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MEF 60

Network Resource Provisioning Interface Profile Specification

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1 List of Contributing Members

The following Member companies of the MEF participated in the development of this document and have requested to be included in this list.

Amartus	Huawei Technologies
CenturyLink	Infinera Corporation
Ciena Corporation	Iometrix
Cisco Systems	NEC Corporation
Coriant	Nokia
Ericsson	RAD Data Communications

Table 1-Contributing Members

2 Abstract

This Interface Profile Specification defines the Presto Management Interface for the network control and management domain in support of [MEF 6.2] and [MEF 51] Services and is a specialization of relevant classes from the MEF NRM (Network Resource Model). The Presto NRP (Network Resource Provisioning) Interface is for use by a Service Orchestration Functionality (SOF) as described in [MEF 55] and in support of processes for Service Configuration and Activation [MEF 56] at the network resource layer.

The Presto NRP requests ICM to create connectivity or functionality associated with specific Service Components of an end-to-end Connectivity Service within the domain managed by each ICM. Presto may also allow the ICM to describe Resources and capabilities it can instantiate.

This document normatively includes the content of the following files as if they were contained within this document:

- NRP_Interface.di
- NRP_Interface.notation
- NRP_Interface.uml

These files are available in the Technical Specifications area of MEF.net alongside this specification.

3 Terminology and Acronyms

This section defines the terms used in this document. In many cases, the normative definitions to terms are found in other documents. In these cases, the third column is used to provide the reference that is controlling, in other MEF or external documents.

Term	Definition	Reference
Access	Connectivity Service supporting connecting one or more UNIs to one or more ENNIs within context of single ICM.	This document
Application Programming Interface (API)	In the context of LSO, API describes one of the Management Interface Reference Points based on the requirements specified in an Interface Profile, along with a data model, the protocol that defines operations on the data and the encoding format used to encode data according to the data model.	[MEF55]
Bandwidth Profile	A hierarchical model for bandwidth sharing within a defined envelope.	[MEF 10.3]
Carrier Ethernet Network (CEN)	A network from a Service Provider or network operator supporting the MEF service and architecture models.	[MEF 12.2]
Connection	Represents an enabled (provisioned) potential for forwarding (including all circuit and packet forms) between two or more NodeEdgePoints of a Node.	[ONF TR-527]
ConnectionEndPoint (CEP)	Represents the ingress/egress port aspects that access the forwarding function provided by the Connection.	[ONF TR-527]
ConnectivityService (CS)	Represents an "intent-like" request for connectivity between two or more ServiceEndPoints. As such, ConnectivityService is a container for connectivity request details and is distinct from the Connection that realizes the request. NOTE: ConnectivityService is a Network Resource Layer ONF TAPI construct that is mapped from MEF EVC by the SOF (or a like client).	[ONF TR-527]
ConnectivityServiceEndPoint (CSEP)	Represents the ingress/egress port aspects that access the forwarding function provided by the Connection. The ConnectionEndPoints have a client-server relationship with the NodeEdgePoints. NOTE: ConnectivityServiceEndPoint is a Network Resource Layer ONF TAPI construct that is mapped from MEF EVC End Point by the SOF (or a like client).	[ONF TR-527]
Context (API Context)	Defines the scope of control, interaction and naming that a particular ONF TAPI provider or client application has with respect to the information exchanged over the interface.	[ONF TR-527]

Term	Definition	Reference
Edge	Connectivity Service supporting connecting one or more UNIs with one or more INNIs in context of a single ICM.	This document
End-to-End	Connectivity Service supporting connecting two or more UNIs within context of a single ICM.	This document
Hypertext Transfer Protocol (HTTP)	A stateless application-level protocol for distributed, collaborative, hypertext information systems.	[IETF RFC 7230]
I-Access	Connectivity Service supporting connecting one or more INNIs and one or more ENNIs in context of a single ICM.	This document
Information Model	An information model is a representation of concepts of interest to an environment in a form that is independent of data repository, data definition language, query language, implementation language, and protocol. The MEF uses UML Class Diagrams to represent objects and relationships of interest to the managed environment.	[MCM]
Infrastructure Control and Management Domain (ICM Domain)	The set of functionality providing domain specific network and topology view resource management capabilities including configuration, control and supervision of the network infrastructure.	[MEF 55]
Interface Profile	Defines the structure, behavior and semantics supporting a specific Management Interface Reference Point identified in the LSO Reference Architecture. The Interface Profile specification contains all the necessary information to implement the related API, including objects, attributes, operations, notifications and parameters.	[MEF 55]
Internal Network-to-Network Interface (INNI)	A reference point representing the boundary between two Infrastructure Control and Management domains that partition an administrative domain.	[MEF 4]
I-Transit	Connectivity Service supporting connecting two or more INNIs in context of a single ICM.	This document
JavaScript Object Notation (JSON)	A text format that facilitates structured data interchange between all programming languages	[ECMA-404]
Lifecycle Service Orchestration (LSO)	Open and interoperable automation of management operations over the entire lifecycle of Layer 2 and Layer 3 Connectivity Services. This includes fulfillment, control, performance, assurance, usage, security, analytics and policy capabilities over all the network domains that require coordinated management and control in order to deliver the service.	[MEF55]

Term	Definition	Reference
Link	An abstract representation of the effective adjacency between two or more associated Nodes in a Topology. It is terminated by NodeEdgePoints of the associated Nodes.	[ONF TR-527]
LSO Presto	The resource management interface reference point need to manage the network infrastructure, including network and topology view related management functions.	[MEF55]
LSO Reference Architecture	A layered abstraction architecture that characterizes the management and control domains and entities that comprise a system and the interfaces among them to enable cooperative orchestration of Connectivity Service.	[MEF55]
Network Infrastructure	Underlying network (both physical and virtual) that supports a ConnectivityService and transport of Service Frames.	[MEF55]
Network Resource	Resource in the control of an ICM Domain and described via objects in [MEF-NRM-Conn]. The relevant resources are extensions to ONF TAPI SIPs, CSEPs and CSs.	This document
Node	Abstract representation of the forwarding-capabilities of a particular set of Network Resources.	[ONF TR-527]
NodeEdgePoint (NEP)	Represents the inward network-facing aspects of the edge-port functions that access the forwarding capabilities provided by the Node.	[ONF TR-527]
Network Resource Provisioning (Presto NRP)	Presto NRP is an API service at the Presto reference point for resource activation requests and topology retrieval requests from SOF to ICM.	This document
ONF Core	Common Information Model which is divided into a number of pieces and is centered on a core fragment that is independent of specific data plane technology. The model includes pieces that provide data plane technology (forwarding technology) specific structures and properties.	[ONF TR-512]
Open Networking Foundation Transport API (ONF TAPI)	The ONF TAPI abstracts a common set of control plane functions, such as Network Topology, Connectivity Requests, Path Computation, Notifications and Network Virtualization to a set of Service interfaces.	[ONF TR-527]
O-Transit	Connectivity Service supporting connecting two or more ENNIs in context of a single ICM.	This document

Term	Definition	Reference
Retrieve-Scope Filter	A retrieve-scope filter in the context of an API allows the client to specify to varying degrees the scope of a request (i.e., REST GET). In addition, it allows the client to filter out and reduce the expected return value(s).	This document
ServiceInterfacePoint (SIP)	Represents the outward customer-facing aspects of the edge-port functions that access the forwarding capabilities provided by the Node. NOTE: A SIP relates to a UNI, ENNI or INNI.	[ONF TR-527]
Topology	An abstract representation of the topological-aspects of a particular set of network resources. It is described in terms of the underlying topological network of Nodes and Links that enable the forwarding capabilities of that particular set of network resources.	[ONF TR-527]
Unified Modeling Language (UML)	The objective of UML is to provide system architects, software engineers and software developers with tools for analysis, design and implementation of software-based systems as well as for modeling business and similar processes.	[MCM]
Use Case	A use case defines a set of actions that define the interactions between an actor and a system in order to achieve a set of goals.	This document

Table 2-Terminology and Acronyms

4 Scope

The Interface Profile Specification defines the requirements, use cases, realized classes, network resource interfaces and associated operations/parameters, state machines, and sequence diagrams that describe the behavior of the Presto NRP interface.

Presto NRP focuses on management and control functions to perform Network and Resource Provisioning (Presto NRP) processes across the Presto interface with SOF client to ICM server bi-directional communication. In addition, topology-based retrieval of components, including those that apply to a given Connectivity Service are defined.

Topology functionality is an important component of the Presto NRP solution. Presto NRP clients can leverage topology retrieval functionality for multiple Presto NRP scenarios. For example, during an augmentation of an existing Presto NRP supporting service topology retrieval should be used prior to adding a resource (i.e., UNI for MEF service) to verify the resource will not break

the existing service. Topology can also be leveraged for temporal check pointing of the network resources and path used to support an existing MEF services.

The scope of this specification is a protocol neutral definition of the information, i.e., the attributes (or properties) of the network resource objects to support the activation of MEF services. The Presto NRP Information Model imports the NRM Information Model which is then refined. The relationships between ONF TAPI, MEF NRM and MEF Presto NRP are detailed later in this document. The collaboration between ONF TAPI, NRM and Presto NRP begin with leveraging the Connectivity and Topology Services from ONF TAPI to NRM/Presto NRP. Presto NRP leverages NRM resource activation model and provides necessary UML artifacts that are intended to be leveraged for YANG data model mappings.

The information provided in this document enables a client (i.e., Service Orchestration Functionality) to decompose MEF Services and specifically EVC [MEF 10.3] and [MEF 6.2] and OVC [MEF 26.2], [MEF 33] and [MEF 51] based Services to Presto NRP objects and attributes for network resource provisioning. Network Resource Provisioning includes activation of Connectivity Services and associated resources. In addition to the activation procedures the Presto NRP supports retrieval of network resource layer topology which is used as part of the Presto NRP activation process.

The future implementation of other ONF TAPI constructs such as Path Computation and Notification Service will provide augmentations to Presto NRP. For example, the current approach to activate a MEF service that has an SLS (Service Level Specification) could be to pass the SLS information from the SOF to the one or more ICMs. The SLS attributes can be used by each ICM to perform their respective path computation and path selection. The Notification Service could be used to support asynchronous API operation.

A Path Computation Service construct and corresponding API enable provisioning to be improved and automated. Specifically, the SOF can query each ICM before the Presto NRP activation to determine if the SLS requirements for each segment can be met.

5 Compliance Levels

The key words "**MUST**", "**MUST NOT**", "**REQUIRED**", "**SHALL**", "**SHALL NOT**", "**SHOULD**", "**SHOULD NOT**", "**RECOMMENDED**", "**MAY**", and "**OPTIONAL**" in this document are to be interpreted as described in RFC 2119 0. All key words must be in upper case, bold text.

Items that are **REQUIRED** (contain the words **MUST** or **MUST NOT**) are labeled as **[Rx]** for required. Items that are **RECOMMENDED** (contain the words **SHOULD** or **SHOULD NOT**) are labeled as **[Dx]** for desirable. Items that are **OPTIONAL** (contain the words **MAY** or **OPTIONAL**) are labeled as **[Ox]** for optional**.**

6 Information Model Sources

MEF NRM reuses and extends the definitions of ONF TAPI ([13], [14]), which is a simplified version of ONF Core IM ([12]). ONF Core IM is a common information model for all network/transport technologies, evolution of TMF and ITU-T models.

It is extensible and non-constraining to new features/functions. ONF TAPI model was simplifying the ONF Core IM to make this more appropriate for transfer over an interface and make the terminology more familiar to users with experience in transport network modeling.

It standardizes a single core technology-agnostic specification that abstracts common transport network functions. ONF TAPI capabilities can be extended through the *specification* pattern. The essential approach is to associate an instance of a ONF TAPI *entity class* with a set of constraints and/or extensions that account for the specific case (*specification class*).

These *specification classes* are definitions of specific cases of usage of an *entity class*, enabling machine interpretation where traditional interface designs would only allow human interpretation. MEF NRM is designed as a set of *specification classes* which extends, or augments, ONF TAPI defined *entity classes*.

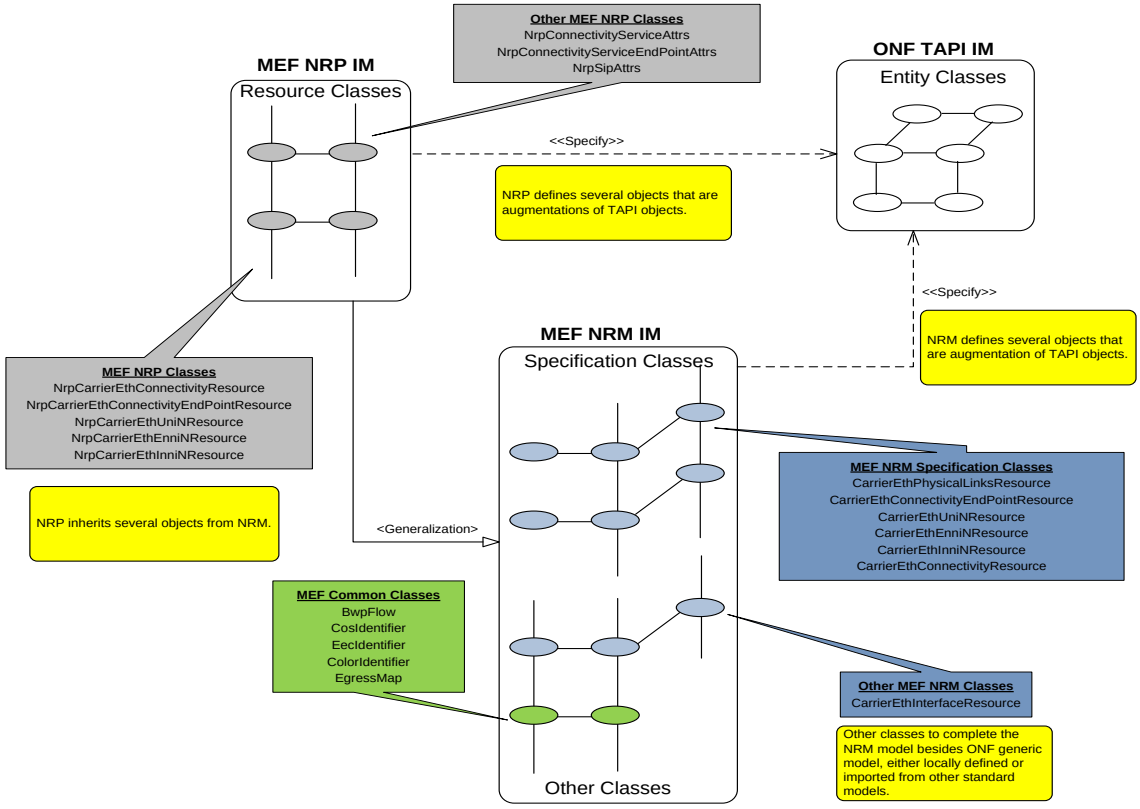

Figure 1-ONF TAPI/NRM/Presto NRP Model Relationships

6.1 MEF Common

There are several reusable constructs/objects that are leveraged by Presto NRP. For example, the objects/constructs used to support hierarchical bandwidth profiles are leveraged within Presto NRP. MEF SCA API call(s) to SOF trigger MEF Presto NRP API call(s) to ICM.

6.2 MEF Presto NRP Interface Profile Specification

This document uses a subset of classes from NRM that are applicable for operations across Presto for configuration and activation of connectivity across an ICM Domain. The UML profile is mapped to ONF TAPI Connectivity Service and Topology Service.

6.3 MEF NRM

The NRM IM is then defined to manage the Network Infrastructure, through SDN Controllers, WAN Controllers, OTN Subnetwork Managers, and other legacy Network Management Systems. The NRM IM structure is based on current and developing best network management solutions by ITU-T, ONF, TM Forum, to allow wider and future proof interoperability across multi-vendor and multi-technology networks.

The NRM IM models the management features defined by MEF Service Information Model [MEF 7.3] in a resource oriented view, at network level, i.e. potentially spanning more technology domains supporting the service. This model can be used as the basis for Presto Interface Profiles defining APIs.

6.4 ONF TAPI

ONF TAPI provides several useful constructs such as Connectivity Services, Topology Services, Path Computation Services, Notification Services and Virtual Network Services. The ONF TAPI Connectivity Service is extended within NRM/Presto NRP and is the network resource defined in activation procedures. It should be noted that ONF TAPI Connectivity Service is a network resource construct that is used to support a MEF Service which is a service definition.

6.4.1 ONF TAPI Topology

The ONF TAPI Topology service is leveraged by MEF Presto NRP. Specifically, the topological queries for Connectivity Services and associated objects is incorporated within the Presto NRP Interface Profile Specification. In addition, the ICM derived ONF TAPI Topology Connection and associated objects are also leveraged by Presto NRP. Topology retrieval can be leveraged by the Presto NRP process for multiple purposes including, but not limited to:

- verification of a network resource activation,
- retrieval of existing network resource activation prior to augmentation,
- verification of path selection

7 Introduction

The figure below illustrates the MEF Lifecycle Service Orchestration Reference Architecture (MEF LSO RA) [MEF 55] with the Presto interface highlighted. Presto is the Management Interface Reference Point between the Service Orchestration Functionality (SOF) and the Infrastructure Control and Management (ICM) needed to allow management and operations interactions of MEF defined services. As an example, SOF receives a Legato-based connectivity service activation request. SOF decomposes the service, performs path computation/selection and sends one or more Presto NRP activation requests.

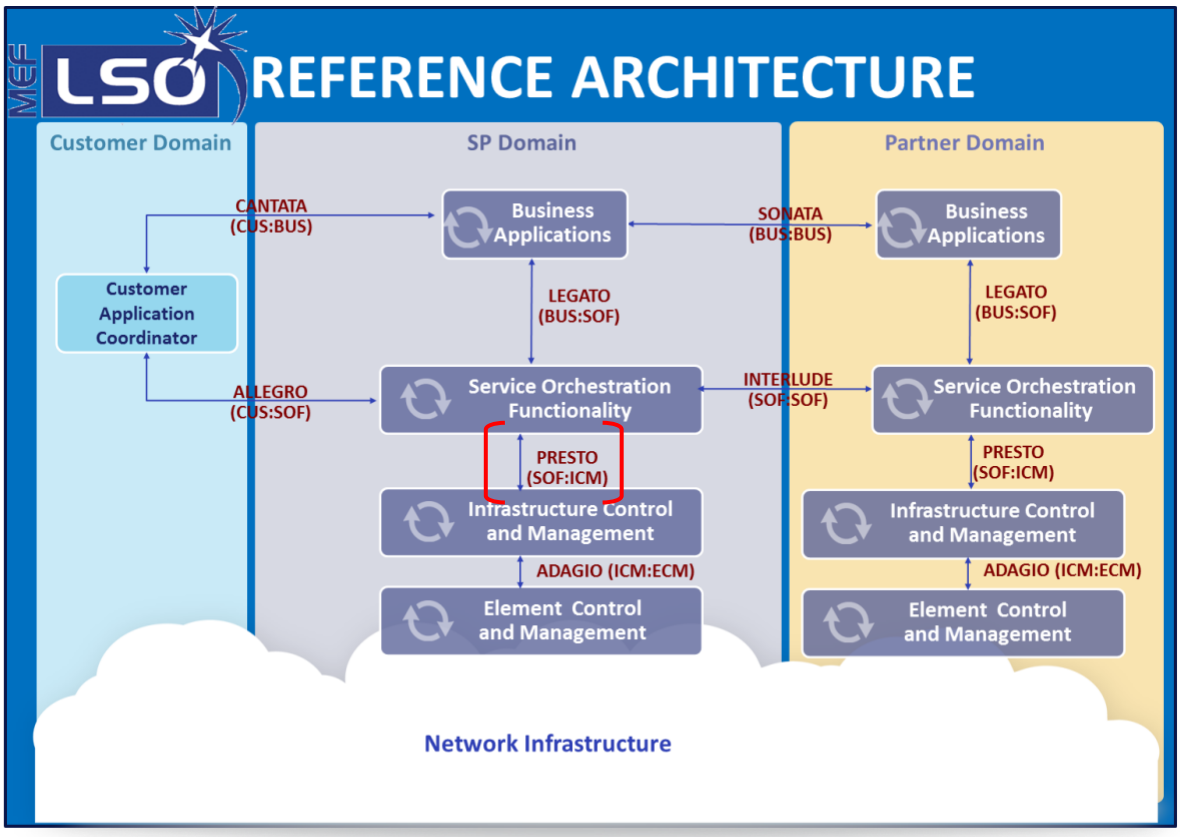

Figure 2-LSO Reference Architecture

7.1 Presto Reference Scenarios

The following section provides a Presto reference with respect to the LSO architecture. Specifically, the various scenarios comprising one or more ICM Domains are illustrated and discussed. The information given provides context for the use case definitions in this document. The reference scenarios presented below are specified for the Presto IRP.

The Presto NRP client (i.e., SOF) is responsible for mapping MEF UNI, INNI and ENNI to specific Service Interface Points (SIPs) - NrpCarrierEthUniNResource, NrpCarrierEthInniNResource and NrpCarrierEthEnniNResource respectively.

7.1.1 Node Edge Point -to- Service Interface Point Process

It is important to note that a Service Interface Point is defined during the network activation process and prior to this process each SIP is a Node Edge Point (NEP). The network activation process is the responsibility of the ICM. The ICM will designate each NEP for a specific SIP functionality.

The ICM process of mapping of each NEP to a specific SIP can be supported by various means such as ICM GUI (Graphical User Interface) or an API call. Note, that how this is accomplished beyond the scope of this document.

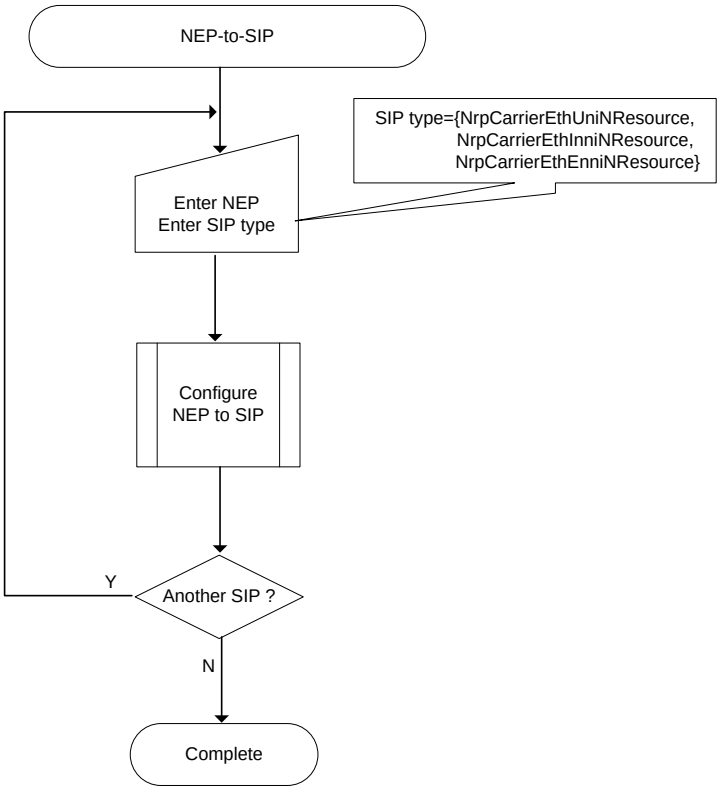

Figure 3-NEP-to-SIP Process Flow

7.1.2 End-to-End Scenario

This scenario is when a MEF EVC Service is managed in one ICM domain in a SP CEN. In this case, the Presto NRP request for a *ConnectivityService* is across one Presto Interface Reference Point located in a single ICM domain. The corresponding ServiceInterfacePoints (SIPs) are all of the Layer Protocol NrpCarrierEthUniNResource type. The ConnectivityService can be of point-to-point or multi-point type.

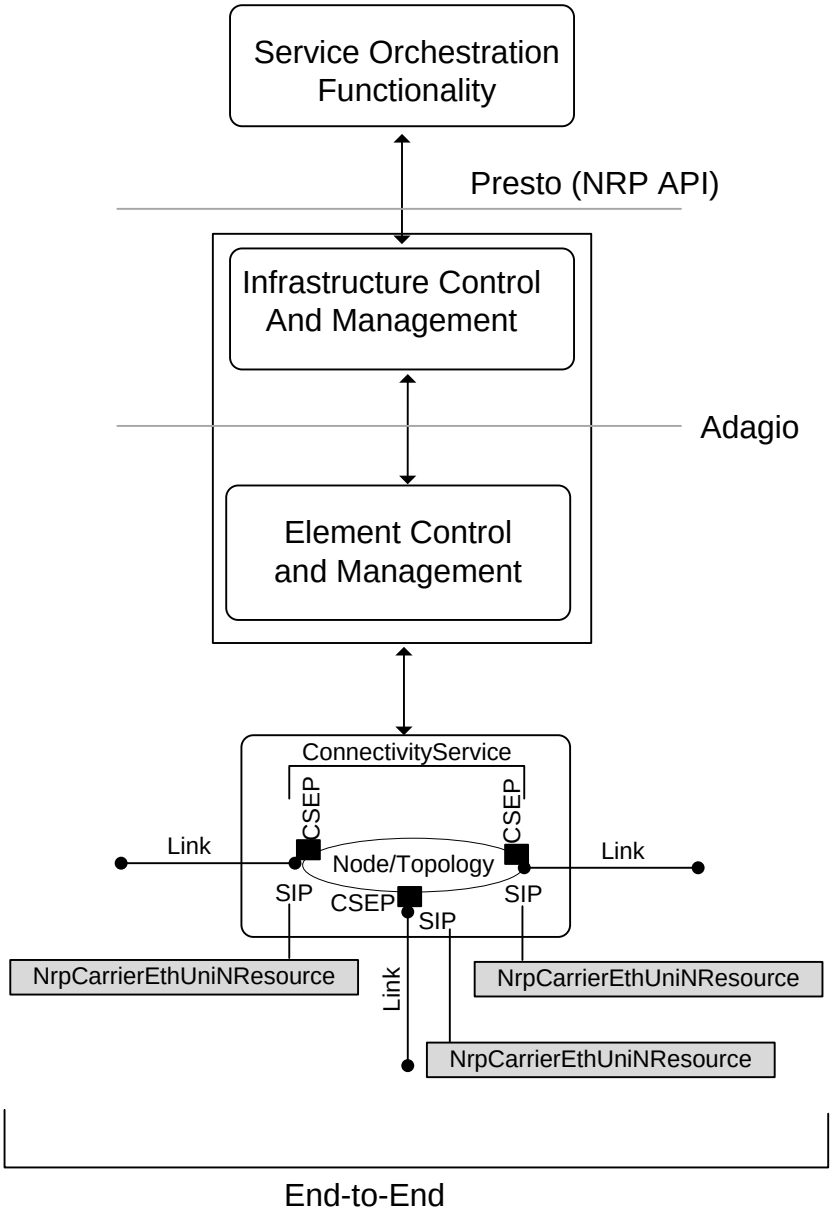

Figure 4-End-to-End Scenario

The service decomposition performed by the SOF in this scenario has defined a MEF EVC-based service. This means that the set of MEF SCA UNIs, SCA EVC and SCA EVC End Points are all managed by a single ICM.

7.1.3 Edge and I-Transit

The Edge and I-Transit scenario occurs when an MEF EVC is managed in two or more ICM domains in a SP CEN. In these cases, the Presto NRP requests for ConnectivityServices are across each of the Presto interfaces. In the Presto Edge part, the corresponding ServiceInterfacePoints (SIPs) are a mix of NrpCarrierEthUniNResource and NrpCarrierEthInniNResource. In the I-Transit part, the corresponding ServiceInterfacePoints are one or more NrpCarrierEthInniNResource. A single INNI with two CSEPs is used for a single carrier implementation of hairpin switching. The ConnectivityService can be of point-to-point or multi-point type.

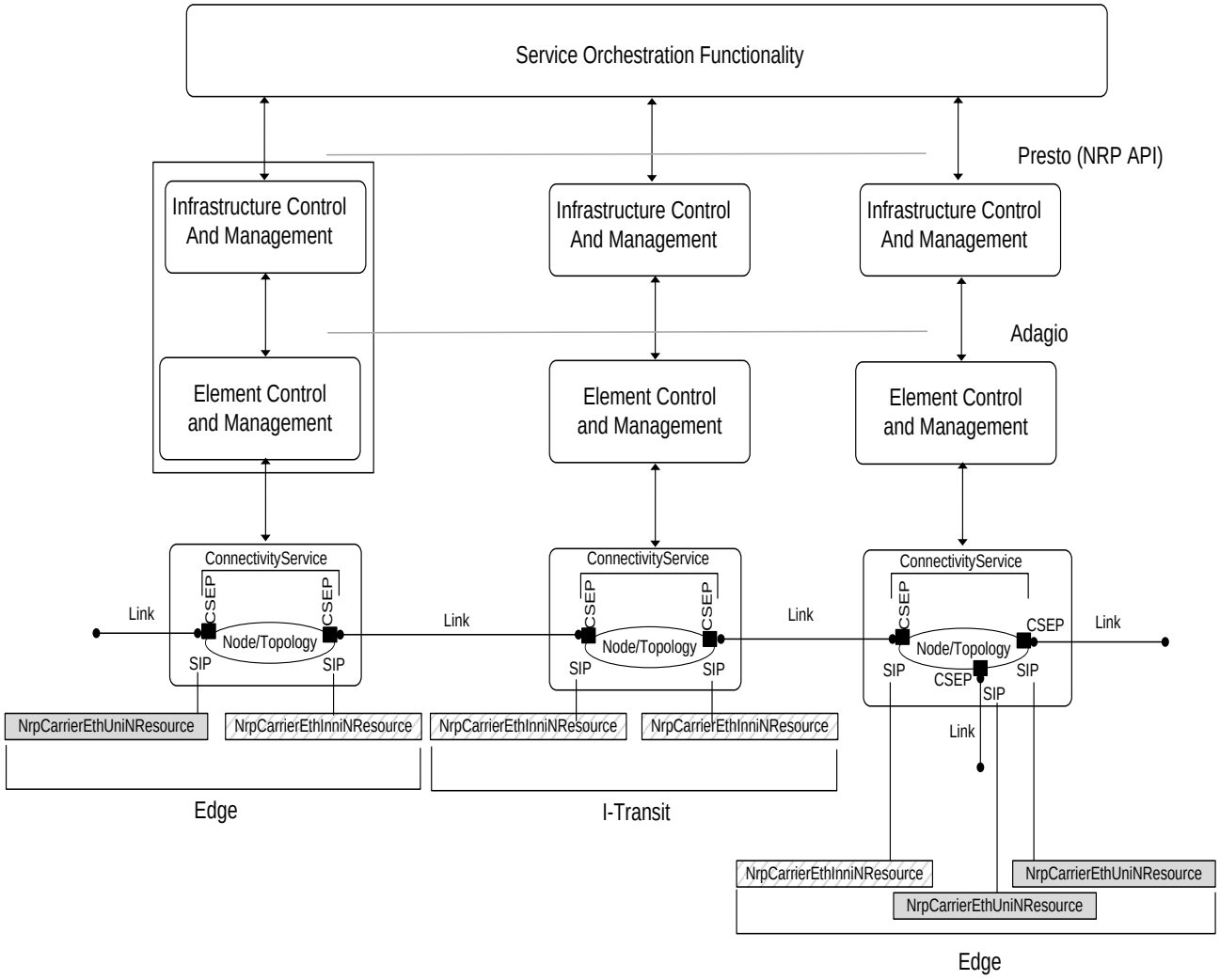

Figure 5-Edge and I-Transit Scenario

7.1.4 Access

This scenario is when a MEF OVC Service is managed in one ICM domain in a SP CEN. In this case, the Presto NRP request for a *ConnectivityService* is across the Presto Interface Reference Point of the single ICM domain. This scenario supports an OVC Service as defined in [MEF 51]. The types of OVC services are Access E-Line and Access E-LAN. The Presto NRP resources are NrpCarrierEthUniNResource type ServiceInterfacePoint, NrpCarrierEthEnniNResource type ServiceInterfacePoint and connectivity associating them with *ConnectivityService*. The ConnectivityService can be of point-to-point or multi-point type.

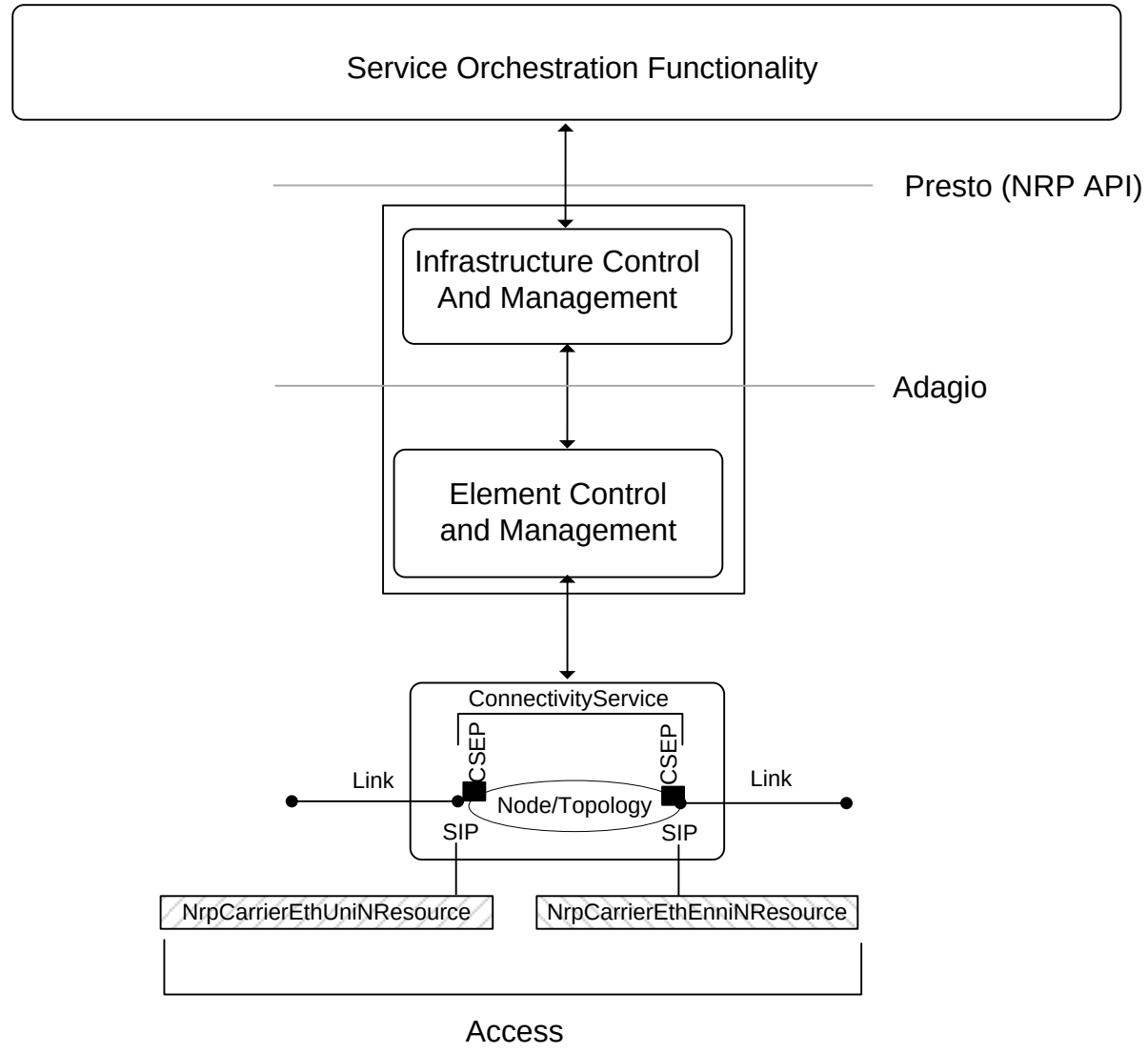

Figure 6-Access

7.1.5 I-Access

The I-Access scenario is when a Presto NRP request is to manage a MEF OVC Service. The Presto NRP resources are NrpCarrierEthInniNResource type ServiceInterfacePoint and NrpCarrierEthEnniNResource type ServiceInterfacePoint and ConnectivityService associating them under the control of a single ICM domain. In this Presto NRP activation the MEF OVC is further segmented into a network resource layer Edge and I-Access. The ConnectivityService can be of point-to-point or multi-point type.

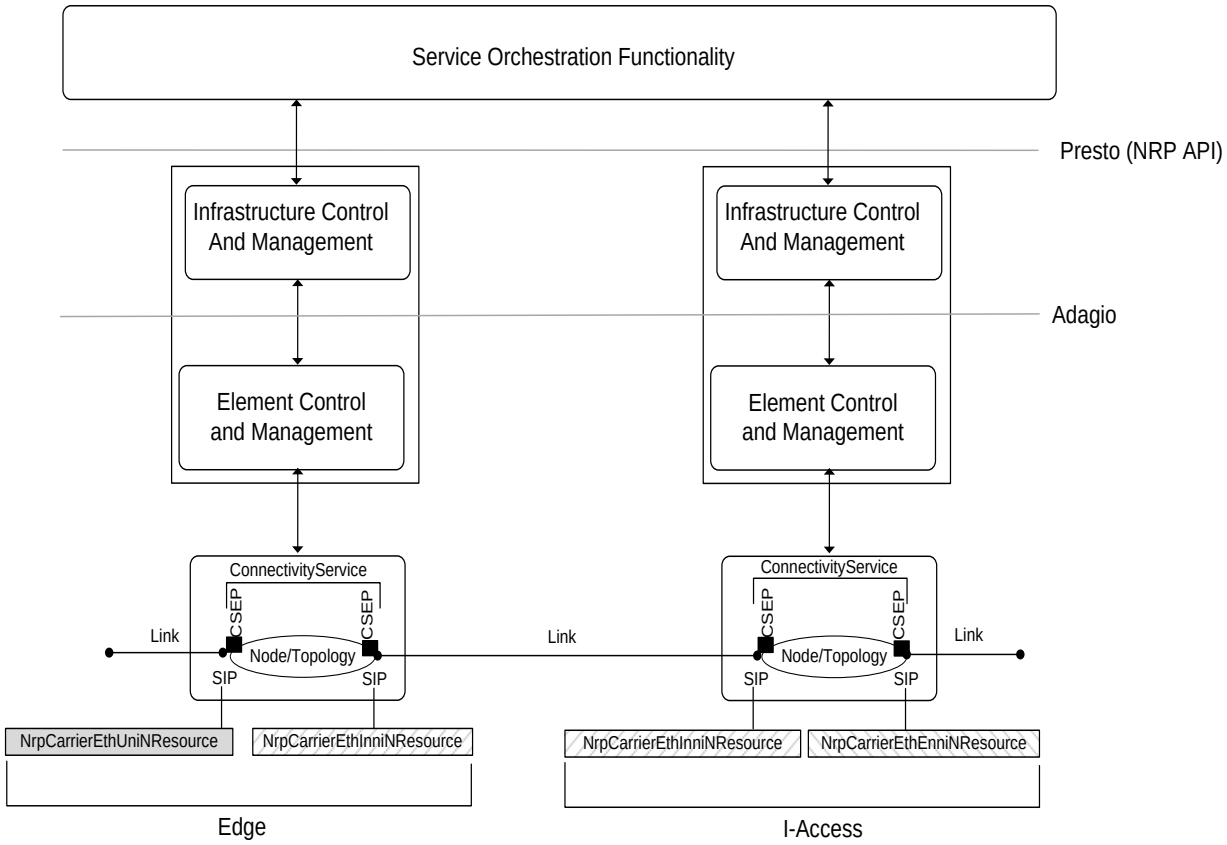

Figure 7-I-Access

7.1.6 O-Transit

This scenario is when a Presto NRP request is to manage a MEF OVC Service. The Presto NRP resources are all NrpCarrierEthEnniNResource ServiceInterfacePoints with ConnectivityService association using a single ICM. The ConnectivityService can be of point-to-point or multi-point type.

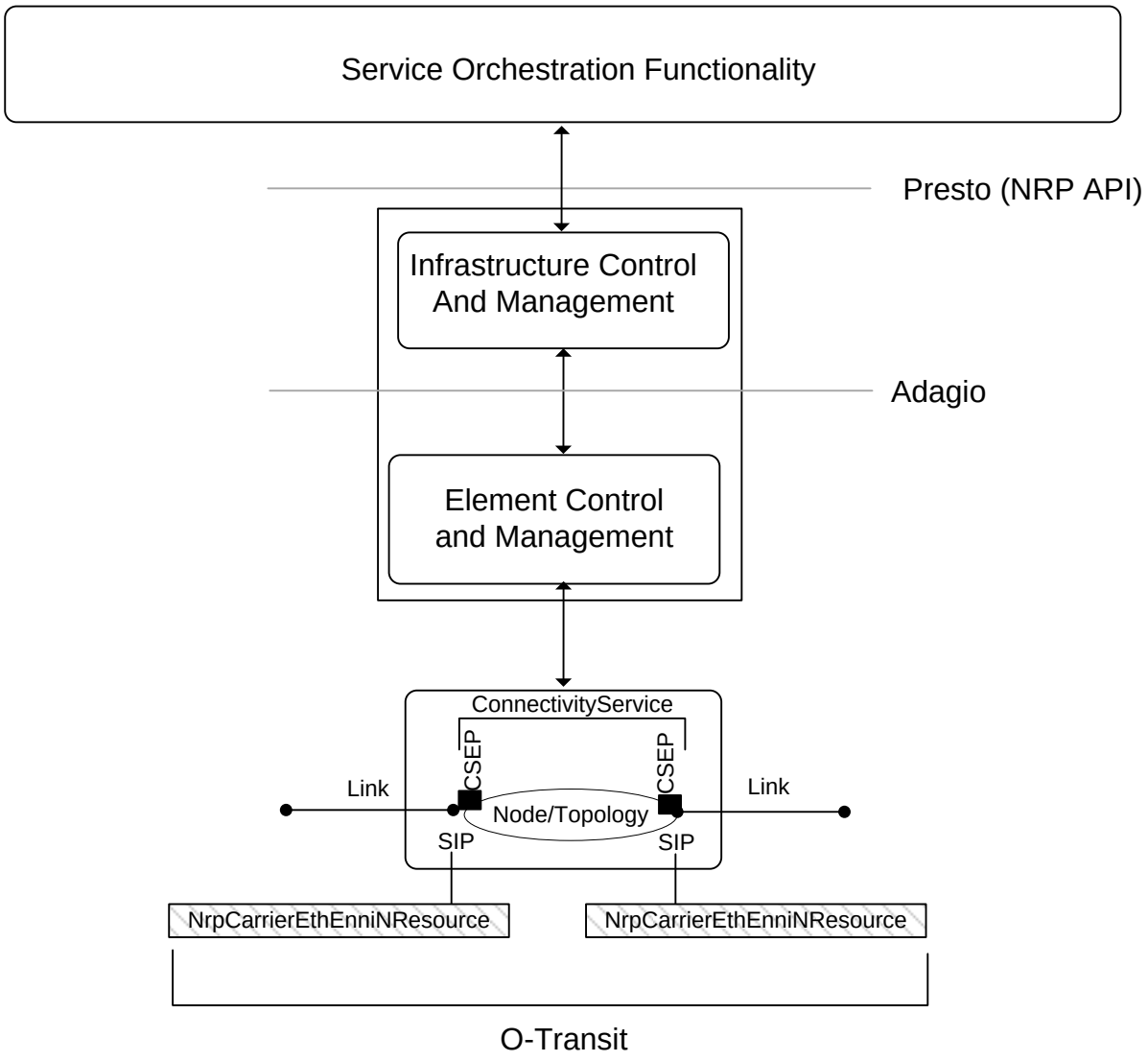

Figure 8-O-Transit

7.1.7 I-Hairpin

This scenario is when a Presto NRP request is for support of a MEF hairpin switching within a single carrier network. Hairpin switching at NrpCarrierEthInniNResource occurs when an ingress S-Tagged frame at a given NrpCarrierEthInniNResource results in an egress S-Tagged NrpCarrierEthInniNResource frame with a different S-VLAN ID value at the same NrpCarrierEthEnniNResource. The ConnectivityService can be of point-to-point or multi-point type.

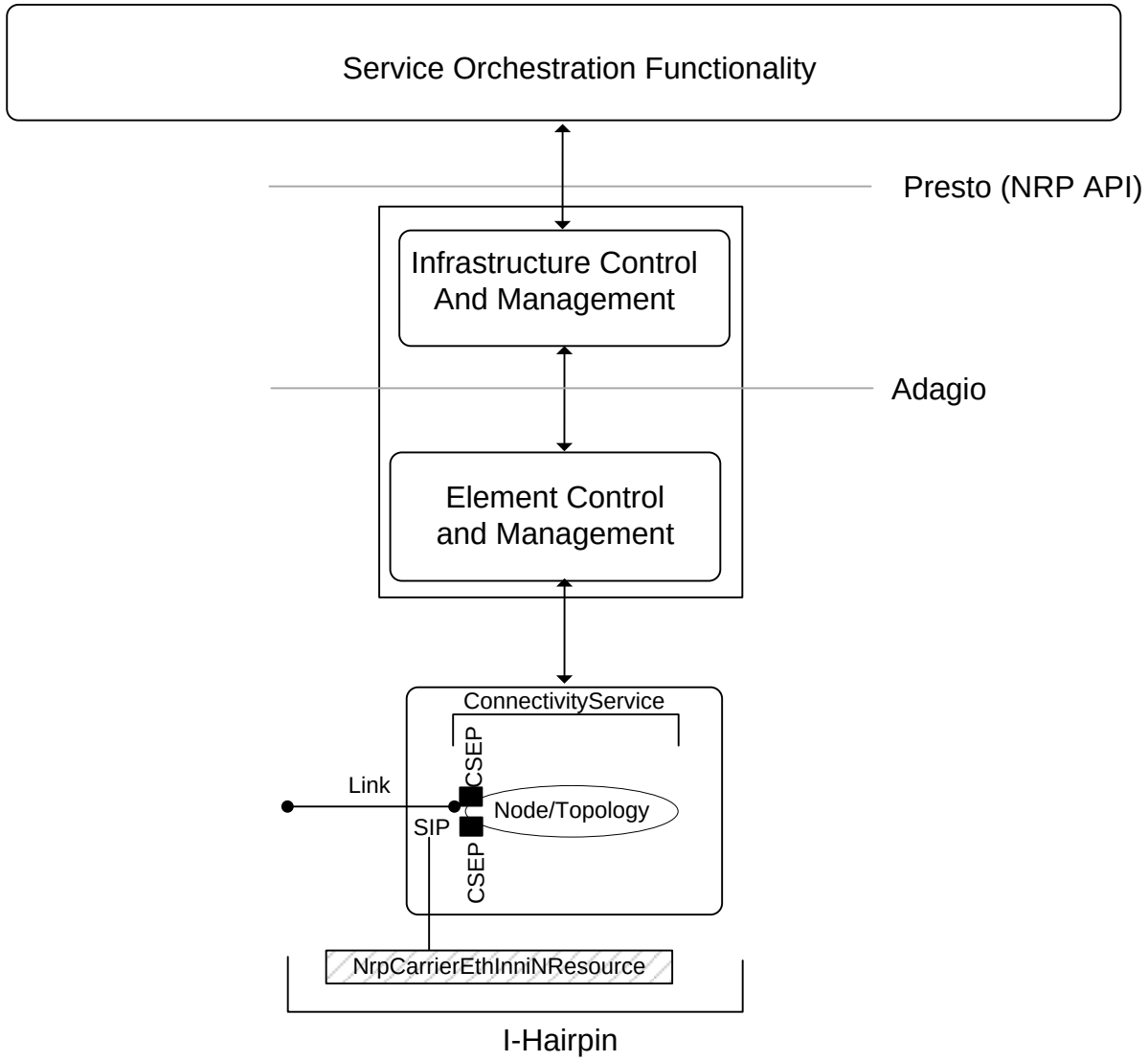

Figure 9-I-Hairpin

7.1.8 E-Hairpin

This scenario is when a Presto NRP request is for support of a MEF hairpin switching that occurs across more than one carrier network. Hairpin switching at NrpCarrierEthEnniNResource occurs when an ingress S-Tagged frame at a given NrpCarrierEthEnniNResource results in an egress S-Tagged NrpCarrierEthEnniNResource frame with a different S-VLAN ID value at the same NrpCarrierEthEnniNResource. The ConnectivityService can be of point-to-point or multi-point type.

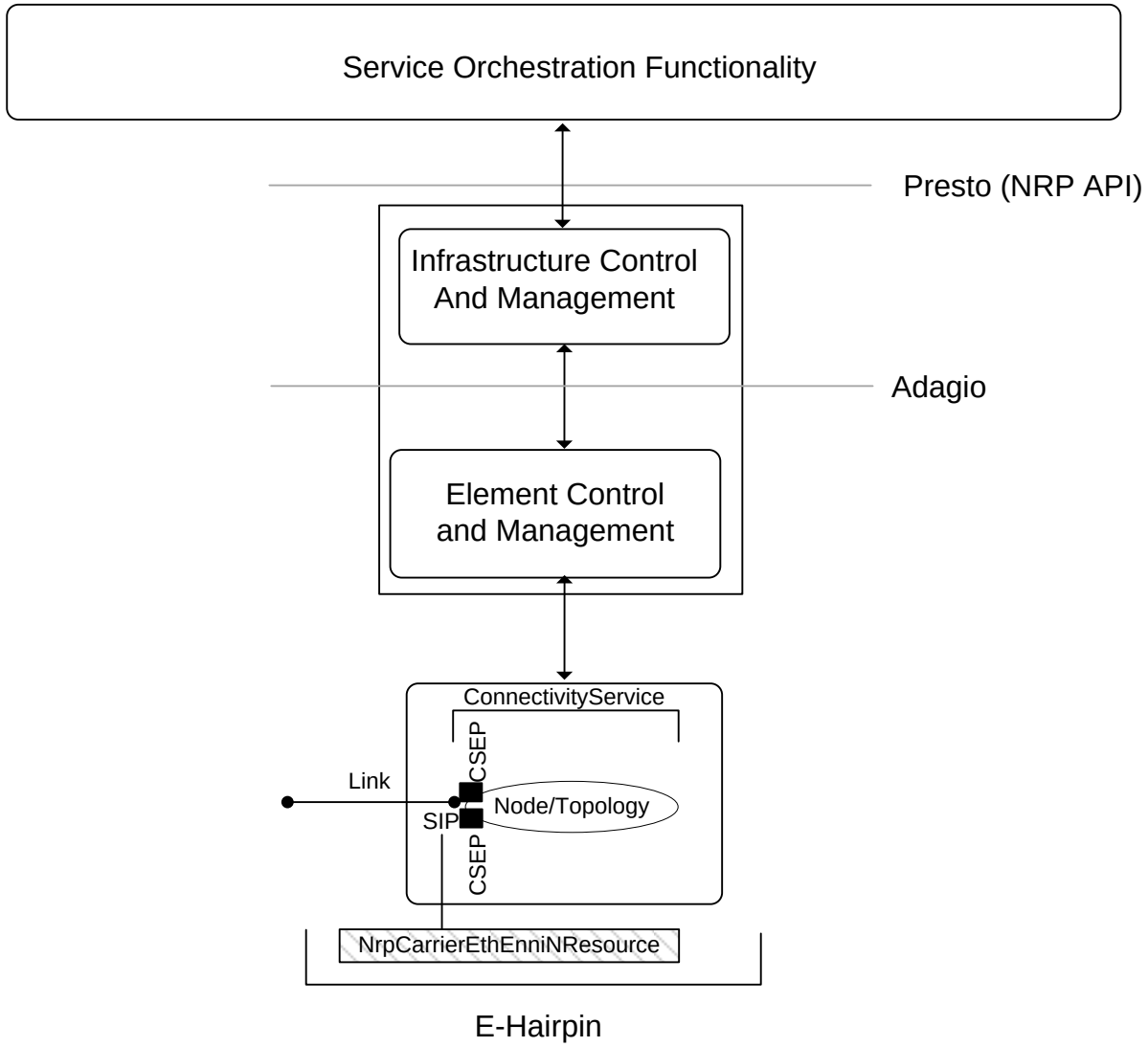

Figure 10-E-Hairpin

8 Presto NRP

This section describes the client-server network resource activation interaction between the SOF (Service Orchestration Functionality) and ICM (Infrastructure Control and Management) across the LSO Presto interface. The specific areas discussed are the SOF service decomposition into Presto NRP API components, the structure of the Presto NRP API call for various scenarios and the corresponding ICM derivation of topology upon successful Presto NRP activation.

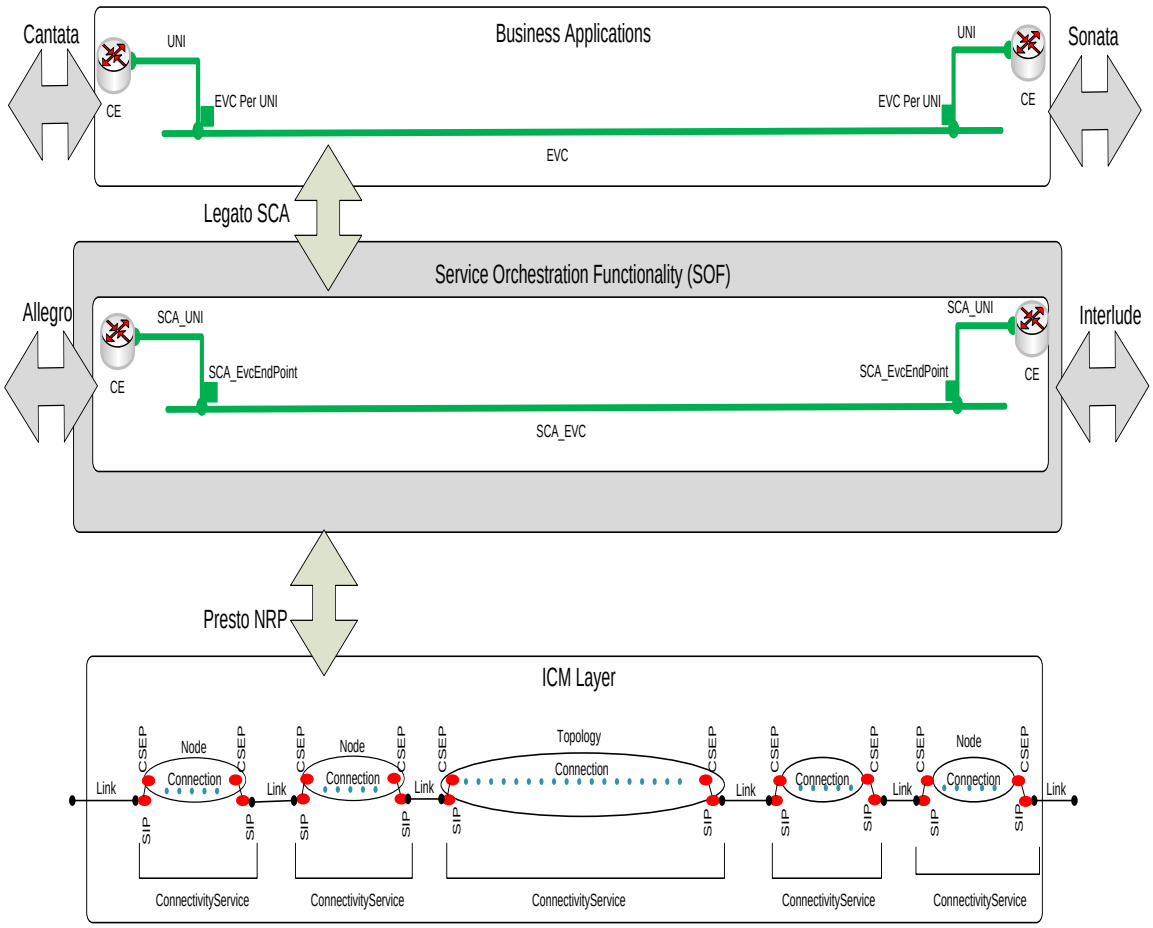

Figure 11-Service Decomposition

SIP: NrpCarrierEthUniNResource and NrpCarrierEthInniNResource
CSEP: NrpCarrierEthConnectivityEndPointResource
CS: NrpCarrierErthConnectivityResource

8.1 SOF-Service Decomposition

The process flow and description begin with the SOF receiving a MEF service activation request over the LSO Legato interface via the MEF SCA API from Business Applications. The SOF is responsible for several sub functions that work together to perform the service decomposition logic that determines the service resource components prior to sending Presto API calls. The following descriptions are provided as an overview the SOF sub functions. These descriptions are further described in [MEF 55].

Conductor is responsible for coordinated execution of the Service Instance delivery orchestration plan, considering behavior mandated by applicable policies, as well as dependencies and metadata that are generated by the Arranger. It delegates and tracks the actual Service Components implementation in various delivery domains [MEF 55].

Arranger receives Services defined by the Composer and decomposes them into a Service Instance delivery orchestration plan using the information model, which provides relationships, constraints, metadata, and Capabilities. This plan guides the deployment of the Service by using the associated lifecycle orchestration behaviors provided by the Composer [MEF 55].

Performer allows Customers to actively control the dynamic behavior of the Service Instances (including both connections and interfaces) visible to those Customers using Policies authored by Customers. This control is typically provided via a dedicated portal. This behavior MAY be constrained by the Service Provider's Policies. The Performer will also implement appropriate constraints (e.g., as defined by the Service Provider or Partner, or by implementing regulatory policies) as necessary. Scheduled control changes (e.g., upgrading the service) are also handled by the Performer [MEF 55].

Registry provides a repository to store common information, settings, options, Policies, Capabilities, and constraints for managed entities, such as Services. The same Registry can be used for Services that are being designed as well as Services that are already deployed. The Registry contains metadata and dependency information, as well as Capability features, to facilitate runtime operations. The Registry uses a standard set of APIs to register, deregister, and query entities [MEF 55].

Topology Inspector discovers, collects, and updates abstract network view topology related information (e.g., network node placement, current and potential connectivity, Capabilities) across internal and external domains. The Topology Inspector is the source of topology inventory information [MEF 55].

The SOF service decomposition takes the MEF service from the LSO Legato interface [MEF 56] and using SOF functional components described above performs MEF service validation and design logic.

A MEF Service, supplied by a Service Provider and delivered to a Customer has two or more UNIs and an EVC. An Operator MEF Service has 0 or more UNIs and 1 or more ENNIs. The Service Provider will interact with 1 or more Operators. A MEF Service will be decomposed into the set of previously defined NRP scenarios.

A Service Provider MEF Service received from a customer has two or more UNIs and an EVC. A Partner MEF Service has 0 or more UNIs and 1 or more ENNIs. The Service Provider will interact with 1 or more Partners.

Included objects are UNI-N(s), EVC End Points(s) and EVC with per object Service Attributes as defined in [MEF 10.3] and [MEF 6.2] and VUNI, Operator UNI, OVC, ENNI and OVC End Points as defined in [MEF 28] and [MEF 26.2].

The SOF service decomposition determines the network resource component(s) that support the MEF service request. For each service component, SOF prepares the Presto NRP constructs to be sent to an ICM. The figure below illustrates a SOF decomposition of an End-to-End to an ICM domain. The SCA represents the MEF service with SCA_UNI(s), respective SCA_EvcEndPoint(s) and SCA_EVC.

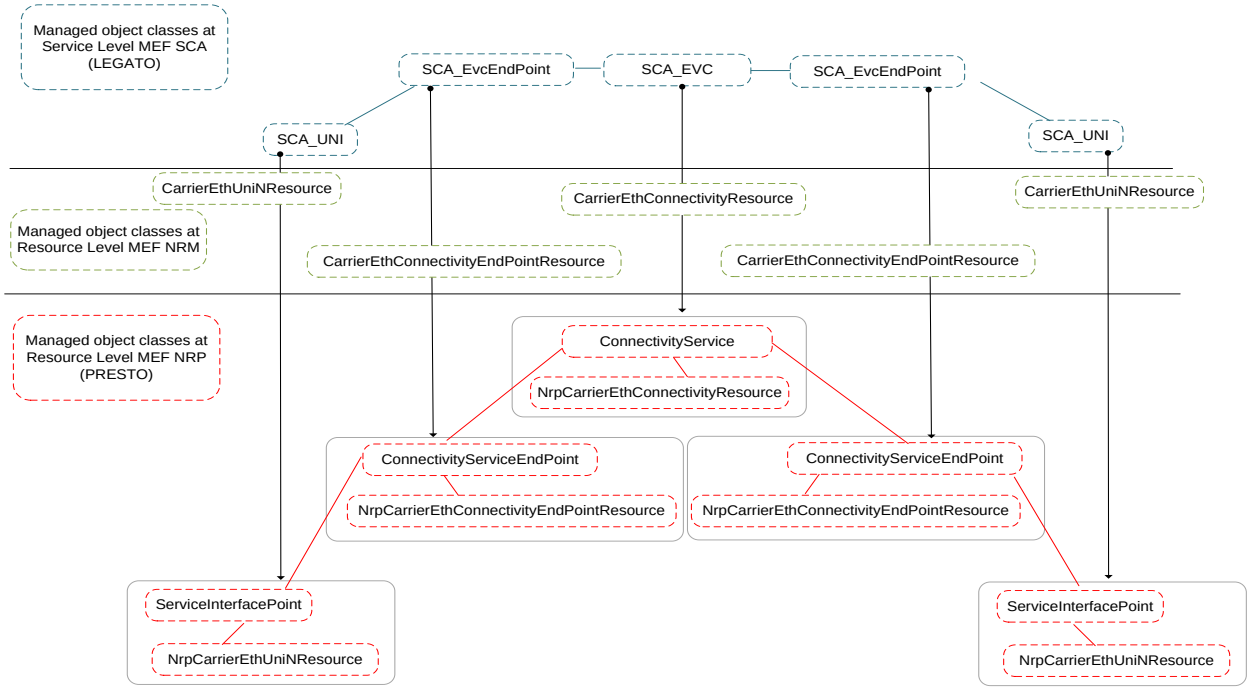

Figure 12-End-to-End

The attributes for Presto NRP objects *NrpCarrierEthUniNResource*, *NrpCarrierEthConnectivityResource* and *NrpCarrierEthConnectivityEndPointResource* are mapped from the respective MEF defined UNI-N, EVC End Point and EVC attributes defined in [MEF 10.3] through the [MEF NRM-Conn]. Specifically, the Presto NRP objects are subclasses of respective NRM classes.

8.2 Presto NRP/ONF TAPI Connectivity/Topology Service

The Presto NRP activation process uses three ONF TAPI defined entities that are common across all Presto NRP network resource activation API calls. These are *ConnectivityService*, *ConnectivityServiceEndPoint* and *ServiceInterfacePoint*. The Presto NRP sub-classes NRM objects specific to the mapping of a MEF EVC or OVC based service. In order to leverage the TAPI CRUD operations NRP augments the TAPI Connectivity Service objects. ONF TAPI Topology objects are leveraged by Presto NRP and are discussed in more detail below.

Typically, prior to invoking *ConnectivityService* operations, the SOF would first perform topology discovery of the ICM's network domain. This would entail invoking following operations:

- *getAllServiceInterfacePoints* – ICM would return a list of *ServiceInterfacePoints*
- *getTopologyList* – ICM would return the list of top-level *Topologies* in its domain
- *getTopologyDetails* - ICM would return a list of *Nodes*, *Links* and *NodeEdgePoint* details. As per ONF TAPI *Topology* concepts, a *Node* contains a set of *NodeEdgePoints* and the *Links* terminate on *NodeEdgePoints* belonging to two different *Nodes*. The *NodeEdgePoint* details includes *NodeEdgePoint*-to-*ServiceInterfacePoint* mapping information.

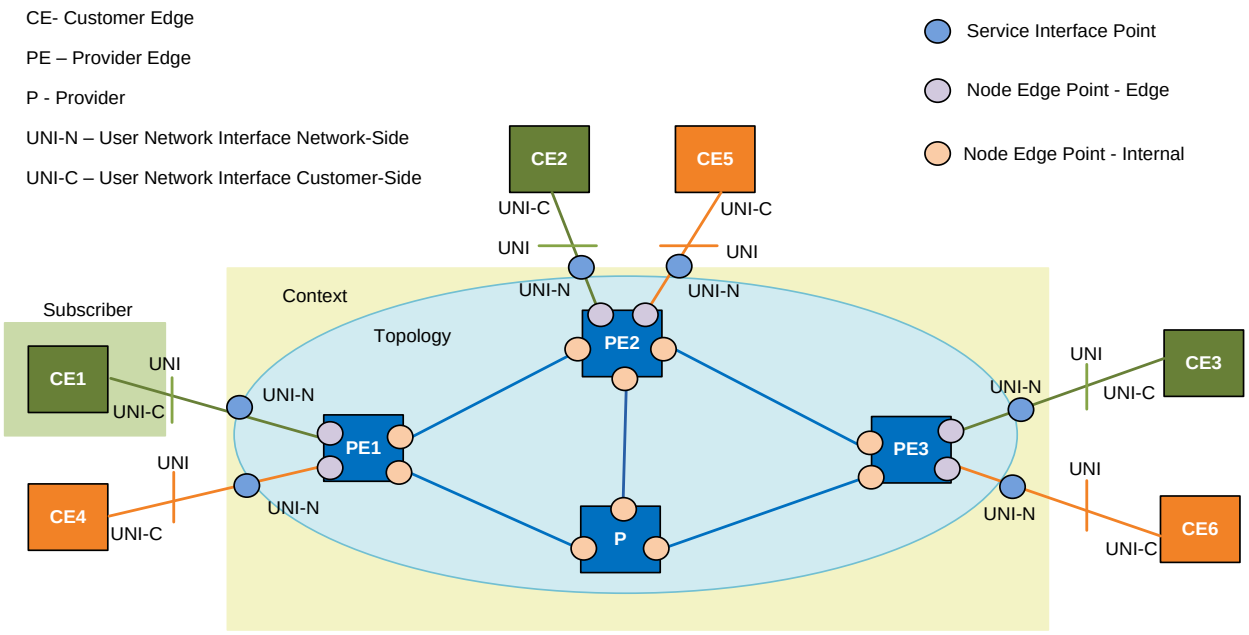

Figure 13-Simple network example to illustrate ONF TAPI Topology

ONF TAPI defines the scope of control, interaction a naming that a particular ONF TAPI provider or client application has with respect to the information exchanged over the interface. This Context is shared between the API provider and its client [ONF TR-527].

ONF TAPI defines Topology as an abstract representation of the topological-aspects of a set of Network Resource. It is described in terms of the underlying topological network of Nodes and Links that enable the forwarding capabilities of that set of Network Resources [ONF TR-527].

The ONF TAPI *ConnectivityService* Interface defines a set of operations including the following CRUD (Create, Read, Update, Delete) operations: *createConnectivityService*, *updateConnectivityService*, *deleteConnectivityService*, *getConnectivityServiceDetails*, *getConnectivityServiceList*. The SOF invokes the *createConnectivityService* operation with two or more *ConnectivityServiceEndPoints*. Each *ConnectivityServiceEndPoint* is associated with a *ServiceInterfacePoint*. The *ConnectivityService* is associated with the two or more *ConnectivityServiceEndPoints*.

Presto NRP Interface Profile Specification defines a state machine with state variables that allow methods expressed as a verb or action, as well as combinations of operations, to be invoked using Presto NRP operations.

Create and delete are examples of verbs/actions. CreateAndDelete and DeactivateAndDelete are examples of combo-verb/action. This concept allows for both single and multiple actions to manage network resources. This would be used when a carrier wants to create the device (or ICM reference to device) and have resources reserved, but may not want them activated initially.

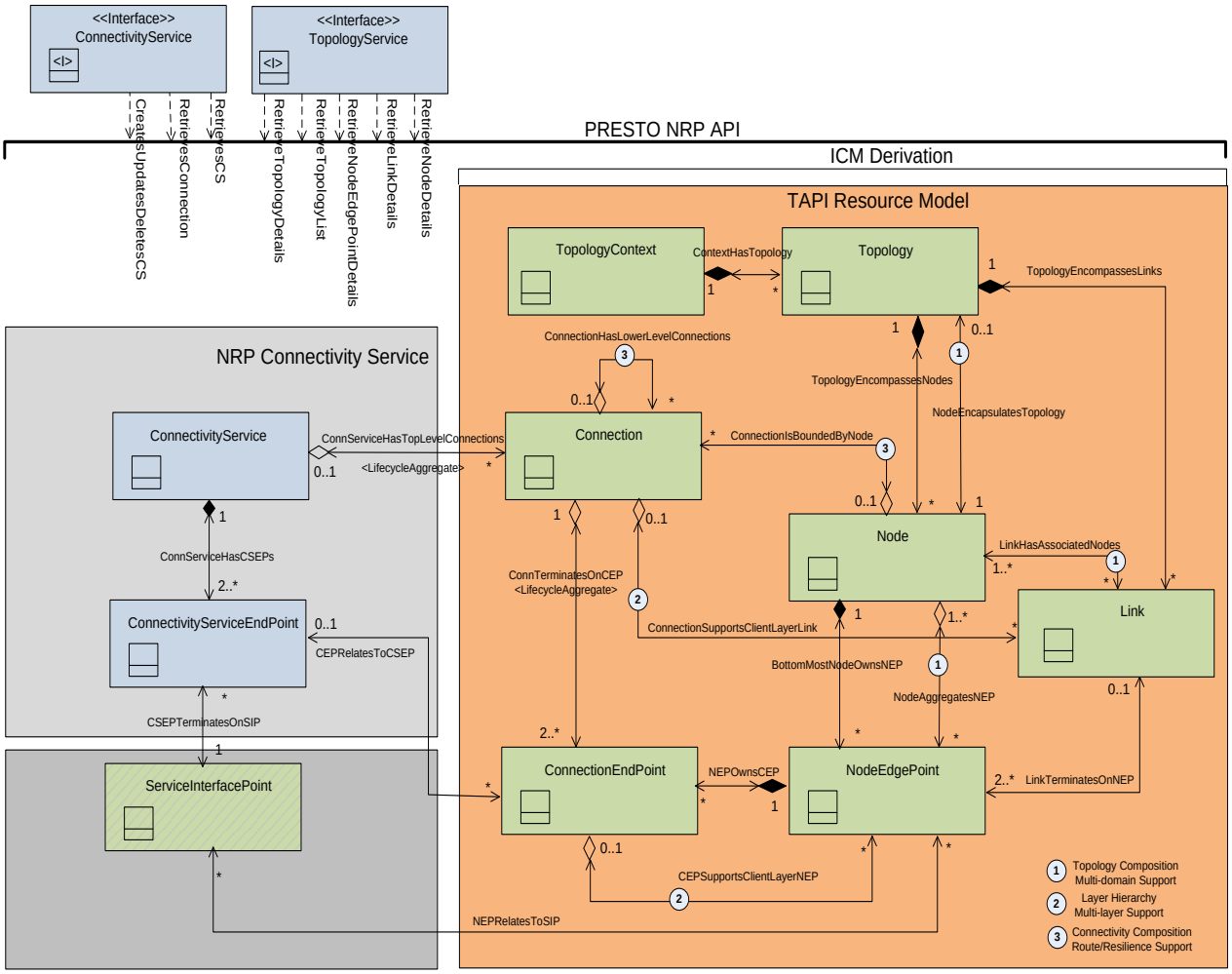

Figure 14-Presto NRP/ONF TAPI Connectivity Service and Topology Service Association

The ICM receives Presto NRP activation requests across the Presto interface from the SOF as defined above. Upon a successful activation, the ICM is responsible for supporting Topology Service functionality as defined in ONF TAPI.

Specifically, the Presto NRP *ConnectivityService* activation request have to use valid and up to date topological information and after successful activation connectivity related entities (*Route*, *Connection*, *ConnectionEndPoint*) have to refer to relevant topological entities (*Node*, *NodeEdgePoint*). The association between Connectivity Service objects and Topology Service objects is illustrated in the figure above.

The diagram above illustrates the Connectivity Service and Topology Service Interfaces that respectively provide the set of Connectivity Service-based CRUD and retrieval operations and Topology-based retrieval operations that are supported by the ICM across the NRP Presto interface.

9 Requirements on ICM

The following section details the set of requirements for Presto NRP Interface Profile. The requirements are in accordance to the functionality of the ICM. The interface reference point is the Presto as defined in [MEF55]. The specific functional requirements are for network resource activation and topology retrieval by the SOF. Network resource activation is invoked by the SOF to the ICM or set of ICMs in response to a MEF SCA service activation request. The requirements are stated with a corresponding source from [MEF 55]. These requirements are correlated with relevant use cases in Section 9 of this document.

9.1 Service Interface Points and Node Edge Points

The set of requirements defined below do not have create and delete operational requirements for SIPs. The reason for this is SIPs are generated from a NEP as explained earlier in this document and therefore will not be created or deleted as part of the Presto NRP process. The Presto NRP process will specify SIP attributes during the various activation processes.

There are requirements below for SIP modification. Specifically, a SIP can have its state changed from an active state to a suspended state. The conditions for these state changes is explained in requirements and corresponding use cases.

R_Presto_NRP_0001	The Presto NRP Interface **MUST** support (C)reate,(R)ead, (U)pdate and (D)elete operations for Connectivity Service/ConnectivityServiceEndPoint.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10, D-LSO-RA-4, D-LSO-RA-6

R_Presto_NRP_0002	The Presto NRP Interface **MUST** support suspending an existing Connectivity Service.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10, D-LSO-RA-4, D-LSO-RA-6

R_Presto_NRP_0003	The Presto NRP Interface **MUST** support resuming an existing Connectivity Service.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10, D-LSO-RA-4, D-LSO-RA-6

R_Presto_NRP_0004	The Presto NRP Interface **MUST** support modifying a Service Interface Point network resource.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10, D-LSO-RA-4, D-LSO-RA-6

R_Presto_NRP_0005	The Presto NRP Interface **MUST** support adding a Service Interface Point network resource to an existing Connectivity Service network resource.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10, D-LSO-RA-4, D-LSO-RA-6

R_Presto_NRP_0006	The Presto NRP Interface **MUST** support removing a Service Interface Point network resource from an existing Connectivity Service network resource.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10, D-LSO-RA-4, D-LSO-RA-6

R_Presto_NRP_0007	The Presto NRP Interface **MUST** support suspending a Service Interface Point network resource which is associated with an existing Connectivity Service network resource.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10, D-LSO-RA-4, D-LSO-RA-6

R_Presto_NRP_0008	The Presto NRP Interface **MUST** support resuming a Service Interface Point network resource which is associated with an existing Connectivity Service network resource.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10,

	D-LSO-RA-4, D-LSO-RA-6

R_Presto_NRP_0009	The Presto NRP Interface **MUST** support suspending a Connectivity Service End Point which is associated with an existing Connectivity Service.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10, D-LSO-RA-4, D-LSO-RA-6

R_Presto_NRP_0010	The Presto NRP Interface **MUST** support resuming a Connectivity Service End Point which is associated with an existing Connectivity Service.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10, D-LSO-RA-4, D-LSO-RA-6

R_Presto_NRP_0011	The Presto NRP Interface **MUST** support the retrieval of ICM derived Connectivity Service and associated components. The retrieval capability must support list and specific requests.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10

R_Presto_NRP_0012	The Presto NRP Interface **MUST** support the retrieval of ICM derived topologies and topological components. The retrieval capability must support list of topological request as well as specific.
Source	R-LSO-RA-8, R-LSO-RA-9, R-LSO-RA-10

10 Use Cases

The following section details the set of use cases that are in support of network resource activation and topology management. Network resource activation is invoked by the SOF in support of a MEF service activation request received on the Legato interface.

Topology retrieval is a needed function during network resource activation procedures. An example of using topology retrieval would be the case when adding a SIP to an existing Connectivity Service. One option is that prior to invoking an activation request the SOF should invoke topology retrieval and then verify the modification does not adversely impact the existing Connectivity Service. Verification by SOF is recommended given SOF has full view of the MEF service. Multiple ICMs supporting a service only have a view of their respective resources.

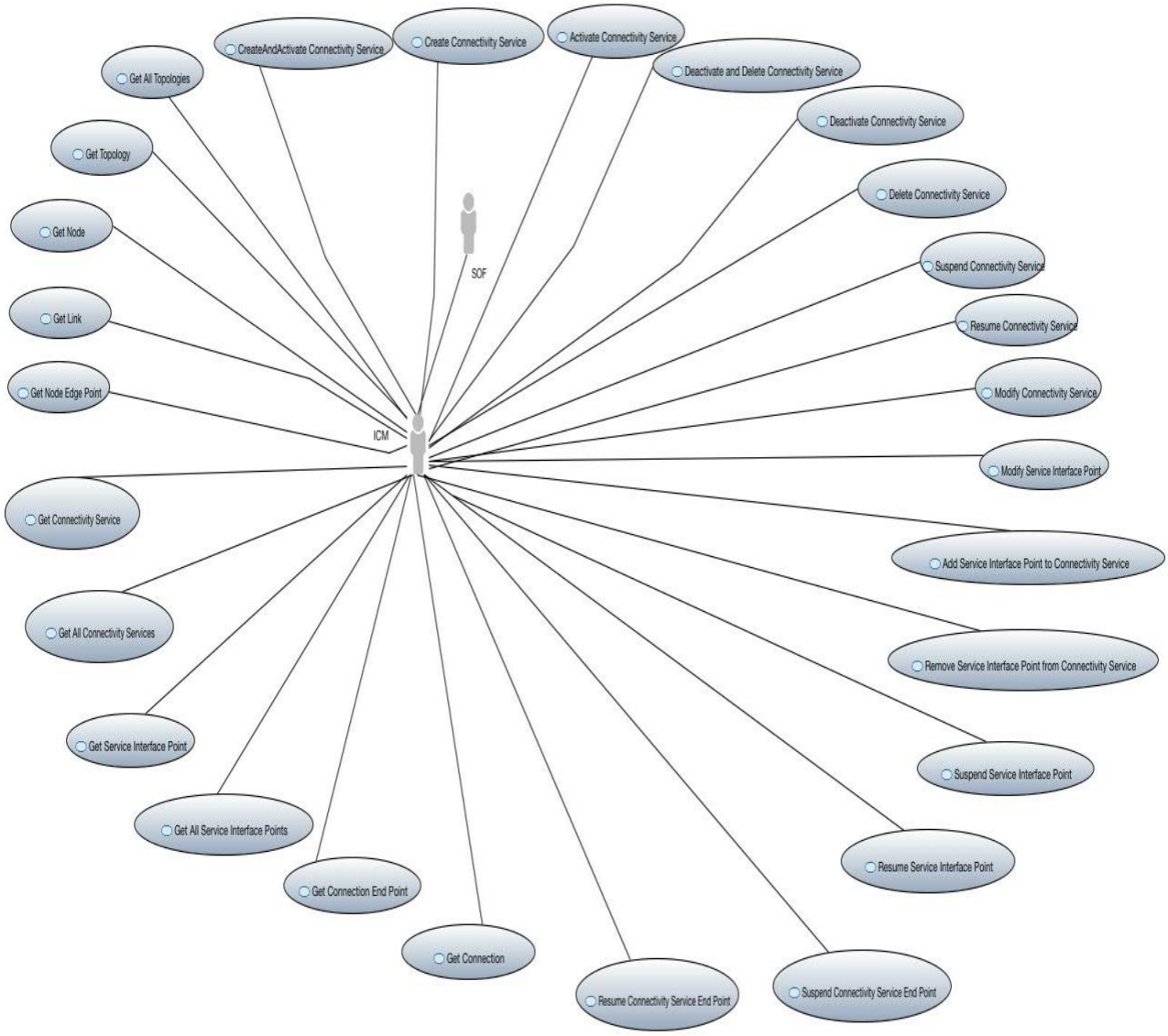

Figure 15-Presto NRP Use Cases

Use Case Id	**UC_Presto_NRP_0001**
Use Case Name	Create and Activate Connectivity Service
Description	The creation and activation of a Connectivity Service with two or more Service Interface Points and associated Connectivity Service End Points under the control of an ICM. Upon successful completion, the network set of resources have been created and the Network Infrastructure [MEF 55] is active.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM.

	1. SOF has determined location/inventory of two or more ServiceInterfacePoints. 2. SOF has information about the path fragments, attributes and constraints it can specify at network resource layer. 3. SOF is aware of other existing ConnectivityServices that could impact the ConnectivityService under consideration and their IDs. 4. The set of network resources required to support the activation are available. 5. The Connectivity Service does not exist. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: One or more NrpCarrierEthEnniNResource g) I-Hairpin: One NrpCarrierEthInniNResource with two or more Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two or more Connectivity Service End Points.
Process Steps	1. SOF determines ServiceInterfacePoints and attribute settings to be applied. NOTE: The ServiceInterfacePoint(s) attributes are added. The affected set of ServiceInterfacePoints is not created – it already exists as part of network activation process. 2. SOF determines ConnectivityService and attribute settings to be applied. 3. SOF determine ConnectivityServiceEndPoints and attribute settings to be applied. 4. SOF sends create and activation request for ConnectivityService. 5. ICM returns result to SOF.
Post-Conditions	1. ConnectivityService is created and activated with Network Infrastructure segment operation active. NOTE: This may be 1 of n Connectivity Service segments at Network Resource Layer that are serving the SOF layer Connectivity Service. The SOF layer Connectivity Service is not considered active until all Network Resource Layer segments are active.

	2. Unique ConnectivityService ID is returned. 3. If Synchronous API operation – return success or failure code/message. 4. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI). 5. Active Network Infrastructure segment and allocated set of Resource device(s). 6. ConnectivityService state: administrativeState is UNLOCKED and operationalState is ENABLED.
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Paths	
Exceptions	There is a chance that when the network resource creation and activation is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • InvalidInput • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply • EntityNotFound • NotInValidState NOTE: If exception occurs the state of ConnectivityService MUST be set to a pre-condition state of not created. NOTE: The full combination of create and activate MUST occur. A partial state change is considered an exception.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0001

Use Case Id	**UC_Presto_NRP_0002**
Use Case Name	Create Connectivity Service
Description	The creation of a Connectivity Service with Service Interface Points and associated Connectivity Service End Points under the control of an ICM. Upon successful completion, the set of network resources have been created and tracked by the ICM. The Network Infrastructure is in inactive state.
Actor(s)	SOF and ICM

Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1) SOF has determined location/inventory of two or more ServiceInterfacePoints. 2) SOF has information about the path fragments, attributes and constraints it can specify at network resource layer. 3) SOF is aware of other existing ConnectivityServices that could impact the ConnectivityService under consideration and their IDs. 4) The set of network resources required to support the creation are available. 5) The Connectivity does not exist. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: Two or more NrpCarrierEthEnniNResource. g) I-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points.
Process Steps	1. SOF determines ServiceInterfacePoints and attribute settings to be applied. NOTE: The ServiceInterfacePoint(s) attributes are added. The affected set of ServiceInterfacePoints is not created – it already exists as part of network activation process. 2. SOF determines ConnectivityService and attribute settings to be applied. 3. SOF determines ConnectivityServiceEndPoints and attribute settings to be applied. 4. SOF sends create request for ConnectivityService. 5. ICM returns result to SOF.
Post-Conditions	1. ConnectivityService is created, but not activated. Network Infrastructure segment operation is not active. NOTE: This may be 1 of n Connectivity Service segments at Network Resource Layer that are serving the SOF layer

	Connectivity Service. The SOF layer Connectivity Service is not considered created until all Network Resource Layer segments are created. 2. Unique ConnectivityService ID is returned. 3. Set of resources are allocated. 4. If Synchronous API operation – return success or failure code/message. 5. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI). 6. Non-active Network Infrastructure segment and allocated set of resources ready for activation on device(s). NOTE: If necessary to keep the Network Infrastructure segment inactive, the creation of network resources MAY be deferred until activation. 7. ConnectivityService state: administrativeState is LOCKED and operationalState is DISABLED.
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when the network resource creation is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • InvalidInput • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply • EntityNotFound • NotInValidState NOTE: If exception occurs the state of ConnectivityService MUST be set to a pre-condition state of not created.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0001

Use Case Id	**UC_Presto_NRP_0003**
Use Case Name	Activate Connectivity Service
Description	The activation of a Connectivity Service with Service Interface Points and associated Connectivity Service End Points under the control of an ICM. Upon successful completion, the Connectivity Service and corresponding Network Infrastructure moves from inactive to activate state. Refer to Presto NRP state machine in this document to see differences between activate/deactivate/suspend/resume.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has determined location/inventory of two or more ServiceInterfacePoints. 2. SOF has unique ID of existing ConnectivityService. 3. Network Infrastructure segment of existing ConnectivityService is not active. 4. The ConnectivityService is not active – ConnectivityService state: OperationalState is DISABLED and AdministrativeState is LOCKED. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: One or more NrpCarrierEthEnniNResource. g) I-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points.
Process Steps	1. SOF sends activate request with ConnectivityService unique ID. 2. Existing ServiceInterfacePoints are activated by ICM. 3. Existing ConnectivityService is activated by ICM. 4. Existing ConnectivityServiceEndPoints are activated by ICM. 5. ICM returns result to SOF.

Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Post-Conditions	1. Active Network Infrastructure segment and allocated set of resources on device(s). 2. ConnectivityService state: administrativeState is LOCKED and operationalStateis ENABLED. 3. If Synchronous API operation – return success or failure code/message. 4. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Alternative Path	
Exceptions	There is a chance that when the network resource activation is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If exception occurs the state of ConnectivityService MUST remain in its previous state.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0001

Use Case Id	**UC_Presto_NRP_0004**
Use Case Name	Deactivate and Delete Connectivity Service
Description	The deactivation and deletion of a Connectivity Service with Service Interface Points and associated Connectivity Service End Points under the control of an ICM. Causes the deactivation and deletion of an already created Common ICM Connectivity Service. Removes all dedicated resources of the previously active Connectivity Service. These are resources on both the ICM and device(s) used to support the Connectivity Service.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has determined location/inventory of two or more ServiceInterfacePoints. 2. SOF has unique ID of existing ConnectivityService. 3. The ConnectivityService is available and active. 4. Network Infrastructure segment of existing ConnectivityService is active. 5. The ConnectivityService is active – ConnectivityService state: operationalState is ENABLED and administrativeState is UNLOCKED. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: One or more NrpCarrierEthEnniNResource. g) I-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points.
Process Steps	1. SOF sends deactivate and delete request with ConnectivityService unique ID. 2. ServiceInterfacePoints associated indirectly with ConnectivityService via ConnectivityServiceEndPoint are not deleted, but any pooled resources are unallocated if there are no remaining ConnectivityService associated with ServiceInterfacePoint.

	3. Existing ConnectivityServiceEndPoints are deactivated and corresponding resources are deleted by ICM. 4. Existing ConnectivityService is deactivated and corresponding resources are deleted ICM. 5. ICM returns result to SOF.
Post-Conditions	1. ConnectivityService that was previously created and active is deactivated and removed. Network Infrastructure segment operation is no longer active. 2. ConnectivityService state: Connectivity service is removed and therefore is Non-Existent. 3. If Synchronous API operation – return success or failure code/message. 4. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when the network resource deactivation and deletion is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If exception occurs the state of ConnectivityService MUST remain in its previous state. NOTE: The full combination of deactivate and delete MUST occur. A partial state change is considered an exception.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0001

Use Case Id	**UC_Presto_NRP_0005**
Use Case Name	Deactivate Connectivity Service
Description	The deactivation of a Connectivity Service with Service Interface Points and associated Connectivity Service End Points under control of an ICM. Upon successful completion, the previously active Connectivity Service will become inactive tracked by the ICM. This is likely the same as suspend from a Network Infrastructure perspective. The difference is the state variable at the ICM. Refer to Presto NRP state machine in this document to see differences between activate/deactivate/suspend/resume.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has determined location/inventory of two or more ServiceInterfacePoints. 2. SOF has unique ID of existing ConnectivityService. 3. Network Infrastructure segment of existing ConnectivityService is active. 4. Set of resources are allocated and active. 5. The ConnectivityService is active – ConnectivityService state: operationalStateis ENABLED and administrativeState is UNLOCKED. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: One or more NrpCarrierEthEnniNResource. g) I-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points.
Process Steps	1. SOF sends deactivate request with ConnectivityService unique ID. 2. Existing active ServiceInterfacePoints and corresponding resources are NOT deactivated given there may be other

	ConnectivityServices sharing the same ServiceInterfacePoint(s). 3. Existing active ConnectivityService and corresponding resources are deactivated, but not deleted. 4. Existing active ConnectivityServiceEndPoints and corresponding set of resources are deactivated, but not deleted by ICM. 5. ICM returns result to SOF.
Post-Conditions	1. ConnectivityService that was previously active is deactivated. 2. Previous active Network Infrastructure segment and allocated set of resources on device(s) are deactivated. 3. ConnectivityService state: administrativeState is LOCKED and operationalState is DISABLED. 4. If Synchronous API operation – return success or failure code/message. 5. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when the network resource deactivation is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If exception occurs the state of ConnectivityService MUST remain in its previous state.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0001

Use Case Id	**UC_Presto_NRP_0006**
Use Case Name	Delete Connectivity Service
Description	The deletion of a Connectivity Service with Service Interface Points and associated Connectivity Service End Points under control of an ICM. Upon successful completion, the previously inactive Connectivity Service will be deleted. Removes all resources of the previously deactivated Connectivity Service. These are resources on both the ICM and device(s) used to support the Connectivity Service.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has determined location/inventory of two or more ServiceInterfacePoints. 2. SOF has unique ID of existing ConnectivityService. 3. Network Infrastructure segment of existing ConnectivityService is inactive. 4. Resources are allocated and are deactivated. 5. The ConnectivityService is deactive – ConnectivityService state: operationalState is DISABLED and AdministrativeState is LOCKED. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: One or more NrpCarrierEthEnniNResource. g) I-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points.
Process Steps	1. SOF sends delete request with ConnectivityService unique ID. 2. ServiceInterfacePoints associated indirectly with ConnectivityService via ConnectivityServiceEndPoint are not deleted, but any pooled resources are unallocated if there are no remaining ConnectivityService associated with ServiceInterfacePoint.

	3. Existing inactive ConnectivityService and corresponding resources are deleted by ICM. 4. Existing inactive ConnectivityServiceEndPoints and corresponding resources are deleted by ICM. 5. ICM returns result to SOF.
Post-Conditions	1. ConnectivityService that was previously inactive is removed with corresponding set of Resources also removed. 2. Previously active Network Infrastructure segment and allocated set of resources on device(s) are removed. 3. ConnectivityService state: Connectivity service is removed and therefore is Non-Existent. 4. If Synchronous API operation – return success or failure code/message. 5. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when the network resource deletion is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If exception occurs the state of ConnectivityService MUST remain in its previous state.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0001

Use Case Id	**UC_Presto_NRP_0007**
Use Case Name	Suspend Connectivity Service
Description	The suspension of a Connectivity Service with Service Interface Points and associated Connectivity Service End Points under control of an ICM. Upon successful completion, all resources of the previously active Connectivity Service are in a suspend state. The Network Infrastructure operation is not active. This is likely the same as deactivate from a Network Infrastructure perspective. The difference is the state variable at the ICM. Refer to Presto NRP state machine in this document to see differences between activate/deactivate/suspend/resume. It is recognized that some devices may not support a suspended state. The suspended state still must be supported in the ICM. Shutdown as described below allows for the resource to remain reserved in the ICM, but may be partially or wholly de-configured in the network device if necessary.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has determined location/inventory of two or more ServiceInterfacePoints. 2. SOF has unique ID of existing ConnectivityService. 3. Network Infrastructure segment of existing ConnectivityService is active. 4. Associated ServiceInterfacePoints are active. 5. Set of resources are allocated and are active. 6. The ConnectivityService is active – ConnectivityService state: operationalState is ENABLED and administrativeState is UNLOCKED. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: One or more NrpCarrierEthEnniNResource.

	g) I-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points.
Process Steps	1. SOF sends suspend request with ConnectivityService unique ID. 2. ICM will place ConnectivityService and associated Resources in suspended state. 3. ICM returns result to SOF. NOTE: Some systems/devices may not support a suspend state. The device actual state may be different (i.e., shutdown). The ICM MUST properly track state of ConnectivityService as suspended.
Post-Conditions	1. ConnectivityService that was previously active and corresponding set of resources are placed in suspended state. 2. Previous active Network Infrastructure segment and allocated set of resources on device(s) are suspended (or shutdown if suspend is not available). 3. ConnectivityService state: AdministrativeState is LOCKED and OperationalState is ENABLED. 4. If Synchronous API operation – return success or failure code/message. 5. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI). NOTE: The suspended state MUST be supported by the ICM. The device MAY support the suspended state.
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when the network resource suspension is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied

	• UnableToComply NOTE: If exception occurs the state of ConnectivityService MUST remain in its previous state.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0002

Use Case Id	**UC_Presto_NRP_0008**
Use Case Name	Resume Connectivity Service
Description	The resumption of a Connectivity Service with Service Interface Points and associated Connectivity Service End Points under the control of an ICM. Upon successful completion, all resources of the previously suspended Connectivity Service are active. The Network Infrastructure operational state moves to active. This is like activate from a Network Infrastructure perspective. Refer to Presto NRP state machine in this document to see differences between activate/deactivate/suspend/resume.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has determined location/inventory of two or more ServiceInterfacePoints. 2. SOF has unique ID of existing ConnectivityService. 3. Network Infrastructure of existing ConnectivityService is suspended in ICM and suspended/shutdown in device(s). 4. Set of resources are allocated and are suspended. 5. The ConnectivityService is active – ConnectivityService state: operationalState is ENABLED and administrativeState is LOCKED. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: One or more NrpCarrierEthEnniNResource. g) I-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points.
Process Steps	1. SOF sends resume request with ConnectivityService unique ID. 2. Verification of corresponding ServiceInterfacePoints are in active state by ICM. 3. Existing active ConnectivityService and corresponding resources are placed in active state by ICM.

	4. Existing active ConnectivityServiceEndPoint and corresponding resources are placed in active state by ICM. 5. ICM returns result to SOF.
Post-Conditions	1. ConnectivityService that was previously suspended and corresponding set of resources (i.e., memory, queues/buffers, CPU) are placed in active state. 2. Previous suspended Network Infrastructure segment and allocated resources are activated. 3. ConnectivityService state: administrativeState is UNLOCKED and operationalState is ENABLED. 4. If Synchronous API operation – return success or failure code/message. 5. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when the network resource resume is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If exception occurs the state of ConnectivityService MUST remain in its previous state.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0003

Use Case Id	**UC_Presto_NRP_0009**
Use Case Name	Modify Connectivity Service/Connectivity Service End Point
Description	The modification of Connectivity Service attribute(s) and/or Connectivity Service End Point attribute(s) under the control of an ICM. Modification must consider effect on entire network resource providing service. Specifically, all objects and attributes associated with the Connectivity Service and/or Connectivity Service End Point must be considered prior to making a modification.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: The following use case is not intended to change the state condition of the ConnectivityService or ConnectivityServiceEndPoint. Suspend, resume, activate and deactivate use cases are for state change. Some modifications should not be done without coordination with customer and may require a deactivation, modification and activation. Bandwidth profile attribute (i.e., CIR) is an example of non-service state impacting. Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has visibility of two or more ServiceInterfacePoints, where one or more is ServiceInterfacePoint/NrpCarrierEthUniNResource and one or more is a ServiceInterfacePoint/NrpCarrierEthInniNResource. 2. SOF has unique ID of existing ConnectivityService/ConnectivityServiceEndPoint. 3. Network Infrastructure of existing ConnectivityService/ConnectivityServiceEndPoint is active/inactive/suspended (any state). 4. Resources are allocated. 5. The ConnectivityService/ConnectivityServiceEndPoint is in one of the states: o active – operationalState is ENABLED and administrativeState is UNLOCKED, o inactive – operationalState is INACTIVE and administrativeState is LOCKED. o suspended – operationalState is ENABLED and administrativeState is LOCKED. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource

	b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: One or more NrpCarrierEthEnniNResource. g) I-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points.
Process Steps	1. SOF sends modify request with ConnectivityService/ConnectivityServiceEndPoint(s) unique ID. 2. Verification of corresponding ServiceInterfacePoint(s) are in active state by ICM. 3. ICM returns result to SOF.
Post-Conditions	1. ConnectivityService/ConnectivityServiceEndPoint(s) and specified attributes are successfully modified. 2. Network Infrastructure segment is in state it was prior to modification. 3. Existing ConnectivityService(s) and corresponding resources remain in the state which it was prior to initiation of modification request. 4. If Synchronous API operation – return success or failure code/message. 5. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when the network resource modification is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied

	• UnableToComply NOTE: If exception occurs the state of ConnectivityService MUST remain in its previous state.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0001

Use Case Id	**UC_Presto_NRP_0010**
Use Case Name	Modify Service Interface Point
Description	The modification of a Service Interface Point attribute(s) and/or supporting resources under the control of an ICM. Modification must consider effect on entire network resource providing service. Specifically, a Service Interface Point may support multiple Connectivity Services and therefore a modification of Service Interface Point MUST not impact these services.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has unique ID of existing ServiceInterfacePoint. 2. SOF has all IDs of ConnectivityServiceEndPoints currently associated with this ServiceInterfacePoint. 3. Network Infrastructure of existing ConnectivityService is active/inactive/suspended (any state). 4. Resources are allocated. 5. The ConnectivityService is in one of the states: o active – operationalState is ENABLED and administrativeState is UNLOCKED, o inactive – operationalState is INACTIVE and administrativeState is LOCKED. o suspended – operationalState is ENABLED and administrativeState is LOCKED. 6. The ServiceInterface is in one of the states: o active – operationalState is ENABLED and administrativeState is UNLOCKED, o inactive – operationalState is INACTIVE and administrativeState is LOCKED. o suspended – operationalState is ENABLED and administrativeState is LOCKED. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: One or more NrpCarrierEthEnniNResource.

	g) I-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points.
Process Steps	1. SOF verifies that modification of ServiceInterfacePoint will not adversely affect the set of associated ConnectionServiceEndPoints. 2. SOF sends modify request with ServiceInterfacePoint unique ID and attributes to be modified. 3. Verification of corresponding ServiceInterfacePoints are in active state by ICM. 4. ICM returns result to SOF.
Post-Conditions	1. ServiceInterfacePoint is successfully modified. 2. Network Infrastructure segment is in state it was prior to modification. 3. Existing ConnectivityService(s) and corresponding resources remain in the state which it was prior to initiation of modification request. 4. If Synchronous API operation – return success or failure code/message. 5. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when the network resource modification is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If exception occurs the state of ServiceInterfacePoint MUST remain in its previous state.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0004

Use Case Id	**UC_Presto_NRP_0011**
Use Case Name	Add Service Interface Point/Connectivity Service End Point to Connectivity Service
Description	The creation/activation of Service Interface Point and/or associated Connectivity Service End Point into already active Connectivity Service under the control of an ICM.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has visibility of two or more ServiceInterfacePoints/Connectivity Service End Points, where two or more are ServiceInterfacePoint/NrpCarrierEthUniNResource. 2. SOF has unique ID of existing ConnectivityService. 3. Network Infrastructure segment of existing ConnectivityService is active, inactive or suspended. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: One or more NrpCarrierEthEnniNResource. g) I-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points.
Process Steps	1. SOF sends request to add (activate/create and activate) ServiceInterfacePoint/Connectivity Service End Point to an existing ConnectivityService using unique ID. 2. Verification that adding ServiceInterfacePoints/ConnectivityServiceEndPoint to existing ConnectivityService does not disrupt the ConnectivityService or components by ICM. NOTE: Adding the ServiceInterfacePoint/ConnectivityServiceEndPoint MUST NOT disrupt the Network Infrastructure of the existing ConnectivityService.

	3. Create and activate or Create ConnectivityServiceEndPoint with corresponding associated ServiceInterfacePoint and resources by ICM. 4. ICM returns result to SOF.
Post-Conditions	1. ServiceInterfacePoint/ConnectivityServiceEndPoint is successfully added to existing ConnectivityService. Indirect relationship via CSEP. 2. Newly added ServiceInterfacePoint/ConnectivityServiceEndPoint and corresponding Network Infrastructure segment and allocated set of resources are enabled. 3. If Synchronous API operation – return success or failure code/message. 4. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when adding a network resource is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0005

Use Case Id	**UC_Presto_NRP_0012**
Use Case Name	Remove Service Interface Point and/or Connectivity Service End Point from Connectivity Service under the control of an ICM.
Description	The deactivation and deletion of ServiceInterfacePoint and/or Connectivity Service End Point from an existing ConnectivityService. Resources are available for reuse after this action.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has visibility of all ServiceInterfacePoints/ConnectivityServiceEndPoints associated with ConnectivityService. 2. SOF has unique ID of existing ConnectivityService and unique ID of ServiceInterfacePoints/ConnectivityServiceEndPoints. 3. Network Infrastructure segment of existing ConnectivityService is active, inactive or suspended. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) End-to-End: Two or more NrpCarrierEthUniNResource b) Edge: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthInniNResource c) I-Transit: One or more NrpCarrierEthInniNResource d) Access: One or more NrpCarrierEthUniNResource and one or more NrpCarrierEthEnniNResource e) I-Access: One or more NrpCarrierEthInniNResource and one or more NrpCarrierEthEnniNResource f) O-Transit: One or more NrpCarrierEthEnniNResource. g) I-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points. h) E-Hairpin: One NrpCarrierEthInniNResource with two Connectivity Service End Points.
Process Steps	1. SOF sends request to remove ServiceInterfacePoint/ConnectivityServiceEndPoint from an existing ConnectivityService using unique ServiceInterfacePoint/ConnectivityServiceEndPoint ID. 2. Verification that removing ServiceInterfacePoints to existing ConnectivityService does not disrupt the ConnectivityService or components by ICM. 3. ICM returns result to SOF.

Post-Conditions	1. ServiceInterfacePoint/ConnectivityServiceEndPoint is successfully removed from existing ConnectivityService. 2. ServiceInterfacePoint/ConnectivityServiceEndPoint and corresponding Network Infrastructure segment and allocated set of resources are removed. 3. If Synchronous API operation – return success or failure code/message. 4. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with create resource location (i.e., URI).
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when the removing a network resource is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If exception occurs the state of ConnectivityService MUST remain in its previous state and ServiceInterfacePoint is NOT removed from ConnectivityService.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0006

Use Case Id	**UC_Presto_NRP_0013**
Use Case Name	Suspend Service Interface Point
Description	The suspension of a ServiceInterfacePoint and associated Connectivity Service End Point under the control of an ICM. Upon successful completion, all resources of the previously active ServiceInterfacePoint are intact. The Network Infrastructure operation is not active. This is likely the same as deactivate from a Network Infrastructure perspective. The difference is the state variable at the ICM. Refer to Presto NRP state machine in this document to see differences between activate/deactivate/suspend/resume. It is recognized that some devices may not support a suspended state. The suspended state still must be supported in the ICM. Shutdown as described below allows for the resource to remain reserved in the ICM, but may be partially or wholly de-configured in the network device if necessary.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has determined location/inventory of ServiceInterfacePoint. 2. SOF has unique ID of existing ConnectivityService. NOTE: Identifier of ServiceInterfacePoint and ConnectivityService is required because multiple ConnectivityServices can be associated with a single ServiceInterfacePoint. 3. Network Infrastructure segment of existing ConnectivityService is active. 4. SOF has unique ID of existing ServiceInterfacePoint. 5. ServiceInterfacePoint state: administrativeState is UNLOCKED and operationalState is ENABLED (state=active). NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. a) NrpCarrierEthUniNResource b) NrpCarrierEthInniNResource c) NrpCarrierEthEnniNResource
Process Steps	1. SOF sends suspend request with ServiceInterfacePoint unique ID. 2. ICM will place ServiceInterfacePoint and associated Resources in suspended state.

	3. ICM returns result to SOF. NOTE: Some systems/devices may not support a suspend state. The device actual state may be different (i.e., shutdown). The ICM MUST properly track state of ServiceInterfacePoint as suspended.
Post-Conditions	1. Previous active Network Infrastructure segment and allocated set of resources on device(s) are suspended (or shutdown if suspend is not available). 2. ServiceInterfacePoint state: administrativeState is LOCKED and operationalState is ENABLED (state=suspended). 3. If Synchronous API operation – return success or failure code/message. 4. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI). NOTE: The suspended state MUST be supported by the ICM. The device MAY support the suspended state.
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when suspending a network resource is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If exception occurs the state of ServiceInterfacePoint MUST remain in its previous state.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0007

Use Case Id	**UC_Presto_NRP_0014**
Use Case Name	Resume Service Interface Point
Description	The resumption of a ServiceInterfacePoint and associated Connectivity Service End Point under the control of an ICM. Upon successful completion, all resources of the previously suspended ServiceInterfacePoint are active. The Network Infrastructure operation is active. This is similar to activate from a Network Infrastructure perspective. Refer to Presto NRP state machine in this document to see differences between activate/deactivate/suspend/resume.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has determined location/inventory of ServiceInterfacePoint. 2. SOF has unique ID of existing ConnectivityService. NOTE: Identifier of ServiceInterfacePoint and ConnectivityService is required because multiple ConnectivityServices can be associated with a single ServiceInterfacePoint. 3. Network Infrastructure of existing ServiceInterfacePoint is suspended in ICM and suspended/shutdown in device(s). 4. SOF has unique ID of existing ServiceInterfacePoint. 5. Set of resources are allocated and are suspended. 6. ServiceInterfacePoint state: administrativeState is LOCKED and operationalState is ENABLED (state=suspended). 7. Resources are allocated and are active. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. 8. NrpCarrierEthUniNResource 9. NrpCarrierEthInniNResource 10. NrpCarrierEthEnniNResource
Process Steps	1. SOF sends resume request with ServiceInterfacePoint unique ID. 2. ICM returns result to SOF.
Post-Conditions	1. ServiceInterfacePoint that was previously suspended and corresponding resources are placed in active state. 2. Previous active Network Infrastructure segment and allocated set of resources on system/device(s) are active 3. ServiceInterfacePoint state: administrativeState is UNLOCKED and operationalState is ENABLED.

	4. If Synchronous API operation – return success or failure code/message. 5. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when resuming a network resource is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If exception occurs the state of ServiceInterfacePoint MUST remain in its previous state.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0008

Use Case Id	**UC_Presto_NRP_0015**
Use Case Name	Suspend Connectivity Service End Point
Description	The suspension of a ConnectivityServiceEndPoint associated with a specific ServiceInterfacePoint under the control of an ICM. Upon successful completion, all resources of the previously active ConnectivityServiceEndPoint are suspended. The Network Infrastructure operation for this resource is not active. This is likely the same as deactivate from a Network Infrastructure perspective. The difference is the state variable at the ICM. Refer to Presto NRP state machine in this document to see differences between activate/deactivate/suspend/resume. It is recognized that some devices may not support a suspended state. The suspended state still must be supported in the ICM. Shutdown as described below allows for the resource to remain reserved in the ICM, but may be partially or wholly de-configured in the network device if necessary. This is an applicable use case when a ServiceInterfacePoint is serving more than one ConnectivityServices and one of the associated ConnectivityServices is needed to be suspended without disruption of other ConnectivityServices.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has determined location/inventory of ServiceInterfacePoint and associated ConnectivityServiceEndPoint. 2. SOF has unique ID of existing ConnectivityService. NOTE: Identifier of ServiceInterfacePoint and ConnectivityService is required because multiple ConnectivityServices can be associated with a single ServiceInterfacePoint. 3. Network Infrastructure segment of existing ConnectivityService is active. 4. SOF has unique ID of existing ServiceInterfacePoint. 5. ConnectivityServiceEndPoint state: administrativeState is UNLOCKED and operationalState is ENABLED (state=active). NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. d) NrpCarrierEthUniNResource e) NrpCarrierEthInniNResource

	f) NrpCarrierEthEnniNResource
Process Steps	1. SOF sends suspend request with ServiceInterfacePoint unique ID and unique ID of ConnectivityService. 2. ICM will place ConnectivityServiceEndPoint and associated Resources in suspended state. 3. ICM returns result to SOF. NOTE: Some systems/devices may not support a suspend state. The device actual state may be different (i.e., shutdown). The ICM MUST properly track state of ConnectivityServiceInterfacePoint as suspended.
Post-Conditions	1. Previous active Network Infrastructure segment and allocated set of resources on device(s) are suspended (or shutdown if suspend is not available). 2. ConnectivityServiceEndPoint state: administrativeState is LOCKED and operationalState is ENABLED (state=suspended). 3. If Synchronous API operation – return success or failure code/message. 4. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI). NOTE: The suspended state MUST be supported by the ICM. The device MAY support the suspended state.
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when suspending a network resource is performed the ConnectivityServiceEndPoint might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If exception occurs the state of ConnectivityServiceEndPoint MUST remain in its previous state.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0009

Use Case Id	**UC_Presto_NRP_0016**
Use Case Name	Resume Connectivity Service End Point
Description	The resumption of a ConnectivityServiceEndPoint associated with a specific ServiceInterfacePoint under the control of an ICM. Upon successful completion, all resources of the previously inactive ConnectivityServiceEndPoint are activated. The Network Infrastructure operation is activated. This is similar to activate from a Network Infrastructure perspective. Refer to Presto NRP state machine in this document to see differences between activate/deactivate/suspend/resume. This is an applicable use case when a ServiceInterfacePoint is serving more than one ConnectivityServices and one of the associated ConnectivityServices is needed to be suspended without disruption of other ConnectivityServices.
Actor(s)	SOF and ICM
Pre-Conditions	NOTE: Determine if Synchronous or Asynchronous API is being used. This will determine how the results are returned by the ICM. 1. SOF has determined location/inventory of ServiceInterfacePoint. 2. SOF has unique ID of existing ConnectivityService. NOTE: Identifier of ServiceInterfacePoint and ConnectivityService is required because multiple ConnectivityServices can be associated with a single ServiceInterfacePoint. 3. Network Infrastructure of existing ConnectivityServiceEndPoint is suspended in ICM and suspended/shutdown in device(s). 4. Set of resources are allocated and are suspended. 5. ServiceInterfacePoint state: administrativeState is LOCKED and operationalState is ENABLED (state=resume). 6. Resources are allocated and are inactive. NOTE: The correct set of Resource Objects based on use case should be associated with the ServiceInterfacePoint. See Section 12.1.1 Augmentation for description. 7. NrpCarrierEthUniNResource 8. NrpCarrierEthInniNResource 9. NrpCarrierEthEnniNResource
Process Steps	1. SOF sends resume request with ServiceInterfacePoint unique ID and unique ID of ConnectivityService. 2. ICM returns result to SOF.

Post-Conditions	1. Previous inactive Network Infrastructure segment and allocated set of resources on device(s) are resumed. 2. ConnectivityServiceEndPoint state: administrativeState is UNLOCKED and operationalState is ENABLED (state=resume). 3. If Synchronous API operation – return success or failure code/message. 4. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Notification/Event	If a notification service and API is provided a notification MUST be sent to subscribers.
Alternative Path	
Exceptions	There is a chance that when resuming a network resource is performed the Connectivity Service might fail because of network resources issues. It might also happen that the request is illegal or cannot be applied. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • NotInValidState • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If exception occurs the state of ConnectivityService MUST remain in its previous state.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0010

Use Case Id	**UC_Presto_NRP_0017**
Use Case Name	Get Connection Details
Description	Retrieve attributes of the Connection entity identified by the provided inputs. This includes references to ConnectionEndPoints terminating the Connection. This includes references to Paths in the underlying Topology. This includes references to the Node containing the Connection.
Actor(s)	SOF and ICM
Pre-Conditions	
Process Steps	1. SOF sends a GET request for Connection Details with a. ConnectivityService ID b. Connection ID or Name: String 2. ICM returns result to SOF.
Post-Conditions	1. List of IDs, Names, User-Labels 2. Operational and Lifecycle States 3. Connectivity Constraints including a. Required Constraints such as Capacity b. Optional Constraints such as Layer, Latency, Cost, etc. 4. Reference to the parent (containing) *Node* 5. List of the following details for every ConnectionEndPoint associated with the Connection a. Role of the terminating ConnectionEndPoint in the context of the Connection b. Directionality of the terminating ConnectionEndPoint in the context of the Connection c. Reference to terminating ConnectionEndPoint 6. List of *Paths* of the specified Connection and details of each including a. List of references to lower-level Connections that describe the *Path* of the specified Connection through the *Nodes* in the underlying Topology. 7. If Synchronous API operation – return success or failure code/message. 8. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Exceptions	There is a chance when retrieving network resources is performed a failure may occur. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput

	• InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0012

Use Case Id	**UC_Presto_NRP_0018**
Use Case Name	Get Connection End Point Details
Description	Retrieve the specified ConnectionEndPoint and detailed set of attributes and associated topology components. Returns attributes of the ConnectionEndPoint identified by the provided inputs. This includes references to the service and client (if any) NodeEdgePoints for this ConnectionEndPoint. This includes references to peer (if any) ConnectionEndPoint that is connected to this ConnectionEndPoint.
Actor(s)	SOF and ICM
Pre-Conditions	
Process Steps	1. SOF sends a GET request for ConnectionEndPoint with input: a. *Connection* ID or Name: String i. ID/name of the containing Connection that owns or references this ConnectionEndPoint. b. *ConnectionEndPoint* ID or Name: String c. When NULL is provided, this API call should return an error condition. 2. ICM returns result to SOF. NOTE: Connections can have lower level Connections and therefore if that is the case a reference is needed as defined in a.
Post-Conditions	1. List of IDs, Names, User-Labels 2. Operational and Lifecycle State 3. List of supported NrpSipAttrs including attribute-details indexed by Layer 4. Reference server (containing) NodeEdgePoint and client NodeEdgePoint. 5. Reference to the Peer (if any) ConnectionEndPoint 6. If Synchronous API operation – return success or failure code/message. or 7. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Exceptions	There is a chance when retrieving network resources is performed a failure may occur. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • InternalError • NotImplemented

	• CommLoss • AccessDenied • UnableToComply
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0012

Use Case Id	**UC_Presto_NRP_0019**
Use Case Name	Get Service Interface Point List
Description	Retrieve a list of ServiceInterfacePoints within control of ICM. This includes the ServiceInterfacePoints that are being used in a ConnectivityService as well as those that are not being used. This includes ServiceInterfacePoints in any state. This also includes the attribute details for each ServiceInterfacePoint including references to mapped NodeEdgePoints.
Actor(s)	SOF and ICM
Pre-Conditions	
Process Steps	1. SOF sends GET request for ServiceInterfacePoint List with inputs: a. Retrieve Scope Filter*:* NrpSipAttrs types. List of NrpSipAttrs types which SOF wants to retrieve. Enumeration value. 2. ICM returns result to SOF.
Post-Conditions	ServiceInterfacePoints can support multiple layers and therefore return in indexed by NrpSipAttrs type. Details for each include: 1. List of IDs, Names, User-Labels 2. Lifecycle State 3. List of supported NrpSipAttrs including attribute-details. 4. Reference to NodeEdgePoint mapped to this ServiceInterfacePoint. 5. If Synchronous API operation – return success or failure code/message. or 6. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Exceptions	There is a chance when retrieving network resources is performed a failure may occur. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0011

Use Case Id	**UC_Presto_NRP_0020**
Use Case Name	Get Service Interface Point Details
Description	Retrieve the details of a specified ServiceInterfacePoint. Returns attributes of the ServiceInterfacePoint identified by the provided inputs including references to the mapped NodeEdgePoints. This includes ServiceInterfacePoint in any state. Includes references to the mapped ConnectionServiceEndPoints.
Actor(s)	SOF and ICM
Pre-Conditions	
Process Steps	1. SOF sends GET request for uniquely identified ServiceInterfacePoint with inputs: a. ServiceInterfacePoint ID 2. When NULL is provided, this API call should return an error condition. 3. ICM returns result to SOF.
Post-Conditions	1. List of IDs, Names, User-Labels 2. Lifecycle State 3. List of supported NrpSipAttrs *types* including attribute-details indexed. 4. Reference to the ConnectionServiceEndPoints mapped to this ServiceInterfacePoint. 5. Reference to the NodeEdgePoint mapped to this ServiceInterfacePoint. 6. If Synchronous API operation – return success or failure code/message. or 7. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Exceptions	There is a chance when retrieving network resources is performed a failure may occur. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0011

Use Case Id	**UC_Presto_NRP_0021**
Use Case Name	Get Connectivity Service List
Description	Retrieve a list of ConnectivityServices. Returns list of ConnectivityService entities that represent the connectivity requests that were received.
Actor(s)	SOF and ICM
Pre-Conditions	
Process Steps	1. SOF sends GET request for ConnectivityService List with inputs: a. Retrieve Scope Filter: NrpConnectivityServiceAttrs List: Enumeration value. If set, the API call will return output that is relevant to the specified NrpConnectivityServiceAttrs only. b. If set/non-empty, the API call will return references to only those encompassed ConnectivityServices that support at least one of the specified layer protocols. c. Include Connections: true or false 2. ICM returns result to SOF.
Post-Conditions	2. List of *ConnectivityServices* indexed by Layer and details for each including: a. List of IDs, Names, User-Labels b. Administrative, Operational and Lifecycle States c. Connectivity Constraints including: d. Required Constraints such as Capacity e. Optional Constraints such as Layer, Latency, Cost, etc. 3. List of following details for every ConnectivityServiceEndPoint and associated ServiceInterfacePoint associated with the ConnectivityService a. Role of the terminating ConnectivityServiceEndPoint/ServiceInterfacePoint in the context of the ConnectivityService b. Directionality of the terminating ConnectivityServiceEndPoint/ServiceInterfacePoint in the context of the ConnectivityService c. Reference to ConnectivityServiceEndPoint/ServiceInterfacePoint 4. Optionally List of Connections realizing the ConnectivityService. 5. If Synchronous API operation – return success or failure code/message. or

	6. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Exceptions	There is a chance when retrieving network resources is performed a failure may occur. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0011

Use Case Id	**UC_Presto_NRP_0022**
Use Case Name	Get Connectivity Service Details
Description	Retrieve the details of specified ConnectivityService. Returns list of ConnectivityService entities that represent the connectivity requests that were received.
Actor(s)	SOF and ICM
Pre-Conditions	
Process Steps	1. SOF sends GET request for uniquely identified ConnectivityService with inputs: a. Retrieve Scope Filter: NrpConnectivityServiceAttrs List: Enumeration value. If set, the API call will return output that is relevant to the specified NrpConnectivityService type only. b. If set/non-empty, the API call will return references to only those encompassed ConnectivityServices that support at least one of the specified layer protocols. c. Include Connections: true or false 2. ICM returns result to SOF.
Post-Conditions	ConnectivityServices and details for each including: 1. ID, Name, User-Labels 2. Administrative, Operational and Lifecycle States 3. Connectivity Constraints including: a. Required Constraints such as Capacity b. Optional Constraints such as Layer, Latency, Cost, etc. 4. List of following details for every ServiceInterfacePoint associated with the Edge ConnectivityService a. Role of the terminating ServiceInterfacePoint in the context of the ConnectivityService b. Directionality of the terminating ServiceInterfacePoint in the context of the ConnectivityService c. Reference to ServiceInterfacePoint d. Reference to ConnectionServiceEndPoint*(s)* associated with each ServiceIntefacePoint. 5. Optionally List of Connections realizing the ConnectivityService. 6. If Synchronous API operation – return success or failure code/message. or 7. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).

Exceptions	There is a chance when retrieving network resources is performed a failure may occur. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0011

Use Case Id	**UC_Presto_NRP_0023**
Use Case Name	Get Node Edge Point Details
Description	Retrieve the details of specified NodeEdgePoint. Returns attributes of the NodeEdgePoint identified by the provided inputs.
Actor(s)	SOF and ICM
Pre-Conditions	
Process Steps	1. SOF sends GET request for uniquely identified NodeEdgePoint with inputs: a. Topology ID or Name: String i. ID/name of the containing Topology that owns this Link. ii. When NULL is provided, this API call should return an error. b. Node ID or Name: String i. ID/name of the containing *Node* that owns or references this NodeEdgePoint. ii. When NULL is provided, this API call should return an error condition. c. NodeEdgePoint ID or Name: String i. When NULL is provided, this API call should return an error. d. Scope Filter: NrpSipAttrs Name List: Enumeration value 2. ICM returns result to SOF. If set/non-empty, the API call will return only the specified NrpSipAttrs attribute-details indexed by Layer.
Post-Conditions	1. List of IDs, Names, User-Labels 2. Administrative, Operational and Lifecycle States 3. List of supported NrpSipAttrs including attribute-details indexed by layers. 4. If Synchronous API operation – return success or failure code/message. or 5. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).

Exceptions	There is a chance when retrieving network resources is performed a failure may occur. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0012

Use Case Id	**UC_Presto_NRP_0024**
Use Case Name	Get Link Details
Description	Retrieve the details of specified Link. Returns attributes of the Link identified by the provided inputs. This includes references to NodeEdgePoints terminating the Link.
Actor(s)	SOF and ICM
Pre-Conditions	
Process Steps	1. SOF sends GET request for uniquely identified Link with inputs: a. Topology ID or Name: String b. ID/name of the containing Topology that owns this Link. c. When NULL is provided, this API call should return an error. d. Link ID or Name: String e. Scope Filter: NrpSipAttrs Name List: Enumeration value. 2. ICM returns result to SOF. If set/non-empty, the API call will return references to only those terminating NodeEdgePoints that support at least one of the specified layer protocols. When NULL is provided, this API call should return an error condition.
Post-Conditions	1. List of IDs, Names, User-Labels 2. Administrative, Operational and Lifecycle States 3. List of supported NrpSipAttrs Names 4. Transfer characteristics such as Cost, Timing, Integrity and Capacity 5. Risk characteristics including shared-risk 6. Validation characteristics – Validation describes the various adjacent discovery and reachability verification protocols. Also, may describe information source and degree of integrity. 7. List of following details for every NodeEdgePoint terminating the Link a. Role of the terminating NodeEdgePoint terminating the Link b. Direction of the terminating NodeEdgePoint in the context of the Link c. Reference to terminating NodeEdgePoint d. List of references to associated Nodes 8. If Synchronous API operation – return success or failure code/message. or

	9. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Exceptions	There is a chance when retrieving network resources is performed a failure may occur. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0012

Use Case Id	**UC_Presto_NRP_0025**
Use Case Name	Get Node Details
Description	Retrieve the details of specified Node. Returns attributes of the Node identified by the provide inputs.
Actor(s)	SOF and ICM
Pre-Conditions	
Process Steps	1. SOF sends GET request for uniquely identified *Node* with inputs: a. Topology ID or Name: String b. ID/name of the containing Topology that owns this Node. c. Node ID or Name: String d. Scope Filter: NrpSipAttrs Name List: Enumeration value 2. ICM returns result to SOF. If set/non-empty, the API call will return references to only those aggregated NodeEdgePoints that support at least one of the specified layer protocols. When NULL for any attribute is provide, this API call should return an error.
Post-Conditions	1. List of IDs, Names, User-Labels 2. List of supported NrpSipAttrs Names 3. Administrative, Operational and Lifecycle States 4. Transfer characteristics such as Cost, Timing, Integrity and Capacity. 5. List of references to aggregated NodeEdgePoints indexed by Layer. 6. If Synchronous API operation – return success or failure code/message. or 7. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Exceptions	There is a chance when retrieving network resources is performed a failure may occur. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply

Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0012

Use Case Id	**UC_Presto_NRP_0026**
Use Case Name	Get Topology Details
Description	Retrieve the details of specified Topology. Returns list of attributes of the Topology identified by the provided inputs.
Actor(s)	SOF and ICM
Pre-Conditions	
Process Steps	1. SOF sends GET request for uniquely identified Topology with inputs: a. Topology ID or Name: String b. Scope Filter: NrpSipAttrs Name List: Enumeration value. 2. ICM returns result to SOF.
Post-Conditions	1. List of IDs, Names, User-Labels 2. List of encompassed Nodes indexed by Layer including Node details. 3. List of encompassed Links indexed by Layer including Link details. 4. If Synchronous API operation – return success or failure code/message. or 5. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Exceptions	There is a chance when retrieving network resources is performed a failure may occur. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0012

Use Case Id	**UC_Presto_NRP_0027**
Use Case Name	Get Topology List
Description	Retrieve the list of Topologies. Returns list of top-level Topology instances directly scoped by the Context.
Actor(s)	SOF and ICM
Pre-Conditions	
Process Steps	1. SOF sends a GET request for all *Topologies* with input: a. Retrieve Scope Filter: NrpSipAttrs List: Enumeration value. If set, the API call will return output that is relevant to the specified NrpSipAttrs only. 2. ICM returns result to SOF.
Post-Conditions	List of Topology entities and details for each including: 1. List of IDs, Names, User-Labels 2. List of encompassed Nodes indexed by Layer including Node details. 3. List of encompassed Links indexed by Layer including Link details. 4. If Synchronous API operation – return success or failure code/message. or 5. If Asynchronous API operation - return message MUST contain a resource representation and a Location header with resource location (i.e., URI).
Exceptions	There is a chance when retrieving network resources is performed a failure may occur. When it does happen, the SOF will be notified with one of the following exceptions. Supported exceptions: • EntityNotFound • InvalidInput • InternalError • NotImplemented • CommLoss • AccessDenied • UnableToComply NOTE: If set/non-empty, the API call will return references to only those Topology instances that support at least one of the specified layer protocols.
Business Process	MEF 50 Table 15
Requirement	R_Presto NRP_0012

11 Traceability Matrices

11.1 Use Case to Requirements

Use Case Id	Use Case Name	Requirements
UC_Presto_NRP_0001	Create and Activate ConnectivityService	R_Presto_NRP_0001
UC_Presto_NRP_0002	Create ConnectivityService	R_Presto_NRP_0001
UC_Presto_NRP_0003	Activate ConnectivityService	R_Presto_NRP_0001
UC_Presto_NRP_0004	Deactivate and Delete ConnectivityService	R_Presto_NRP_0001
UC_Presto_NRP_0005	Deactivate ConnectivityService	R_Presto_NRP_0001
UC_Presto_NRP_0006	Delete ConnectivityService	R_Presto_NRP_0001
UC_Presto_NRP_0007	Suspend ConnectivityService	R_Presto_NRP_0002
UC_Presto_NRP_0008	Resume ConnectivityService	R_Presto_NRP_0003
UC_Presto_NRP_0009	Modify ConnectivityService/ConnectivityServiceEndPoint	R_Presto_NRP_0001
UC_Presto_NRP_0010	Modify ServiceInterfacePoint	R_Presto_NRP_0004
UC_Presto_NRP_0011	Add ServiceInterfacePoint to ConnectivityService	R_Presto_NRP_0005
UC_Presto_NRP_0012	Remove ServiceInterfacePoint from ConnectivityService	R_Presto_NRP_0006
UC_Presto_NRP_0013	Suspend ServiceInterfacePoint	R_Presto_NRP_0007
UC_Presto_NRP_0014	Resume ServiceInterfacePoint	R_Presto_NRP_0008
UC_Presto_NRP_0015	Suspend Connectivity Service End Point	R_Presto_NRP_0009
UC_Presto_NRP_0016	Resume Connectivity Service End Point	R_Presto_NRP_0010
UC_Presto_NRP_0017	Get Connection Details	R_Presto_NRP_0012
UC_Presto_NRP_0018	Get ConnectionEndPoint Details	R_Presto_NRP_0012
UC_Presto_NRP_0019	Get ServiceInterfacePoint List	R_Presto_NRP_0011
UC_Presto_NRP_0020	Get ServiceInterfacePoint Details	R_Presto_NRP_0011
UC_Presto_NRP_0021	Get ConnectivityService List	R_Presto_NRP_0011
UC_Presto_NRP_0022	Get ConnectivityService Details	R_Presto_NRP_0011
UC_Presto_NRP_0023	Get NodeEdgePoint Details	R_Presto_NRP_0012
UC_Presto_NRP_0024	Get Link Details	R_Presto_NRP_0012
UC_Presto_NRP_0025	Get Node Details	R_Presto_NRP_0012
UC_Presto_NRP_0026	Get Topology Details	R_Presto_NRP_0012
UC_Presto_NRP_0027	Get Topology List	R_Presto_NRP_0012

Table 3-Use Case to Requirements

12 Realized Classes

The Presto NRP model primarily leverages the MEF NRM and ONF TAPI. In addition [MEF 7.3] objects associated with hierarchical bandwidth profiles are used within NRP. The bandwidth profile objects are in the MEF-Common model and imported into MEF NRM. MEF NRM provides a mapping from MEF SCA service objects and attributes to network resource objects and attributes. The Presto NRP model refines the NRM model elements. The ONF objects, Connectivity Service, Connectivity Service End Point and Service Interface Point are leveraged by Presto NRP and shown in following sections. The following section details the realized set of classes and corresponding relationships and object attributes associated with the Presto NRP model.

12.1 Class Diagrams and Class Tables

This section defines the Presto NRP interface class diagrams and presents the detailed class definitions for Presto NRP realized classes. The Presto NRP classes are sub-classed from NRM classes and are associated with ONF TAPI classes using an augmentation mechanism. In addition, this section provides mapping of MEF SCA objects to MEF Presto NRP objects.

12.1.1 Augmentation

The following section provides context for the Presto NRP objects that are created and associated with ONF TAPI objects in support of network resource activation. The discussion is based on modeling principles and how a corresponding YANG data model is derived.

The Presto NRP IPS model has been extended using software patterns to support the UML-YANG mapping tool known as Project EAGLE provided by the Informal Inter-SDO Model Initiative [IISOMI EAGLE]. The EAGLE tool provides the capability to translate UML to YANG as defined in RFC7950 with the intention that the output YANG files can be used in a REST style API definition.

12.1.2 MEF SCA/MEF NRM to MEF Presto NRP Mappings

The following section details mapping of MEF SCA [MEF 56] objects and attributes to MEF Presto NRP objects and attributes. The mapping is a functional component of the LSO SOF.

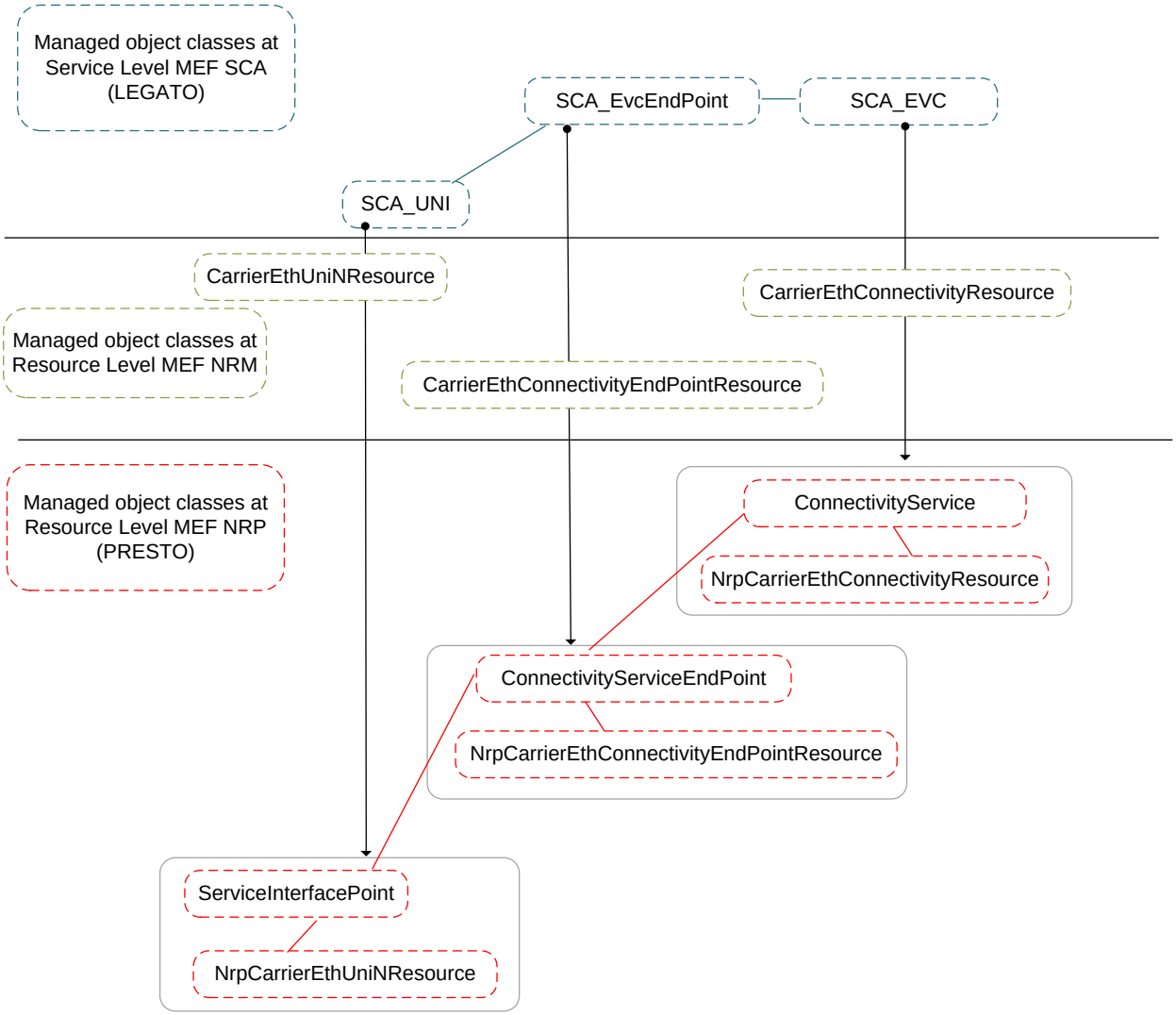

Figure 16-MEF SCA UNI/EVC/EVC End Point-to-MEF Presto NRP Mappings

The UNI, EVC End Point and EVC and corresponding service attributes are defined in [MEF 6.2] and [MEF 10.3]. The corresponding MEF SCA objects (SCA_UNI, SCA_EvcEndPoint and SCA_EVC) map to MEF Presto NRP ServiceInterfacePoint, ConnectivityServiceEndPoint and ConnectivityService respectively.

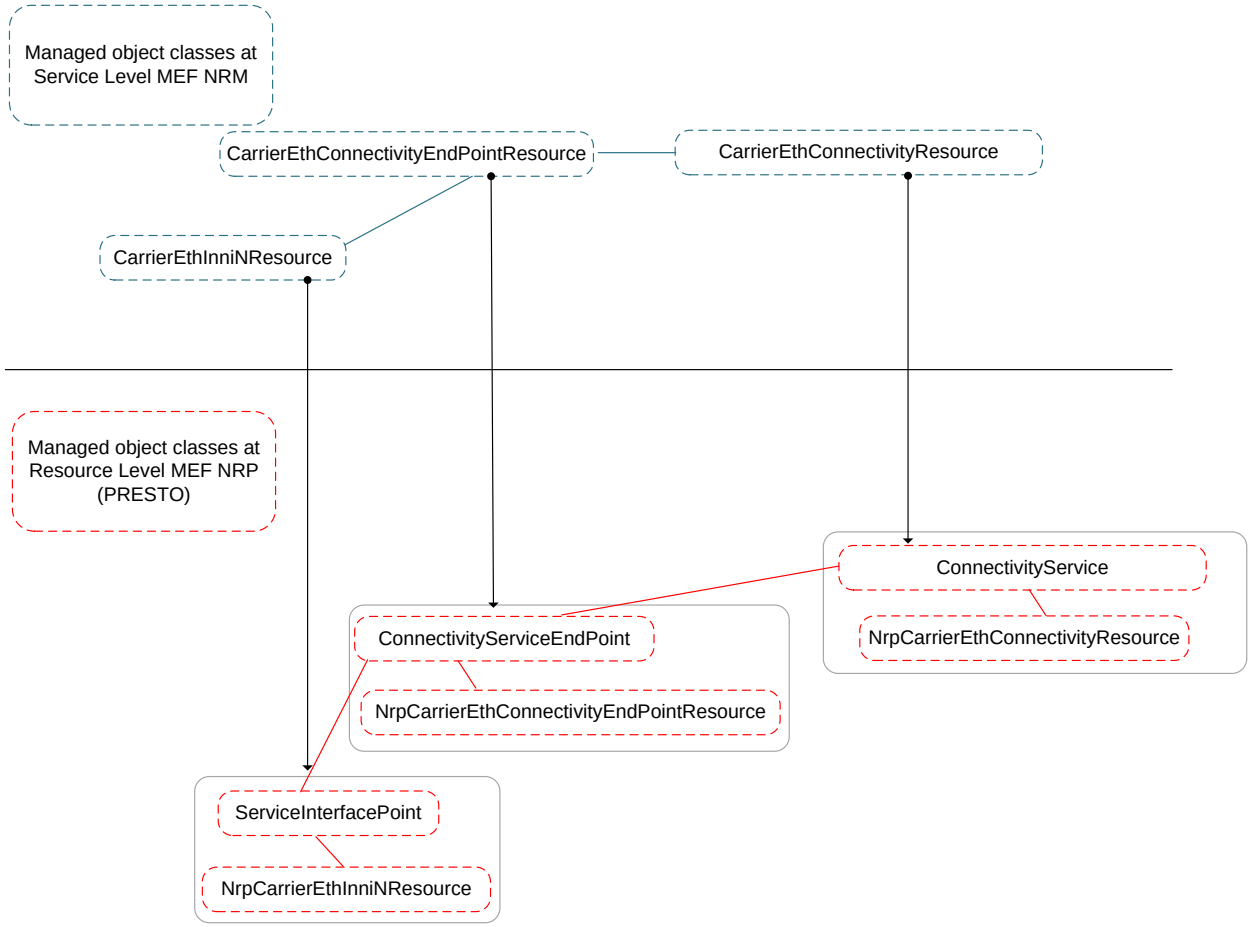

Figure 17-MEF Service Decomposition INNI Per CSP-to-MEF Presto NRP Mapping

The INNI is defined in [MEF 4]. MEF NRM objects map to MEF Presto NRP ServiceInterfacePoint, ConnectivityServiceEndPoint and ConnectivityService respectively.

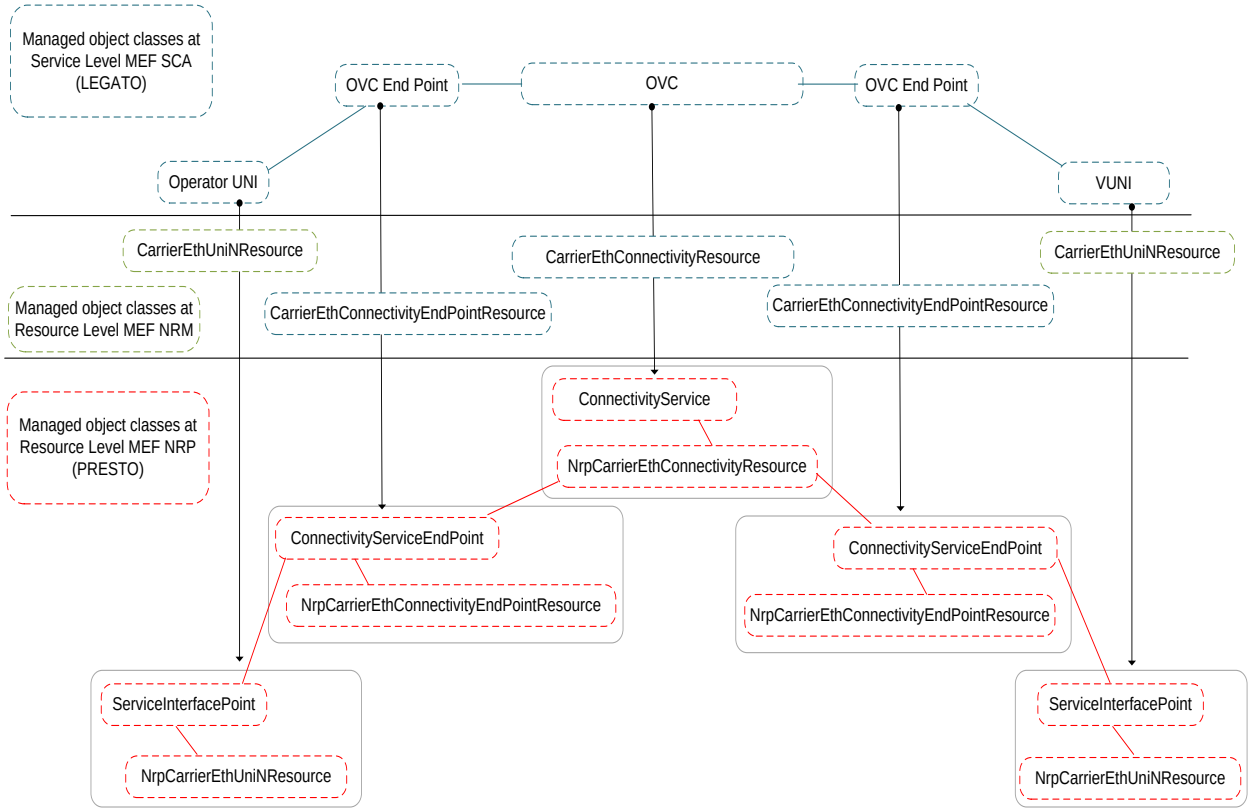

Figure 18-MEF 7.3[1] Operator UNI/VUNI/OVC/OVC End Point-to-MEF Presto NRP Mapping

The Operator UNI, VUNI, OVC, OVC End Point and corresponding service attributes are currently defined in [MEF 26.2]. These MEF SCA objects map to MEF Presto NRP ServiceInterfacePoint, ConnectivityServiceEndPoint and ConnectivityService respectively.

[1] Reference MEF 7.3 now. Next release of MEF SCA will support OVC-based services and corresponding objects.

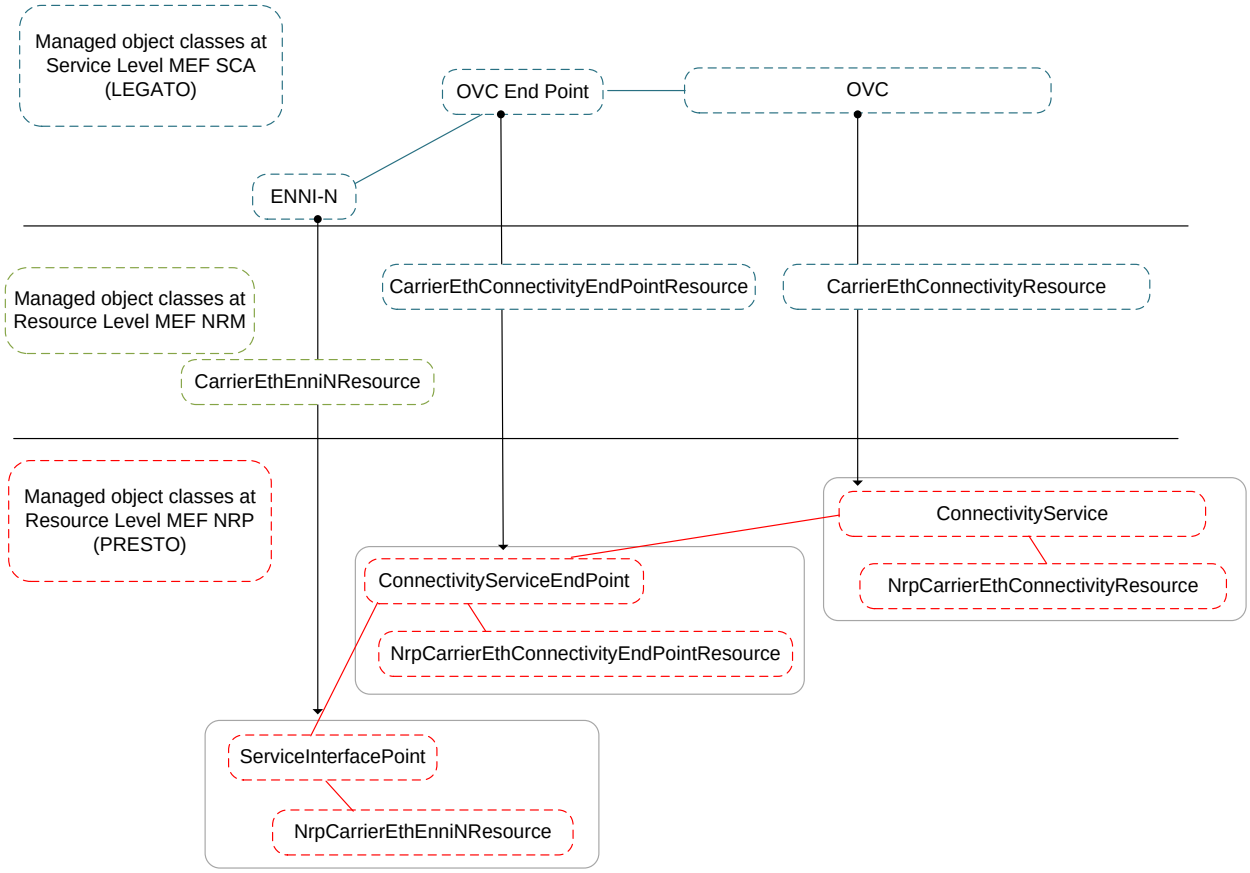

Figure 19-MEF 7.3[2] ENNI/OVC/OVC End Point-to-MEF Presto NRP Mapping

The ENNI, OVC, OVC End Point and corresponding service attributes are currently defined in [MEF 26.2]. These MEF SCA objects map to MEF Presto NRP ServiceInterfacePoint, ConnectivityServiceEndPoint and ConnectivityService respectively.

[2] Reference MEF 7.3 now. Next release of MEF SCA will support OVC-based services and corresponding objects.

12.2 Presto NRP Base Classes

The following section discusses the Presto NRP classes and association with ONF TAPI and NRM models in support of activation and topology functionality.

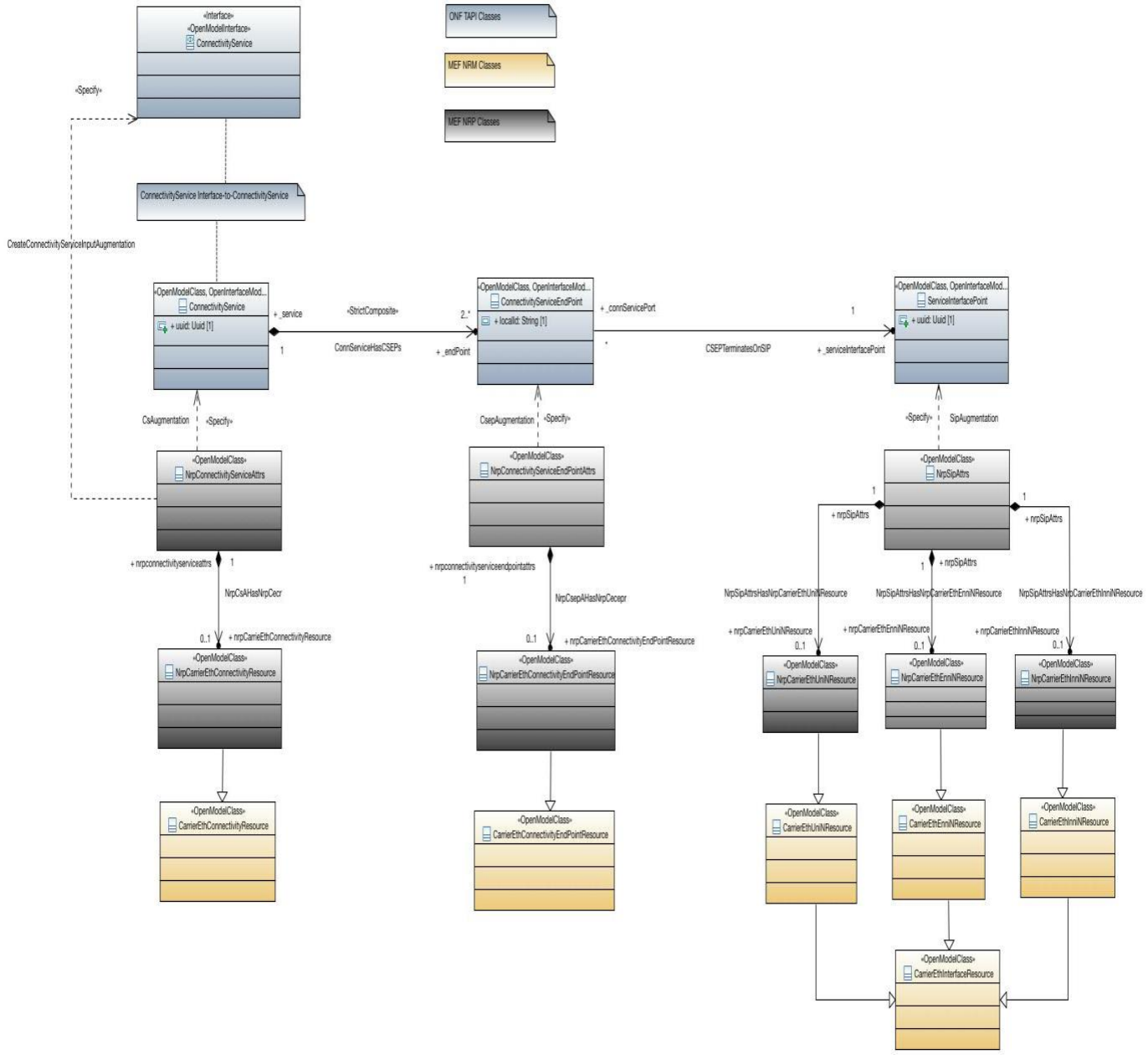

Figure 20-Presto NRP Base Classes

12.2.1 ONF TAPI Base Classes and Unique Identifiers

The Presto NRP object uniqueness is derived from the ONF TAPI base classes of Connectivity Service, Connectivity Service End Point and Service Interface Point. Unique identifiers are attributes of each of the ONF TAPI objects.

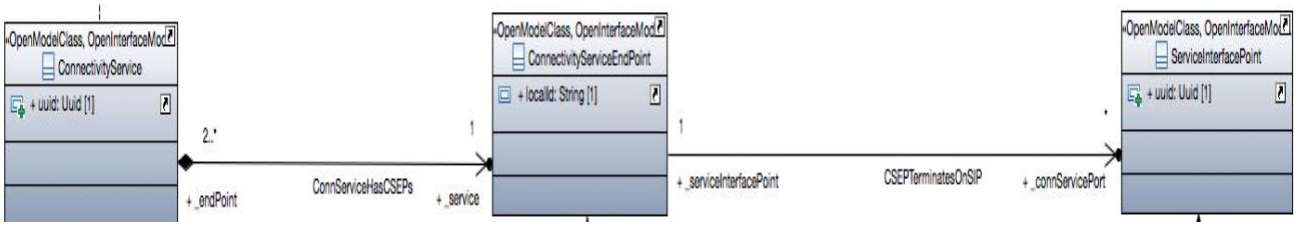

Figure 21-ONF TAPI and Unique IDs

12.3 End Point Classes

The following section discusses the End Point classes used to support UNI, INNI and ENNI objects. The corresponding Presto NRP objects are NrpCarrierEthUniNResource, NrpCarrierEthInniNResource and NrpCarrierEthEnniNResource. The MEF-Common model provides the BwpFlow and Envelope objects that are used to ingress and egress bandwidth profiles.

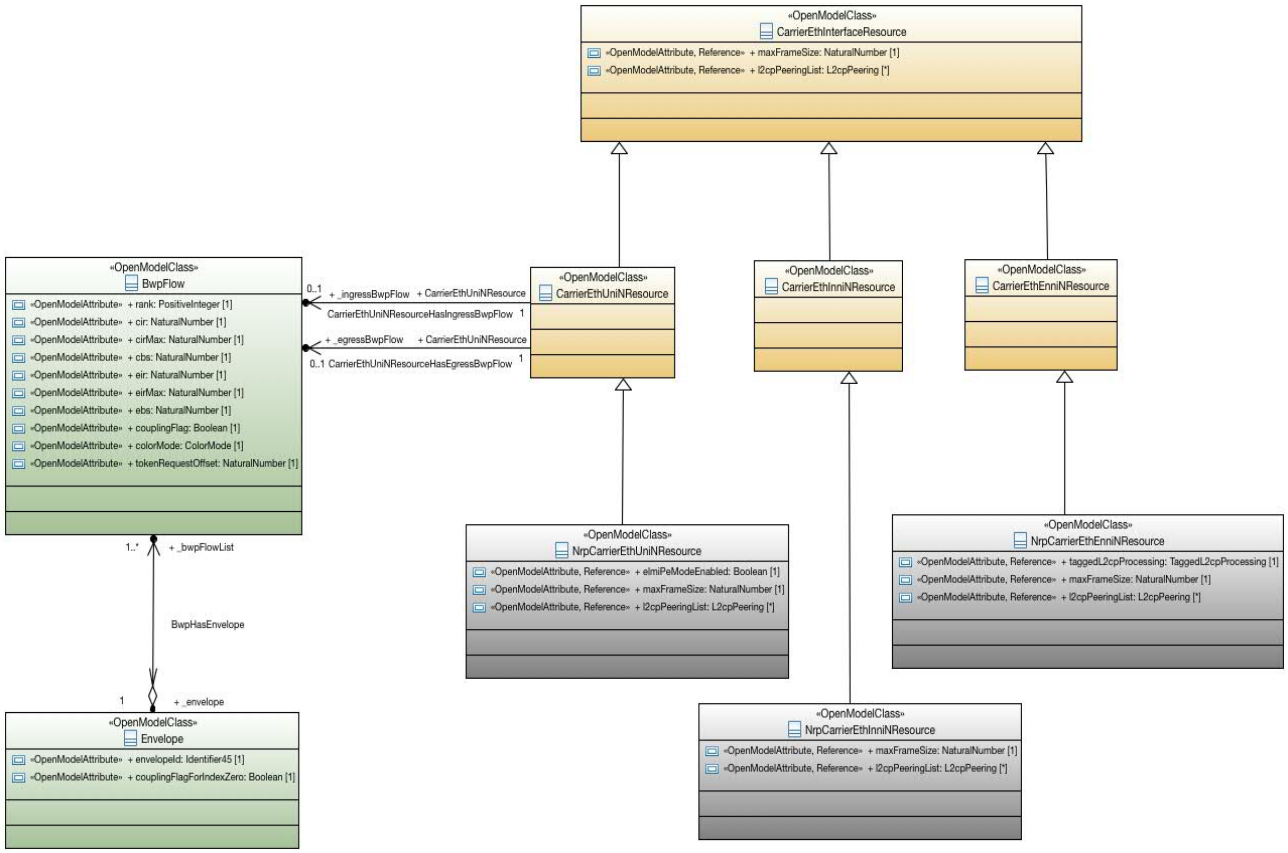

Figure 22-End Point Classes

12.3.1 NrpCarrierEthUniNResource

NrpCarrierEthUniNResource is the network resource object representation that is mapped from MEF SCA_UNI object. The attributes support the necessary functionality of UNI. The NrpCarrierEthUniNResource is sub-classed from NRM CarrierEthUniNResource. The NrpCarrierEthUniNResource is associated with ONF TAPI ServiceInterfacePoint using NrpSipAttrs augmentation.

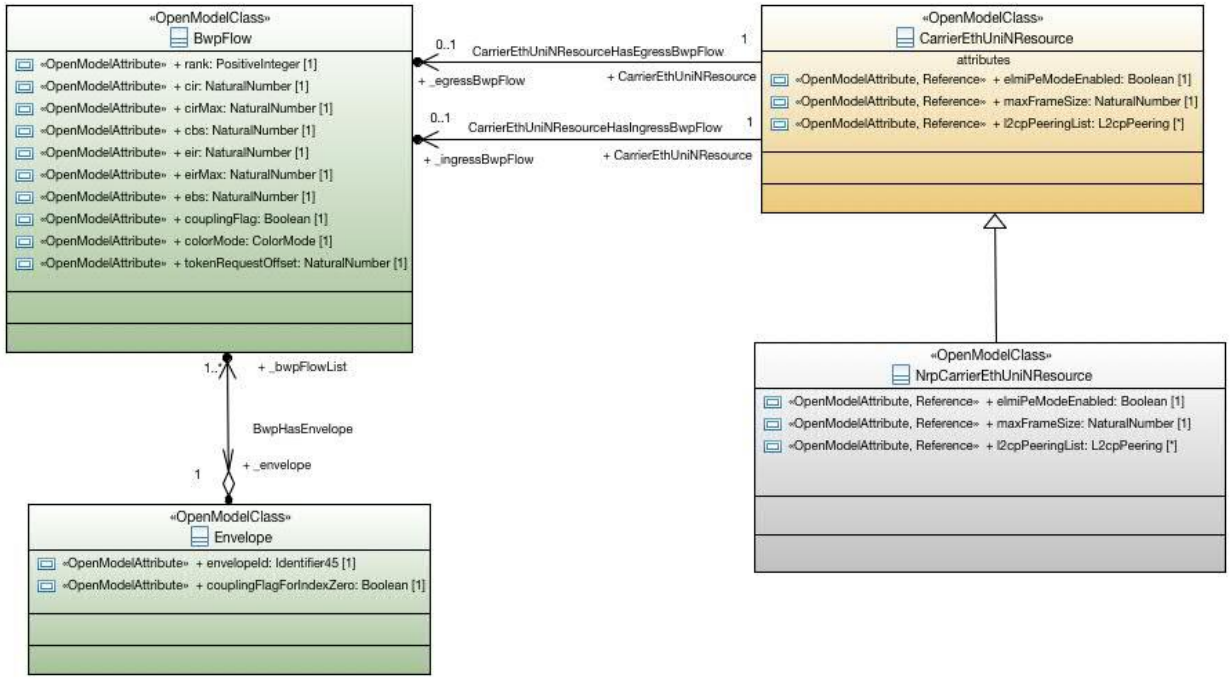

Figure 23-NrpCarrierEthUniNResource

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
elmiPeModeEnabled	Boolean	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	MEF 7.3: This attribute denotes whether the ELMI is enabled or not. When the value is TRUE, the CEN MUST meet the mandatory requirements in MEF 16 that apply to the UNI-N. Note: Ethernel Local Management Interface protocol contents are defined which clearly identify MEF Service/Resource constructs like UNI and EVC, hence the attribute cannot be placed in an Ethernet generic class.
_ingressBwpFlow	BwpFlow	0..1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	MEF 7.3: This attribute denotes an ingress bandwidth profile if applicable.
_egressBwpFlow	BwpFlow	0..1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	MEF 7.3: This attribute denotes an egress bandwidth profile if applicable.
maxFrameSize NOTE: Inherited attribute from CarrierEthInterfaceResource	NaturalNumber	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This value limits the length of frames carried by a CarrierEthInterfaceResource. This is agreed between the Service Provider and the Customer for CarrierEthUniNResource, between Operators for CarrierEthEnniNResource and must match between devices for CarrierEthInniNResource.
l2cpPeeringList NOTE: Inherited attribute from CarrierEthInterfaceResource	L2cpPeering	0..*	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute represents the L2CP Peering defined in MEF 45 when applied to the CarrierEthUniNResource/CarrierEthEnniNResource.

Table 4-NrpCarrierEthUniNResource Attributes

12.3.2 NrpCarrierEthInniNResource

NrpCarrierEthInniNResource is the network resource object representation that represents a device edge vertices associated to another device edge vertices through a link/edge within a common ICM domain. The attributes support the necessary functionality of INNI. The NrpCarrierEthInniNResource is sub-classed from NRM CarrierEthInniNResource. The NrpCarrierEthInniNResource is associated with ONF TAPI ServiceInterfacePoint using NrpSipAttrs augmentation.

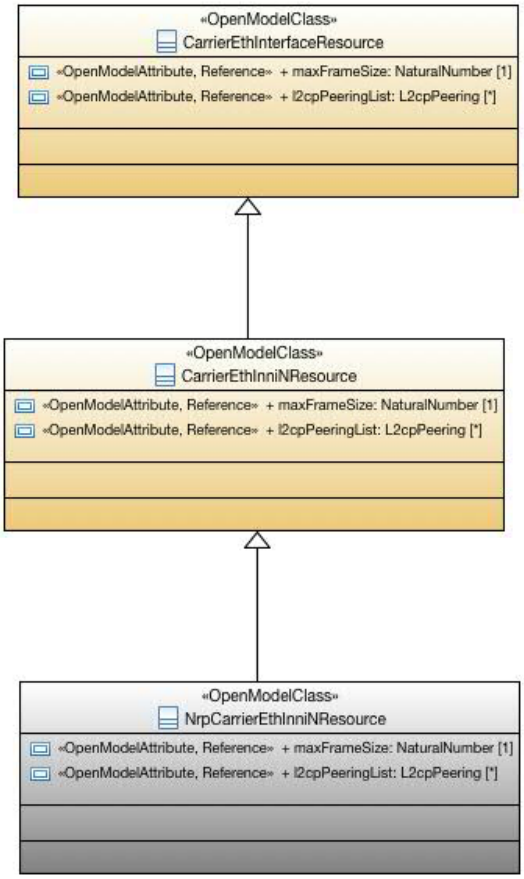

Figure 24-NrpCarrierEthInniNResource

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
maxFrameSize NOTE: Inherited attribute from CarrierEthInterfaceResource	NaturalNumber	1	Reference • reference:MEF 26.2 section 14.8, table 54 and MEF 10.3 section 9.7 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This value indicates the maximum length of frames supported by this Interface.
l2cpPeeringList NOTE: Inherited attribute from CarrierEthInterfaceResource	L2cpPeering	0..*	Reference • reference:MEF 26.2 section 10.1, 14.21 MEF 45 section 8.2 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute represents the L2CP Peering Service defined in MEF 45 section 8.2 when applied to the UNI/ENNI/INNI.

Table 5-NrpCarrierEthInniNResource Attributes

12.3.3 NrpCarrierEthEnniNResource

NrpCarrierEthEnniNResource is the network resource object representation that is mapped from MEF SCA_ENNI object. The attributes support the necessary functionality of ENNI. The NrpCarrierEthEnniNResource is sub-classed from NRM CarrierEthEnniNResource. The NrpCarrierEthEnniNResource is associated with ONF TAPI ServiceInterfacePoint using NrpSipAttrs augmentation.

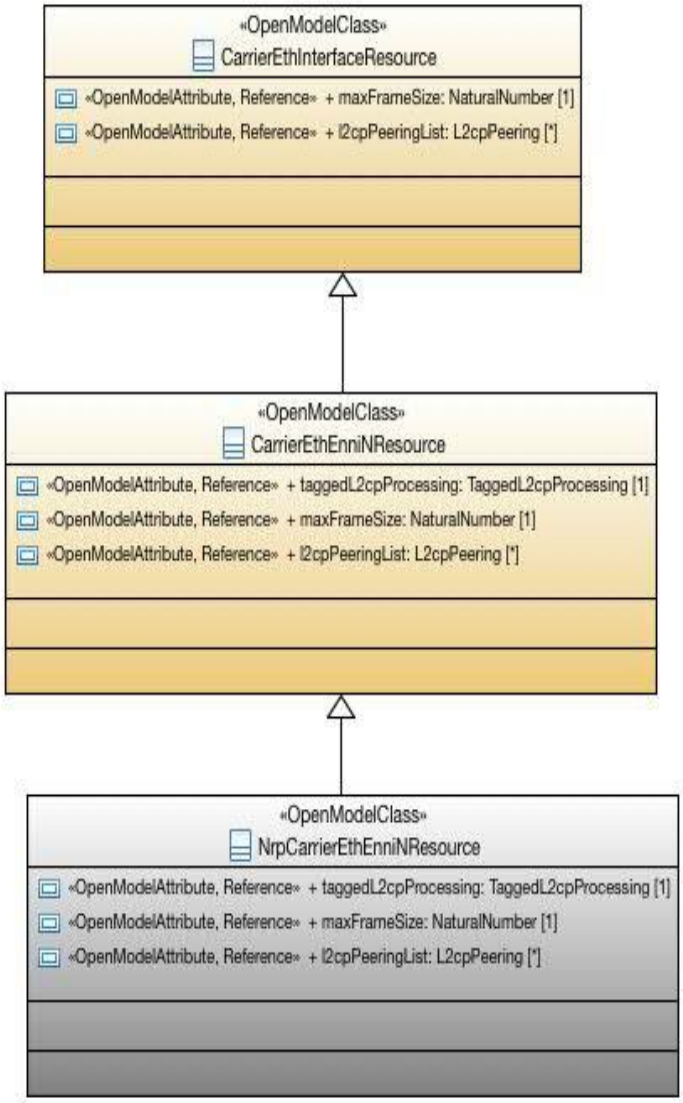

Figure 25-NrpCarrierEthEnniNResource

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
taggedL2cpProcessing	TaggedL2cpProcessing	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	MEF 7.3: This attribute represents the Tagged L2CP Processing defined in MEF 45 section 8.3 (IEEE 802.1 compliant or 802.1 non-compliant. Desired to be 802.1 compliant). It is one of the ENNI Operator Multi-lateral attributes, which requires the CENs at the ENNI-N to agree on the values but may allow these values to be different.
maxFrameSize NOTE: Inherited attribute from CarrierEthInterfaceResource	NaturalNumber	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This value limits the length of frames carried by a CarrierEthInterfaceResource. This is agreed between the Service Provider and the Customer for CarrierEthUniNResource, between Operators for CarrierEthEnniNResource and must match between devices for CarrierEthInniNResource.
l2cpPeeringList NOTE: Inherited attribute from CarrierEthInterfaceResource	L2cpPeering	0..*	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute represents the L2CP Peering defined in MEF 45 when applied to the CarrierEthUniNResource/CarrierEthEnniNResource.

Table 6-NrpCarrierEthEnniNResource Attributes

12.4 NrpCarrierEthConnectivityResource

NrpCarrierEthConnectivityResource is the network resource object representation that is mapped from MEF SCA_EVC/OVC object. The attributes support the necessary functionality of EVC or OVC. The NrpCarrierEthConnectivityResource is sub-classed from NRM CarrierEthConnectivityResource. The CarrierEthConnectivity is associated with ONF TAPI ConnectivityService object.

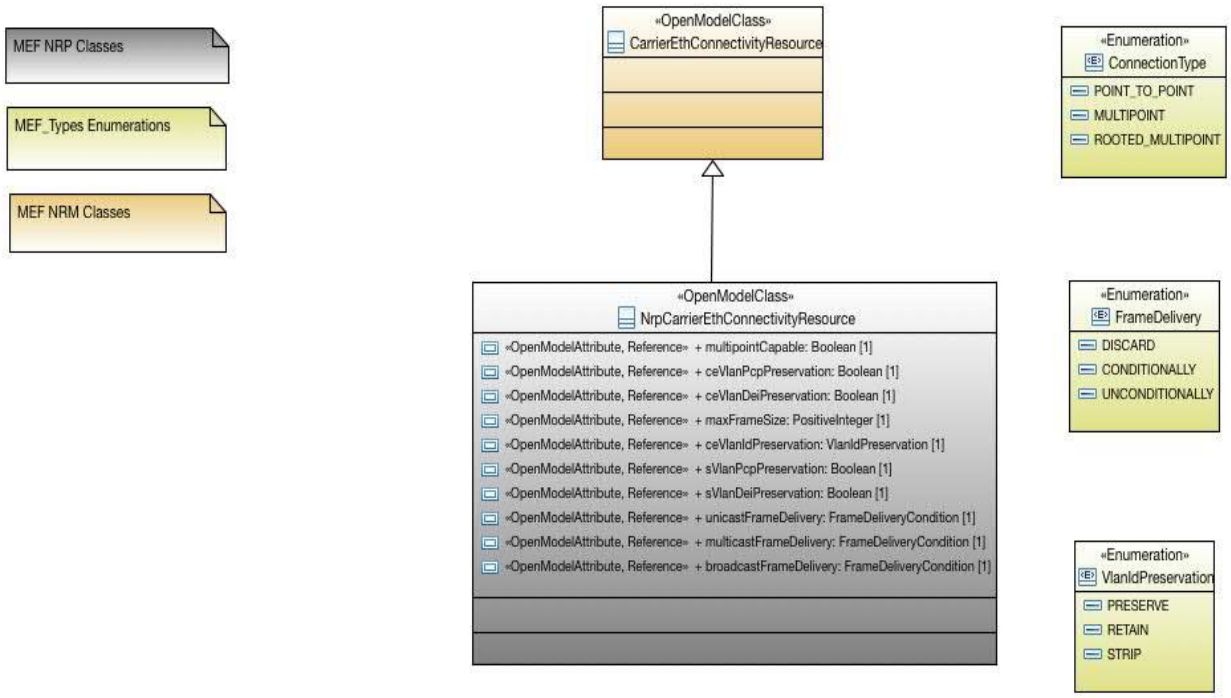

Figure 26-NrpCarrierEthConnectivityResource and associations

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
multipointCapable	Boolean	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	A value of "true" indicates that the End Points can be added/removed during Connectivity Service lifecycle.
ceVlanPcpPreservation	Boolean	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute can be used to preserve the value of the CE-VLAN PCP field in VLAN Tagged Service Frames across a Connectivity Service.
ceVlanDeiPreservation	Boolean	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute can be used to preserve the value of the CE-VLAN DEI field in VLAN Tagged Service Frames across a Connectivity Service.
maxFrameSize	PositiveInteger	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute denotes the maximum frame size in bytes.
ceVlanIdPreservation	VlanIdPreservation	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute describes a relationship between the format of the VLAN ID and related fields values of the frame at one External Interface and the format and VLAN ID and related fields values of the corresponding frame at another External Interface. Used the MEF 7.3 OVC type (PRESERVE/STRIP/RETAIN) as it depends on EVC/OVC decomposition performed by SOFs.
sVlanPcpPreservation	Boolean	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute describes a relationship between the S-VLAN PCP value of a frame at one ENNI and the S-VLAN PCP of the corresponding frame at another ENNI supported by the Operator CEN where each ENNI has a Connectivity Service End Point that is associated by the Connectivity Service.
sVlanDeiPreservation	Boolean	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute describes a relationship between the S-VLAN DEI value of a frame at one ENNI and the S-VLAN DEI of the corresponding frame at another ENNI supported by the Operator CEN where each ENNI has a Connectivity Service End Point that is associated by the Connectivity Service.
unicastFrameDelivery	FrameDeliveryCondition	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	When the value is conditionally determined the conditions that determine whether a Data Service Frame is delivered or discarded MUST be specified. Conditions can be described in the name-value pair list.
multicastFrameDelivery	FrameDeliveryCondition	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	When the value is conditionally determined the conditions that determine whether a Data Service Frame is delivered or discarded MUST be specified. Conditions can

				be described in the name-value pair list.
broadcastFrameDelivery	FrameDeliveryCondition	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	When the value is conditionally determined conditions that determine whether a Data Service Frame is delivered or discarded MUST be specified. Conditions can be described in the name-value pair list.
_carrierEthernetSls	CarrierEthernetSls	0..1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	Service Level Specification defining Ethernet performance objectives.

Table 7-NrpCarrierEthConnectivityResource Attributes

12.5 NrpCarrierEthConnectivityEndPointResource and associations

NrpCarrierEthConnectivityEndPointResource is the network resource object representation that is mapped from MEF SCA_EvcEndPoint/SCA_OvcEndPoint. The attributes support the necessary functionality of EVC and OVC End Points. The NrpCarrierEthConnectivityEndPointResource is sub classed from NRM CarrierEthConnectivityEndPointResource. The NrpCarrierEthConnectivityEndPointResource is associated with NrpConnectivityServiceEndPointAttrs. NrpConnectivityServiceEndPointAttrs is an augmentation of ONF TAPI ConnectivityServiceEndPoint.

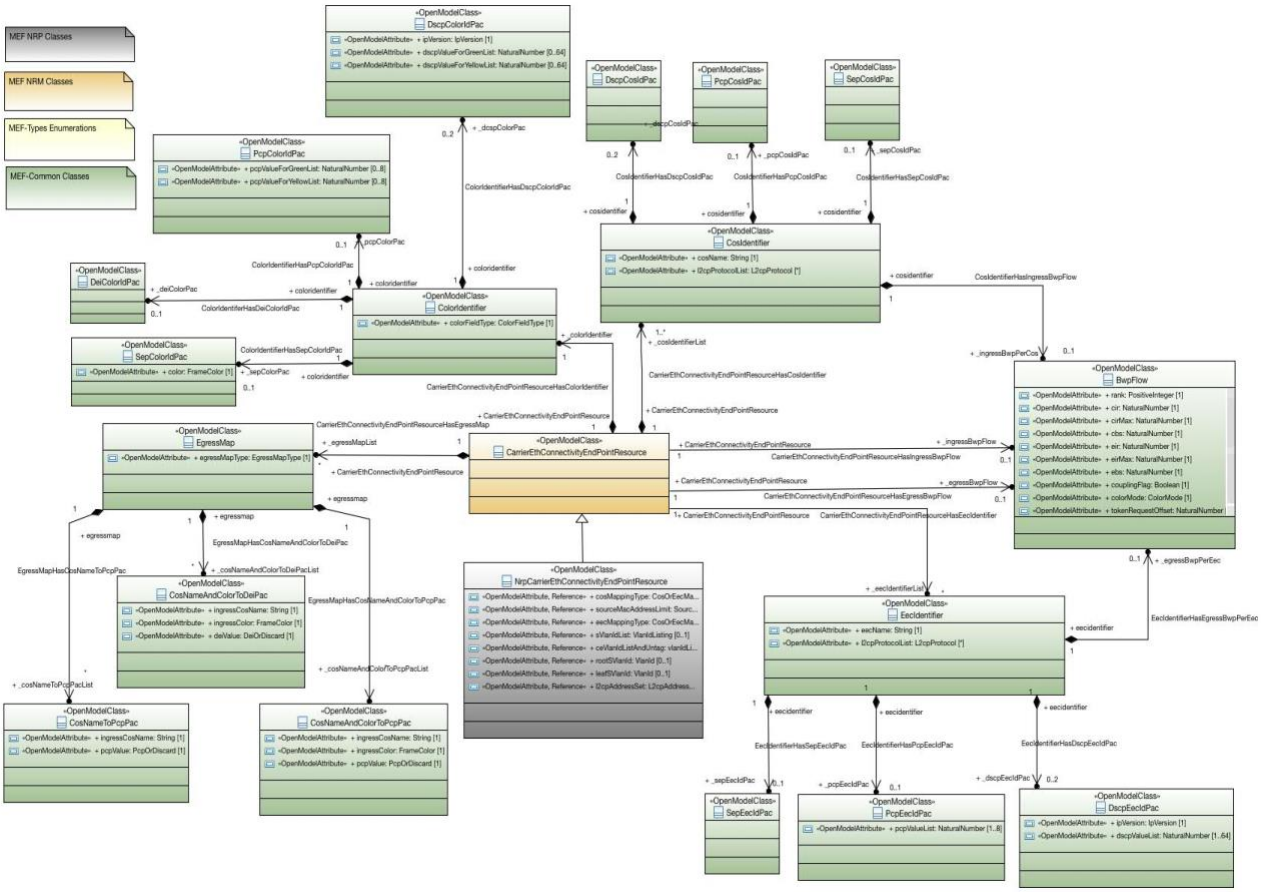

Figure 27-NrpCarrierEthConnectivityEndPointResource and associations

12.5.1 NrpCarrierEthConnectivityEndPointResource

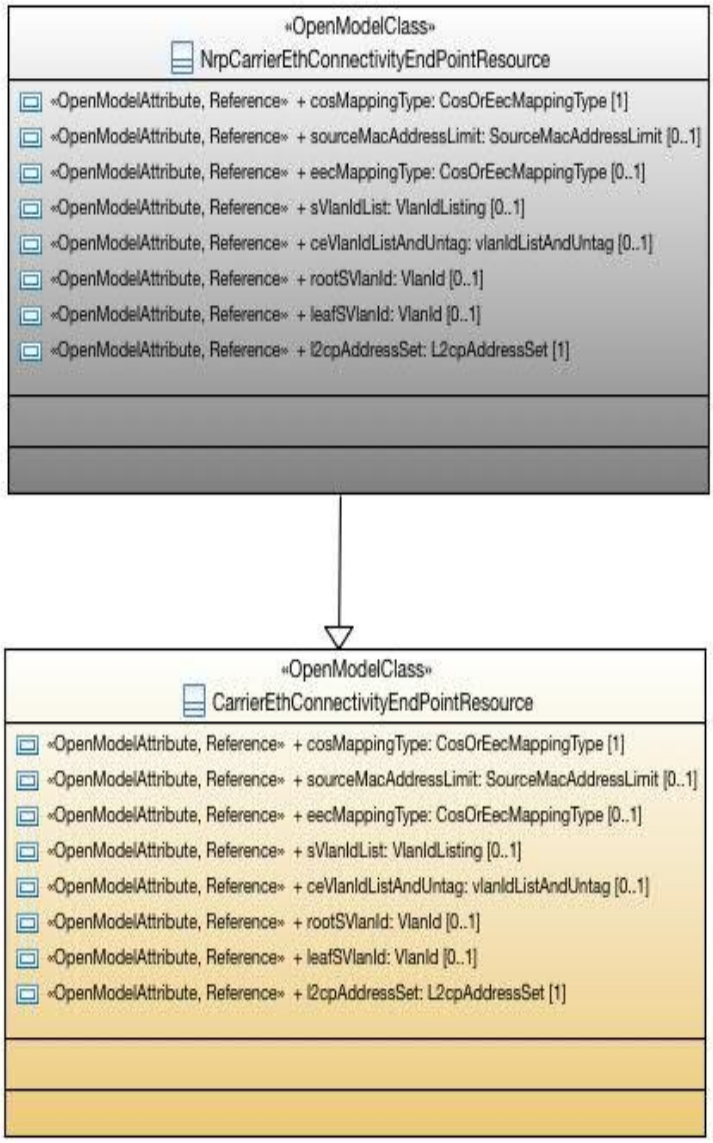

Figure 28-NrpCarrierEthConnectivityEndPointResource

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
cosMappingType	CosOrEecMappingType	1	Reference • reference:MEF 10.3 section 10.2 and MEF 26.2 section 16.6 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	The Class of Service (CoS) is used to specify ingress Bandwidth Profiles. The CoS Mapping Type is one of SEP (Service End Point) based, PCP based or DSCP based.
sourceMacAddressLimit	SourceMacAddressLimit	1	Reference • reference:MEF 10.3 section 10.9 and MEF 26.2 section 16.15 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute limits the number of source MAC Addresses that can be used in ingress EI Frames mapped to the Connectivity Service End Point of all types over a time interval. When not present, the number of source MAC addresses is unlimited. Two independent parameters control the behavior of this attribute: N : A positive integer and t : A time interval. This attribute operates by maintaining a list of maximum length N of source MAC addresses which are aged-out of the list if not seen in a time interval t. If an ingress Service Frame arrives with a new source MAC address when the list is full, the Service Frame is discarded.
eecMappingType	CosOrEecMappingType	1	Reference • reference:MEF 10.3 section 10.4 and MEF 26.2 section 16.9 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	The Egress Equivalence Class (EEC) is used to specify Egress Bandwidth Profiles. The EEC Mapping Type is one of SEP (Service End Point) based, PCP based or DSCP based. When the list of EEC Identifier is empty, this attribute shall be unset. Otherwise it shall be set.
_colorIdentifier	ColorIdentifier	1	Reference • reference:MEF 10.3 section 10.3 and MEF 26.2 section 16.7 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute represents the relationship between the Connectivity Service End Point and a Color Identifier.
sVlanIdList	VlanIdListing	0..1	Reference • reference:MEF 26.2 section 16.5.1 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	List of one or more S-VLAN ID values. An S-Tagged Frame, whose S-VLAN ID value matches an entry in this attribute, maps to the Connectivity Service End Point. Type=LIST: all listed VLAN IDs. Type=EXCEPT: all VLAN IDs except the listed ones. Type=ALL, all VLAN IDs, hence vlanId list is not applicable.
ceVlanIdListAndUntag	VlanIdListAndUntag	0..1	Reference • reference:MEF 10.3 section 9.10 MEF 26.2 section 16.5.4 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	List of one or more C-VLAN ID values. A C-Tagged Frame, whose C-VLAN ID value matches an entry in this attribute, maps to the Connectivity Service End Point. It is possible to specify whether untagged and priority tagged frames are included in the mapping.

				Type=LIST: all listed VLAN IDs. Type=EXCEPT: all VLAN IDs except the listed ones. Type=ALL, all VLAN IDs, hence vlanId list is not applicable.
rootSVlanId	VlanId	0..1	Reference • reference:MEF 26.2 section 16.5.2 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute applies only to End Points with Trunk End Point Role. It identifies the S-VLAN ID of frames mapped to either a Root End Point or a Trunk End Point (via the Root S-VLAN ID value) of the Connectivity Service.
leafSVlanId	VlanId	0..1	Reference • reference:MEF 26.2 section 16.5.2 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute applies only to End Points with Trunk End Point Role. It identifies the S-VLAN ID of frames mapped to either a Leaf End Point or a Trunk End Point (via the Leaf S-VLAN ID value) of the Connectivity Service.
_cosIdentifierList	CosIdentifier	1..*	Reference • reference:MEF 10.3 section 10.2 and MEF 26.2 section 16.6 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute represents the relationship between the Connectivity Service End Point and the Class of Service Identifier(s).
_eecIdentifierList	EecIdentifier	0..*	Reference • reference:MEF 10.3 section 10.4 and MEF 26.2 section 16.9 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute represents the relationship between the Connectivity Service End Point and the Egress Equivalence Class Identifier(s).
_egressMapList	EgressMap	0..*	Reference • reference:MEF 26.2 section 16.8 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute represents the relationship between the End Point and the Egress Map(s). This attribute is a set of mappings that determine the content of the S-Tag or C-Tag of an egress EI Frame.
l2cpAddressSet	L2cpAddressSet	1	Reference • reference:MEF 45 section 8.1 MEF 26.2 section 12.16 OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute specifies the subset of the Bridge Reserved Addresses that are filtered (i.e. L2CP Frames with this destination address are Peered or Discarded but not Passed) at a L2CP Decision Point.
_egressBwpFlow	BwpFlow	0..1	Reference • reference:MEF 10.3 section 12 and MEF 26.2 section 13. OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute denotes the relationship between a Connectivity Service End Point and the bandwidth profile flow. It describes egress policing on all egress EI Frames mapped to a given End Point.
_ingressBwpFlow	BwpFlow	0..1	Reference • reference:MEF 10.3 section 12 and MEF 26.2 section 13. OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	This attribute denotes the relationship between a Connectivity Service End Point and the bandwidth profile flow. It describes ingress policing on all ingress EI Frames mapped to a given End Point.

Table 8-NrpCarrierEthConnectivityEndPointResource Attributes

12.5.2 NrpConnectivityServiceAttrs

The NrpConnectivityServiceAttrs class supports several <<Specify>> stereotype to support the use of the Specification pattern defined in ONF TAPI model and operations for a ONF TAPI ConnectivityService. The Presto NRP ConnectivityService has a tagged value to the Context for the ConnectivityService. The Presto NRP CreateConnectivityServiceOutputAugmentation has a tagged value to the output yang augment statement for a ConnectivityService. The Presto NRP abstraction CreateConnectivityServiceInputAugmentation with a tagged value to the input yang augment statement for a ConnectivityService.

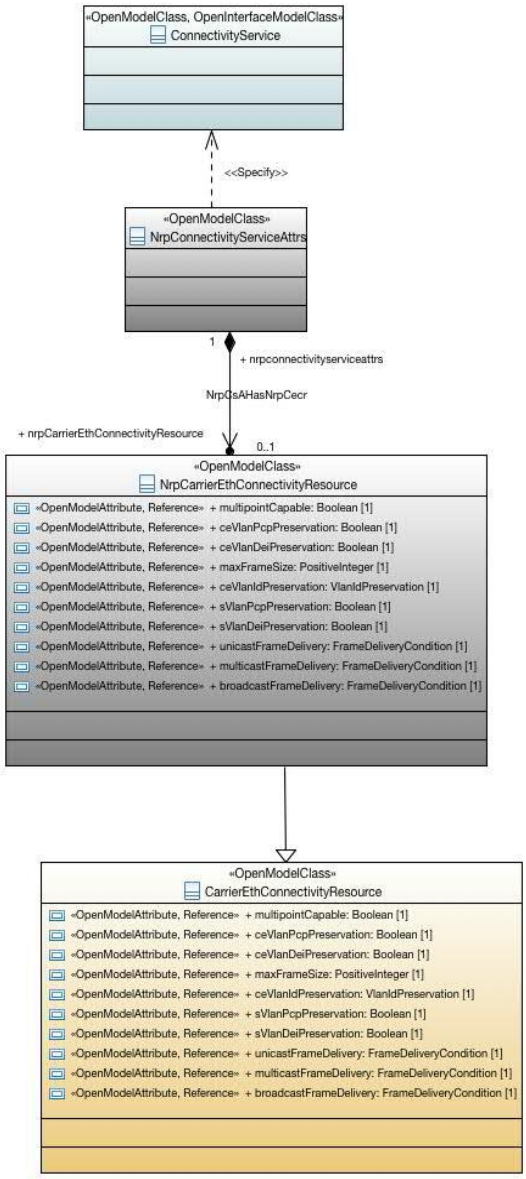

Figure 29-NrpConnectivityServiceAttrs

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
nrpCarrierEthConnectivityResource	NrpCarrierEthConnectivityResource	0..1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	The NrpConnectivityServiceAttrs class supports several <<Specify>> stereotype to support Specification of the ONF TAPI model and operations for a ONF TAPI ConnectivityService. The Presto NRP abstraction ConnectivityService has a tagged value mapping to the Context for ConnectivityService.

Table 9-NrpConnectivityServiceAttrs Attributes

12.5.3 NrpConnectivityServiceEndPointAttrs

The NrpConnectivityServiceEndPointAttrs class supports several <<Specify>> stereotype to support Specification of the ONF TAPI model and operations for a ONF TAPI ConnectivityServiceEndPoint. The Presto NRP NrpCsepAugment has a tagged value to the Context for the ConnectivityServiceEndPoint. The Presto NRP CcsEndPointOutputAugmentation with a tagged value to the output yang augment statement for a ConnectivityServiceEndPoint. The Presto NRP CcsEndPointInputAugmentation with a tagged value to the input yang augment statement for a ConnectivityServiceEndPoint.

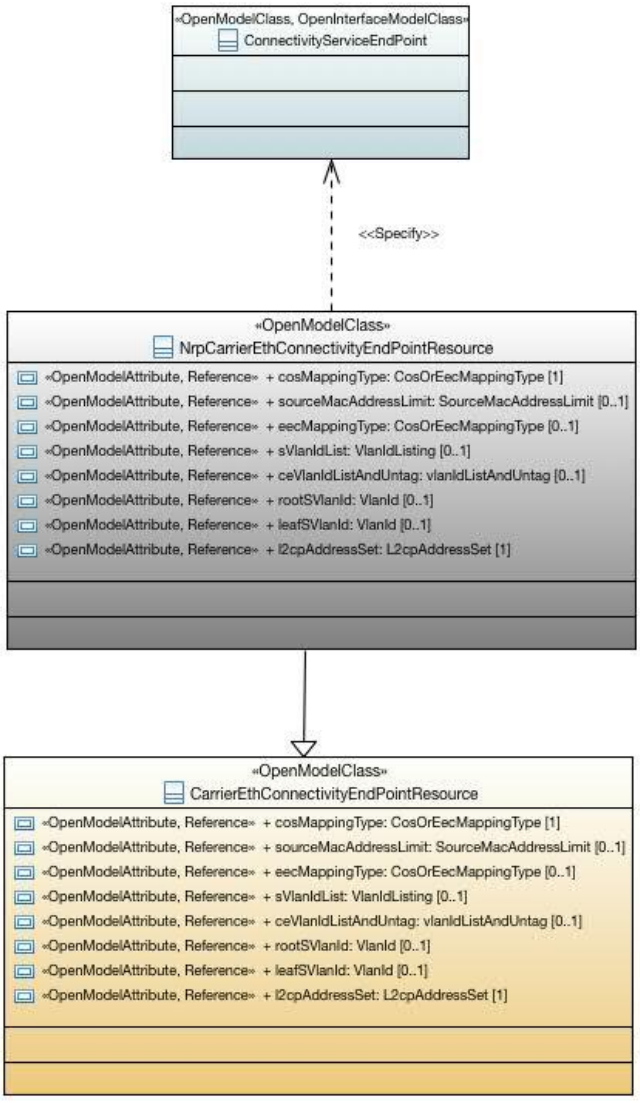

Figure 30-NrpConnectivityServiceEndPointAttrs

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
nrpCarrierEthConnectivityEndPointResource	NrpCarrierEthConnectivityEndPointResource	0..1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	The NrpConnectivityServiceEndPointAttrs class supports several <<Specify>> stereotype to support Specification of the ONF TAPI model and operations for a ONF TAPI ConnectivityServiceEndPoint.

Table 10-NrpConnectivityServiceEndPoint Attributes

12.5.4 NrpSipAttrs

The NrpSipAttrs class supports the <<Specify>> stereotype to support the use of the Specification pattern defined in the ONF TAPI model for ServiceInterfacePoint. The Presto NRP SipAugmentation has a tagged value to the Context for the ServiceInterfacePoint.

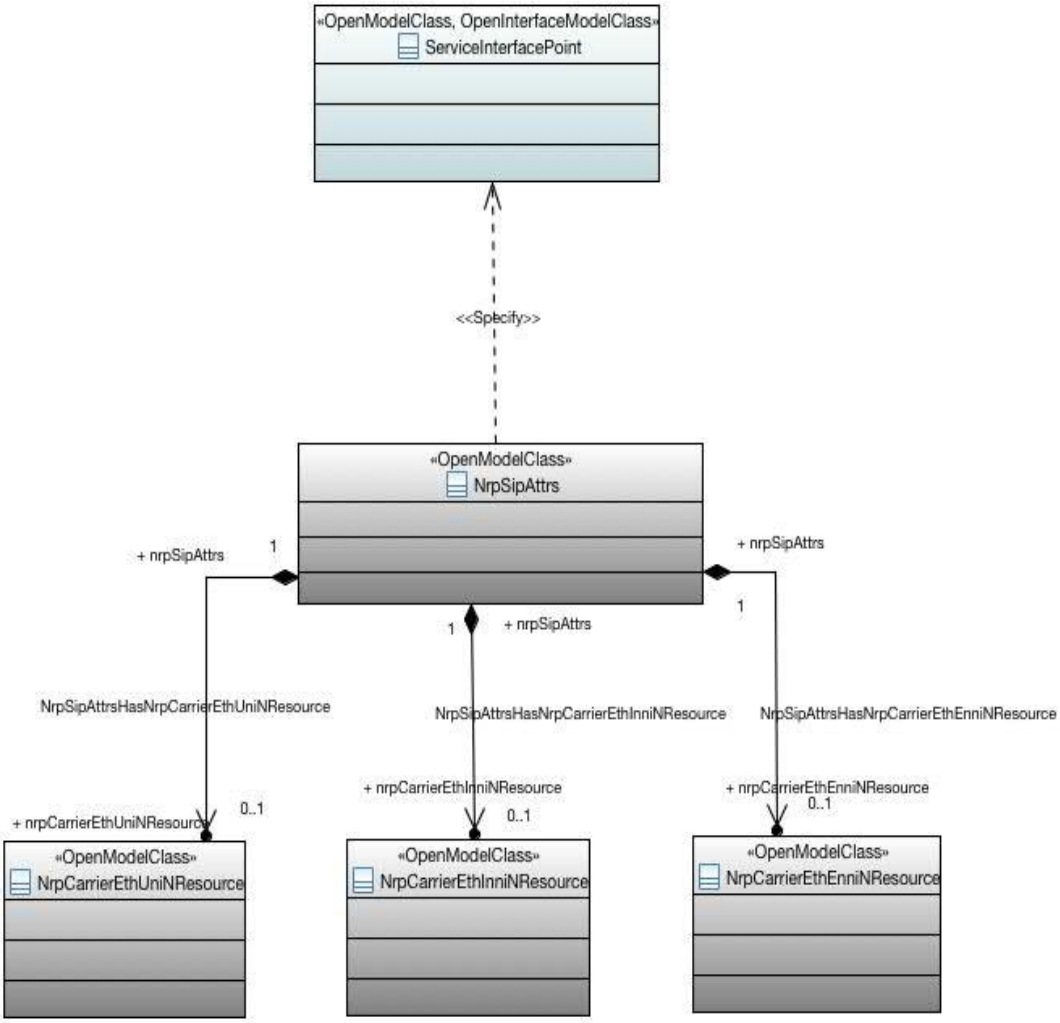

Figure 31-NrpSipAttrs

The NrpSipAttrs will have a reference to one of NrpCarrierEthUniNResource, NrpCarrierEthInniNResource or NrpCarrierEthEnniNResource at a given time.

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
NrpCarrierEthUniNResource	NrpCarrierEthUniNResource	0..1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	Reference to NrpCarrierEthUniNResource.
NrpCarrierEthInniNResource	NrpCarrierEthInniNResource	0..1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	Reference to NrpCarrierEthInniNResource.
NrpCarrierEthEnniNResource	NrpCarrierEthEnniNResource	0..1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint • support: MANDATORY	Reference to NrpCarrierEthEnniNResource.

Table 11-NrpSipAttrs Attributes

12.6 MEF-Common

MEF-Common provides a set of common objects that can be leveraged by Presto NRP as well as other APIs. MEF-Common leverages [MEF 7.3] objects that are reusable by NRP and other IPS in future.

12.6.1 BWP

The BwpFlow object class represents the Bandwidth Profile Flow which includes the bandwidth profile parameters such as CIR, CIR Max, EIR, EIR Max, CBS, EBS, Coupling Flag, Color Mode, etc. The BwpFlow object class is associated with OperatorUni, ServiceProviderUni, VUNI, CosIdentifier, EecIdentifier, and Envelope, etc.

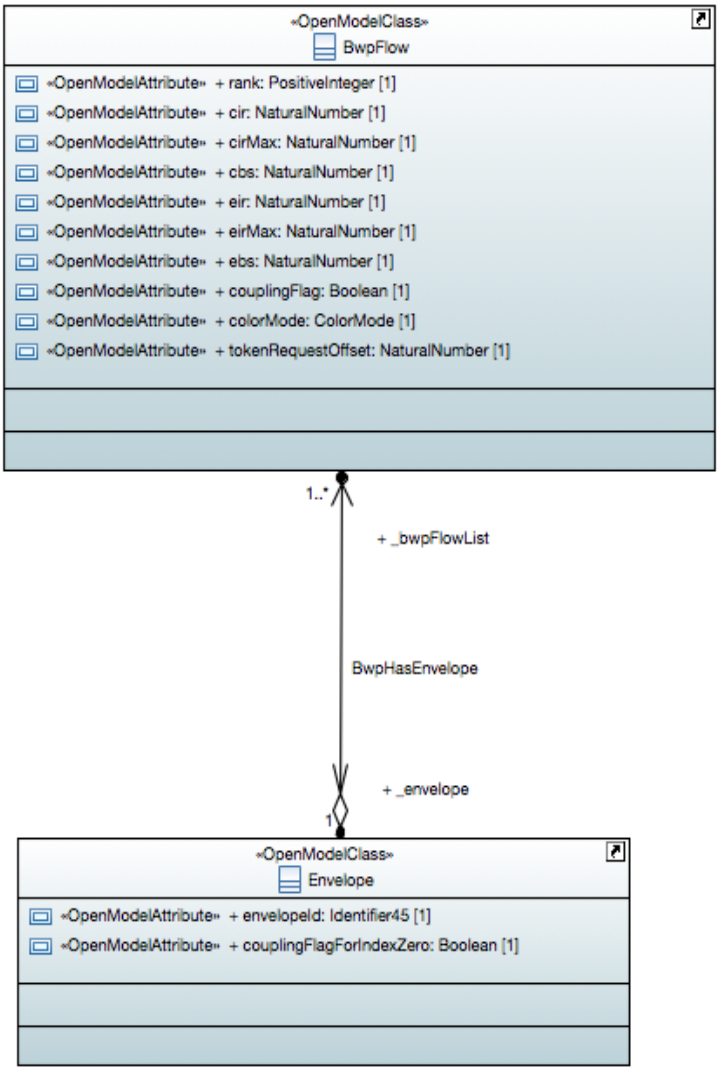

Figure 32-Bandwidth Profile

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
rank	PositiveInteger	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint support: MANDATORY	This attribute denotes the rank of the bandwidth profile in the envelope.
cir	NaturalNumber	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint support: MANDATORY	This attribute denotes the Committed Information Rate that limits the average rate of frames that will be declared Green, in bits per second.
cirMax	NaturalNumber	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint support: MANDATORY	This attribute denotes the maximum Committed Information Rate that limits the rate of tokens added to the committed token bucket, in bits per second.
cbs	NaturalNumber	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint support: MANDATORY	This attribute denotes the Committed Burst Size that limits the maximum number of bytes available for a burst of frames that will be declared Green, in bytes.
eir	NaturalNumber	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint support: MANDATORY	This attribute denotes the Excess Information Rate that limits the average rate of frames that will be declared Yellow, in bits per second.
eirMax	NaturalNumber	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint support: MANDATORY	This attribute denotes the Maximum Excess Information Rate that limits the rate of tokens added to the excess token bucket, in bits per second.
ebs	NaturalNumber	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint support: MANDATORY	This attribute denotes the Excessive Burst Size that limits the maximum number of bytes available for a burst of frames that will be declared Yellow, in bytes.
couplingFlag	Boolean	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint support: MANDATORY	This attribute denotes the Coupling Flag that determines if overflow Green tokens can be used as Yellow tokens. FALSE for 0 (overflow green tokens are discarded) and TRUE for 1 (overflow green tokens can be used as yellow tokens).
colorMode	ColorMode	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint support: MANDATORY	This attribute denotes the Color Mode that indicates whether the Color Identifier of the frame is considered by the Bandwidth Profile Algorithm.
tokenRequestOffset	NaturalNumber	1	OpenModelAttribute • isInvariant: false • valueRange: no range constraint support: MANDATORY	This attributes adjusts the number of tokens requested for each external interface frame.

Table 12-Bandwidth Profile Attributes

12.6.2 Envelope

The Envelope object class represents the UNI/ENNI service attribute Envelope, which is a bandwidth profile parameter that consists of an envelope ID and an envelope coupling flag (0) that controls conversion of unused green tokens into yellow tokens in the bandwidth profile algorithm. The Envelope object class is associated with UNI (via OperatorUni or ServiceProviderUni), ENNI (via EnniService), and BwpFlow(s), etc.

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
envelopeId	Identifier45	1		This attribute is a string that identifies the Envelope.
couplingFlagForIndexZero	Boolean	1		This attribute denotes the coupling flag for index zero. FALSE for NO and TRUE for YES (overflow Green tokens can be used as Yellow tokens).

Table 13-Envelope Attributes

12.6.3 Color Identifier

The ColorIdentifier object class represents the Color Identifier. The Color Identifier is a tuple of the form <F, M> where F is a field in the ingress EI Frame and M is a mapping between each possible value of the field F and a Color. The ColorIdentifier object class is associated with CarrierEthernetServiceEndPoint (EvcEndPoint or OvcEndPoint), in addition to the different field F, such as SepColorIdPac, PcpColorIdPac, DeiColorIdPac, and DscpColorIdPac, etc.

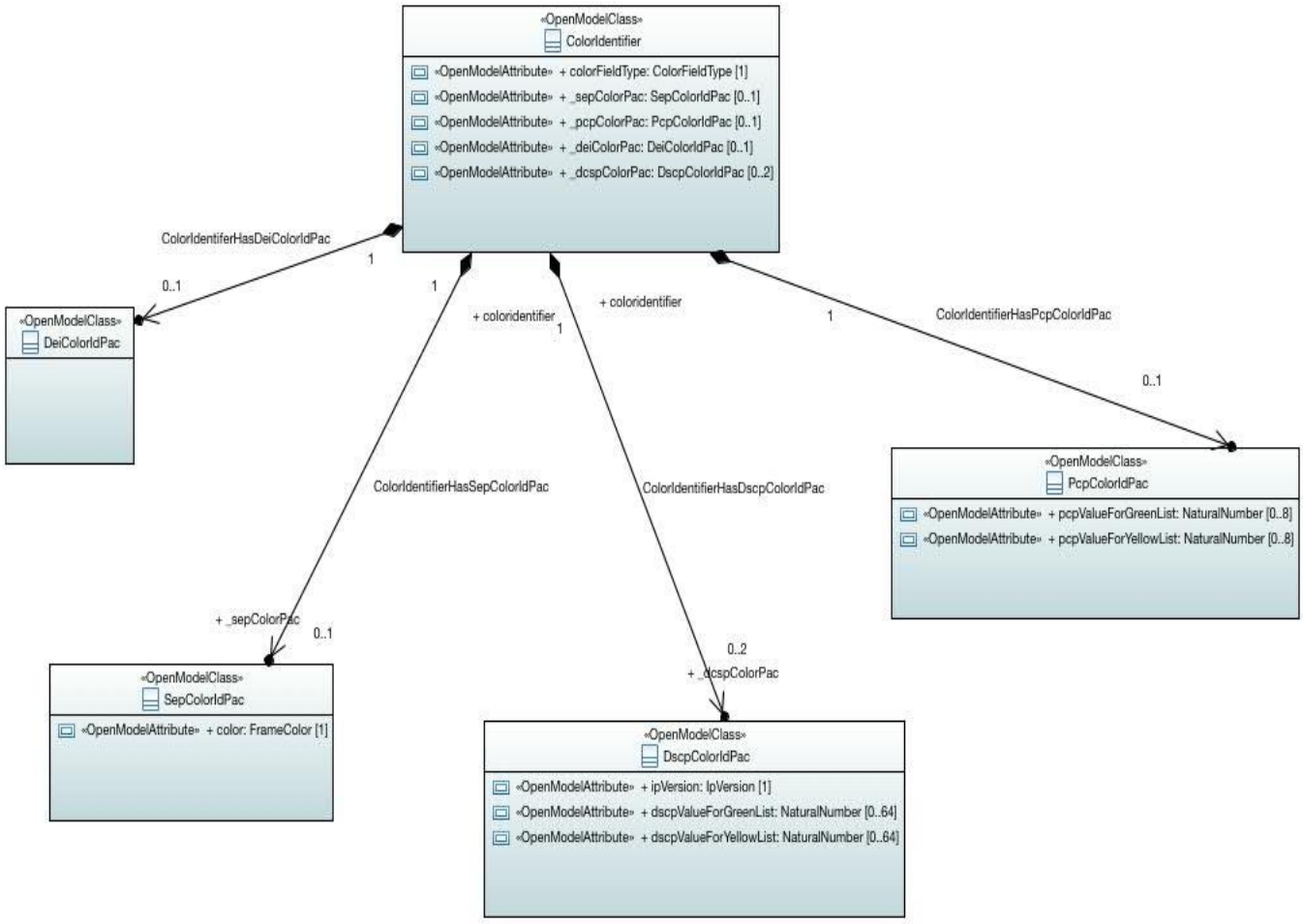

Figure 33-Color Identifier

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
colorFieldType	ColorFieldType	1		This attribute determines which conditional package (among EVC/OVC End Point, PCP, DEI or DSCP) to be used as the Color Identifier.
_sepColorPac	SepColorIdPac	0..1		This attribute represents the relationship between the ColorIdentifier and the SepColorIdPac (representing the choice that maps EVC End Point or OVC End Point to Color).
_pcpColorPac	PcpColorIdPac	0..1		This attribute represents the relationship between the ColorIdentifier and the PcpColorIdPac (representing the choice that maps Vlan tag PCPs to Color).
_deiColorPac	DeiColorIdPac	0..1		This attribute represents the relationship between the ColorIdentifier and the DeiColorIdPac (representing the choice that maps Vlan tag DEI to Color).
_dscpColorPac	DscpColorIdPac	0..2		This attribute represents the relationship between the ColorIdentifier and the DscpColorIdPac (representing the choice that maps DSCP values to Color).

Table 14-Color Identifier Attributes

12.6.4 CoS Identifier

The CosIdentifier object class represents the Class of Service Identifier. Each ingress EI Frame mapped to the given EVC/OVC End Point has a single Class of Service. The Class of Service can be determined from inspection of the content of the ingress EI Frame. It is associated with the SepCosIdPac, or the PcpCosIdPac, or the DscpCosIdPac (when the Class of Service Identifier mapping type is Service End Point, or PCP values, or DSCP values respectively). EI Frames of L2CP protocols may be identified by a Class of Service Identifier, mapping to specific CoS Name.

NOTE: Only one of the associations below is active at a time.

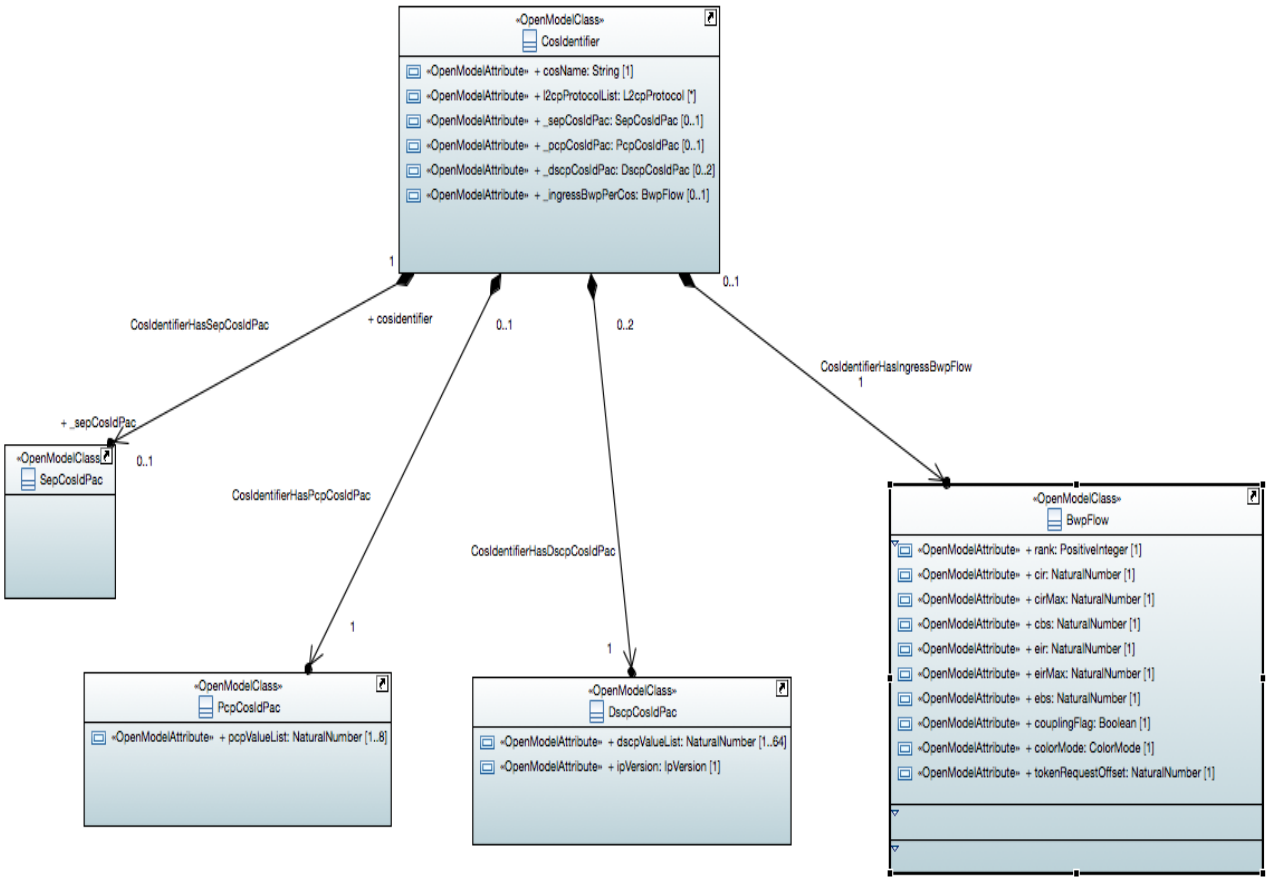

Figure 34-CoS Identifier

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
cosName	String	1		This attribute denotes the Class of Service name that the CosIdentifier maps to.
l2cpProtocolList	L2cpProtocol	*		This attribute lists the L2CP protocols that map to the Class of Service Name.
_sepCosIdPac	SepCosIdPac	0,,1		This attribute represents the relationship between the CosIdentifier and the SepCosIdPac when the cosMappingType of EvcEndPoint or OvcEndPoint is END_POINT and the cosName is not only for L2CP.
_pcpCosIdPac	PcpCosIdPac	0..1		This attribute represents the relationship between the CosIdentifier and the PcpCosIdPac when the cosMappingType of EvcEndPoint or OvcEndPoint is PCP and the cosName is not only for L2CP.
_dscpCosIdPac	DscpCosIdPac	0..2		This attribute represents the relationship between the CosIdentifier and DscpCosIdPac when the cosMappingType of EvcEndPoint or OvcEndPoint is DSCP and the cosName is not only for L2CP.
_ingressBwpPerCos	BwpFlow	0..1		This attribute represents the relationship between the CosIdentifier and the BwpFlow for ingress bandwidth profile per CoS Name.

Table 15-CoS Identifier Attributes

12.6.5 Eec Identifier

The EecIdentifier object class represents the Egress Equivalence Class Identifier. Each egress EI Frame mapped to the given EVC/OVC End Point has a single Egress Equivalence Class. The Egress Equivalence Class can be determined from inspection of the content of the egress EI Frame. It is associated with the SepCosIdPac, or the PcpCosIdPac, or the DscpCosIdPac (representing mapping to EVC/OVC End Point, or PCP, or DSCP respectively). EI Frames of L2CP protocols may be identified by an Egress Equivalence Class Identifier, mapping to specific Egress Equivalence Class Name.

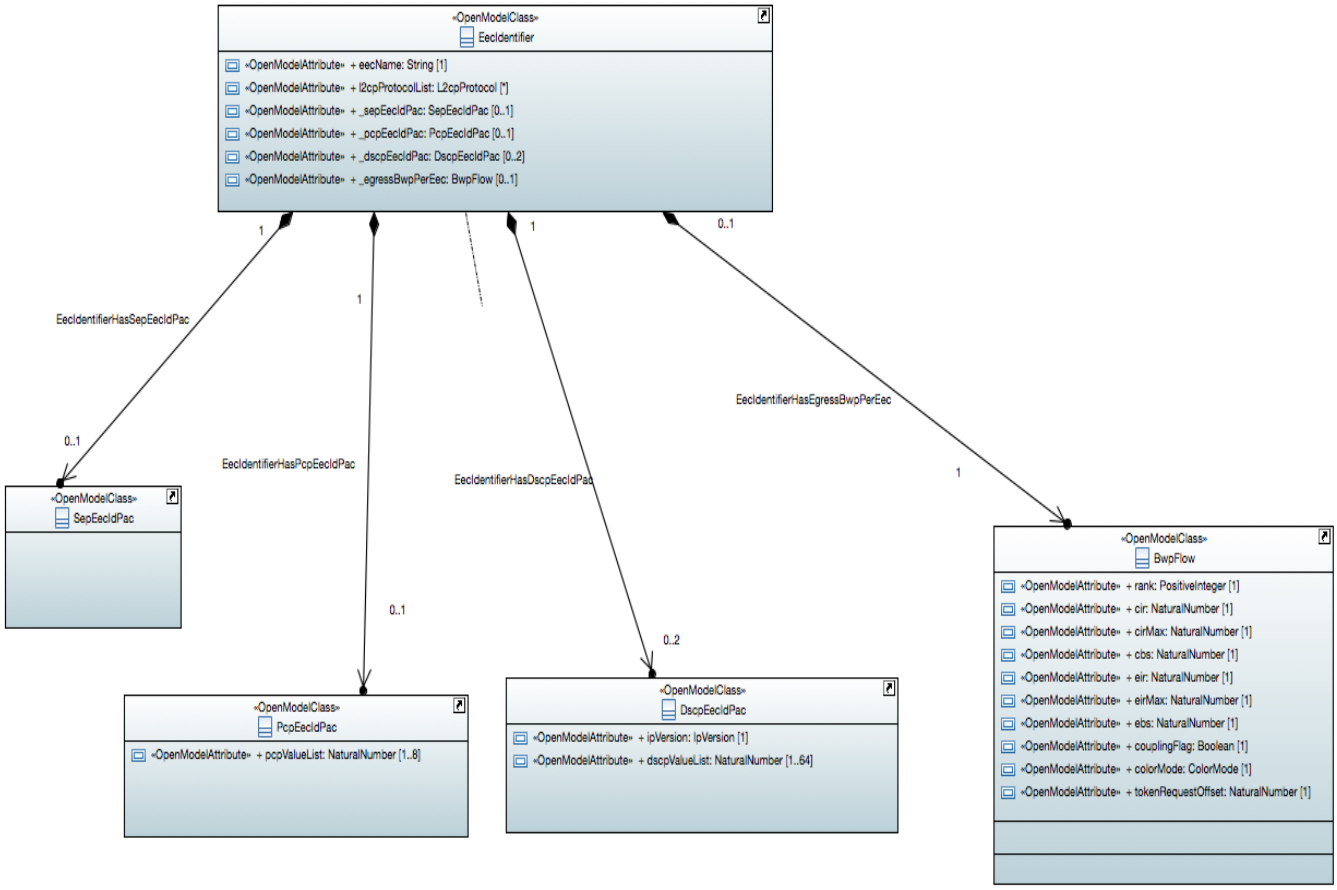

Figure 35-Eec Identifier

NOTE: Only one of the associations below is active at a time.

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
eecName	String	1		This attribute denotes the Egress Equivalence Class Name that the EecIdentifier maps to.
l2cpProtocolList	L2cpProtocol	*		This attribute lists the L2CP protocols that map to the Egress Equivalence Class Name.
_sepEecIdPac	SepCosIdPac	0,,1		This attribute represents the relationship between the EecIdentifier and the SepEecIdPac when the eecMappingType of EvcEndPoint or OvcEndPoint is END_POINT and the eecName is not only for L2CP. This is not addressed in MEF 10.3 but can be future consideration.
_pcpEecIdPac	PcpCosIdPac	0..1		This attribute represents the relationship between the EecIdentifier and the PcpEecIdPac when the eecMappingType of EvcEndPoint or OvcEndPoint is PCP and the eecName is not only for L2CP.
_dscpEecIdPac	DscpCosIdPac	0..2		This attribute represents the relationship between the EecIdentifier and DscpEecIdPac when the eecMappingType of EvcEndPoint or OvcEndPoint is DSCP and the eecName is not only for L2CP.
_egressBwpPerEec	BwpFlow	0..1		This attribute represents the relationship between the EecIdentifier and the BwpFlow for egress bandwidth profile per EEC Name.

Table 16-Eec Identifier Attributes

12.6.6 Egress Map

The EgressMap object class represents the Egress Map that is a set of mappings that determine the content of the S-Tag or C-Tag of an egress EI Frame. It is associated with EvcEndPoint or OvcEndPoint.

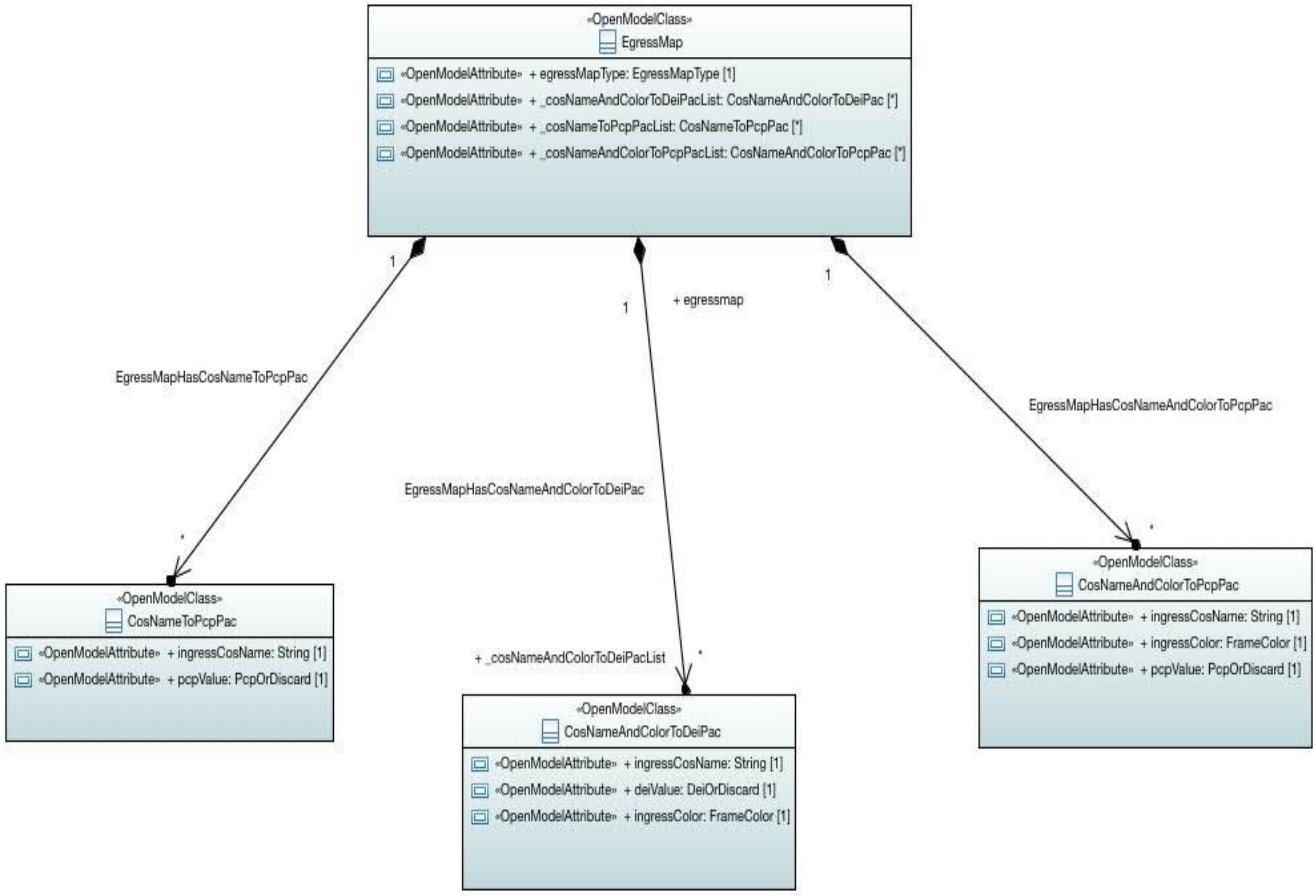

Figure 36-Egress Map

Applied stereotypes:

- OpenModelClass
  - support: MANDATORY

Attribute Name	Type	Mult.	Stereotypes	Description
egressMapType	EgressMapType	1		This attribute determines which form to take to apply for egress frame color indication, among CoS name and Ingress Color to C-Tag PCP, or CoS name and Ingress Color to S-Tag PCP, or CoS Name and Ingress Color to C-Tag DEI, or CoS Name and Ingress Color to S-Tag DEI, or CoS Name to C-Tag PCP, or CoS Name to S-Tag PCP
_cosNameAndColorToDeiPackList	CosNameAndColorToDeiPac	*		This attribute represents the relationship between the EgressMap and the CosNameAndColorToDeiPac (representing the attribute set for using CoS Name and Ingress color to egress DEI mapping).
_cosNameToPcpPacList	CosNameToPcpPac	*		This attribute represents the relationship between the EgressMap and the CosNameToPcpPac (representing the attribute set for using CoS Name to egress DEI mapping).
_cosNameAndColorToPcpPacList	CosNameAndColorToPcpPac	*		This attribute represents the relationship between the EgressMap and the CosNameAndColorToPcpPac (representing the attribute set for using CoS Name and Ingress color to egress PCP mapping).

Table 17-Egress Map Attributes

13 MEF Common Data Types

Below are list the MEF common data types and enumerations used by Presto NRP model.

13.1 Data Types

13.1.1 NaturalNumber

An Integer >= 0.

Attribute Name	Type	Mult.	Description
naturalNum	Integer	1	This is an integer >= 0

Table 18-NaturalNumber Attributes

13.1.2 L2cpProtocol

This data type defines a L2CP protocol (LLC address type or EtherType) with possible subtype.

• Attribute Name	Type	Mult.	Description
l2cpProtocolType	L2cpProtocolType	1	This attribute specifies the type of L2CP protocol, ie., LLC or EtherType.
llcAddressOrEtherType	NaturalNumber	1	This attribute specifies the LLC address or the EtherType value.
subType	NaturalNumber	[0..1]	This attribute specifies the subtype of the L2CP protocol.

Table 19-L2cpProtocol Attributes

13.1.3 L2cpPeering

This is a list specifies the L2CP Protocol Identifier and Destination Address in use by the protocol entity.

Attribute Name	Type	Mult.	Description
protocolId	L2cpProtocol	1	This is a L2CP Protocol Identifier
destinationAddress	NaturalNumber	1	This is a MAC Address.
linkIdList	PositiveInteger	*	It is possible that a protocol (e.g. ESMC) could operate on some, but not all of the physical links. When linkId is not listed, the protocol peering applies to all members of the aggregation link.

Table 20-L2cpPeering Attributes

13.1.4 SourceMacAddressLimit

Limits the number of source MAC Addresses that can be used in ingress external interface frames mapped to the End Point of all types over a time interval

Attribute Name	Type	Mult.	Description
limit	NaturalNumber	1	This attribute denotes the maximum acceptable source MAC.
timeInterval	NaturalNumber	1	This attribute denotes the time interval in milliseconds.

Table 21-SourceMacAddressLimt Attributes

13.1.5 PositiveInteger

An integer > 0.

Attribute Name	Type	Mult.	Description
positiveInt	Integer	1	This attribute is an integer > 0.

Table 22-PostiveInteger Attributes

13.1.6 VlanId

This is for VLAN ID from 1 to 4094.

Attribute Name	Type	Mult.	Description
vlanId	PositiveInteger	1	This is the Vlan ID value.

Table 23-VlanId Attributes

13.1.7 VlanIdListing

The list VLAN IDs, either when type=LIST, or when type=EXCEPT (which means the VLAN IDs expect the listed). When type=ALL, the vlanId list is not applicable.

Attribute Name	Type	Mult.	Description
Type	VlanIdMappingType	1	Can be LIST, or ALL, or EXCEPT
vlanIdList	VlanId	*	VLAN ID list

Table 24-VlanIdListing Attributes

13.1.8 VlanIdListOrUntag

Attribute Name	Type	Mult.	Description
Type	VlanIdMappingTypeOrUntag	1	VLAN ID type
vlanIdList	VlanId	*	VLAN ID list

Table 25-VlanIdListOrUntag Attributes

13.2 Enumerations

13.2.1 L2cpAddressSet

This lists the L2CP Address Set. Refer to MEF 45.

Contains Enumeration Literals:

- CTA: CE-VLAN Tag Aware
- CTB: CE-VLAN Tag Blind
- CTB2: CE-VLAN Tag Blind option 1

13.2.2 TaggedL2cpProcessing

Either 802.1 compliant or not. Refer to MEF 45.

Contains Enumeration Literals:

- 802.1_COMPLIANT
- 802.1_NON_COMPLIANT

13.2.3 L2cpProtocolType

This lists the L2CP protocol types, either EtherType or LLC Address.

Contains Enumeration Literals:

- ETHERTYPE
- LLC

13.2.4 VlanIdPreservation

Either 802.1 compliant or not. Refer to MEF 45.

Contains Enumeration Literals:

- PRESERVE: To achieve EVC CE-VLAN ID Preservation
- RETAIN: C-Tag, if present, is encapsulated with the C-Tag VLAN ID value retained.
- STRIP: C-Tag is discarded.

13.2.5 VlanIdMappingType

Vlan ID types, ALL for all vlan IDs, LIST for a list of VLAN IDs, EXCEPT for all Vlan IDs except the listed.

Contains Enumeration Literals:

- ALL: All Vlan IDs.
- EXCEPT: All Vlan IDs except the listed.
- LIST: List of Vlan IDs.

13.2.6 VlanIdMappingTypeOrUntag

Vlan ID types, ALL for all vlan IDs, LIST for a list of VLAN IDs, EXCEPT for all Vlan IDs except the listed, UNTAGGED to indicate that untagged and priority-tagged are mapped to this end point.

Contains Enumeration Literals:

- ALL: All Vlan IDs.
- EXCEPT: All Vlan IDs except the listed.
- LIST: List of Vlan IDs.
- UNTAGGED: Untagged and priority-tagged.

13.2.7 FrameDelivery

Service frame delivery defined in MEF 10.3. When the value is conditionally, the specific condition has to be addressed by the users. What conditions should be supported are not in the scope.

Contains Enumeration Literals:

- DISCARD: Frame must be discarded.
- CONDITIONALLY: Frame will be delivered with specified conditions.
- UNCONDITIONALLY: Frame will be delivered unconditionally.

13.2.8 CosOrEecMappingType

This lists the Class of Service Identifier type, or the Equivalence Class Identifier type.

Contains Enumeration Literals:

- END_POINT: Using EVC End Point or OVC End Point to map to the CoS Name as CoS ID.
- PCP: Using PCP field to map to the CoS Name as CoS ID.
- DSCP: Using DSCP field to map to the CoS Name as CoS ID.

14 Service Interfaces & Operations

This section defines the Presto NRP Interface and the associated operations with their parameters. The ONF TAPI *ConnectivityService* and corresponding operations and parameters are used. The MEF Presto NRP extensions from ONF TAPI are the realized objects and attributes that are actually implemented.

The figure below illustrates the Connectivity Service Interface associated with the Presto demarcation between SOF and ICM. The ICM realizes the Connectivity Service Interface and as a server provides a set of operations associated with the Connectivity Service Interface. The client (Service Orchestrator) uses the Connectivity Service Interface by issuing CRUD operations supported by server (ICM).

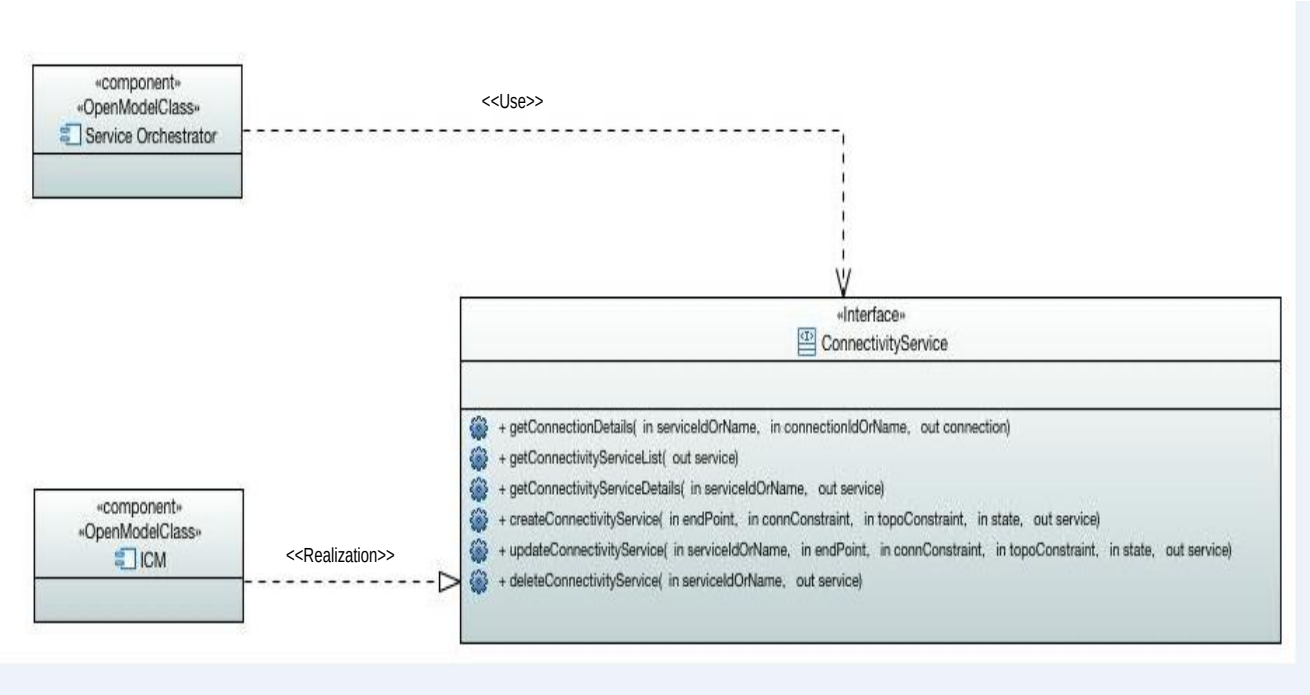

Figure 37-ConnectivityService Interface

14.1 Interfaces

The ConnectivityService Interface provides client interface access to the activation functionality of the Presto NRP API. This is where the CRUD operations are invoked.

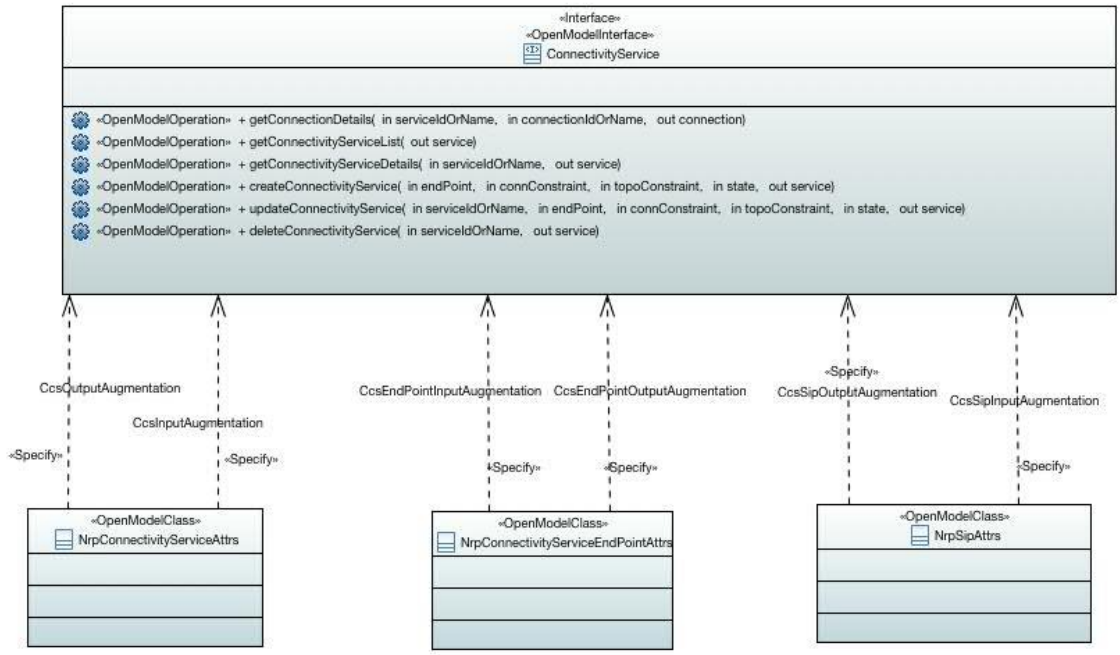

Figure 38-NrpConnectivityService Interface

14.2 Connectivity Service Operations

The following section details the set of operations based on the ONF TAPI model and leveraged by the MEF Presto NRP model specific to Connectivity Service activation. The client SOF will make the operational calls to the ICM server.

14.2.1 getConnectionDetails

The getConnectionDetails operation is called by the SOF to request (from the ICM) the attributes of the Connection identified with Service ID of the containing ConnectivityService.

14.2.2 getConnectivityServiceList

The getConnectivityServiceList operation is used by the SOF to request (from the ICM) the list of ConnectivityService entities that represent the connectivity requests that were sent by SOF and received by ICM. The input is a retrieve scope filter.

14.2.3 getConnectionEndPointDetails

The getConnectionEndPointDetails operation is used by the SOF to request (from the ICM) the attributes of the ConnectionEndpoint identified with Service ID of the containing ConnectivityService.

14.2.4 getConnectivityServiceDetails

The getConnectionServiceDetails operation is called by the SOF to request (from the ICM) the attributes of the ConnectionService entity identified by the input service ID.

14.2.5 createConnectivityService

The createConnectivityService operation is called by the SOF to ICM to create, or create and activate (by the ICM) a ConnectivityService in support of network resource activation. The combination of verb and compound verb operations are supported by leveraging the OperationalState and AdministrativeState variables as described later in document. Using the state variables allows for a differentiation between create and createAndActivate.

14.2.6 updateConnectivityService

The updateConnectivityService operation is called by the SOF to support suspend, resume, activate, deactivate and modify actions on a ConnectivityService. The combination of verb and compound verb operations are supported by leveraging the OperationalState and AdministrativeState variables as described later in document.

14.2.7 deleteConnectivityService

The deleteConnectivityService operation is called by the SOF to delete, or deactivate and delete (by the ICM) a ConnectivityService in support of network resource activation. The combination of verb and compound verb operations are supported by leveraging the OperationalState and AdministrativeState variables as described later in document. Using the state variables allows for a differentiation between delete and deactivateAndDelete.

14.3 Topology Service Operations

The following section details the set of operations based on the ONF TAPI model and leveraged by the MEF Presto NRP model specific to Topology Service. The client SOF will make the operational calls to the ICM server.

14.3.1 getTopologyList

The getTopologyList operation is called by SOF requesting a list of Topologies under the control of an ICM. The ICM is responsible for returning a list of top-level Topology instances scoped by the Context.

14.3.2 getTopologyDetails

The getTopologyDetails operation is called by SOF requesting the details of a specific Topology. The ICM is responsible for returning attributes of the Topology identified by the provided inputs.

14.3.3 getNodeDetails

The getNodeDetails operation is called by SOF requesting details of a specific Node. The ICM is responsible for returning attributes of the Node identified by the provided inputs.

14.3.4 getLinkDetails

The getLinkDetails operation is called by SOF requesting details of a specific Link. The ICM is responsible for returning attributes of the Link identified by the provided inputs.

14.3.5 getNodeEdgePointDetails

The getNodeEdgePointDetails operation is called by SOF requesting details of a specific Node Edge Point. The ICM is responsible for returning attributes of the NodeEdgePoint identified by the provided inputs.

14.4 Verb/Action – Operation Mapping

The set of verb/action and combo-verb/combo-action are mapped to a combination of operation and state variable(s). The following section details this association.

14.4.1 createAndActivate

The *createAndActivate* operation is invoked when a *ConnectivityService* is requested to be created and activated. This means the necessary resources on device(s) are created and activated. The Network Infrastructure segment is considered to be in an active state. Prior to the *createAndActivate* action the *ConnectivityService* is non-existent.

The action causes the *ConnectivityService* state to be changed to: operationalState=ENABLED/administrativeState=UNLOCKED.

14.4.2 create

The *create* operation is invoked when a *ConnectivityService* is requested to be created. This means the necessary resources on device(s) are created, but not activated. The Network Infrastructure segment is considered to be created and in an inactive state. Prior to the *create* action the *ConnectivityService* is non-existent or in a Non-Existent State.

The action causes the *ConnectivityService* state changes from the Initial State to: operationalState=DISABLED/administrativeState=LOCKED.

14.4.3 activate

The *activate* operation is invoked when an existing *ConnectivityService* is requested to be activated. This means the necessary resources on device(s) are already created and are being moved to an active state. The Network Infrastructure segment is moved to an active state. Prior to the *activate* action the *ConnectivityService* is in OperationalState=DISABLED/AdministrativeState=LOCKED.

The action causes the *ConnectivityService* state to be changed to: operationalState=ENABLED/administrativeState=UNLOCKED.

14.4.4 deactivateAndDelete

The *deactivateAndDelete* operation is invoked when an existing *ConnectivityService* is requested to be deactivated and deleted. This means the existing resources on device(s) are deactivated and deleted. The Network Infrastructure segment is removed.

Prior to the *deactivateAndDelete* action the *ConnectivityService* is in operationalState=ENABLED/administrativeState=UNLOCKED. The action causes the *ConnectivityService* state to be changed to non-existent.

14.4.5 deactivate

The *deactivate* operation is invoked when an existing *ConnectivityService* is requested to be deactivated. This means the existing resources on device(s) that are active are now deactivated. The Network Infrastructure segment is deactivated or not operational. Prior to the *deactivate* action the *ConnectivityService* is in operationalState=ENABLED/administrativeState=UNLOCKED.

The action causes the *ConnectivityService* state to be changed to: operationalState=DISABLED/administrativeState=LOCKED.

14.4.6 delete

The *delete* operation is invoked when an existing *ConnectivityService* is requested to be deleted. This means the existing resources on device(s) that are deactivated are now deleted. The Network Infrastructure segment is removed. Prior to the *delete* action the *ConnectivityService* is in operationalState=DISABLED/administrativeState=LOCKED. The action causes the *ConnectivityService* to be removed.

14.4.7 suspend

The *suspend* operation is invoked when an existing *ConnectivityService, ConnectivityServiceEndPoint or ServiceInterfacePoint* is requested to be suspended. This means the existing resources on device(s) that are active are now suspended from operation. The Network Infrastructure segment is suspended or non-operational. Prior to the *suspend* action the *ConnectivityService/ConnectivityServiceEndPoint/ServiceInterfacePoint* is in operationalState=ENABLED/administrativeState=UNLOCKED.

The action causes the *ConnectivityService/ConnectivityServiceEndPoint/ServiceInterfacePoint* to be changed to: OperationalState=ENABLED/AdministrativeState=LOCKED.

14.4.8 resume

The *resume* operation is invoked when an existing *ConnectivityService, ConnectivityServiceEndPoint or ServiceInterfacePoint* is requested to be resumed. This means the existing resources on device(s) that are suspended are now resumed to operation. The Network Infrastructure segment is resumed operational.

Prior to the *resume* action the *ConnectivityService/ConnectivityServiceEndPoint/ServiceInterfacePoint* is in operationalState=ENABLED/administrativeState=LOCKED. The action causes the *ConnectivityService/ConnectivityServiceEndPoint/ServiceInterface* to be changed to: operationalState=ENABLED/administrativeState=UNLOCKED.

14.4.9 modify

The *modify* operation can be applied to a *ConnectivityService*, *ConnectivityServiceEndPoint* and *ServiceInterfacePoint*. can be invoked from multiple states. Depending upon the modification the actual action may or may not be allowed.

14.4.10 get

The *get* operation is used to retrieve objects and object attributes specific to *ConnectivityService*, *Topology*, and *Topology* components. The get operation MUST NOT change the state of retrieved objects/attributes.

15 Presto NRP State Machines

This section defines the set of Presto NRP state machines. The Presto NRP state machines are defined for Connectivity Service, Connectivity Service End Point and Service Interface Point. The state machine defines the states and transitions a network resource may be in (or follow) for behavioral operations of configuration and activation.

The states and actions are the same for all three state machines. Three combination states are used to represent the Presto NRP states of active, inactive and suspended.

15.1 Connectivity Service State Machine Diagram

The Connectivity Service State machine has three combination states. Each combination state has an administrative state and an operational state. A state change to one or both of the state variables without a valid state transition is considered an exception.

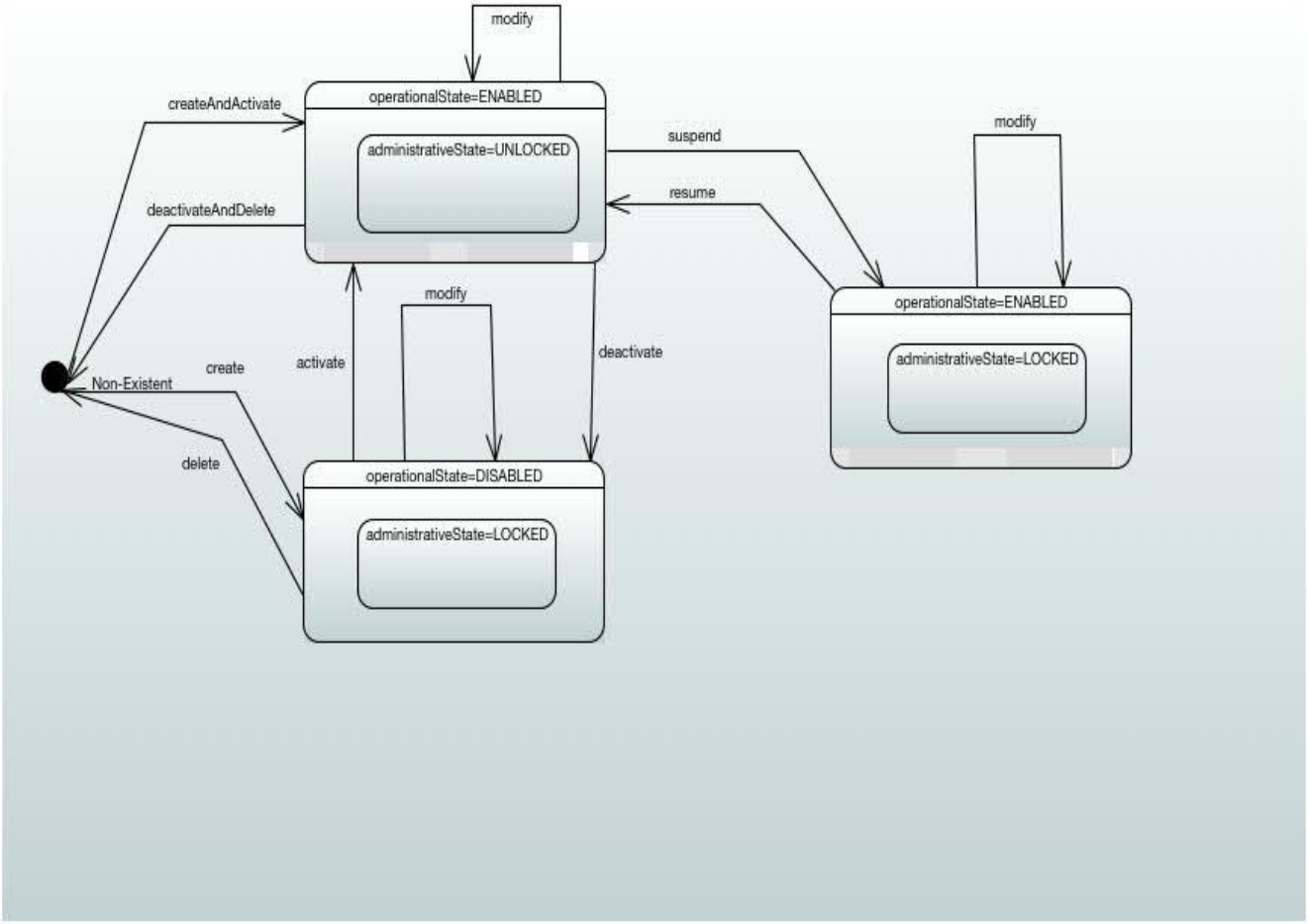

Figure 39-Connectivity Service State Machine

15.2 Connectivity Service End Point State Machine Diagram

The Connectivity Service End Point State machine has three combination states. Each combination state has an administrative state and an operational state.

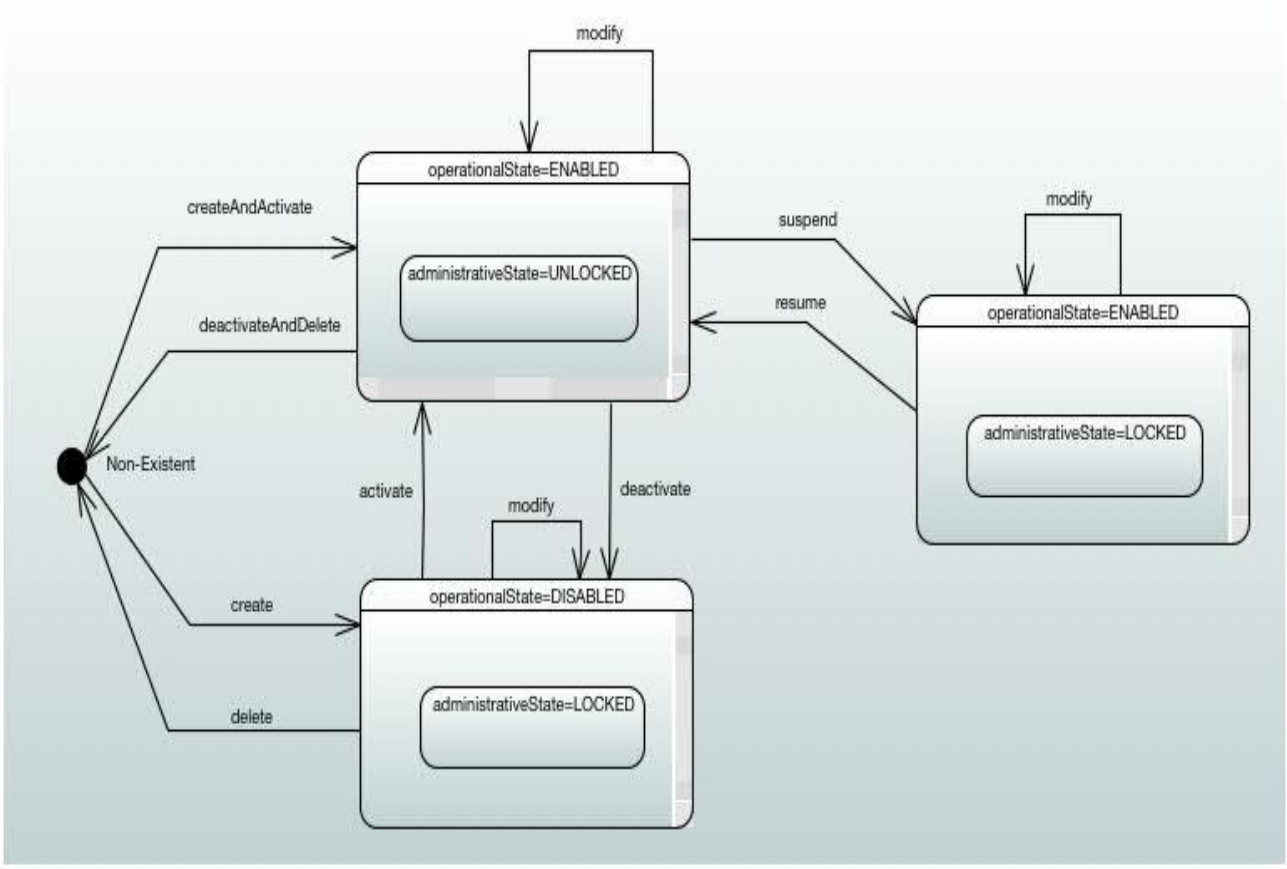

Figure 40-Connectivity Service End Point State Machine

15.3 Service Interface Point State Machine Diagram

The Service Interface Point State machine has three combination states. Each combination state has an administrative state and an operational state.

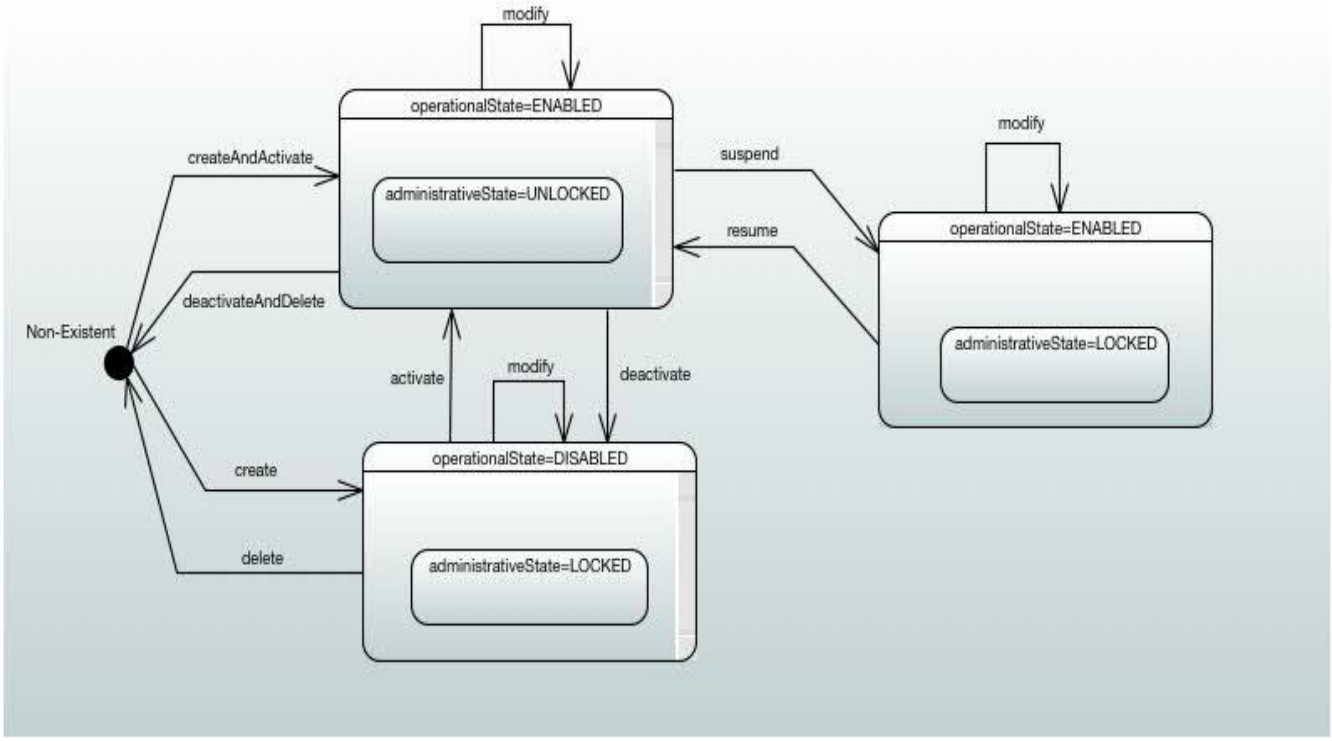

Figure 41-Service Interface Point State Machine Diagram

15.4 State Machine Interaction

There exist multiple conditions within one state machine that generates a trigger/event into one or more of the other state machines.

An example, is a Connectivity Service suspend transition must generate a suspend in the set of associated Connectivity Service End Point state machines.

Similarly, a resume in the Connectivity Service state machine must generate a resume in the set of associated Connectivity Service End Point state machines.

15.5 States and Actions

This section defines the states within the State Machine that are supported for network resources. Two state variables are used: operationalState and administrativeState in combinations to support three states: active, inactive and suspended.

15.5.1 Non-Existent

The network resource is non-existent and has no state because it does not exist. This is prior to any event/action being invoked. The following actions will cause this state to be entered in case of successful completion of the action.

- *deactivateAndDelete* action when a network resource is in operationalState=ENABLED/administrativeState=UNLOCKED (active state).
- *delete* action when a network resource is in operationalState=DISABLED/administrativeState=LOCKED (inactive state).

15.5.2 operationalState=ENABLED/administrativeState=UNLOCKED (state=active)

The network resource has been created and activated. The associated resources in the node/device/topology are created and the associated Network Infrastructure is activated. The effect of the administrativeState being unlocked and the operationalState being enabled is that traffic is flowing through the node/device/topology. The following actions will cause this state to be entered in case of successful completion of the action.

- *createAndActivate* action when a network resource is non-existent will cause this state to be entered.
- *resume* action when a network resource is in operationalState=ENABLED/administrativeState=LOCKED (suspended state).
- *activate* action when a network resource is in operationalState=DISABLED/administrativeState=LOCKED (inactive state).
- *modify* action when a network resource is in operationalState=ENABLED/administrativeState=UNLOCKED (active state).

15.5.3 operationalState=DISABLED/administrativeState=LOCKED (state=inactive)

The network resource has been created, but not activated. The associated resources in the node/device/topology are created and the associated Network Infrastructure is not activated. The effect of the administrativeState being locked and the operationalState being disabled is that traffic is NOT flowing through the node/device/topology. The following actions will cause this state to be entered in case of successful completion of the action.

- *create* action when a network resource is non-existent will cause this state to be entered.
- *deactivate* action when a network resource is in operationalState=ENABLED/administrativeState=UNLOCKED (activate state).
- *modify* action when a network resource is in operationalState=ENABLED/administrativeState=LOCKED (inactive state).

15.5.4 operationalState=ENABLED/administrativeState=LOCKED (state=suspended)

The network resources have been created, but are suspended. The associated resources in the node/device/topology are created and the associated Network Infrastructure is not activated. The effect of the administrativeState being locked and the operationalState being enabled is that traffic is NOT flowing through the node/device/topology.

- *suspend* action when a network resource is in operationalState=ENABLED/administrativeState=UNLOCKED (active state).
- *modify* action when a network resource is in operationalState=ENABLED/administrativeState=LOCKED (suspended state).

16 References

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Appendix A-Exceptions

Exception	Description
EntityNotFound	The entity or resource referenced does not exit.
InvalidInput	The request was incorrect encoded.
NotInValidState	The resource is in a state that does not allow you to perform a specified action.
NotImplemented	Requested method or operation is not implemented.
CommLoss	Communications between client and server is lost.
AccessDenied	Access denied typically due to a permission or other access check.
UnableToComply	General exception to state inability to execute a method or operation.

Table 26-Exception Descriptions

Appendix B-Sequence Diagrams

This section defines a set of Presto NRP sequence diagrams. The intent of providing sequence diagrams is to illustrate client and server-side interactions using the Presto NRP API.

B.1 Network Discovery

The following diagram shows the interaction between a SOF client and a single ICM server in providing a discovery of the underlying network.

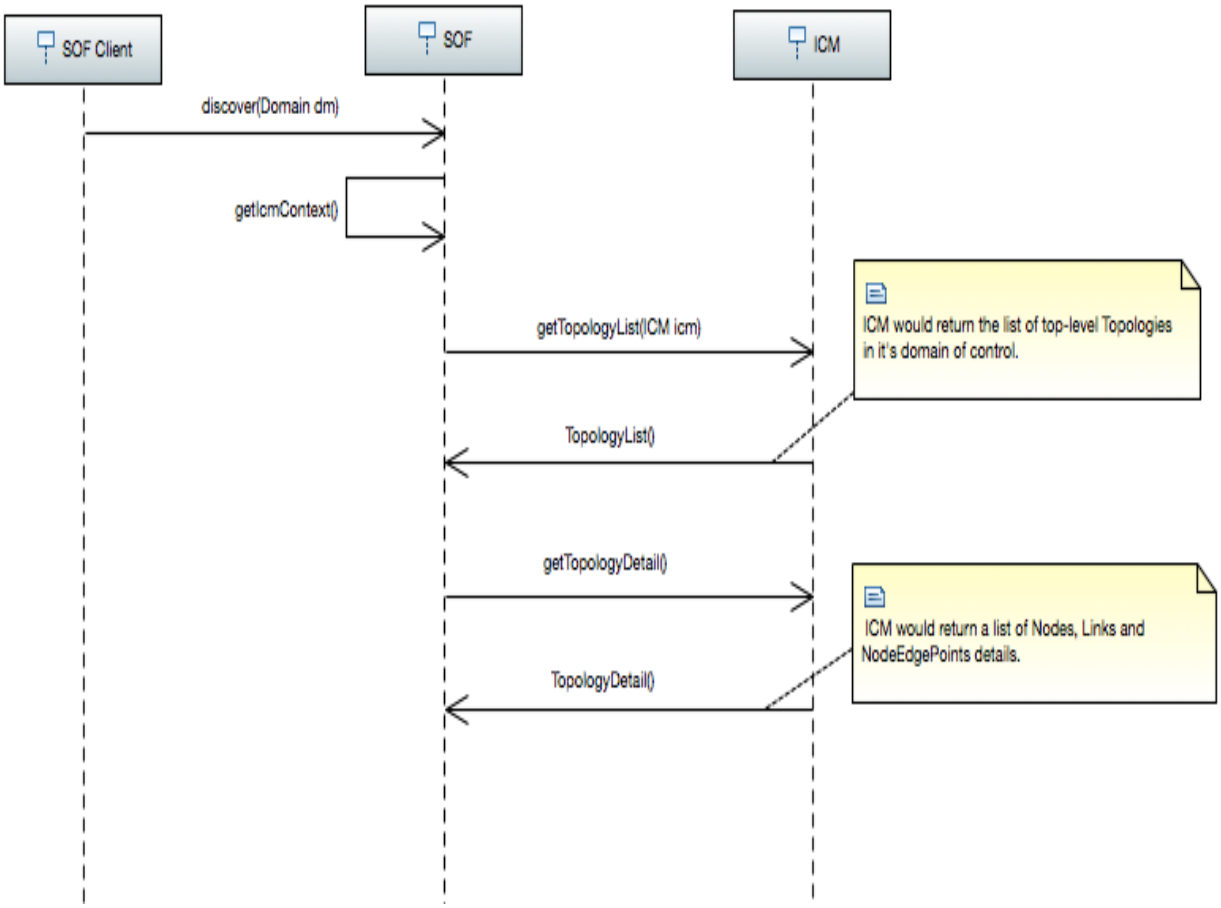

Figure 42-Network Discovery Sequence Diagram

B.2 Feasibility

The following diagram shows the interaction that can be used when a customer request a MEF service based on geographic location. In this example, it is assumed that inventory system is in place that can associate customer geographic location with available interfaces (ServiceInterfacePoints) to meet edge customer connectivity requirements.

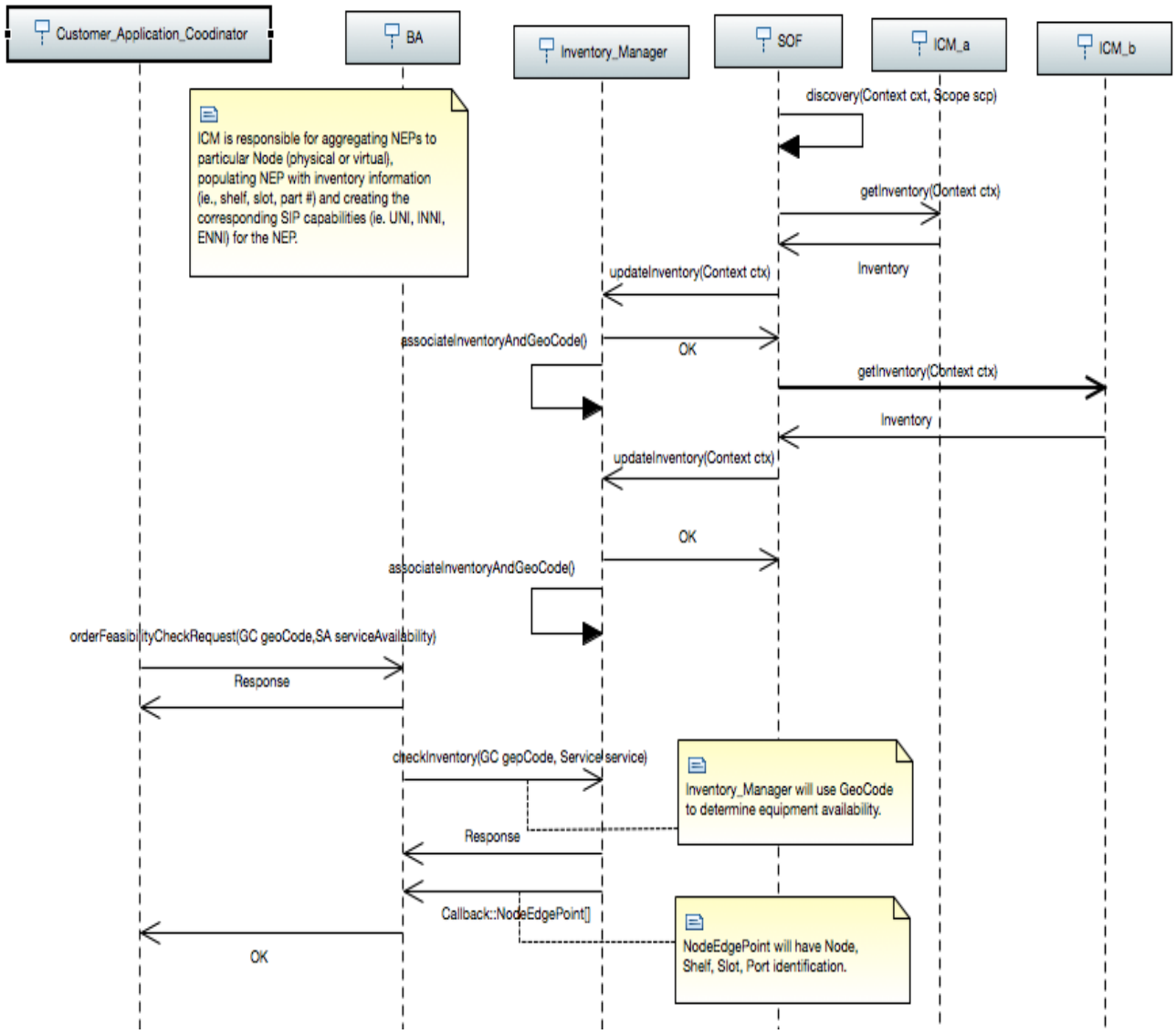

Figure 43-Feasibility Sequence Diagram

B.3 SLS-based Activation

The following diagram shows the interaction that can be used when a customer request a MEF service based on the need for supporting a service level agreement across multiple domains.

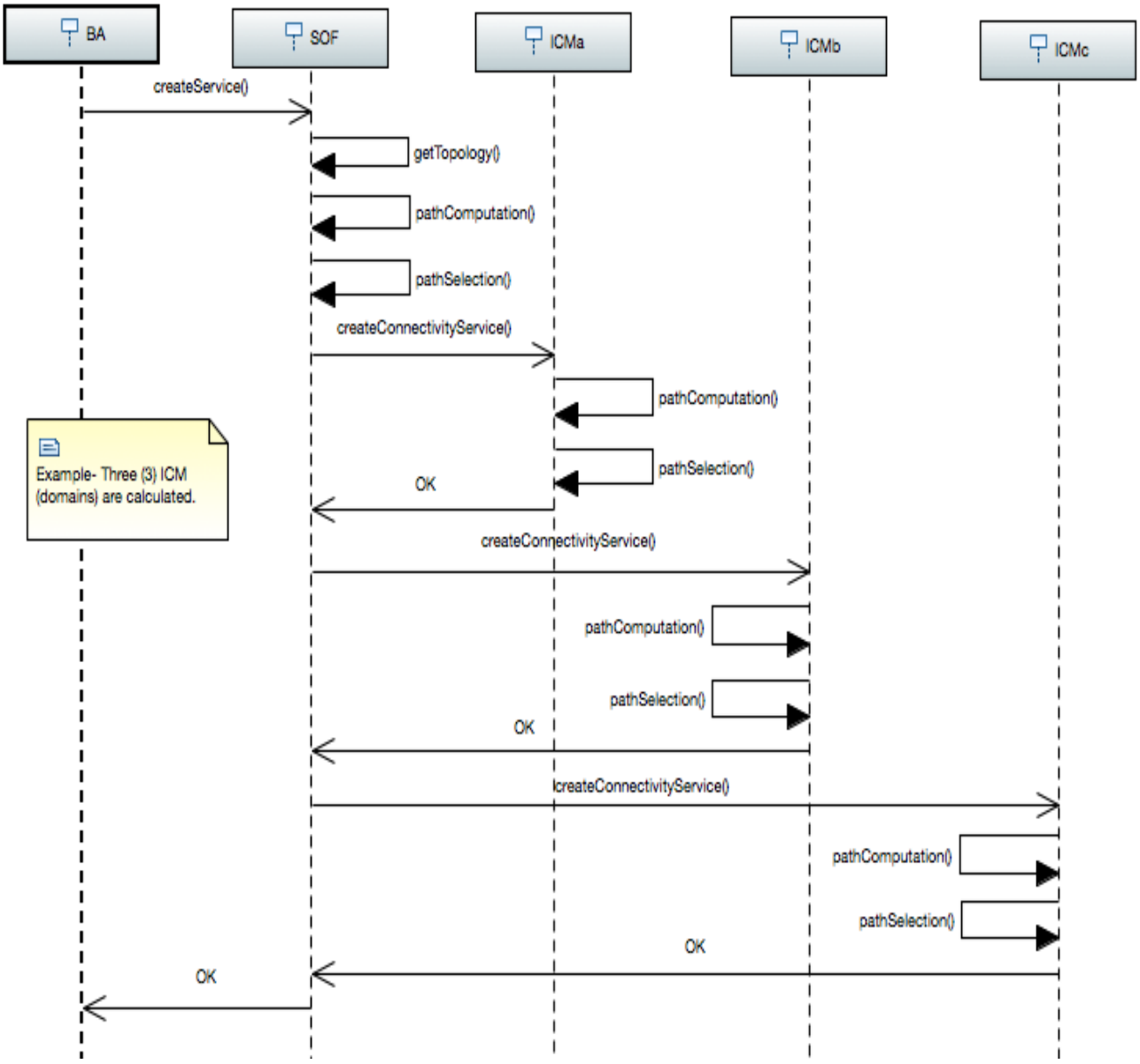

Figure 44-SLS based activation