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# Introduction

At TP 41, SDS-2019-0369 was discussed regarding the next step for WI-0053 (semantic enablement) and the consensus reached was that given the maturity of technical contents in TR-0033, it is time for moving the normative contents from TR-0033 to the related TSs (i.e., TS-0001 and TS-0034).

Note that, the current content organization for semantic related topics is as follows:

* The resource definitions and the brief introductions for each of the semantic features are described in TS-0001 (clause 9.6 for resource definition and clauses 10.2.4 for briefly introducing semantic features)
* The detailed descriptions for each of semantic feature as well as corresponding resource CRUD operations are mainly described in TS-0034

According to the above organization, this contribution includes the following changes towards TS-0001 (another companion contribution SDS-2019-0461 is towards TS-0034):

* The resource definitions for the three semantic reasoning related resources, i.e., <*reasoningRules*>, <*ruleRepository*>, and <*reasoningJobInstance*> (See Change #1).
* A brief introduction is added in clause 10.2.14 for the semantic reasoning feature (See Change #2).
* Updates to resource summary table in TS-0001 due to the introduction of those three semantic reasoning related resources (Change #3)

Note that, all the changes introduced in this contribution are directly from TR-0033 without any new technical-related additions/deletions/modifications, except for necessary editorial/format changes.

R01:

1. Did some more editorial changes
2. Deleted “creator” attribute from several tables as suggested by Dale.

### -----------------------Start of change 1-------------------------------------------

### 9.6.X Resource Type *ruleRepository*

A *<ruleRepository>* resource is a child resource of the *<CSEBase>* resource. The *<ruleRepository>* resource may have one or multiple <*reasoningRules*> child resources to represent different sets of reasoning rules in the oneM2M system. A reasoning initiator can create <*reasoningJobInstance*> child resources of a *<ruleRepository>* resource to initiate desired reasoning operations.

The *<ruleRepository>* resource shall contain the child resources specified in Table 9.6.X-1 and the attributes specified in Table 9.6.X-2.

**Table 9.6.X-1: Child resources of <*ruleRepository*> resource**

| **Child Resources of *<ruleRepository>*** | **Child Resource Type** | **Multiplicity** | **Description** | **<*ruleRepositoryAnnc*> Child Resource Types** |
| --- | --- | --- | --- | --- |
| *[variable]* | *<reasoningRules>* | 0..n | <*reasoningRules*> resource for describing a set of reasoning rules. | *<reasoningRulesAnnc>* |
| *[variable]* | *<subscription>* | 0..n | See [i.3], clause 9.6.8. | *<subscription>* |
| *[variable]* | *<reasoningJobInstance>* | 0..n | <*reasoningJobInstance*> resource for describing a specific reasoning job instance. | <*reasoningJobInstanceAnnc*> |

**Table 9.6.X-2: Attributes *of <ruleRepository> resource***

| **Attribute Name****<*ruleRepository*>** | **Multiplicity** | **RW/RO/WO** | **Description** | **<*ruleRepositoryAnnc*> Attributes** |
| --- | --- | --- | --- | --- |
| *resourceName* | 1 | WO | See clause 9.6.1.3. | NA |
| *parentID* | 1 | RO | See clause 9.6.1.3. | NA |
| *expirationTime* | 1 | RW | See clause 9.6.1.3. | NA |
| *accessControlPolicyIDs* | 0..1 (L) | RW | See clause 9.6.1.3. | NA |
| *labels* | 0..1 (L) | RW | See clause 9.6.1.3. | MA |
| *creationTime* | 1 | RO | See clause 9.6.1.3. | MA |
| *lastModifiedTime* | 1 | RO | See clause 9.6.1.3. | MA |
| *announceTo* | 0..1 (L) | RW | See clause 9.6.1.3. | NA |
| *announcedAttribute* | 0..1 (L) | RW | See clause 9.6.1.3. | NA |
| *dynamicAuthorizationConsultationIDs* | 0..1 (L) | RW | See clause 9.6.1.3. | OA |
|  |  |  |  |  |

### 9.6.Y Resource Type *reasoningRules*

A <*reasoningRules*> resource can be used to store a set of related reasoning rules (e.g. for supporting a particular application). A *<reasoningRules>* resource is a child resource of the *<ruleRepository>* resource. By performing the CRUD operations on the <*reasoningRules*> resources, various reasoning rules (e.g., user-defined reasoning rules based on business logic) can be created, discovered, retrieved, updated and deleted inside the oneM2M system.

The *<reasoningRules>* resource shall contain the child resources specified in Table 9.6.Y-1 and the attributes specified in Table 9.6.Y-2.

**Table 9.6.Y-1: Child resources of *<reasoningRules>* resource**

| **Child Resources of <*reasoningRules*>** | **Child Resource Type** | **Multiplicity** | **Description** | **<*reasoningRulesAnnc*> Child Resource Types** |
| --- | --- | --- | --- | --- |
| *[variable]* | *<subscription>* | 0..n | See [1], clause 9.6.8 | *<subscription>* |

**Table 9.6.Y-2: Attributes of *<reasoningRules>* resource**

| **Attribute Name****<*reasoningRules*>** | **Multiplicity** | **RW/RO/WO** | **Description** | **<*reasoningRulesAnnc*> Attributes** |
| --- | --- | --- | --- | --- |
| *resourceName* | 1 | WO | See clause 9.6.1.3. | NA |
| *parentID* | 1 | RO | See clause 9.6.1.3. | NA |
| *expirationTime* | 1 | RW | See clause 9.6.1.3. | NA |
| *accessControlPolicyIDs* | 0..1 (L) | RW | See clause 9.6.1.3. | NA |
| *labels* | 0..1 (L) | RW | See clause 9.6.1.3. | MA |
| *creationTime* | 1 | RO | See clause 9.6.1.3. | MA |
| *lastModifiedTime* | 1 | RO | See clause 9.6.1.3. | MA |
| *announceTo* | 0..1 (L) | RW | See clause 9.6.1.3. | NA |
| *announcedAttribute* | 0..1 (L) | RW | See clause 9.6.1.3. | NA |
| *dynamicAuthorizationConsultationIDs* | 0..1 (L) | RW | See clause 9.6.1.3. | OA |
|  |  |  |  |  |
| *ontologyRef* | 1(L) | WO | A reference (URIs) of the ontologies used to represent the reasoning rules that are stored in the content attribute.  | OA |
| *ruleRepresentation* | 1 | RW | Indicates the format of the rules, e.g. Rule Interchange Format (RIF).  | OA |
| *content* | 1 | RW | Stores a set of rules.  | OA |

### 9.6.Z Resource Type *reasoningJobInstance*

A <*reasoningJobInstance*> resource represents a specific reasoning job instance for enabling the two types of reasoning operations (One type is a one-time reasoning operation and the other type is a continuous reasoning operation). A reasoning initiator such as an AE or a CSE may initiate a desired reasoning operation by creating a <*reasoningJobInstance*> resource as a child resource of a *<ruleRepository>* resource.

The *<reasoningJobInstance>* resource shall contain the child resources specified in Table 9.6.Z-1 and the attributes specified in Table 9.6.Z-2.

**Table 9.6.Z-1: Child resources of *<reasoningJobInstance>* resource**

| **Child Resources of <*reasoningJobInstance*>** | **Child Resource Type** | **Multiplicity** | **Description** | **<*reasoningJobInstance*> Child Resource Types** |
| --- | --- | --- | --- | --- |
| *[variable]* | *<subscription>* | 0..n | See clause 9.6.8 | *<subscription>* |

**Table 9.6.Z-2: Attributes of *<reasoningJobInstance>* resource**

| **Attribute Name** | **Multiplicity** | **RW/RO/WO** | **Description** | **<*reasoningJobInstance*> Attributes** |
| --- | --- | --- | --- | --- |
| *resourceName* | 1 | WO | See clause 9.6.1.3. | NA |
| *parentID* | 1 | RO | See clause 9.6.1.3. | NA |
| *expirationTime* | 1 | RW | See clause 9.6.1.3. | NA |
| *accessControlPolicyIDs* | 0..1 (L) | RW | See clause 9.6.1.3. | NA |
| *labels* | 0..1 (L) | RW | See clause 9.6.1.3. | MA |
| *creationTime* | 1 | RO | See clause 9.6.1.3. | MA |
| *lastModifiedTime* | 1 | RO | See clause 9.6.1.3. | MA |
| *announceTo* | 0..1 (L) | RW | See clause 9.6.1.3. | NA |
| *announcedAttribute* | 0..1 (L) | RW | See clause 9.6.1.3. | NA |
| *dynamicAuthorizationConsultationIDs* | 0..1 (L) | RW | See clause 9.6.1.3. | OA |
|  |  |  |  |  |
| *reasoningType* | 1 | WO | The type of the reasoning job represented by this resource.The supported values of this attribute include:* “one-time”
* “continuous”
 | OA |
| *mode* | 0..1 | WO | The supported values of this attribute include:* “Periodic” - the reasoning job represented by this resource is executed periodically.
* “When the invovled FS/RS changes” - if the *factSet* and/or *ruleSet* attributes change, the reasoning job represented by this resource is executed.

This attribute is present only when the value of *reasoningType* is set to “continuous”. | OA |
| *period* | 0..1 | RW | The time period for executing the reasoning job represented by this resource. For example, every two hours.This attribute is present only when the value of *mode* is present and set to “Periodic”. | OA |
| *factSet* | 1 (L) | RW | A list of URIs of the resources that store the facts used by this reasoning job.  | OA |
| *ruleSet* | 1 (L) | RW | A list of URIs of resources that store the reasoning rules used by this reasoning job.  | OA |
| *result* | 1 | RO | The latest reasoning result produced by this reasoning job. | OA |
| *resultRepresentation* | 1 | RW | Indicates the type of serialization of the *result* attribute, e.g. RDF/XML, OWL/XML. | OA |

### -----------------------End of change 1-------------------------------------------

### -----------------------Start of change 2-------------------------------------------

### 10.2.14 Semantics management

Semantics management is performed for the purpose of leveraging CRUD operations on semantic-related resources to enable semantic functionalities in service layer (e.g. enhancing the meaning of resources and data in the system).

Table 10.2.14-1 summarizes the specialized resource types defined for the purpose of providing semantic enablement, providing references to the resource type definition clause. The table also provides references to the corresponding CRUD procedures.

**Table 10.2.14 -1: Specialized resource types for semantic management**

|  |  |  |  |
| --- | --- | --- | --- |
| ***Resource type*** | ***Description*** | ***Resource Type Reference*** | ***CRUD procedures*** |
| *<semanticDescriptor>* | Resource type used for annotating resources with semantic descriptions, providing the means for resource discovery in a semantically- aware fashion and for semantic queries | 9.6.30 | [14] Clause 6.1 |
| *<semanticFanOutPoint>* | Virtual resource type used to form an overall graph based on the content of the semantic descriptors associated with the members of the group, for the purpose of performing semantic resource discovery and semantic query | 9.6.14a | [14] Clause 6.2 |
| *<semanticMashupJobProfile>* | Resource type describing the profile and necessary information (e.g. input parameters, member resources, mashup function, output parameters) required for a specific mashup service. | 9.6.53 | [14] Clause 6.3 |
| *<semanticMashupInstance>* | Resource type describing a mashup instance based on mashup request and implementing the semantic mashup function. Each instance corresponds to a semantic mashup job profile . | 9.6.54 | [14] Clause 6.4 |
| *<mashup>* | Virtual resource type used for triggering a calculation and generation of the mashup result based on its parent resource. | 9.6.55 | [14] Clause 6.5 |
| *<semanticMashupResult>* | Resource type storing the result generated when it executes a semantic mashup operation | 9.6.56 | [14] Clause 6.6 |
| *<ontology>* | Resource type storing the representation of an ontology | 9.6.51 | [14] Clause 6.8 |
| *<ontologyRepository>* | Resource type for storage of all ontology representations | 9.6.50 | [14] Clause 6.7 |
| *<semanticValidation>* | Virtua resource type used to trigger validation of semantic content | 9.6.52 | [14] Clause 6.9 |
| *<ruleRepository>* | Resource type for storage of different reasoning rule sets.  | 9.6.X | [14] Clause 6.X |
| *<reasoningRules>* | Resource type for storage of a particular set of reasoning rules.  | 9.6.Y | [14] Clause 6.Y |
| *<reasoningJobInstance>* | Resource type for describing a reasoning job instance.  | 9.6.Z | [14] Clause 6.Z |

Table 10.2.14-2 summarizes the specialized procedures defined for the purpose of providing semantic enablement, providing references to the TS-0034 [14] clauses where the detail procedural descriptions are provided.

**Table 10.2.14-2: Specialized procedures and functions for semantic management**

|  |  |  |
| --- | --- | --- |
| ***Procedure*** | ***Description*** | ***Reference*** |
| Access Control for Semantic Content | Functionality enabling the use of access control information applicable to resources for accessing RDF triple content when executing semantic operations. | [14] Clause 7.2 |
| Semantics Annotation | Functionality for providing semantic description for resources and content | [14] Clause 7.3 |
| Semantic Filtering and Discovery | Procedures for the discovery of resources and semantic information, respectively, based on the semantic annotation. | [14] Clause 7.4 |
| Semantics Mash-up | Procedures enabling the creation, execution and result retrieval of functions based on semantic mashup. | [14] Clause 7.7 |
| Semantic Query | Procedures for directly retrieving both explicitly and implicitly derived information based on syntactic, semantic and structural information contained in semantic content data (such as RDF triples). The result of a semantic query is the semantic information/knowledge for answering/matching the query. | [14] Clause 7.5 |
| Semantic Validation | Procedures enabling the validation of semantic content. | [14] Clause 7.10 |
| Ontology Management | Procedures enabling the use and management of ontologies. | [14] Clause 7.9 |
| Semantic Reasoning | Procedures enabling semantic reasoning-related functionalities. | [14] Clause 7.11 |

### -----------------------End of change 2-------------------------------------------

### -----------------------End of change 3-------------------------------------------

#### Resource Type Summary

Table 9.6.1.1-1 introduces the normal and virtual resource types and their related child or parent resource types. Details of each resource type follow in the remainder of this clause.

Table 9.6.1.1-1 lists each specified ordinary – i.e. not announced – resource type. An addition of suffix "Annc" to the respective resource type identifier indicates the associated announced resource type. Resource types that can occur as child resources of announced resources are summarized in Table 9.6.26.1-1 "Announced Resource Types".

Among the resource types listed in Table 9.6.1.1-1, the following are termed "Content Sharing Resources" in oneM2M Specifications for the purpose of referring to any of those resource types:

* *container;*
* *contentInstance;*
* *flexContainer;*
* *timeSeries;*
* *timeSeriesInstance.*

Table 9.6.1.1-1: Resource Types

| Resource Type | Short Description | Child Resource Types | Parent Resource Types | Clause |
| --- | --- | --- | --- | --- |
| *accessControlPolicy* | Stores a representation of privileges. It is associated with resources that shall be accessible to entities external to the Hosting CSE. It controls "who" is allowed to do "what" and the context in which it can be used for accessing resources | *subscription, transaction* | *AE, AEAnnc, remoteCSE, remoteCSEAnnc, CSEBase* | 9.6.2 |
| *AE* | Stores information about the AE. It is created as a result of successful registration of an AE with the Registrar CSE | *subscription, container,* *flexContainer,**group, accessControlPolicy,* *pollingChannel, semanticDescriptor,**timeSeries, transaction, transactionMgmt,**triggerRequest, crossResourceSubscription, backgroundDataTransfer, semanticMashupInstance, locationPolicy, action* | *CSEBase* | 9.6.5 |
| *container* | Shares data instances among entities. Used as a mediator that buffers data exchanged between AEs and/or CSEs. The exchange of data between AEs (e.g. an AE on a Node in a field domain and the peer-AE on the infrastructure domain) is abstracted from the need to set up direct connections and allows for scenarios where both entities in the exchange do not have the same reachability schedule | *container,* *flexContainer, contentInstance, subscription, latest, oldest，semanticDescriptor, timeSeries, transaction, action* | *AE, AEAnnc, container, containerAnnc, remoteCSE, remoteCSEAnnc,* *CSEBase,**flexContainer, flexContainerAnnc* | 9.6.6 |
| *contentInstance* | Represents a data instance in the *<container>* resource | *semanticDescriptor, transaction* | *Container, containerAnnc* | 9.6.7 |
| *flexContainer* | A template which allows to define specialized (customizable) versions of containers with a flexible and lightweight structure  | *container,* *flexContainer, subscription, semanticDescriptor, timeSeries, transaction, action* | *AE, AEAnnc, container, containerAnnc,* *flexContainer, flexContainerAnnc, remoteCSE, remoteCSEAnnc,* *CSEBase* | 9.6.35 |
| *CSEBase* | The structural root for all the resources that are residing on a CSE. Stores information about the CSE itself | *remoteCSE, remoteCSEAnnc, node, AE, container, group, accessControlPolicy, subscription, mgmtCmd, locationPolicy, statsConfig, statsCollect, request, delivery,**schedule,**notificationTargetPolicy, ruleRepository**flexContainer,**timeSeries, AEContactList, transaction, transactionMgmt, crossResourceSubscription, backgroundDataTransfer, semanticMashupJobProfile, semanticMashupInstance, action* | *None specified* | 9.6.3 |
| *delivery* | Forwards requests from CSE to CSE | *subscription, transaction* | *CSEBase* | 9.6.11 |
| *eventConfig* | Defines events that trigger statistics collection | *subscription, transaction* | *statsConfig* | 9.6.24 |
| *execInstance* | Contains all execution instances of the same Management Command | *subscription, transaction* | *mgmtCmd* | 9.6.17 |
| *fanOutPoint (V)* | Virtual resource containing target for group requestIt is used for addressing bulk operations to all the resources that belong to a group | *None specified* | *group* | 9.6.14 |
| *group* | Stores information about resources of the same type that need to be addressed as a Group. Operations addressed to a Group resource shall be executed in a bulk mode for all members belonging to the Group | *fanOutPoint,**subscription,**semanticFanOutPoint, semanticDescriptor, transaction, action* | *AE, AEAnnc, remoteCSE, remoteCSEAnnc, CSEBase* | 9.6.13 |
| *latest (V)* | Virtual resource that points to most recently created *<contentInstance>* and <*timeSeriesInstance*> child resource within a *<container>* *and a <timeSeries>* resource | *None specified* | *container, timeSeries* | 9.6.27 |
| *locationPolicy* | Includes information to obtain and manage geographical location. It is only referenced within a container, the *contentInstances* of the container provide location information | *subscription, transaction* | *CSEBase, AE* | 9.6.10 |
| *mgmtCmd* | Management Command resource represents a method to execute management procedures required by existing management protocols | *execInstance,**subscription, transaction* | *CSEBase* | 9.6.16 |
| *mgmtObj* | Management Object resource represents management functions that provides an abstraction to be mapped to external management technology. It represents the node and the software installed in the node (see note) | *subscription, transaction, semanticDescriptor* | *node, mgmtObjAnnc* | 9.6.15Annex D |
| *m2mServiceSubscriptionProfile* | Data pertaining to the M2M Service Subscription | *serviceSubscribedNode,**subscription, transaction* | *CSEBase*  | 9.6.19 |
| *node* | Represents specific Node information | *mgmtObj,* *subscription, semanticDescriptor, schedule, transaction, action* | *CSEBase* | 9.6.18 |
| *notificationTargetMgmtPolicyRef* | Represents a list of notification targets and the deletion policy | *subscription, transaction* | *subscription* | 9.6.31 |
| *notificationTargetPolicy* | Represents a notification target deletion policy with pre-defined action and deletion rules | *subscription, policyDeletionRules, transaction* | *CSEBase* | 9.6.32 |
| *notificationTargetSelfReference (V)* | Virtual resource used to remove the Notification Target | *None specified* | *subscription* | 9.6.34 |
| *oldest (V)* | Virtual resource that points to first created *<contentInstance>* and <*timeSeriesInstance*> child resource within a *<container>* *and a <timeSeries>* resource | *None specified* | *container, timeSeries* | 9.6.28 |
| *pollingChannel* | Represent a channel that can be used for a request-unreachable entity | *pollingChannelURI* | *remoteCSE, AE* | 9.6.21 |
| *pollingChannelURI (V)* | Virtual resource used to perform service layer long polling of a resource Hosting CSE by a request-unreachable entity | *None specified* | *pollingChannel* | 9.6.22 |
| *policyDeletionRules* | Represents a set of rules which is associated with notification target removal policy | *subscription, transaction* | *notificationTargetPolicy* | 9.6.33 |
| *remoteCSE* | Represents a remote CSE for which there has been a registration procedure with the registrar CSE identified by the CSEBase resource | *container, containerAnnc,**contentInstanceAnnc* *flexContainer, flexContainerAnnc,**group, groupAnnc, accessControlPolicy, accessControlPolicyAnnc, subscription, pollingChannel,* *timeSeries,**timeSeriesAnnc, timeSeriesInstanceAnnc,**mgmtObjAnnc,**nodeAnnc,**AEAnnc,**locationPolicyAnnc, transaction, crossResourceSubscription, backgroundDataTransfer, semanticMashupJobProfile, semanticMashupJobProfileAnnc, semanticMashupInstance,**semanticMashupInstanceAnnc,* *action* | *CSEBase* | 9.6.4 |
| *request* | Expresses/access context of an issued Request | *subscription, transaction* | *CSEBase* | 9.6.12 |
| *schedule* | Contains scheduling information for delivery of messages | *subscription, transaction* | *subscription, CSEBase,* * *node*
 | 9.6.9 |
| *serviceSubscribedNode* | Node information | *subscription, transaction* | *m2mServiceSubscriptionProfile* | 9.6.20 |
| *statsCollect* | Defines triggers for the IN-CSE to collect statistics for applications | *subscription, transaction* | *CSEBase (in IN‑CSE)* | 9.6.25 |
| *statsConfig* | Stores configuration of statistics for applications | *eventConfig,**subscription, transaction* | *CSEBase (in IN‑CSE)* | 9.6.23 |
| *subscription* | Subscription resource represents the subscription information related to a resource. Such a resource shall be a child resource for the subscribed-to resource | *schedule, notificationTargetSelfReference, notificationTargetMgmtPolicyRef, transaction* | *accessControlPolicy, accessControlPolicyAnnc, AE, AEAnnc, container, containerAnnc, CSEBase, delivery, eventConfig, execInstance, group, groupAnnc, locationPolicy, locationPolicyAnnc, mgmtCmd, mgmtObj, mgmtObjAnnc, m2mServiceSubscriptionProfile, node, nodeAnnc, serviceSubscribedNode, remoteCSE, remoteCSEAnnc, request, schedule, scheduleAnnc,**semanticDescriptor, semanticDescriptorAnnc, statsCollect, statsConfig,**flexContainer, flexContainerAnnc,**timeSeries, timeSeriesAnnc, ruleRepository, reasoningRules, reasoningJobInstance* | 9.6.8 |
| *serviceSubscribedAppRule* | Represents a rule that defines allowed App-ID and AE-ID combinations that are acceptable for registering an AE on a Registrar CSE | *subscription, transaction* | *CSEBase* | 9.6.29 |
| *semanticDescriptor* | Stores semantic description pertaining to a resource and potentially sub-resources. | *subscription, transaction* | *AE, container, contentInstance, group, node, flexContainer, timeSeries, mgmtObj* | 9.6.30 |
| *semanticFanOutPoint* | Virtual resource used as target for semantic discovery aimed at a logical graph distributed over multiple *semanticDescriptor* resources, which belong to the corresponding *group* parent resource | *transaction* | *group* | 9.6.14a |
| *dynamicAuthorizationConsultation* | Represents consultation information used by a CSE when performing consultation-based dynamic authorization |  *transaction* | *AE, AEAnnc, remoteCSE, remoteCSEAnnc, CSEBase* | 9.6.40 |
| *timeSeries* | Stores and Shares Time Series Data instances among entities. | *timeSeriesInstance, subscription, semanticDescriptor,**latest, oldest, transaction, action* | *AE, AEAnnc, remoteCSE, remoteCSEAnnc, CSEBase,**container, containerAnnc, flexContainer, flexContainerAnnc* | 9.6.36 |
| *timeSeriesInstance* | Represents a Time Series Data instance in the *<timeSeries>* resource |  *transaction* | *timeSeries, timeSeriesAnnc* | 9.6.37 |
| *authorizationDecision* | Represents an access control decision point | *subscription, transaction* | *CSEBase* | 9.6.41 |
| *authorizationPolicy* | Represents an access control policy retrieval point | *subscription, transaction* | *CSEBase* | 9.6.42 |
| *authorizationInformation* | Represents an access control information point | *role**token**subscription, transaction* | *CSEBase* | 9.6.43 |
| *localMulticastGroup* | Stores local multicast group information of member hosting CSE. |  *transaction* | *CSEBase* | 9.6.44 |
| *AEContactList* | Contains information about a CSE that has resources that referencing an AE-ID | *AEContactListPerCSE, subscription, transaction* | *CSEBase* | 9.6.45 |
| *AEContactListPerCSE* | Contains information about a CSE that has resources that referencing an AE resource identifier for tracking purposes | *None specified* | *AEContactList* | 9.6.46 |
| *transactionMgmt* |  | *subscription* | *CSEBase, AE, remoteCSE* | 9.6.47 |
| *transaction* |  | *action* | *All non-virtual resource types with the exception of the following:**request, delivery, pollingChannel, transactionMgmt, transaction* | 9.6.48 |
| *triggerRequest* | Used by an AE to initiate, replace or recall a device trigger request  | *subscription* | *AE* | 9.6.49 |
| *ontologyRepository* | Represents the collection of the managed ontologies and the semantic validation service | *ontology, semanticValidation, subscription* | *CSEBase* | 9.6.50 |
| *ontology* | Store the representation of an ontology | *subscription* | *ontologyRepository* | 9.6.51 |
| *semanticValidation* | A virtual resource as the interface to perform semantic validation on the received <semanticDescriptor> resource against the referenced ontology. | *None specified* | *ontologyRepository* | 9.6.52 |
| *semanticMashupJobProfile* | Represents the profile and description of a semantic mashup service | *semanticMashupInstance, semanticDescriptor, subscription* | *CSEBase, remoteCSE* | 9.6.53 |
| *semanitcMashupInstance* | Represents a semantic mashup instance | *semanticMashupResult, semanticDescriptor, mashup, subscription* | *semanticMashupJobProfile, AE, remoteCSE, CSEBase* | 9.6.54 |
| *mashup* | A virtual resource use to trigger the calculation and generation of new mashup result | *Not specified* | *semanticMashupInstance* | 9.6.55 |
| *semanticMashupResult* | Represent semantic mashup results | *semanticDescriptor, subscription* | *semanticMashupInstance* | 9.6.56 |
| *multimediaSession* | Stores a representation of a multimedia session information requested by a registering AE | *subscription*  | *AE* | 9.6.57 |
| *crossResourceSubscription* | represents the cross-resource subscription information related to multiple subscribed-to resources. Such a resource shall include a list of subscribed-to resources as its attribute, or shall be created as a child resource of a <group> resource where member resources shall be the subscribed-to resources.  | *schedule, notificationTargetSelfReference, notificationTargetMgmtPolicyRef, transaction*  | *CSEBase, remoteCSE, AE* | 9.6.58 |
| *backgroundDataTransfer* | Stores information for a background data transfer request | *None specified* | *AE, remoteCSE, CSEBase* | 9.6.60 |
| *action* | Specifies the action(s) that is performed whenever an event is triggered at the <*dependency>* resource | *dependency* | *CSEBase, remoteCSE, node, AE, container, flexContainer, group, timeSeries, transaction* | 9.6.61 |
| *dependency* | Specifies the condition(s) of a monitored event which triggers the operation(s) specified by the <*action>* resource | *None specified* | *action* | 9.6.62 |
| *e2eQosSession* | Specifiesed the end-to-end (E2E) QoS session requirements for the exchange of oneM2M request and response primitives between oneM2M entities. | *subscription*  | *CSEBase, remoteCSE, AE* | 9.6.63 |
| *ruleRepository* | Specifies one or multiple <*reasoningRules*> child resources to represent different sets of reasoning rules in the oneM2M system | *reasoningRules, reasoningJobInstance* | *CSEBase* | 9.6.X |
| *reasoningRules* | Store a set of related reasoning rules | *subscription* | *ruleRepository* | 9.6.Y |
| *reasoningJobInstance* | Represents a specific reasoning job instance for enabling one-time or continuous reasoning operations. | *subscription* | *ruleRepository* | 9.6.Z |
| NOTE: See clause 9.6.12 for a summary of specializations of *<mgmtObj>.* |

### -----------------------End of change 3-------------------------------------------