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**1. Introduction**

This contribution introduces conformance test purposes for DISCOVERY CSF in terms of test cases for BO and BI test. Prior to write the test cases for DISCOVERY CSF, we analyzed and annotated the specification requirements of TS-0001 and TS-0004 especially requirements relevant for the DIS CSF.

The test purpose reference has to not only include the specification identifier associated with version number and relevant clause identifier e.g. TS-0001 [-v1.13.0] 10.2.6.2, but also the relevant requirement annotation identifier, e.g. TS-0001\_RD\_017, REQ-0001-10002 etc.

# Requirement annotation analysis of TS-0001 [v1.12.0]

## 6.2.5 Discovery

6.2.5.1 General Concepts

The Discovery (DIS) CSF searches information about applications and services as contained in attributes and resources. The result of a discovery request from an Originator depends upon the filter criteria and is subject to access control policy allowed by M2M Service Subscription. An Originator could be an AE or another CSE. The scope of the search could be within one CSE, or in more than one CSE. The discovery results are returned back to the Originator.

6.2.5.2 Detailed Descriptions

The DIS CSF uses the Originator provided filter criteria (e.g. a combination of keywords, identifiers, location and semantic information) that can limit the scope of information returned to the Originator.

The discovery request indicates the address of the resource where the discovery is to be performed. Upon receiving such request, the DIS CSF discovers, identifies, and returns the matching information regarding discovered resources according to the filter criteria.

A successful response includes the discovered information or address(es) pertaining to the discovered resources. In the latter case the Originator can retrieve the resources using such discovered address. Based on the policies or Originator request, the CSE which received the discovery request can forward the request to other registered ASN-CSEs, MN-CSEs or IN-CSEs.

## 10.1.2 RETRIEVE (R)

The RETRIEVE operation shall be used for retrieving the information stored for any of the attributes for a resource at the Receiver CSE. The Originator CSE or AE may request to retrieve a specific attribute by including the name of such attribute in the ***Content*** parameter in the request message.

**Originator** requests retrieval of all attributes or a specific attributes of the target resource by using RETRIEVE Request. See clause 8.1.2 for the information to be included in the Request message. If only some specific attributes need to be retrieved, the name of such attributes shall be included in the ***Content*** parameter of the Request message.

**Receiver** The Receiver performs local processing to verify the existence of requested resource and checks privileges for retrieving the information related to the resource. After successful verification, the Receiver shall return the requested information, otherwise an error indication shall be returned.



**Figure 10.1.2-1: Procedure for RETRIEVing a Resource**

**Step 001:** The Originator shall send mandatory parameters and may send optional parameters in Request message for RETRIEVE operation as specified in clause 8.1.2.

**Step 002:** The Receiver shall verify the existence (including ***Filter Criteria*** checking, if it is given) of the target resource or the attribute and check if the Originator has appropriate privileges to retrieve information stored in the resource/attribute.

**Step 003:** The Receiver shall respond with mandatory parameters and may send optional parameters in Response message for RETRIEVE operation as specified in clause 8.1.3.

**General Exceptions:**

1. The targeted resource/attribute in ***To*** parameter does not exist. The Receiver responds with an error.
2. The Originator does not have privileges to retrieve information stored in the resource on the Receiver. The Receiver responds with an error.

## 10.2.6 Resource Discovery Procedures

10.2.6.1 Introduction

The resource discovery procedures allow discovering of resources residing on a CSE. The use of the ***Filter Criteria*** parameter allows limiting the scope of the results.

Resource discovery shall be accomplished using the RETRIEVE method by an Originator which shall also include the root of where the discovery begins: e.g. *<CSEBase>.* The unfiltered result of the resource discovery procedure includes all the child resources under the root of where the discovery begins, which the Originator has a Discover access right on.

Filter criteria conditions may be provided as parameters to the RETRIEVE method. The filter criteria conditions describe the rules for resource discovery, e.g. resource types, creation time and matching string. The filter criteria can also contain the parameters for specifying the maximum size of the answer (upper limit). Table 8.1.2-2 describes the ***Filter Criteria*** parameter.

A match shall happen when a resource matches the configured filter criteria conditions and the Originator has a Discover access right on the resource. A successful response contains a list for the matched resources addressable in any of the forms expressed in clause 9.3.1 if matches are found. If no matches are found, a successful response returns no matched resources. If ***Discovery Result Type*** parameter is specified in a discovery request, the Hosting CSE shall choose the addressing form specified by the ***Discovery Result Type*** parameter.

The discovery results may be modified by the Hosting CSE to restrict the scope of discoverable resources according to the Originator's access control policy or M2M service subscription.

The Hosting CSE may also implement a configured upper limit on the size of the answer. In such a case when the Originator and the Hosting CSE have different upper limits, the smaller of the two shall apply.

10.2.6.2 Discovery procedure via Retrieve Operation

This procedure shall be used for the discovery of resources under *<CSEBase>* that match the provided ***Filter Criteria***parameter. The discovery result shall be returned to the Originator using a successful Response message.

**Table 10.2.6.2-1: Discovery procedure via Retrieve Operation**

|  |  |
| --- | --- |
| ***<resource>* RETRIEVE** | |
| Associated Reference Point | Mca, Mcc and Mcc' |
| Information in Request message | All parameters defined in table 8.1.2-3 apply with the specific details for:  ***To:*** Address of the root of where the discovery begins  ***Filter Criteria:*** Filter criteria for searching and expected returned result  ***Discovery Result Type:*** optional, format of discovery results returned |
| Processing at Originator before sending Request | According to clause 10.1.2 with the following:  Setup the RETRIEVE operation in the Request  Include the conditions in the filter criterion to limit the scope of the discovery results  Specify the desired format of returned discovery results |
| Processing at Receiver | According to clause 10.1.2 with the following specific processing:  Checks the validity of the Request (e.g. format of ***Filter Criteria***)  Checks if the request is in accordance with the M2M service subscription  May change the filter criteria according to local policies  Searches matched resources from the addressed resource hierarchy  Limits the discovery result according to DISCOVER privileges of the discovered resources  Limits the discovery result according to the upper limit on the size of the answer  The Hosting CSE shall read the values of all attributes belonging to the addressed resource structure and the references of all sub-resources and it shall build a representation of these. The Hosting CSE shall use the appropriate addressing (see clause 9.3.1) form for each element included in the list in accordance with the incoming request. If ***Filter Criteria*** is provided in the request, the Hosting CSE uses it identifying the resources whose attributes match the ***Filter Criteria***. The Hosting CSE shall respond to the Originator with the appropriate list of discovered resources in the Hosting CSE.  The Hosting CSE may modify the ***Filter Criteria*** including upper limit provided by the Originator or the discovery results based on the local policies  If the size of the result list is bigger than the upper limit or the scope of discoverable resources, according to the Originator's access control policy or service subscription has been modified by the Hosting CSE, the full list is not returned. Instead, an incomplete list is returned and an indication is added in the response for warning the requestor. |
| Information in Response message | All parameters defined in table 8.1.3-1 apply with the specific details for:  Contains the address list of discovered resources expressed in any of the methods depicted in clause 9.3.1. The address list may be empty if no result matching the filter criterion is discovered  Contains an incomplete list warning if the full list is not returned |
| Processing at Originator after receiving Response | According to clause 10.1.2 |
| Exceptions | According to clause 10.1.2, with the following:  The requesting M2M AE or CSE is not registered  The request contains invalid parameters |

# Requirement annotation analysis of TS-0004 [v1.5.0]

## Receiver CSE actions

#### 7.3.2.1 Check the validity of received request primitive

The validity checking of the message carrying the received request primitive is specified by the protocol mapping Technical Specifications (CoAP binding [22], HTTP binding [23], and MQTT binding [24]). The received resource representation (e.g. in plain XML, binary XML or JSON) shall be validated against the provided schema definitions.

If the ***Request Expiration Timestamp*** is given in the request and expired, the Receiver CSE shall reject the request with an "REQUEST\_TIMEOUT" ***Response Status Code*** parameter value.

If the received request is communicated within an established Security Association (TS-0003 [7]), and

* the Receiver knows that the Registree using the established Security Association is an AE; and
* the Receiver knows the AE-ID(s) of the Registree using the established Security Association; and
* the ***From*** parameter does not match the allowed AE-ID(s) of the Registree using the established Security Association,

then the request shall be rejected with an "ACCESS\_DENIED" ***Response Status Code*** parameter value.

If the received request is communicated within an established Security Association, and

* the Receiver knows that the Registree using the established Security Association is a CSE; and
* the Receiver knows the CSE -ID of the Registree using the established Security Association; and
* if one of the following applies:
* the ***From*** parameter is an CSE-ID that matches one of the Receiver''s Registree CSE''s CSE-ID other than the CSE-ID of the Registree using the established Security Association, or
* the ***From*** parameter is an CSE-Relative C-Type AE-ID-Stem, or
* the ***From*** parameter is an SP-Relative AE-ID or Absolute AE-ID with a C-Type AE-ID-Stem, and the CSE-ID portion of the ***From*** parameter matches one of the Receiver''s Registree CSE''s CSE-ID other than the CSE-ID of the Registree for the established Security Association,

then the request shall be rejected with an "ACCESS\_DENIED" ***Response Status Code*** parameter value .

NOTE: An SP-Relative-AE-ID or Absolute AE-ID with a C-Type AE-ID-Stem always includes a CSE-ID portion (see TS-0001 [6]).

If the received request is communicated outside of an established Security Association, and

* if the ***From*** parameter includes an AE-ID, and
* the request is not a CREATE <AE> Request, and
* the ***From*** parameter does not match the AE-ID of an AE currently registered to the Receiver

then the request shall be rejected with a "ACCESS\_DENIED" ***Response Status Code*** parameter value.

If the received request is communicated outside of an established Security Association, and the ***From*** parameter includes a CSE-ID, then the request shall be rejected with an "ACCESS\_DENIED" ***Response Status Code*** parameter value.

If a received request needs to be forwarded to another CSE and if CMDH processing is supported, then in addition, the "CMDH message validation procedure" defined in clause H.2.3. shall be carried out.

If the message is not valid, the request shall be rejected with a ***Response Status Code*** indicating "BAD\_REQUEST" error.

If the receiver does not support the content format (i.e. type of serialization) requested by the originator, the request shall be rejected with a ***Response Status Code*** indicating "NOT\_ACCEPTABLE" error.

## 7.3.3.17 Using Filter Criteria for identification of target resources

When the Filter Criteria primitive parameter is present in a request primitive, it shall be applied for identification of the applicable target resources of the respective operation. This may apply to Retrieve, Delete and Discovery operations as specified in

7.3.3.6, 7.3.3.8 and 7.3.3.14, respectively.

The Filter Criteria primitive parameter defines conditions on resource attributes. Resources matching the conditions shall be selected as target of the operation. Table 7.3.3.17‑1 summarizes the various filter criteria and conditions. Each row in the table represents a different filter condition type.

If multiple conditions of different type (i.e. different condition tags) are present in the Filter Criteria parameter, these shall be satisfied all to pass the overall combined filter condition, i.e. the combined condition shall be derived by applying Boolean AND operation across each individual condition.

If multiple conditions of the same type (i.e. same condition tag) are present in the Filter Criteria parameter, these shall be combined by applying Boolean OR operation. This applies to condition tags labels, resourceType, contentType or attribute for multiplicity n > 1.

Table 7.3.3.17‑1: Summary on Filter conditions

|  |  |  |  |
| --- | --- | --- | --- |
| Condition Tag | Multiplicity | Targeted Resource Attribute | Matching Condition |
| createdBefore, | 0..1 | creationTime | creationTime < createdBefore, see clause 7.3.3.17.1. |
| createdAfter | 0..1 | createdAfter ≤ creationTime , see clause 7.3.3.17.1. |
| lastModifiedBefore | 0..1 | lastModifiedTime | lastModifiedTime < lastModifiedBefore, see clause 7.3.3.17.2. |
| lastModifiedAfter | 0..1 | lastModifiedAfter ≤ lastModifiedTime, see clause 7.3.3.17.2. |
| stateTagSmaller | 0..1 | stateTag | stateTagSmaller < stateTag, see clause 7.3.3.17.3. |
| stateTagBigger | 0..1 | stateTag ≤ stateTagBigger, see clause 7.3.3.17.3. |
| expireBefore | 0..1 | expirationTime | expirationTime < expireBefore, see clause 7.3.3.17.4. |
| expireAfter | 0..1 | expireAfter ≤ expirationTime , see clause 7.3.3.17.4. |
| Labels | 0..n | labels | see clause 7.3.3.17.5. |
| resourceType | 0..n | resourceType | see clause 7.3.3.17.6. |
| sizeBelow | 0..1 | contentSize | contentSize < sizeBelow, see clause see clause 7.3.3.17.7. |
| sizeAbove | 0..1 | sizeAbove ≤ contentSize, see clause see clause 7.3.3.17.7. |
| typeOfContent | 0..n | contentInfo | matched with typeOfContent component in contentInfo, see clause 7.3.3.17.8. |
| Attribute | 0..n | (variable) | name and value of Filter Criteria attribute matches resource attribute, see clause 7.3.3.17.9. |
| Limits | 0..1 | (not applicable) | Constraint on maximum number of targeted resources, see clause 7.3.3.17.10. |
| filterUsage | 0..1 | (not applicable) | Indicator specifying the use case of Filter Criteria parameters. |

##### Conditions on the creationTime attribute

The Filter Criteria elements createdBefore and createdAfter define a time interval which is tested against the creationTime attribute of the applicable resources.

This filter criterion shall be satisfied if any of the following three conditions is fulfilled:

1. only createdBefore given in Filter Criteria:   
   creationTime < createdBefore
2. only createdAfter given in Filter Criteria:  
   createdAfter ≤ creationTime)
3. both, createdBefore and createdAfter given in Filter Criteria:   
   (createdAfter ≤ creationTime) AND (creationTime < createdBefore)

NOTE: In case 3) the Filter Criteria will only generate a match if createdAfter < createdBefore.

##### Conditions on the lastModifiedTime attribute

The Filter Criteria elements lastModifiedBefore and lastModifiedAfter define a time interval which is tested against the lastModifiedTime attribute of the applicable resources.

This filter criterion shall be satisfied if any of the following three conditions is fulfilled:

1. only lastModifiedBefore given in Filter Criteria:   
   lastModifiedTime < lastModifiedBefore
2. only lastModifiedAfter given in Filter Criteria:   
   lastModifiedAfter ≤ lastModifiedTime
3. both, lastModifiedBefore and lastModifiedAfter given in Filter Criteria:   
   (lastModifiedAfter ≤ lastModifiedTime) AND (lastModifiedTime < lastModifiedBefore))

NOTE: In case 3) the Filter Criteria will only generate a match if lastModifiedAfter < lastModifiedBefore.

##### Conditions on stateTag attribute

The Filter Criteria elements stateTagSmaller and stateTagBigger define a number range which is tested against the stateTag attribute of the applicable resources.

This filter criterion shall be satisfied if any of the following three conditions is fulfilled:

1. only stateTagSmaller given in Filter Criteria:   
   stateTag < stateTagSmaller
2. only stateTagBigger given in Filter Criteria:   
   stateTagBigger ≤ stateTag
3. both, stateTagSmaller and stateTagBigger given in Filter Criteria:  
   (stateTagBigger ≤ stateTag) AND (stateTag < stateTagSmaller)

NOTE: In case 3) the Filter Criteria will only generate a match if stateTagBigger **<** stateTagSmaller

##### Conditions on expirationTime attribute

The Filter Criteria elements expireBefore and expireAfter define a time interval which is tested against the expirationTime attribute of the applicable resources.

This filter criterion shall be satisfied if any of the following three conditions is fulfilled:

1. only expireBefore given in Filter Criteria:   
   expirationTime < expireBefore
2. only expiredAfter given in Filter Criteria:   
   expireAfter ≤ expirationTime
3. both, expireBefore and expireAfter given in Filter Criteria:  
   (expireAfter ≤ expirationTime) AND (expirationTime < expireBefore)

NOTE: In case 3) the Filter Criteria will only generate a match if ***expireAfter*** < ***expireBefore***.

============ Start of 1ST Part: Test Purpose Section 7.2==========================

# 7 Test Purposes (TP)

## 7.2 Test Purposes for oneM2M

### 7.2.2 Group CSE

#### 7.2.2.5 Discovery (DIS)

Editor Note: all the uppercased italic strings denotes type of primitives defined in the oneM2M specification, for example, *FILTER\_CRITERIA\_TYPE* denotes the category of filter criteria, while the uppercased normal strings, e.g. ATTRIBUTE\_VALUE denotes the user-input value.

###### 7.2.2.5.1 Inopportune Behavioral Test Cases

|  |  |  |  |
| --- | --- | --- | --- |
| **TP Id** | | TP/oneM2M/CSE/DIS/BO/001 | |
| **Test objective** | | Check that the IUT rejects the discovery requests to theresource TARGET\_RESOURCE\_ADDRESS when AE has no privilege to perform the discovery request for the resource TARGET\_RESOURCE\_ADDRESS | |
| **Reference** | | TS-0001 [-v1.12.0] 10.2.6.2 & 7.2.3.14, TS-0004 [-v1.5.0] 7.3.3.14, REQ-0001-10160 | |
| **Config Id** | | CF01 | |
| **PICS Selection** | | PICS\_CSE | |
| **Initial conditions** | **with {**  the IUT **being** in the "initial state"  **and** the IUT **having** **registered** the AE  **and** the AE **not having** privileges to perform RETRIEVE operation on the resource  TARGET\_RESOURCE\_ADDRESS  **}** | | |
| **Expected behaviour** | **Test events** | | **Direction** |
| **when {** the IUT **receives** a valid RETRIEVE request **from** AE **containing**  To**set to** TARGET\_RESOURCE\_ADDRESS**and**  From**set to** AE\_ID**and**  FilterUsage**set to** 1 (Discovery Criteria) **and**  **no** Content attribute **}** | | IUT 🡨 AE |
| **then {**  the IUT sends a Response message **containing**  Response Status Code **set to** 4103 (ACCESS\_DENIED)  **}** | | IUT 🡪 AE |

Editor Note: Inopportune Behavior (BO) test cases test against IUT in cases of after receipt of a syntactically correct request primitives but not expected in the actual message exchange or state.

|  |  |  |  |
| --- | --- | --- | --- |
| **TP Id** | | TP/oneM2M/CSE/DIS/BO/002 | |
| **Test objective** | | Check that the IUT responds with an error when the AE sends requests to discover the resource TARGET\_RESOURCE\_ADDRESS which does not exist in the Hosting CSE | |
| **Reference** | | TS-0001 [-v1.12.0] 10.2.6.2, TS-0004 [-v1.5.0] 7.3.3.14, REQ-0001-10160 | |
| **Config Id** | | CF01 | |
| **PICS Selection** | | PICS\_CSE | |
| **Initial conditions** | **with {** the IUT **being** in the "initial state"  **and** the IUT **having registered** the AE  **and** the IUT **not having** **created** a resource TARGET\_RESOURCE\_ADDRESS  **}** | | |
| **Expected behaviour** | **Test events** | | **Direction** |
| **when {**  the IUT **receives** a valid RETRIEVE request **from** AE **containing**  To**set to** TARGET\_RESOURCE\_ADDRESS**and**  From**set to** AE\_ID**and**  FilterUsage**set to** 1 (Discovery Criteria) **and**  **no** Content attribute  **}** | | IUT 🡨 AE |
| **then {**  the IUT **sends** a Response message **containing**  Response Status Code **set to** 4004 (NOT\_FOUND)  **}** | | IUT 🡪 AE |

###### 7.2.2.5.2 Invalid Behavioral Test Case

|  |  |  |  |
| --- | --- | --- | --- |
| **TP Id** | | TP/oneM2M/CSE/DIS/BI/001 | |
| **Test objective** | | Check that the IUT responds the originator with an error when the originator sends a request including an invalid format of filter criteria to discover the resource TARGET\_RESOURCE\_ADDRESS | |
| **Reference** | | TS-0001 [-v1.12.0] 10.2.6, TS-0004 [-v1.5.0] 7.3.3.6, REQ-0001-10184, REQ-0004-07209 | |
| **Config Id** | | CF01 | |
| **PICS Selection** | | PICS\_CSE | |
| **Initial conditions** | | **with {** the IUT **being** in the "initial state"  **and** the IUT **having registered** the originator AE  **and** the IUT **having** a resource TARGET\_RESOURCE\_ADDRESS **allowing**  the AE to perform RETRIEVE operation  } | |
| **Expected behaviour** | **Test events** | | **Direction** |
| **when {**  the IUT **receives** a valid RETRIEVE request **from** AE **containing**  To**set to** TARGET\_RESOURCE\_ADDRESS **and**  From**set to** AE\_ID**and**  FilterUsage **set to** 1 (Discovery Criteria) **and**  FilterCriteria **set to** FILTER\_CRITERIA\_CONDITIONS**not being** valid format **and**  **no** Content attribute  **}** | | IUT 🡨 AE |
| **then {**  the IUT **sends** a Response message **containing**  Response Status Code **set to** 4102 (CONTENTS\_UNACCEPTABLE)  **}** | | IUT 🡪 AE |

|  |  |  |  |
| --- | --- | --- | --- |
| **TP Id** | | TP/oneM2M/CSE/DIS/BI/002 | |
| **Test objective** | | Check that the IUT responds the originator with an error when the originator sends a request to discover the resource TARGET\_RESOURCE\_ADDRESS including two conflicted filter criteria of different type FILTER\_CRITERIA\_CONDITION\_1 and FILTER\_CRITERIA\_CONDITION*\_*2 (E.G. *createBefore < createdAfter*) | |
| **Reference** | | TS-0001 [-v1.13.0] 6.2.5, TS-0004 [-v1.5.0] 7.3.3.17, REQ-0004-07241, REQ-0004-07242, REQ-0004-07243, REQ-0004-07244 | |
| **Config Id** | | CF01 | |
| **PICS Selection** | | PICS\_CSE | |
| **Initial conditions** | **with {** the IUT **being** in the "initial state"  **and** the IUT **having registered** the originator AE  **and** the IUT **having** a resource TARGET\_RESOURCE\_ADDRESS **allowing**  the AE to perform RETRIEVE operation  } | | |
| **Expected behaviour** | **Test events** | | **Direction** |
| **when {**  the IUT **receives** a valid RETRIEVE request from AE **containing**  To**set to** TARGET\_RESOURCE\_ADDRESS**and**  From**set to** AE\_ID **and**  FilterUsage **set to** 1 (Discovery Criteria) **and**  FilterCriteria **set to** FILTER\_CRITERIA\_CONDITIONS**having** conflict conditions **and**  **no** Content attribute **}** | | IUT 🡨 AE |
| **then {**  the IUT **sends** a Response message **containing**  Response Status Code **set to** 4102 (CONTENTS\_UNACCEPTABLE) **}** | | IUT 🡪 AE |

|  |  |  |  |
| --- | --- | --- | --- |
| TP ID | REQ Reference | FILTER\_CRITERIA\_  CONDITION\_1 | FILTER\_CRITERIA\_  CONDITION\_2 |
| TP/oneM2M/CSE/DIS/BI/002 -1 | REQ-0004-07241 | createdBefore | createdAfter |
| TP/oneM2M/CSE/DIS/BI/002 -2 | REQ-0004-07242 | lastModifiedBefore | lastModifiedAfter |
| TP/oneM2M/CSE/DIS/BI/002 -3 | REQ-0004-07243 | stateTagSmaller | stateTagBigger |
| TP/oneM2M/CSE/DIS/BI/002 -4 | REQ-0004-07244 | expireBefore | expireAfter |

============ End of 1ST Part: Test Purpose Section 7.2==========================