|  |
| --- |
| Input contributionUse case |
| Use Case Title:\* | Semantic Recommendation in CSEs for Discovery  |
| Group Name:\* | RDM |
| Source:\* | INRIA, UPM |
| Contact: | INRIA, UPMLuigi Liquori, Luigi.Liquori@inria.fr Andrea Cimmino, cimmino@upm.esMarie-Agnès Peraldi-Frati, marie-agnes.peraldi\_frati@inria.fr Raúl García-Castro, rgarcia@upm.es |
| Date:\* | 2020-04-23 |
| Abstract:\* | This use case aims at extending the requirements of the Advanced Semantic Discovery (ASD) by illustrating new ones through the example of a 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 an Advanced Semantic Discovery (ASD) of suitable devices relying on fine-grained discovery criteria. In addition, the Advanced Semantic Discovery (ASD) must cope with devices belonging to different Service Providers. In this scenario a Semantic Recommendation (SR) is required to resolve queries through the overlay network of CSEs. |
| 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:\* |  |
| 'Template Version: January 2019 (do not modify) |

**oneM2M Notice**

The document to which this cover statement is attached is submitted to oneM2M. Participation in, or attendance at, any activity of oneM2M, constitutes acceptance of and agreement to be bound by terms of the Working Procedures and the Partnership Agreement, including the Intellectual Property Rights (IPR) Principles Governing oneM2M Work found in Annex 1 of the Partnership Agreement.

### Advanced Semantic Discovery - Semantic Recommendation in a network of nodes across IoT DomainsDescription

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, etc), building devices (lights, door sensors, occupancy sensors, etc) , personal devices (smart bands, smartphones, etc), and devices related to health (hearth rate sensor, glucose monitor, etc). These IoT devices are connected across in the hospital network but they do not necessarily belong to the same oneM2M Service Providers..

In this scenario, several actors need to discover and use IoT devices that are allocated outside their oneM2M Service Providers. 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 sufficiently rich discovery in order to meet the previous example Please note that the definitions and acronyms provided in clause 12.20.1 of the current document apply to this use case:

* It is fully distributed in order for the *Advanced Semantic Discovery* (ASD) to reach from one oneM2M Service Provider to others that may contain relevant infrastructures.
* The *Advanced Semantic Discovery Query* (ASDQ) is expressed using an *Advanced Semantic Discovery Query Language* (ASDQL) so specific semantic terms from domains like energy or eHealth can be used.
* *The Advanced Semantic Discovery* (ASD) needs to happen in quasi real-time and therefore the communication mechanism across infrastructures that belong to different Service Provider should not be blind; instead it should be guided by a *Semantic Recommendation* (SR).

This use case can be generalized to other domains in which IoT devices are spitted in different IoT Service Providers and discovery needs be performed across them avoiding flooding the infrastructures, i.e., relying on a guided Semantic Recommendation System(SRS) to which infrastructures perform the Advanced Semantic Discovery (ASD), and to which discard, leveraging the network load.

The following definition introduces the concept of Semantic Recommendation:

**[Semantic Recommendation (SR)]**

We define Semantic Recommendation **(**SR) a capability in the CSE that takes routing decisions for forwarding a received Advanced Semantic Discovery Query (ASDQ). This is the Semantic Routing Tables (SRT) defined in clause 12.20.1 of the current document enriched with semantic annotations suggesting the resources that may be found on the routing selection.

### 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

IN-CSE and MN-CSE

IoT devices from the different domains

Medical staff, building staff, or technicians

### Pre-conditions

A network infrastructure distributed across different IoT Service Providers. Intuitively, network infrastructure of the oneM2M Service Providers 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 as a Semantic Recommendation (SR) in order to assist the advanced semantic discovery resolution task performed by the CSEs involved in. As smarter is the Semantic Recommendation (SR), as efficient will be the discovery in terms of time, CSEs visited, and number of queries forwarded, among others. The discovery should allow expressing 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.

**Note.** Semantic Discovery Agreement (SDA) is defined in clause 12.20.1 of the current document.

### Triggers

The IoT energy devices, or a technician, send first an Advanced Semantic Discovery Query (ASDQ) to find all the non-critical IoT devices allocated in the building. Then, a second Advanced Semantic Discovery Query (ASDQ) is issued to find all the critical IoT devices from the eHealth domain, and if required, a third Advanced Semantic Discovery Query (ASDQ) is issued to find relevant medical staff that could be near critical devices. The different Advanced Semantic Discovery Query (ASDQ) 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 the third about the people, their roles in hospital, and their location.

###  Normal Flow

1. An IoT energy device, or a technician, sends an ordinary oneM2M Semantic Discovery Query (SDQ) to its CSE, written in SPARQL. The SPARQL query will contain terms about sensors that consume energy, that are not from the eHealth domain, and that are located in the building.
2. The CSE verifies the integrity of the Semantic Discovery Query (SDQ), and it tries to answer. If the CSE is not able to reply, it builds an Advanced Semantic Discovery Query (ASDQ) wrapping the Semantic Discovery Query (SDQ). Then the CSE forwards the Advanced Semantic Discovery Query (ASDQ) to other CSEs that may be located in the same oneM2M Service Provider, or in a different oneM2M Service Providers, or even sent to a non oneM2M IoT Service Provider. The CSE does not broadcast the Advanced Semantic Discovery Query (ASDQ), but it selects the relevant CSEs to answer the Advanced Semantic Discovery Query (ASDQ) according to the Semantic Recommendation (SR).
3. The CSE of the Building will receive the Advanced Semantic Discovery Query (ASDQ) and will try to solve the embedded Semantic Discovery Query (SDQ). The building contains suitable IoT devices so that the CSE will be able to produce and forward back a positive answer.
4. Finally, the IoT energy device, or a technician, will receive the answer and the semantic discovery terminates successfully.

### Alternative flow

 Void

### Post-Conditions

The query is answered if a resource that fulfils the discovery criteria is present in the network and “reasonably” reachable. Because of Semantic Recommendation, the whole task will be completed in an “acceptable” time even when crossing different IoT Service Providers domains is required.

### High Level illustration



### Potential requirements

The following potential requirements are additional to the ones already identified in clause 12.20.10:

1. The oneM2M system shall integrate already standardized ontology extensions to the current oneM2M ontology to cope with new specific domains (ex: SAREF core and its extensions SAREF4BLDG, SAREF4ENVI, SAREF4ENERGY, SAREF4CITY, SAREF4AGRI, SAREF4WATER).
2. Based on semantic information, the oneM2M system shall take routing decisions for forwarding a received Advanced Semantic Discovery Query (ASDQ). The semantic information will allow the oneM2M system to maximize and to accelerate the semantic discovery process.