



Study on Semantic Consideration from an oneM2M perspective, ETRI

Group Name: WG5

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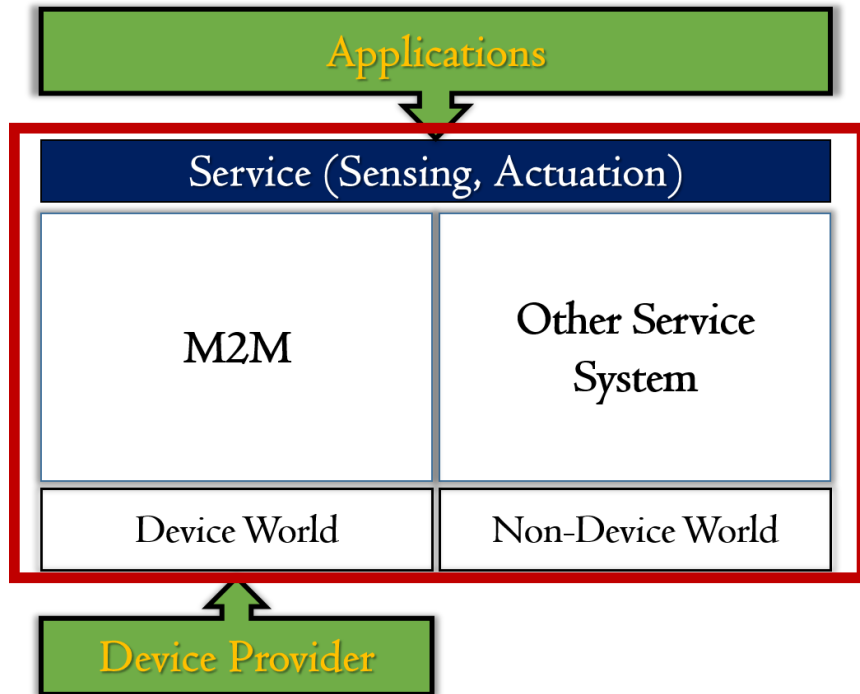
Meeting Date: 2014-11-11

Agenda Item: WI-0005

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oneM2M system users



oneM2M system user

- Application developers
- Device providers(HW/SW)



- Sensing: get raw data or get processed information
- Actuation: storing, computing, displaying, playing, etc.

Users' Requirements

- Application developers' Requirements
 - [URA#1] Effective and easy thing(service) discovery and utilization
 - [URA#2] Cognitive service provision
- Device providers' requirements
 - [URD#1] One-implementation for many-purpose uses

System Requirements

- [SR#1] The M2M System shall provide a consistent view(information model) on things (including both of physical devices and virtual devices) [URA#1,URD#1]
 - abstraction
- [SR#2] The M2M System shall provide capabilities of semantic discovery [URA#1]
 - Semantic data interoperability, semantic-based discovery
- [SR#3] The M2M System shall provide capabilities of semantic mashup [URA#2]
 - Virtual things manipulation
- [SR#4] The M2M System shall provide capabilities of data analysis for context aware service provision [URA#2]
 - Reasoning(inference)

Functional system requirements

FSR	description	SR	TS-0002
FSR#1	The M2M System shall provide a generic information model for M2M system representation(including thing, physical device, virtual device, sensing data, etc.)	SR#1	ABR-001, ABR-003
FSR#2	The M2M System shall be able to provide translation mechanisms between Information Models used by M2M Applications, M2M Devices/Gateways, and other devices.	SR#1	ABR-002
FSR#3	The M2M System shall provide capabilities to model relationship between resources and M2M Applications	SR#1	-
FSR#4	The M2M System shall provide capabilities to manage semantic descriptions of resources and M2M Applications, e.g, create, retrieve, update, delete, associate/link.	SR#1	SMR-001
FSR#5	The M2M System shall be able to provide interworking capabilities between different modeling languages for semantic descriptions.	SR#1	SMR-003
FSR#6	The M2M System shall provide data repository for M2M system information(thing specifications, thing measurements)	SR#1	-

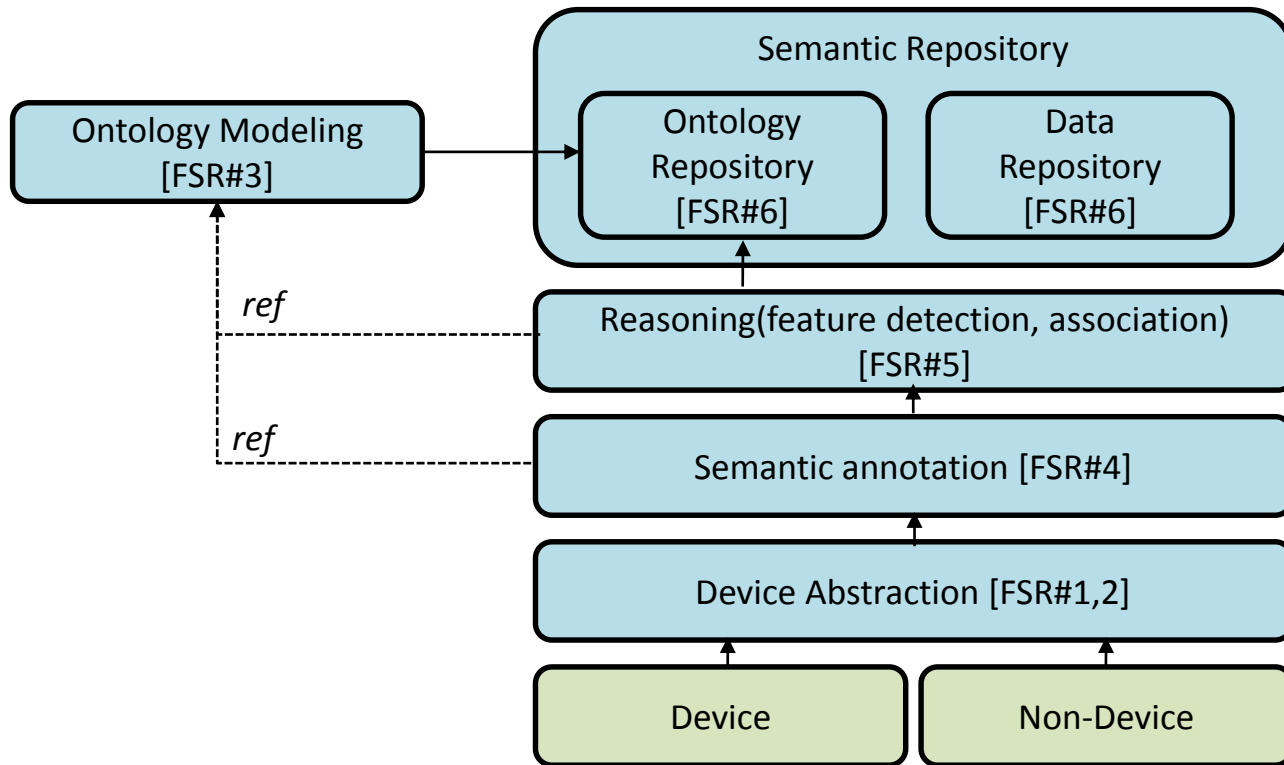
Functional system requirements

FSR	description	SR	TS-0002
FSR#7	The M2M System shall be able to provide interworking capabilities between different modeling languages for semantic descriptions.	SR#2	SMR-003
FSR#8	The M2M System shall provide capabilities to discover M2M Resources based on semantic descriptions.	SR#2	SMR-004
FSR#9	The M2M System shall support the capability to access semantic descriptions which are outside of the M2M System.	SR#2	SMR-005
FSR#10	The M2M System shall be able to provide capabilities for performing Semantic Mash-up using M2M data from M2M Applications and/or from the M2M System (e.g. to create Virtual Devices, offer new M2M Services, etc.)	SR#3	SMR-007
FSR#11	The M2M System shall be able to support capabilities for performing M2M data Analytics based on semantic descriptions from M2M Applications and /or from the M2M System.	SR#4	SMR-006

Non-functional system requirements

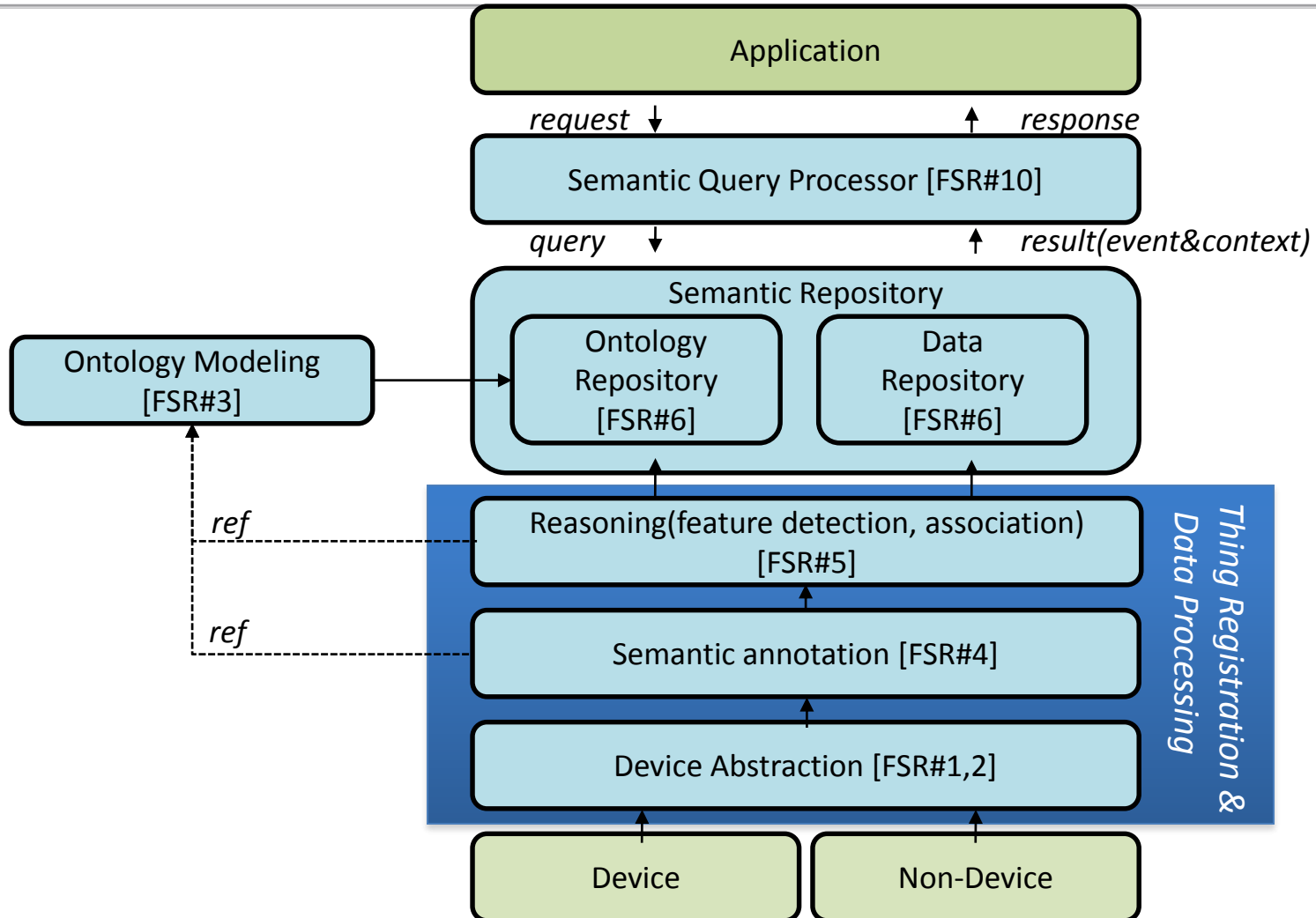
TS-0002	description	System requirement
SMR-002	The M2M System shall support a common modeling language for semantic descriptions (including relationships between Things) in order to make them available to M2M Applications.	SR#1

Use cases - #1: thing registration

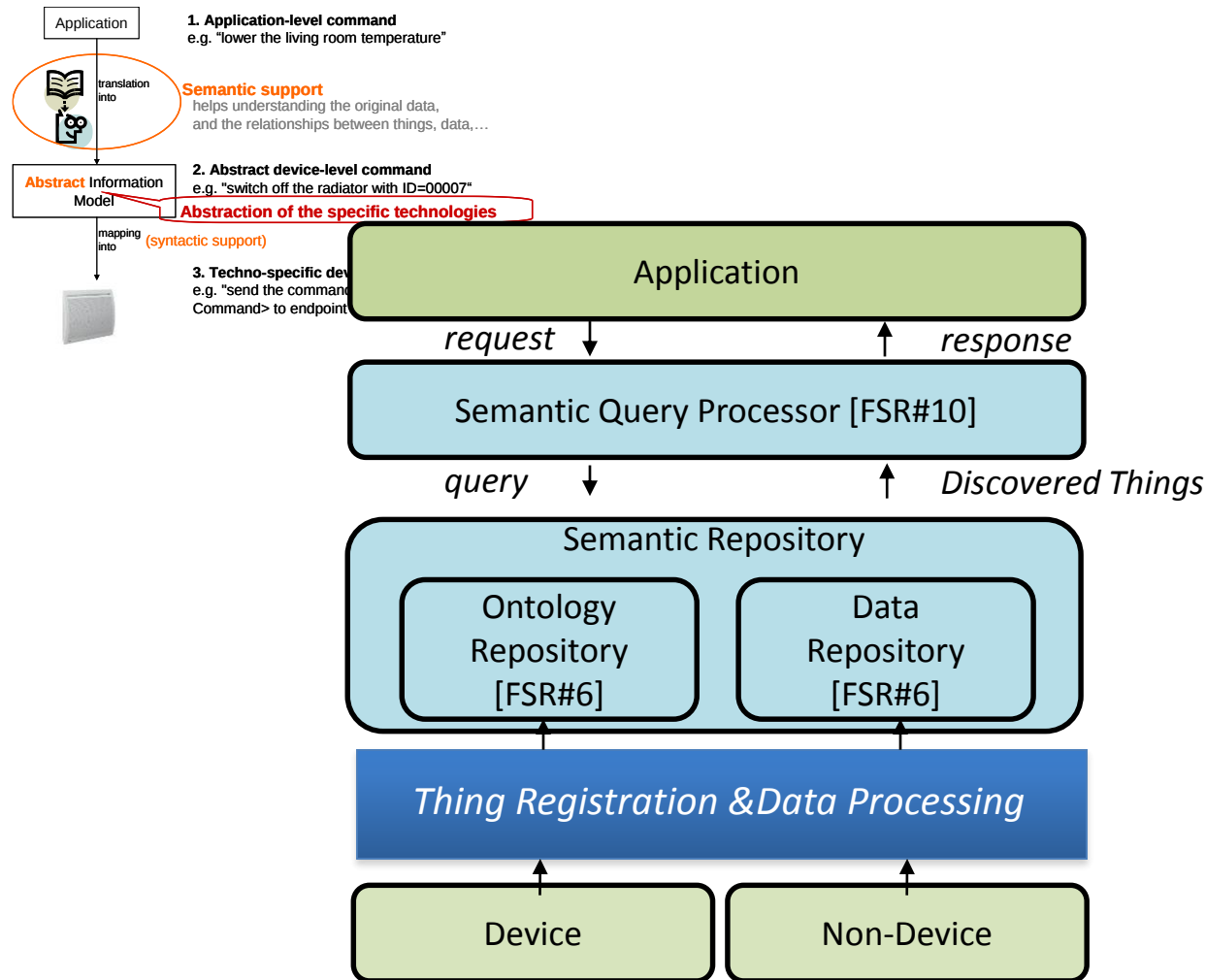


- Device: An apparatus through which a user can perceive and interact with the internet(W3C)
- Non-device: an software entity through which a user can perceive and interact with the internet

Use cases - #2: data flow-in



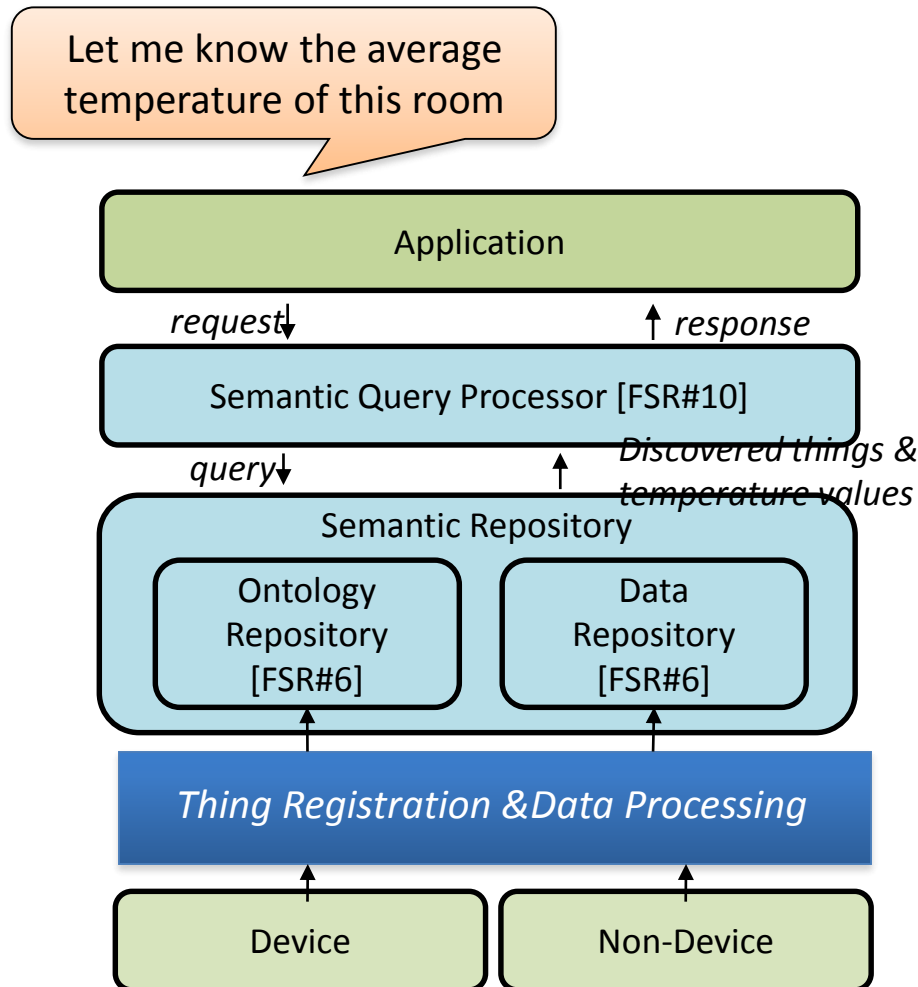
Use cases - #3: semantic discovery



1. App query "lower the living room temperature"
2. Semantic parsing of the query.
3. Semantic discovery with thingType = "temperature" and location = "living room" by using ontology
4. Select things based on context
5. Send a response to the application

And then, an application may send commands to the selected things to lower room temperature

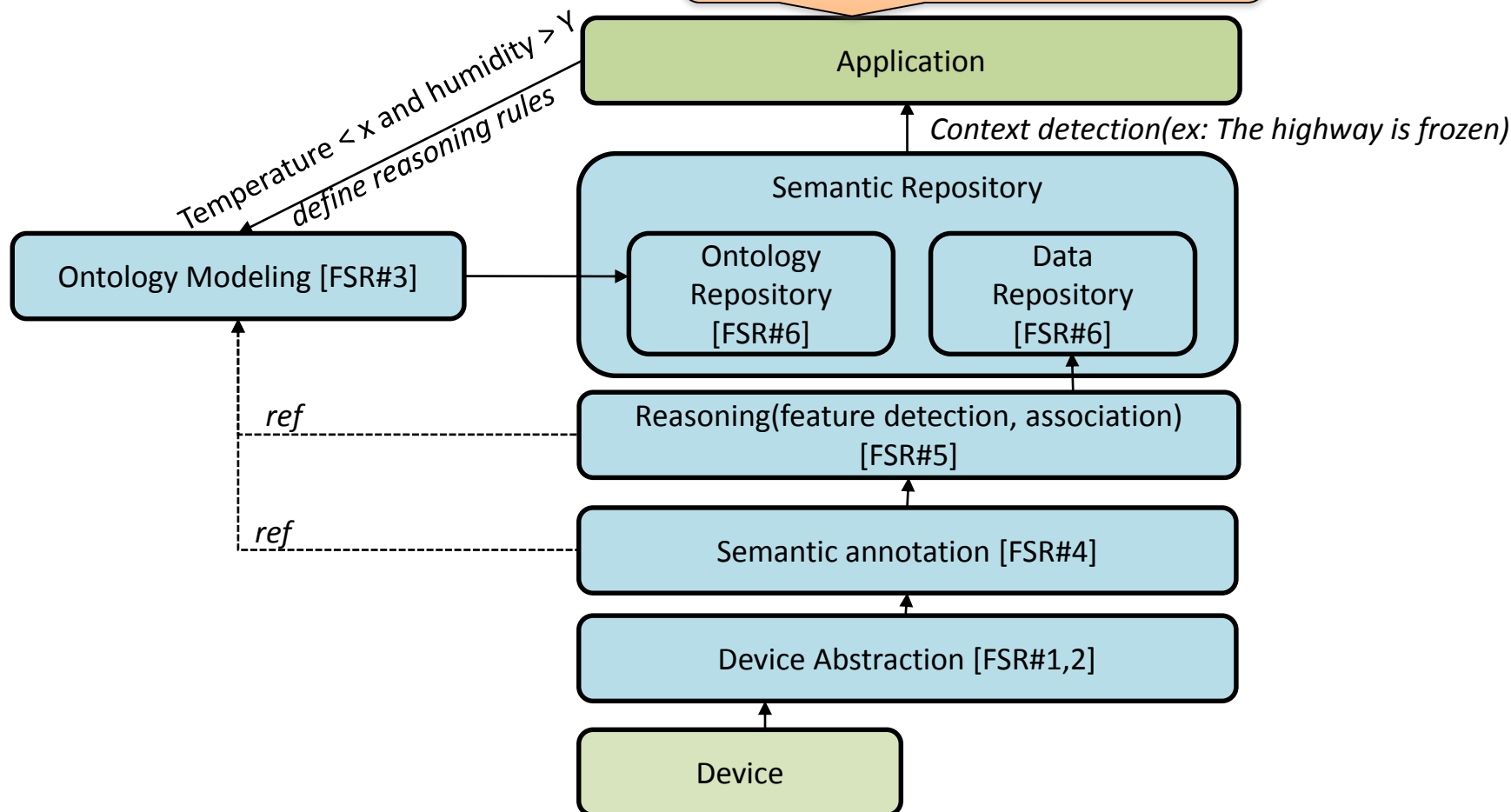
Use cases - #4: semantic mashup



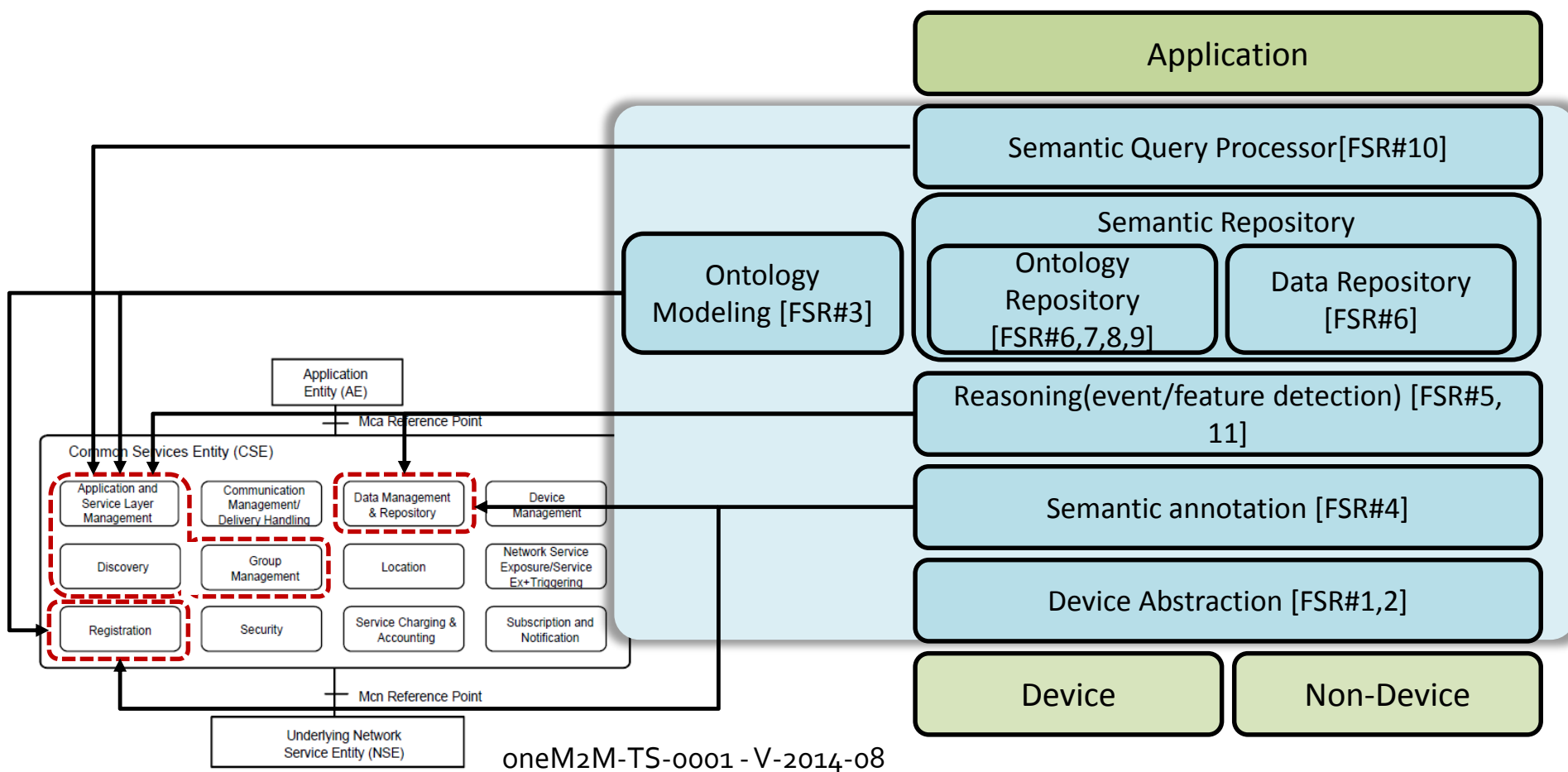
1. App query “average temperature of this room”
2. Semantic parsing of the request
3. Semantic discovery with thingType = “temperature” and location = “living room” by using ontology
4. Make a things-group based on context
5. Take average value from collected sensing data

Use cases - #5: reasoning

If the highway is frozen, let drivers know to make a detour in other ways



Semantic System framework (draft)

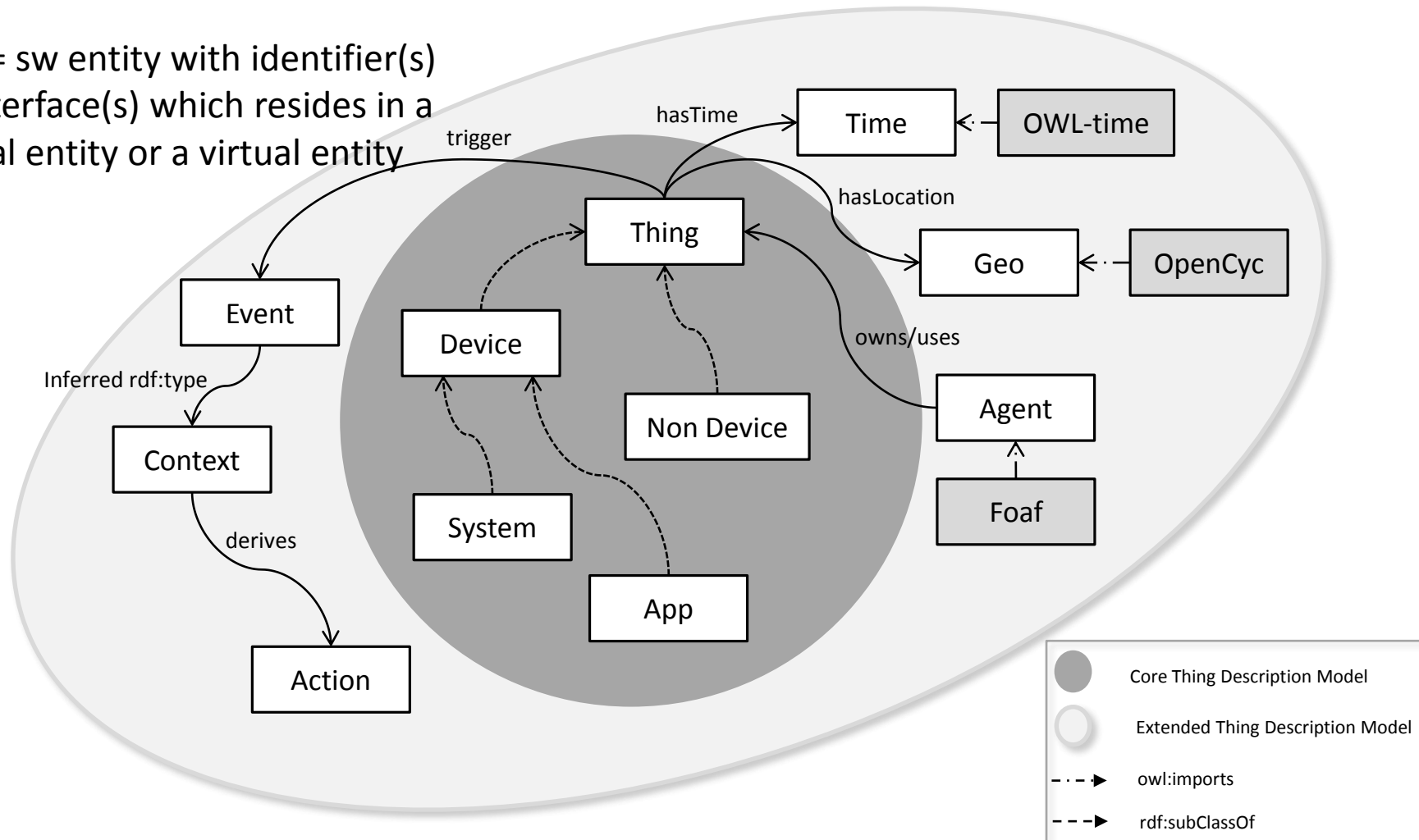


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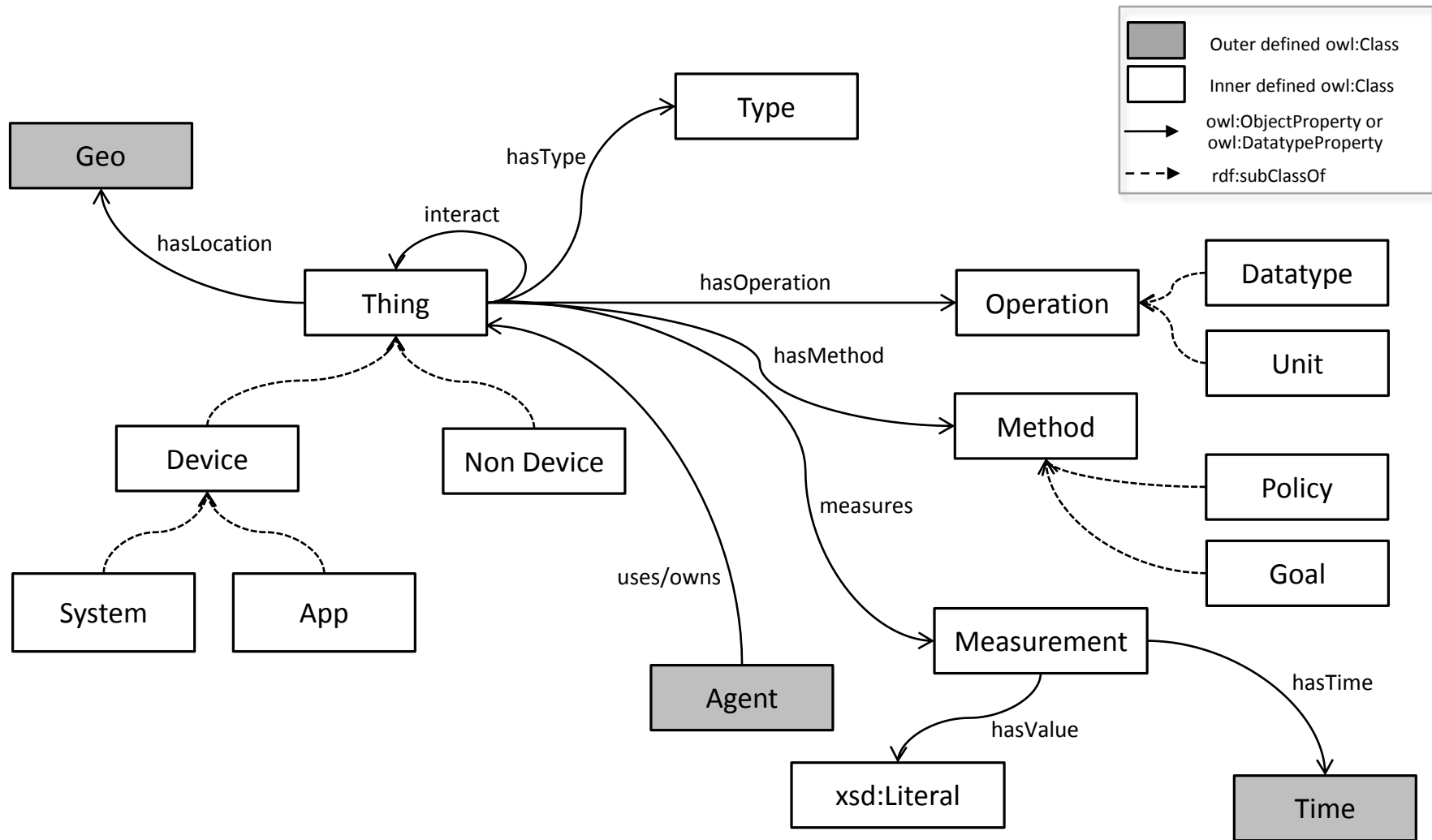
Figure 6.2-1: Common Services Functions

Thing Description model (draft)

Thing = sw entity with identifier(s) and interface(s) which resides in a physical entity or a virtual entity



Core Thing description model



Core Thing description model–Turtle#1

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .  
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .  
@prefix owl: <http://www.w3.org/2002/07/owl#> .  
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .  
@prefix geo: <http://GeoOntology#> .  
@prefix agent: <http://AgentOntology#> .  
@prefix time: <http://TimeOntology#>  
@base: <http://ThingOntology#> .
```

```
<http:// ThingOntology#> rdf:type owl:Ontology;  
                           rdfs:comment "This is an Thing Ontology";  
                           owl:imports <http://AgentOntology#>;  
                           owl:imports <http://GeoOntology#>;  
                           owl:imports <http://TimeOntology#>.
```

```
# Thing Ontology Classes  
:Thing rdf:type owl:Class.
```

Core Thing description model–Turtle#2

```
:Device rdf:type owl:Class;  
        rdfs:subClassOf :Thing.  
:NonDevice rdf:type owl:Class;  
           rdfs:subClassOf :Thing.  
:System rdf:type owl:Class;  
        rdfs:subClassOf :Device.  
:App rdf:type owl:Class;  
     rdfs:subClassOf :Device.  
  
:Type rdf:type owl:Class.  
  
:Operation rdf:type owl:Class.  
:Datatype rdf:type owl:Class;  
          rdfs:subClassOf :Operation.  
:Unit rdf:type owl:Class;  
      rdfs:subClassOf :Operation.
```

Core Thing description model–Turtle#3

```
:Method rdf:type owl:Class.  
:Policy rdf:type owl:Class;  
        rdfs:subClassOf : Method.  
:Goal rdf:type owl:Class;  
       rdfs:subClassOf : Method.  
  
:Measurement rdf:type owl:Class.  
  
# Thing Ontology Properties  
:interact rdf:type owl:ObjectProperty;  
         rdfs:domain :Thing;  
         rdfs:range :Thing.  
  
:hasType rdf:type owl:ObjectProperty;  
         rdfs:domain :Thing;  
         rdfs:range :Type.
```

Core Thing description model–Turtle#4



```
:hasLocation rdf:type owl:ObjectProperty;  
              rdfs:domain :Thing;  
              rdfs:range geo:LocationCoordinate.
```

```
:hasOperation rdf:type owl:ObjectProperty;  
              rdfs:domain :Thing;  
              rdfs:range :Operation.
```

```
:hasMethod rdf:type owl:ObjectProperty;  
           rdfs:domain :Thing;  
           rdfs:range :Method.
```

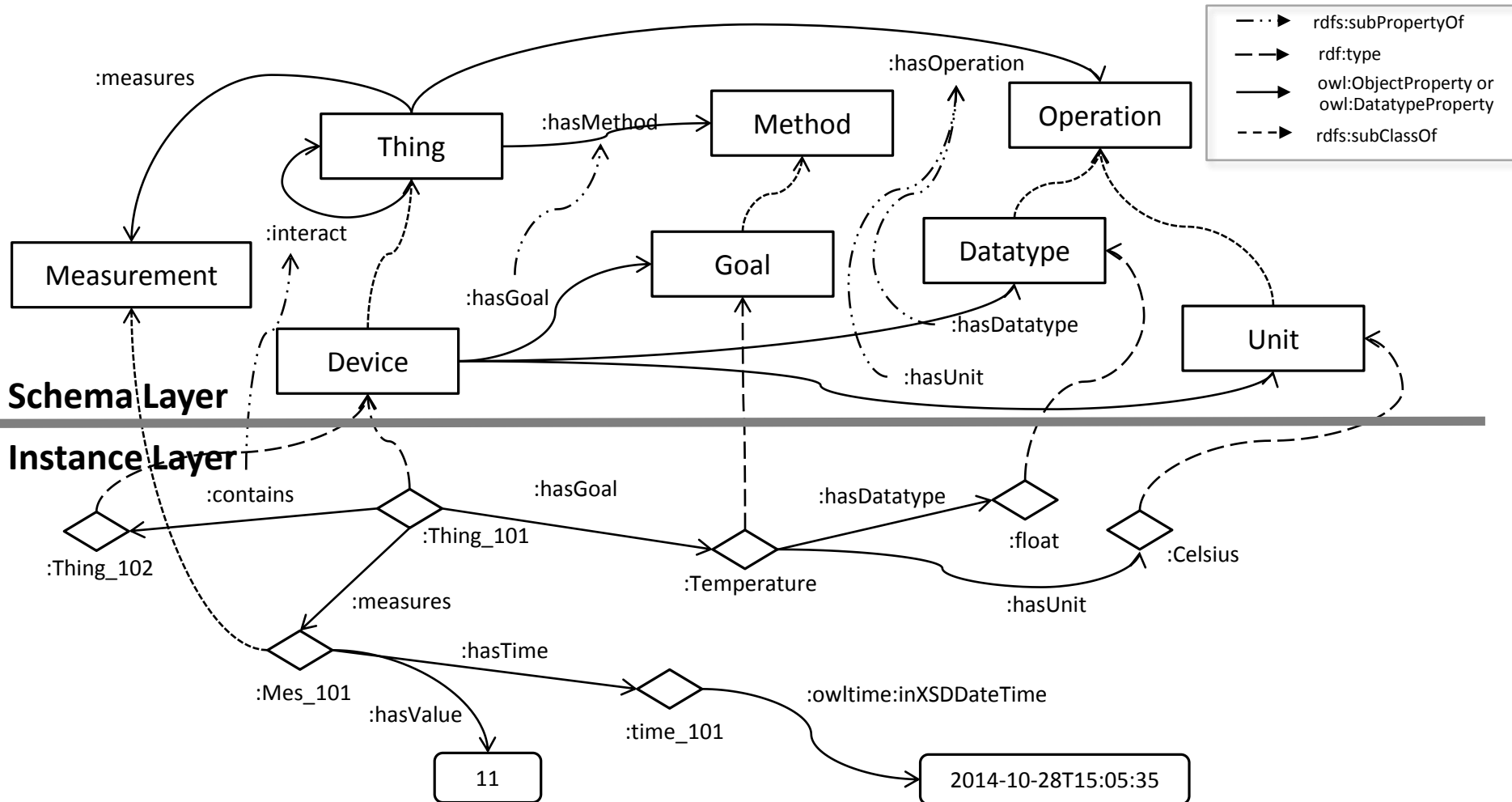
```
:measures rdf:type owl:ObjectProperty;  
          rdfs:domain :Thing;  
          rdfs:range :Measurement.
```

Core Thing description model–Turtle#5

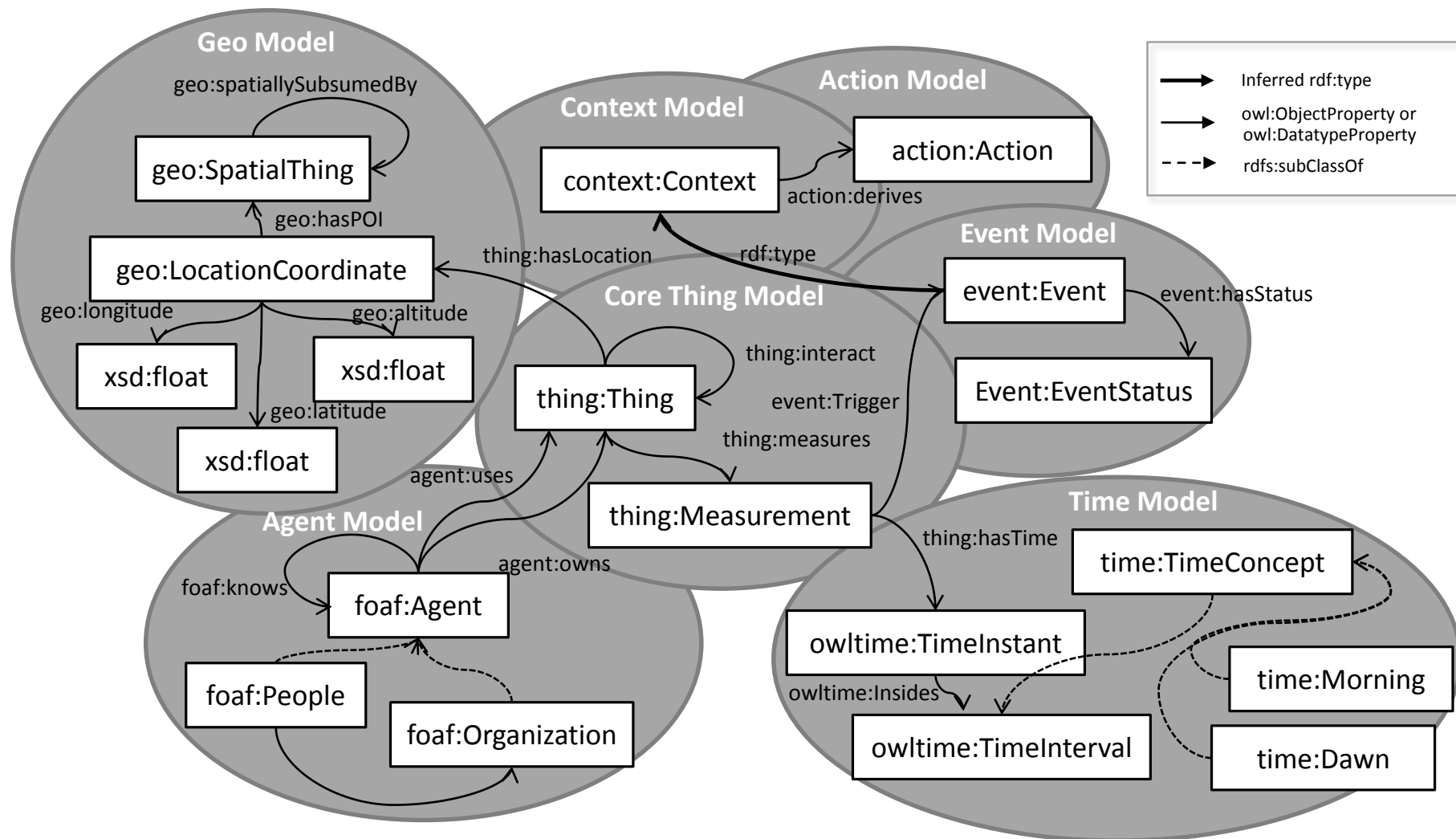


```
:hasValue rdf:type owl:DatatypeProperty;  
          rdfs:domain :Measurement;  
          rdfs:range xsd:Literal  
  
:hasTime rdf:type owl:ObjectProperty;  
         rdfs:domain :Measurement;  
         rdfs:range owltime:TimeInstant.
```

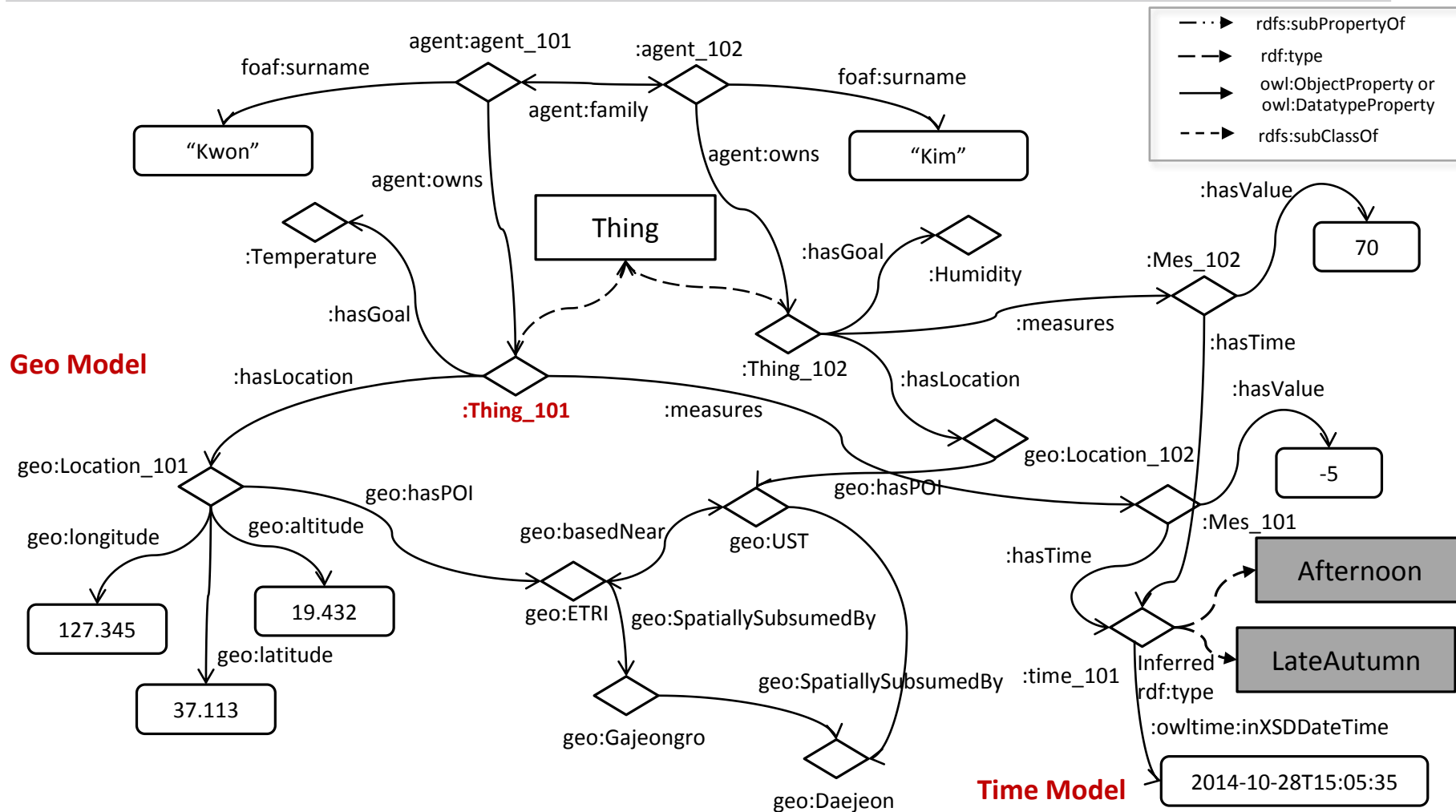
Use cases - #6: Core Thing Description



Extended Thing model

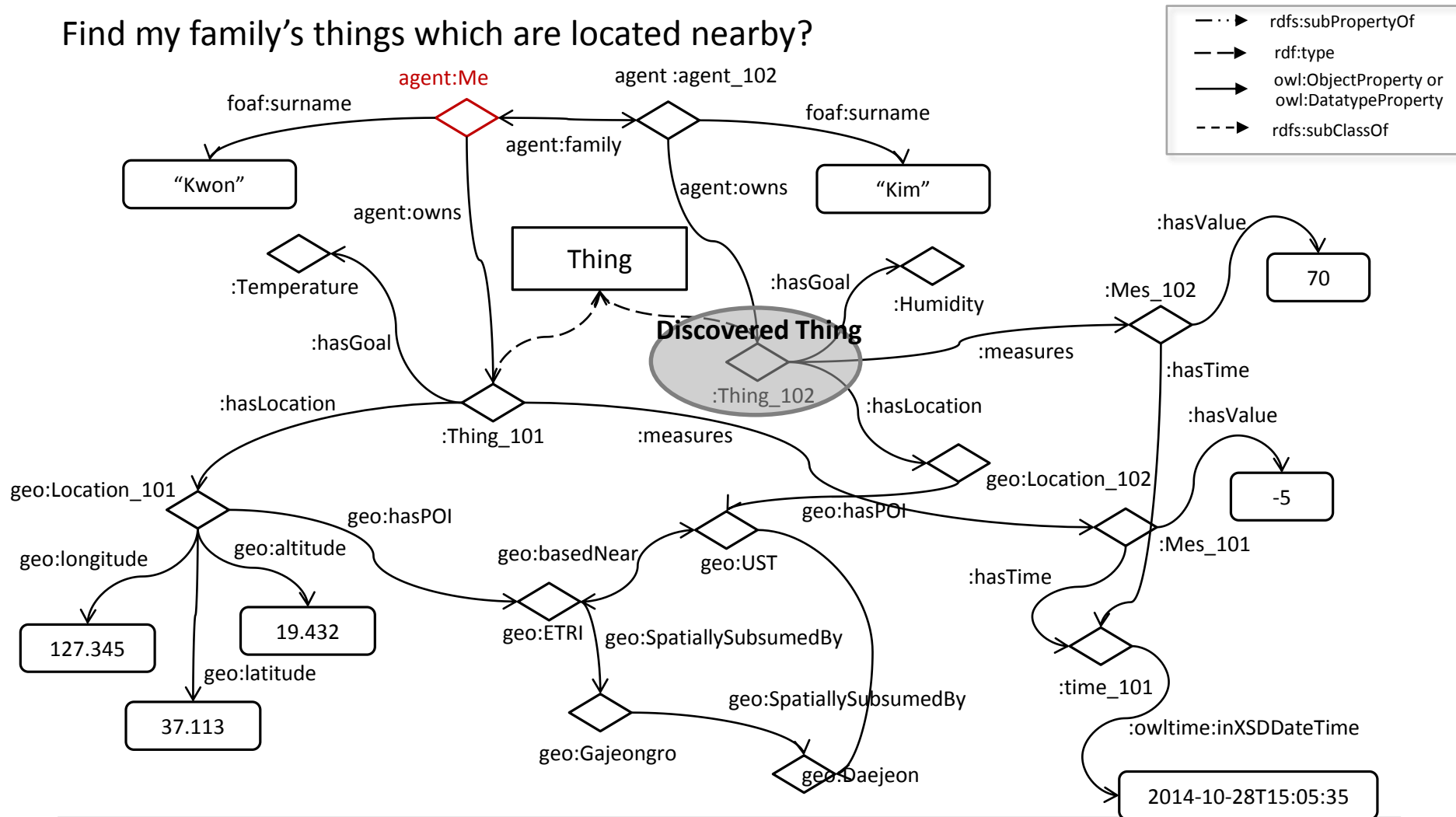


Use cases - #7: Extended Thing Description



Use cases - #8: Semantic Discovery

Find my family's things which are located nearby?



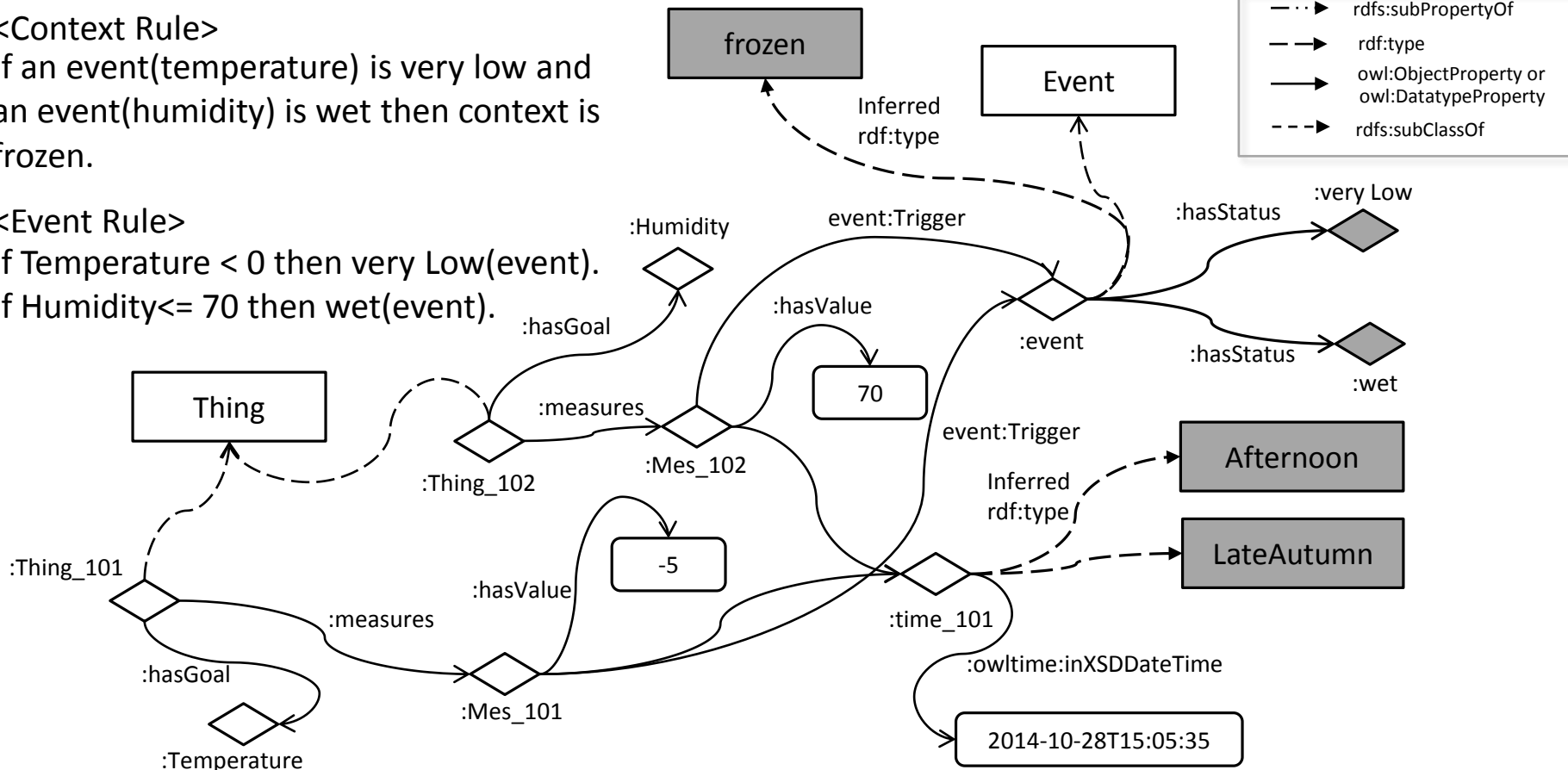
Use cases - #9: Reasoning

<Context Rule>

If an event(temperature) is very low and an event(humidity) is wet then context is frozen.

<Event Rule>

If Temperature < 0 then very Low(event).
If Humidity <= 70 then wet(event).



Proposal

- Propose to rearrange TR from the purpose of semantic adoption in oneM2M to detailed level description (semantic framework and data model)
 - **#1 : goal clarification of semantic technology adoption into oneM2M system(users' requirement)**
 - **#2 : rearrangement of system requirements based on users' requirements**
 - **#3 : propose a semantic system framework based on use cases analysis**
 - **#4 : propose generic information model on things**
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