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| Input contributionUse case |
| Use Case Title:\* | Semantic Recommendation in CSEs for Discovery  |
| Group Name:\* | RDM |
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| Date:\* | 2020-04-23 |
| Abstract:\* | This use case looks at the semantic discovery requirements illustrating an Hospital that has a large number of IoT devices from different domains, which have different goals in the infrastructure. In this scenario, it is necessary to perform a discovery task of suitable devices relying on fine-grained discovery criteria. In addition, the discovery must cope devices belonging to different administrative domains.  |
| Agenda Item:\* |  |
| Work item(s): | [WI-0101](http://member.onem2m.org/Application/documentapp/downloadLatestRevision/?docId=31941) - Advanced Semantic Discovery |
| Document(s) Impacted\* | TR 001 |
| Intended purpose ofdocument:\* | [x]  Decision[ ]  Discussion [ ]  Information[ ]  Other <specify> |
| Decision requested or recommendation:\* |  |
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## Semantic Recommendation in CSEs for Discovery

### Description

This use case is built upon a cross-domain scenario in which a Hospital has a large number of IoT devices which are in charge of performing different tasks. The IoT devices can be classified into the following categories: energy devices (load consumption, flexibility monitoring, energy switch, …), building devices (lights, door sensors, occupancy sensors, …) , personal devices (smart bands, smartphones, …), and devices related to health (hearth rate sensor, glucose monitor, …). These IoT devices are connected across in the hospital network but they do not belong to the same administrative domain; which hinders their usability, traceability, or accessibility.

In this scenario, several actors need to discover and use IoT devices that are allocated outside their administrative domain. For instance, if the energy devices detect an incoming negative peak of energy, entailing that a large number of devices should be switched off to avoid the whole hospital to run out of energy (losing critical systems for the patients). Then, the energy devices (or an application in charge) should be able to discover all the sensors in the building that are related to energy (like light bulbs or air condition) and switch them off. Also, the same actor (the energy devices or an application in charge) should detect the critical eHealth IoT devices for the patients and ensure that they are switched on. In the case that one of the eHealth IoT devices would run off, then the energy devices, or an application in charge, should perform a discovery task over the personal devices in order to find relevant people, i.e., doctors, nearby the critical eHealth IoT devices that are running out of energy in order to assist the patients.

 This use case assumes that there is an interoperability platform (oneM2M) that allows monitoring and controlling the different IoT devices regardless their vendor. Also, the platform should ensure a secure and private environment so no unauthorized third party could access the network. This platform should ensure a sufficient rich discovery in order to meet the previous example. The following features should characterize this discovery task:

* Fully distributed in order for the query to reach from one administrative domain to others that may contain relevant infrastructures.
* The discovery should count with an expressive query language so specific semantic terms from domains like energy or eHealth can be used in the discovery.
* Discovery needs to happen in real-time and therefore the communication mechanism across infrastructures that belongs to different administrative domains should not be blind; instead it should be guided by the semantics of the query in order to boost-up the discovery task. Infrastructures perform discovery using a suitable local semantic recommendation system.

This use case can be generalized to other domains in which IoT devices are spitted in different administrative domains and discovery needs be performed across them avoiding flooding the infrastructures, i.e., relying on a guided system that will recommend to which infrastructures perform the discovery, and to which discard, leveraging the network load.

### Source

ETSI TR 103 714: “SmartM2M; Study for oneM2M Discovery and Query use cases and requirements”

oneM2M TS-0012: “oneM2M Base Ontology”

oneM2M TR-0045: “Developer Guide Implementing Semantics”

oneM2M TS-0001: “Functional Architecture”

###  Actors

M2M Applications, M2M Service providers

IoT devices from the different domains

Medical staff, building staff, or technicians

### Pre-conditions

A network infrastructure distributed across different administrative domains. Intuitively, network infrastructure is a set of M2M devices and Application Entities (AE) that have been installed and registered to their corresponding MN-CSE (Middle Node – Common Services Entity). The MN-CSEs have in turn been registered to the corresponding IN-CSE (Infrastructure Node – Common Service Entity).

All the different CSEs have *“Semantic Discovery Agreements”* (SDA) with each other, resulting in a tree-like network topology. In such a topology, the CSEs should rely on a *“recommendation-like system”* in order to assist the discovery resolution task performed by the CSEs involved in. As smarter is the “recommendation-like” system, as efficient will be the discovery in terms of time, CSEs visited, and number of query forwarded, among others. The discovery protocol should allow to express some network directives to address efficient routing across CSEs.

Both the registering and the discovery should be expressed according to the oneM2M described in TS0012. Nevertheless, due to tailored-domain terms required in our use case, the registering and the discovery should be also expressed with specific domain ontologies like the different extensions of SAREF.

### Triggers

The IoT energy devices, or a technician, send first a semantic discovery in order to find all the non-critical IoT devices allocated in the building. Then, a semantic discovery in order to find all the critical IoT devices from the eHealth domain, and if required, a last semantic discovery to find relevant medical staff that could be near critical devices. The different discovery tasks will rely on specific semantics, the first will contain information about devices and if they consume energy, the second about eHealth devices that are critical and cannot be switched off, and finally, about people, their roles in hospital, and their location.

###  Normal Flow

 Following the first discovery task is showcased:

1. An IoT energy device, or a technician, sends a query to its CSE. The SPARQL query will contain terms about sensors that consume energy, are not from the eHealth domain, and are located in the building.
2. The CSE verifies the integrity of the query, and following, it tries to answer the query. If the CSE is not able, then, forwards the query to other CSEs located in different administrative domain. The CSE does not broadcast the query, but instead selects relevant CSEs to answer the query considering its embedded semantics thanks to the “recommendation-like” system.
3. The CSE of the Building will receive the query (since the “recommendation-like” system guided the discovery to this CSE), and will try to solve it. Since the building contains suitable IoT devices the CSE will be able to produce and forward back an answer.
4. Finally the IoT energy device, or a technician, will receive the answer that was forwarded across the distributed network crossing two administrative domains, i.e., the building and the energy domain.

###  Alternative flow

Void

### Post-Conditions

The query should be answered, if a resource that fulfils the discovery criteria is present in the network and “reasonably” reachable. Also, the whole task should finish in a “acceptable” time and hops across CSEs.

### High Level illustration



### Potential requirements

1. The oneM2M system shall provide mechanisms that allow performing routing of the discovery request, based on the embedded semantic of the query, and the semantic of the registered CSEs, oneM2M devices, and Application Entities (AE).
2. The oneM2M ontology shall provide domain specific (eHealth, Building, Wearable, smart energy in this example) features to characterize service provider domains, like in SAREF modules.
3. A OneM2M system shall provide a query language able to manage network directives that will guide the discovery, e.g., upstream, downstream, sidestream, or depth.
4. OneM2M system shall provide underlying mechanisms for query splitting, rewriting and reassembling in CSEs in order to answer the queries with partial content registered in different CSEs.