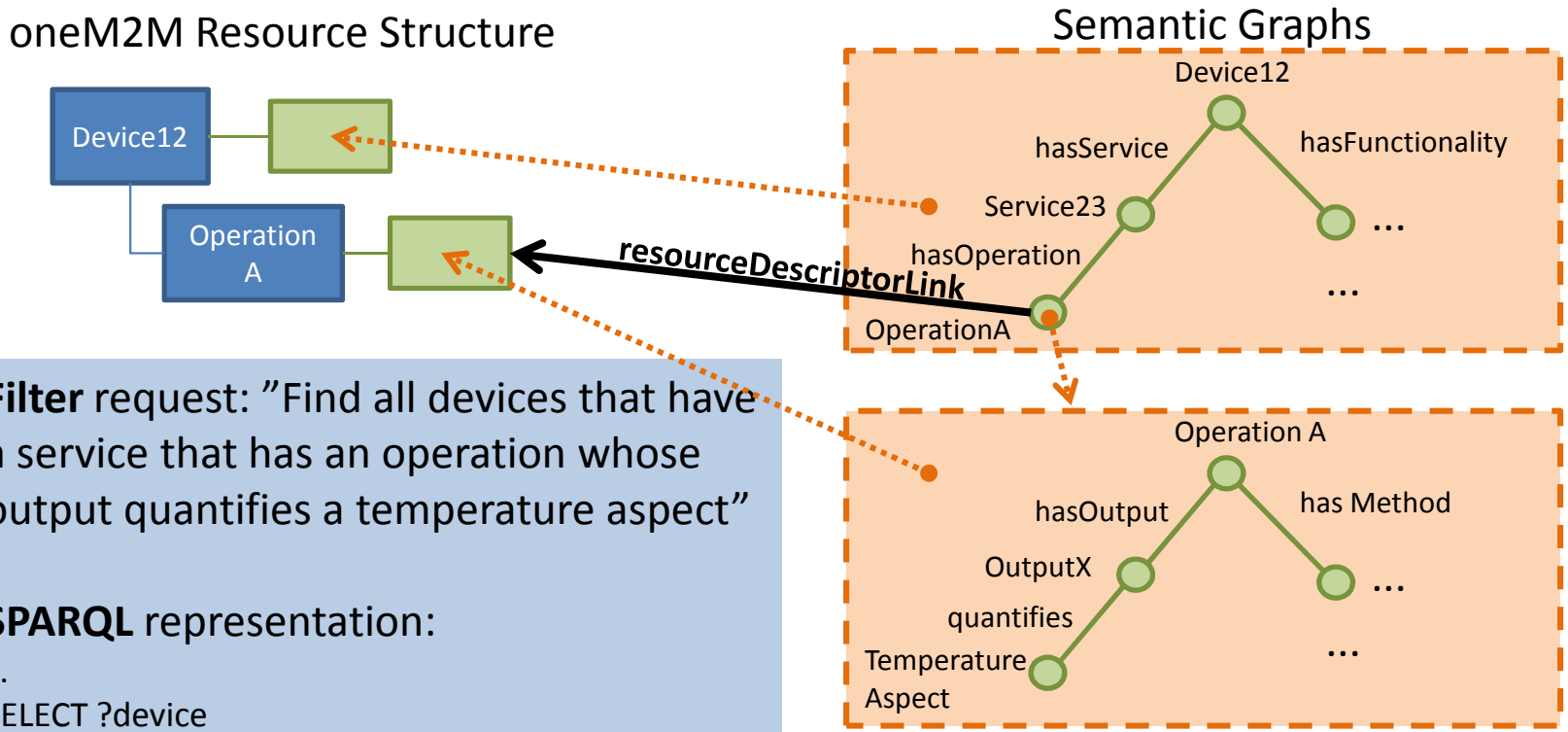
# Concrete Example using Annotation Property




**Filter** request: ”Find all devices that have a service that has an operation whose output quantifies a temperature aspect”

**SPARQL** representation:

```
…
SELECT ?device
WHERE { ?device rdf:type base:Device .
        ?device base:hasService ?service .
        ?service base:hasOperation ?operation .
        ?operation base:hasOutput ?output .
        ?output base:quantifies
                temp:TemperatureAspect
}
```

On encountering the OperationA instance with resourceDescriptorLink referencing the semantic descriptor of the OperationA resource, its content is added and the SPARQL execution is executed on the extended content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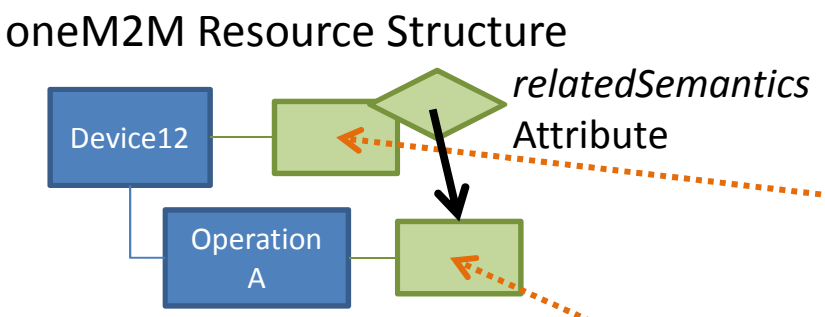
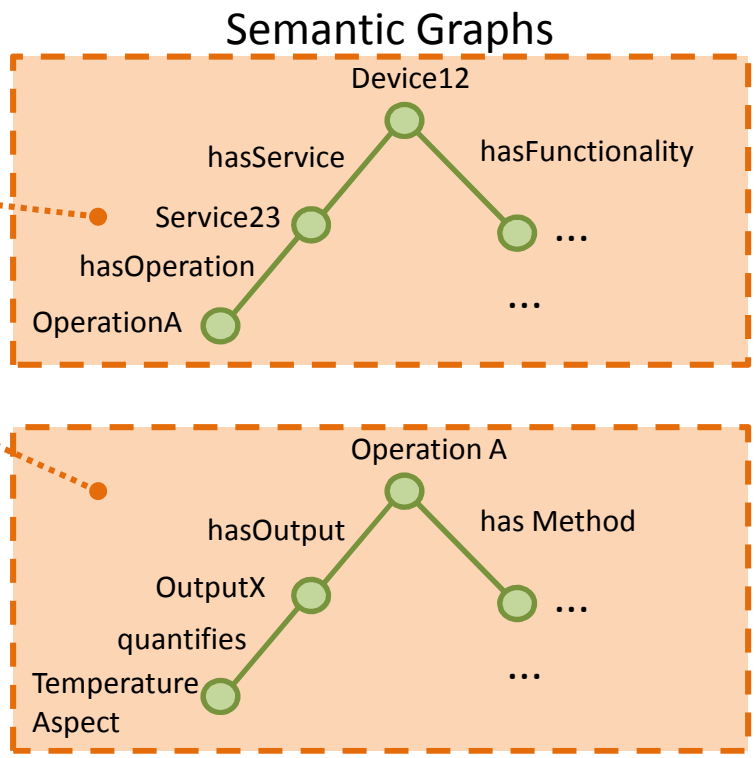
# Concrete Example using Semantic Descriptor attribute




**Filter** request: ”Find all devices that have a service that has an operation whose output quantifies a temperature aspect”

**SPARQL** representation:

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SELECT ?device
WHERE { ?device rdf:type base:Device .
        ?device base:hasService ?service .
        ?service base:hasOperation ?operation .
        ?operation base:hasOutput ?output .
        ?output base:quantifies
                temp:TemperatureAspect
}
```

Before evaluating the semantic filter (SPARQL), the content of the semantic descriptor resource and the content of all resources linked through the *relatedSemantics* attribute are loaded and the SPARQL request is evaluated on the integrated information.


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# Semantic Modelling: oneM2M Base Ontology (1)

- Goal of oneM2M Base Ontology: model key concepts relevant for oneM2M platform to support
  - Interoperability within oneM2M
  - **Generic Interworking with other technologies**
- oneM2M Base Ontology does **not** model **domain-specific aspects**
- **But** supports mapping of domain-specific ontologies, e.g. SAREF ontology


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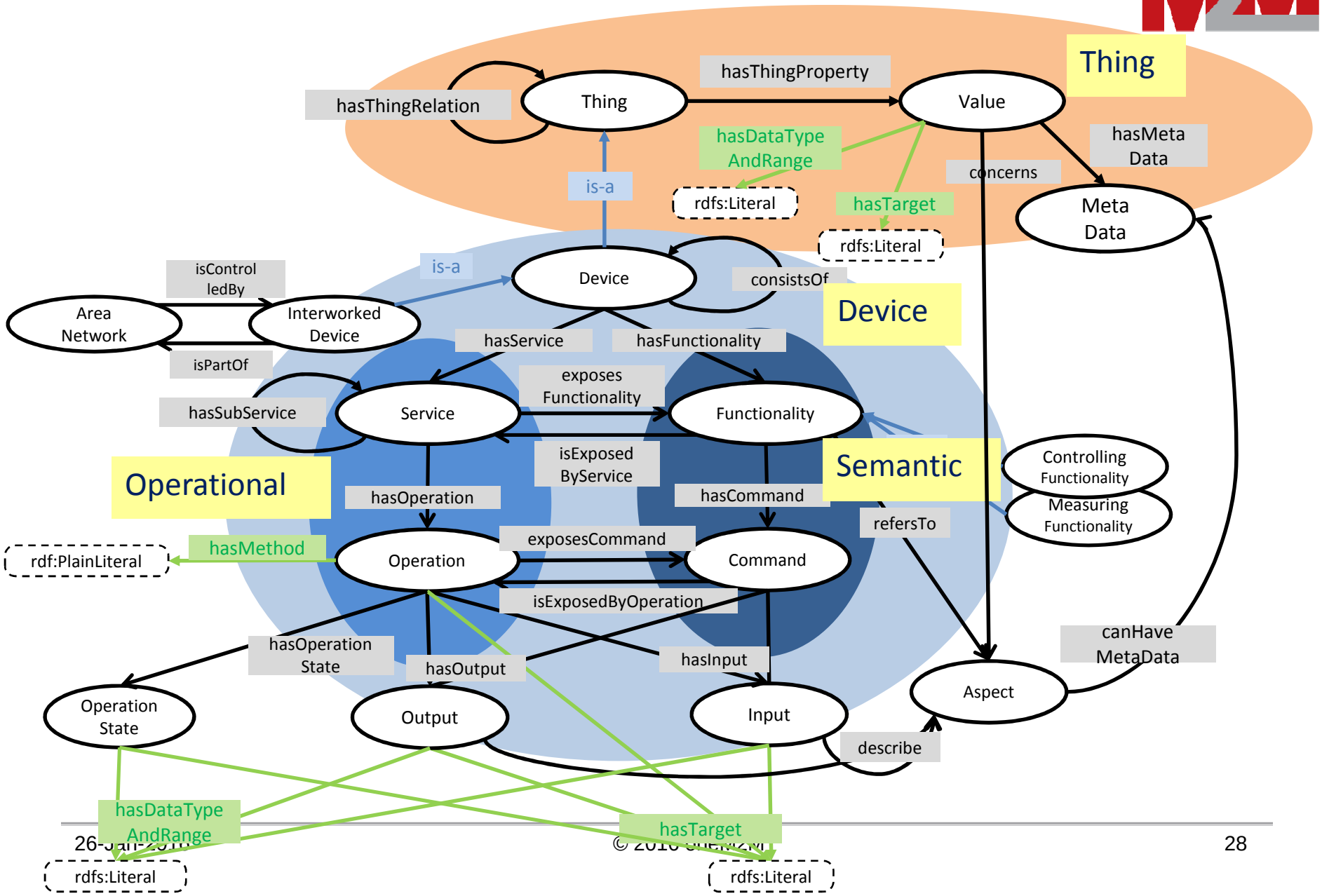
# oneM2M Base Ontology (2)



# Generic Interworking with non-oneM2M devices based on Semantics

- oneM2M defines **Mapping Rules** based on classes defined in oneM2M Base Ontology
- Examples:
  - *Devices* are mapped to <*AE*> resources
  - *Operations* are mapped to <*container*> resources
  - *Functionality* is specified in semantic descriptor of AE

→ oneM2M resource structure, e.g. of non-oneM2M device, is defined based on semantic model

→ Applications know how to interact, e.g. with devices, through oneM2M

→ Tool support, e.g. for creating skeleton of Interworking Proxy, is possible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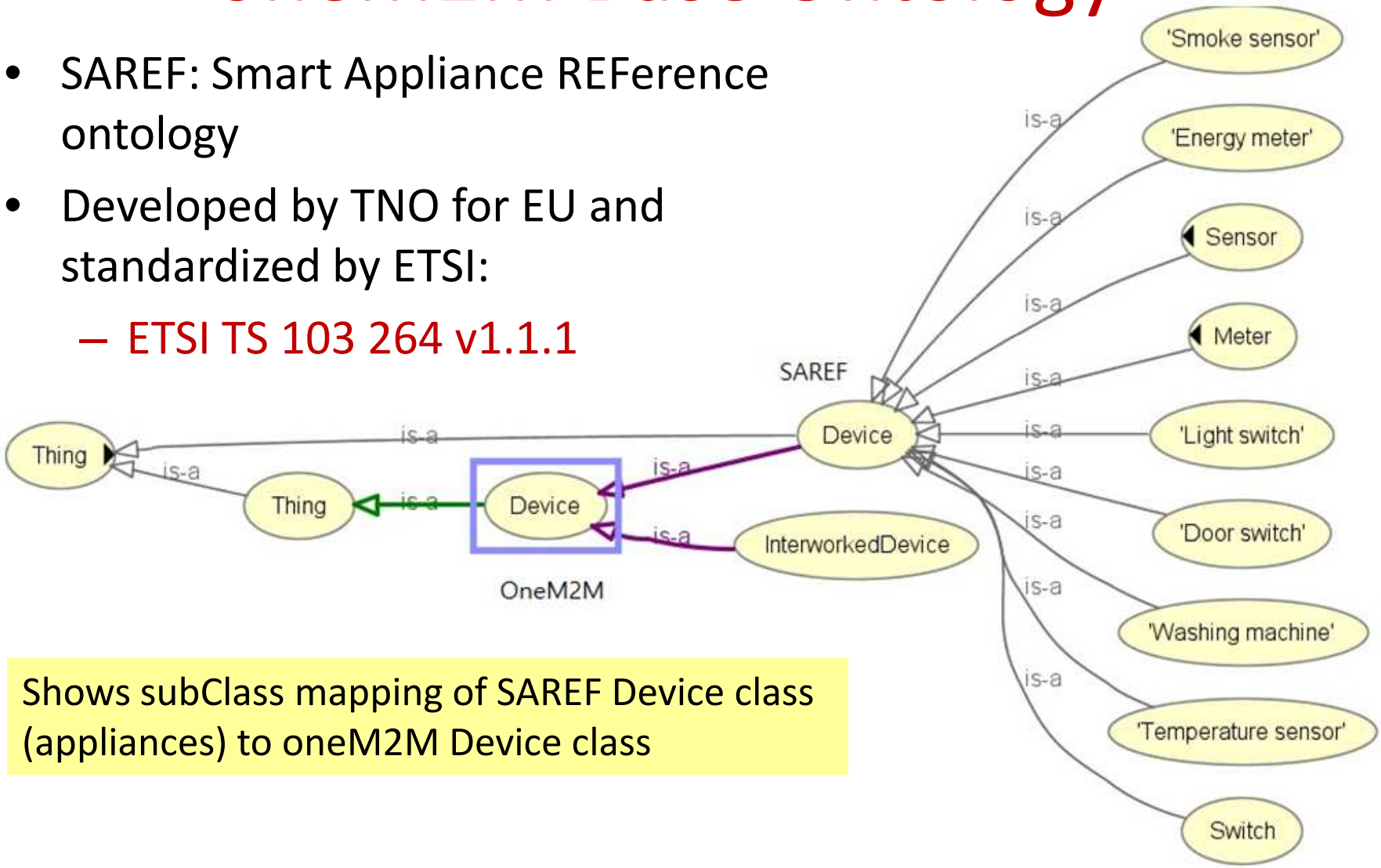
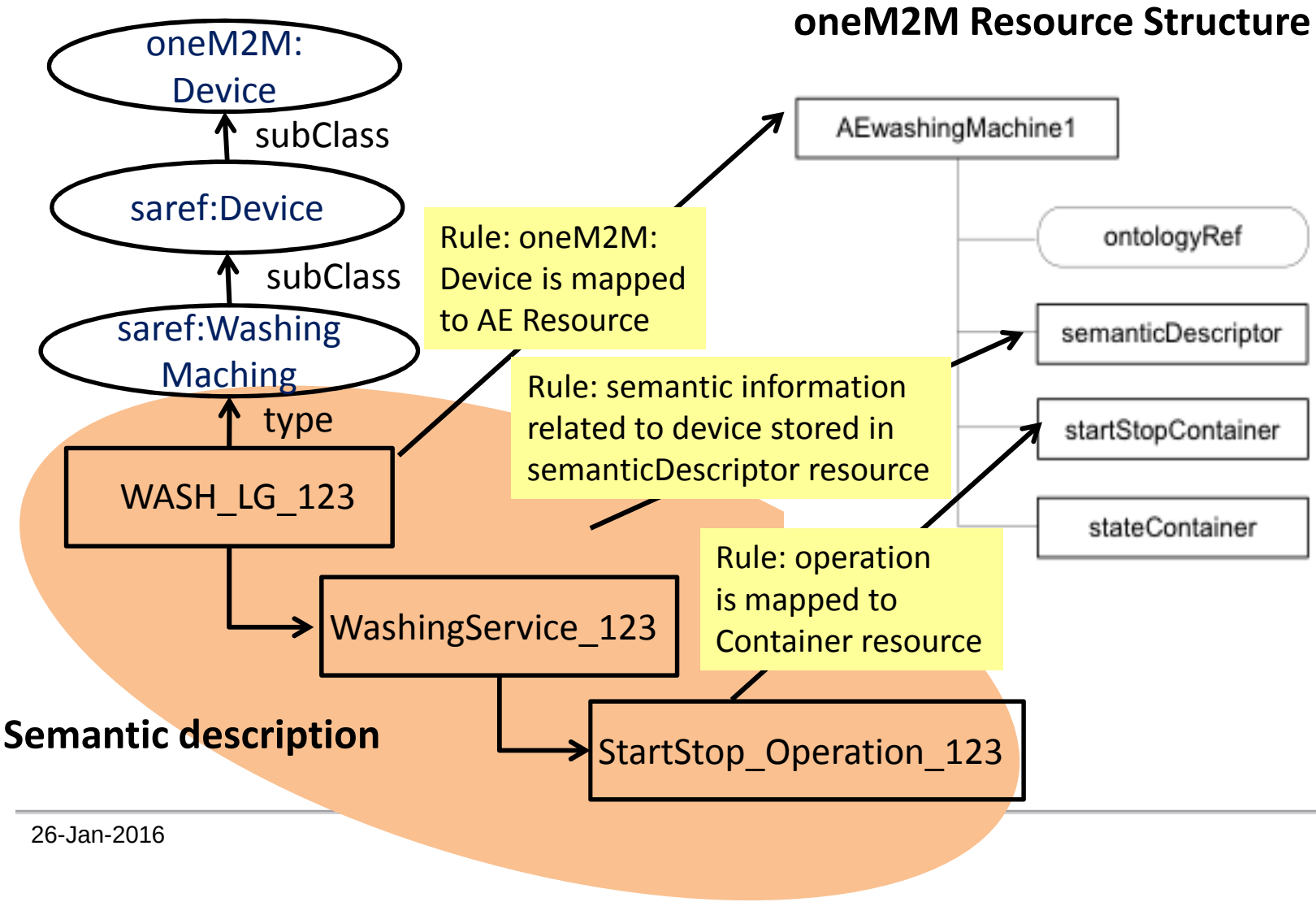
# Example: Mapping SAREF to oneM2M Base Ontology

- SAREF: Smart Appliance REFerence ontology
- Developed by TNO for EU and standardized by ETSI:
  - ETSI TS 103 264 v1.1.1




Shows subClass mapping of SAREF Device class (appliances) to oneM2M Device class

# Example: oneM2M resource structure for SAREF washing machine



# Outlook

- oneM2M Release 2 contains basic semantic functionality and oneM2M base ontology
- Further semantic support, including support of direct semantic queries, analytics and mash-ups envisioned for Release 3
- Feedback from W3C Web of Things including exploration of opportunities for collaboration welcome!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# Proposed terms of collaboration

- **Scope of the collaboration:**
  - IoT archiecture and protocol
- **Method of work:**
  - oneM2M (MAS WG) to present its work on semantic interop. to W3C Web of Things WG and get feedback
  - oneM2M to provide its use cases for consideration by the W3C Web of Things working group
  - W3C to present its work on Web of Things to oneM2M
  - W3C to keep oneM2M updated about the progress of their work on Web of Things (e.g. semantic support for constrained devices)
  - Other methods of works may be developed as we progress (incremental process)
- **Boundaries:** No IPR licensing or confidentiality agreement will be provided. Instead, consultation will be established.
- **Deliverables:** Each organization to publish its own deliverables (no common deliverable currently planned)
  - Any content that may be useful as a technical contribution must come into oneM2M via a oneM2M member
- **Communications:** Both organizations to list each other on their respective web pages (when applicable), and to identify opportunities for joint press releases when we have an appropriate story to tell.
- **Timeline of expected results:** may influence R2, more impact expected for R3
- **oneM2M involved WG:** MAS (primary), SEC, PRO


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