Service Layer API for oneM2M

Final Draft

97 Pages

Abstract

oneM2M is a global standard organization that specifies a common M2M Service Layer for IoT, called Common Services Entities (CSE). An application can discover and access functionalities in a CSE with RESTful operations, which are Create, Retrieve, Update, Delete and Notify. oneM2M specifies a variety of communication methods, 4 protocol bindings (HTTP, MQTT, CoAP, Websocket) and 3 serializations (XML, JSON, CBOR). This RFC describes the way to provide a high level API for oneM2M RESTful operations hiding the difference of the variety of communication methods.

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0.3 Feedback

This document can be downloaded from the OSGi Alliance design repository at https://github.com/osgi/design
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0.4 Table of Contents

0.5 Terminology and Document Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY" and "OPTIONAL" in this document are to be interpreted as described in 10.1.

`Source code is shown in this typeface.`

0.6 Revision History

The last named individual in this history is currently responsible for this document.

Revision	Date	Comments
Initial	*SEP 15 2017*	Initial Contribution. Hiroyuki Maeomichi, NTT, maeomichi.hiroyuki@lab.ntt.co.jp
0.0.1	*SEP 21 2017*	Updated alternatives, some figures, added description on validator. Hiroyuki Maeomichi, NTT, maeomichi.hiroyuki@lab.ntt.co.jp

Revision	Date	Comments
0.0.2	*April 17 2018*	Update based on discussion in Washington meeting. Hiroyuki Maeomichi, NTT, maeomichi.hiroyuki@lab.ntt.co.jp
0.0.3	*June 22 2018*	Add new fields and class reflecting R3 draft of oneM2M: Added fields in RequestPrimitiveDTO, ResponsePrimitiveDTO, and FilterCriteriaDTO, and ReleaseVersion enum. Organize DTOs: Added AttributeDTO, LocalIdTokenIdAssigmentDTO, and DasInfoDTO and remove DynAuthLocalIdAssignmentsDTO and DynAuthReqInfoDTO Introduce OperationIF interface as a super interface of ProtocolBinding interface and CSE interface for enabling concise application code. This replaces former simple.Client. Organize Introspection interfaces with less methods. They are moved to dedicated package.
0.0.4	*June 25 2018*	Add section 'Mapping Rules for Generic DTO' Update Javadoc with more explanations. (moved old classes to org.osgi.service.onem2m.old package for preparing deletion.) Add description to Security Consideration section. Add oneM2M R3 specs and XSD to references.
0.0.5	*Jun 27 2018*	Modified after discussion in Washington DC F2F. Restructure service interfaces; now 2 interface is remaining. For receiving notification, dedicated interface is prepared. Remove Introspection interfaces. Reduce service properties by removing ones for informative purpose. Add example flow to control devices. Modify security consideration in section 9.2.
0.06	*Jun 29 2018*	Add examples, with code snipets. Add 'Data Modification in Protocol Binding' section. Add discovery() method with additional parameter.
0.07	*Sep 17 2018*	Remove all service properties. Add some reasons to considered alternative section.
0.0.8	*May 22 2019*	Add configuration chapter.(5.4) Fix API parameter.

Revision	Date	Comments
0.1	*Feb 04 2020*	Remove configuration chapter (introduce 0.0.8) Fix Figure, typo. Add GenericDTO Remove Instruction(in red text)
0.2	*Feb 18 2020*	Reflect comments from Andreas Kraft. Add two DTOs (NotificationEventDTO, IPEDiscoveryRequestDTO)

1 Introduction

oneM2M is a global standard organization that specifies a common M2M Service Layer for the Internet of Things (IoT), called Common Services Entities (CSE). An application can discover and access functionalities in a CSE with RESTful operations, which are Create, Retrieve, Update, Delete and Notify. TS-0001 [2] defines more than 40 resource types to expose CSE's functionalities. oneM2M specifies a variety of communication methods, a combination of 4 protocol bindings (HTTP, MQTT, CoAP, Websocket) and 3 serializations (XML, JSON, CBOR).

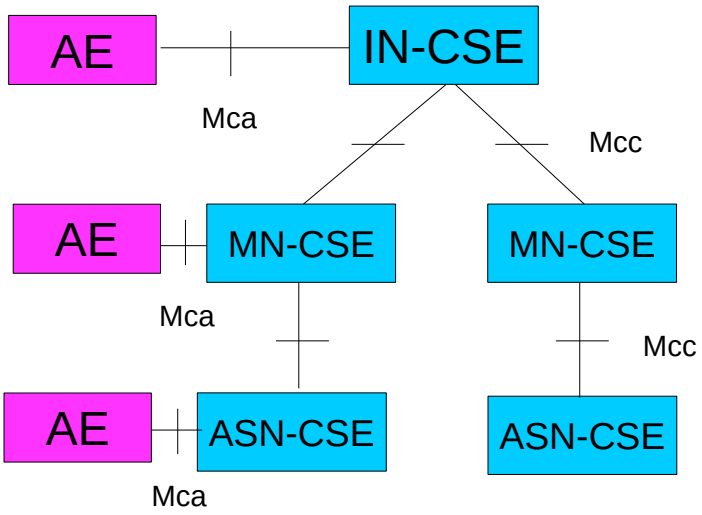
This RFP discuss the way to provide a high level API (namely service layer API) for oneM2M RESTful operations hiding the difference of a variety of communication methods.

2 Application Domain

2.1 IoT Application configuration using oneM2M

oneM2M's middleware, called CSE, can be deployed in different locations and they are connected to each other forming a tree topology. Depending on deployed location in the topology, CSEs are categorized to 3 types: IN-

CSE, MN-CSE and ASN-CSE. An IN-CSE is located at the top of the tree, ASN-CSE's are located at leafs, and MN-CSE's are located located on branches.

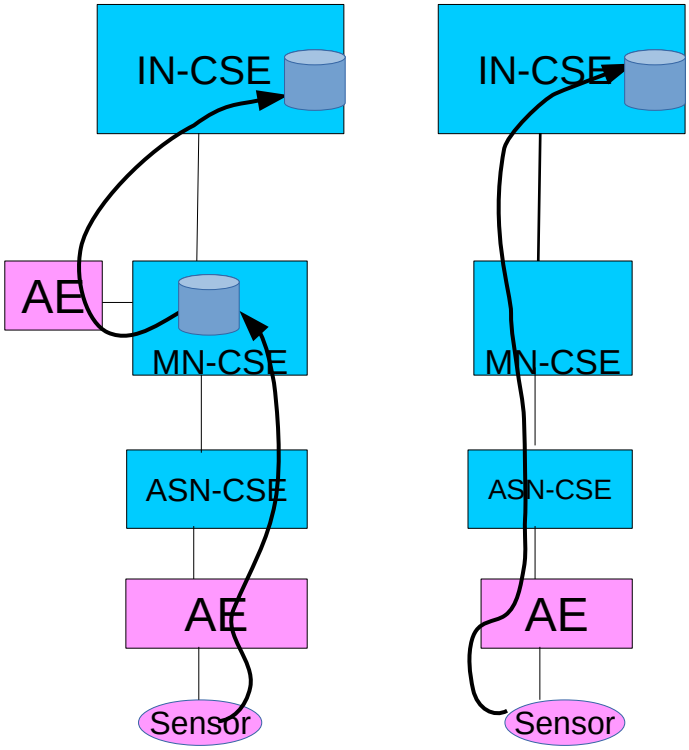


oneM2M's applications, called Application Entitys (AE), connects to one of the CSEs. After a AE is connected to the CSE, the AE can access to all other CSEs, by retargeting function requests (similar to routing) too CSEs.

An AE accesses a CSE's functionality through a RESTful API, which consists of Create, Retrieve, Update, Delete and Notify in targeting more than 40 types of resources. For examples, a typical resource types are <*contentInstance*> that expresses IoT data, and <*container*> that holds a set of <*contentInstance*>s. An AE can create or retrieve the resources of type <contentInstance> on any CSE by the retargeting functionality, as far as permission is allowed. the interface between CSEs is called *Mcc* and interface between CSE and AE is called M*ca*. Both interfaces look almost the same, but the functionalities vary.

It is possible to develop a variety of types of distributed applications using this architecture. For example, for IoT data aggregation applications it is possible to develop gradual aggregation application types or direct aggregation application types. In gradual aggregation application type, an AE connected to an ASN-CSE creates <*conentInstance*>s in the ASN-CSE, and intermediate applications calculate statistics and put the result on IN-CSE as a <*contentInstance*>, while, in direct aggregation application type, an AE connected to an ASN-CSE creates <*contentInstance*>s in the IN-CSE directly.

Beneath the CSE layer, oneM2M specifies the NSE (Network Services Entity), but this RFC doesn't cover the NSE layer.



2.2 Communication methods used in oneM2M

oneM2M allows a variety of communication methods, a combination of 4 protocol bindings (HTTP, MQTT, CoAP, Websocket) and 3 serializations (XML, JSON, CBOR). More might be added in the future. oneM2M provides specifications on different levels.

Firstly, TS-0001 [2] specifies the resource definitions, it defines more than 40 resource types, such as <contentInstance> for storing IoT data and <timeSeriesInstance> for periodic sensor measurement with leap detection mechanism.

Secondly TS-0004 [3] specifies procedures and serializations in independent manner from protocol bindings. Resource type and protocol data unit are defined using XSD for XML serialization. Mapping between XML and other serializations such as JSON are also specified.

Thirdly TS-0008, TS-0009, TS-0010, TS-0020 specify protocol specific details for CoAP, HTTP, MQTT and Web Socket respectively.

2.3 Long name and short name

oneM2M introduced two types of notation, called long name and short name for resource types, attribute and so on. A long name is human friendly string and specifications mainly use this notation, while the short name is an abbreviated unique string consist of typically 2 or 3 characters (but not limited and sometimes longer) that is used in communications. In most cases, the initial characters of long name are assigned as short name, for examples, **ct** for the CreationTime attribute and **at** for the AnnounceTo attribute.

3 Problem Description

oneM2M specifies protocol based interfaces, but doesn't specify a programing level API. As previously mentioned oneM2M allows a variety of communication methods, which are the combinations of 4 protocol bindings (HTTP, MQTT, CoAP, Websocket) and 3 serializations (XML, JSON, CBOR).

First problem is application portability. Without a standardized API, application program tends to depend on the communication method initially intend to use and it will became hard to operate in another environment in which another communication method is used. (For example, an application designed for XML/HTTP, tend to run on environment use JSON/Websocket)

The second problem is the latency of the communication between CSE and application. Even if CSE and application is located in the same physical environment, current oneM2M specifications define methods through protocols which requires serialization/deserialization of data, context-switch of applications, validation of incoming data and resulted in large latency compared to the situation both CSE and Application resides in the same Java VM and communicate with Java interfaces. Large latency reduces applicable area of oneM2M based solution.

The third problem is the complexity of handling of long name and short name. Even if the short name is defined it is not straight forward to translate them manually.

4 Requirements

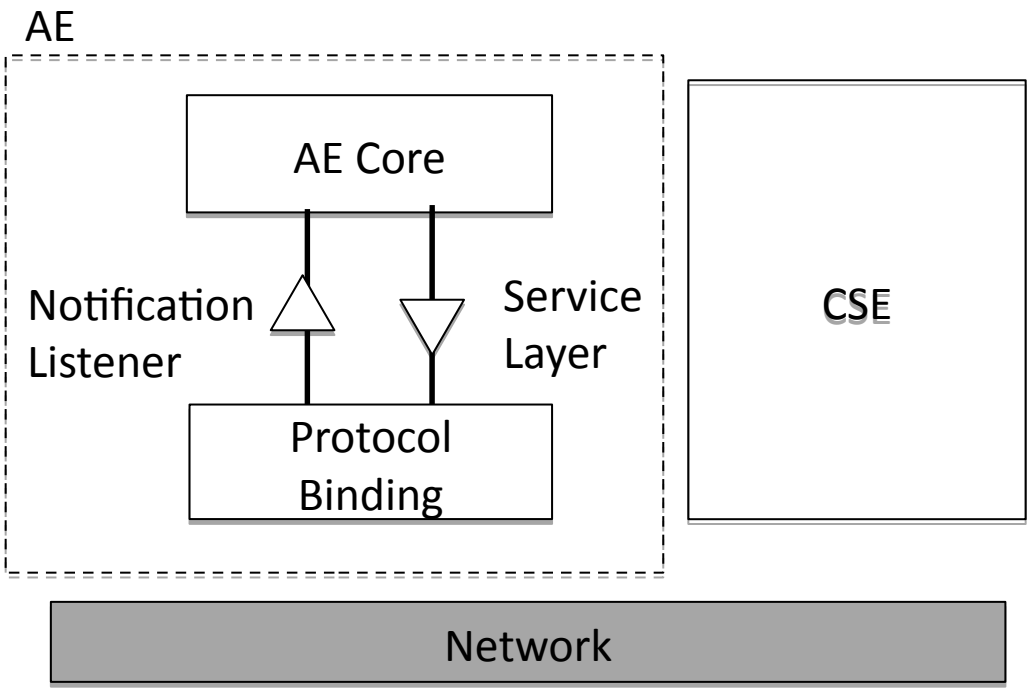
- R0010 – The solution MUST provide means to access an externally hosted CSE from an application.
- R0011 – The solution MUST provide means to access an externally hosted CSE from a client CSE.
- R0012 – The solution MUST provide means to select a communication method for application.
- R0013 – The solution MUST provide means to select a communication method for client CSE.
- R0020 – The solution MUST provide means for client CSE to accept requests from an externally hosted CSE.
- R0020 – The solution MUST provide means for client CSE to accept requests from an externally hosted application.

- R0030 – The solution MUST provide means to communicate through a Java interface between a CSE and an application that are located in the same OSGi framework.
- R0040 – The solution SHOULD hide differences of communication methods, which are combinations of 4 protocol bindings and 3 serializations (XML, JSON, CBOR).
- R0050 – The solution SHOULD provide developer friendly way for handling short names.
- R0060 – The solution MUST provide asynchronous interface using 'call by value', such as DTO.

5 Technical Solution

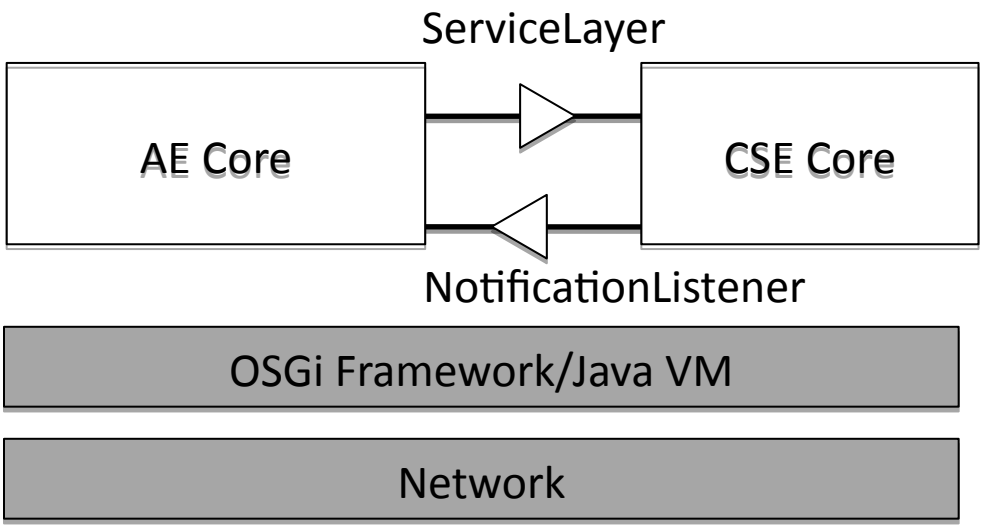
5.1 Overview for the solution

A protocol binding service is introduced to handle different protocols and serializations. A oneM2M application uses the protocol binding service through a Service Layer Interface to communicate with a CSE. The interface is a protocol and serialization agnostic interface; it has no protocol and serialization specific methods, parameters, so that an application can communicate with a CSE without knowing which protocol is actually used.

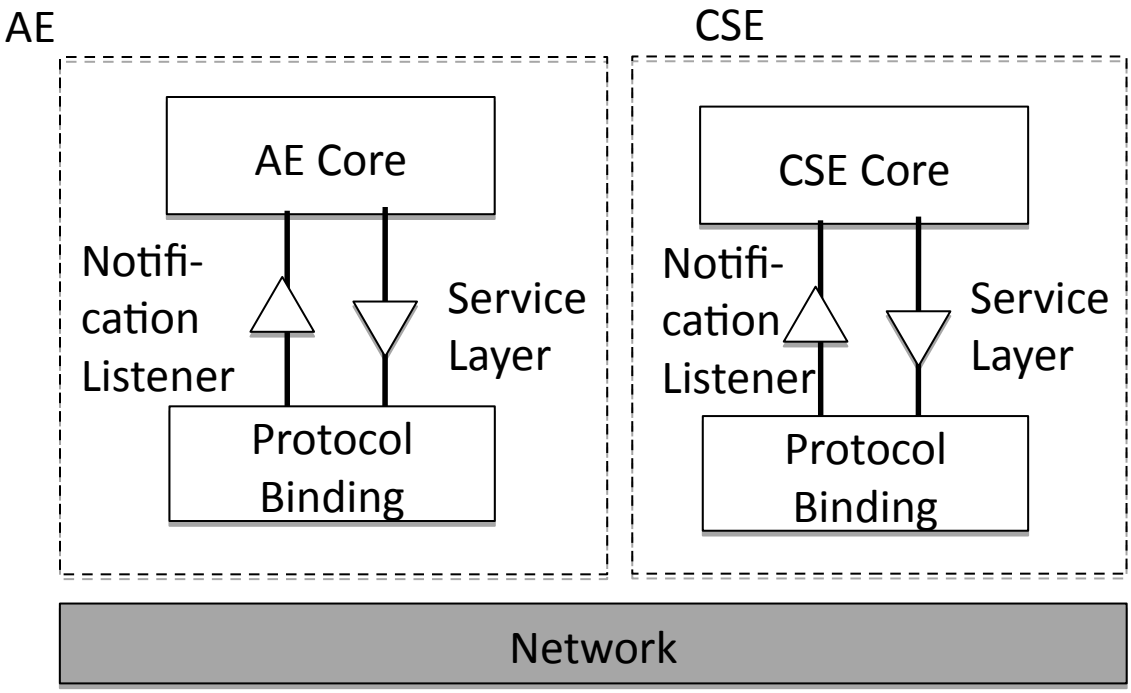


In the above figure, the term of Core is introduced for AE Core and CSE Core. This is for specifying parts which do not contain ProtocolBinding of AE and CSE.

Another use case is that the AE Core and the CSE core are located on the same OSGi Framework. In this use case, the AE Core and the CSE core communicate directly with the ServiceLayer API, without inter-mediating ProtocolBinding Services. the following figure depicts the overall configuration. Though this type of communication is not defined in oneM2M specification, communicating directly without serializing data between AE and CSE allows shorter latency and less computational resources.



The following figure (right hand side) shows potential implementation of CSE, which are consisted fo CSE core and Protocol Binding Service, as symmetric to AE side. APIs defined in this RFC is consistent with the usage, but this RFC does not mandate that usage and it is left to implementor's choice.



5.2 Service Layer Interface

The Service Layer Interface is for allowing an AE to send requesst and receive responses.

request() method allows very raw data type access and it enables all possible message exchanges among oneM2M entities. This is called the low level API.

```
Promise<ResponseDTO> request(RequestDTO request);
```

Here as a return type, org.osgi.util.promise.Promise is used for realizing both synchronous and asynchronous type of invocation.

Meanwhile, the low level API can be redundant to application developers, because they need to write composition of requestPrimitive and decomposition of responsePrimitive. This interface is provided for application developer allowing less application codes. It provides methods with higher level of abstraction; operation level of resource such as create, retrieve, update, delete and so on. They do not cover all of possible messages of oneM2M but do typical ones. Implementation of these methods automatically inserts ‘requestID’ and ‘from’ parameter to RequestDTO.

Note: If this RFC doesn’t provide these methods, developers likely to create similar ones in their own (various) way.

The create() method is a method to create new resource under specified uri. The second argument resource is expression of resource to be generated. The resourceType field of the resourceDTO must be assigned. For other fields depends on resource type. Section 7.4 of TS-00004 specifies the optionalities of the fields.

The retrieve() methods are methods to retrieve resource on URI specified by uri argument. There are two variations of retrieve methods, one has 'targetAttributes' argument and the other doesn't have. The arguments are for specifying attributes to be retrieved. The retrieve method without 'targetAttributes' arguments behaves as all of attributes are specified.

The update() method is a method to update resource on the URI specified by uri argument. The resource argument holds attributes to be updated. Attributes not to be updated shall not included in the argument.

The delete() method is a method to delete resouce on the URI specified by uri argument.

The discovery() methods are methods to find resources under URI specified by uri argument with condition specified by fc arguments. There are two variations of the methods, one has additional 'drt' argument which specifies the expression of returned URIs. The possible parameter can be structured or unstructured. The method with 'drt' argument behaves as structured is specified.
The notify() method is a method to send notification to URI specified by uri argument. The notification argument expresses notification to be sent.

```
package org.osgi.service.onem2m.servicelayer;

import org.osgi.onem2m.dto.RequestDTO;
import org.osgi.onem2m.dto.ResponseDTO;
import org.osgi.util.promise.Promise;

/**
 * Service Layer Interface, which locates between AE and Protocol Binding Service.
 */
public interface ServiceLayer {
	/**
	 * send a request.
	 *
	 * @param request request
	 * @return promise for ResponseDTO.
	 */
	public Promise<ResponsePrimitiveDTO> request(RequestPrimitiveDTO request);

	/**
	 * create resource
	 *
	 * @param uri URI for parent resource
	 * @param resource resource data
	 * @return Promise of created resource
	 */
	public Promise<ResourceDTO> create(String uri, ResourceDTO resource);

	/**
	 * retrieve resource
	 *
```

```
	 * @param uri URI for retrieving resource
	 * @return retrieved resource data
	 */
	public Promise<ResourceDTO> retrieve(String uri);

	/**
	 * retrieve subset of attributes.
	 *
	 * @param uri URI for retrieving resource
	 * @param targetNames attribute names for retrival
	 * @return retrieved resource data
	 */
	public Promise<ResourceDTO> retrieve(String uri, List<String>
targetAttributes);

	/**
	 * update resource
	 *
	 * @param uri URI for updating resource
	 * @param resource data resource
	 * @return updated resource
	 */
	public Promise<ResourceDTO> update(String uri, ResourceDTO resource);

	/**
	 * delete resource
	 *
	 * @param uri target URI for deleting resource
	 */
	public Promise<Boolean> delete(String uri);

	/**
	 * find resources
	 *
	 * @param uri URI for top of search
	 * @param fc filter criteria
	 * @return list of URIs matching the condition specified in fc
	 */
	public Promise<List<String>> discovery(String uri, FilterCriteriaDTO fc);

	     /**
	 * find resources
	 *
	 * @param uri URI for top of search
	 * @param fc filter criteria
	 * @param drt Discovery Result Type (structured/unstructured)
```

```
        * @return list of URIs matching the condition specified in fc
        */
       public Promise<List<String>> discovery(String uri, FilterCriteriaDTO
fc, RequestPrimitiveDTO.DiscoveryResultType drt);

       /**
        * send notification
        *
        * @param notification
        */
       public Promise<Boolean> notify(String uri, NotificationDTO notification );

}
```

5.3 Notification Listener Interface

The NotificationListener interface is a interface for receiving notifications. The bundles that receives notifications must implement this interface and register the service object to the OSGi service registry. In case of the multiple application are running on the OSGi framework, multiple instances of the service object of NotificationListner iare registered in the OSGi service registry. The implementation of the protocol binding must look for the proper instance by checking its registering bundle,

```
public interface NotificationListener {
       /**
        * receive notification.
        *
        * @param request request
        */
       public void notified(RequestPrimitiveDTO request);

}
```

5.4 Service Property for Interfaces

No service properties are defined for ServiceLayer interface and NotificationListener interface.

5.5 Service Binding

Proper instance of ServiceLayer service must be bound to proper AE Core. Implementation of ServiceLayer should created by ServiceFactory to provide a proper service instance depending on calling AE Core.

5.6 Data Modification in ServiceLayer Service

Usually ServiceLayer service doesn't change any logical information on passing data, but as an exception ServiceLayer service modifies the passing data by adding pointOfAccess information on following case.

1. create() for <AE> resource

2. update() for <AE> only when pointOfAccess'is specified.

3. request() when content is equivalent to above.

This is because AE Core entity may not know the pointOfAccess information and processing show above simply solve the problem.

5.7 Example: Registration

This section explains how application registers to its hosting CSE. In order to interact with the oneM2M system the bundle obtains a reference to the `ServiceLayer` service from the service registry

```
@Component
public class MyLightSwitchComponent {
@Reference
ServiceLayer client
}
```

After getting client, it starts registration by creating <AE> resource.<AE> resource creation requires App-ID, AE-ID, requestReachability attributes. In the following code, "C" is passed for AE-ID, this means asking CSE for assigning the value. Assigned value is is included in returned resource

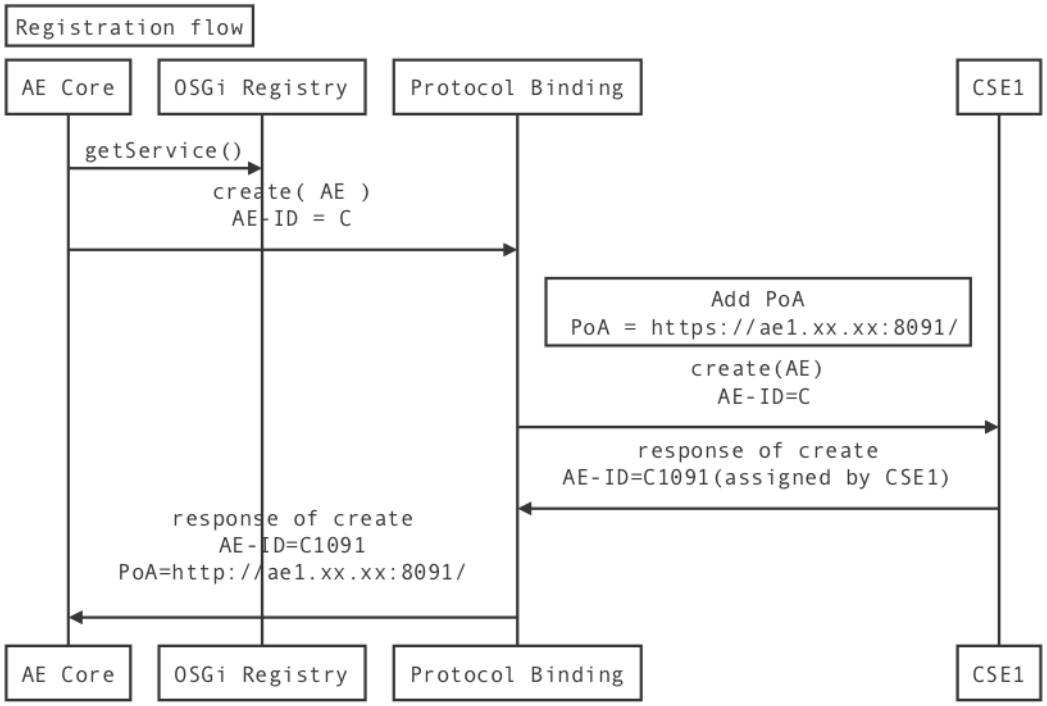
The information of pointOfAccess is kept in ServiceLayer Service, it is assigned by ServiceLayer Service. before sending the request message to network. The value is also returned in response.

After success response of <AE> resource, it registers NotificationListener with returned AE-ID and pointOfAccess as the service property

```
@Component
public class RegistrationExample implements NotificationListener {
      @Reference
      ServiceLayer client;

      BundleContext context;
       @Activate
       void start(BundleContext context) {
              this.context = context;

              // create AE: This means registration.
```

```
              ResourceDTO dto = new ResourceDTO();
              dto.resourceType = ResourceType.AE.getValue();
              dto.attribute.put("App-ID", "01.com.company.lightApp1<");
              dto.attribute.put("AE-ID", "C");
              dto.attribute.put("requestReachability", Boolean.TRUE);
              final Promise<ResourceDTO> ret = client.create("/CSE1/csebase", dto);
             // csebase is the name of <CSEBase> resource, which are the root of CSE resou
rce tree.



              ret.onResolve(new Runnable() {
                     public void run() {
                            ResourceDTO ae = null;
                           try {
                                  ae = ret.getValue();
                           } catch (Exception e) {
                                  e.printStackTrace();
                                  return;
                           }
                            Dictionary prop = new Properties();
                            prop.put("AE-ID",ae.attribute.get("AE-ID"));
                            prop.put("PoA",ae.attribute.get("pointOfAccess");
                            context.registerService(new String[] {"org.osgi.service.onem2m.
NotificationListener"}, this, prop);
                     }
              });
       }

      @Override
      public void notified(RequestPrimitiveDTO request) {
             //....
      }
```

Following figure shows sequence diagram of the registration flow.



5.8 Example: Turning Light ON

This section explains how application turns on the lights located on remote site. There are mainly two ways to represent devices in oneM2M.

First way uses <flecContainer> resource type for representing device, its status, and so on. The resource type is introduced in oneM2M release 2 and it allows having custom attributes in it. Based on the resource, variety of the data model for devices, especially of home domain, are specified in TS-0023. With this way application can use standardized data model and operate device status in commonly used manner.

Second way uses <container> and <contentInstance> resource types for representing device and its status. These resource types are introduced very beginning of oneM2M and this approach is well explained in developer guide (TR-0025 [TODO ref. WEB]) Meanwhile, the resource type is not primarily designed for this purpose, but for storing data, so that how to operate device could be different from usual manner. To change state, new <contentInstance> is created with new status in its content attribute. <container> usually has multiple <contentInstance>s underneath and the latest one is supposed to be the latest status.

5.8.1 Example (Using <flexContainer>

In this example a simple bundle wishes to swtich light devices on when the bundle is started, and switch them off again when the bundle is stopped. Here it is assumed that registration process described in the previous section is done.

1. When the bundle has obtained a reference to the ServiceLayer then it can use the `discover` method to find all of the lightbulbs in the system

```
public class MyLightSwitchComponent {
@Reference
ServiceLayer client;

Promise<List<String>> discoveredLightbulbs;

@Activate
void start() {
  discoveredLightbulbs = findLightBulbs();
}

private Promise<List<String>> findLightBulbs() {
    String baseURI = "/homegateway/csebase/"; // csebase  is name for <CSEBase> resource
and it is the root of  the CSE resource tree )

    FilterCriteriaDTO filter = new FilterCriteriaDTO();
    filter.resourceType = Collections.singletonList(
      ResourceType.flexContainer.getValue());
    AttributeDTO attr = new AttributeDTO();
    attr.name = "contentDefinition";
    attr.value = "org.onem2m.home.device.light";
    filter.attribute = Collections.singletonList(attr);
    filter.filterOperation = FilterCriteriaDTO.FilterOperation.AND;

    return client.discovery(baseURI, filter);
}
}
```

2. Once the lightbulbs are discovered then the bundle can switch on the bulbs by creating a content instance using the `update` method

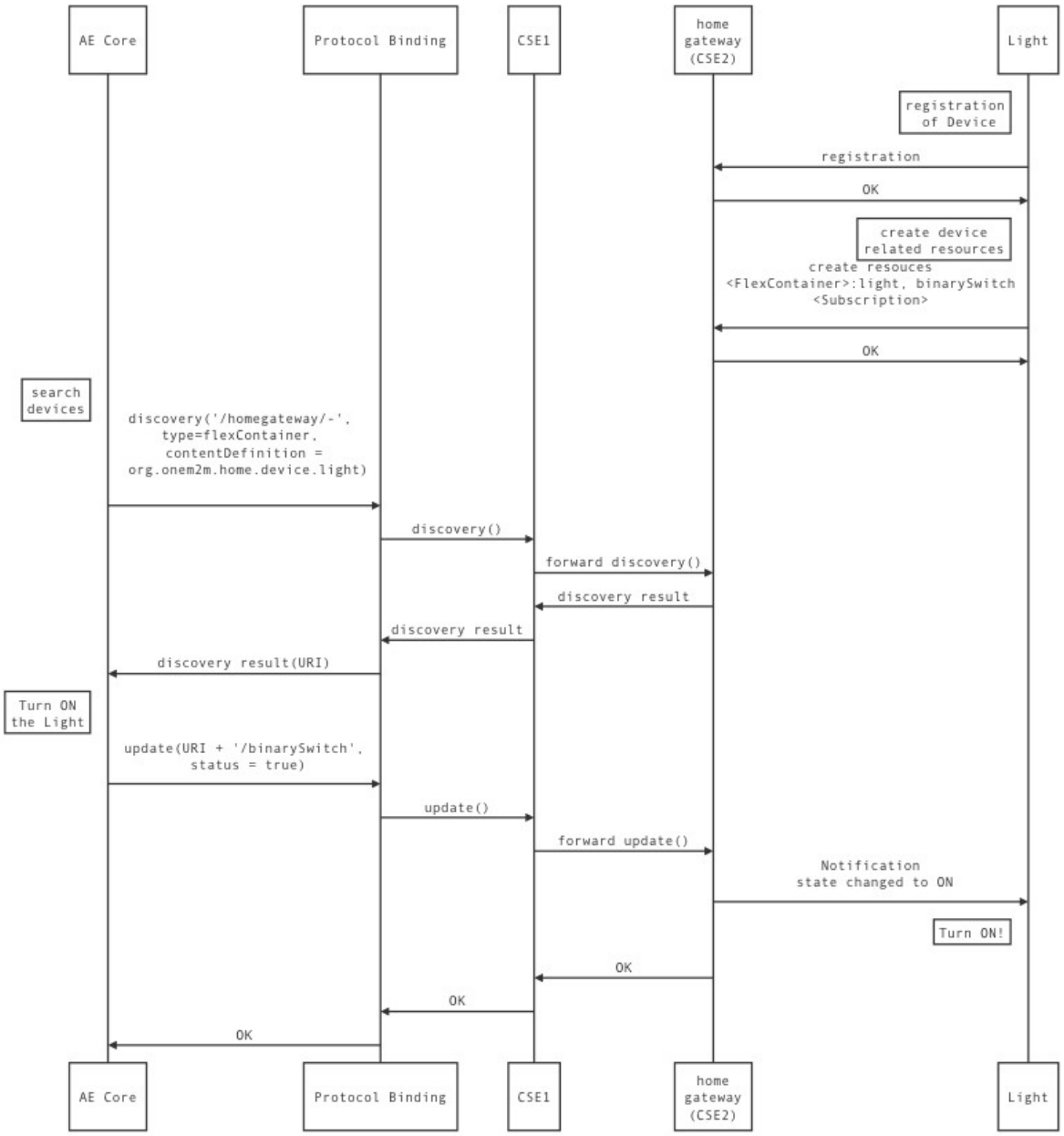
```
public class MyLightSwitchComponent {
@Reference
ServiceLayer client;
Promise<List<ResourceDTO> allTurnedOn;

@Activate
void start() {
```

```
  allTurnedOn = findLightBulbs().
        flatMap(l -> Promises.all(
            l.stream()
                .map(this::turnOn)
                .collect(toList())));
}

private Promise<ResourceDTO> turnOn(String bulbUri) {
  ResourceDTO dto = new ResourceDTO();
  dto.attribute.put("powerStatus", Boolean.TRUE);
  return client.update(bulbUri + "/binarySwitch", dto );
}
}
```

3. Finally, the bulbs can be turned off again when the bundle is stopped.

```
public class MyLightSwitchComponent {
@Reference
ServiceLayer client;
Promise<List<ResourceDTO> allTurnedOn;

@Deactivate
void stop() {
    findLightBulbs().flatMap(l -> Promises.all(
        l.stream()
            .map(this::turnOff)
     .collect(toList())));
}
}
```

Following figure shows the example showing how application turn on the light device on the remote.



5.8.2 Example (Using <container> and <contentInstance>

In this example, device is expressed as <container> resource type in remote CSE (Home Gateway). Discovery is changed as follows. Here it assumes that all <container>s representing lightbulb have label of “lightBulb”.

```
private Promise<List<String>> findLightBulbs() {
```

```
        String baseURI = "/homegateway/csebase/";

        FilterCriteriaDTO filter = new FilterCriteriaDTO();
        filter.resourceType = Collections.singletonList(
            ResourceType.container.getValue());
        filter.labels = Collections.singletonList("lightBulb");
        filter.filterOperation = FilterCriteriaDTO.FilterOperation.AND;
        return client.discovery(baseURI, filter);
}
```

Light can be controlled by creating new <contentInstance> resource as follows.

```
   private Promise<ResourceDTO> turnOn(String bulbUri) {
        ResourceDTO dto = new ResourceDTO();
        dto.resourceType = ResourceType.container.getValue();
        dto.attribute.put("content", "ON");
        return client.create(bulbUri , dto );
    }
```

6 Data Transfer Objects

6.1 Design Policy of DTOs

Data transfer Object was chosen as data object passing by the interfaces, following OSGi's design convention. Though data structure near root structures are designed specific DTO, deeper data types are to be stored as generic types, such as Map, List and Wrapper classes of Java Primitives. Following figure depict reference relationship among object. (See also the considered Alternatives)

In the class definition, some data types are shown as Object, but the assigned value shall be one of types allowed for OSGi DTO.

In figure, followed 'DTO' of DTO class name is committed.

6.2 RequestPrimitiveDTO

RequestPrimitiveDTO holds a Request Information used for oneM2M communication.

```
package org.osgi.service.onem2m.dto;

import java.util.*;

public class RequestPrimitiveDTO extends org.osgi.dto.DTO {

	public Operation operation;

	public String to;
	public String from;

	public String requestIdentifier;

	public Integer resourceType;
	public PrimitiveContentDTO content;
	public List<String> roleIDs;

	public String originatingTimestamp;
	public String requestExpirationTimestamp;
	public String resultExpirationTimestamp;
	public String operationExecutionTime;

	public ResponseTypeInfoDTO responseType;
	public String resultPersistence;

	public ResultContent resultContent;
	public String eventCategory;

	public Boolean deliveryAggregation;
	public String groupRequestIdentifier;
	public FilterCriteriaDTO filterCriteria;

	public DiscoveryResultType discoveryResultType;
	public String tokens;
	public List<String> tokenIDs;
	public List<String> localTokenIDs;
```

```
	public Boolean tokenReqIndicator;

	// Added at R3.0
	public List<String> groupRequestTargetMembers;
	public Boolean authSignatureIndicator;
	public List<String> authSignature;
	public Boolean authRelationshipIndicator;
	public Boolean semanticQueryIndicator;
	public ReleaseVersion releaseVersion;
	public String verndorInformation;

	public static enum DiscoveryResultType {
		structured(1), unstructured(2);
		// omitted
	}

	public static enum ResultContent {
		nothing(1), attributes(2), hierarchicalAddress(3),
		hierarchicalAddressAndAttributes(4),
attributesAndChildResources(5),
attributesAndChildResourceReferences(6),
childResourceReferences(7), originalResource(8), childResources(9);

		// omitted
	}

	public static enum Operation {
		Create(1), Retrieve(2), Update(3), Delete(4), Notify(5);
		// methos are omitted.
	}

}
```

6.3 ResponsePrimitiveDTO

ResponsePrimitiveDTO holds a Response Information used for oneM2M communication.

```
package org.osgi.service.onem2m.dto;
import java.util.*;

public class ResponsePrimitiveDTO extends org.osgi.dto.DTO{

	public Integer responseStatusCode;
```

```
	public String requestIdentifier;
	public PrimitiveContentDTO content;
	public String to;
	public String from;
	public String originatingTimestamp;
	public String resultExpirationTimestamp;
	public String eventCategory;

	public ContentStatus contentStatus;

	public Integer contentOffset;
	public List<LocalTokenIdAssignmentDTO> assignedTokenIdentifiers;
	public List<DasInfoDTO> tokenReqInfo;

	// Added R3.0
	public Boolean AuthSignatureReqInfo;
	public ReleaseVersion releaseVersionIndicator;
	public String vendorInformation;

	public static enum ContentStatus{
		PARTIAL_CONTENT, // 1
		FULL_CONTENT;  //2

	}
}
```

6.4 ResponseTypeInfoDTO

```
package org.osgi.service.onem2m.dto;

import java.util.*;

public class ResponseTypeInfoDTO extends org.osgi.dto.DTO {

	public java.lang.Integer responseTypeValue;

	public List<java.lang.String> notificationURI;

	public static enum ResponseType {
		nonBlockingRequestSynch(1), nonBlockingRequestAsynch(2),
blockingRequest(3), flexBlocking(4);
		// methos are omitted.
	}
}
```

6.5 FilterCriteriaDTO

```
package org.osgi.service.onem2m.dto;
import java.util.*;

public class FilterCriteriaDTO extends org.osgi.dto.DTO{
	public String createdBefore;
	public String createdAfter;
	public String modifiedSince;
	public String unmodifiedSince;
	public Integer stateTagSmaller;
	public Integer stateTagBigger;
	public String expireBefore;
	public String expireAfter;
	public List<String> labels;
	public List<Integer> resourceType;

	public Integer sizeAbove;

	public Integer sizeBelow;
	public List<String> contentType;
	public AttributeDTO attribute;

	public FilterUsage filterUsage;

	public Integer limit;
	public String semanticsFilter;

	public FilterOperation filterOperation;

	public Integer contentFilterSyntax;
	public String contentFilterQuery;

	public Integer level;

	public Integer offset;

	// added in R3
	public List<String> childLabels;
	public List<String> parentLabels;
	public String labelsQuery;
	public Integer childResourceType;
	public Integer parentResourceType;
	public AttributeDTO childAttribute;
```

```
	public AttributeDTO parentAttribute;
	public String applyRelativePath;


	public static enum FilterOperation {
		AND(1), OR(2);
		// methos are omitted.
	}

	public static enum FilterUsage {
		DiscoveryCriteria(1), ConditionalRetrival(2), IPEOndemandDiscovery(3);
		// methos are omitted.

	}
}
```

6.6 ResourceDTO

```
package org.osgi.service.onem2m.dto;
import java.util.*;

public class ResourceDTO extends org.osgi.dto.DTO{

	// Universal Attribute, which can be held by all resources.

	public Integer resourceType;

	public String resourceID;

	public String parentID;

	public String creationTime;

	public String lastModifiedTime;

	public String resourceName;

	// optional, Universal Attributes
	public List<String> labels;

	/**
	 * Non Universal Attribute.
	 * Value Part must be the types that are allowed for OSGi DTO.
	 */
	public Map<String, Object> attribute;
```

```
}
```

6.7 NotificationDTO

NotificationDTO has information of notification.

```
package org.osgi.service.onem2m.dto;
import java.util.*;

public class NotificationDTO extends org.osgi.dto.DTO{
	public NotificationEventDTO  notificationEvent;

	public Boolean verificationRequest;

	public Boolean subscriptionDeletion;
	public String subscriptionReference;
	public String creator;
	public String notificationForwardingURI;


	public IPEDiscoveryRequestDTO ipeDiscoveryRequest;

	IPEDiscoveryRequestDTO
	public String notificationTarget;
	public Boolean targetRemovalRequest;
	public Boolean targetRemovalAllowance;
	public Boolean aeRegistrationPointChange;
	public Boolean aeReferenceIDChange;
	public String trackingID1;
	public String trackingID2;

}
```

6.8 Other DTOs

There are some other DTOs, please refer Javadoc section for them.

6.9 Mapping Rules for Generic DTO

Following table summarizes mapping rule between oneM2M data types and Generic types used in DTOs. There are two types of XSD are defined in oneM2M, which are long name version and short name version. The long name should be used.

oneM2M Types (XML Schema)	Type of OSGi DTO	
Basic Types of XML Schema	Wrapper Object of Java primitive	For example: xs:integer, xs:float
xs:string,xs:token,xs:anyURI ~~m2m:ID~~,	String	
m2m:timestamp (based on xs:string)	String	YYYYMMDDThhmmss,ssssss
m2m:absRelTimestamp	String	Union of m2m:timestamp and xs:long. This is exception of union rule above. Distinction is done by existence of 'T'
xs:sequence (as complexType)	Map	Name of element is used for key of map.
xs:list, xs:sequence (as list)	List	
xs:union	Map	Base attribute of restriction tag is used for key of map. Only one key is allowed. See Example of missingDataList:

Following XML is an example of missingData.

```
<xs:simpleType name="missingDataList">
      <xs:union>
        <simpleType>
            <restriction base='m2m:listOfTimeStamp' />
        </simpleType>
        <simpleType>
            <restriction base='m2m:listOfRelTimeStamp' />
        </simpleType>
      </xs:union>
    </xs:simpleType>
```

7 Javadoc

Please include Javadoc of any new APIs here, once the design has matured. Instructions on how to export Javadoc for inclusion in the RFC can be found here: https://www.osgi.org/members/RFC/Javadoc

OSGi Javadoc

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Package org.osgi.service.onem2m

Interface Summary		Page
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ServiceLayer	Primary Interface for an oneM2M entity to send request and get response to/from other oneM2M entity.	35

Exception Summary		Page
OneM2MException	General Exception for oneM2M.	34

Interface NotificationListener

org.osgi.service.onem2m

`public interface` **`NotificationListener`**

Primary Interface for an oneM2M entity to send request and get response to/from other oneM2M entity.

Method Summary		Page
`void`	**`notified`**`(RequestPrimitiveDTO request)` receive notification.	33

Method Detail

notified

`void` **`notified`**`(RequestPrimitiveDTO request)`

receive notification.

Parameters:

`request` - request primitive

Class OneM2MException

org.osgi.service.onem2m

```
java.lang.Object
  └java.lang.Throwable
    └java.lang.Exception
      └java.io.IOException
        └org.osgi.service.onem2m.OneM2MException
```

All Implemented Interfaces:

Serializable

```
public class OneM2MException
extends IOException
```

General Exception for oneM2M.

Field Summary		Page
	cause Cause of Exception	34
	errorCode Error Code	34

Constructor Summary	Page
OneM2MException()	34

Field Detail

errorCode

```
public errorCode
```

Error Code

cause

```
public cause
```

Cause of Exception

Constructor Detail

OneM2MException

```
public OneM2MException()
```

Interface ServiceLayer

org.osgi.service.onem2m

`public interface` **`ServiceLayer`**

Primary Interface for an oneM2M entity to send request and get response to/from other oneM2M entity.

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org.osgi.util.promise.Promise	**update**(String uri, ResourceDTO resource) update resource	36

Method Detail

request

`org.osgi.util.promise.Promise` **`request`**`(RequestPrimitiveDTO request)`

send a request.

Parameters:
`request` - request primitive
Returns:
promise of ResponseDTO.

---

create

`org.osgi.util.promise.Promise` **`create`**`(String uri, ResourceDTO resource)`

create resource

Parameters:
`uri` - URI for parent resource

`resource` - resource data

Returns:

Promise of created resource

---

retrieve

```
org.osgi.util.promise.Promise retrieve(String uri)
```

retrieve resource

Parameters:

`uri` - URI for retrieving resource

Returns:

retrieved resource data

---

retrieve

```
org.osgi.util.promise.Promise retrieve(String uri,
                                       List targetAttributes)
```

retrieve subset of attributes.

Parameters:

`uri` - URI for retrieving resource

`targetAttributes` - names of the target attribute

Returns:

retrieved resource data

---

update

```
org.osgi.util.promise.Promise update(String uri,
                                     ResourceDTO resource)
```

update resource

Parameters:

`uri` - URI for updating resource

`resource` - data resource

Returns:

updated resource

---

delete

```
org.osgi.util.promise.Promise delete(String uri)
```

delete resource

Parameters:

`uri` - target URI for deleting resource

---

discovery

```
org.osgi.util.promise.Promise discovery(String uri,
                                        FilterCriteriaDTO fc)
```

find resources. Discovery Result Type is kept as blank and default value of target CSE is used for the parameter.

Parameters:
`uri` - URI for top of search
`fc` - filter criteria
Returns:
list of URIs matching the condition specified in fc

---

discovery

```
org.osgi.util.promise.Promise discovery(String uri,
                                        FilterCriteriaDTO fc,
                                        RequestPrimitiveDTO.DiscoveryResultType drt)
```

find resources

Parameters:
`uri` - URI for top of search
`fc` - filter criteria
`drt` - Discovery Result Type (structured/unstructured)
Returns:
list of URIs matching the condition specified in fc

---

notify

```
org.osgi.util.promise.Promise notify(String uri,
                                     NotificationDTO notification)
```

send notification

Package org.osgi.service.onem2m.dto

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DasInfoDTO	DTO expressing DasInfo.	43
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IPEDiscoveryRequestDTO	IPEDiscoveryRequestDTO is an element of NotificationEventDTO	55
LocalTokenIdAssignmentDTO	DTO expressing LocalTokenIdAssignment.	56
NotificationDTO	DTO expressing Notification.	57
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ResponsePrimitiveDTO.ContentStatus	Enum ContentStatus	86

Class AttributeDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.AttributeDTO
```

```
public class AttributeDTO
extends org.osgi.dto.DTO
```

DTO expresses Attribute. This is typically used in FilterCriteriaDTO for expressing matching condition.

Field Summary		Page
	name Attribute name	40
	value Supposed value of the attribute	40

Constructor Summary	Page
AttributeDTO()	40

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

name

```
public name
```

Attribute name

value

```
public value
```

Supposed value of the attribute

Constructor Detail

AttributeDTO

```
public AttributeDTO()
```

Class ChildResourceRefDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └org.osgi.dto.DTO
    └org.osgi.service.onem2m.dto.ChildResourceRefDTO
```

```
public class ChildResourceRefDTO
extends org.osgi.dto.DTO
```

DTO expressing ChildResourceRef.

Field Summary		Page
	name name of the child resource pointed to by the URI	41
	specializationID resource type specialization of the child resource pointed to by the URI in case @type represents a flexContainer.	42
	type resourceType of the child resource pointed to by the URI	41
	uri URI to the child resource.	41

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ChildResourceRefDTO()	42

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

uri

```
public uri
```

URI to the child resource.

name

```
public name
```

name of the child resource pointed to by the URI

type

```
public type
```

resourceType of the child resource pointed to by the URI

---

specializationID

`public` **`specializationID`**

resource type specialization of the child resource pointed to by the URI in case @type represents a flexContainer. This is an optional field.

Constructor Detail

ChildResourceRefDTO

`public` **`ChildResourceRefDTO`**`()`

Class DasInfoDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.DasInfoDTO
```

```
public class DasInfoDTO
extends org.osgi.dto.DTO
```

DTO expressing DasInfo. DAS is short for Dynamic Authorization Server.

Field Summary		Page
	dasRequest Information to send to the Dynamic Authorization Server	43
	securedDasRequest Secured Information to send to the Dynamic Authorization Server.	43
	uri Dynamic Authorization Server URI	43

Constructor Summary	Page
DasInfoDTO()	44

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

uri

```
public uri
```

Dynamic Authorization Server URI

dasRequest

```
public dasRequest
```

Information to send to the Dynamic Authorization Server

securedDasRequest

```
public securedDasRequest
```

Secured Information to send to the Dynamic Authorization Server. JWS or JWE is assigned to this field.

Constructor Detail

DasInfoDTO

```
public DasInfoDTO()
```

Class FilterCriteriaDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.FilterCriteriaDTO
```

```
public class FilterCriteriaDTO
extends org.osgi.dto.DTO
```

DTO expressing FilterCriteria. This data structure is used for searching resources.

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final static class	FilterCriteriaDTO.FilterUsage Enum FilterUsage	52

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	childLabels Child Labels	49
	childResourceType Child Resource Type	49
	contentFilterQuery Content Filter Query	48
	contentFilterSyntax Content Filter Syntax	48
	contentType Content Type	48
	createdAfter Created After	46
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	expireAfter Expire After	47
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	labels Labels	47
	labelsQuery Label Query	49
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	modifiedSince Modified Since	47
	offset Offset	48
	parentAttribute Parent Attribute	49
	parentLabels Parent Labels	49
	parentResourceType Parent Resource Type	49
	resourceType Resource Type	47
	semanticsFilter Semantic Filter	48
	sizeAbove Size Above	47
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	stateTagBigger State Tag Bigger	47
	stateTagSmaller State Tag Smaller	47
	unmodifiedSince Unmodified Since	47

Constructor Summary	Page
FilterCriteriaDTO()	49

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

createdBefore

public **createdBefore**

Created Before

createdAfter

public **createdAfter**

Created After

modifiedSince

`public` **`modifiedSince`**

Modified Since

unmodifiedSince

`public` **`unmodifiedSince`**

Unmodified Since

stateTagSmaller

`public` **`stateTagSmaller`**

State Tag Smaller

stateTagBigger

`public` **`stateTagBigger`**

State Tag Bigger

expireBefore

`public` **`expireBefore`**

Expire Before

expireAfter

`public` **`expireAfter`**

Expire After

labels

`public` **`labels`**

Labels

resourceType

`public` **`resourceType`**

Resource Type

sizeAbove

`public` **`sizeAbove`**

Size Above

sizeBelow

`public` **`sizeBelow`**

Size Below

contentType

public **contentType**

Content Type

attribute

public **attribute**

Attribute

filterUsage

public **filterUsage**

Filter Usage

limit

public **limit**

Limit number of Answers

semanticsFilter

public **semanticsFilter**

Semantic Filter

filterOperation

public **filterOperation**

Filter Operation

contentFilterSyntax

public **contentFilterSyntax**

Content Filter Syntax

contentFilterQuery

public **contentFilterQuery**

Content Filter Query

level

public **level**

Level

offset

public **offset**

Offset

childLabels

`public` **`childLabels`**

Child Labels

parentLabels

`public` **`parentLabels`**

Parent Labels

labelsQuery

`public` **`labelsQuery`**

Label Query

childResourceType

`public` **`childResourceType`**

Child Resource Type

parentResourceType

`public` **`parentResourceType`**

Parent Resource Type

childAttribute

`public` **`childAttribute`**

Child Attribute

parentAttribute

`public` **`parentAttribute`**

Parent Attribute

applyRelativePath

`public` **`applyRelativePath`**

Apply Relative Path

See Also:

`TS-0004 7.3.3.17.17`

Constructor Detail

FilterCriteriaDTO

`public` **`FilterCriteriaDTO`**`()`

Class FilterCriteriaDTO.FilterOperation

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ java.lang.Enum
    └ org.osgi.service.onem2m.dto.FilterCriteriaDTO.FilterOperation
```

All Implemented Interfaces:
Comparable, Serializable

Enclosing class:
FilterCriteriaDTO

```
final public static class FilterCriteriaDTO.FilterOperation
extends Enum
```

Enum FilterOperation

See Also:
TS-0004 6.3.4.2.34

Field Summary		Page
static	**AND** Logical AND	50
static	**OR** Logical OR	50

Method Summary		Page
int	**getValue**() get assigned value	51
static FilterCriteriaDTO.FilterOperation	**valueOf**(String name)	51
static FilterCriteriaDTO.FilterOperation[]	**values**()	51

Field Detail

AND

```
public static final AND
```

Logical AND

OR

```
public static final OR
```

Logical OR

Method Detail

values

```
public static FilterCriteriaDTO.FilterOperation[] values()
```

~~valueOf~~

```
public static FilterCriteriaDTO.FilterOperation valueOf(String name)
```

~~getValue~~

```
public int getValue()
```

get assigned value

Returns:
assigned integer value

Class FilterCriteriaDTO.FilterUsage

org.osgi.service.onem2m.dto

```
java.lang.Object
  └java.lang.Enum
    └org.osgi.service.onem2m.dto.FilterCriteriaDTO.FilterUsage
```

All Implemented Interfaces:
Comparable, Serializable

Enclosing class:
FilterCriteriaDTO

```
final public static class FilterCriteriaDTO.FilterUsage
extends Enum
```

Enum FilterUsage

See Also:
TS-0004 6.3.4.2.31

Field Summary		Page
static	**ConditionalRetrival** Conditional Retrieve	52
static	**DiscoveryCriteria** Discovery Criteria	52
static	**IPEOndemandDiscovery** IPE on Demand Discovery	53

Method Summary		Page
int	**getValue**() get assigned integer value	53
static FilterCriteriaDTO.FilterUsage	**valueOf**(String name)	53
static FilterCriteriaDTO.FilterUsage[]	**values**()	53

Field Detail

DiscoveryCriteria

```
public static final DiscoveryCriteria
```

Discovery Criteria

~~ConditionalRetrival~~

```
public static final ConditionalRetrival
```

Conditional Retrieve

IPEOndemandDiscovery

```
public static final IPEOndemandDiscovery
```

IPE on Demand Discovery

Method Detail

values

```
public static FilterCriteriaDTO.FilterUsage[] values()
```

valueOf

```
public static FilterCriteriaDTO.FilterUsage valueOf(String name)
```

getValue

```
public int getValue()
```

get assigned integer value

Returns:
assigned integer value

Class GenericDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.GenericDTO
```

```
public class GenericDTO
extends org.osgi.dto.DTO
```

GenericDTO expresses miscellaneous data structures.

Field Summary		Page
	element Substructure of DTO.	54
	type type of data structure, which is represented by this DTO.	54

Constructor Summary	Page
GenericDTO()	54

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

type

```
public type
```

type of data structure, which is represented by this DTO. This is optional field. The creator of the DTO may use the field for clarification purpose. Receiver should not rely on this information to analyze data structure, since this information may not provided.

element

```
public element
```

Substructure of DTO. Type of the value part should be one of types allowed as OSGi DTO.

Constructor Detail

GenericDTO

```
public GenericDTO()
```

Class IPEDiscoveryRequestDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.IPEDiscoveryRequestDTO
```

```
public class IPEDiscoveryRequestDTO
extends org.osgi.dto.DTO
```

IPEDiscoveryRequestDTO is an element of NotificationEventDTO

See Also:
TS-0004 6.3.5.13

Field Summary		Page
	filterCriteria FilterCriteria	55
	originator originator	55

Constructor Summary	Page
IPEDiscoveryRequestDTO()	55

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

originator

```
public originator
```

originator

filterCriteria

```
public filterCriteria
```

FilterCriteria

See Also:
TS-0004 6.3.5.8

Constructor Detail

IPEDiscoveryRequestDTO

```
public IPEDiscoveryRequestDTO()
```

Class LocalTokenIdAssignmentDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.LocalTokenIdAssignmentDTO
```

```
public class LocalTokenIdAssignmentDTO
extends org.osgi.dto.DTO
```

DTO expressing LocalTokenIdAssignment.

Field Summary		Page
	localTokenID local token ID	56
	tokenID token ID	56

Constructor Summary	Page
LocalTokenIdAssignmentDTO()	56

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

localTokenID

```
public localTokenID
```

local token ID

tokenID

```
public tokenID
```

token ID

Constructor Detail

LocalTokenIdAssignmentDTO

```
public LocalTokenIdAssignmentDTO()
```

Class NotificationDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.NotificationDTO
```

```
public class NotificationDTO
extends org.osgi.dto.DTO
```

DTO expressing Notification.

Field Summary		Page
	creator creator	58
	ipeDiscoveryRequest IPE Discovery Request.	58
	notificationEvent Notification Event	57
	notificationForwardingURI URI for notification target	58
	subscriptionDeletion Flag showing subscription deletion This field is optional.	58
	subscriptionReference URI referring subscription resource.	58
	verificationRequest Flag showing verification request.	57

Constructor Summary	Page
NotificationDTO()	58

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

notificationEvent

```
public notificationEvent
```

Notification Event

verificationRequest

```
public verificationRequest
```

Flag showing verification request. This field is optional.

---

subscriptionDeletion

`public` **`subscriptionDeletion`**

Flag showing subscription deletion This field is optional.

subscriptionReference

`public` **`subscriptionReference`**

URI referring subscription resource.

creator

`public` **`creator`**

creator

notificationForwardingURI

`public` **`notificationForwardingURI`**

URI for notification target

ipeDiscoveryRequest

`public` **`ipeDiscoveryRequest`**

IPE Discovery Request.

Constructor Detail

NotificationDTO

`public` **`NotificationDTO`**`()`

Class NotificationEventDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.service.onem2m.dto.NotificationEventDTO
```

```
public class NotificationEventDTO
extends Object
```

NotificationEventDTO This data structure is held in NotificationDTO.

See Also:
TS-0004 6.3.5.13

Nested Class Summary		Page
final static class	NotificationEventDTO.NotificationEventType NotificationEventType	61

Field Summary		Page
	notificationEventType notificationEventType	60
	operationMonitor operationMonitor	59
	representation m2m:representation	59

Constructor Summary	Page
NotificationEventDTO()	60

Field Detail

representation

```
public representation
```

m2m:representation

See Also:
TS-0004 6.3.5.62

---

operationMonitor

```
public operationMonitor
```

operationMonitor

See Also:
TS-0004 6.3.5.57

notificationEventType

`public` **`notificationEventType`**

notificationEventType

See Also:
`TS-0004 6.3.4.2.19`

Constructor Detail

NotificationEventDTO

`public` **`NotificationEventDTO`**`()`

Class NotificationEventDTO.NotificationEventType

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ java.lang.Enum
    └ org.osgi.service.onem2m.dto.NotificationEventDTO.NotificationEventType
```

All Implemented Interfaces:

Comparable, Serializable

Enclosing class:

NotificationEventDTO

```
final public static class NotificationEventDTO.NotificationEventType
extends Enum
```

NotificationEventType

See Also:

TS-0004 6.3.4.2.19

Field Summary		Page
static	**create_of_direct_child_resource** create_of_direct_child_resource	62
static	**delete_of_direct_child_resouce** create_of_direct_child_resouce	62
static	**delete_of_resource** delete_of_resource	62
static	**retrieve_of_container_resource_with_no_child_resource** retrieve_of_container_resource_with_no_child_resource	62
static	**updagte_of_resource** updagte_of_resouce.	61

Method Summary		Page
int	**getValue**()	62
static NotificationEventDTO.NotificationEventType	**valueOf**(String name)	62
static NotificationEventDTO.NotificationEventType[]	**values**()	62

Field Detail

updagte_of_resource

```
public static final updagte_of_resource
```

updagte_of_resouce. This is the default value.

delete_of_resource

```
public static final delete_of_resource
```

delete_of_resource

create_of_direct_child_resource

```
public static final create_of_direct_child_resource
```

create_of_direct_child_resource

delete_of_direct_child_resouce

```
public static final delete_of_direct_child_resouce
```

create_of_direct_child_resouce

retrieve_of_container_resource_with_no_child_resource

```
public static final retrieve_of_container_resource_with_no_child_resource
```

retrieve_of_container_resource_with_no_child_resource

Method Detail

values

```
public static NotificationEventDTO.NotificationEventType[] values()
```

valueOf

```
public static NotificationEventDTO.NotificationEventType valueOf(String name)
```

getValue

```
public int getValue()
```

Class PrimitiveContentDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.PrimitiveContentDTO
```

```
public class PrimitiveContentDTO
extends org.osgi.dto.DTO
```

DTO expressing Primitive Content. This Data structure is used as union. Only one field MUST have a value, the others MUST be null.

Field Summary		Page
	aggregatedNotification Aggregated Notification	64
	aggregatedResponse Aggregated Response	64
	attributeList Attribute List	65
	childResourceRefList Child Resource RefList	65
	debugInfo Debug Info	64
	listOfURIs List Of URIs	64
	notification Notification	65
	queryResult Query Result	65
	requestPrimitive Request Primitive	65
	resource Resource	64
	resourceWrapper Resource Wrapper	64
	responsePrimitive Response Primitive	64
	securityInfo Security Info	64
	uri URI	64

Constructor Summary	Page
PrimitiveContentDTO()	65

Methods inherited from class org.osgi.dto.DTO

toString

Field Detail

resource

public **resource**

Resource

resourceWrapper

public **resourceWrapper**

Resource Wrapper

aggregatedNotification

public **aggregatedNotification**

Aggregated Notification

securityInfo

public **securityInfo**

Security Info

responsePrimitive

public **responsePrimitive**

Response Primitive

debugInfo

public **debugInfo**

Debug Info

listOfURIs

public **listOfURIs**

List Of URIs

uri

public **uri**

URI

aggregatedResponse

public **aggregatedResponse**

Aggregated Response

childResourceRefList

`public` **`childResourceRefList`**

Child Resource RefList

notification

`public` **`notification`**

Notification

attributeList

`public` **`attributeList`**

Attribute List

requestPrimitive

`public` **`requestPrimitive`**

Request Primitive

queryResult

`public` **`queryResult`**

Query Result

Constructor Detail

PrimitiveContentDTO

`public` **`PrimitiveContentDTO`**`()`

Class ReleaseVersion

org.osgi.service.onem2m.dto

```
java.lang.Object
  └java.lang.Enum
    └org.osgi.service.onem2m.dto.ReleaseVersion
```

All Implemented Interfaces:
Comparable, Serializable

```
final public class ReleaseVersion
extends Enum
```

Enum expressing oneM2M specification version. This information is introduced after Release 2.0 and oneM2M uses only R2A,R3_0 (as 2a and 3).

Field Summary		Page
static	**R1_0** Release 1	66
static	**R1_1** Release 1.1	66
static	**R2_0** Release 2	67
static	**R2A** Release 2A	67
static	**R3_0** Release 3	67

Method Summary		Page
static ReleaseVersion	**valueOf**(String name)	67
static ReleaseVersion[]	**values**()	67

Field Detail

R1_0

```
public static final R1_0
```

Release 1

R1_1

```
public static final R1_1
```

Release 1.1

R2_0

```
public static final R2_0
```

Release 2

R2A

```
public static final R2A
```

Release 2A

R3_0

```
public static final R3_0
```

Release 3

Method Detail

values

```
public static ReleaseVersion[] values()
```

valueOf

```
public static ReleaseVersion valueOf(String name)
```

Class RequestPrimitiveDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.RequestPrimitiveDTO
```

```
public class RequestPrimitiveDTO
extends org.osgi.dto.DTO
```

DTO expresses Request Primitive.

Nested Class Summary		Page
final static class	RequestPrimitiveDTO.DiscoveryResultType	73
final static class	RequestPrimitiveDTO.Operation enum type for Operation	75
final static class	RequestPrimitiveDTO.ResultContent enum type for Result Content	77

Field Summary		Page
	authorRelIndicator Author Relation Indicator	72
	authorSignIndicator Author Sign Indicator	72
	authorSigns Author Signs	72
	content Primitive Content	70
	deliveryAggregation Delivery Aggregation	71
	discoveryResultType Discovery Result Type	71
	eventCategory Event Category	71
	filterCriteria Filter Criteria	71
	from From Parameter.	70
	groupRequestIdentifier Group Request Identifier	71
	groupRequestTargetMembers Group Request Target Members	72
	localTokenIDs Local Token Identifiers	72
	operation Operation	69

	operationExecutionTime Operation Execution Time	70
	originatingTimestamp Originating Timestamp	70
	releaseVersionIndicator Release Version	72
	requestExpirationTimestamp Request Expiration Timestamp	70
	requestIdentifier Request Identifier	70
	resourceType Resource Type	70
	responseType Response Type Info	71
	resultContent Result Content	71
	resultExpirationTimestamp Result Expiration Timestamp	70
	resultPersistence Result Persistence	71
	roleIDs Role IDs	70
	semanticQueryIndicator Semantic Query Indicator	72
	to To Parameter	70
	tokenIDs Token Identifiers	71
	tokenRequestIndicator Token Request Indicator	72
	tokens tokens	71
	vendorInformation Vendor Information	72

Constructor Summary	Page
RequestPrimitiveDTO()	72

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

operation

public **operation**

Operation

to

public **to**

To Parameter

from

public **from**

From Parameter. In other word, originator of request is stored.

requestIdentifier

public **requestIdentifier**

Request Identifier

resourceType

public **resourceType**

Resource Type

content

public **content**

Primitive Content

roleIDs

public **roleIDs**

Role IDs

originatingTimestamp

public **originatingTimestamp**

Originating Timestamp

requestExpirationTimestamp

public **requestExpirationTimestamp**

Request Expiration Timestamp

resultExpirationTimestamp

public **resultExpirationTimestamp**

Result Expiration Timestamp

operationExecutionTime

public **operationExecutionTime**

Operation Execution Time

responseType

public **responseType**

Response Type Info

resultPersistence

public **resultPersistence**

Result Persistence

resultContent

public **resultContent**

Result Content

eventCategory

public **eventCategory**

Event Category

deliveryAggregation

public **deliveryAggregation**

Delivery Aggregation

groupRequestIdentifier

public **groupRequestIdentifier**

Group Request Identifier

filterCriteria

public **filterCriteria**

Filter Criteria

discoveryResultType

public **discoveryResultType**

Discovery Result Type

tokens

public **tokens**

tokens

tokenIDs

public **tokenIDs**

Token Identifiers

localTokenIDs

public **localTokenIDs**

Local Token Identifiers

tokenRequestIndicator

public **tokenRequestIndicator**

Token Request Indicator

groupRequestTargetMembers

public **groupRequestTargetMembers**

Group Request Target Members

authorSignIndicator

public **authorSignIndicator**

Author Sign Indicator

authorSigns

public **authorSigns**

Author Signs

authorRelIndicator

public **authorRelIndicator**

Author Relation Indicator

semanticQueryIndicator

public **semanticQueryIndicator**

Semantic Query Indicator

releaseVersionIndicator

public **releaseVersionIndicator**

Release Version

vendorInformation

public **vendorInformation**

Vendor Information

Constructor Detail

RequestPrimitiveDTO

public **RequestPrimitiveDTO**()

Class RequestPrimitiveDTO.DiscoveryResultType

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ java.lang.Enum
    └ org.osgi.service.onem2m.dto.RequestPrimitiveDTO.DiscoveryResultType
```

All Implemented Interfaces:

Comparable, Serializable

Enclosing class:

RequestPrimitiveDTO

```
final public static class RequestPrimitiveDTO.DiscoveryResultType
extends Enum
```

Field Summary		Page
static	**structured** structured	73
static	**unstructured** unstructured	73

Method Summary		Page
int	**getValue**()	74
static RequestPrimitiveDTO.DiscoveryResultType	**valueOf**(String name)	74
static RequestPrimitiveDTO.DiscoveryResultType[]	**values**()	74

Field Detail

structured

```
public static final structured
```

structured

unstructured

```
public static final unstructured
```

unstructured

Method Detail

values

public static RequestPrimitiveDTO.DiscoveryResultType[] **values**()

valueOf

public static RequestPrimitiveDTO.DiscoveryResultType **valueOf**(String name)

getValue

public int **getValue**()

Class RequestPrimitiveDTO.Operation

org.osgi.service.onem2m.dto

```
java.lang.Object
  └java.lang.Enum
    └org.osgi.service.onem2m.dto.RequestPrimitiveDTO.Operation
```

All Implemented Interfaces:

Comparable, Serializable

Enclosing class:

RequestPrimitiveDTO

```
final public static class RequestPrimitiveDTO.Operation
extends Enum
```

enum type for Operation

Field Summary		Page
static	**Create** Create	75
static	**Delete** Delete	76
static	**Notify** Notify	76
static	**Retrieve** Retrieve	76
static	**Update** Update	76

Method Summary		Page
int	**getValue**() get assigned integer value	76
static RequestPrimitiveDTO.Operation	**valueOf**(String name)	76
static RequestPrimitiveDTO.Operation[]	**values**()	76

Field Detail

Create

```
public static final Create
```

Create

Retrieve

```
public static final Retrieve
```

Retrieve

Update

```
public static final Update
```

Update

Delete

```
public static final Delete
```

Delete

Notify

```
public static final Notify
```

Notify

Method Detail

values

```
public static RequestPrimitiveDTO.Operation[] values()
```

valueOf

```
public static RequestPrimitiveDTO.Operation valueOf(String name)
```

getValue

```
public int getValue()
```

get assigned integer value

Returns:

assigned integer value

Class RequestPrimitiveDTO.ResultContent

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ java.lang.Enum
      └ org.osgi.service.onem2m.dto.RequestPrimitiveDTO.ResultContent
```

All Implemented Interfaces:
Comparable, Serializable

Enclosing class:
RequestPrimitiveDTO

```
final public static class RequestPrimitiveDTO.ResultContent
extends Enum
```

enum type for Result Content

Field Summary		Page
static	**attributes** attributes	78
static	**attributesAndChildResourceReferences** attributesAndChildResourceReferences	78
static	**attributesAndChildResources** attributesAndChildResources	78
static	**childResourceReferences** childResourceReferences	78
static	**childResources** childResources	78
static	**hierarchicalAddress** hierarchicalAddress	78
static	**hierarchicalAddressAndAttributes** hierarchicalAddressAndAttributes	78
static	**nothing** nothing	78
static	**originalResource** originalResource	78

Method Summary		Page
int	**getValue**() get assigned integer value	79
static RequestPrimitiveDTO.ResultContent	**valueOf**(String name)	79
static RequestPrimitiveDTO.ResultContent[]	**values**()	79

Field Detail

nothing

```
public static final nothing
```

nothing

attributes

```
public static final attributes
```

attributes

hierarchicalAddress

```
public static final hierarchicalAddress
```

hierarchicalAddress

hierarchicalAddressAndAttributes

```
public static final hierarchicalAddressAndAttributes
```

hierarchicalAddressAndAttributes

attributesAndChildResources

```
public static final attributesAndChildResources
```

attributesAndChildResources

attributesAndChildResourceReferences

```
public static final attributesAndChildResourceReferences
```

attributesAndChildResourceReferences

childResourceReferences

```
public static final childResourceReferences
```

childResourceReferences

originalResource

```
public static final originalResource
```

originalResource

childResources

```
public static final childResources
```

childResources

Method Detail

values

```
public static RequestPrimitiveDTO.ResultContent[] values()
```

~~valueOf~~

```
public static RequestPrimitiveDTO.ResultContent valueOf(String name)
```

~~getValue~~

```
public int getValue()
```

get assigned integer value

Returns:

assigned integer value

Class ResourceDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.ResourceDTO
```

```
public class ResourceDTO
extends org.osgi.dto.DTO
```

DTO expressing Resource.

Field Summary		Page
	attribute Non Universal Attribute.	81
	creationTime Creation time	81
	labels Labels This field is optional.	81
	lastModifiedTime last modified time	81
	parentID Parent ID Resource ID of parent resource.	81
	resourceID Resource ID	80
	resourceName Resource name	81
	resourceType Resource Type	80

Constructor Summary	Page
ResourceDTO()	81

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

resourceType

```
public resourceType
```

Resource Type

resourceID

```
public resourceID
```

Resource ID

parentID

`public` **`parentID`**

Parent ID Resource ID of parent resource.

creationTime

`public` **`creationTime`**

Creation time

lastModifiedTime

`public` **`lastModifiedTime`**

last modified time

resourceName

`public` **`resourceName`**

Resource name

labels

`public` **`labels`**

Labels This field is optional.

attribute

`public` **`attribute`**

Non Universal Attribute. Value Part must be the types that are allowed for OSGi DTO.

Constructor Detail

ResourceDTO

`public` **`ResourceDTO`**`()`

Class ResourceWrapperDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.ResourceWrapperDTO
```

```
public class ResourceWrapperDTO
extends org.osgi.dto.DTO
```

DTO expressing ResourceWrapper.

Field Summary		Page
	resource Resource	82
	uri URI for the resource	82

Constructor Summary	Page
ResourceWrapperDTO()	82

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

uri

```
public uri
```

URI for the resource

resource

```
public resource
```

Resource

Constructor Detail

ResourceWrapperDTO

```
public ResourceWrapperDTO()
```

Class ResponsePrimitiveDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.ResponsePrimitiveDTO
```

```
public class ResponsePrimitiveDTO
extends org.osgi.dto.DTO
```

DTO expressing Response Primitive.

Nested Class Summary		Page
final static class	ResponsePrimitiveDTO.ContentStatus Enum ContentStatus	86

Field Summary		Page
	assignedTokenIdentifiers Assigned Token Identifiers	85
	AuthSignatureReqInfo AuthSignatureReqInfo	85
	content Primitive Content	84
	contentOffset Content Offset	85
	contentStatus Content Status	85
	eventCategory Event Category	84
	from From Parameter	84
	originatingTimestamp Originating Timestamp	84
	releaseVersionIndicator Release Version Indicator	85
	requestIdentifier Request Identifier	84
	responseStatusCode Response Status Code	84
	resultExpirationTimestamp ResultExpiration Timestamp	84
	to To Parameter	84
	tokenReqInfo Token Request Info	85
	vendorInformation Vendor Information	85

Constructor Summary	Page
ResponsePrimitiveDTO()	85

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

responseStatusCode

public **responseStatusCode**

Response Status Code

requestIdentifier

public **requestIdentifier**

Request Identifier

content

public **content**

Primitive Content

to

public **to**

To Parameter

from

public **from**

From Parameter

originatingTimestamp

public **originatingTimestamp**

Originating Timestamp

resultExpirationTimestamp

public **resultExpirationTimestamp**

ResultExpiration Timestamp

eventCategory

public **eventCategory**

Event Category

contentStatus

public **contentStatus**

Content Status

contentOffset

public **contentOffset**

Content Offset

assignedTokenIdentifiers

public **assignedTokenIdentifiers**

Assigned Token Identifiers

tokenReqInfo

public **tokenReqInfo**

Token Request Info

AuthSignatureReqInfo

public **AuthSignatureReqInfo**

AuthSignatureReqInfo

releaseVersionIndicator

public **releaseVersionIndicator**

Release Version Indicator

vendorInformation

public **vendorInformation**

Vendor Information

Constructor Detail

ResponsePrimitiveDTO

public **ResponsePrimitiveDTO**()

Class ResponsePrimitiveDTO.ContentStatus

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ java.lang.Enum
    └ org.osgi.service.onem2m.dto.ResponsePrimitiveDTO.ContentStatus
```

All Implemented Interfaces:

Comparable, Serializable

Enclosing class:

ResponsePrimitiveDTO

```
final public static class ResponsePrimitiveDTO.ContentStatus
extends Enum
```

Enum ContentStatus

Field Summary		Page
static	**FULL_CONTENT** FULL_CONTENT	86
static	**PARTIAL_CONTENT** PARTIAL_CONTENT	86

Method Summary		Page
static ResponsePrimitiveDTO.ContentStatus	**valueOf**(String name)	87
static ResponsePrimitiveDTO.ContentStatus[]	**values**()	87

Field Detail

PARTIAL_CONTENT

```
public static final PARTIAL_CONTENT
```

PARTIAL_CONTENT

FULL_CONTENT

```
public static final FULL_CONTENT
```

FULL_CONTENT

Method Detail

values

```
public static ResponsePrimitiveDTO.ContentStatus[] values()
```

valueOf

```
public static ResponsePrimitiveDTO.ContentStatus valueOf(String name)
```

Class ResponseTypeInfoDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.ResponseTypeInfoDTO
```

```
public class ResponseTypeInfoDTO
extends org.osgi.dto.DTO
```

Expressing ResponseTypeInfo

Nested Class Summary		Page
final static class	ResponseTypeInfoDTO.ResponseType enum ResponseType	89

Field Summary		Page
	notificationURI Notification URI	88
	responseTypeValue Response Type Value	88

Constructor Summary	Page
ResponseTypeInfoDTO()	88

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

responseTypeValue

```
public responseTypeValue
```

Response Type Value

notificationURI

```
public notificationURI
```

Notification URI

Constructor Detail

ResponseTypeInfoDTO

```
public ResponseTypeInfoDTO()
```

Class ResponseTypeInfoDTO.ResponseType

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ java.lang.Enum
    └ org.osgi.service.onem2m.dto.ResponseTypeInfoDTO.ResponseType
```

All Implemented Interfaces:

Comparable, Serializable

Enclosing class:

ResponseTypeInfoDTO

```
final public static class ResponseTypeInfoDTO.ResponseType
extends Enum
```

enum ResponseType

Field Summary		Page
static	**blockingRequest** blockingRequest	90
static	**flexBlocking** flexBlocking	90
static	**nonBlockingRequestAsynch** nonBlockingRequestAsynch	89
static	**nonBlockingRequestSynch** nonBlockingRequestSynch	89

Method Summary		Page
int	**getValue**() get assigned value	90
static ResponseTypeInfoDTO.ResponseType	**valueOf**(String name)	90
static ResponseTypeInfoDTO.ResponseType[]	**values**()	90

Field Detail

nonBlockingRequestSynch

```
public static final nonBlockingRequestSynch
```

nonBlockingRequestSynch

nonBlockingRequestAsynch

```
public static final nonBlockingRequestAsynch
```

nonBlockingRequestAsynch

blockingRequest

```
public static final blockingRequest
```

blockingRequest

flexBlocking

```
public static final flexBlocking
```

flexBlocking

Method Detail

values

```
public static ResponseTypeInfoDTO.ResponseType[] values()
```

valueOf

```
public static ResponseTypeInfoDTO.ResponseType valueOf(String name)
```

getValue

```
public int getValue()
```

get assigned value

Returns:

assigned integer value.

Class SecurityInfoDTO

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ org.osgi.dto.DTO
    └ org.osgi.service.onem2m.dto.SecurityInfoDTO
```

```
public class SecurityInfoDTO
extends org.osgi.dto.DTO
```

DTO expressing Security Info.

Nested Class Summary		Page
final static class	SecurityInfoDTO.SecurityInfoType Enum SecurityInfoType	93

Field Summary		Page
	dasRequest Das Request	91
	dasResponse Das Response	92
	escertkeMessage Escertke Message	92
	esprimObject Esprim Object	92
	esprimRandObject Esprim Rand Objecgt	92
	securityInfoType Security Info Type	91

Constructor Summary	Page
SecurityInfoDTO()	92

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

securityInfoType

```
public securityInfoType
```

Security Info Type

dasRequest

```
public dasRequest
```

Das Request

dasResponse

```
public dasResponse
```

Das Response

esprimRandObject

```
public esprimRandObject
```

Esprim Rand Objecgt

esprimObject

```
public esprimObject
```

Esprim Object

escertkeMessage

```
public escertkeMessage
```

Escertke Message

Constructor Detail

SecurityInfoDTO

```
public SecurityInfoDTO()
```

Class SecurityInfoDTO.SecurityInfoType

org.osgi.service.onem2m.dto

```
java.lang.Object
  └ java.lang.Enum
    └ org.osgi.service.onem2m.dto.SecurityInfoDTO.SecurityInfoType
```

All Implemented Interfaces:

Comparable, Serializable

Enclosing class:

SecurityInfoDTO

```
final public static class SecurityInfoDTO.SecurityInfoType
extends Enum
```

Enum SecurityInfoType

Field Summary		Page
static	**DynamicAuthorizationRelationshipMappingRequest** DynamicAuthorizationRelationshipMappingRequest	94
static	**DynamicAuthorizationRelationshipMappingResponse** DynamicAuthorizationRelationshipMappingResponse	94
static	**DynamicAuthorizationRequest** DynamicAuthorizationRequest	94
static	**DynamicAuthorizationResponse** DynamicAuthorizationResponse	94
static	**ESCertKEMessage** ESCertKEMessage	94
static	**ESPrimObject** ESPrimObject	94
static	**ReceiverESPrimRandObjectRequest** ReceiverESPrimRandObjectRequest	94
static	**ReceiverESPrimRandObjectResponse** ReceiverESPrimRandObjectResponse	94

Method Summary		Page
int	**getValue**() Get assigned value.	95
static SecurityInfoDTO.SecurityInfoType	**valueOf**(String name)	94
static SecurityInfoDTO.SecurityInfoType[]	**values**()	94

Field Detail

DynamicAuthorizationRequest

```
public static final DynamicAuthorizationRequest
```

DynamicAuthorizationRequest

DynamicAuthorizationResponse

```
public static final DynamicAuthorizationResponse
```

DynamicAuthorizationResponse

ReceiverESPrimRandObjectRequest

```
public static final ReceiverESPrimRandObjectRequest
```

ReceiverESPrimRandObjectRequest

ReceiverESPrimRandObjectResponse

```
public static final ReceiverESPrimRandObjectResponse
```

ReceiverESPrimRandObjectResponse

ESPrimObject

```
public static final ESPrimObject
```

ESPrimObject

ESCertKEMessage

```
public static final ESCertKEMessage
```

ESCertKEMessage

DynamicAuthorizationRelationshipMappingRequest

```
public static final DynamicAuthorizationRelationshipMappingRequest
```

DynamicAuthorizationRelationshipMappingRequest

DynamicAuthorizationRelationshipMappingResponse

```
public static final DynamicAuthorizationRelationshipMappingResponse
```

DynamicAuthorizationRelationshipMappingResponse

Method Detail

values

```
public static SecurityInfoDTO.SecurityInfoType[] values()
```

valueOf

```
public static SecurityInfoDTO.SecurityInfoType valueOf(String name)
```

getValue

```
public int getValue()
```

Get assigned value.

Returns:
assigned value

8 Considered Alternatives

8.1 Representation of DTO

8.1.1 JAXB generated Class

As alternative solution, utilization of generated Java classes by JAXB has been considered, since oneM2M provides well defined XSD for defining data format. With the following aspects, this approach is not applied.

Many classes: 66 XSD files are defined in XSD v3.2.0 of oneM2M specification and JAXB tool (xjc) generates more than 140 Java classes. Using many classes as interface could make specification more complicated than its nature.

No Uniqueness: Generated classes by JAXB tool(xjc) are not unique, because it is possible to customize generation processes.

Changeability: Depending on the version of oneM2M, XSD files differ. It is preferable to choose version independent API, as much as possible. oneM2M ensures any data can be converted to JSON and CBOR, so proposed approach can be used with out modification, even if XSD file would be changed.

8.1.2 Generic DTO

Generic DTO, which has Map<String, Obj> in the top, has been discussed in Gent meeting. But it seems bad usage of defining DTO.

8.1.3 Specific DTO

SpecificDTO definitions have been generated from XSD generated classes. The number of DTO exceeds 170 and Java doc pages are getting 300 pages. It is apparently too much to express data formats. So middle approach of generic DTO and specific DTO has been chosen.

8.2 Resource Types Expression

In DTO, enum was eagerly used for clear candidates of possible values. But resource types seems more fragile because new resource types could be easily added. So Integer was chosen for resource types.

8.3 Use of Annotation defined by JAXB in DTO

Currently annotations defined by JAXB was used in DTO. It was pointed out as confusing because it might give impression that it only support XML serialization. But it was kept in the definitions by following reasons.

1. Removing the annotations are easier than inserting.

2. It is informative to specify optionality.

New OSGI annotation specifying optionality could be possible, but it might take time because it should be published as Core specification and R7 just has released.

8.4 Service Property for Service Layer Interface

In previous version, property named as PoAforAE is supposed to attach to Service Layer Interface. The way application need to search dedicated service for the AE, however, is not easy for developers nor OSGi way. The property has been removed and matching will be done by using Service Factory and mapping of bundle location and appropriate PoA is known by the service implementation.

8.5 Service Property for Notification Listener Interface

In previous version, property named as PoA and AE-ID are supposed to attach to Notification Listener Interface.

To attache AE-ID, application need to check result of <AE> resource creation and know modified AE-ID by CSE, and attach it as a property. This is complicated procedure and it is not a good design choice requiring all applications to implement this manner. Regarding PoA, the design that AE does not need to care of PoA was chosen.

Implementation of Service Layer Interface should manage both information by monitoring method request for creating <AE> resource and modifying the response. [This part need to be confirmed by reference implementation.]

9 Security Considerations

9.1 ServiceLayer Service with secure protocol configuration

In case that ServiceLayer Service uses secure protocols, it is expected to handle pre-shared key or certificate and other parameters. Those configuration could be very diverse. This is out of scope of this RFC and it is responsibility of bundle developer that provides ProtocolBindingService.

9.2 Binding of AE Core and Protocol Binding

Protocol Binding has identity information, such as a key or certificate, which represents AE, so that AE core MUST be bound to the right protocol service binding. It is implementation's responsibility of protocol binding, it SHOULD utilize Service Factory to determine calling entity.

10 Document Support

10.1 References

[1]. Bradner, S., Key words for use in RFCs to Indicate Requirement Levels, RFC2119, March 1997.

[2]. oneM2M TS-0001 Functional Architecture, http://onem2m.org/images/files/deliverables/Release2/TS-0001-%20Functional_Architecture-V2_10_0.pdf

[3]. oneM2M TS-0004 Service Layer Core Protocol, http://onem2m.org/images/files/deliverables/Release2/TS-0004_Service_Layer_Core_Protocol_V2_7_1.zip

[4]. oneM2M TS-0001 Functional Architecture Draft v3.11.0, http://www.onem2m.org/technical/published-drafts

[5]. oneM2M TS-0004 Service Layer Core Protocol Draft v3.7.0, http://www.onem2m.org/technical/published-drafts

[6]. XSD files for oneM2M, https://git.onem2m.org/PRO/XSD.git

[7]. Software Requirements & Specifications. Michael Jackson. ISBN 0-201-87712-0 (NOTE:Is this needed?)

10.2 Author's Address

Name	Hiroyuki Maeomichi
Company	NTT
Address	Midoricho 3-9-11, Musashino, Tokyo, Japan
Voice	+81 422 59 4072
e-mail	maeomichi.hiroyuki@lab.ntt.co.jp

10.3 Acronyms and Abbreviations

CSE: Common Services Entity

AE: Application Entity

CBOR: Concise Binary Object Representation

DTO: Data Transfer Object

JAXB: The Java Architecture for XML Binding

XSD: XML Schema Definition Language

10.4 End of Document