|  |  |
| --- | --- |
| CHANGE REQUEST | |
| Meeting ID:\* | SDS #44.2 |
| Source:\* | Xu Li, Convida, [li.xu@convidawireless.com](mailto:li.xu@convidawireless.com)  Dale Seed, Convida, [seed.dale @convidawireless.com](mailto:wang.chonggang@convidawireless.com) |
| Date:\* | 2020-03-16 |
| Reason for Change/s:\* | Do some maintenances and bug fixes for ontology mapping and semantic reasoning related resources. |
| CR against: Release\* | Release 4 |
| CR against: WI\* | Active <WI-0053>  MNT maintenance / < Work Item number(optional)>  Is this a mirror CR? Yes  No  mirror CR number: (Note to Rapporteur - use latest agreed revision)  STE Small Technical Enhancements / < Work Item number (optional)>  Only ONE of the above shall be ticked |
| CR against: TS/TR\* | TS-0001 V4.4.0 |
| Clauses \* |  |
| Type of change: \* | Editorial change  Bug Fix or Correction  Change to existing feature or functionality  New feature or functionality  Only ONE of the above shall be ticked |
| Impacted other TS/TR(s) | N/A |
| Post Freeze checking:\* | This CR contains only essential changes and corrections? YES  NO  This CR may break backwards compatibility with the last approved version of the TS? YES  NO |
| Template Version: January 2017 (Do not modify) | |

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# Introduction

This CR did several maintenances for the ontology mapping related resources:

1. Adds missing rows to Table 9.6.1.1-1 of TS-0001 for the <ontologyMapping>, <ontologyMappingAlgorithm> and <ontologyMappingAlgorithmRepository> resources.
2. Table 9.6.50-1 is updated to add <ontologyMapping> and <ontologyMappingAlogrithmRepository> as a child resource of <ontologyRepository>.

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

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, multimediaSession, dynamicAuthorizationConsultation, nwMonitoringReq, timeSyncBeacon, primitiveProfile* | *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, flexContainerInstance, latest, oldest, subscription, semanticDescriptor, timeSeries, transaction, action* | *AE, AEAnnc, container, containerAnnc,*  *flexContainer, flexContainerAnnc, remoteCSE, remoteCSEAnnc,*  *CSEBase* | 9.6.35 |
| *flexContainerInstance* | Represents a timestamped Data instance in the *<flexContainer>* resource | *transaction, semanticDescriptor* | *flexContainer* | 9.6.59 |
| *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, semanticRuleRepository,*  *flexContainer,*  *timeSeries, AEContactList, transaction, transactionMgmt, crossResourceSubscription, backgroundDataTransfer, semanticMashupJobProfile, semanticMashupInstance, action, m2mServiceSubscriptionProfile, dynamicAuthorizationConsultation, localMulticastGroup, serviceSubscribedAppRule, authorizationPolicy, authorizationDecision, authorizationInformation, ontologyRepository, nwMonitoringReq, timeSyncBeacon, primitiveProfile* | *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 request  It 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>* , <*timeSeriesInstance*> or <flexContainerInstance> child resource within a *<container>,*  *<timeSeries> or <flexContainer>* resource | *None specified* | *container, timeSeries, or flexContainer* | 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* | 9.6.15  Annex D |
| *m2mServiceSubscriptionProfile* | Data pertaining to the M2M Service Subscription | *serviceSubscribedNode,*  *subscription, transaction, serviceSubscribedUserProfile* | *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>*, <*timeSeriesInstance*> or *<flexContainerInstance>* child resource within a *<container>, <timeSeries> or <flexContainer>* resource | *None specified* | *container, timeSeries, or flexContainer* | 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, dynamicAuthorizationConsultation, dynamicAuthorizationConsultationAnnc, nwMonitoringReq, timeSyncBeacon, primitiveProfile* | *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, nwMonitoringReq, semanticRuleRepository, reasoningRules, reasoningJobInstance, timeSyncBeacon, primitiveProfile* | 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 |  | *group* | 9.6.14a |
| *dynamicAuthorizationConsultation* | Represents consultation information used by a CSE when performing consultation-based dynamic authorization | *subscription, 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 |
| *role* | Represents a role that is assigned to an AE or CSE. | *subscription, transaction* | *authorizationInformation* | 9.6.38 |
| *token* | Used for storing a token that is issued to an AE or CSE. | *subscription, transaction* | *authorizationInformation* | 9.6.39 |
| *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, timeSyncBeacon* | 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, ontologyMapping, ontologyMappingAlgorithmRepository* | *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 |
| *ontologyMapping* | Represents a mapping operation between two different ontologies. | *subscription* | *ontologyRepository* | 9.6.70 |
| *ontologyMappingAlgorithmRepository* | Represents the collection of ontology mapping algorithms. | *subscription, ontologyMappingAlogrithm* | *ontologyRepository* | 9.6.71 |
| *ontologyMappingAlogrithm* | Represents an ontology mapping algorithm | *None specified* | *ontologyMappingAlgorithmRepository* | 9.6.72 |
| *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* | Specifies 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 |
| *nwMonitoringReq* | Specifiesed the request that an AE retrieves the Underlying Network information. The resource provides the characteristics of the Underlying Network status in a particular geographic area such as congestion status and number of devices. | *subscription* | *CSEBase, remoteCSE, AE* | 9.6.64 |
| *semanticRuleRepository* | Specifies one or multiple <reasoningRules> child resources to represent different sets of reasoning rules in the oneM2M system | *reasoningRules, reasoningJobInstance* | *CSEBase* | 9.6.65 |
| *reasoningRules* | Store a set of related reasoning rules | *subscription* | *semanticRuleRepository* | 9.6.66 |
| *reasoningJobInstance* | Represents a specific reasoning job instance for enabling one-time or continuous reasoning operations. | *subscription* | *semanticRuleRepository* | 9.6.67 |
| *serviceSubscribedUserProfile* | Stores user profile information for a given M2M Service User | *subscription, transaction* | *m2mServiceSubscriptionProfile* | 9.6.68 |
| *timeSyncBeacon* | Specifies criteria that a Hosting CSE uses to generate time synchronization beacon notifications | *subscription,*  *transaction* | *CSEBase, remoteCSE, AE* | 9.6.69 |
| *primitiveProfile* | Stores message parameters and/or resource attributes that can be applied (i.e. added, removed or modified) to a request or a response primitive. | *subscription, transaction* | *CSEBase, remoteCSE, AE* | 9.6.73 |
| NOTE: See clause 9.6.12 for a summary of specializations of *<mgmtObj>.* | | | | |

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

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

### 9.6.50 Resource Type *ontologyRepository*

An *<ontologyRepository>* resource is a child resource of the *<CSEBase>* resource.

The *<ontologyRepository>* resource may have one or multiple <*ontology*> child resources to represent and manage both internal and external ontologies in the oneM2M system. By performing the CRUD operations on the <*ontology*> resources, explicit ontologies can be imported (created), discovered, retrieved, updated and deleted inside the oneM2M system, and can be used for semantic validation when they are referenced by <*semanticDescriptor*> resources. The details of <*ontology*> resource are specified in clause 9.6.51.

The *<ontologyRepository>* resource may also contain a (virtual) child resource *<semanticValidation>* as the interface to accept semantic validation request from an AE or a CSE. Upon receiving an Update request with *<semanticDescriptor>* resource representation addressing the *<semanticValidation>* resource, the hosting CSE shall perform the semantic validation against the *<semanticDescriptor>* resource received in the request. The details of <*semanticValidation*> resource are specified in clause 9.6.52.

The *<ontologyRepository>* resource shall contain the child resources as specified in table 9.6.50-1.

**Table 9.6.50-1: Child resources of *<ontologyRepository>* resource**

| **Child Resources of *<ontologyRepository>*** | **Child Resource Type** | **Multiplicity** | **Description** | **<*ontologyRepositoryAnnc*> Child Resource Types** |
| --- | --- | --- | --- | --- |
| *[variable]* | *<ontology>* | 0..n | See clause 9.6.51 | *<ontologyAnnc>* |
| *smv* | *<semanticValidation>* | 1 | See clause 9.6.52 | *None* |
| *[variable]* | *<subscription>* | 0..n | See clause 9.6.8 | *<subscription>* |
| *[variable]* | *<ontologyMapping>* | 0..n | See clause 9.6.70 | *<ontologyMappingAnnc>* |
| *[variable]* | *<ontologyMappingAlogrithmRepository>* | 0..n | See clause 9.6.71 | *< ontologyMappingAlogrithmRepositoryAnnc>* |

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

## ----------------------- Start of change 3 -----------------------

### Resource Type *CSEBase*

A *<CSEBase>* resource shall represent a CSE. The *<CSEBase>* resource shall be the root for all resources that are residing in the CSE. A CSE shall be represented by only one *<CSEBase>* resource.

The *<CSEBase>* resource shall contain the child resources specified in table 9.6.3-1.

Table 9.6.3-1: Child resources of *<CSEBase>* resource

|  |  |  |  |
| --- | --- | --- | --- |
| Child Resources of *<CSEBase>* | Child Resource Type | Multiplicity | Description |
| *[variable]* | *<remoteCSE>* | 0..n | See clause 9.6.4 |
| *[variable]* | *<remoteCSEAnnc>* | 0..n | Announced variant of <*remoteCSE>*. Resourcewith CSE-specific information for a CSE that announced itself to another CSE with which it does not have a registration relationship. |
| *[variable]* | *<node>* | 0..n | See clause 9.6.18 |
| *[variable]* | *<AE>* | 0..n | See clause 9.6.5 |
| *[variable]* | *<container>* | 0..n | See clause 9.6.6 |
| *[variable]* | *<flexContainer>* | 0..n | See clause 9.6.35 |
| *[variable]* | *<group>* | 0..n | See clause 9.6.13 |
| *[variable]* | *<accessControlPolicy>* | 0..n | See clause 9.6.2 |
| *[variable]* | *<subscription>* | 0..n | See clause 9.6.8 |
| *[variable]* | *<mgmtCmd>* | 0..n | See clause 9.6.16 |
| *[variable]* | *<locationPolicy>* | 0..n | See clause 9.6.10 |
| *[variable]* | *<statsConfig>* | 0..n | See clause 9.6.23 |
| *[variable]* | *<statsCollect>* | 0..n | See clause 9.6.25 |
| *[variable]* | *<request>* | 0..n | See clause 9.6.12 |
| *[variable]* | *<delivery>* | 0..n | See clause 9.6.11 |
| *[variable]* | *<schedule>* | 0..1 | This resource defines the reachability schedule information of the entity. The absence of this resource implies the entity is always reachable. See clause 9.6.9 |
| *[variable]* | *<role>* | 0..n | See clause 9.6.38 |
| *[variable]* | *<token>* | 0..n | See clause 9.6.39 |
| *[variable]* | *<m2mServiceSubscriptionProfile>* | 0..n | See clause 9.6.19 |
| *[variable]* | *<serviceSubscribedAppRule>* | 0..n | See clause 9.6.29 |
| *[variable]* | *<notificationTargetPolicy>* | 0..n | See clause 9.6.32 |
| *[variable]* | *<dynamicAuthorizationConsultation>* | 0..n | See clause 9.6.40 |
| *[variable]* | *<timeSeries>* | 0..n | See clause 9.6.36 |
| *[variable]* | *<authorizationDecision>* | 0..n | See clause 9.6.41 |
| *[variable]* | *<authorizationPolicy>* | 0..n | See clause 9.6.42 |
| *[variable]* | *<authorizationInformation>* | 0..n | See clause 9.6.43 |
| *[variable]* | *<localMulticastGroup>* | 0..n | See clause 9.6.44 |
| *[variable]* | *<transactionMgmt>* | 0..n | See clause 9.6.47 |
| *[variable]* | *<transaction>* | 0..n | See clause 9.6.48 |
| *[variable]* | *<ontologyRepository>* | 0..1 | See clause 9.6.50 |
|  |  |  |  |
|  |  |  |  |
| *[variable]* | *<semanticMashupJobProfile>* | 0..n | See clause 9.6.53 |
| *[variable]* | *<semanticMashupInstance>* | 0..n | See clause 9.6.54 |
| *[variable]* | *<AEContactList>* | 0..n | See clause 9.6.45 |
| *[variable]* | *<e2eQosSession>* | 0..1 | See clause 9.6.63 |
| *[variable]* | *<nwMonitoringReq>* | 0..n | See clause 9.6.64 |
| *[variable]* | *<semanticRuleRepository>* | 0..1 | See clause 9.6.65 |

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