



Mplify Standard

Mplify 102

**LSO Internet Protocol Service Schemas and
Developer Guide**

April 2026

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1 List of Contributing Members

The following members of the Mplify participated in the development of this document and have requested to be included in this list.

- Amartus
- Bloomberg
- Proximus

2 Abstract

This Mplify Standard consisting of this Developer Guide and its associated software artifacts (JSON/YAML Schemas) defines and describes the service-specific payload for the LSO APIs for a set of Service Functions – specifically, Service Order and Service Inventory, for IP Services. The document starts with an overview of LSO and IP Subscriber and Operator Services. It then provides a basic information model for the Mplify IP Service Attributes. The final sections describe the Data Model focused on the JSON/YAML Schemas associated with this specification.

This document can be thought of as a developer's guide for the IP Services Data Model and the schemas provided that embody the Data Model. Mplify Services are described by a set of Service Attributes. Each Service Attribute describes an aspect of the service that is agreed between the provider and the user of the service. The documents that describe the Service Attributes for Subscriber and Operator IP Services are MEF 61.1 [10] and MEF 61.1.1 [11] .

This standard normatively incorporates the following files by reference as if they were part of this document, from GitHub repositories:

[MEF-LSO-Allegro-SDK](#)

commit id: [e94bb24cba19a19f52abe61907d91b36716f2f8e](#)

[MEF-LSO-Interlude-SDK](#)

commit id: [6c1005864a73ad7f06c838ab420ff8275d06b8a5](#)

[MEF-LSO-Legato-SDK](#)

commit id: [8dfd3b4d914c7c7aed5c14de9f0ad79499bc5435](#)

Schemas for IP Service Classes:

- `schema/serviceSchema/ip/ipEnni.yaml`
- `schema/serviceSchema/ip/ipEnniCommon.yaml`
- `schema/serviceSchema/ip/ipEnniLink.yaml`
- `schema/serviceSchema/ip/ipSIs.yaml`
- `schema/serviceSchema/ip/ipUni.yaml`
- `schema/serviceSchema/ip/ipUniAccessLink.yaml`
- `schema/serviceSchema/ip/ipUniAccessLinkTrunk.yaml`
- `schema/serviceSchema/ip/ipvc.yaml`
- `schema/serviceSchema/ip/ipvcEndPoint.yaml`

Schemas for IP Service Common Classes:

- `schema/common/common.yaml`
- `schema/common/ip/ipCommon.yaml`
- `schema/common/ip/ipRoutingProtocolsCommon.yaml`

3 Terminology and Abbreviations

This section defines the terms used in this document. In many cases, the normative definitions of terms are found in other documents. In these cases, the third column is used to provide the reference that is controlling, in other Mplify or external documents. If the reference includes an asterisk (*), the definition has been adapted from the original.

Term	Definition	Reference
Business Applications	The Service Provider functionality supporting Business Management Layer functionality (e.g., product catalog, order management, billing, relationship management, etc.)	MEF 55.1 [13]
External Interface	Either a UNI or an ENNI.	MEF 61.1 [10]
External Network Network Interface	The demarcation point marking the boundary of responsibility between two Operators whose networks are operated as separate administrative domains.	MEF 61.1 [10]
IP UNI Access Link	A UNI Access Link for an IP Service, i.e., a subnetwork corresponding to a distinct IP subnet, that forms part of a UNI The subnet might use both IPv4 and IPv6 addressing.	MEF 61.1 [10]
IP UNI Access Link Trunk	A construct that encapsulates the details of the Layer 1 and Layer 2 configuration shared by one or more IP UNI Access Links.	MEF 61.1.1 [11]
IP User Network Interface	A UNI at which an IP Service is accessed.	MEF 61.1 [10]
IP Virtual Connection	An association of two or more IPVC Eps that limits the exchange of IP Packets to IPVC Eps for the IPVC.	MEF 61.1 [10]
IPVC End Point	A logical entity at a given External Interface to which a distinct subset of IP Packets passing over the External Interface is mapped.	MEF 61.1 [10]
Order	One or more Service Order Items formulated into a fulfillment request made by a Client to a Server.	This document (derived from MEF 57.2)

Term	Definition	Reference
Service Attribute	Specific information that is agreed upon between the provider and the user of the service, that describes some aspect of the service behavior or capability.	MEF 61.1 [10]
Service Agreement	Level The contract between the Subscriber and Service Provider specifying the service level commitments and related business agreements for a service.	MEF 61.1 [10]
Service Specification	Level The technical details of the service level, in terms of performance objectives, agreed between the Service Provider and Subscriber as part of the SLA.	MEF 61.1 [10]
Service Provider	In the context of this document, a Service Provider is an Ethernet Service Provider. In this document, we use Service Provider to include Super Operator as specified in MEF 26.2 (also referred to as SP/SO).	This Document

Table 1-Terminology

Term	Definition	Reference
BUS	See <i>Business Applications</i>	MEF 55.1 [13]
ENNI	External Network Network Interface	MEF 61.1 [10]
EI	External Interface	MEF 61.1 [10]
IP UNI	IP User Network Interface	MEF 61.1 [10]
IPVC	Internet Protocol (IP) Virtual Connection	MEF 61.1 [10]
IPVC EP	Internet Protocol (IP) Virtual Connection End Point	MEF 61.1 [10]
SLA	Service Level Agreement	MEF 61.1 [10]
SLS	Service Level Specification	MEF 61.1 [10]

Table 2-Abbreviations

4 Compliance Levels

The key words "**MUST**", "**MUST NOT**", "**REQUIRED**", "**SHALL**", "**SHALL NOT**", "**SHOULD**", "**SHOULD NOT**", "**RECOMMENDED**", "**NOT RECOMMENDED**", "**MAY**", and "**OPTIONAL**" in this document are to be interpreted as described in BCP 14 (RFC 2119 [2], RFC 8174 [8]) when, and only when, they appear in all capitals, as shown here. All key words must be in 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.

5 Numerical Prefixes

This document uses the prefix notation to indicate multiplier values as shown in Table 3-Numerical Prefix Conventions.

Decimal		Binary	
Symbol	Value	Symbol	Value
k	10^3	Ki	2^{10}
M	10^6	Mi	2^{20}
G	10^9	Gi	2^{30}
T	10^{12}	Ti	2^{40}
P	10^{15}	Pi	2^{50}
E	10^{18}	Ei	2^{60}
Z	10^{21}	Zi	2^{70}
Y	10^{24}	Yi	2^{80}

Table 3-Numerical Prefix Conventions

6 Introduction

LSO provides a programmatic interface for establishing an automated exchange of information (i.e., Service Order, Service Inventory) between a Business Application and Service Orchestration Function. These APIs are hierarchically structured. The outer-most structure includes information relating to the access method (e.g., REST), next is information relating to the function being requested (e.g., Service Order or Inventory, etc.) and the inner-most structure contains information relating to the specific service, for example IP Service).

The specific types of IP Services are Subscriber and Operator IP Services. Subscriber IP Services are requested between a Customer and a Service Provider or a Service Provider and a Partner. Operator IP Services are requested between a Service Provider (SP) and a Partner. The Service Attributes for Subscriber and Operator IP Services are defined in MEF 61.1 [10] and MEF 61.1.1 [11].

This specification is accompanied by a Data Model for Subscriber and Operator IP Services instantiated as a set of JSON/YAML schemas that can be used within the LSO APIs to perform Service Order and Service Inventory requests.

The Data Model for Subscriber IP Services includes resource representations for:

- IPVC: An IP Service is formed of an IP Virtual Connection (IPVC) that links together IPVC End Points at EIs.
- IPVC End Point: A logical entity at an External Interface (EI), to which a subset of packets that traverse the EI is mapped.
- IP UNI: A User Network Interface (UNI) is a demarcation point between the responsibility of the SP and the responsibility of the Subscriber. Note that a given UNI always relates to a single SP and a single Subscriber.
- IP UNI Access Link: An individual connection between the Subscriber and the SP that forms part of a UNI.
- IP UNI Access Link Trunk: A UNI Access Link Trunk is a construct that encapsulates the details of Layer 1 and Layer 2 configuration shared by one or more UNI Access Links.

The Data Model for Operator IP Services includes resource representations for:

- IP ENNI: An External Network Network Interface (ENNI) is the demarcation point between the responsibility of one Operator and another - other words, it is the interface where the two Operators interconnect.
- IP ENNI Common: ENNI Common Attributes that apply to each agreed between two LLOs (Lowest Level Operators).

- IP ENNI Link: An ENNI can comprise one more distinct IP Links, each of which is a single IP hop. These links are known as ENNI Links, and typically each corresponds to a distinct IP subnet (which can have both IPv4 and IPv6 addressing). ENNI Links are assumed to be point-to-point.

The document contains the following sections:

- Overview of LSO Architecture (Section 7)
- Overview of IP Services Model (Section 8)
- Overview of Subscriber IP Services (Section 9)
- Overview of Operator IP Services (Section 10)
- Data Model Design Principles and Assumptions (Section 11)
- Data Models for IP Services (Section 12)
- Relationship between the Entities (Section 13)
- Subscriber IP Service Data Model (Section 14)
- Operator IP Service Data Model (Section 15)
- Common Resources and Types (Section 16)
- IP Common Resources and Types (Section 17)
- IP Routing Protocols Common Resources and Types (Section 18)
- IP Bandwidth Profile and Bandwidth Profile Envelope (Section 19)
- IP SLS (Section 20)
- Usage examples Informative (Appendix A)
- Service Order Operations (Appendix B)

7 Overview of LSO Architecture

MEF 55.1 [13] describes the Reference Architecture for Lifecycle Service Orchestration (LSO) of MEF-defined connectivity services. MEF 55.1 [13] defines seven LSO Reference Points that are abstract interconnection points between different domains - either within the service provider domain (intra-domain) or between service provider and other business entities (inter-domain). One of these LSO Reference Points is LSO Legato which defines the abstract boundary point between a Service Provider's or Partner's Business Application (BA) and Service Orchestration Functionality (SOF) for providing connectivity services provisioning.

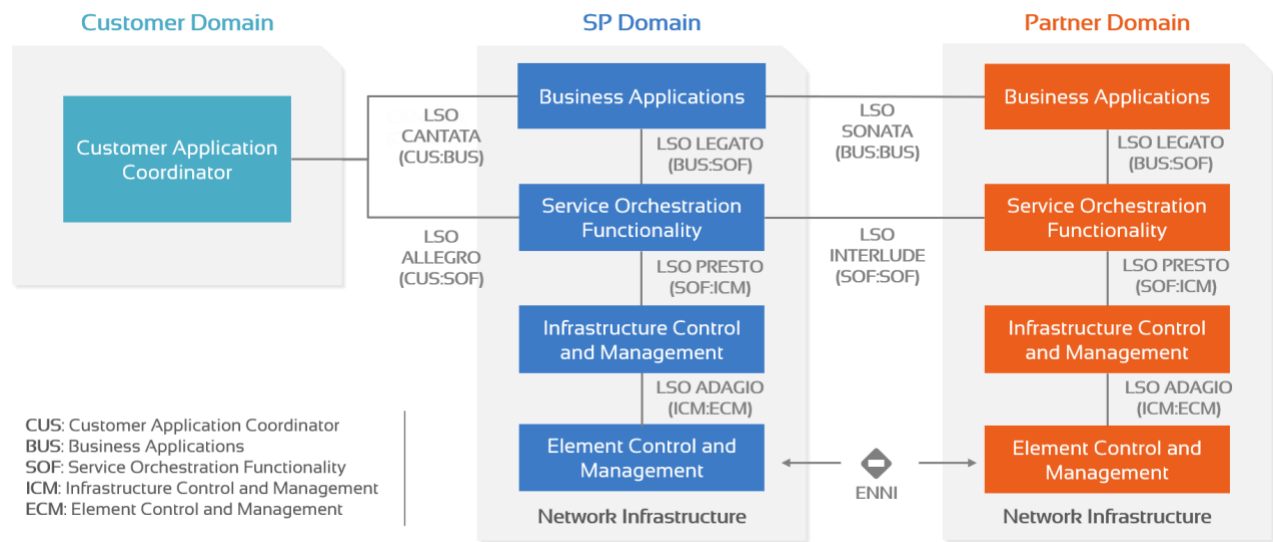


Figure 1-LSO Reference Diagram

The access to automated service provisioning functionality is provided using the Service Provisioning API at LSO IRPs Allegro, Interlude and Legato. LSO IRPs provides a suite of APIs for ordering, inventory, etc. which are standardized by Mplify as LSO Service APIs, and which are made available by Mplify in a series of releases of the LSO Service SDK.

The LSO Service APIs comprise two parts: one is the service-independent functionality, or Basic API Structure, and the second is the service-specific payload, or Information Payload, as shown in Figure 2.

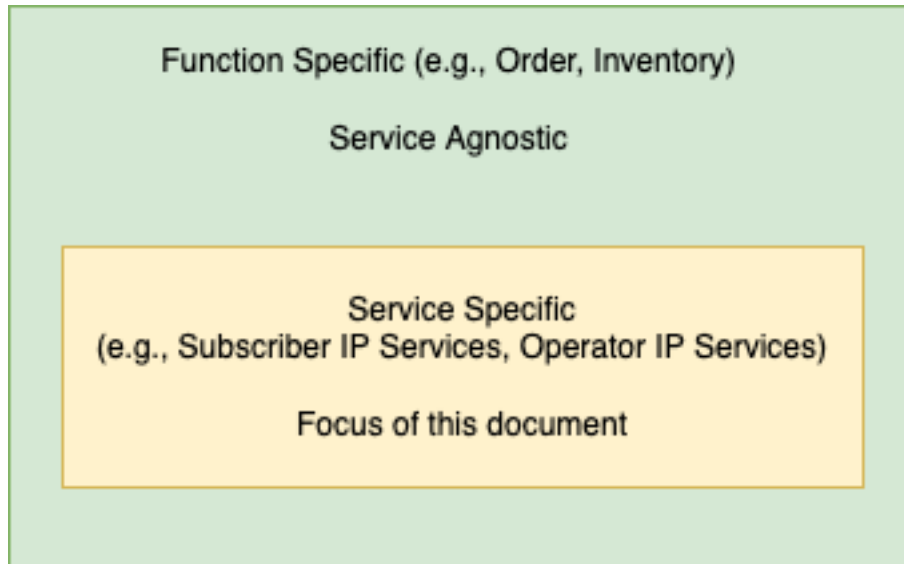


Figure 2-LSO API Envelope and Payload Structure

This document defines the service-specific payload, shown as YAML/JSON Data Model in Figure 2, specifically for a MEF 3.0 Subscriber and Operator services as defined in MEF 61.1 [10], and MEF 61.1.1 [11]. The envelope resources of the API and association to specific payload resources will be discussed in detail later in this document.

8 Overview IP Services Model

The IP Services model has seven main classes, Ipvc, IpvcEndPoint, IpUni, IpUniAccessLink, IpUniAccessLinkTrunk, IpEnni, and IpEnniLink. An IP Service is defined as having an IPVC and one or more IPVC End Points.

The IP Service Model supports Subscriber and Operator IP Services. Figure 3 shows the entire IP Services Model including classes used for both Subscriber and Operator IP Services. Further details for both Service types will be provided in this document.

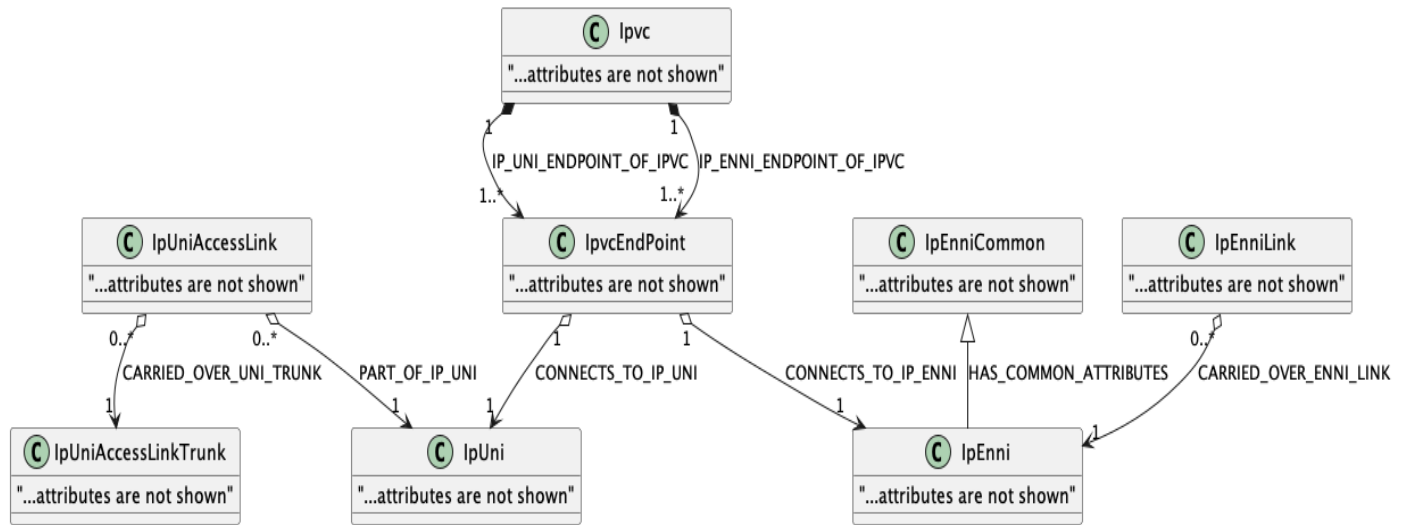


Figure 3-IP Service Model Overview

The Subscriber IP Service Model is composed of an IpUni and corresponding IpvcEndPoint; corresponding IpUniAccess Links; corresponding IpUniAccessLinkTrunks and an Ipvc. An IP Service which requires a Service Provider and one or more Operators will have in addition to the Subscriber IP Service Model components, IpEnni(s), and IpEnniLink(s). An example IP Service with the main Subscriber service components is shown in Figure 4.

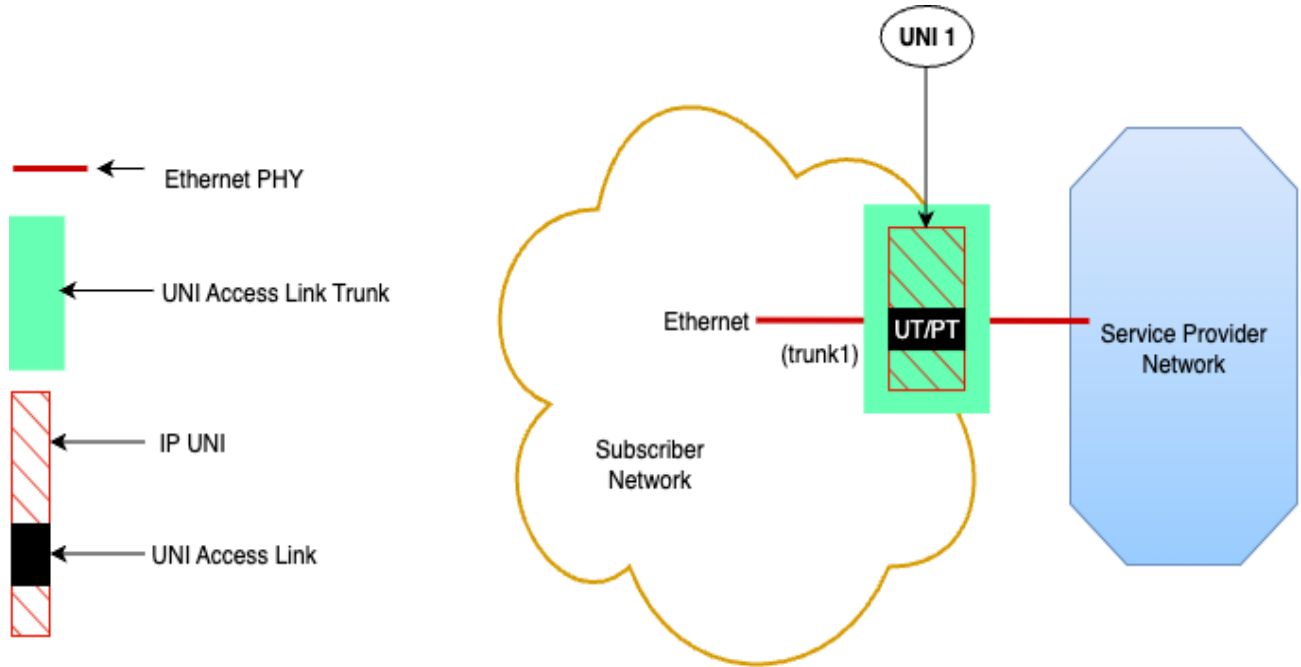


Figure 4-IP Service Topology

The IP Service Topology shows a single Ethernet link which is the UNI Access Link Trunk. The UNI Access Link comprises all untagged and priority tagged frames (UT/PT designation) which traverse the UNI Access Link Trunk and IP UNI.

9 Overview of Subscriber IP Services

This specification describes a data model for MEF-defined IP Subscriber Services. A Subscriber IP Service is an IP Service provided to an end user (the Subscriber) by a Service Provider. There is no restriction on the type of organization that can act as a Subscriber; for example, a Subscriber can be an enterprise, a mobile operator, an IT system integrator, a government department, etc. At its most basic, a Subscriber IP Service provides connectivity for IP Packets between different parts of the Subscriber's network (usually at different physical locations) or between the Subscriber's network and an external network, such as the public Internet or a private cloud service.

A User Network Interface (IpUni) is the demarcation point between the responsibility of the SP and the responsibility of the Subscriber. A given IpUni always relates to a single SP and a single Subscriber.

A given IpUni consists of one or more distinct IP links, each of which is a single IP hop from a service perspective (i.e., there is no intermediate router that processes the IP Packets traversing the link). Each such IP link is known as a UNI Access Link (IpUniAccessLink) and is a subnetwork corresponding to a distinct IP subnet (which can have both IPv4 and IPv6 addressing).

An IP Service is formed of an IP Virtual Connection (Ipsc) that links together IPVC End Points (IpscEndPoints) at External Interfaces (EIs). In the case of a Subscriber IP Service, the IPVC End Points (IpscEndPoints) are specifically at UNIs (IpUnis). Each IpUniAccessLink is carried by an underlying construct that encapsulates the Layer 1 and Layer 2 characteristics of the link. This construct is the UNI Access Link Trunk (IpUniAccessLinkTrunk). An IpUniAccessLinkTrunk may carry packets for a single IpUniAccessLink, as is the case where the IpUniAccessLink is a direct physical connection or may carry packets for multiple IpUniAccessLinks.

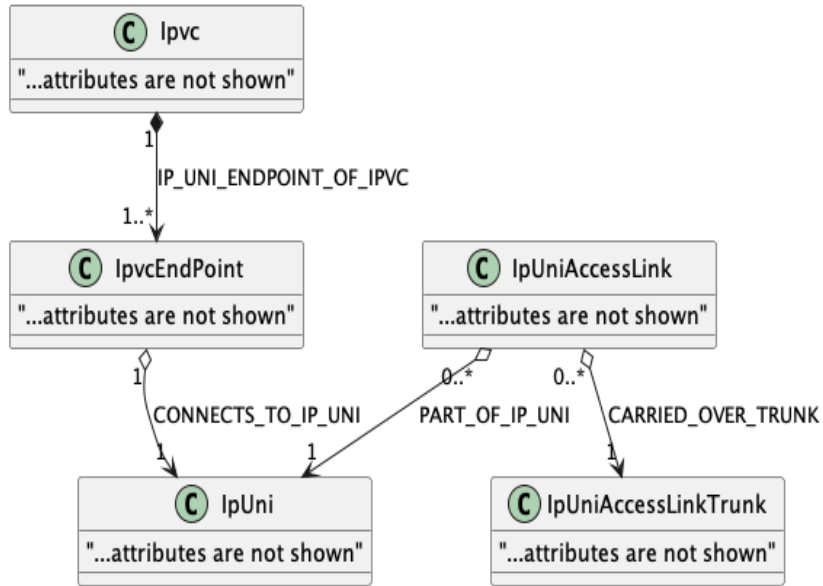


Figure 5-Subscriber IP Service Model

For Subscriber IP Services an IPVC has one or more IPVC End Points. The IPVC End Point points to exactly one IP UNI, and IP UNI Access Links connects to one IP UNI.

10 Overview of Operator IP Services

This specification describes a data model for MEF-defined IP Operator Services. When a Service Provider provides an end-to-end Subscriber IP Service to a Subscriber, they might not be able to implement the entire service using their own network - for instance, one of the Subscriber UNIs might not be in a geographic region where the Service Provider does not operate. In this case, the Service Provider must partner with another Operator who can reach that UNI. The Operator provides an IP connectivity service between the UNI and a point where they can interconnect with the SP's network as described in MEF 61.1 [10] and MEF 61.1.1 [11].

An External Network Network Interface (ENNI) is the demarcation point between the responsibility of one Operator and another - in other words, it is the interface where two Operators interconnect.

Like a UNI, an ENNI can comprise one or more distinct IP Links, each of which is a single IP hop. These links are known as ENNI Links, and typically each corresponds to a distinct IP subnet (which can have both IPv4 and IPv6 addressing). ENNI Links are assumed to be point-to-point.

When two Operators are connected by several ENNI Links, they need to agree how these links are grouped together to form ENNIs (via the ENNI List of ENNI Links Common Attribute). Each ENNI Link belongs to exactly one ENNI.

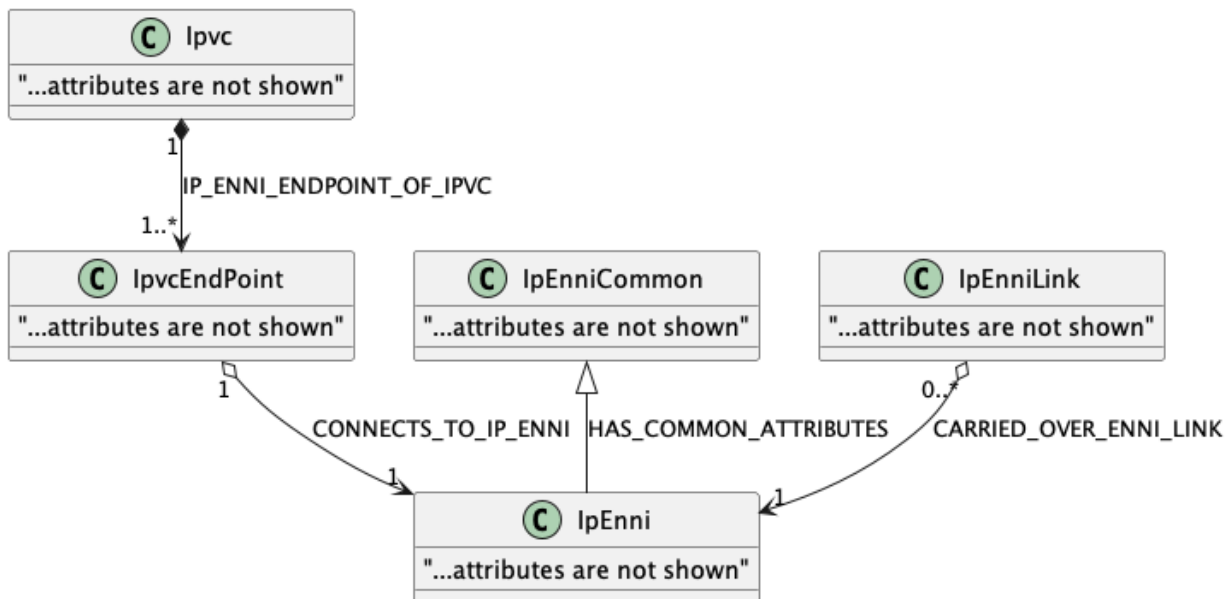


Figure 6-Operator IP Service Model

For Operator IP Services an IPVC has one or more IPVC End Points. The IPVC End Point points to one IP ENNI. The IP ENNI has a reference to IP ENNI Common attributes, and the IP ENNI Link is carried over ENNI Links.

11 Data Model Design Principles and Assumptions

A Service Attribute for a Service can have a value that is a simple datatype such as an integer or string (or list of simple datatypes) or a value that is an object with multiple properties or a composition of objects. Within this document each simple value (integer, string, Boolean, etc.) is referred to as a Service-Specific Attribute. A Service-Specific Attribute could be a Service Attribute (in the case where the Service Attribute itself has a simple type) or it could be a parameter within a Service Attribute (if the Service Attribute is a structured object or a composition of such objects). The classification for each Service-Specific Attribute may be different across Service Function, Service Action, and Service Offering.

The IP Service data model supports both INSTALL and CHANGE actions for Service Order for IPVC, IP UNI, IP UNI Access Link, IP UNI Access Link Trunk, IPVC End Point, ENNI, and ENNI Link. The IP Service data model supports the RETRIEVE action for Inventory for all Service Order components.

The location and physical layer of a UNI Access Link Trunk or ENNI Link cannot be changed once it is ordered; instead, this is handled as an installation (UNI Access Link Trunk or ENNI Link at new location) and disconnect (UNI Access Link Trunk or ENNI Link at previous location), as there is often a requirement for a smooth transition with minimum downtime.

12 Data Models for IP Services

The data models for the IP Service configuration are expressed as a set of YAML/JSON schemas based on JSON schema draft 7 and encoded in YAML. These schemas accompany this document. This section explains the organization and structure of these schemas.

12.1 Organization and Structure of the Schemas

The schemas are organized into a file structure as shown in Figure 7.

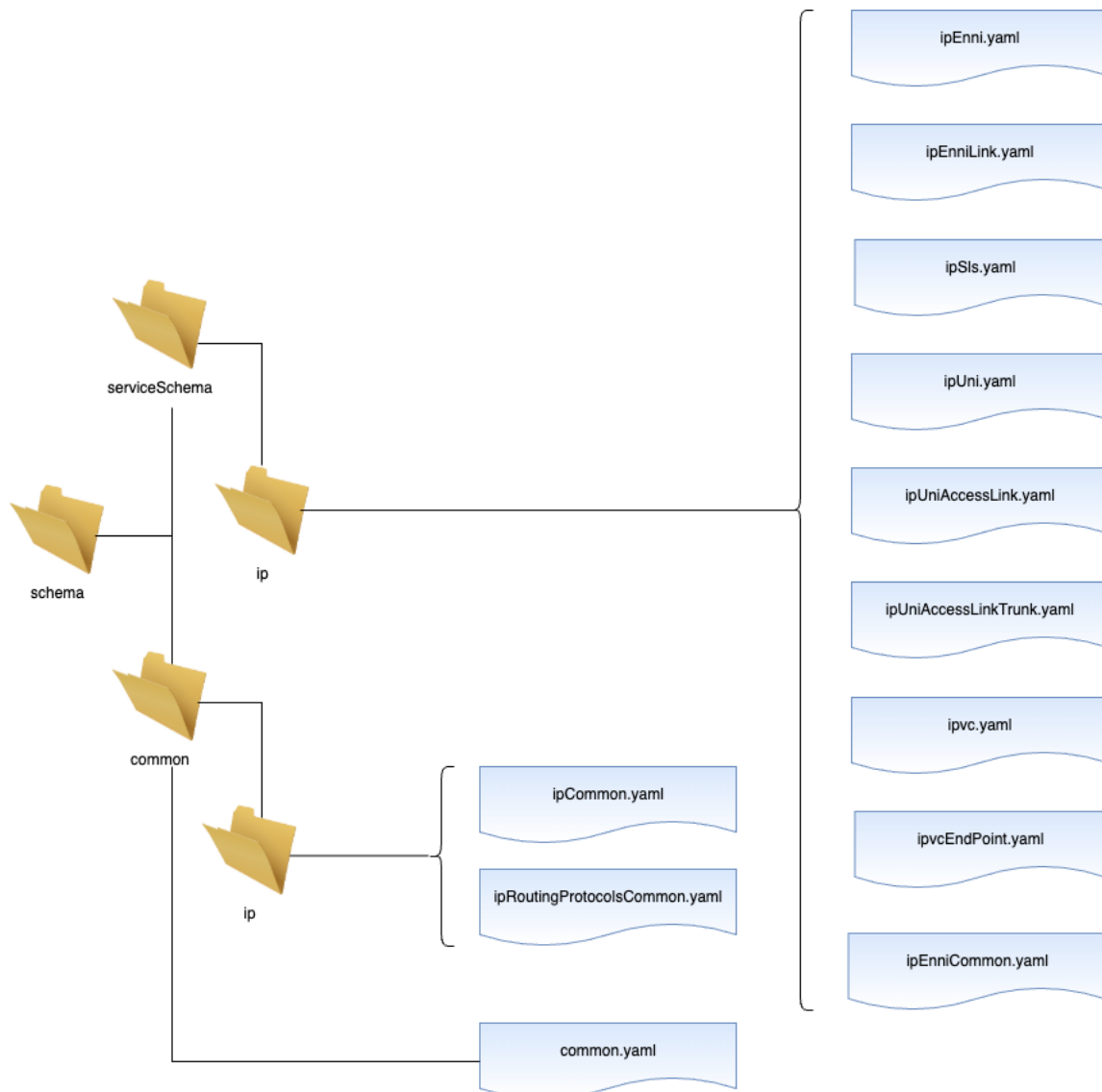


Figure 7-Schema Files Organization

Both Subscriber and Operator IP Service schemas are provided in the same directory. There are several common files that provide common resources that are shared with Subscriber and Operator IP services. One of those files is `ipCommon.yaml`:

- `schema/common/ip/ipCommon.yaml` – provides classes shared among all IP services.

These common classes are referenced in the relevant product component schema files. For example, the `IpUniAccessLink.ipv4ConnectionAddressing` attribute specified in `IpUniAccessLink.yaml` file refers to common `UniIpv4ConnectionAddressing` definition:

```
ipv4ConnectionAddressing:
  description: UniIpv4ConnectionAddressing is a data type representing how
  Ipv4addresses are allocated to the devices on the UNI Access Link. Reference MEF 61.1
  Section 13.4 UNI Access Link IPv4 Connection Addressing Service Attribute.
  $ref: "../../common/ip/ipCommon.yaml#/definitions/UniIpv4ConnectionAddressing"
```

The *ipCommon* YAML file contains resources that are common across Subscriber and Operator IP service components as well as a number of utility resources and types.

On a CHANGE request a single Service Attribute cannot be changed. The Client must send a full-service configuration that were previously specified by the Client (in an INSTALL request or previous CHANGE request). Any Optional Service Attributes that are not specified in a CHANGE request are reset to their default value.

- [R1]** The Service Inventory for a service **MUST** include all Service Attributes that are categorized as Mandatory.
- [R2]** The Service Inventory for a service **MUST** include all Service Attributes that are categorized as Optional.

Including Service Attributes in the Inventory as specified in the previous requirements facilitates the CHANGE action. The Buyer can RETRIEVE the current values for the Service Attributes and make the desired changes and submit the CHANGE request.

12.2 Additional Details

This section includes an explanation of some additional conventions for the schema structure as well as some additional attributes that have been added to facilitate product specification for some common edge cases.

12.2.1 Naming Conventions

In the schemas, resource and type names are upperCamelCase and Service Attribute property names are lowerCamelCase.

13 Relationships Between Entities

This section describes the constraints and relationships between the primary Service Order Items for both Subscriber and Operator IP Services. There are specific Service Order Items for both Subscriber and Operator IP Services that are described in respective sections below.

13.1 Subscriber IP Services Relationships Between Entities

This section description the constraints and relationships between the five primary Service Order Items (IPVC, IPVC End Point, IP UNI, IP UNI Access Link, and IP UNI Access Link Trunk) for Subscriber IP Services.

The use case for Subscriber IP Services is based on ordering the IPVC, IPVC End Point, a new or existing IP UNI, a new IP UNI Access Link, and IP UNI Access Link Trunk.

The Subscriber IPVC Service is associated with exactly one IPVC, The IPVC is associated with one or more IPVC End Points, associated IP UNIs with each IPVC End Point, associated IP UNI Access Link with each IP UNI and associated IP UNI Access Link Trunk with each IP UNI Access Link. Figure 8 illustrates the Service-agnostic Service Order with several Service Order Items and their Service-specific relationship to a Subscriber IP Service.

A Service Order is composed of one or more Service Order Items. This is supported in the service-agnostic part of the Service Order API. The service-specific payload (IP Services) is where the main components are supported as part of IP Service Schemas. Each Service Order Item is then associated with a service-specific orderable component (i.e., Ipvc) which is within the payload. Figure 8-Subscriber IP Service Order

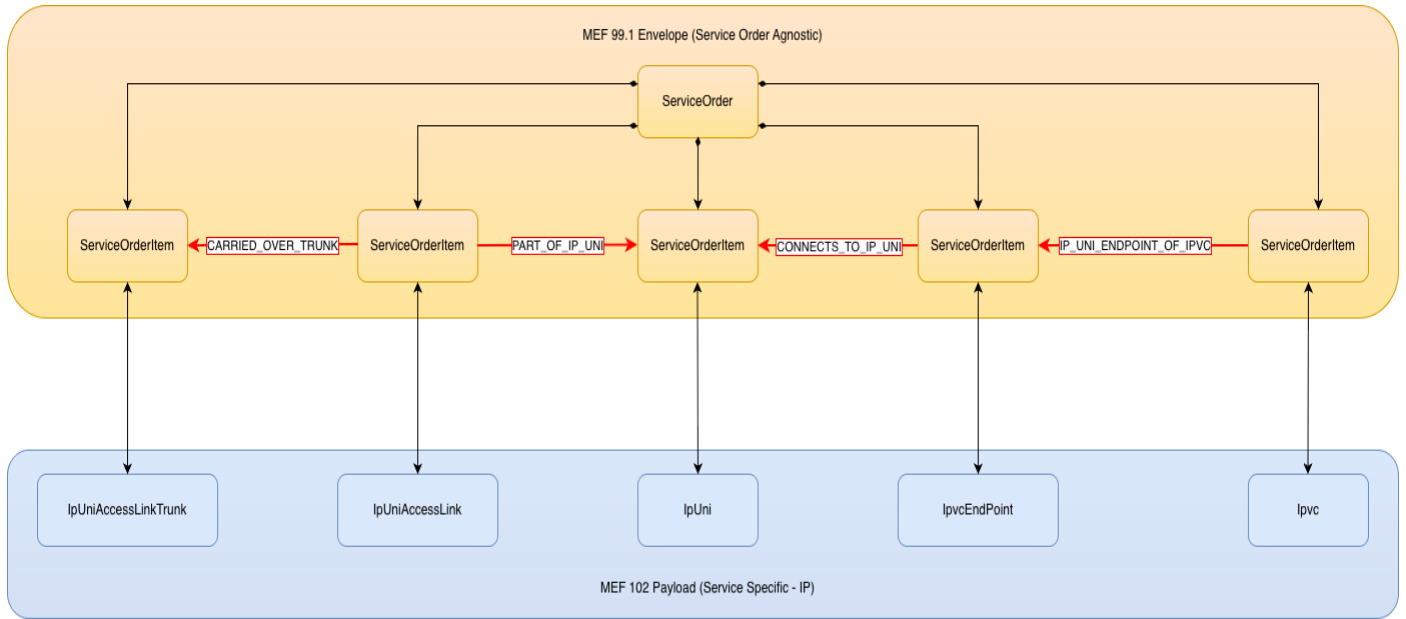


Figure 8-Subscriber IP Service Order API Associations

The relationships between each of the Service Order Items for Subscriber IP Services are shown in Table 4. The values in the Relationship Type column are used in the *relationshipType* field of the *OrderItemRelationship* types. Specification of IP UNI Access Link, IP UNI Access Link Trunk and IPVC are mandatory at INSTALL and CHANGE of the service.

Source Service Resource	Relationship Type	Cardinality	Target Service Resource
IpvC	IP_UNI_ENDPOINT_OF_IPVC	1	IpvEndPoint
IpvEndPoint	CONNECTS_TO_IP_UNI	1	IpUni
IpUniAccessLink	PART_OF_IP_UNI	1	IpUni
IpUniAccessLinkTrunk	CARRIED_OVER_TRUNK	1	IpUniAccessLink

Table 4-Subscriber IP Service Relationship Roles

- [R3]** For a Subscriber IP Service, the Relationship Type field between the *IpvC* Source Service Resource and *IpvEndPoint* Target Service Resource **MUST** be *IP_UNI_ENDPOINT_OF_IPVC*.
- [R4]** For a Subscriber IP Service, the Relationship Type field between the *IpvEndPoint* Source Service Resource and *IpUni* Target Service Resource **MUST** be *CONNECTS_TO_IP_UNI*.
- [R5]** For a Subscriber IP Service, the Relationship Type field between the *IpUniAccessLink* Source Service Resource and *IpUni* Target Service Resource **MUST** be *PART_OF_IP_UNI*.

- [R6] For a Subscriber IP Service, the Relationship Type field between the `IpUniAccessLinkTrunk` Source Service Resource and `IpUniAccessLink` Target Service Resource **MUST** be `CARRIED_OVER_TRUNK`.
- [R7] For a Subscriber IP Service, the relationship to an `IpUni` **MUST** reference an IP UNI Service Order Item.
- [R8] For a Subscriber IP Service, the relationship to an `IpUniAccessLink` **MUST** reference an `IpUniAccessLink` Service Order Item.
- [R9] For a Subscriber IP Service, the relationship to an `Ipvc` **MUST** reference an IPVC Service Order Item.
- [R10] For Service Order, the relationship to an `IpUnAccessLinkTrunk` **MUST** be specified for every INSTALL of, or CHANGE to, a Subscriber IP Service.
- [R11] For a CHANGE to Subscriber IP Service the relationship to the `IpUniAccessLinkTrunk` **MUST NOT** be changed from the value present in the Service Inventory.
- [R12] For a CHANGE to Subscriber IP Service the relationship to the `IpvcEndPoint` **MUST NOT** be changed from the value present in the Service Inventory.
- [R13] For a CHANGE to Subscriber IP Service the relationship to the `IpUni` **MUST NOT** be changed from the value present in the Service Inventory.
- [R14] For a CHANGE to Subscriber IP Service the relationship to the `IpAccessLink` **MUST NOT** be changed from the value present in the Service Inventory.

The Subscriber IP UNI, IP UNI Access Link, IP UNI Access Link Trunk and IPVC End Point are included with the IPVC for a Subscriber IP Service Order. The Subscriber IP UNI Access Link Trunk is associated with a specific `INSTALL_LOCATION` and is required at `INSTALL` and `CHANGE`. Once a Subscriber UNI Access Link Trunk is associated with a specific location, the `INSTALL_LOCATION` cannot be changed. The install location is captured in the service-agnostic part of the Service Order API. The value in the Place Relationship Role column in the table below is used in the role field of the `RelatedPlaceRefOrValue` type.

Service Resource	Place Relationship Role	Cardinality	Install	Change
<code>IpUniAccessLinkTrunk</code>	<code>INSTALL_LOCATION</code>	1	Mandatory	Mandatory

Table 5-Subscriber IP Place Relationship Role

- [R15] For a Subscriber IP Service, the Role field (role) of the Related Place (*RelatedPlaceRefOrValue*) type **MUST** contain one of the values shown in the Place Relationship Role column in Table 5.
- [R16] For Service Order, the Related Place (*RelatedPlaceRefOrValue*) **MUST** be specified for every INSTALL of, or CHANGE to an `IpUniAccessLinkTrunk`.
- [R17] For a CHANGE to an `IpUniAccessLinkTrunk` service, the Related Place **MUST NOT** be changed from the value present in the Service Inventory.

Changing the `UniAccessLinkTrunk` location is not supported for an IP Service. The value included in a CHANGE request must be identical to the value in the Inventory. The relationships applicable to Subscriber IP Services are shown in Figure 9.

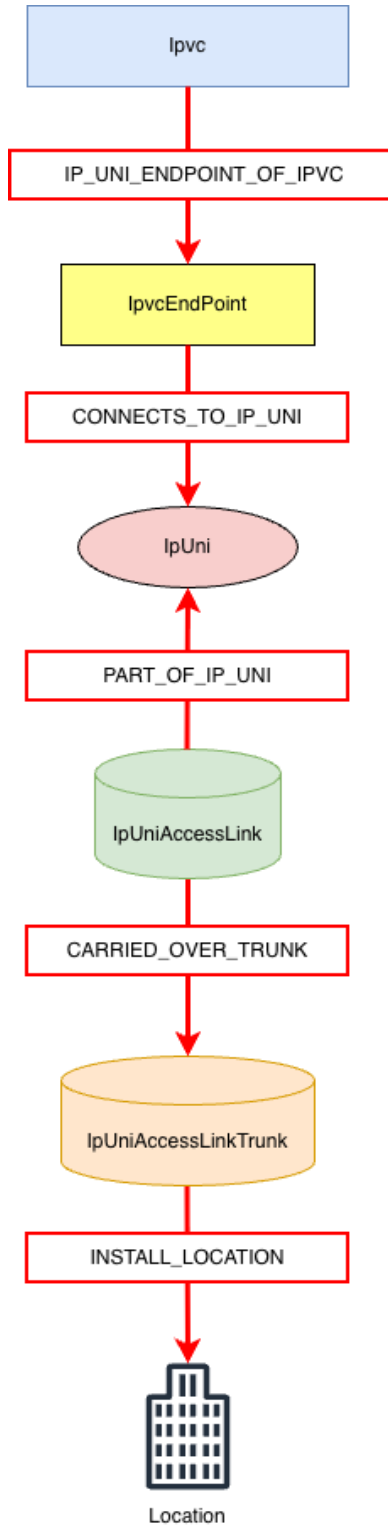


Figure 9-Subscriber IP Services Entities and Relationships

13.2 Operator IP Services Relationships Between Entities

This section description the constraints and relationships between the eight primary Service Order Items (IPVC, IPVC End Point, IP UNI, IP UNI Access Link, IP UNI Access Link Trunk, IP ENNI, and IP ENNI Trunk) for Operator IP Services.

The use case for Operator IP Services is based on ordering the IPVC, IPVC End Points with a new or existing IP UNI, a new IP UNI Access Link, and IP UNI Access Link Trunk; a new or existing IP ENNI and associated ENNI resources – IP ENNI Common and IP ENNI Trunk.

The Operator IPVC Service is associated with exactly one IPVC, The IPVC is associated with one or more IPVC End Points, associated IP UNIs with each IPVC End Point, associated IP UNI Access Link with each IP UNI and associated IP UNI Access Link Trunk with each IP UNI Access Link. In addition, the IPVC has an IPVC End Point associated with an IP ENNI. Figure 10 illustrates the Service-agnostic Service Order with several Service Order Items and their Service-specific relationship to an Operator IP Service.

A Service Order is composed of one or more Service Order Items. This is supported in the service-agnostic part of the Service Order API. The service-specific payload (IP Services) is where the main components are supported as part of IP Service Schemas. Each Service Order Item is then associated with a service-specific orderable component (i.e., Ipvc) which is within the payload.

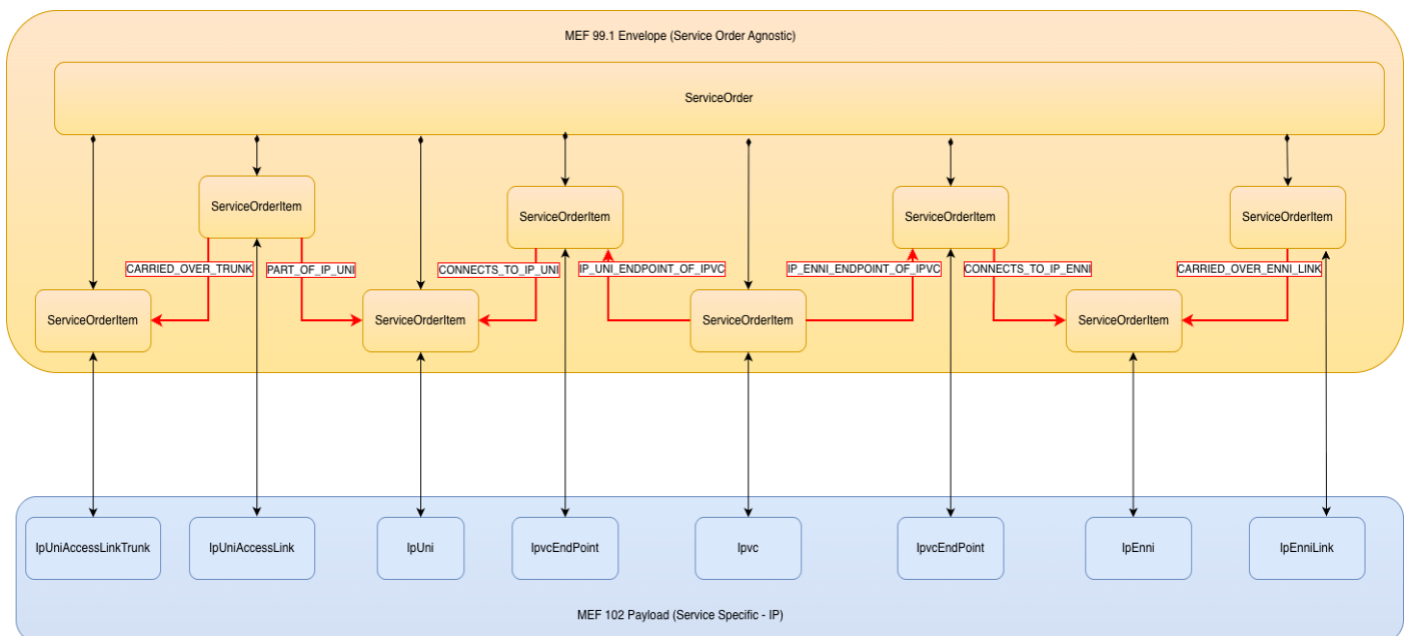


Figure 10-Operator IP Service Order API Associations

The relationships between each of the Service Order Items for Operator IP Services are shown in Table 6. The values in the Relationship Type column are used in the relationshipType field of the OrderItemRelationship types. Specification of IP UNI Access Link, IP UNI Access Link Trunk, IP ENNI, IP ENNI Trunk, IP ENNI Common and IPVC are mandatory at INSTALL and CHANGE of the service.

Source Service Resource	Relationship Type	Cardinality	Target Service Resource
Ipvc	IP_UNI_ENDPOINT_OF_IPVC	1	IpvcEndPoint
Ipvc	IP_ENNI_ENDPOINT_OF_IPVC	1	IpvcEndPoint
IpvcEndPoint	CONNECTS_TO_IP_UNI	1	IpUni
IpvcEndPoint	CONNECTS_TO_IP_ENNI	1	IpEnni
IpUniAccessLink	PART_OF_IP_UNI	1	IpUni
IpUniAccessLink	CARRIED_OVER_TRUNK	1	IpUniAccessLinkTrunk
IpEnniLink	CARRIED_OVER_ENNI_LINK	1	IpEnni

Table 6-Operator IP Service Relationship Roles

- [R18]** For an Operator IP Service, the Relationship Type field between the **Ipvc** Source Service Resource and **IpvcEndPoint** supporting a UNI IPVC End Point Target Service Resource **MUST** be **IP_UNI_ENDPOINT_OF_IPVC**.
- [R19]** For an Operator IP Service, the Relationship Type field between the **Ipvc** Source Service Resource and **IpvcEndPoint** supporting an ENNI IPVC End Point Target Service Resource **MUST** be **IP_ENNI_ENDPOINT_OF_IPVC**.
- [R20]** For an Operator IP Service, the Relationship Type field between the **IpvcEndPoint** Source Service Resource and **IpUni** Target Service Resource **MUST** be **CONNECTS_TO_IP_UNI**.
- [R21]** For an Operator IP Service, the Relationship Type field between the **IpvcEndPoint** Source Service Resource and **IpEnni** Target Service Resource **MUST** be **CONNECTS_TO_IP_ENNI**.
- [R22]** For an Operator IP Service, the Relationship Type field between the **IpUniAccessLink** Source Service Resource and **IpUni** Target Service Resource **MUST** be **PART_OF_IP_UNI**.
- [R23]** For an Operator IP Service, the Relationship Type field between the **IpUniAccessLink** Source Service Resource and **IpUniAccessLinkTrunk** Target Service Resource **MUST** be **CARRIED_OVER_TRUNK**.

- [R24] For an Operator IP Service, the Relationship Type field between the `IpEnniLink` Source Service Resource and `IpEnni` Target Service Resource **MUST** be `CARRIED_OVER_ENNI_LINK`.
- [R25] For Service Order, the relationship to an `IpEnniLinkTrunk` **MUST** be specified for every `INSTALL` of, or `CHANGE` to, an Operator IP Service.
- [R26] For an Operator IP Service, the relationship to an `IpEnni` **MUST** reference an `IpEnni` Service Order Item.
- [R27] For an Operator IP Service, the relationship to an `IpEnniLink` **MUST** reference an `IpEnniLink` Service Order Item.
- [R28] For a `CHANGE` to Operator IP Service the relationship to the `IpUniAccessLinkTrunk` **MUST NOT** be changed from the value present in the Service Inventory.
- [R29] For a `CHANGE` to Operator IP Service the relationship to the `IpvceEndPoint` associated with the `IpUni` **MUST NOT** be changed from the value present in the Service Inventory.
- [R30] For a `CHANGE` to Operator IP Service the relationship to the `IpvceEndPoint` associated with the `IpEnni` **MUST NOT** be changed from the value present in the Service Inventory.
- [R31] For a `CHANGE` to Operator IP Service the relationship to the `IpUni` **MUST NOT** be changed from the value present in the Service Inventory.
- [R32] For a `CHANGE` to Operator IP Service the relationship to the `IpAccessLink` **MUST NOT** be changed from the value present in the Service Inventory.
- [R33] For a `CHANGE` to Operator IP Service the relationship to the `IpEnni` **MUST NOT** be changed from the value present in the Service Inventory.
- [R34] For a `CHANGE` to Operator IP Service the relationship to the `IpEnniLink` **MUST NOT** be changed from the value present in the Service Inventory.

The Operator IP UNI, IP UNI Access Link, IP UNI Access Link Trunk, IPVC End Points, IP ENNI Link, IP ENNI and IP ENNI Common are included with the IPVC for an Operator IP Service Order. The Operator IP UNI Access Link Trunk and IP ENNI Trunk is associated with a specific `INSTALL_LOCATION` and is required at `INSTALL` and `CHANGE`. Once an Operator UNI Access Link

Trunk is associated with a specific location, the INSTALL_LOCATION cannot be changed. The same is true for an ENNI Link The install location is captured in the service-agnostic part of the Service Order API. The value in the Place Relationship Role column in the table below is used in the role field of the *RelatedPlaceRefOrValue* type.

Service Resource	Place Relationship Role	Cardinality	Install	Change
IpUniAccessLinkTrunk	INSTALL_LOCATION	1	Mandatory	Mandatory
IpEnniLink	INSTALL_LOCATION	1	Mandatory	Mandatory

Table 7-Operator IP Place Relationship Roles

- [R35]** For an Operator IP Service, the Role field (role) of the Related Place (*RelatedPlaceRefOrValue*) type **MUST** contain one of the values shown in the Place Relationship Role column in Table 7.
- [R36]** For Service Order, the Related Place (*RelatedPlaceRefOrValue*) **MUST** be specified for every INSTALL of, or CHANGE to an *IpUniAccessLinkTrunk*.
- [R37]** For Service Order, the Related Place (*RelatedPlaceRefOrValue*) **MUST** be specified for every INSTALL of, or CHANGE to an *IpEnniLink*.
- [R38]** For a CHANGE to an *IpUniAccessLinkTrunk* service, the Related Place **MUST NOT** be changed from the value present in the Service Inventory.
- [R39]** For a CHANGE to an *IpEnniAccessLink* service, the Related Place **MUST NOT** be changed from the value present in the Service Inventory.

Changing the UNI Access Link Trunk location is not supported for an IP Service. The value included in a CHANGE request must be identical to the value in the Inventory. Changing the ENNI Link location is not supported for an IP Service. The value included in a CHANGE request must be identical to the value in the Inventory. The relationships applicable to Operator IP Services are shown in Figure 11.

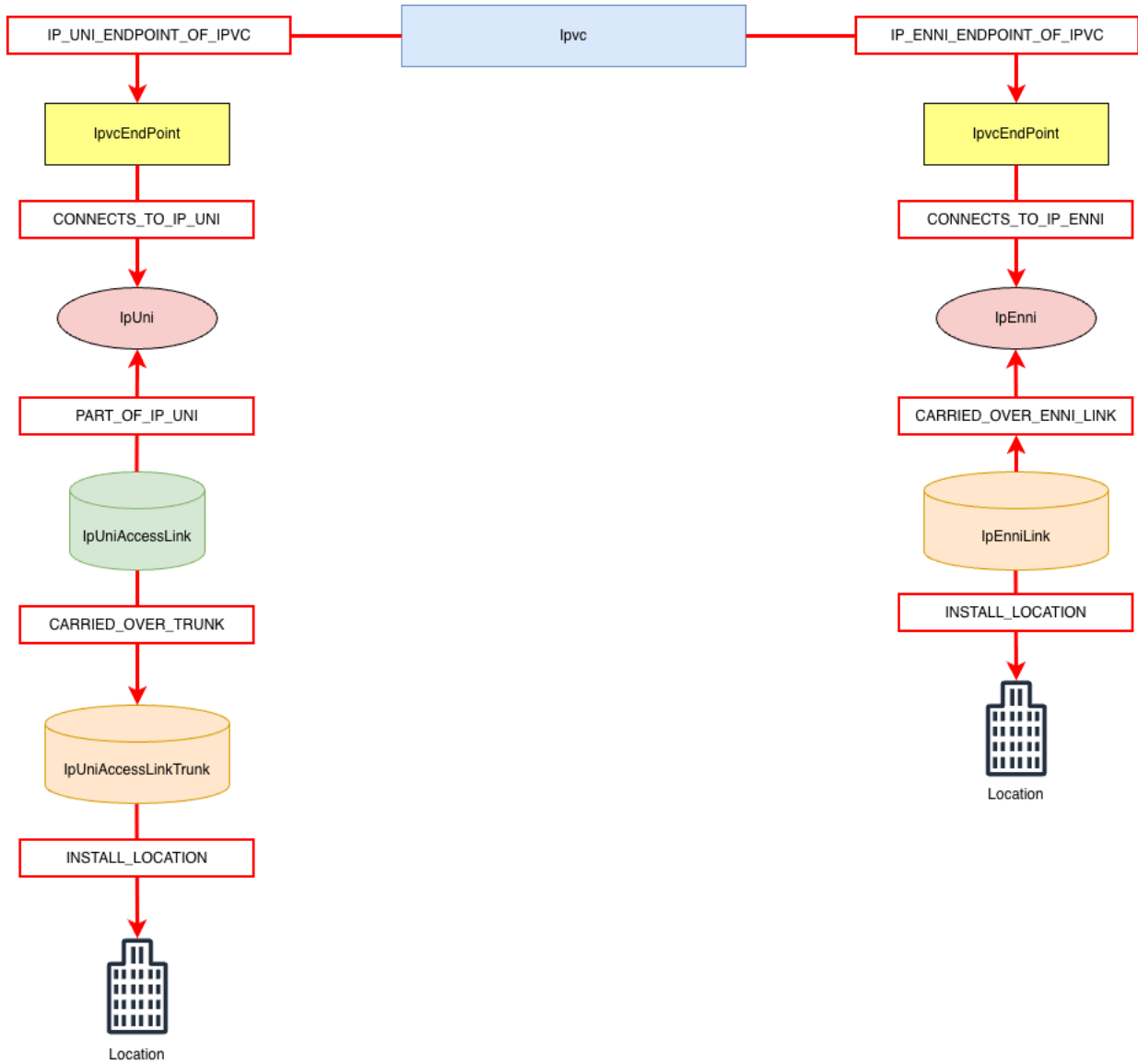


Figure 11-Operator IP Services Entities and Relationships

14 Subscriber IP Services Data Model

A Subscriber IP Service is an IP Service provided to an end user (the Subscriber) by a Service Provider. There is no restriction on the type of organization that can act as a Subscriber; for example, a Subscriber can be an enterprise, a mobile operator, an IT system integrator, a government department, etc. At its most basic, a Subscriber IP Service provides connectivity for IP Packets between different parts of the Subscriber's network (usually at different physical locations) or between the Subscriber's network and an external network, such as the public Internet or a private cloud service.

The Resources and corresponding Attributes are listed in groups:

- Subscriber IP Services Resource:
 - IpvC
 - IpvCEndPoint
 - IpUni
 - IpUniAccessLink
 - IpUniAccessLinkTrunk

14.1 IpvC

An IP Service is formed of an IP Virtual Connection (IPVC) that links together IPVC End Points at External Interfaces (EIs). Reference MEF 61.1 Section 7.4 IP Virtual Connections and IPVC End Points. NOTE: The association of IPVC and IPVC End Points is implemented within the envelope part of the API.

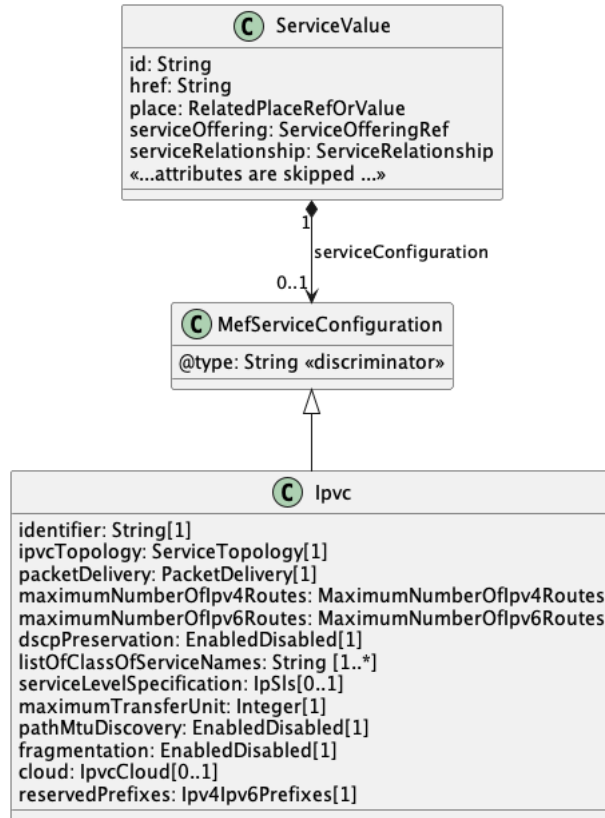


Figure 12-IpvC Model

Figure 12 presents the class diagram of classes present in the ipvC.yaml file. Note that all empty classes on it are only to show the type of the relation attributes while maintaining the readability of the diagram. Their detailed model will be described later.

Schema File Name: schema/serviceSchema/ip/ipvC.yaml			
\$id: urn:mef:iso:spec:service:ipvC:v1.0.0:all			
Attribute Name	Type	Multiplicity	Description
identifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> <i>"[\x20-\x7F]+"</i>	1	A unique string identifier for the IPV.C. Reference MEF 61.1 Section 10.1 IPV.C Identifier Service Attribute.
ipvCTopology	ServiceTopology	1	Attribute denoting the packet flow between any of the IPV.C End Points for the IPV.C. Reference MEF 61.1 Section 10.2 IPV.C Topology Service Attribute.
packetDelivery	PacketDelivery	1	Indicates whether packets are delivered per standard IP routing behavior or by some other means. Reference MEF 61.1 Section 10.4 IPV.C Packet Delivery Service Attribute.
maximumNumberOfIpv4Routes	MaximumNumber OfIpv4Routes	1	Maximum number of IPv4 routes supported by the service as a whole. Reference MEF 61.1

Schema File Name: schema/serviceSchema/ip/ipvc.yaml			
Sid: urn:mef:iso:spec:service:ipvc:v1.0.0:all			
			Section 10.5 IPVC Maximum Number of IPv4 Routes Service Attribute. Absence of this attribute corresponds to a value of "Unlimited".
maximumNumberOfIpv6Routes	MaximumNumber OfIpv6Routes	1	Maximum number of IPv6 routes supported by the service as a whole. Reference MEF 61.1 Section 10.6 IPVC Maximum Number of IPv6 Routes Service Attribute. Absence of this attribute corresponds to a value of "Unlimited".
dscpPreservation	EnabledDisabled	1	Indicates where the SP or Operator is allowed to modify the value of the IP DS field in the IP header of the Subscriber's traffic as it traverses the IPVC. Reference MEF 61.1 Section 10.7 IPVC DSCP Preservation Service Attribute.
listOfClassOfServiceNames	String	1.. *	The list of CoS Names supported by the IPVC. Reference MEF 61.1 Section 10.8 IPVC List of Class of Service Names Service Attribute.
serviceLevelSpecification	IpSls	0..1	The set of performance objectives for each CoS Name in the IPVC. The absence of this attribute corresponds to a value of "NONE". Reference MEF 61.1 Section 10.9 IPVC Service Level Specification Service Attribute.
maximumTransferUnit	Integer	1	Indicates the maximum size (in octets) of an IP packet that can traverse the IPVC without fragmentation. Reference MEF 61.1 Section 10.10 IPVC MTU Service Attribute.
pathMtuDiscovery	EnabledDisabled	1	Indicates whether the Path MTU Discovery is supported for the IPVC. Reference MEF 61.1 Section 10.11 IPVC Path MTU Discovery Service Attribute.
fragmentation	EnabledDisabled	1	Indicates whether IPv4 Packets can be fragmented. Reference MEF 61.1 Section 10.12 IPVC Fragmentation Service Attribute.
cloud	IpvcCloud	0..1	Reference MEF 61.1 Section 10.13 IPVC Cloud Service Attribute. The absence of this attribute corresponds to a value of "NONE".
reservedPrefixes	Ipv4OrIpv6Prefix	0..*	Reference MEF 61.1 Section 10.14 IPVC Reserved Prefixes Service Attribute.

Table 8-Ipvc Service Attributes

14.2 IpvceEndPoint

An IPVC End Point is a logical entity at an EI, to which a subset of packets that traverse the EI is mapped. Reference MEF 61.1 Section 7.4 IP Virtual Connections and IPVC End Points.

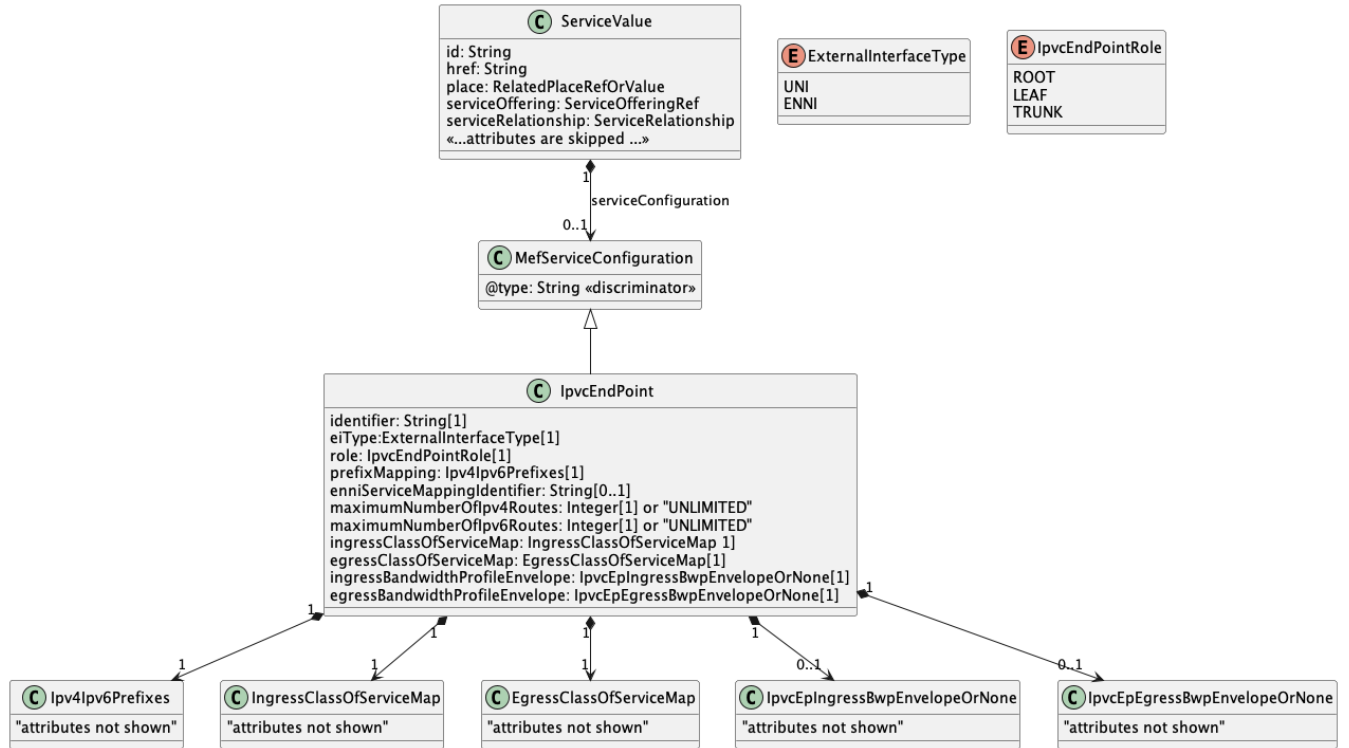


Figure 13-IpcEndPoint Model

Schema File Name: schema/serviceSchema/ip/ipvCEndPoint.yaml			
\$id: urn:mef:iso:spec:service:ipvcEndPoint:v1.0.0:all			
Attribute Name	Type	Multiplicity	Description
identifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> "[\x20-\x7F]+"	1	A unique identifier for the IPVC End Point for management purposes. Reference MEF 61.1 Section 11.1 IPVC EP Identifier Service Attribute.
eiType	ExternalInterfaceType	1	Indicates whether the IPVC End Point is at a UNI or an ENNI. (Operator IPVC EPs only). Reference MEF 61.1 Section 11.2 IPVC EP EI Type Service Attribute.
role	IpcEndPointRole	1	Role of the IPVC End Point in a rooted multipoint IPVC. Reference MEF 61.1 Section 11.4 IPVC EP Role Service Attribute.
prefixMapping	IpcIpv6Prefixes	1	Is a list, possibly empty of IP Prefixes. It is used to specify which subnets with the Subscriber Network can access the IPVC via this IPVC EP. Reference MEF 61.1 Section 11.5 IPVC EP Prefix Mapping Service Attribute.
enniServiceMappingIdentifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> "[\x20-\x7F]+"	0..1	ENNI Service Mapping Identifier assigned by the SP/SO for associating IPVC End Points across and ENNI. (Operator IPVC End Points only). Reference MEF 61.1 Section 11.6 IPVC EP ENNI Service Mapping Identifier Service Attribute.

Schema File Name: schema/serviceSchema/ip/ipvcEndPoint.yaml			
\$id: urn:mef:iso:spec:service:ipvcEndPoint:v1.0.0:all			
maximumNumberOfIpv4Routes	MaximumNumberofIpv4Routes	1	Maximum number of IPv4 routes supported by this IPVC End Point. Reference MEF 61.1 Section 11.7 IPVC EP Maximum Number of IPv4 Routes Service Attribute. Absence of this attribute corresponds to a value of "Unlimited".
maximumNumberOfIpv6Routes	MaximumNumberofIpv6Routes	1	Maximum number of IPv6 routes supported by this IPVC End Point. Reference MEF 61.1 Section 11.8 IPVC EP Maximum Number of IPv6 Routes Service Attribute. Absence of this attribute corresponds to a value of "Unlimited".
ingressClassOfServiceMap	IngressClassOfServiceMap	1	Specification of how ingress packets are mapped to different CoS Names. Reference MEF 61.1 Section 11.9 IPVC EP Ingress Class of Service Map Service Attribute.
egressClassOfServiceMap	EgressClassOfServiceMap	1	Specification of how Class of Service is indicated in egress packets. Reference MEF 61.1 Section 11.10 IPVC EP Egress Class of Service Map Service Attribute.
ingressBandwidthProfileEnvelope	IpvcEpIngressBwpEnvelopeOrNone	1	Ingress Bandwidth Profile Envelope for the IPVC End Point. The absence of this attribute corresponds to a value of "None". Reference MEF 61.1 Section 11.11 IPVC EP Ingress Bandwidth Profile Envelope Service Attribute.
egressBandwidthProfileEnvelope	IpvcEpEgressBwpEnvelopeOrNone	1	Egress Bandwidth Profile Envelope for the IPVC End Point. The absence of this attribute corresponds to a value of "None". Reference MEF 61.1 Section 11.12 IPVC EP Egress Bandwidth Profile Envelope Service Attribute.

Table 9-IPvcEndPoint Service Attributes

NOTE: The IPVC EP (End Point) EI (External Interface) attribute is not provided given the relationship to IPVC EP and either UNI or ENNI is provided in the envelope part of the API (i.e., MEF 99.1).

14.3 IpUni

A User Network Interface (UNI) is the demarcation point between the responsibility of the SP and the responsibility of the Subscriber. Note that a given UNI always relates to a single SP and a single Subscriber. Reference MEF 61.1[11] Section 7.3 UNIs and UNI Access Links.

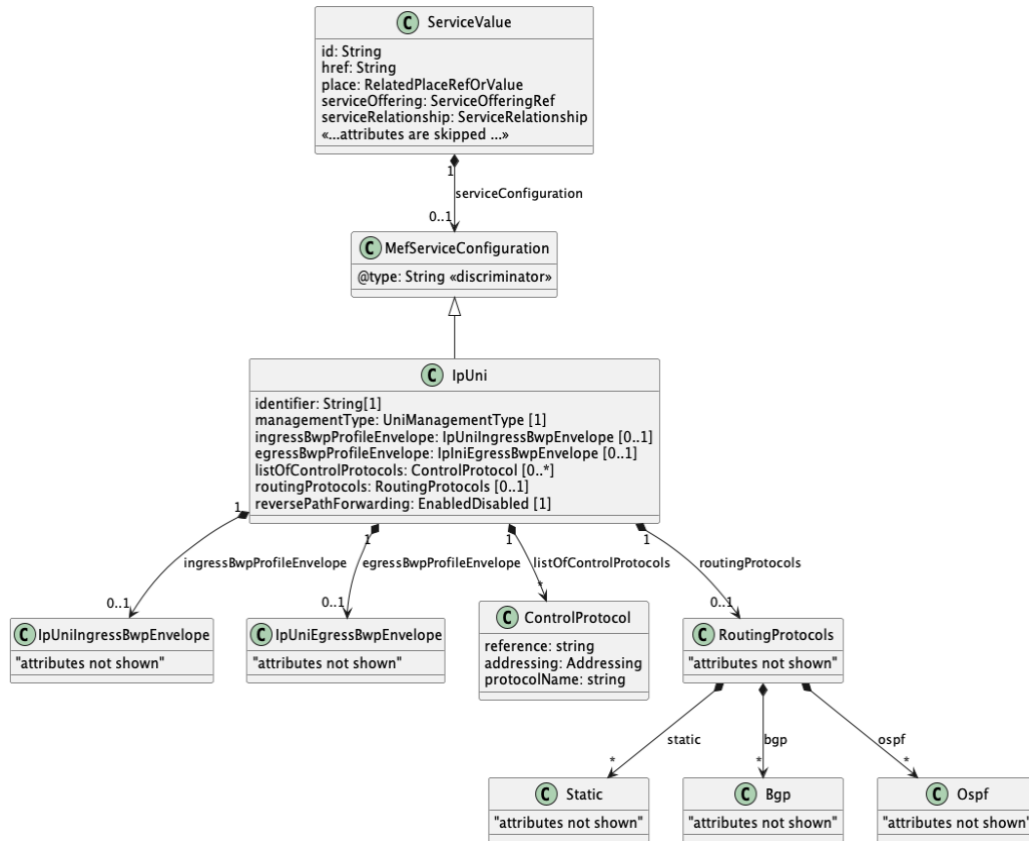


Figure 14-IpUni Model

Schema File Name: schema/serviceSchema/ip/IpUni.yaml			
\$id: urn:mef:iso:spec:service:ip-uni:v1.0.0:all			
Attribute Name	Type	Multiplicity	Description
identifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> <i>"[\x20-\x7F]+"</i>	1	Unique string identifier for the UNI. Reference MEF 61.1 Section 12.1 UNI Identifier Service Attribute.
managementType	UniManagementType	1	Attribute indicating whether the CE is the responsibility of the Subscriber or the Service Provider. Reference MEF 61.1 Section 12.2 UNI Management Type Service Attribute.
ingressBwpProfileEnvelope	IpUniIngressBwpEnvelope	0..1	Attribute used for an ingress UNI Bandwidth Profile. Reference MEF 61.1 Section 12.4 UNI Ingress Bandwidth Profile Envelope Service Attribute. Absence of this attribute corresponds to a value of "None".
egressBwpProfileEnvelope	IpUniEgressBwpEnvelope	0..1	Attribute used for an egress UNI Bandwidth Profile. Reference MEF 61.1 Section 12.5 UNI Egress Bandwidth Profile Envelope Service Attribute. Absence of this attribute corresponds to a value of "None".
listOfControlProtocols	ControlProtocol	0..*	Indication of IP Control Protocols that are not forwarded transparently by the SP. Reference MEF 61.1 Section 12.6 UNI

Schema File Name: schema/serviceSchema/ip/IpUni.yaml \$id: urn:mef:iso:spec:service:ip-uni:v1.0.0:all			
			List of Control Protocols Service Attribute. Absence of this attribute corresponds to a value of "None".
routingProtocols	RoutingProtocols	0..1	List of Routing Protocols used across the UNI. Reference MEF 61.1 Section 12.7 UNI Routing Protocols Service Attribute. Absence of this attribute corresponds to a value of "None".
reversePathForwarding	EnabledDisabled	1	Indicates whether Reverse Path Forwarding checks are used by the SP at the UNI. Reference MEF 61.1 Section 12.8 UNI Reverse Path Forwarding Service Attribute.

Table 10-IpUni Service Attributes

NOTE: The UNI List of UNI Access Links attribute is not provided given the relationship to UNI Access Links is provided in the envelope part of the API (i.e., MEF 99.1).

14.4 IpUniAccessLink

An individual connection between the Subscriber and the SP that forms part of a UNI. Reference MEF 61.1[10] Section 7.3 UNIs and UNI Access Link.

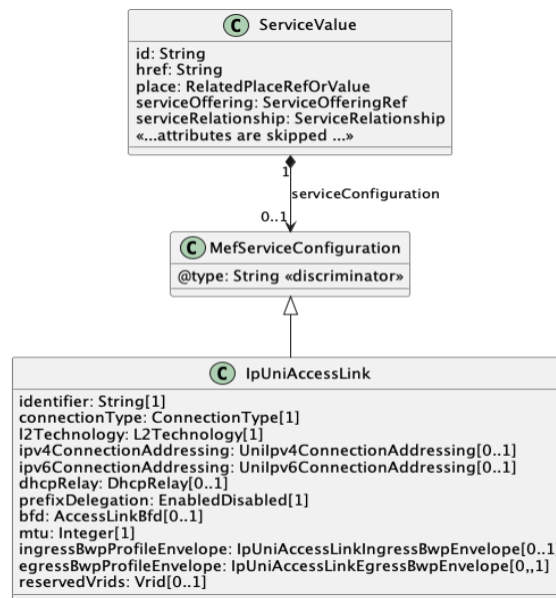


Figure 15-IpUniAccessLink Model

Schema File Name: schema/serviceSchema/ip/IpUniAccessLink.yaml \$id: urn:mef:iso:spec:service:ip-uni-access-link:v1.0.0:all			
Attribute Name	Type	Multiplicity	Description
identifier	String Min length=1 Max length=53 Pattern=pattern: "[x20-x7F]+"	1	Unique identifier for the UNI Access Link management purposes. Reference MEF 61.1 Section 13.1 UNI Access Link Identifier Service Attribute.



Schema File Name: schema/serviceSchema/ip/IpUniAccessLink.yaml			
\$id: urn:mef:iso:spec:service:ip-uni-access-link:v1.0.0:all			
connectionType	ConnectionType	1	Attribute that indicates the number of interfaces that can be attached to the UNI Access Link. Reference MEF 61.1 Section 13.2 UNI Access Link Connection Type Service Attribute.
l2Technology	L2Technology	1	Describes the underlying network layers that carry IP Packets across the UNI. Reference MEF 61.1 Section 13.3 UNI Access Link L2 Technology Service Attributes.
ipv4ConnectionAddressing	Unilpv4ConnectionAddressing	0..1	IPv4 Connection Addressing. Reference MEF 61.1 Section 13.4 UNI Access Link IPv4 Connection Addressing Service Attribute. Absence of this attribute corresponds to a value of "None".
ipv6ConnectionAddressing	Unilpv6ConnectionAddressing	0..1	IPv6 Connection Addressing. Reference MEF 61.1 Section 13.5 UNI Access Link IPv6 Connection Addressing Service Attribute. Absence of this attribute corresponds to a value of "None".
dhcpRelay	DhcpRelay	0..1	Indicates whether DHCP Relay functionality is enabled. Reference MEF 61.1 Section 13.6 UNI Access Link DHCP Relay Service Attribute. Absence of this attribute corresponds to a value of "Disabled".
prefixDelegation	EnabledDisabled	1	Indicates whether DHCP Prefix delegation is enabled. Reference MEF 61.1 Section 13.7 UNI Access Link Prefix Delegation Service Attribute.
bfd	AccessLinkBfd	1	Indicates whether the Bidirectional Forwarding Detection (BFD) function is enabled or disabled on the UNI Access Link. Reference MEF 61.1 Section 13.8 UNI Access Link BFD Service Attribute.
mtu	Integer ≥ 576	1	Maximum size, in octets of an IP Packet that can traverse the IP UNI Access Link. Reference MEF 61.1 Section 13.9 UNI Access Link IP MTU Service Attribute.
ingressBwpProfileEnvelope	IpUniAccessLinkIngressBwpEnvelope	0..1	Ingress Bandwidth Profile Envelope for the UNI Access Link. Reference MEF 61.1 Section 13.10 UNI Access Link Ingress Bandwidth Profile Envelope Service Attribute. Absence of this attribute corresponds to a value of "None".
egressBwpProfileEnvelope	IpUniAccessLinkEgressBwpEnvelope	0..1	Egress Bandwidth Profile Envelope for the UNI Access Link. Reference MEF 61.1 Section 13.11 UNI Access Link Egress Bandwidth Profile Envelope Service Attribute. Absence of this attribute corresponds to a value of "None".
reservedVrids	Vrid	0..*	List of VRRP (Virtual Router Redundancy Protocol) VRIDs (Virtual Router Identifier) reserved for use by the SP or Operator. Reference MEF 61.1 Section 13.12 UNI Access Link Reserved VRIDs Service Attribute.

Table 11-IpUniAccessLink Service Attributes

14.5 IpUniAccessLinkTrunk

A UNI Access Link Trunk is a construct that encapsulates the details of Layer 1 and Layer 2 configuration shared by one or more UNI Access Links. Reference MEF 61.1.1 Section A1-1 UNI Access Link Trunk Service Attributes.

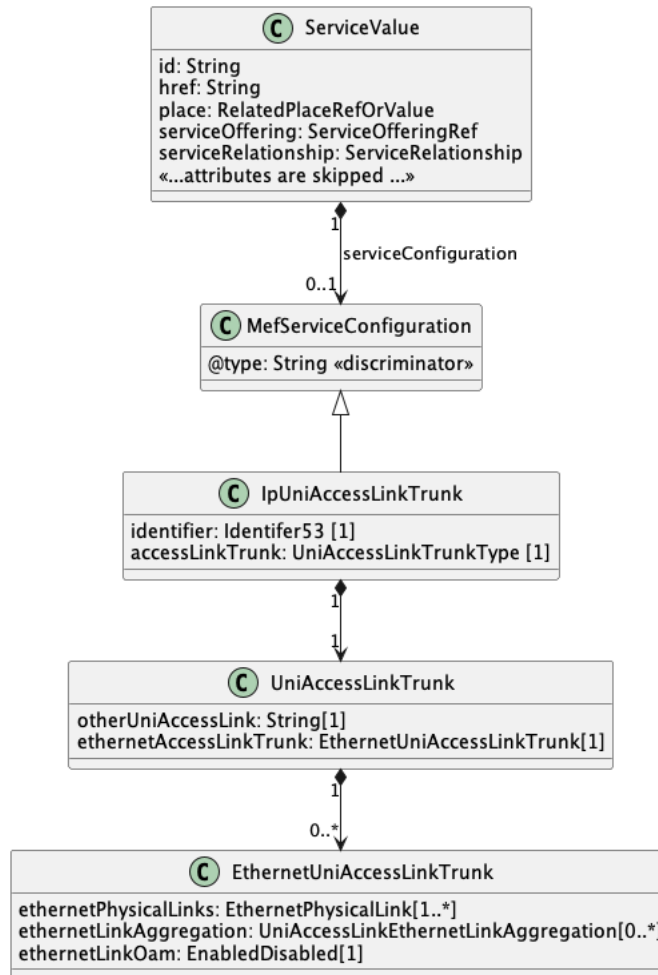


Figure 16-IpUniAccessLinkTrunk Model

Schema File Name: schema/serviceSchema/ip/IpUniAccessLinkTrunk.yaml			
\$id: urn:mef:iso:spec:service:ip-uni-access-link-trunk:v1.0.0:all			
Attribute Name	Type	Multiplicity	Description
identifier	String Min length=1 Max length=53 Pattern=pattern: "[\x20-\x7F]+"	1	Unique identifier for the UNI Access Link Trunk for management purposes. Reference MEF 61.1.1 Section A1-1.1 UNI Access Link Trunk Identifier Service Attribute.

Schema File Name: schema/serviceSchema/ip/ipUniAccessLinkTrunk.yaml			
\$id: urn:mef:iso:spec:service:ip-uni-access-link-trunk:v1.0.0:all			
accessLinkTrunk	UniAccessLinkTrunk	1	A UNI Access Link Trunk is a construct that encapsulates the physical link properties of one or more UNI Access Links.

Table 12-IpUniAccessLinkTrunk Service Attributes

14.6 UniAccessLinkTrunk

A UNI Access Link Trunk is a construct that encapsulates the physical link properties of one or more UNI Access Links.

Schema File Name: schema/serviceSchema/ip/ipUniAccessLinkTrunk.yaml			
minProperties: 1			
maxProperties: 1			
Attribute Name	Type	Multiplicity	Description
otherUniAccessLink	String Enum: • OTHER	0..1	Indicate that the UNI Access Link is OTHER.
ethernetAccessLinkTrunk	EthernetUniAccessLinkTrunk	0..1	Selection EthernetUniAccessLinkTrunk.

Table 13-UniAccessLinkTrunk Attributes

14.7 EthernetUniAccessLinkTrunk

A UNI Access Link Trunk is a construct that encapsulates the physical link properties of one or more UNI Access Links.

Schema File Name: schema/serviceSchema/ip/ipUniAccessLinkTrunk.yaml			
Attribute Name	Type	Multiplicity	Description
ethernetPhysicalLinks	EthernetPhysicalLink	1.. *	A list of the physical link types along with some additional capabilities. Reference MEF 61.1.1 Section A1-1.3.1 UNI Access Link Trunk List of Ethernet Physical Links Service Attribute.
ethernetLinkAggregation	UniAccessLinkEthernetLinkAggregation	0.. *	Indicates whether the UNI Access Link Trunk is a Link Aggregation Group, and if so, specifies parameters that control the mapping of Ethernet frames to links in the LAG. Reference MEF 61.1.1 Section A1-1.3.2 UNI Access Link Trunk Ethernet Link Aggregation Service Attribute.
ethernetLinkOam	EnabledDisabled	1	Controls when and how Link OAM per IEEE Std 802.3-2018 is run on the physical links in the UNI Access Link Trunk. The value is either Enabled or Disabled. Reference MEF 61.1.1 Section A1-1.3.3.

Table 14-Ethernet UniAccessLinkTrunk Attributes

15 Operator IP Services Data Model

When a Service Provider provides an end-to-end Subscriber IP Service to a Subscriber, they might not be able to implement the entire service using their own network – for instance, one of the Subscriber’s UNIs might be in a geographic region where the Service Provider does not operate. In this case, the Service Provider must partner with another Operator who can reach that UNI. The Operator provides an IP connectivity service between the UNI and a point where they can interconnect with the SP’s network. Such IP Services – provided by one Operator to another Operator or a Service Provider, to implement part of an end-to-end Subscriber IP Service – are known as Operator IP Services.

- Operator IP Services:
 - IpUni
 - IpUniAccessLink
 - IpvEndPoint
 - Ipv
 - IpEnni
 - IpEnniLink
 - IpEnniCommon

15.1 IpEnni

An External Network Network Interface (ENNI) is the demarcation point between the responsibility of one Operator and another - other words, it is the interface where the two Operators interconnect. Reference MEF 61.1[10] Section 8.2 ENNI and ENNI Links.

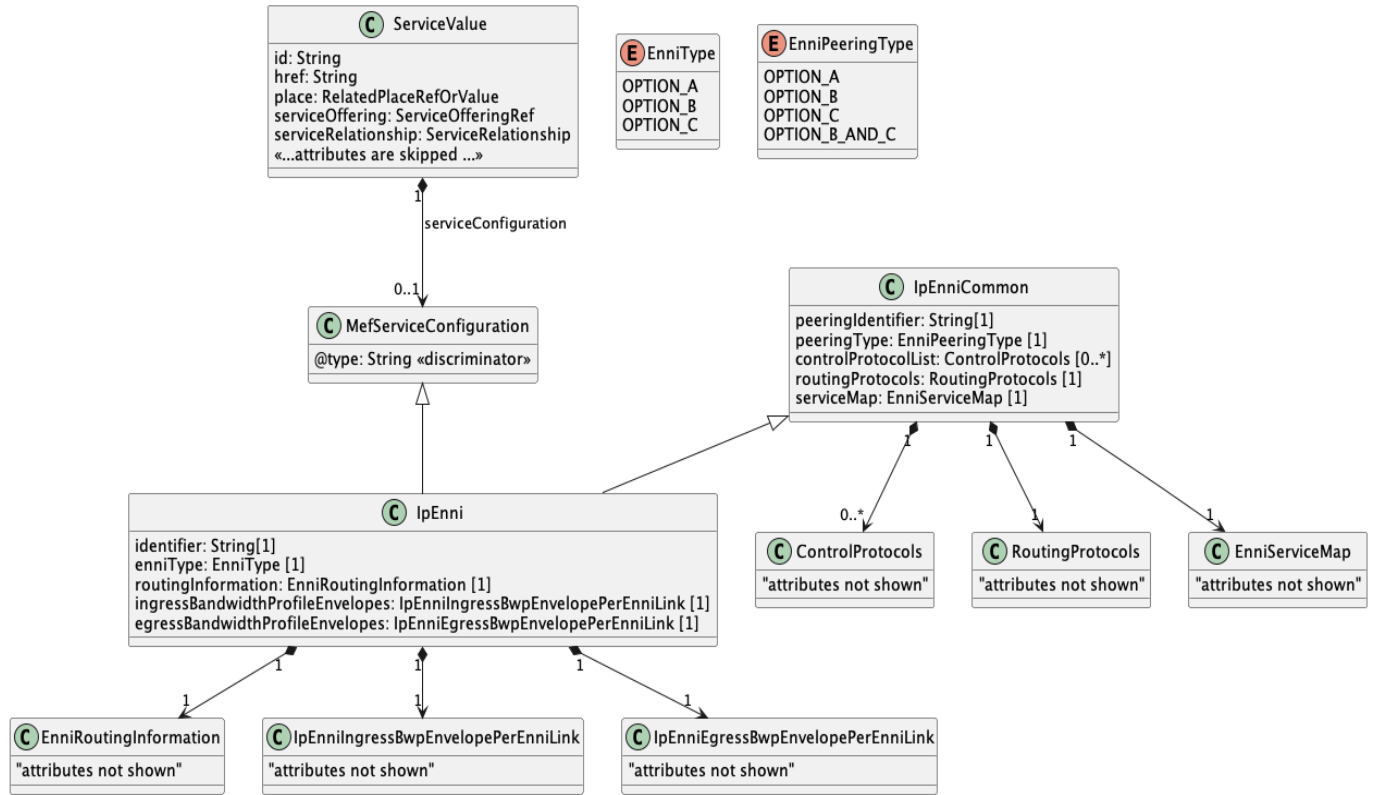


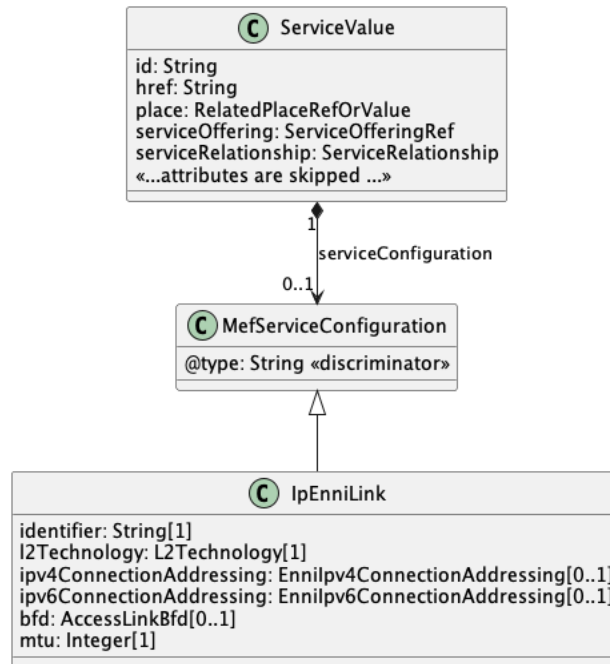
Figure 17-IpEnni Model

Schema File Name: schema/serviceSchema/ip/IpEnni.yaml			
\$id: urn:mef:lso:spec:service:ip-enni:v1.0.0:all			
allOf: IpEnniCommon			
Attribute Name	Type	Multiplicity	Description
identifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> <i>"[\\x20-\\x7F]+"</i>	1	Unique string for the ENNI. Reference MEF 61.1 Section 14.1 ENNI Identifier Attribute.
enniType	EnniType	1	Indication of the type of BGP Peering at the ENNI. Reference MEF 61.1 Section 14.2 ENNI Type Service Attribute.
routingInformation	EnniRoutingInformation	1	Per-service routing information applicable at the ENNI. Reference MEF 61.1 Section 14.3 ENNI Routing Information Service Attribute.
ingressBandwidthProfileEnvelopes	IpEnniIngressBwpEnvelopePerEnniLink	1	Bandwidth Profile Envelope per ENNI Link used for an ingress Bandwidth Profile. Reference MEF 61.1 Section 14.4 ENNI Ingress Bandwidth Profile Envelopes Service Attribute.
egressBandwidthProfileEnvelopes	IpEnniEgressBwpEnvelopePerEnniLink	1	Bandwidth Profile Envelope per ENNI Link used for an egress Bandwidth Profile. Reference MEF 61.1 Section 14.5 ENNI Egress Bandwidth Profile Envelopes Service Attribute.

Table 15-IpEnni Service Attributes

15.2 IpEnniLink

An ENNI can comprise one or more distinct IP Links, each of which is a single IP hop. These links are known as ENNI Links, and typically each corresponds to a distinct IP subnet (which can have both IPv4 and IPv6 addressing). ENNI Links are assumed to be point-to-point. Reference MEF 61.1 Section 8.2 ENNIs and ENNI Links.


Figure 18-IpEnniLink Model

Schema File Name: schema/serviceSchema/ip/IpEnniLink.yaml			
\$id: urn:mef:iso:spec:service:ip-enni-link:v1.0.0:all			
Attribute Name	Type	Multiplicity	Description
identifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> " <i>[\x20-\x7F]+</i> "	1	Unique String identifier for the ENNI Link. Reference MEF 61.1 Section 16.1 ENNI Link Identifier Attribute.
L2Technology	L2Technology	1	Describes the underlying Layer 2 that carries IP Packets over the ENNI. Reference MEF 61.1 Section 16.2 ENNI Link L2 Technology Attribute.
ipv4ConnectionAddressing	Ennilpv4Connection Addressing	0..1	IPv4 Connection Addressing. Reference MEF 61.1 Section 16.3 ENNI Link IPv4 Connection Addressing Attribute.
ipv6ConnectionAddressing	Ennilpv6Connection Addressing	0..1	IPv6 Connection Addressing. Reference MEF 61.1 Section 16.4 ENNI Link IPv6 Connection Addressing Attribute.

bfd	AccessLinkBfd	1	Indicates whether Bidirectional Forwarding Detection (BFD) is enabled on the ENNI Link, and if so if the parameters that need to be agreed. Reference MEF 61.1 Section 16.5 ENNI Link BFD Attribute.
mtu	Integer ≥ 576	1	Maximum size, in octets of an IP Packet that can traverse the ENNI Link. Reference MEF 61.1 Section 16.6 ENNI Link MTU Attribute.

Table 16-IpEnniLink Service Attributes

15.3 IpEnniCommon

ENNI Common Attributes that apply to each ENNI agreed between two LLOs (Lowest Level Operators). Reference MEF 61.1[10] Section 15 ENNI Common Attributes.

Schema File Name: schema/serviceSchema/ip/IpEnniCommon.yaml			
Attribute Name	Type	Multiplicity	Description
peeringIdentifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> <i>"[\x20-\x7F]+"</i>	1	Unique identifier for the ENNI for management purposes. Reference MEF 61.1 Section 15.1 ENNI Peering Common Attribute.
peeringType	EnniPeeringType	1	Indication of the type of BGP Peering at the ENNI. Reference MEF 61.1 Section 15.2 ENNI Peering Type Common Attribute.
controlProtocolsList	ControlProtocols	0..*	Indication of IP Control Protocols that are not forwarded transparently by the LLO. Reference MEF 61.1 Section 15.4 ENNI List of Control Protocols Common Attribute.
routingProtocols	RoutingProtocols	1	List of Routing Protocols used across the ENNI. Reference MEF 61.1 Section 15.5 ENNI Routing Protocols Common Attribute.
serviceMap	EnniServiceMap	1	Mapping of ENNI Service Mapping Contexts across the ENNI. Reference MEF 61.1 Section 15.6 ENNI Service Map Common Attribute.

Table 17-IpEnniCommon Attributes

15.4 EnniList

The ENNI List of ENNI Links Common Attribute is a list of 3-tuples of the form (*ID, L1, Links*). Each entry in the list corresponds to a distinct L1 link across the ENNI – in most cases, this means a separate physical link (although virtual or logical links are not precluded). The first element in the 3-tuple, *ID*, is the identifier of the L1 link. The second element, *L1*, contains the details of the L1 technology used for the link. The third element, *Links*, is a list (possibly empty) of ENNI Link Identifiers (see section 16.1) for the ENNI Links in this ENNI that traverse the L1 link. Reference MEF 61.1 Section 15.3 ENNI List of ENNI Links Common Attribute.

Schema File Name: schema/serviceSchema/ip/ipEnniCommon.yaml			
Attribute Name	Type	Multiplicity	Description
identifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> "[\x20-\x7F]+"	1	L1 Link Identifier. Reference MEF 61.1 Section 15.3.1 L1 Link Identifier.
ennidentifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> "[\x20-\x7F]+"	1..*	ENNI Identifiers.
l1Technology	L1Technology	0..1	Layer 1 technology.

Table 18-EnniList Attributes

15.5 EnniPeeringType

File: schema/serviceSchema/ip/ipEnniCommon.yaml

Attribute indicates the type of BGP Peering used across the ENNI. The possible values are Option A, Option B, Option C or Option B and C. They refer to the options described in RFC 4364. Reference MEF 61.1 Section 15.2 ENNI Peering Type Common Attribute. For Options reference MEF 61.1 Section 8.6 Connecting Services across an ENNI.

Contains Enumeration Literals:

- **OPTION_A:**
 - A separate eBGP session is used across each ENNI Link and each session carries routes for one service. This results in packets for different services being sent over different ENNI Links. The packets can be plain IP Packets since it is the different links that distinguish them.
- **OPTION_B:**
 - One or more eBGP sessions are used across the ENNI, each exchanging labelled VPN routes for multiple services. The routes for different services are distinguished by attributes such a Route Distinguishers and Route Targets. This results in IP Packets across the ENNI being encapsulated in MPLS where IP Packets for different services have different MPLS labels. Typically, each packet has a single MPLS label, that identifies both the egress PE and the service.
- **OPTION_C:**
 - One or more eBGP sessions are used across the ENNI only to distribute labeled unicast routes (and labels) towards each Operator's own routers; furthermore, multi-hop eBGP sessions are used between the ingress PE and the egress PE (or equivalent route reflectors) to exchange labelled VPN routes for each service.

This results in IP Packets across the ENNI being encapsulated in MPLS, typically with two MPLS labels, one representing the egress PE, and the second that (roughly speaking) identifies the service.

- OPTIONS_B_AND_C:
 - Combination of Options B and C.

15.6 EnniServiceMap

For an ENNI using Option A, the ENNI Service Map Common Attribute is a mapping from ENNI Service Mapping Contexts a set of ENNI Link Identifiers for ENNI Links in the ENNI. Reference MEF 61.1 Section 15.6.1 ENNI Service Map for Option A.

Schema File Name: schema/serviceSchema/ip/ipEnniCommon.yaml			
Attribute Name	Type	Multiplicity	Description
enniServiceMappingContext	EnniServiceMappingContext	1	Pointer to ENNI Service Mapping Context.
enniLinks	EnniList	1	Pointer to ENNI Link list.

Table 19-EnniServiceMap Attributes

15.7 EnniServiceMappingContext

A pair of SP/SO, ENNI Service Mapping Identifier. It uniquely identifies services for a given SP/SO on either side of the ENNI that have been assigned the same ENNI Service Mapping Identifier. Reference MEF 61.1 Section 15.6.1 ENNI Service Map for Option A.

Schema File Name: schema/serviceSchema/ip/ipEnniCommon.yaml			
Attribute Name	Type	Multiplicity	Description
serviceProvider	String	1	Service Provider identifier.
serviceOperator	String	1	Service Operator identifier.
enniServiceMappingIdentifier	String	1	ENNI Service Mapping identifier.

Table 20-EnniServiceMappingContext Attributes

16 Common Resources and Types

This section is structure like the previous section but focuses on common resources and types used by the Service Attributes. Most of these are structured to support a variety of Mplify Services. This section details the data types and enumerations that are used by the many Mplify Service model.

16.1 ConnectorType

Enumeration representing type of connector presented to Subscriber.

Schema File Name: schema/common/common.yaml

Contains Enumeration Literals:

- RJ45:
 - Enumeration representing connector type for Copper based on IEC 60603-7, TIA568.
- SC:
 - Enumeration representing connector type for Fiber based on IEC 61754-4.
- LC:
 - Enumeration representing connector type for Fiber based on IEC 61754-20.
- OTHER:

16.2 EnabledDisabled

Enumeration used to indicate Enabled/Disabled state of an attribute.

Schema File Name: schema/common/common.yaml

Contains Enumeration Literals:

- ENABLED
- DISABLED

16.3 EthernetPhysicalLayer

Enumeration representing the different Ethernet physical layers. Reference MEF 61.1.1 Table A1-4 Ethernet PHYs for UNI Access Link Trunks.

Schema File Name: schema/common/common.yaml

Contains Enumeration Literals:

- 10BASE_FB

- 10BASE_FL
- 10BASE_FP
- 10BASE_T
- 10BASE_T1L
- 10BASE_T1S
- 10BASE_TE
- 10BROAD36
- 10PASS_TS
- 100BASE_BX10
- 100BASE_FX
- 100BASE_LX10
- 100BASE_T
- 100BASE_T1
- 100BASE_T2
- 100BASE_T4
- 100BASE_TX
- 100BASE_X
- 1000BASE_BX10
- 1000BASE_CX
- 1000BASE_LX
- 1000BASE_LX10
- 1000BASE_PX10
- 1000BASE_PX20
- 1000BASE_RHA
- 1000BASE_RHB
- 1000BASE_RHC
- 1000BASE_SX
- 1000BASE_T
- 1000BASE_T1
- 1000BASE_X
- 2_5GBASE_T
- 2_5GBASE_T1
- 5GBASE_T
- 5GBASE_T1
- 10GBASE_E
- 10GBASE_EW

- 10GBASE_L
- 10GBASE_LR
- 10GBASE_LRM
- 10GBASE_LW
- 10GBASE_LX4
- 10GBASE_R
- 10GBASE_S
- 10GBASE_SR
- 10GBASE_SW
- 10GBASE_T
- 10GBASE_T1
- 10GBASE_X
- 25GBASE_CR
- 25GBASE_CR_S
- 25GBASE_ER
- 25GBASE_SR
- 25GBASE_T
- 40GBASE_CR4
- 40GBASE_ER4
- 40GBASE_FR
- 40GBASE_LR4
- 40GBASE_R
- 40GBASE_SR4
- 40GBASE_T
- 50GBASE_CR
- 50GBASE_ER
- 50GBASE_FR
- 50GBASE_LR
- 50GBASE_SR
- 100GBASE_CR10
- 100GBASE_CR2
- 100GBASE_CR4
- 100GBASE_DR
- 100GBASE_ER4
- 100GBASE_LR4
- 100GBASE_R

- 100GBASE_SR10
- 100GBASE_SR2
- 100GBASE_SR4
- 200GBASE_CR4
- 200GBASE_DR4
- 200GBASE_ER4
- 200GBASE_FR4
- 200GBASE_LR4
- 200GBASE_SR4
- 400GBASE_DR4
- 400GBASE_ER8
- 400GBASE_FR8
- 400GBASE_LR8
- 400GBASE_SR16
- 400GBASE_SR4_2
- 400GBASE_SR8

16.4 FourOctetInteger

A four-octet value range integer 0-4294967295.

Schema File Name: schema/common/common.yaml

type: integer

format: int64

minimum: 0

maximum: 4294967295

16.5 Gender

Enumeration representing the gender of the connector presented to the Subscriber.

Schema File Name: schema/common/common.yaml

Contains Enumeration Literals:

- SOCKET:
 - Subscriber is expected to provide a cable (copper or fiber) with a plug (with a connector type specified in *ct*).
- PLUG:

- The SP provides the cable, then it is presenting a plug to the Subscriber (*gn* is *plug*), and the Subscriber is expected to provide equipment that can connect to a plug of type *ct*.

16.6 InformationRate

A value and a unit of measure that specifies an Information Rate.

Schema File Name: schema/common/common.yaml			
Attribute Name	Type	Multiplicity	Description
irValue	Number Minimum: 0	1	The value of the information rate. For example, if the rate is 70 kbps, 70 is the value.
irUnits	InformationRateUnits	1	The unit of measure for the Information Rate. For example, if the Information Rate is 70KBPS this element is KBPS. Note that the values are decimal values. 1 KBPS is 1000 bits per second and 1MBPS is 1,000,000 bits per second.

Table 21-InformationRate Attributes

16.7 InformationRateUnits

Enumeration representing information rate units.

File: schema/common/common.yaml

Contains Enumeration Literals:

- BPS:
 - Bits per second.
- KBPS:
 - Kilobits per second.
- MBPS:
 - Megabits per second.
- GBPS:
 - Gigabits per second.
- TBPS:
 - Terabits per second.
- PBPS:
 - Petabits per second.
- EBPS:
 - Exabits per second.
- ZBPS:
 - Zettabits per second.

- YBPS:
 - Yottabits per second.

16.8 LACPVersion

File: schema/common/common.yaml

Indicates which version of the Link Aggregation Control Protocol, LACP, is used. (See clause 6.4 in IEEE Std 802.1AX-2020). The possible values are LACPv1, LACPv2, or Static. If the value is Static, LACP is not used.

Contains Enumeration Literals:

- LACPv1:
- LACPv2:
- STATIC:
 - LACP is not used.

16.9 Percentage

This is a number of percent – a number between 0 and 100.

Schema File Name: schema/common/common.yaml

type: number
 minimum: 0
 maximum: 100

16.10 TimeDuration

This class is used to describe durations expressed as a 2-tuple, (value, units). The units from nanoseconds to years.

Schema File Name: schema/common/common.yaml			
Attribute Name	Type	Multiplicity	Description
timeDurationValue	Integer	1	The value of the duration. For example, if the duration is 20 ms, this element is 20.
timeDurationUnits	TimeDurationUnits	1	The unit of measure in the duration. For example, if an interval is 2ms, this element is MS.

Table 22-TimeDuration Attributes

16.11 TimeDurationUnits

Enum listing the units of measure for a Time Duration.

Schema File Name: schema/common/common.yaml

Contains Enumeration Literals:

- NS:
 - Nanoseconds
- US:
 - Microseconds
- MS
 - Milliseconds
- SEC
 - Seconds
- MIN
 - Minutes
- HOUR
- DAY
- WEEK
- MONTH
- YEAR

16.12 VlanId

Data type used for VLAN id configuration. Defined as a Integer, Value 1 to 4094.

Schema File Name: schema/common/common.yaml

type: integer

minimum: 1

maximum: 4094

17 IP Common Resources and Types

This section is structure like the previous section but focuses on IP Service common resources and types used by the Service Attributes. All of these are structured to support a variety of IP Services. This section details the data types and enumerations that are used by the IP Service model.

17.1 Addressing

File: schema/common/ip/ipCommon.yaml

Enumeration representing the Address type for the Control Protocols data type.

Contains Enumeration Literals:

- SP_OPERATOR_ADDRESSES:
 - If the addressing information is SP/Operator Addresses, then Ingress IP Packets for the specified protocol that have a multicast or broadcast destination address, or a unicast destination address that is reachable within the SP's or Operator's network, are considered to be IP Control Protocol Packets, and Egress IP Packets for the specified protocol that have a source address that is reachable within the SP's or Operator's network are considered to be IP Control Protocol Packets.
- ANY:
 - If the addressing information is Any, then all IP Packets for the specified protocol that cross the UNI are IP Control Protocol Packets.

17.2 ClassOfServiceMapEntry

Values for the Cloud Ingress Class of Service Map. Reference MEF 61.1 Table 11 - Values for the Cloud Ingress Class of Service Map, 11.0 IPVC EP Ingress Class of Service Map Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
cosName	String	1	Class of Service Name.
destinationIpAddress	Ipv4Prefix	0..1	Destination IP address.
destinationL4Port	Integer Minimum: 0 Maximum: 65535	0..1	Destination Layer 4 port number. Integer from 0 to 65535.
ethernetPcp	Integer Minimum: 0 Maximum: 7	0..1	PCP values (Integer 0 to 7).
ipds	Integer Minimum: 0 Maximum: 63	0..1	DSCP values (Integer 0 to 63).
I4Protocol	Integer	0..1	Layer 4 protocol number. Integer from 0 to 255.

	Minimum: 0 Maximum: 255		
sourceIpAddress	Ipv4Prefix	0..1	Source IP address.
sourceL4Port	Integer Minimum: 0 Maximum: 65535	0..1	Source Layer 4 port number. Integer from 0 to 65535.

Table 23-ClassOfServiceMapEntry Attributes

17.3 ConnectionType

File: *schema/common/ip/ipCommon.yaml*

An enumeration representing the connection type.

Contains Enumeration Literals:

- P2P:
 - Point-to-Point. Indicates that the link is logically point to point.
- MULTIPOINT:
 - Multipoint. Indicating that the link is logically multipoint.

17.4 ControlProtocols

Data type representing Control Protocols. Each entry consists of a 3-tuple containing the protocol name, addressing information (either SP/Operator Addresses or Any) and one or more references. Reference MEF 61.1 Section 12.6 UNI List of Control Protocols Service Attribute.

Schema File Name: <i>schema/common/ip/ipCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description
addressing	Addressing	0..1	Enumeration representing the addressing.
protocolName	String	1	Protocol name.
reference	String	1..*	Protocol reference.

Table 24-ControlProtocols Attributes

17.5 Demux

Is a value that is specific to each type of UNI Access Link Trunk and indicates which Layer 2 sub-channel should be selected for this UNI Access Link.

File: <i>schema/common/ip/ipCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description
utpt	Boolean	1	Untagged and priority tagged frames.
vlanId	VlanId	0..*	VLAN ID.

Table 25-Demux Attributes

17.6 DhcpRelay

The UNI Access Link DHCP Relay Service Attribute is either Disabled or a pair containing a list of one or more DHCP Service IP addresses and an IPVC End Point Identifier.

Schema File Name: schema/common/ip/ipCommon.yaml			
minProperties: 1			
maxProperties: 1			
Attribute Name	Type	Multiplicity	Description
dhcpRelayDisabled	String Enum: <ul style="list-style-type: none">DISABLED	1	DHCP Relay Disabled.
dhcpRelayEnabled	DhcpRelayEnabled	1	Pointer to DhcpRelay.

Table 26-DhcpRelay Attributes

17.7 DhcpRelayEnabled

Dynamic Host Configuration Protocol (DHCP) Relay functionality is useful when the Subscriber uses DHCP (per RFC 2131[3] and RFC 8415[9]) in the Subscriber Network but does not want to place a DHCP server (or possibly a pair of redundant DHCP servers) in each part of the network.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
dhcpServerList	DhcpServer	1..*	Non-empty list of IP addresses for DHCP Servers belonging to the Subscriber. Reference MEF 61.1 Section 13.6 UNI Access Link DHCP Relay Server Attribute.
ipvcEndPointIdentifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> "[\x20-\x7F]+"	1	IPVC identifier as described in MEF 61.1 Section 11.1.

Table 27-DhcpRelayEnabled Attributes

17.8 DhcpServer

Data type representing a DHCP Server.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipv4Address	Ipv4Address	0..*	List of DHCP Server(s) IPv4 addresses.
ipv6Address	Ipv6Address	0..*	List of DHCP Server(s) IPv6 addresses.

Table 28-DhcpServer Attributes

17.9 DscpMapping

IP DSCP mapping of CoS name to DSCP value.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
cosName	String	1	Class of Service name.
ipDscp	DscpValue	1	DSCP value (Integer 0 to 63).

Table 29-DscpMapping Attributes

17.10 EgressClassOfServiceMap

Pair of values (D, P). D specifies how to set the DS field in Egress IP Data Packets based on CoS Name. It is either None, or a mapping from CoS Names to DSCP values. P specifies how to set the PCP field in VLAN Tagged Ethernet Frames containing Egress IP Data Packets based on CoS Name. It is either None, or a mapping from CoS Names to PCP values. Reference MEF 61.1 Section 11.10 IPVC EP Egress Class of Service Map Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
defaultCosName	String	1	Default Class of Service Name.
pcpMapping	PcpMapping	0..*	Reference to CoS to Ethernet PCP mapping.
dscpMapping	DscpMapping	0..*	Reference to CoS to IP DSCP mapping.

Table 30-EgressClassOfServiceMap Attributes

17.11 EndPointIdentifierAndCosName

Data type representing IPVC End Point Identifier and CoS name used for Bandwidth Profiles.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipvcEndPointIdentifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> <i>"[\x20-\x7F]+"</i>	1	IPVC End Point Identifier for an IPVC End Point located at the UNI.
cosName	String	1	Class of Service Name.

Table 31-EndPointIdentifierAndCosName Attributes

17.12 EnnIpv4ConnectionAddressing

The ENNI Link IPv4 Connection Addressing specifies how IPv4 addresses are allocated to the devices connected to the ENNI Link. It is either NONE or STATIC, plus in the case of STATIC, some

additional parameters. Reference MEF 61.1 Section 16.3 ENNI Link IPv4 Connection Addressing Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
enniLinkIpv4AddressType	EnniLinkIpv4AddressType	0..1	IPv4 address type for ENNI Link. Values are None or STATIC. If the attribute is not assigned that is equivalent of NONE.
ipv4PrimarySubnet	EnniIpv4Subnet	1	IPv4 Primary Subnet for ENNI Link.
ipv4SecondarySubnet	EnniIpv4Subnet	0..*	IPv4 Secondary Subnet for ENNI Link.

Table 32-EnniIpv4ConnectionAddressing Attributes

17.13 EnniIpv4Subnet

Data type representing IPv4 Subnet for ENNI Links. Reference MEF 61.1 16.3 ENNI Link IPv4 Connection Addressing Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipv4Prefix	Ipv4Prefix	1	IPv4 Prefix (IPv4 address prefix and mask length between 0 and 31, in bits).
firstLloIpv4Address	String	1	First LLO (Lowest Level Operator) IPv4 Address.
secondLloIpv4Address	String	1	Second LLO (Lowest Level Operator) IPv4 Address.

Table 33-EnniIpv4Subnet Attributes

17.14 EnniLinkIpv4AddressType

File: schema/common/ip/ipCommon.yaml

Enumeration to indicate ENNI Link IPv4 Address Type.

Contains Enumeration Literals:

- STATIC

17.15 EnniIpv6ConnectionAddressing

The ENNI Link IPv6 Connection Addressing specifies how IPv6 addresses are allocated to the devices connected to the ENNI Link. It is one of the three values None, Static or LL-only, plus in the case of Static, some additional properties. Reference MEF 61.1 Section 16.4 ENNI Link IPv6 Connection Addressing Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
enniLinkIpv6AddressType	EnniLinkIpv6AddressType	0..1	IPv6 address type for ENNI Link. Values are NONE, STATIC and LL-only. If the attribute is not assigned that is equivalent of NONE.
enniIpv6Subnet	EnniIpv6Subnet	0..1	IPv6 Subnet for ENNI Link.

Table 34-Ennilpv6ConnectionAddressing Attributes

17.16 Ennilpv6Subnet

Data type representing IPv6 Subnet for ENNI Links. Reference MEF 61.1 Section 16.4 ENNI Link IPv6 Connection Addressing Attribute.

Schema File Name: <code>schema/common/ip/ipCommon.yaml</code>			
Attribute Name	Type	Multiplicity	Description
ipv6Prefix	Ipv6Prefix	1	IPv6 Prefix (IPv6 address prefix and mask length between 0 and 127 in bits).
firstLloIpv6Address	String	1	First LLO (Lowest Level Operator) IPv6 Address.
secondLloIpv6Address	String	1	Second LLO (Lowest Level Operator) IPv6 Address.

Table 35-Ennilpv6Subnet Attributes

17.17 EnniLinkIpv6AddressType

File: `schema/common/ip/ipCommon.yaml`

Enumeration to indicate ENNI Link IPv6 Address Type.

Contains Enumeration Literals:

- STATIC
- LL_ONLY

17.18 EnniRoutingInformation

For an ENNI Option A, the ENNI Routing Information Service Attribute is a mapping of ENNI Service Mapping Identifiers to four-tuples of the form (Administrative Distance, Route Flap Damping, AS Override, Static Routes). Each four-tuple applies to the corresponding ENNI Service Mapping Identifier. Reference MEF 61.1 Section 14.3.1 ENNI Routing Protocols for Option A.

Schema File Name: <code>schema/common/ip/ipCommon.yaml</code>			
Attribute Name	Type	Multiplicity	Description
enniServiceMappingIdentifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> <i>"[\x20-\x7F]+"</i>	1	A string identifier that is used at the ENNI to match the IPVC EP on one side of the ENNI with IPVC EPs on the other side. Reference MEF 61.1 Section 11.6 IPVC EP ENNI Service Mapping Identifier Service Attribute.
administrativeDistance	Integer	1	The Administrative Distance for a given ENNI Service Mapping Identifier is an integer greater than 0 that indicates the value of the administrative distance assigned by the Operator to eBGP routes received from another Operator over the ENNI Links that are assigned to that ENNI Service Mapping Identifier at an ENNI using Option A. Reference MEF 61.1 Section 14.3.1.1 Administrative Distance.

routeFlapDamping	EnabledDisabled	1	The Route Flap Damping parameter for a given ENNI Service Mapping Identifier indicates whether the Operator applies route flap damping to routes received from another Operator over the ENNI Links assigned to that ENNI Service Mapping Identifier. Reference MEF 61.1 Section 14.3.1.2 Route Flap Damping.
asOverride	EnabledDisabled	1	The AS Override parameter for a given ENNI Service Mapping Identifier indicates whether AS Override behavior is enabled at the ENNI, for routes advertised towards another Operator over the ENNI Links assigned to that ENNI Service Mapping Identifier. Reference MEF 61.1 Section 14.3.1.3 AS Override.
staticRoute	StaticRoute	0..*	The Static Routes parameter for a given ENNI Service Mapping Identifier is a list of static routes over the ENNI for the service identified by that ENNI Service Mapping Identifier. The list can be empty. Reference MEF 61.1 Section 14.3.1.4 Static Routes.

Table 36-EnniRoutingInformation Attributes

17.19 EnniType

File: schema/common/ip/ipCommon.yaml

Indication of the type of BGP Peering at the ENNI. Reference MEF 61.1 Section 14 ENNI Service Attributes.

Contains Enumeration Literals:

- OPTION_A:
- OPTION_B:
- OPTION_C:

17.20 ExternalInterfaceType

File: schema/common/ip/ipCommon.yaml

Enumeration representing the different External Interface types.

Contains Enumeration Literals:

- UNI:
 - External interface type is UNI (User Network Interface).
- ENNI:
 - External interface type is ENNI (External Network Network Interface).

17.21 HeaderFieldTypes

HeaderFieldTypes is an enumeration for fields defined in MEF 61.1 Section 10.13.2 Cloud Ingress Class of Service Map.

File: *schema/common/ip/ipCommon.yaml*

Contains Enumeration Literals:

- SOURCE_IP_ADDRESS:
 - Field type Source IP Address.
- DESTINATION_IP_ADDRESS:
 - Field type Destination IP Address.
- L4_PROTOCOL:
 - Field type Layer 4 Protocol.
- SOURCE_L4_PORT:
 - Field type Source Layer 4 Port.
- DESTINATION_L4_PORT:
 - Field type Destination Layer 4 Port.
- ETHERNET_PCP:
 - Field type Ethernet PCP.
- IP_DS:
 - Field type IP Differentiated Service.

17.22 IngressClassOfServiceMap

Is a triple (F,M,D) where F is a list of one or more fields in the packet header that are used to determine the CoS Name, M is a mapping from combinations of values of those fields to CoS Names, and D is a default CoS Name used when the map cannot be applied. Reference MEF 61.1 Section 10.13.2 Cloud Ingress Class of Service Map and Section 11.10 IPVC EP Egress Class of Service Map Service Attribute.

Schema File Name: <i>schema/common/ip/ipCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description
defaultCosName	String	1	Default Class of Service Name. Reference MEF 61.1 Section 10.13.2 Cloud Ingress Class of Service Map and Section 11.9 IPVC EP Ingress Class of Service Map Service Attribute.
headerFieldTypes	HeaderFieldTypes	1..*	Header Field Types.
ingressClassOfServiceMapping	ClassOfServiceMapEntry	0..*	Class of Service Map Entry.

Table 37-IngressClassOfServiceMap Attributes

17.23 IpvEndPointRole

The IPVCEndPointRole is one of Root, Leaf, or Trunk and specifies the role the IPVCEndPointRole plays in the IPVCEndPointRole Topology. Reference MEF 61.1 Section 11.4 IPVCEndPointRole Role Service Attribute.

File: schema/common/ip/ipvCommon.yaml

Contains Enumeration Literals:

- ROOT:
 - The IPVCEndPointRole connects multiple UNIs with restricted connectivity. Reference MEF 61.1 Section 7.10 IPVCEndPointRole Topology.
- LEAF:
 - An IPVCEndPointRole End Point with role of Leaf can only send and receive traffic from IPVCEndPointRole End Points with a role of Root. Reference MEF 61.1 Section 7.10 IPVCEndPointRole Topology.
- TRUNK:
 - Indicates that the IPVCEndPointRole End Points carry traffic from both roots and leaves. Reference MEF 61.1 Section 8.7 Rooted Multipoint Services across an ENNI.

17.24 Ipv4Address

Data type representing IPv4 address.

File: schema/common/ip/ipvCommon.yaml

- type: String
- format: ipv4

17.25 Ipv4AddressType

Enumeration representing IPv4 Address Types specific for UNI Access Links.

File: schema/common/ip/ipvCommon.yaml

Contains Enumeration Literals:

- DHCP:
 - Dynamic Host Configuration Protocol (DHCP) is used by the Subscriber devices to request IPv4 addresses in each subnet from the SP or Operator.
- STATIC:
 - IPv4 addresses in each IPv4 subnet are statically assigned to the SP or Operator and to the Subscriber.
- UNNUMBERED:

- The SP or Operator and the Subscriber each assign an IPv4 address (from their own address pools) independently. These addresses can be on different subnets, and so an interface-based routing protocol is needed to ensure reachability.

17.26 Ipv4OrIpv6Address

Data type representing IPv4 address or Ipv6 address.

Schema File Name: schema/common/ip/ipCommon.yaml			
minProperties: 1			
maxProperties: 1			
Attribute Name	Type	Multiplicity	Description
ipv4Address	Ipv4Address	1	IPv4 Address
ipv6Address	Ipv6Address	1	IPv6 Address

Table 38-Ipv4OrIpv6Address Attributes

17.27 Ipv4OrIpv6Prefix

Data type representing IPv4 address prefix and mask length between 0 and 31 bits.

Schema File Name: schema/common/ip/ipCommon.yaml			
minProperties: 1			
maxProperties: 1			
Attribute Name	Type	Multiplicity	Description
ipv4Prefix	Ipv4Prefix	1	IPv4 Prefix
ipv6Prefix	Ipv6Prefix	1	IPv6 Prefix

Table 39-Ipv4OrIpv6Prefix Attributes

17.28 Ipv4Prefix

Data type representing IPv4 address prefix and mask length between 0 and 31 bits.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipv4Address	Ipv4Address	1	IPv4 Address.
prefixLength	Integer Minimum: 0 Maximum: 31	1	IPv4 address prefix. Length 0-31.

Table 40-Ipv4Prefix Attributes

17.29 Ipv4PrimarySubnet

IPv4 Subnet used in context of Primary IPVC subnet. It adds the subscriber subscriberIpv4Address attribute to the Ipv4SecondarySubnet.

Schema File Name: schema/common/ip/ipCommon.yaml
--

allOf: ipv4SecondarySubnet			
Attribute Name	Type	Multiplicity	Description
subscriberIpv4Address	Ipv4Address	1	Subscriber IPv4 address.

Table 41-Ipv4PrimarySubnet Attributes

17.30 Ipv4SecondarySubnet

Data type representing an IPv4 subnet logical partition of an IP network. Included is list of Service Provider IPv4 addresses.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipv4Prefix	Ipv4Prefix	1	IPv4 address prefix (IPv4 address prefix and mask length between 0 and 31 in bits).
serviceProviderIpv4Addresses	Ipv4Address	1..*	List of Service Provider IPv4 addresses. [R25] "If IPv4 Connection Addressing is DHCP, the UNI Access Link IPv4 Connection Addressing Primary Subnet parameter MUST contain only a single Service Provide IPv4 Address." Reference – MEF 69.1 Section 9.4.
reservedPrefixes	Ipv4Prefix	0..*	List of IPv4 Prefixes, possibly empty.

Table 42-Ipv4SecondarySubnet Attributes

17.31 Ipv6Address

Data type representing IPv6 address.

File: *schema/common/ip/ipCommon.yaml*

- type: String
- format: ipv6

17.32 Ipv6AddressType

Enumeration representing IPv6 Address Types specific for UNI Access Links.

File: *schema/common/ip/ipCommon.yaml*

Contains Enumeration Literals:

- DHCP:
 - Dynamic Host Configuration Protocol (DHCP) is used by the Subscriber devices to request IPv6 addresses in each subnet from the SP or Operator.
- SLAAC:
 - Stateless Address Autoconfiguration (SLAAC) is used by the Subscriber devices to create unique IPv6 global addresses within an IP Prefix advertised by the SP or Operator as describer in RFC 4862.

- **STATIC:**
 - IPv6 addresses in a given IPv6 subnet are statically assigned to the SP or Operator and to the Subscriber.
- **LL_ONLY:**
 - If the value is LL-only, these are only IPv6 addresses used on the UNI Access Link.

17.33 Ipv6Prefix

Data type representing IPv4 address prefix and mask length between 0 and 127 bits.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
Ipv6Address	Ipv6Address	1	IPv6 Address.
prefixLength	Integer Minimum: 0 Maximum: 127	1	IPv6 address prefix. Length 0-127.

Table 43-Ipv6Prefix Attribute

17.34 Ipv6Subnet

IPv6Subnet is a data type representing an IPv6 subnet logical partition of an IP network. Included is list of Service Provider IPv6 addresses.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipv6prefix	Ipv6Prefix	1	IPv6 Prefix (IPv6 address prefix and mask length between 0 and 127 in bits).
serviceProviderIpv6Address	Ipv6Address	1..*	Service Provider (for Subscriber IP Services) or Operator (for Operator IP Services) IPv6 Addresses (Non-empty list of IPv6 addresses).
ipv6ReservedPrefixList	Ipv6Prefix	0..*	Reserved Prefixes List (List of IPv6 Prefixes, possibly empty).

Table 44-Ipv6Subnet Attributes

17.35 L1Technology

Layer 1 technology.

Schema File Name: schema/common/ip/ipCommon.yaml

Contains Enumeration Literals:

- 10BASE_T
- 10BASE_FP
- 10BASE_FB

- 10BASE_FL
- 100BASE_T
- 100BASE_T4
- 100BASE_X
- 100BASE_T2
- 1000BASE_X
- 1000BASE_T
- 1000BASE_SX
- 1000BASE_LX
- 1000BASE_CX
- 10GBASE_W
- 10GBASE_SR
- 10GBASE_LR
- 10GBASE_ER
- 10GBASE_LX
- 10GBASE_SW
- 10GBASE_LW
- 10GBASE_EW

17.36 L2Technology

Specifies the UNI Access Link Trunk used to carry IP Packets across the UNI along with information needed to identify IP Packets for this UNI Access Link. Reference MEF 61.1.1 Section 13.3 UNI Access Link L2 Technology Service Attribute.

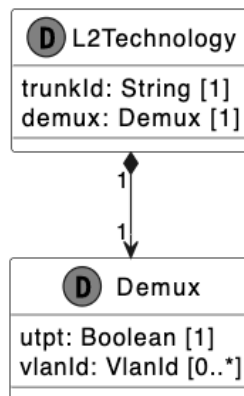


Figure 19-L2Technology Model

Schema File Name: schema/common/ip/ipCommon.yaml

Attribute Name	Type	Multiplicity	Description
trunkId	String	1	UNI Access Link Trunk Identifier.
demux	Demux	1	Value that is specific to each type of UNI Access Link Trunk and indicates which Layer 2 sub-channel should be selected for this UNI Access Link.

Table 45-L2Technology Attributes

17.37 MaximumNumberOfIpv4Routes

Maximum number of IPv4 routes supported by the service as a whole. Absence of this attribute corresponds to a value of “Unlimited”. Reference MEF 61.1 Section 10.5 IPVC Maximum Number of IPv4 Routes Service Attribute and MEF 61.1 Section 11.7 IPVC EP Maximum Number of IPv4 Routes Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
value	Integer	1	The maximum of IPv4 routes.
numOfIpv4RoutesUnlimited	String Enum: • UNLIMITED	1	Indicates whether the maximum is unlimited.

Table 46-MaximumNumberOfIpv4Routes Attributes

17.38 MaximumNumberOfIpv6Routes

Maximum number of IPv6 routes supported by the service as a whole. Absence of this attribute corresponds to a value of “Unlimited”. Reference MEF 61.1 Section 10.6 IPVC Maximum Number of IPv6 Routes Service Attribute and MEF 61.1 Section 11.8 IPVC EP Maximum Number of IPv6 Routes Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
value	Integer	1	The maximum of IPv6 routes.
numOfIpv6RoutesUnlimited	String Enum: • UNLIMITED	1	Indicates whether the maximum is unlimited.

Table 47-MaximumNumberOfIpv6Routes Attributes

17.39 PacketDelivery

For each Ingress IP Data Packet that is mapped to one of the IPVC EPs for the IPVC it takes one of two values. STANDARD_ROUTING or POLICY-BASED_ROUTING.

File: *schema/common/ip/ipCommon.yaml*

Contains Enumeration Literals:

- STANDARD_ROUTING:
 - If the IPVC Packet Delivery is Standard Routing, the egress UNI and UNI Access Link or egress ENNI and ENNI Link are generally selected by examining the destination IP address in the packet and matching it to an IP Prefix reachable via the IPVC EP at the egress EI – in other words, by normal IP routing.
- POLICY_BASED_ROUTING:
 - The behavior and requirements when the IPVC Packet Delivery Service Attribute is set to Policy-Based Routing are deferred to a future revision of this specification (MEF 61.1).

17.40 PcpMapping

Ethernet PCP mapping for CoS name to PCP value.

Schema File Name: <i>schema/common/ip/ipCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description
cosName	String	1	Class of Service name.
ethernetPcp	Pcp	1	PCP value (Integer 0 to 7).

Table 48-PcpMapping Attributes

17.41 PeeringAddress

Peering Addresses. Connection Addresses, or Loopbacks plus a list of pairs of IP addresses.

Reference MEF 61.1 Section 12.7.3 BGP.

Schema File Name: <i>schema/common/ip/ipCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description
peeringAddressType	PeeringAddressType	1	If the Peering Address parameter is CONNECTION_ADDRESSES, a separate BGP peering session is established over each UNI Access Link, using the primary IPv4 addresses in the UNI Access Link IPv4 Connection Addressing Service Attribute (MEF 61.1 Section 13.4) or the first IPv6 addresses in the UNI Access Link IPv6 Connection Addressing Service Attribute (MEF 61.1 Section 13.5), as indicated by the Connection Address Family parameter. If the Peering Addresses parameter is LOOPBACKS, a list of pairs of IP addresses is additionally specified, each pair containing the Subscriber’s loopback address and the SP’s or Operator’s loopback address. A single BGP peering session is established for each pair of addresses.

subscriberAndSpLoopbackAddresses	SubscriberAndSpLoopbackAddresses	1	A list of pairs of IP addresses, each pair containing the Subscriber's loopback address and the SP's or Operator's loopback address. A single BGP peering session is established for each pair of addresses.
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Table 49-PeeringAddress Attributes

17.42 PeeringAddressType

If the Peering Addresses parameter is CONNECTION_ADDRESSES, a separate BGP peering session is established over each UNI Access Link, using the primary IPv4 addresses in the UNI Access Link IPv4 Connection Addressing Service Attribute (section 13.4) or the first IPv6 addresses in the UNI Access Link IPv6 Connection Addressing Service Attribute (section 13.5), as indicated by the Connection Address Family parameter. If the Peering Addresses parameter is LOOPBACKS, a list of pairs of IP addresses is additionally specified, each pair containing the Subscriber's loopback address and the SP's or Operator's loopback address. A single BGP peering session is established for each pair of addresses.

File: *schema/common/ip/ipCommon.yaml*

Contains Enumeration Literals:

- CONNECTION_ADDRESSES
- LOOPBACKS

17.43 PortMap

LACP Portmap as a 2-tuple <vid,lspl> where vid is VLAN ID and lspl is Link Selection Priority List. Reference MEF 61.1.1 Section A1-1.3.2 UNI Access Link Ethernet Link Aggregation Service Attribute.

Schema File Name: <i>schema/common/ip/ipCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description
vlanId	VlanId	1	VLAN ID.
linkSelectionPriorityList	Integer	0..*	Link Selection Priority List.

Table 50-PortMap Attributes

17.44 RouteDistinguisherFields

BGP Route Distinguisher with two fields.

Schema File Name: <i>schema/common/ip/ipCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description
field_1	String	1	Route Distinguisher field 1.
field_2	String	1	Route Distinguisher field 2.

Table 51-RouteDistinguisherFields Attributes

17.45 ServiceTopology

Enumeration used to represent the different Service Topologies.

File: schema/common/ip/ipCommon.yaml

Contains Enumeration Literals:

- **MULTIPOINT:**
 - A multipoint IPVC allows packets to flow between any of the IPVC End Points for the IPVC. In this case, every IPVC End Point has a root role. Reference MEF 61.1 Section 10.2 IPVC Topology Service Attribute.
- **ROOTED_MULTIPOINT:**
 - A rooted multipoint service is used to implement a hub-and-spoke topology. In a rooted multipoint service, each IPVC End Point is assigned either root or leaf role. Reference MEF 61.1 Section 10.2 IPVC Topology Service Attribute.
- **CLOUD_ACCESS:**
 - A cloud access IPVC allows traffic to flow between one or more IPVC End Points and the public Internet or private cloud service. Reference MEF 61.1 Section 10.2 IPVC Topology Service Attribute.

17.46 StaticRoute

Data type representing IP static routes.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipv4Prefix	Ipv4Prefix	0..1	IPv4 address prefix.
ipv6Prefix	Ipv6Prefix	0..1	IPv6 address prefix.
administrativeDistance	Integer	1	The administrative distance is a numeric metric used to control which routes are selected, when there are multiple routes for the same IP Prefix. A lower number indicates a more preferable route.
targetRole	TargetRole	1	The target role indicates whether the route is towards an IPVC EP in the SP/SO's or a higher IPVC with Role role or Leaf role.

Table 52-StaticRoute Attributes

17.47 SubscriberAndSpLoopbackAddresses

A list of pairs of IP addresses, each pair containing the Subscriber’s loopback address and the SP’s or Operator’s loopback address. A single BGP peering session is established for each pair of addresses.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
subscriberLoopbackAddresses	Ipv4OrIpv6Addresses	1	Subscriber's loopback address for BGP establishing a session.
spLoopbackAddress	Ipv4OrIpv6Addresses	1	Service Provider's loopback address for BGP establishing a session.

Table 53-SubscriberAndSpLoopbackAddresses Attributes

17.48 SynchronousEthernet

Enumeration representing the value of fs which indicates if the physical link supports Synchronous Ethernet.

File: schema/ip/common/ipCommon.yaml

Contains Enumeration Literals:

- DISABLED:
 - Enumeration representing fs and Synchronous Ethernet MUST NOT be used on corresponding physical link. ESMC - Ethernet Synchronous Messaging Channel.
- ESMC:
 - Enumeration representing fs and Synchronous Ethernet MUST be used on corresponding physical link. ESMC - Ethernet Synchronous Messaging Channel.
- NO_ESMC:
 - Enumeration representing fs and Synchronous Ethernet MUST NOT be used on corresponding physical link. ESMC - Ethernet Synchronous Messaging Channel.

17.49 TargetRole

Enumeration representing the Static Route Target Role. Reference MEF 61.1 Section 14.3.1.4 Static Routes.

File: schema/ip/common/ipCommon.yaml

Contains Enumeration Literals:

- ROOT:
 - Root role.
- LEAF:
 - Leaf role.

17.50 TwoOctetInteger

A two-octet value (Integer) range integer 0-65535.

File: *schema/ip/common/ipCommon.yaml*

- minimum: 0
- maximum: 65535

17.51 UniAccessLinkEthernetLinkAggregation

Link Aggregation, as described in IEEE Std. 802.1AX-2020 allows one or more parallel instances of full-duplex point-to-point Ethernet links to be aggregated to form a Link Aggregation Group (LAG) such that the MAC Client (the UNI Access Link) can treat the LAG as if it were a single link. Reference MEF 61.1.1 Section A1-1.3.2 UNI Access Link Trunk Ethernet Link Aggregation Service Attribute.

Schema File Name: <i>schema/common/ip/ipCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description
lacpVersion	LacpVersion	1	Link Aggregation Control Protocol version.
portMap	PortMap	0..*	LAG port map representing VLAN ID to Aggregation Link Map.

Table 54-UniAccessLinkAggregation Attributes

17.52 Unilpv4ConnectionAddressing

Unilpv4ConnectionAddressing is a data type representing how IPv4 addresses are allocated to the devices on the UNI Access Link. Reference - MEF 61 Section 13.4. [R22] "At a UNI Access Link in a UNI with an IPVC EP for an Advanced Internet Access Service, UNI Access Link IPv4 Connection Addressing MUST be Static or null. Reference - MEF 69.1 Section 9.4.

Schema File Name: <i>schema/common/ip/ipCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description
ipv4AddressingType	ipv4AddressingType	1	IPv4 Connection Addressing.
ipv4PrimarySubnet	ipv4PrimarySubnet	1	Primary IPv4 Subnet. Includes IPv4 Prefix and Service Provider IPv4 Addresses.
ipv4SecondarySubnet	ipv4SecondarySubnet	0..*	Secondary IPv4 Subnet List. Includes IPv4 Prefix and Service Provider IPv4 Addresses.

Table 55-Unilpv4ConnectionAddressing Attributes

17.53 Unilpv6ConnectionAddressing

Unilpv6ConnectionAddressing is a data type representing how IPv6 addresses are allocated to the devices on the UNI Access Link. Reference MEF 61.1 Section 13.5 UNI Access Link IPv6 Connection Addressing Service Attribute.

Schema File Name: <i>schema/common/ip/ipCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description

Ipv6AddressingType	Ipv6AddressingType	1	IPv6 Connection Addressing.
subscriberIpv6Address	Ipv6Address	1	Subscriber IPv6 address.
ipv6Subnet	Ipv6Subnet	0..*	IPv6 Subnet.

Table 56-UniIpv6ConnectionAddressing Attributes

17.54 UniManagementType

Enumeration representing the UNI Management Type options. Reference MEF 61.1 Section 12.2 UNI Management Type Service Attribute.

File: schema/ip/common/ipCommon.yaml

Contains Enumeration Literals:

- SUBSCRIBER_MANAGEMENT:
 - Enumeration indicating the CE is the responsibility of the Subscriber.
- PROVIDER_MANAGEMENT:
 - Enumeration indicating the CE is the responsibility of the Service Provider.

17.55 Vrid

VRID (Virtual Router ID) as defined in RFC 5798[6] is a number (Integer) between 1 and 255.

File: schema/ip/common/ipCommon.yaml

- minimum: 1
- maximum: 255

18 IP Routing Protocol Common Resources and Types

This section focuses on IP routing protocol common resources and types used by the Service Attributes. All of these are structured to support a variety of IP Services. This section details the data types and enumerations that are used by the IP Service model.

18.1 AccessLinkBfd

The Access Link BFD Service Attribute indicates whether Bidirectional Forwarding Detection (BFD) is enabled on the UNI Access Link. Reference MEF 61.1 Section 13.8 UNI Access Link BFD Service Attribute and Section 16.5 ENNI Link BFD Attribute.

Schema File Name: schema/common/ip/ipRoutingProtocols.yaml			
Attribute Name	Type	Multiplicity	Description
connectionAddressFamily	AddressFamilyIpv4I pv6Both	1	The Connection Address Family parameter specifies whether the session is established over IPv4 or IPv6 or whether two separate sessions are established using IPv4 and IPv6. Reference MEF 61.1 Section 13.8 UNI Access Link BFD Service Attribute and Section 16.5 ENNI Link BFD Attribute.
transmissionInterval	Integer Minimum: 0	1	Transmission Interval in milliseconds. Reference MEF 61.1 Section 13.8 and 16.5.
detectMultiplier	Integer Minimum: 0	1	BFD Detect as an Integer. Reference MEF 61.1 Section 13.8 and 16.5 Attribute.
activeEnd	BfdActiveEnd	1	BFD Active End. At least one end of BFD session has to have an active role, meaning that it sends out asynchronous control messages regardless of whether it has received any. Reference MEF 61.1 Section 13.8 UNI Access Link BFD Service Attribute.
authenticationType	BfdAuthenticationTy pe	1	BFD Authentication as describer in RFC 5880. Reference MEF 61.1 Section 13.8 UNI Access Link BFD Service Attribute and Section 16.5 ENNI Link BFD Attribute.

Table 57-AccessLinkBfd Attributes

18.2 AddressFamilyIpv4Ipv6

Specifies whether the session is established over IPv4 or IPv6.

File: schema/common/ip/ipRoutingProtocolsCommon.yaml

Contains Enumeration Literals:

- IPV4
- IPV6

18.3 AddressFamilyIpv4Ipv6Both

Specifies whether the session is established over IPv4 or IPv6 or whether two separate sessions are established using IPv4 and IPv6.

File: schema/common/ip/ipRoutingProtocolsCommon.yaml

Contains Enumeration Literals:

- IPV4
- IPV6
- BOTH

18.4 BfdActiveEnd

At least one end of the BFD session must have an active role, meaning that it sends out asynchronous control messages regardless of whether it has received any. This enumeration represents the values that can be set for the BFD Active End. Reference MEF 61.1 Section 13.8 UNI Access Link BFD Service Attribute [R171] and [R172].

File: schema/common/ip/ipRoutingProtocolsCommon.yaml

Contains Enumeration Literals:

- SUBSCRIBER:
 - Subscriber takes active BFD role.
- SP:
 - Service Provider takes active BFD role.
- BOTH:
 - Subscriber and Service Provider take active BFD role.

18.5 BfdAuthenticationType

UNI Access Link BFD authentication type. When Authentication is NOT NONE, RFC5880 Section 6.7 Authentication mechanisms are used.

File: schema/common/ip/ipRoutingProtocolsCommon.yaml

Contains Enumeration Literals:

- NONE:
 - No BFD authentication.
- SIMPLE_PASSWORD:
 - Simple Password Authentication is the most straightforward (and weakest) form of authentication. In this method of authentication one or more Passwords (with corresponding Key IDs) are configured in each system and one of these Password/ID pairs is carried in each BFD Control packet. The receiving system accepts the packet if the Password and Key ID matches one of the Password/ID pairs configured in that system. Reference IETF RFC5880 Section 6.7.2.

- KEYED_MD5:
 - The Keyed MD5 and Meticulous Key MD5 Authentication mechanisms are very similar to those used in other protocols. In these methods of authentication, one or more security keys (with corresponding key IDs) are configured in each system. Reference RFC5880 Section 6.7.3 Keyed MD5 and Meticulous Keyed MD5 Authentication.
- METICULOUS_KEYED_MD5:
 - The Keyed MD5 and Meticulous Key MD5 Authentication mechanisms are very similar to those used in other protocols. In these methods of authentication, one or more security keys (with corresponding key IDs) are configured in each system. Reference RFC5880 Section 6.7.3 Keyed MD5 and Meticulous Keyed MD5 Authentication.
- KEYED_SHA1:
 - The Keyed SHA1 and Meticulous Key SHA1 Authentication mechanisms are very similar to those used in other protocols. In these methods of authentication, one or more secret keys (with corresponding key IDs) are configured in each system. Reference RFC5880 Section 6.7.4 Keyed SHA1 and Meticulous Keyed SHA1 Authentication.
- METICULOUS_KEYED_SHA1:
 - The Keyed SHA1 and Meticulous Key SHA1 Authentication mechanisms are very similar to those used in other protocols. In these methods of authentication, one or more secret keys (with corresponding key IDs) are configured in each system. Reference RFC5880 Section 6.7.4 Keyed SHA1 and Meticulous Keyed SHA1 Authentication.

18.6 Bgp

When an entry in the UNI Routing Protocol is for BGP, BGP as specified in RFC 4271 is used across the UNI to exchange routing information. Reference MEF 61.1 Section 12.7.3 BGP.

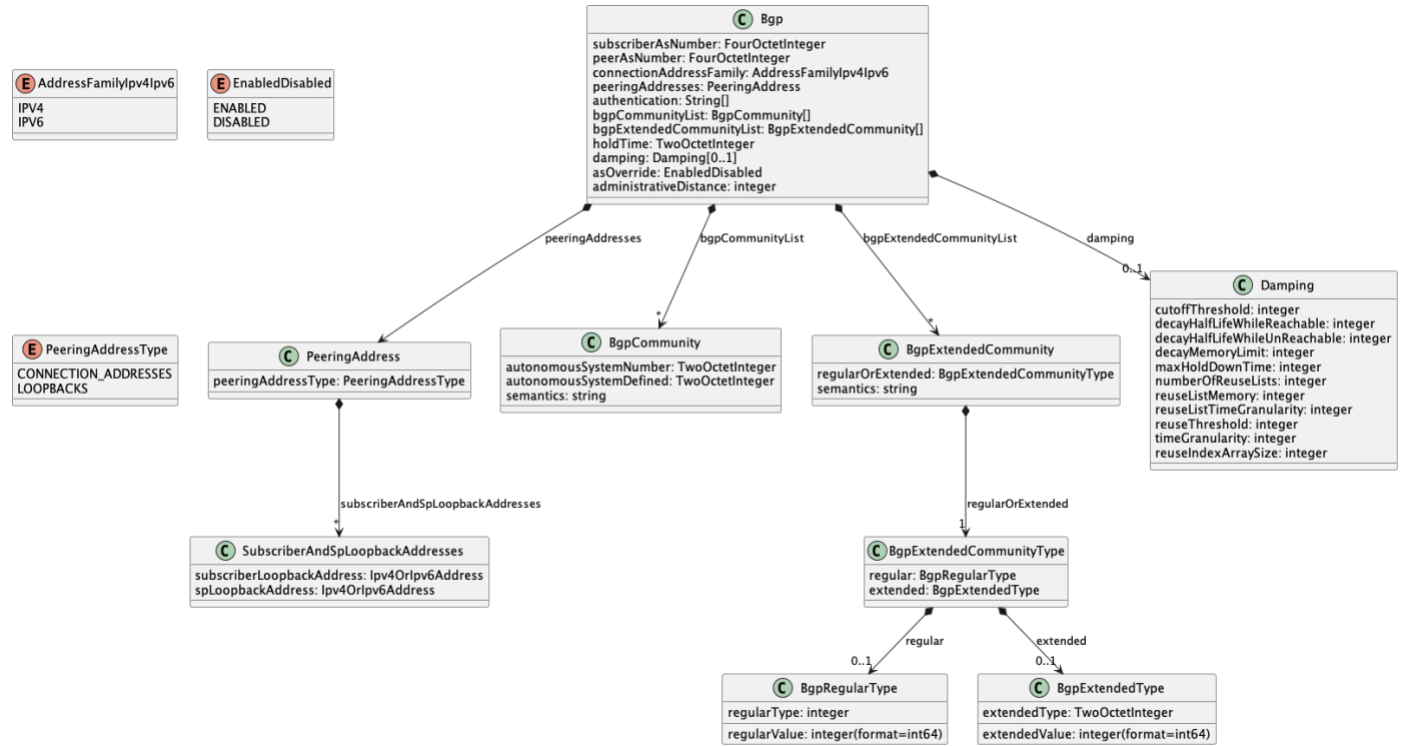


Figure 20-Bgp Model

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
subscriberAsNumber	FourOctetInteger	1	BGP Subscriber Autonomous System number.
peerAsNumber	FourOctetInteger	1	BGP Peer Autonomous System Number.
connectionAddressFamily	AddressFamilyIpv4Ipv6	1	Connection Address Family (IPv4 or IPv6).
peeringAddresses	PeeringAddresses	1	Peering Addresses.
authentication	String	1..*	BGP Authentication (None or MD5 plus a password).
bgpCommunityList	BgpCommunity	0..*	Used to control which routers are accepted, preferred, distributed, or advertised.
bgpExtendedCommunityList	BgpExtendedCommunity	0..*	Mechanism for labeling information carried in BGP-4. Provide enhancement over existing BGP Community Attribute: An extended range, the addition of type field.
holdTime	TwoOctetInteger	1	Hold time in seconds. Indicates the agreed Hold Time used for BGP sessions. The possible values are 0 or an integer in the range 3 -65535.
damping	Damping	0..1	Route flap damping. When the Damping parameter is NONE, the attribute is NOT set. When not NONE a single set of parameters described in Section 4.3 of RFC 2430 MUST be agreed.
asOverride	EnabledDisabled	1	Autonomous System Override. The SP (or Operator) can overwrite instances of the Subscriber's AS Number in the AS Path with their own AS Number,

			when advertising routes to the Subscriber. This needs to be explicitly agreed between the SP and the Subscriber, and/or between an SP/SO and an Operator.
administrativeDistance	Integer	1	BGP Administrative Distance.

Table 58-Bgp Attributes

18.7 BgpCommunity

A community is a group of destinations which share some common property. Each autonomous system administrator may define which communities a destination belongs to.

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
autonomousSystemNumber	TwoOctetInteger	1	The first two octets encoding the Autonomous System value.
autonomousSystemDefined	TwoOctetInteger	1	The remaining octets.
semantics	String	1	Text describing how the Seller will handle routes tagged with this Community.

Table 59-BgpCommunity Attributes

18.8 BgpExtendedCommunity

This attribute provides a mechanism for labeling information carried in BGP-4. These labels can be used to control the distribution of this information, or for other applications.

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Required:			
<ul style="list-style-type: none"> regularOrExtended sematic 			
Attribute Name	Type	Multiplicity	Description
regularOrExtended	BgpExtendedCommunityType	1	Indicates whether the BGP Extended Community is of Regular Type or Extended Type.
semantics	String		Text describing how the Seller will handle routes tagged with this Community.

Table 60-BgpExtendedCommunity Attributes

18.9 BgpExtendedCommunityType

Options for BGP Extended Community types. Either Regular Type or Extended Type.

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
regular	BgpRegularType	1	BGP Regular Type.
extended	BgpExtendedType	1	BGP Extended Type.
minProperties: 1			

maxProperties: 1

Table 61-BgpExtendedCommunityType Attributes

18.10 BgpRegularType

This resource provides a mechanism for labeling the information carrier in.

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
regularType	Integer	1	Regular Type Field, 1 octet length. <ul style="list-style-type: none"> • Minimum: 0 • Maximum: 255
regularValue	Integer Format: int64 Minimum: 0 Maximum: 7205759403792794 0	1	Octets 2-8 of the value part of the address. Used in case only Regular Type is provided.

Table 62-BgpRegularType Attributes

18.11 BgpExtendedType

This resource provides a mechanism for labeling the information carrier in.

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
extendedType	TwoOctetInteger	1	Extended Type Field 2, 2 octets length.
extendedValue	Integer Format: int64 Minimum: 0 Maximum: 281474976710655	1	Octets 3-8 of the value part of the address. Used in case only Extended Type is provided.

Table 63-BgpExtendedType Attributes

18.12 CloudDataLimit

Specifies an absolute limit on the amount of data the Subscriber can transmit to, or receive from, the cloud service in a given time period. It is either Unlimited or a 4-tuple (scdl, tccl, uccl, dccl). Reference MEF 61.1 Section 10.13.3 Cloud Data Limit.

Schema File Name: schema/common/ip/common.yaml			
Attribute Name	Type	Multiplicity	Description
startTime	DateTime	1	Specifies a start time.
duration	TimeDuration	1	Specifies a duration. Together with the start time, it describes a service of contiguous time intervals, starting at the specified start time and each lasting for the specified duration.

upload	Integer	1	An integer indicating a limit, in octets, on the amount of IP traffic that can be transmitted towards the cloud service during each time interval described by startTime and duration.
download	Integer	1	An integer indicating a limit, in octets, on the amount of IP traffic received from the cloud service that can be delivered to the Subscriber during each time interval described by startTime and duration.

Table 64-CloudDataLimit Attributes

18.13 CloudDns

Data type representing a Domain Name System.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
dnsType	DnsType	1	Domain Name System type.
dnsServerIpv4List	Ipv4Address	0..*	DNS server list an IPv4 addresses.
dnsServerIpv6List	Ipv6Address	0..*	DNS server list an IPv6 addresses.

Table 65-CloudDns Attributes

18.14 CloudType

File: schema/common/ip/ipCommon.yaml

Indicates the type of cloud service being accessed. Reference MEF 61.1 Table 10-Subscriber IPVC Cloud Service Attribute parameters.

Contains Enumeration Literals:

- INTERNET_ACCESS:
 - Indicates the cloud access IPVC is used to access the public Internet.
- PRIVATE:
 - Indicates the cloud access IPVC provides a direct connection over the Service Provider's network to a cloud service.

18.15 Damping

BGP Damping parameters as defined in RFC 2439BGP Route Flap Damping, Section 4.2.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
cutoffThreshold	Integer	1	This value is expressed as a number of route withdrawals. It is the value above which a route advertisement will be suppressed.

decayHalfLifeWhileReachable	Integer	1	This value is the time duration in seconds during which the accumulated stability figure of merit will be reduced by half if the route is considered reachable (whether suppressed or not).
decayHalfLifeWhileUnreachable	Integer	1	This value is the time duration in seconds during which the accumulated stability figure of merit will be reduced by half if the route is considered unreachable. If not specified or set to zero, no decay will occur while a route remains unreachable.
decayMemoryLimit	Integer	1	This is the maximum time (in seconds) that any memory of previous instability will be retained given that the route's state remains unchanged, whether reachable or unreachable. This parameter is generally used to determine array sizes.
maxHoldDownTime	Integer	1	This value is the maximum time a route can be suppressed no matter how unstable it has been prior to this period of stability. In seconds.
numberOfReuseLists	Integer	1	This is the number of reuse lists. It may be determined from reuse-list-max or set explicitly.
reuseListMemoryReuseListMax	Integer	1	This is the time (in seconds) value corresponding to the last reuse list. This may be the maximum value of T-hold for all parameter sets of may be configured.
reuseListTimeGranularity	Integer	1	This is the time (in seconds) interval between evaluations of the reuse lists. Each reuse list corresponds to an additional time increments.
reuseThreshold	Integer	1	This value is expressed as a number of route withdrawals. It is the value below which a suppressed route will now be used again.
timeGranularity	Integer	1	This is the time granularity in seconds used to perform all decay computations.

Table 66-Damping Attributes

18.16 DnsType

Enumeration representing the different types of DNS.

File: schema/common/ip/ipRoutingProtocolsCommon.yaml

Contains Enumeration Literals:

- NONE:
- DHCP:
 - If DNS type is Dynamic Host Configuration Protocol, the SP provides DNS server addresses via DHCP at each UNI.
- PPP:
 - If DNS type is Point to Point Protocol, the SP provides DNS service addresses via PPP at each UNI.
- STATIC:

- If DNS type is Static, the DNS server addresses are listed explicitly.
- SLAAC:
 - If DNS type is StateLess Address Auto Configuration, the SP provides DNS server addresses via SLAAC Router Advertisement options (per RFC 8106).

18.17 DscpValue

DSCP value.

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
value	Integer Minimum: 0 Maximum: 63	1	0 <= value <= 63.

Table 67-Dscp Attributes

18.18 EthernetPhysicalLink

Data type representing UNI Access Link Trunk List of Ethernet Physical Links of form <id,pl,fs,ct,gn> as defined in MEF 61.1.1 Section A1-1.3.1.

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml

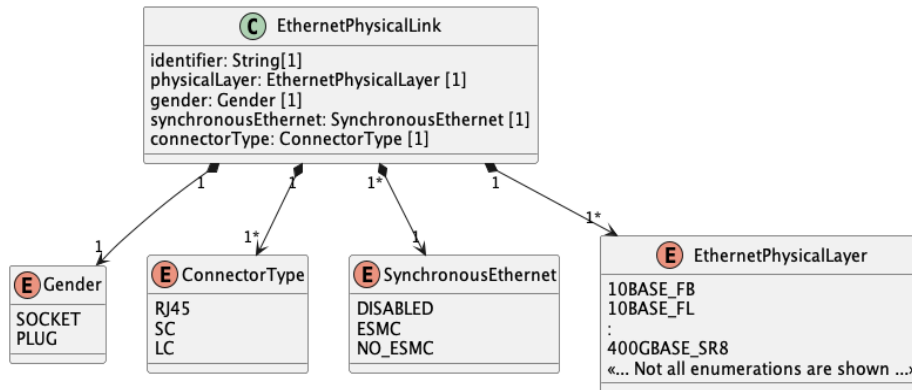


Figure 21-EthernetPhysicalLink Model

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
identifier	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> " <i>[\x20-\x7F]+</i> "	1	The identification of the physical link.
physicalLayer	EthernetPhysical Layer	1	The value of pl specifies a physical layer.

gender	Gender	1	The value of gn indicates the gender of the connector presented to the Subscriber.
synchronousEthernet	SynchronousEthernet	1	Enumeration representing value of fs synchronous ethernet.
connectorType	ConnectorType	1	Enumeration representing ct Connector Type.

Table 68-EthernetPhysicalLink Attributes

18.19 ForwardingInformation

Forwarding information, consisting of either a nexthop IP address in the Subscriber Network (if the access medium is multipoint capable, e.g., Ethernet), or a specific UNI Access Link (if the access medium is strictly point-to-point, e.g., HDLC, PPP over DSL).

Schema File Name: schema/common/ip/ipCommon.yaml			
minProperties: 1			
maxProperties: 1			
Attribute Name	Type	Multiplicity	Description
nextHopIpAddress	String	0..1	Next Hop IP Address.
uniAccessLink	String <i>Min length=1</i> <i>Max length=53</i> <i>Pattern=pattern:</i> <i>"[\x20-\x7F]+"</i>	0..1	UNI Access Link unique identifier.

Table 69-ForwardingInformation Attributes

18.20 IpvcCloud

The IPVC Cloud Service Attribute is a set of parameters describing the access connectivity to the cloud service. Reference MEF 61.1 Section 10.13 IPVC Cloud Service Attribute.

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
type	CloudType	1	Cloud Type indicates the type of cloud service being accessed. Reference MEF 61.1 Section 10.13.1 Cloud Type.
ingressClassOfServiceMap	IngressClassOfServiceMap	1	Specification of how ingress packets are mapped to different CoS Names. Reference MEF 61.1 Section 10.13.2 Cloud Ingress Class of Service Map.
dataLimit	CloudDataLimit	0..1	Limit on the amount of Data traffic sent to/received from the cloud service. Unlimited or a 4-tuple (scdl, Tcdl, ucdl, dcdl). If not provided, then Unlimited. Reference MEF 61.1 Section 10.13.3 Cloud Data Limit.
dns	CloudDns	0..1	Whether and how DNS is provided for the service. Reference MEF 61.1 Section 10.13.5 Cloud DNS

			Service.
networkAddressTranslation	Ipv4Prefix	0..1	Whether Network Address Translation is used, and if so the IPv4 Prefix. If not selected, then Disabled. Reference MEF 61.1 Section 10.13.4 Cloud Network Address Translation.
subscriberPrefixList	Ipv4IOrIpv6Prefix	0..*	List of Public IP Prefixes used in the Subscriber Network. Reference MEF 61.1 Section 10.13.6 Cloud Subscriber Prefix List.

Table 70-IpvCloud Attributes

18.21 Ospf

When an entry in the UNI Routing Protocols is for OSPF, OSPF as specified in RFC 2328 for IPv4) and/or RFC 5340 (for IPv6) is used across each UNI Access Link to exchange routing information. Reference MEF 61.1 Section 12.7.2 OSPF.

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
areald	Ipv4Address	1	Area ID (0-429967295), normally expressed as an IPv4 address.
areaType	OspfAreaType	1	OSPF Area Type enumeration.
authenticationType	OspfAuthenticationType	1	OSPF Authentication Type.
helloInterval	TwoOctetInteger	1	Hello Interval (0-65535, in seconds).
deadInterval	Integer Minimum: 0 Maximum: 429967295	1	Dead interval (0-4294967295, in seconds).
retransmissionInterval	Integer Minimum: 0	1	Retransmit Interval (Integer greater than 0, in seconds).
administrativeDistance	Integer Minimum: 1	1	Administrative Distance (Integer greater than 0).

Table 71-Ospf Attributes

18.22 OspfAreaType

OSPF Area Type enumeration as defined in RFC-3101. Reference MEF 61.1 Section 12.7.2.

File: schema/common/ip/ipRoutingProtocolsCommon.yaml

Contains Enumeration Literals:

- NORMAL:
 - The area is not a STUB or NSSA.
- STUB: Stub Area.
- NSSA: Not-so-Stubby Area.

18.23 OspfAuthenticationType

OSPF Authentication Type enumeration.

File: *schema/common/ip/ipRoutingProtocolsCommon.yaml*

Contains Enumeration Literals:

- NONE:
 - This is the default method and means that no authentication is used for OSPF.
- PASSWORD:
 - It is also known as "authentication with unencrypted text", because the password in the update is sent as unencrypted text over the network.
- MESSAGE_DIGEST:
 - The password is never exchanged between peers. Instead, it is calculated using the MD5 algorithm.

18.24 RoutingProtocols

Data type to support routing protocols and associated parameters that are used to exchange IP routes across the UNI. The value is a list of protocols (possibly empty), where each entry consists of the protocol name (one of Static, OSPF or BGP) the type of routes that will be exchanged (one of IPv4 or IPv6 or Both) and set of additional parameters as specified. Reference MEF 61.1 Section 12.7 UNI Routing Protocols Service Attributes.

Schema File Name: <i>schema/common/ip/ipRoutingProtocolsCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description
static	Static	0..1	Static routing configuration options.
ospf	RoutingProtocolsOspfOptions	0..1	OSPF routing protocol configuration options.
bgp	RoutingProtocolsBgpOptions	0..1	BGP routing protocol configuration options.

Table 72-RoutingProtocols Attributes

18.25 RoutingProtocolsBgpOptions

BGP routing protocol configuration options. The configuration of the BGP can be provided for the following type of routes that will be exchanged:

- ipv4, or
- ipv6, or
- both, or (one BGP session exchanging both IPv4 and IPv6)
- ipv4 and ipv6 (separate BGP sessions for exchanging IPv4 and IPv6)

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipv4	Bgp	1	Configuration for exchanging IPv4 types of routes.
ipv6	Bgp	1	Configuration for exchanging IPv6 types of routes.
both	Bgp	1	Common configuration for exchanging both IPv4 and IPv6 types of routes.

Table 73-RoutingProtocolsBgpOptions Attributes

18.26 RoutingProtocolsOspfOptions

OSPF routing protocol configuration options. The configuration of the OSPF can be provided for the following type of routes that will be exchanged:

- ipv4, or
- ipv6, or
- ipv4 and ipv6

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipv4	Ospf	1	Configuration for exchanging IPv4 types of routes.
ipv6	Ospf	1	Configuration for exchanging IPv6 types of routes.

Table 74-RoutingProtocolsOspfOptions Attributes

18.27 Static

When an entry in the UNI Routing Protocols list is Static, the IP Prefixes used in the Subscriber Network that are reachable via this UNI are specified as additional parameters in the entry. These are known as Static IP Prefixes. Reference MEF 61.1 Section 12.7.1 Static.

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
staticIpEntry	StaticIpEntry	1..*	Pointer to StaticIpEntry

Table 75-Static Attributes

18.28 StaticIpEntry

StaticIpEntry data type including IPv4/IPv6 prefixes, forwarding information and administrative distance.

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
administrativeDistance	Integer Minimum: 1	1	Administrative Distance, an integer > 0.

forwardingInformation	ForwardingInformation	1	Forwarding information with either Next Hop IP address or UNI Access Link identifier.
staticIpPrefix	Ipv4OrIpv6Prefix	1	Static IP prefix either IPv4 or IPv6.

Table 76-StaticIpEntry Attributes

19 IP Bandwidth Profile and Bandwidth Profile Envelope

The following section provides a detailed information model for the IP Bandwidth Profile and IP Bandwidth Profile Envelope as specified in MEF 61.1 Section 17.1 Structure of Bandwidth Profiles. The following section will provide the complete set of IP Bandwidth Profile/Bandwidth Profile Envelope models.

The two data types that each specific model inherits are `IpBwpEnvelope` and `IpBwpFlow`. The set of resources described in this section are in the `schema/common/ip/ipCommon.yaml` file.

19.1 BurstBehavior

Enumeration used to select the Bandwidth Profile Flow Burst Behavior attribute. Reference MEF 61.1 Section 17.3 Table 29 Bandwidth Profile Parameters for a Bandwidth Profile Flow.

File: schema/common/ip/ipCommon.yaml

Contains Enumeration Literals:

- OPTIMIZE_DELAY:
 - Enumeration representing the Burst Behavior of optimization of delay.
- OPTIMIZE_THROUGHPUT:
 - Enumeration representing the Burst Behavior of optimization of throughput.

19.2 IpBwpFlow

A Bandwidth Profile Flow is a stream of IP Packets meeting certain criteria. The criteria than can be used depends on which BWP Envelope the BWP Flow is a part of. Reference MEF 61.1 Section 17.2 Bandwidth Profile Flows.

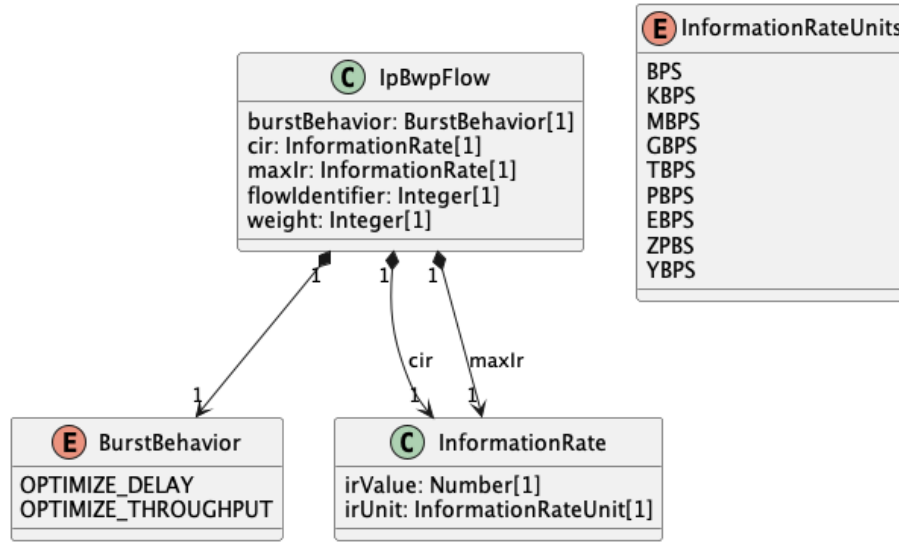


Figure 22-IpBwpFlow Model

Schema File Name: schema/common/ip/ipRoutingProtocolsCommon.yaml			
Attribute Name	Type	Multiplicity	Description
flowIdentifier	Integer	1	Identifier for the BWP Flow within the BWP Envelope. Unique integer between 1 and n where n is the number of BWP Flows in the BWP Envelope. Reference MEF 61.1 Table 29 - Bandwidth Profile Parameters for a Bandwidth Profile Flow.
cir	InformationRate	1	Identifier for Committed Information Rate in bits per second. Average information rate of IP Packets that is committed to this BWP Flow. Reference MEF 61.1 Table 29 - Bandwidth Profile Parameters for a Bandwidth Profile Flow.
maxlr	InformationRate	1	Identifier for Maximum Information Rate in bits per second. Limit on the average information rate of IP Packets for this BWP Flow. Reference MEF 61.1 Table 29 - Bandwidth Profile Parameters for a Bandwidth Profile Flow.
weight	Integer	1	Identifier for Weight as an integer greater than or equal to 0. Relative weight for this BWP Flow compared to other BWP Flows in the BWP Envelope. Reference MEF 61.1 Table 29 - Bandwidth Profile Parameters for a Bandwidth Profile Flow.
burstBehavior	BurstBehavior	1	Identifier for Burst Behavior either Optimize-Delay or Optimize-Throughput. Whether the SP is requested to optimize the delay characteristic of this flow, or the throughput. Reference MEF 61.1 Table 29 - Bandwidth Profile Parameters for a Bandwidth Profile Flow.

Table 77-IpBwpFlow

19.2.1 IpBwpEnvelope

A BWP Envelope is a list of Bandwidth Profile Flows, plus additional parameters for the BWP as a whole. A BWP Envelope is a set of one or more BWP Flows that are associated such that the amount of traffic for one flow can affect the amount that is permitted for another flow.

Reference MEF 61.1 Section 17.3 Bandwidth Profile Envelopes.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
maxIrE	InformationRate	1	The Envelope Maximum Information Rate in bits per second. This is the limit on the total aggregate information rate of traffic across all BWP Flows in the Envelope. Reference MEF 61.1 Section 17.3 Bandwidth Profile Envelopes.
tE	Float	1	The Envelope IR Time in milliseconds. This is the time period over which average Information Rates are calculated and thus it limits the size of a burst. Reference MEF 61.1 Section 17.3 Bandwidth Profile Envelopes.

Table 78-IpBwpEnvelope

19.3 UNI Ingress Bandwidth Profile Envelope

The following section details the UNI Ingress Bandwidth Profile Envelope model as defined in MEF 61.1 Section 12.4. Note that the tables below do not repeat inherited attributes from superclasses.

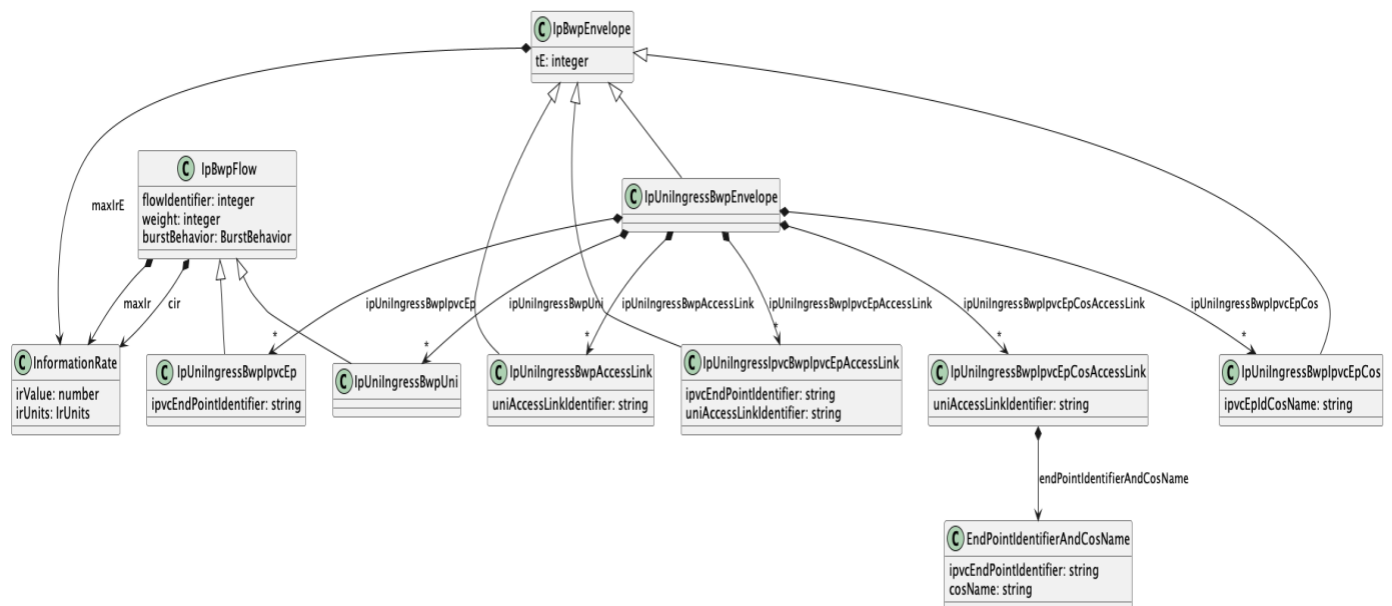


Figure 23-IpUniIngressBwpEnvelope Model

19.3.1 IpUnIngressBwpEnvelope

A single Bandwidth Profile Envelope consisting of parameters and Bandwidth Profile Flow specifications. If specified, the BWP Envelope is used for an ingress Bandwidth Profile. The BWP Flows can be defined per UNI, per IPVC EP, per UNI Access Link, per CoS Name, etc. Reference MEF 61.1 Section 12.4 UNI Ingress Bandwidth Profile Envelope Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipUnIngressBwplpvcEpCos	IpUnIngressBwplpvcEpCos	0..*	Pointer to IpUnIngressBwplpvcEpCos.
ipUnIngressBwpAccessLink	IpUnIngressBwpAccessLink	0..*	Pointer to IpUnIngressBwpAccessLink.
ipUnIngressBwplpvcEpAccessLink	IpUnIngressIpvcEpBwpAccessLink	0..*	Pointer to IpUnIngressIpvcEpBwpAccessLink.
ipUnIngressBwplpvcEpCosAccessLink	IpUnIngressBwplpvcEpCosAccessLink	0..*	Pointer to IpUnIngressBwplpvcEpCosAccessLink
ipUnIngressBwplpvcEp	IpUnIngressBwplpvcEp	0..*	Pointer to IpUnIngressBwplpvcEp.
ipUnIngressBwpUni	IpUnIngressBwp	0..1	Pointer to IpUnIngressBwpUni

Table 79-IpUnIngressBwpEnvelope Attributes

19.3.2 IpUnIngressBwp

All Ingress IP Data Packets at the UNI. Reference MEF 61.1 Section 12.4 UNI Ingress BWP Envelope. NOTE: No attributes are needed.

19.3.3 IpUnIngressBwplpvcEp

All Ingress IP Data Packets at the UNI that are mapped to any of a given set of IPVC EPs. Reference MEF 61.1 Section 12.4 UNI Ingress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipvcEndPointIdentifier	String	1..*	IPVC End Point Identifier for an IPVC End Point located at the UNI. Reference MEF 61.1 Table 28.

Table 80-IpUnIngressBwplpvcEp Attributes

19.3.4 IpUnIngressBwplpvcEpCos

All Ingress IP Data Packets at the UNI that are mapped to any of a given set of (IPVC, EP, CoS Name) pairs. Reference MEF 61.1 Section 12.4 UNI Ingress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description

ipvcEpldCosName	EndPointIdentifier AndCosName	1..*	IPVC End Point and CoS Identifier. Reference MEF 61.1 Table 28.
-----------------	----------------------------------	------	---

Table 81-IpUnilngressBwplpvcEpCos Attributes

19.3.5 IpUnilngressBwpAccessLink

All Ingress IP Data Packets at the UNI that are received over one of a give set of UNI Access Links. Reference MEF 61.1 Section 12.4 UNI Ingress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
uniAccessLinkIdentifier	String	1..*	UNI Access Link Identifier. Reference MEF 61.1 Table 28.

Table 82-IpUnilngressBwpAccessLink Attributes

19.3.6 IpUnilngressBwplpvcEpAccessLink

All Ingress IP Data Packets at the UNI that are received over one of a given set of UNI Access Links, and are mapped to any of a given set of IPVC End Points. BWP Flow Parameters are a set each entry comprising of a UNI Access Link Identifier for a UNI Access Link in the UNI, a set, each entry comprising IPVC End Point Identifier for an IPVC End Point located at the UNI. Reference MEF 61.1 Section 12.4 UNI Ingress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
uniAccessLinkIdentifier	String	1..*	UNI Access Link Identifier. Reference MEF 61.1 Table 28.
ipvcEndPointIdentifier	String	1..*	IPVC End Point Identifier. Reference MEF 61.1 Table 28.

Table 83-IpUnilngresslpvcEpBwpAccessLink Attributes

19.3.7 IpUnilngressBwplpvcEpCosAccessLink

All Ingress IP Data Packets at the UNI that are received over one of a given set of UNI Access Links, and that are mapped to the any of a given set of (IPVC EP, CoS Name) pairs. Reference MEF 61.1 Section 12.4 UNI Ingress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
uniAccessLinkIdentifier	String	1..*	UNI Access Link Identifier. Reference MEF 61.1 Table 28.
ipvcEpldCosName	EndPointIdentifierA ndCosName	1..*	IPVC End Point and CoS Identifier. Reference MEF 61.1 Table 28.

Table 84-IpUnilngressBwplpvcEpCosAccessLink Attributes

19.4 UNI Egress Bandwidth Profile Envelope

The following section details the UNI Egress Bandwidth Profile Envelope model as defined in MEF 61.1 Section 12.5. Note that the tables below do not repeat inherited attributes from superclasses.

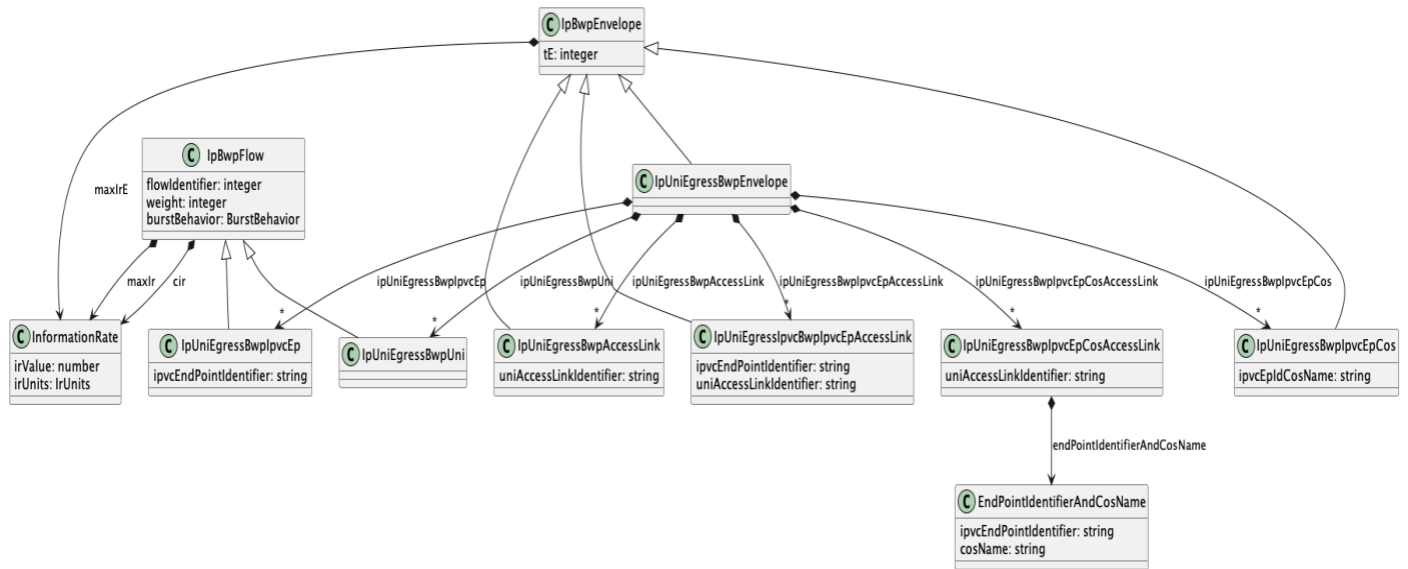


Figure 24-IpUniEgressBwpEnvelope Model

A single Bandwidth Profile Envelope consisting of parameters and Bandwidth Profile Flow specifications. If specified, the BWP Envelope is used for an egress Bandwidth Profile. The BWP Flows can be defined per UNI, per IPVC EP, per UNI Access Link, per CosName, etc. Reference MEF 61.1 Section 12.5 UNI Egress Bandwidth Profile Envelope Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipUniEgressBwpUni	IpUniEgressBwpUni	0..1	Pointer to IpUniEgressBwpUni
ipUniEgressBwpIpcvcbwAccessLink	IpUniEgressBwpIpcvcbwAccessLink	0..*	Pointer to IpUniEgressBwpIpcvcbwAccessLink
ipUniEgressBwpIpcvcbwAccessLinkCos	IpUniEgressBwpIpcvcbwAccessLinkCos	0..*	Pointer to IpUniEgressBwpIpcvcbwAccessLinkCos
ipUniEgressBwpIpcvcbwAccessLink	IpUniEgressBwpIpcvcbwAccessLink	0..*	Pointer to IpUniEgressBwpIpcvcbwAccessLink
ipUniEgressIpcvcbwAccessLink	IpUniEgressIpcvcbwAccessLink	0..*	Pointer to IpUniEgressIpcvcbwAccessLink
ipUniEgressBwpIpcvcbwAccessLinkCos	IpUniEgressBwpIpcvcbwAccessLinkCos	0..*	Pointer to IpUniEgressBwpIpcvcbwAccessLinkCos

Table 85-IpUniEgressBwpEnvelope Attributes

19.4.1 IpUniEgressBwp

All Egress IP Data Packets at the UNI. Reference MEF 61.1 Section 12.4 UNI Egress BWP Envelope. NOTE: No attributes are needed.

19.4.2 IpUniEgressBwplpvcEp

All Egress IP Data Packets at the UNI that are mapped to any of a given set of IPVC EPs. Reference MEF 61.1 Section 12.5 UNI Egress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipvcEndPointIdentifier	String	1..*	IPVC End Point Identifier for an IPVC End Point located at the UNI. Reference MEF 61.1 Table 28.

Table 86- IpUniEgressBwplpvcEp Attributes

19.4.3 IpUniEgressBwplpvcEpCos

All Egress IP Data Packets at the UNI that are mapped to any of a given set of (IPVC, EP, CoS Name) pairs. Reference MEF 61.1 Section 12.5 UNI Egress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipvcEpdCosName	EndPointIdentifierAndCosName	1..*	IPVC End Point and CoS Identifier. Reference MEF 61.1 Table 28.

Table 87- IpUniEgressBwplpvcEpCos Attributes

19.4.4 IpUniEgressBwpAccessLink

All Egress IP Data Packets at the UNI that are received over one of a give set of UNI Access Links. Reference MEF 61.1 Section 12.5 UNI Egress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
uniAccessLinkIdentifier	String	1..*	UNI Access Link Identifier. Reference MEF 61.1 Table 28.

Table 88- IpUniEgressAccessLink Attributes

19.4.5 IpUniEgresslpvcEpBwpAccessLink

All Egress IP Data Packets at the UNI that are received over one of a given set of UNI Access Links, and are mapped to any of a given set of IPVC End Points. BWP Flow Parameters are a set each entry comprising UNI Access Link Identifier for a UNI Access Link in the UNI, a set, each entry comprising IPVC End Point Identifier for an IPVC End Point located at the UNI. Reference MEF 61.1 Section 12.5 UNI Egress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description

uniAccessLinkIdentifier	String	1..*	UNI Access Link Identifier. Reference MEF 61.1 Table 28.
ipvcEndPointIdentifier	String	1..*	IPVC End Point Identifier for an IPVC End Point located at the UNI. Reference MEF 61.1 Table 28.

Table 89-IpUniEgressIpvcEpBwpAccessLink Attributes

19.4.6 IpUniEgressBwpIpvcEpCosAccessLink

All Egress IP Data Packets at the UNI that are received over one of a given set of UNI Access Links, and that are mapped to the any of a given set of (IPVC EP, Cos Name) pairs. Reference MEF 61.1 Section 12.5 UNI Egress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
uniAccessLinkIdentifier	String	1..*	UNI Access Link Identifier. Reference MEF 61.1 Table 28.
ipvcEpldCosName	EndPointIdentifierAndCosName	1..*	IPVC End Point Identifier for an IPVC End Point located at the UNI. Reference MEF 61.1 Table 28.

Table 90-IpUniEgressBwpIpvcEpCosAccessLink Attributes

19.5 UNI Access Link Ingress Bandwidth Profile Envelope Model

The following section details the UNI Access Link Ingress Bandwidth Profile Envelope model as defined in MEF 61.1 Section 13.10. Note that the tables below do not repeat inherited attributes from superclasses.

19.5.1 IpUniAccessLinkIngressBwpEnvelope

A single Bandwidth Profile Envelope consisting of parameters and Bandwidth Profile Flow specifications. An Ingress Bandwidth Profile Envelope can be specified for one of a UNI, a UNI Access, or an IPVC EP. Reference MEF 61.1 Section 13.10 UNI Access Link Ingress Bandwidth Profile Envelope Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipUniAccessLinkIngressBwp	IpUniAccessLinkIngressBwp	0..1	Pointer to IpUniAccessLinkIngressBwp.
ipUniAccessLinkBwpIpvcEp	IpUniAccessLinkIngressBwpIpvcEp	0..*	Pointer to IpUniAccessLinkBwpIpvcEp
ipUniAccessLinkBwpIpvcEpCos	IpUniAccessLinkIngressBwpIpvcEpCos	0..*	Pointer to IpUniAccessLinkBwpIpvcEpCos

Table 91-IpUniAccessLinkIngressBwpEnvelope Attributes

19.5.2 IpUniAccessLinkIngressBwp

All Ingress IP Data Packets at the UNI Access Link. Reference MEF 61.1 Reference MEF 61.1 Section 13.10 UNI Access Link Ingress BWP Envelope. NOTE: No attributes are needed.

19.5.3 IpUniAccessLinkIngressBwplpvcEp

All Ingress IP Data Packets at the UNI that are received over the UNI Access Link and are mapped to any of a given set of IPVC End Points. Reference MEF 61.1 Section 13.10 UNI Access Link Ingress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipvcEpIdentifier	String	1..*	IPVC End Point Identifier for an IPVC End Point located at the UNI Access Link. Reference MEF 61.1 Table 28.

Table 92-IpUniAccessLinkIngressBwplpvcEp Attributes

19.5.4 IpUniAccessLinkIngressBwplpvcEpCos

All Ingress IP Data Packets at the UNI that are received over the UNI Access Link and are mapped to any of a given of IPVC End Point that has a CoS Name. Reference MEF 61.1 Section 13.10 UNI Access Link Ingress BWP Envelope.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipvcEpIdentifier	String	1	IPVC End Point Identifier for an IPVC End Point located at the UNI Access Link. Reference MEF 61.1 Table 28.
ipvcEpIdCosName	EndPointIdentifierAndCosName	1..*	IPVC End Point Identifier for an IPVC End Point located at the UNI. Reference MEF 61.1 Table 28.

Table 93-IpUniAccessLinkIngressBwplpvcEpCos Attributes

19.6 UNI Access Link Egress Bandwidth Profile Envelope Model

The following section details the UNI Access Link Egress Bandwidth Profile Envelope model as defined in MEF 61.1 Section 13.11. Note that the tables below do not repeat inherited attributes from superclasses.

19.6.1 IpUniAccessLinkEgressBwpEnvelope

A single Bandwidth Profile Envelope consisting of parameters and Bandwidth Profile Flow specifications. An Egress Bandwidth Profile Envelope can be specified for one of a UNI, a UNI Access, or an IPVC EP. Reference MEF 61.1 Section 13.11 UNI Access Link Egress Bandwidth Profile Envelope Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description

ipUniAccessLinkEgressBwp	IpUniAccessLinkEgressBwp	0..1	Pointer to IpUniAccessLinkEgressBwp.
ipUniAccessLinkEgressBwplpvcEp	IpUniAccessLinkEgressBwplpvcEp	0..*	Pointer to IpUniAccessLinkEgressBwplpvcEp.
ipUniAccessLinkEgressBwplpvcEpCos	IpUniAccessLinkEgressBwplpvcEpCos	0..*	Pointer to IpUniAccessLinkEgressBwplpvcEpCos

Table 94-IpUniAccessLinkEgressBwpEnvelope Attributes

19.6.2 IpUniAccessLinkEgressBwp

All Egress IP Data Packets at the UNI Access Link. Reference MEF 61.1 Reference MEF 61.11 Section 13.11 UNI Access Link Egress BWP Envelope. NOTE: No attributes are needed.

19.6.3 IpUniAccessLinkEgressBwplpvcEp

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipvcEpIdentifier	String	1	IPVC End Point Identifier for an IPVC End Point located at the UNI Access Link. Reference MEF 61.1 Table 28.

Table 95-IpUniAccessLinkEgressBwplpvcEp Attributes

19.6.4 IpUniAccessLinkEgressBwplpvcEpCos

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipvcEpIdentifier	String	1	IPVC End Point Identifier.
ipvcEpIdCosName	EndPointIdentifierAndCosName	1..*	IPVC End Point Identifier for an IPVC End Point located at the UNI. Reference MEF 61.1 Table 28.

Table 96-IpUniAccessLinkEgressBwplpvcEpCos Attributes

19.7 ENNI Access Link Ingress Bandwidth Profile Envelope per ENNI Link Model

The following section details the ENNI Access Link Ingress Bandwidth Profile Envelope model as defined in MEF 61.1 Section 14.4. Note that the tables below do not repeat inherited attributes from superclasses.

19.7.1 IpEnniIngressBwpEnvelopePerEnniLink

Is a list (possibly empty) of pairs of (ENNI Service Mapping Identifier, Bandwidth Profile Envelope), where each Bandwidth Profile Envelope consists of parameters and Bandwidth Profile Flow specifications. An Ingress Bandwidth Profile Envelope at an ENNI can be specific for either ENNI Links or an IPVC EP. Reference MEF 61.1 Section 14.4 ENNI Ingress Bandwidth Profile Envelopes Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description

ipEnniIngressBwp	IpEnniIngressBwp	0..1	Reference to IpEnniIngressBwp
ipEnniIngressBwpCos	IpEnniIngressBwpCos	1.. *	Reference to IpEnniIngressBwpCos

Table 97-IpEnniIngressBwpEnvelopePerEnniLink Attributes

19.7.2 IpEnniIngressBwp

All Ingress IP Data Packets at the ENNI Access Link. Reference MEF 61.1 Section 14.4. NOTE: No attributes are needed.

19.7.3 IpEnniIngressBwpCos

All Egress-Eligible IP Data Packets at the ENNI that if transmitted, would be transmitted over the ENNI Link, and that were mapped on ingress to any of a given set of CoS Names. Reference MEF 61.1 Section 14.4.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
cosName	String	1	Class of Service name.

Table 98-IpEnniIngressBwpCos Attributes

19.8 ENNI Access Link Egress Bandwidth Profile Envelope per ENNI Model

The following section details the ENNI Access Link Egress Bandwidth Profile Envelope model as defined in MEF 61.1 Section 14.5. Note that the tables below do not repeat inherited attributes from superclasses.

19.8.1 IpEnniEgressBwpEnvelopePerEnniLink

Is a list (possibly empty) of pairs of (ENNI Service Mapping Identifier, Bandwidth Profile Envelope), where each Bandwidth Profile Envelope consists of parameters and Bandwidth Profile Flow specifications. An Egress Bandwidth Profile Envelope at an ENNI can be specific for either ENNI Links or an IPVC EP. Reference MEF 61.1 Section 14.5 ENNI Egress Bandwidth Profile Envelopes Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipEnniEgressBwp	IpEnniEgressBwp	0..1	Reference to IpEnniEgressBwp
ipEnniEgressBwpCos	IpEnniEgressBwpCos	0.. *	Reference to IpEnniEgressBwpCos.

Table 99-IpEnniEgressBwpEnvelopePerEnniLink Attributes

19.8.2 IpEnniEgressBwp

All Egress IP Data Packets at the ENNI Access Link. Reference MEF 61.1 Section 14.5. NOTE: No attributes are needed.

19.8.3 IpEnniEgressBwpCos

All Egress-Eligible IP Data Packets at the ENNI that if transmitted, would be transmitted over the ENNI Link, and that were mapped on ingress to any of a given set of CoS Names. Reference MEF 61.1 Section 14.5.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
cosName	String	1	Class of Service name.

Table 100- IpEnniEgressBwpCos Attributes

19.9 IPVC End Point Ingress Bandwidth Profile Envelope

The following section details the IPVC End Point Ingress Bandwidth Profile Envelope model as defined in MEF 61.1 Section 11.11. Note that the tables below do not repeat inherited attributes from superclasses.

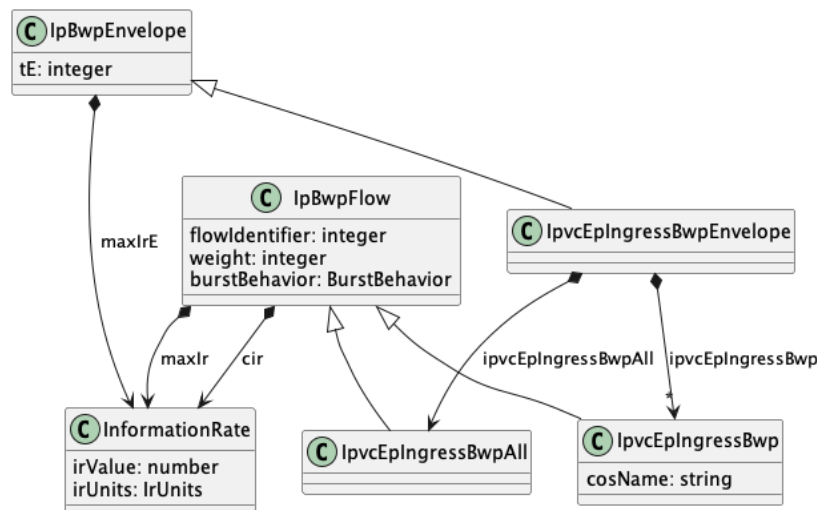


Figure 25- IpvcEpIngressBwpEnvelope Model

19.9.1 IpvcEpIngressBwpEnvelope

A single Bandwidth Profile Envelope consisting of parameters and Bandwidth Profile specifications. An Ingress Bandwidth Profile Envelope can be specified for one of a UNI, a UNI Access Link and ENNI Link or an IPVC End Point. Reference MEF 61.1 Section 11.11 IPVC EP Ingress Bandwidth Profile Envelope Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
ipvcEpIngressBwpAll	IpvcEpIngressBwpAll	0..1	Pointer to IpvcEpIngressBwpAll.
ipvcEpIngressBwp	IpvcEpIngressBwp	1..*	Pointer to IpvcEpIngressBwp.

Table 101-IpvcEpIngressBwpEnvelopeAttributes

19.10 IpvcEpIngressBwpEnvelopeOrNone

Ingress Bandwidth Profile Envelope for the IPVC End Point. The absence of this attribute corresponds to a value of “None”. Reference MEF 61.1 Section 11.11 IPVC EP Ingress Bandwidth Profile Service Attribute.

Schema File Name: schema/common/ip/ipCommon.yaml			
minProperties: 1			
maxProperties: 1			
Attribute Name	Type	Multiplicity	Description
ingressBwpEnvelopeValue	IpvcEpIngressBwpEnvelope	1	Pointer to IpvcEpIngressBwpEnvelope.
ingressBwpEnvelopeNone	String Enum: • NONE	1	Indicates that there is no Egress Bandwidth Profile Envelope.

Table 102-IpvcEpIngressBwpEnvelopeOrNone Attributes

19.10.1 IpvcEpIngressBwpAll

A single Bandwidth Profile Envelope consisting of parameters and Bandwidth Profile specification applied to all ingress IP Packets. Reference MEF 61.1 Section 11.11. NOTE: No attributes are needed.

19.10.2 IpvcEpIngressBwp

An Ingress Bandwidth for and IPVC End Point with an associated Class of Service identifier.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
cosName	String	1..*	Class of Service name.

Table 103-IpvcEpIngressBwpAttributes

19.11 IPVC End Point Egress Bandwidth Profile Envelope

The following section details the IPVC End Point Egress Bandwidth Profile Envelope model as defined in MEF 61.1 Section 11.12. Note that the tables below do not repeat inherited attributes from superclasses.

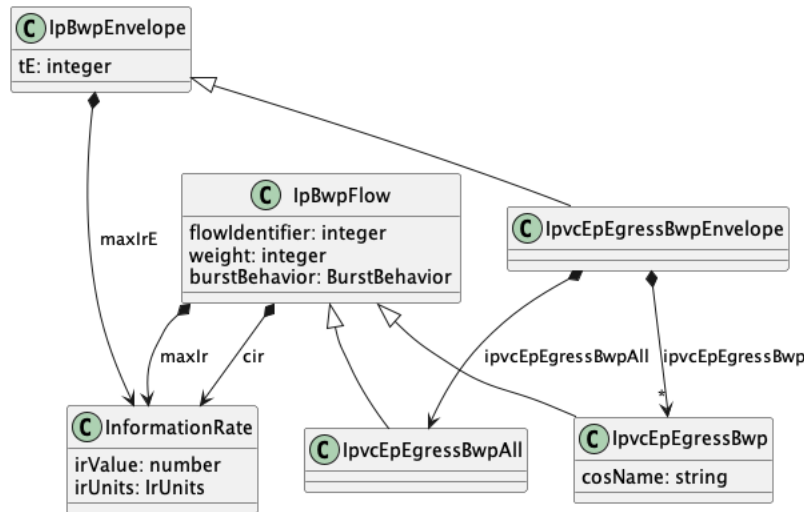


Figure 26-*IpvcEpEgressBwpEnvelope* Model

19.11.1 *IpvcEpEgressBwpEnvelope*

A single Bandwidth Profile Envelope consisting of parameters and Bandwidth Profile specifications. An Egress Bandwidth Profile Envelope can be specified for one of a UNI, a UNI Access Link and ENNI Link or an IPVC End Point. Reference MEF 61.1 Section 11.11 IPVC EP Egress Bandwidth Profile Envelope Service Attribute.

Schema File Name: <i>schema/common/ip/ipCommon.yaml</i>			
Attribute Name	Type	Multiplicity	Description
<i>ipvcEpEgressBwpAll</i>	<i>IpvcEpEgressBwpAll</i>	0..1	Pointer to <i>IpvcEpEgressBwpAll</i>
<i>ipvcEpEgressBwp</i>	<i>IpvcEpEgressBwp</i>	1.. *	Pointer to <i>IpvcEpEgressBwp</i>

Table 104-*IpvcEpEgressBwpEnvelope* Attributes

19.12 *IpvcEpEgressBwpEnvelopeOrNone*

Egress Bandwidth Profile Envelope for the IPVC End Point. The absence of this attribute corresponds to a value of “None”. Reference MEF 61.1 Section 11.12 IPVC EP Egress Bandwidth Profile Service Attribute.

Schema File Name: <i>schema/common/ip/ipCommon.yaml</i>			
minProperties: 1			
maxProperties: 1			
Attribute Name	Type	Multiplicity	Description
<i>egressBwpEnvelopeValue</i>	<i>IpvcEpEgressBwpEnvelope</i>	1	Pointer to <i>IpvcEpEgressBwpEnvelope</i> .
<i>egressBwpEnvelopeNone</i>	String Enum: • NONE	1	Indicates that there is no Egress Bandwidth Profile Envelope.

Table 105-IpvcEpEgressBwpEnvelopeOrNone Attributes**19.12.1 IpvcEpEgressBwpAll**

All Egress IP Data Packets at the IPVC End Point. Reference MEF 61.1 Section 11.12. NOTE: No attributes are needed.

19.12.2 IpvcEpEgressBwp

An Egress Bandwidth for and IPVC End Point with an associated Class of Service identifier.

Schema File Name: schema/common/ip/ipCommon.yaml			
Attribute Name	Type	Multiplicity	Description
cosName	String	1	Class of Service name.

Table 106-IpvcEpEgressBwp Attributes

20 IP SLS

The IPVC Service Level Specification (SLS) describes the performance objectives for the performance of conformant IP Data Packets that flow over the IPVC. The following section is the model representative of the resources and attributes defined in MEF 61.1 Section 10.9 IPVC Service Level Specification Service Attribute.

The following performance metrics are supported as part of an IP SLS:

1. One-way Mean Packet Delay Percentile
2. One-way Mean Packet Delay
3. One-way Mean Packet Delay Variation
4. One-way Mean Packet Delay Range
5. One-way Packet Loss Ratio
6. Service Up Time
7. Mean Time to Repair

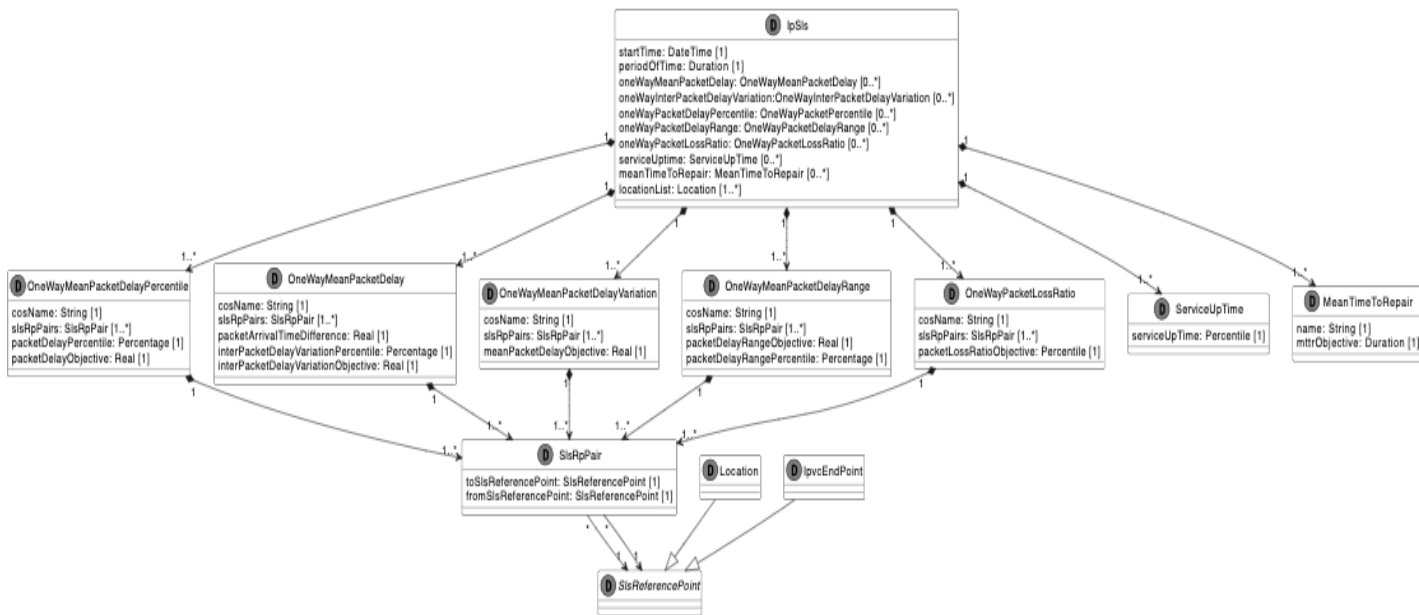


Figure 27-IP SLS Model

Figure 28 below provides an example of the value for the IPVC Service Level Specification Attribute.

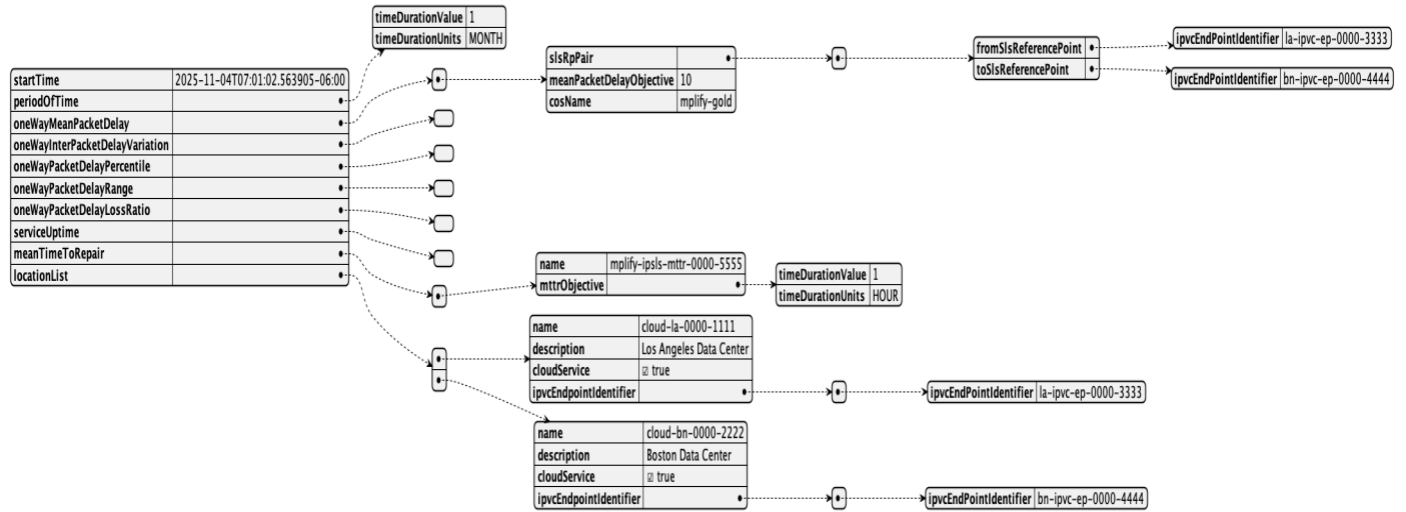


Figure 28-IPVC Service Level Specification Service Attribute JSON Example

20.1 IpSIs

The IPVC Service Level Specification (SLS) describes the performance objectives for the performance of conformant IP Data Packets that flow over the IPVC. The IPVC Service Level Specification Attribute is either None, or a four-tuple of the form (s,T,E,L) where s is the start time, T is a period of time, E is a set of SLS entries and L is a set of the CoS Name and number of other parameters specific to the Performance Metric. Reference MEF 61.1 Section 10.9 IPVC Service Level Specification Service Attribute.

Schema File Name: schema/ip/ipSIs.yaml			
Attribute Name	Type	Multiplicity	Description
startTime	String Format: Date-Time	1	Start time of IP SLS.
periodOfTime	TimeDuration	1	Period of time over which IP SLS is measured.
oneWayMeanpacketdelay	OneWayMeanPacketDelay	0..*	Pointer to One-way Mean Packet Delay metric.
oneWayInterpacketdelayvariation	OneWayInterPacketDelayVariation	0..*	Pointer to One-way Inter-Packet Delay Variation metric.
oneWayPacketdelayrange	OneWayPacketDelayRange	0..*	Pointer to One-way Packet Delay Range metric.
oneWayPacketLossRatio	OneWayPacketLossRatio	0..*	Pointer to One-way Packet Loss Ratio metric.
oneWayPacketDelayPercentile	OneWayPacketDelayPercentile	0..*	Pointer to One-way Packet Delay Percentile metric.
serviceUptime	ServiceUpTime	0..*	Pointer to Service uptime metric.
meanTimeToRepair	MeanTimeToRepair	0..*	Pointer to Mean Time To Repair metric.
locationList	Location	1..*	Pointer to Location list.

Table 107-IpSIs Attributes

The following requirements ([R18], [R19], [R20]), specify the required values that apply to CoS Labels:

- [R40]** If the SLS for a Subscriber IP VPN Service contains at least one entry for a CoS Label, the value of T in the SLS MUST be less than or equal to 1 calendar month.
- [R41]** In an SLS for a Subscriber IP VPN Service, each entry for a CoS Label MUST use parameter values that are not in parenthesis conforming with Table 3.
- [R42]** In an SLS for a Subscriber IP VPN Service, each entry for a CoS Label MUST use performance objective values that are not in parenthesis for the appropriate Performance Tier conforming with Table 4 through Table 9.

20.2 IpvceEndPointIdentifier

IPVC End Point identifier as described in MEF 61.1 Section 11.1. Note, it points to the value of IpvceEndPoint.identifier Service Attribute.

Schema File Name: schema/ip/ipSls.yaml			
Attribute Name	Type	Multiplicity	Description
	String <i>maxLength=53</i>	1	IPVC End Point identifier as described in MEF 61.1 Section 11.1. Note, it points to the value of IpvceEndPoint.identifier Service Attribute.

Table 108-IpvceEndPointIdentifier Attributes

20.3 IpvceEndPointRef

A subclass of a SlsReferencePoint point to an instance of IPVC Endpoint.

Schema File Name: schema/ip/ipSls.yaml			
Attribute Name	Type	Multiplicity	Description
IpvceEndPointIdentifier	IpvceEndPointIdentifier	1	IPVC End Point identifier as described in MEF 61.1 Section 11.1. Note, it points to the value of IpvceEndPoint.identifier Service Attribute. It is not intended to point to the potential Service identifier is IPVC End Point is an instance of a service.

Table 109-IpvceEndPointRef Attributes

20.4 Location

A subclass of a SlsReferencePoint.

Schema File Name: schema/ip/ipSls.yaml			
Attribute Name	Type	Multiplicity	Description
name	String	1	Location name.
description	String	1	Location description.

cloudService	Boolean	1	Attribute to indicate if associated with a cloud service.
ipvcEndPointIdentifier	IpvcEndPointRef	1..*	Pointer to IPVC End Point

Table 110-Location Attributes

20.5 MeanTimeToRepair

The Mean Time To Repair Performance Metric is the arithmetic mean of the durations of all outages that start in a given time period, excluding any pre-agreed maintenance.

Schema File Name: schema/ip/ipSls.yaml			
Attribute Name	Type	Multiplicity	Description
name	String	1	Name.
mttrObjective	TimeDuration	1	MTTR Objective.

Table 111-MeanTimeToRepair Attributes

20.6 OneWayInterPacketDelayVariation

The One-way Inter-Packet Delay Variation Performance Metric is the maximum, over all the ordered pairs of SLS-RPs in a given set S, of the vth percentile of differences between the one-way packet delays of Qualified Packets that arrive at time separated by a given interval tau, for a given ordered pair of SLS-RPs, a given CoS Name, and a given time period Tk. Reference MEF 61.1 Section 10.9.6 One-way Inter-Packet Delay Variation Performance Metric.

Schema File Name: schema/ip/ipSls.yaml			
Attribute Name	Type	Multiplicity	Description
cosName	String	1	One of the values in the IPVC List of Class of Service Names Service Attribute. Reference MEF 61.1 Section 10.9.6 One-way Inter-Packet Delay Variation Performance Metric, Table-6.
packetArrivalTimeDifference	Number	1	Difference in the time of arrival of packets. Reference MEF 61.1 Section 10.9.6 One-way Inter- Packet Delay Variation Performance Metric, Table 6.
slsRpPairs	SlsRpPair	1.. *	Set of ordered SLS-RP pairs. Reference MEF 61.1 Section 10.9.6 One-way Inter-Packet Delay Variation Performance Metric, Table-6.
interPacketDelayVariationPercentile	Percentage	1	Inter-Packet Delay Variation Percentile. Reference MEF 61.1 Section 10.9.6 One-way Inter- Packet Delay Variation Performance Metric, Table 6.
interPacketDelayVariationObjective	Number	1	Inter-Packet Delay Variation Objective. Reference MEF 61.1 Section 10.9.6 One-way Inter- Packet Delay Variation Performance Metric, Table 6.

Table 112-OneWayInterPacketDelayVariation Attributes

20.7 OneWayMeanPacketDelay

The One-way Mean Packet Delay Performance Metric is the maximum, over all the ordered pairs of SLS-RPs in a given set S, of the arithmetic mean of one-way packet delay for Qualified

Packets for a given ordered pair of SLS-RPs, a given CoS Name, and a given time period Tk.
Reference MEF 61.1 Section 10.9.5 One-way Mean Packet Delay Performance Metric.

Schema File Name: schema/ip/ipSls.yaml			
Attribute Name	Type	Multiplicity	Description
cosName	String	1	One of the values in the IPVC List of Class of Service Names Service Attribute. Reference MEF 61.1 Section 10.9.5 One-way Mean Packet Delay Performance Metric, Table-5.
meanPacketDelayObjective	Number	1	Mean Packet Delay Objective. Reference MEF 61.1 Section 10.9.5 One-way Mean Packet Delay Performance Metric, Table-5.
slsRpPairs	SlsRpPair	1.. *	Set of ordered SLS-RP pairs. Reference MEF 61.1 Section 10.9.5 One-way Mean Packet Delay Performance Metric, Table-5.

Table 113-OneWayMeanPacketDelay Attributes

20.8 OneWayPacketDelayPercentile

The One-way Packet Delay Percentile Performance Metric is the maximum, over all the order pairs of SLS-RPs in a given set S, of the pth percentile of one-way packet delay for Qualified Packets for a given order pair of SLS-RPs, a given CoS Name and a given time period Tk.
Reference MEF 61.1 Section 10.9.4 One-way Packet Delay Percentile Performance Metric.

Schema File Name: schema/ip/ipSls.yaml			
Attribute Name	Type	Multiplicity	Description
cosName	String	1	One of the values in the IPVC List of Class of Service Names Service Attribute. Reference MEF 61.1 Section 10.9.4 One-way Packet Delay Percentile Performance Metric, Table-4.
packetDelayPercentile	Percentage	1	Packet Delay Percentile. Reference MEF 61.1 Section 10.9.4 One-way Packet Delay Percentile Performance Metric, Table-4.
packetDelayObjective	Number	1	Packet Delay Objective. Reference MEF 61.1 Section 10.9.4 One-way Packet Delay Percentile Performance Metric, Table-4.
slsRpPairs	SlsRpPair	1.. *	Set of ordered SLS-RP pairs. Reference MEF 61.1 Section 10.9.4 One-way Packet Delay Percentile Performance Metric, Table-4.

Table 114-OneWayPacketDelayPercentile Attributes

20.9 OneWayPacketDelayRange

The One-way Packet Delay Range Performance Metric is the maximum, over all the ordered pairs of SLS-RPs in a given set S, of the difference between the rth percentile of one-way packet delay and the minimum one-way packet delay, for Qualified Packets for a given ordered pair of SLS-RPs, a given CoS Name, and a given time period Tk. Reference MEF 61.1 Section 10.9.7 One-way Packet Delay Range Performance Metric.

Schema File Name: schema/ip/ipSls.yaml			
Attribute Name	Type	Multiplicity	Description
slsRpPairs	SlsRpPair	1.. *	Set of ordered SLS-RP pairs. Reference MEF 61.1 Section 10.9.7 One-way Packet Delay Range Performance Metric, Table-7.
packetDelayRangePercentile	Percentage	1	Packet Delay Range Percentile. Reference MEF 61.1 Section 10.9.7 One-way Packet Delay Range Performance Metric, Table 7.
packetDelayRangeObjective	Number	1	Packet Delay Range Objective. Reference MEF 61.1 Section 10.9.7 One-way Packet Delay Range Performance Metric, Table 7.
cosName	String	1	One of the values in the IPVC List of Class of Service Names Service Attribute. Reference MEF 61.1 Section 10.9.7 One-way Mean Packet Delay Performance Metric, Table-7.

Table 115-OneWayPacketDelayRange Attributes

20.10 OneWayPacketLossRatio

The One-way Packet Loss Ratio Performance Metric is the maximum, over the ordered pairs of SLS-RPs in a given set S, of the ratio of lost packets to transmitted packets for a given ordered pair of SLS-RPs, a given CoS Name and a given time period Tk. Reference MEF 61.1 Section 10.9.8 One-way Packet Loss Ratio Performance Metric.

Schema File Name: schema/ip/ipSls.yaml			
Attribute Name	Type	Multiplicity	Description
slsRpPairs	SlsRpPair	1.. *	Set of ordered SLS-RP pairs. Reference MEF 61.1 Section 10.9.8 One-way Packet Loss Ratio Performance Metric, Table-8.
cosName	String	1	One of the values in the IPVC List of Class of Service Names Service Attribute. Reference MEF 61.1 Section 10.9.8 One-way Packet Loss Ratio Performance Metric, Table-8.
packetLossRatioObjective	Percentage	1	Packet Loss Ratio Objective. Reference MEF 61.1 Section 10.9.8 One-way Packet Loss Ratio Performance Metric, Table 8.

Table 116-OneWayPacketLossRatio Attributes

20.11 ServiceUptime

The Service Uptime Performance Metric is the proportion of time, during a given time period Tk, that the service is working from the perspective of the Subscriber (for a Subscriber IP Service) or the perspective of the SP/SO (for an Operator IP Service), excluding any pre-agreed

exceptions, for example maintenance intervals. Reference MEF 61.1[10] Section 10.9 Service Uptime Performance Metric.

Schema File Name: schema/ip/ipSls.yaml			
Attribute Name	Type	Multiplicity	Description
serviceUptimeObjective	Percentage	1	Service Uptime Objective. Reference MEF 61.1 Section 10.9.9 Service Uptime Performance Metric, Table 9.

Table 117-ServiceUptime Attributes

20.12 SlsReferencePoint

SlsReferencePoint is an abstract data type that can be subclassed to IpvcEndPoint and Location. Reference MEF 61.1 Section 10.9.1 SLS Reference Points.

20.13 SlsRpPair

Service Level Specification Reference Point Pair. In a multipoint or rooted multipoint IPVC, performance objectives are ideally specified as applying between pairs of IPVC EPs - in other words, they apply to the performance that IP Data Packets experience as they flow from one EI to another. The SlsRpPair is a representation of this association. Reference MEF 61.1 Section 10.9.1.

Schema File Name: schema/ip/ipSls.yaml			
Attribute Name	Type	Multiplicity	Description
toSlsReferencePoint	SlsReferencePoint	1	Pointer to the “to” SLS Reference Point.
fromSlsReferencePoint	SlsReferencePoint	1	Pointer to the “from” SLS Reference Point.

Table 118-SlsRpPair Attributes

21 References

- [1] IETF JSON Schema draft 7, *JSON Schema: A Media Type for Describing JSON Documents* and associated documents, by Austin Wright and Henry Andrews, March 2018. Copyright © 2018 IETF Trust and the persons identified as the document authors. All rights reserved.
- [2] IETF RFC 2119, *Key words for use in RFCs to Indicate Requirement Levels*, by Scott Bradner, March 1997.
- [3] IETF RFC 2131, *Dynamic Host Configuration Protocol*, by R. Droms, March 1997.
- [4] IETF RFC 3444, *On the Difference between Information Models and Data Models*, January 2003.
- [5] IETF RFC 4271, *A Border Gateway Protocol 4 (BGP-4)*, by Dr. Yakov Rekhter, January 2006. Copyright © The Internet Society (2006). All Rights Reserved.
- [6] IETF RFC 5798, *Virtual Router Redundancy Protocol (VRRP) Version 3 for IPv4 and IPv6*, By S. Nadas, Ed., March 2010, Copyright © 2010 IETF Trust and the persons identified as the document authors. All rights reserved.
- [7] IETF RFC 7419, *Common Interval Support in Bidirectional Forwarding Detection*, by N. kiya, December 2014. Copyright © 2014 IETF Trust and the persons identified as the document authors. All rights reserved.
- [8] IETF RFC 8174, *Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words*, by Barry Leiba, May 2017. Copyright © IETF Trust and the persons identified as the document authors (2017). All Rights Reserved.
- [9] IETF RFC 8415, *Dynamic Host Configuration Protocol for IPv6 (DHCPv6)*, by T. Mrugalski, November 2018. Copyright © 2018 IETF Trust and the persons identified as the document authors. All rights reserved.
- [10] MEF 61.1, *IP Service Attributes*, May 2019.
- [11] MEF 61.1.1, *Amendment to MEF 61.1: UNI Access Link Trunks, IP Addresses, Mean Time to Repair Performance Metric*, July 2022.
- [12] MEF 69.1, *Subscriber IP Service Definitions*, February 2022.

- [13] MEF 55.1, *Lifecycle Service Orchestration (LSO): Reference Architecture and Framework*, January 2021.

Appendix A Usage examples (Informative)

This appendix aims to provide an extensive set of examples to cover:

- Different Service Order configuration variants,
- Basic Service Order API walkthrough to order an IP Service,
- Common modifications,
- Terminating a Service
- List of Service Orders

The full examples are delivered as a Postman collection file available at:

- /documentation/serviceSchema/ip/Postman/Mplify_99_1_with_Mplify_102_Service_Ordering_Management.postman_collection.json

A.1 High-level Flow

The Interface Reference Points each form a set of APIs that service different functions in the end-to-end flow.

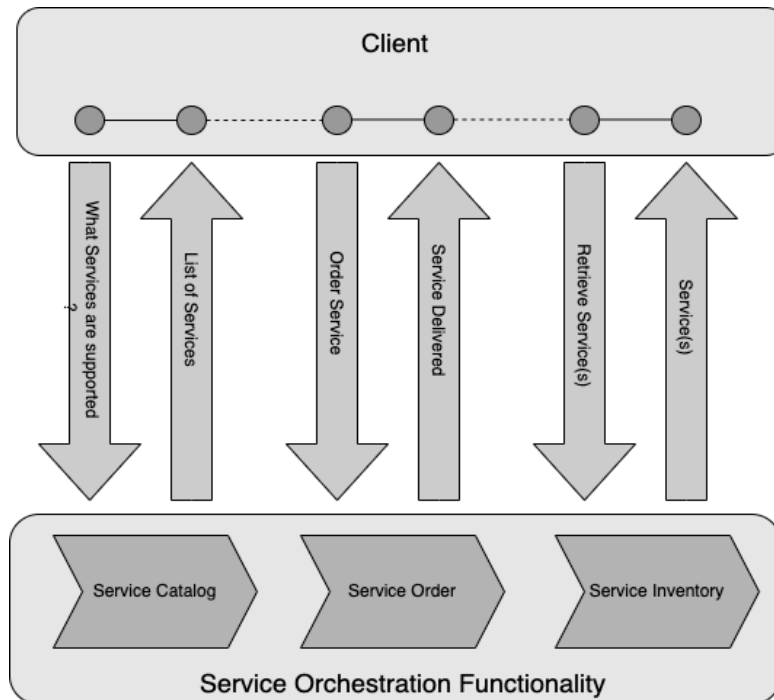


Figure 29-Service End-to-End Function Flow

Service Catalog – allows the Client to query SOF for available Services as well as what attributes are fixed and/or elastics with values/ranges.

Service Order – allows the Client to request the SOF to initiate and complete the fulfillment process of installation of a Service Offering, an update to an existing Service, or a disconnect of an existing Service.

Service Inventory – allows the Client to retrieve information about existing Service instances from the SOF’s Service Inventory.

All the above-mentioned APIs are provided in the SDK together with accompanying Developer Guides. Please refer to those documents for more details and examples of functional APIs.

A.2 Integration of Service Specification into the Service Order API

The Service Order API is service-agnostic in the meaning that they serve as an interaction between the Client and the Server (SOF) and they do not contain any service-specific information in their specifications. To pass the service-specific information, an extension pattern is used. This applies to any of the Service APIs that carry service-specific information: Service Catalog, Service Order and Service Inventory.

The extension hosting type in the API data model is `MefServiceConfiguration`. The `@type` attribute of that type must be set of a value that uniquely identifies the service specification. See Figure 30 to Figure 33 for the Extension Pattern for Subscriber and Operator IP Services. A unique identifier for Mplify standard service specifications is in URN format and is assigned by Mplify. This identifier is provided as root schema `$id` and in service specification documentation.

The example below shows a header of an IP UNI, where `$id: urn:mef:lso:spec:service:ip-uni:v1.0.0:all` the above-mentioned URN:

```
$id: urn:mef:lso:spec:service:ip-uni:v1.0.0:all
$schema: http://json-schema.org/draft-07/schema#
title: Mplify LSO Service - IP UNI Specification
```

The extension pattern specific to Subscriber IP Services is illustrates in two figures below. The Subscriber IP Service Extension Model is aligned with Figure 9. This includes URN representations for `IpUni`, `Ipvc`, `IpvcEndPoint`, `IpUniAccessLink` and `IpUniAccessLinkTrunk`. The URNs are:

- `urn:mef:lso:spec:service:ip-uni:v1.0.0:all`
- `urn:mef:lso:spec:service:ipvc:v1.0.0:all`
- `urn:mef:lso:spec:service:ipvc-end-point:v1.0.0:all`

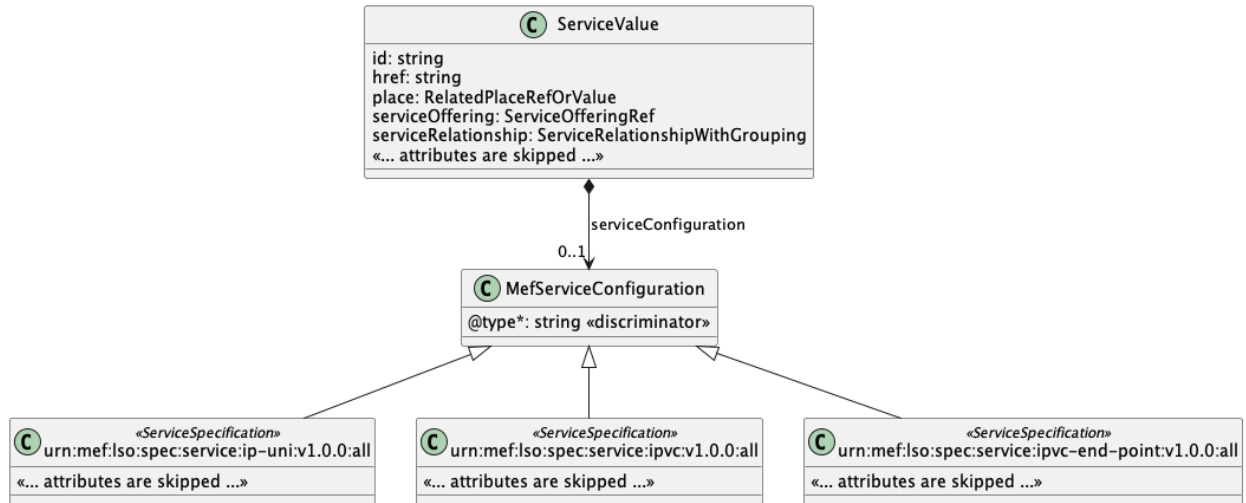


Figure 30-The Extension Pattern: Subscriber IP (1 of 2)

The second figure for Subscriber IP Services illustrates the following URNs:

- urn:mef:lso:spec:service:ip-uni-access-link:v1.0.0:all
- urn:mef:lso:spec:service:ip-uni-access-link-trunk:v1.0.0:all

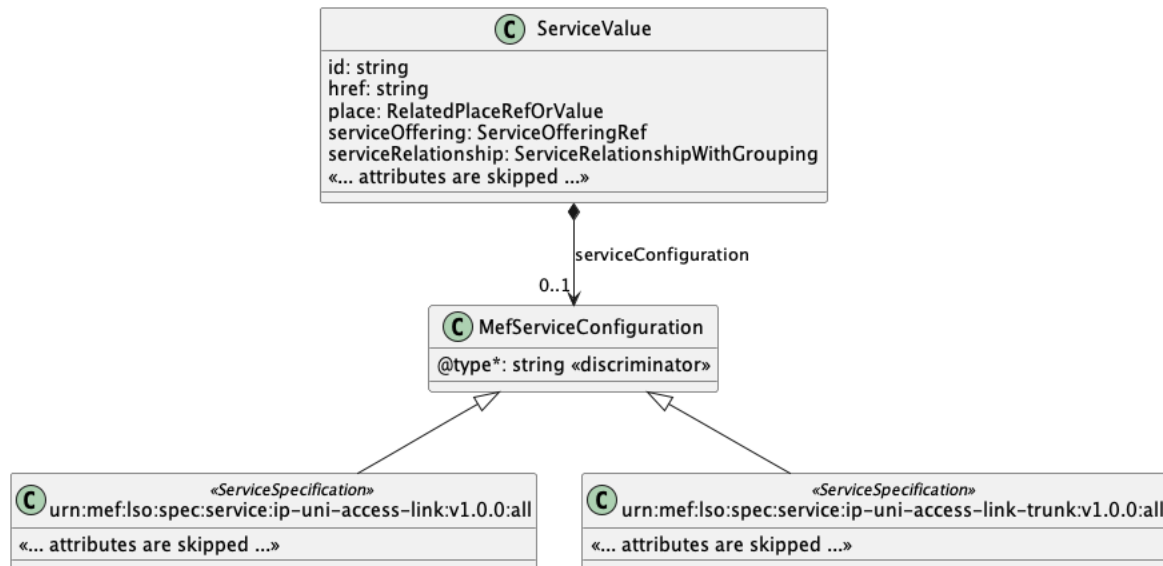


Figure 31-The Extension Pattern: Subscriber IP (2 of 2)

The Operator IP Service Extension Model is aligned with Figure 11. This includes URN representations for `IpUni`, `Ipvc`, `IpvcEndPoint`, `IpUniAccessLink`, `IpUniAccessLinkTrunk`, `IpEnni`, `IpCommon` and `IpEnniTrunk`. The URNs are:

- urn:mef:lso:spec:service:ip-uni:v1.0.0:all
- urn:mef:lso:spec:service:ipvc:v1.0.0:all

- urn:mef:lso:spec:service:ipvc-end-point:v1.0.0:all
- urn:mef:lso:spec:service:ip-uni-access-link:v1.0.0:all

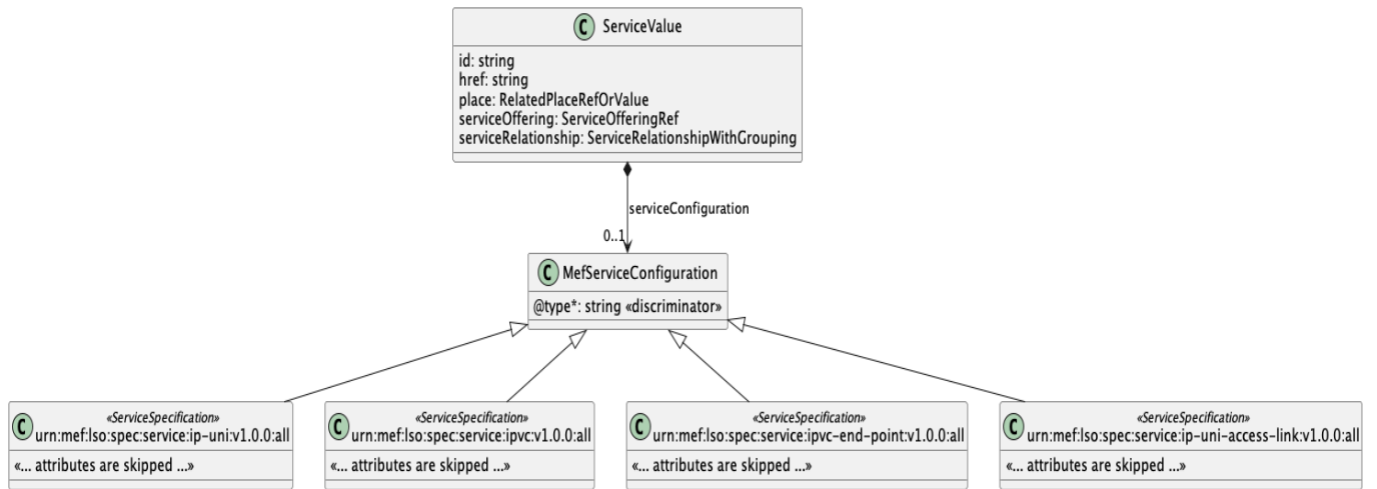


Figure 32-The Extension Pattern: Operator IP (1 of 2)

The remaining IP Operator Service URNs:

- urn:mef:lso:spec:service:ip-uni-access-link-trunk:v1.0.0:all
- urn:mef:lso:spec:service:ip-enni:v1.0.0:all
- urn:mef:lso:spec:service:ip-enni-link:v1.0.0:all

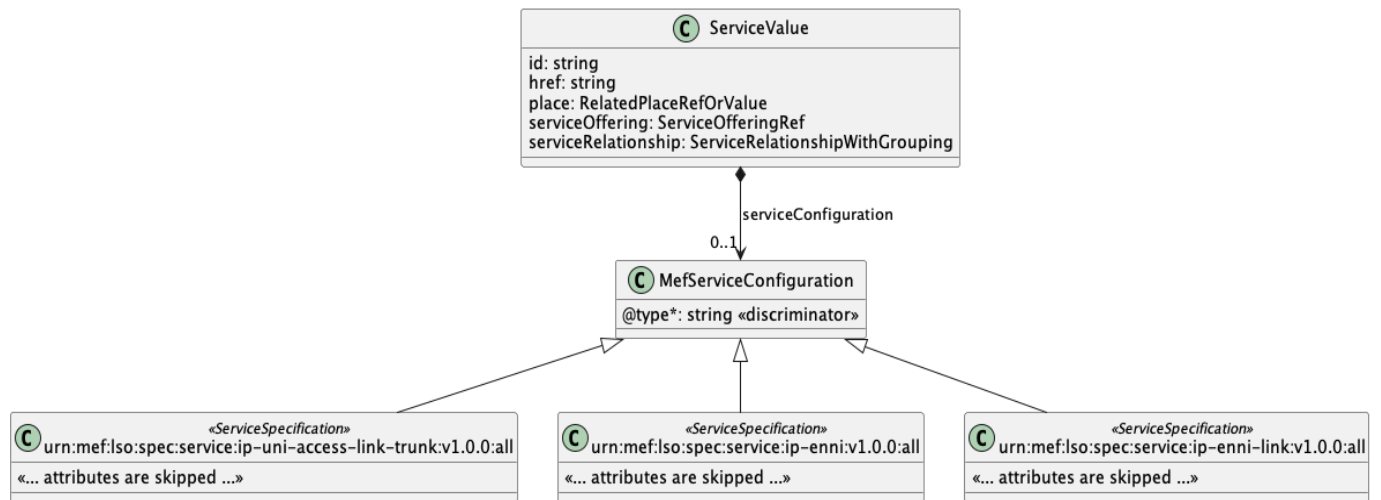


Figure 33-The Extension Pattern: Operator IP (2 of 2)

Use of non-Mplify standard service definitions is allowed. In such a case the schema identifier must be agreed upon between the Client and the SOF.

A.3 Service Order Create Process

The `ServiceOrderCreate` process is initiated by the Buyer/Client with the determination of the one or more `ServiceOrderItems` that will be part of a Service Order using the `ServiceOrderCreate`. Each Service Order Item through the Extension pattern is associated with a Mplify Service specific payload component (i.e., `IpUni`, `IpUniAccessLink`, `IpUniAccessLinkTrunk`, `IpvceEndPoint`, `Ipvce`).

The Buyer/Client sends a request with a `ServiceOrderCreate` type in the body. The SOF performs request validation, assigns an `id`, and returns `ServiceOrder` type in the response body, with a state set to `acknowledged`. From this point, the `ServiceOrder` is ready for further processing. The Buyer/Client can track the progress of the process by either subscribing for notifications (Asynchronous operation) or by periodically polling (Synchronous operation) the `ServiceOrder`. The two patterns are illustrated in sequence diagrams below.

A.3.1 Interaction Flow – Polling process (Synchronous)

The sequence flow for the Synchronous or Polling process begins with a Buyer/Client initiating a build request for a `ServiceOrder_Create` with one or more `ServiceOrderItems`. `ServiceOrderItems` include `IpUni`, `IpUniAccessLink`, `IpUniAccessTrunk`, `IpvceEndPoint`, `IpEnni`, `IpEnniLink` and `Ipvce` and associated relationships between resources.

The sequence begins with the Buyer/Client building the `ServiceOrderCreate` including the set of `ServiceOrderItems`. In the Synchronous operation of the API once the REST POST operation is sent the Buyer/Client needs to poll (REST GET) to determine the state of the request.



Figure 34-Service Order Polling process (Synchronous)

NOTE: A complete Subscriber IP Service Order would include [IpUniAccessLink](#) and [IpUniAccessLinkTrunk](#) which are not shown to simplify the diagram.

A.3.2 Interaction Flow – Notification process (Asynchronous)

The sequence flow for the Asynchronous or Notification process begins with the Buyer/Client subscribing to Service Order asynchronous events. The Buyer/Client informs the Seller/Server the callback URL to send notifications.

The Buyer/Client builds a request for a `ServiceOrder_Create` with one or more `ServiceOrderItems`. `ServiceOrderItems` include `IpUni`, `IpUniAccessLink`, `IpUniAccessTrunk`, `IpvCEndPoint`, `IpEnni`, `IpEnniLink` and `IpvC` and associated relationships between resources.

The Buyer/Client sends the `ServiceOrderCreate` in a REST POST to the Seller/Server. The Seller/Server will send asynchronous events with state updates the Buyer/Client.

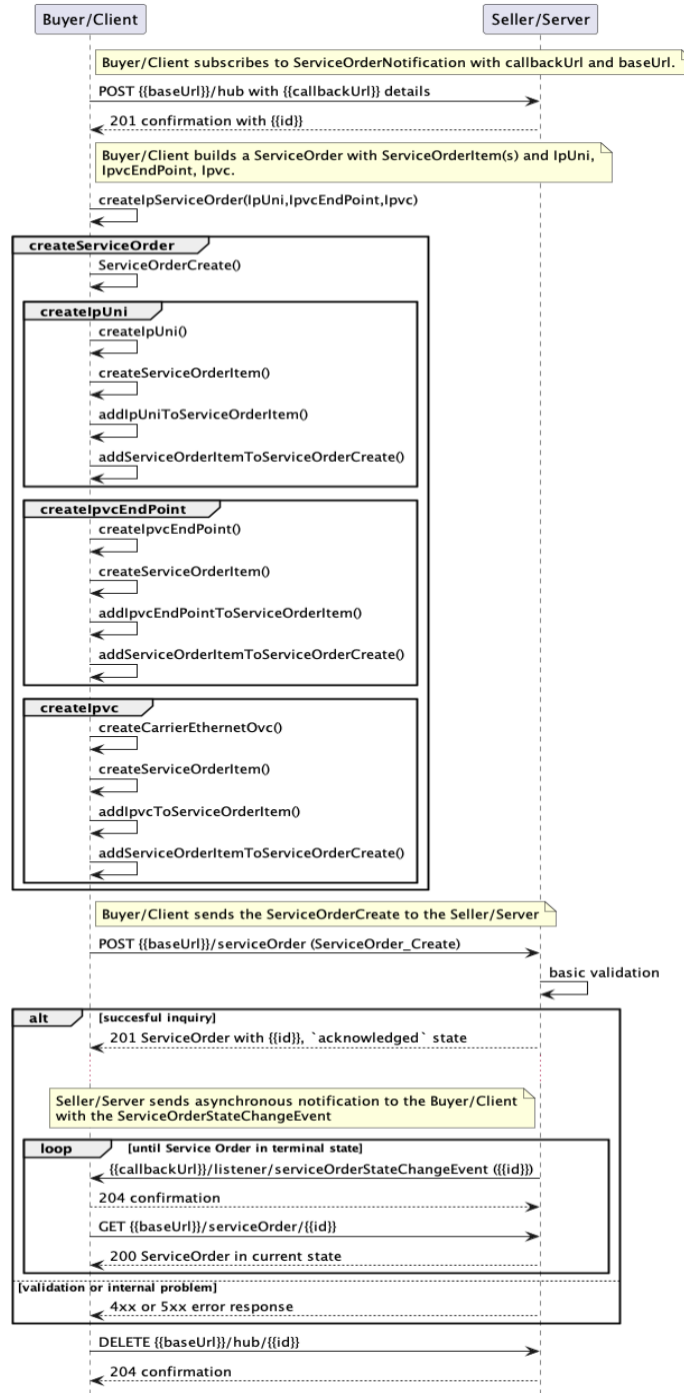


Figure 35- Service Order Notification process (Asynchronous)

NOTE: A complete IP Service Order would include [IpUniAccessLink](#) and [IpUniAccessLinkTrunk](#) which are not shown to simplify the diagram.

Appendix B Service Order Operations

The following section provides details on the set of Service Order operations that is supported with the MEF 99.1 Service Ordering Management API (Envelope) and MEF 102 Service Schemas (Payload). The current set of operations available include:

- GET /serviceOrder – List or find Service Order objects.
- POST /serviceOrder – Creates a Service Order.
- GET /serviceOrder/{id} – Retrieves a Service Order by ID.
- POST /hub – Register a listener
- DELETE /hub/{id} – Unregister a listener.
- GET /hub/{id} – Retrieve an Event Subscription by ID.

The remainder of this section will provide detailed JSON example of the REST operations and responses.

B.1 UC1: GET /serviceOrder and Response

The following section provides an example for a retrieval of list of Service Orders given query parameters: state, orderDate, completionDate, expectedCompletionDate, startDate. The REST request is:

```
GET /{{baseUrl}}/mefApi/legato/serviceOrderingManagement/v6/serviceOrder
```

The following example below shows the response to a Service Order list request. The response has an IP UNI, IPVC End Point and IPVC.

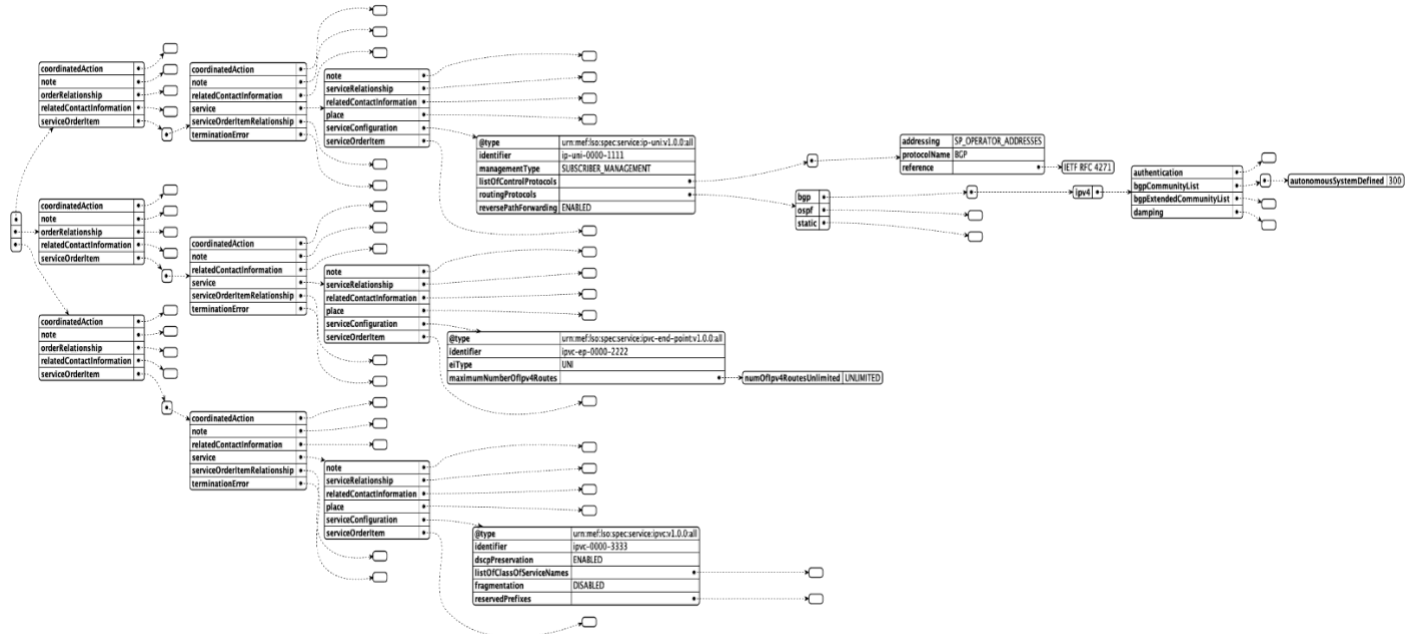


Figure 36-List Service Order Response

The following snippet presents the actual JSON for the example Service Order List response.

```
[ {
  "coordinatedAction" : [ ],
  "note" : [ ],
  "orderRelationship" : [ ],
  "relatedContactInformation" : [ ],
  "serviceOrderItem" : [ {
    "coordinatedAction" : [ ],
    "note" : [ ],
    "relatedContactInformation" : [ ],
    "service" : {
      "note" : [ ],
      "serviceRelationship" : [ ],
      "relatedContactInformation" : [ ],
      "place" : [ ],
      "serviceConfiguration" : {
        "@type" : "urn:mef:lso:spec:service:ip-uni:v1.0.0:all",
        "identifier" : "ip-uni-0000-1111",
        "managementType" : "SUBSCRIBER_MANAGEMENT",
        "listOfControlProtocols" : [ {
          "addressing" : "SP_OPERATOR_ADDRESSES",
          "protocolName" : "BGP",
          "reference" : [ "IETF RFC 4271" ]
        } ],
        "routingProtocols" : {
          "bgp" : [ {

```

```

    "ipv4" : {
      "authentication" : [ ],
      "bgpCommunityList" : [ {
        "autonomousSystemDefined" : 300
      } ],
      "bgpExtendedCommunityList" : [ ],
      "damping" : [ ]
    }
  } ],
  "ospf" : [ ],
  "static" : [ ]
},
"reversePathForwarding" : "ENABLED"
},
"serviceOrderItem" : [ ]
},
"serviceOrderItemRelationship" : [ ],
"terminationError" : [ ]
} ]
}, {
"coordinatedAction" : [ ],
"note" : [ ],
"orderRelationship" : [ ],
"relatedContactInformation" : [ ],
"serviceOrderItem" : [ {
  "coordinatedAction" : [ ],
  "note" : [ ],
  "relatedContactInformation" : [ ],
  "service" : {
    "note" : [ ],
    "serviceRelationship" : [ ],
    "relatedContactInformation" : [ ],
    "place" : [ ],
    "serviceConfiguration" : {
      "@type" : "urn:mef:lso:spec:service:ipvc-end-point:v1.0.0:all",
      "identifier" : "ipvc-ep-0000-2222",
      "eiType" : "UNI",
      "maximumNumberOfIpv4Routes" : {
        "numOfIpv4RoutesUnlimited" : "UNLIMITED"
      }
    }
  },
  "serviceOrderItem" : [ ]
},
"serviceOrderItemRelationship" : [ ],
"terminationError" : [ ]
} ]
}, {
"coordinatedAction" : [ ],
"note" : [ ],

```

```

"orderRelationship" : [ ],
"relatedContactInformation" : [ ],
"serviceOrderItem" : [ {
  "coordinatedAction" : [ ],
  "note" : [ ],
  "relatedContactInformation" : [ ],
  "service" : {
    "note" : [ ],
    "serviceRelationship" : [ ],
    "relatedContactInformation" : [ ],
    "place" : [ ],
    "serviceConfiguration" : {
      "@type" : "urn:mef:lso:spec:service:ipvc:v1.0.0:all",
      "identifier" : "ipvc-0000-3333",
      "dscpPreservation" : "ENABLED",
      "listOfClassOfServiceNames" : [ ],
      "fragmentation" : "DISABLED",
      "reservedPrefixes" : [ ]
    },
    "serviceOrderItem" : [ ]
  },
  "serviceOrderItemRelationship" : [ ],
  "terminationError" : [ ]
} ]
} ]

```

B.2 UC2: POST /serviceOrder and Response

The following section provides an example of a Service Order Create with all support actions (ADD, MODIFY, DELETE) and corresponding response. The payload for the request is shown in Figure 37. The example is for a Subscriber IP service. The REST request:

```
POST /{{baseUrl}}/mefApi/legato/serviceOrderingManagement/v6/serviceOrder
```

The Service Order Request shown in Figure 37 is a partial request for the diagram to be readable. See the complete request in JSON following the JSON figure that follows.

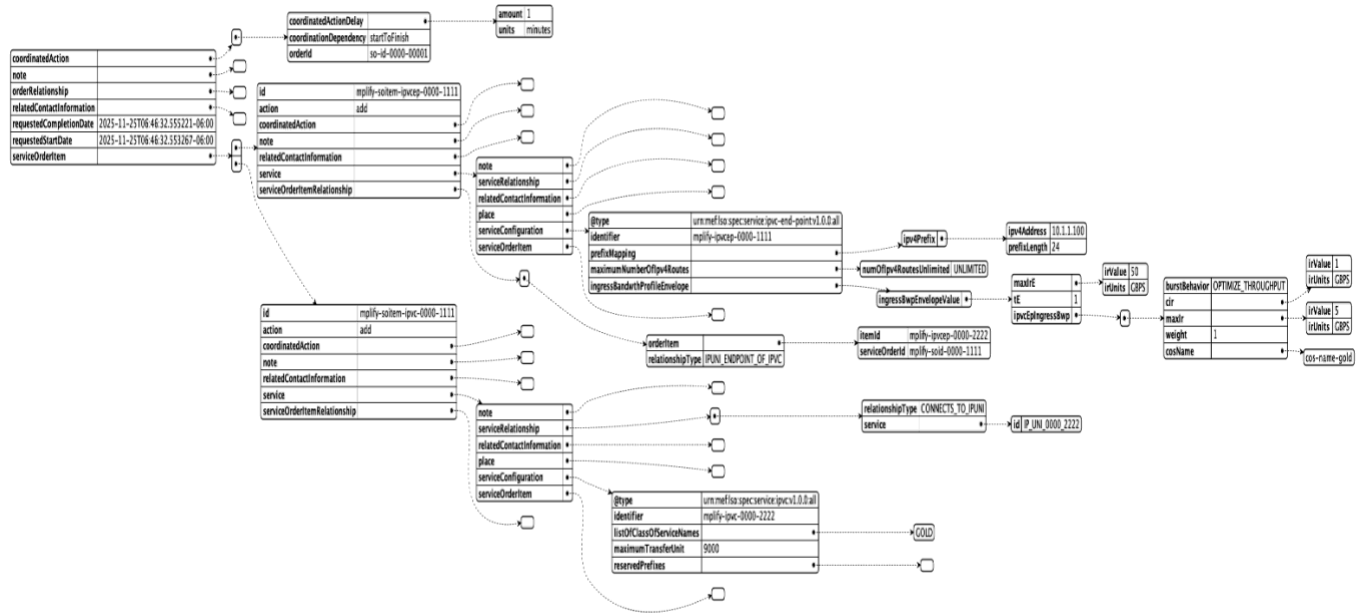


Figure 37-Service Order Request-action=ADD

The following snippet presents the actual JSON for the example Service Order Create request. There are five (5) Service Order Items for Subscriber IP Service: IP UNI, IPVC End Point, IPVC, IP UNI Access Link and IP UNI Access Link Trunk. Not all Service Order Items are shown.

```
{
  "coordinatedAction" : [ {
    "coordinatedActionDelay" : {
      "amount" : 1,
      "units" : "minutes"
    },
    "coordinationDependency" : "startToFinish",
    "orderId" : "so-id-0000-00001"
  } ],
  "note" : [ ],
  "orderRelationship" : [ ],
  "relatedContactInformation" : [ ],
  "requestedCompletionDate" : "2025-11-25T06:46:32.555221-06:00",
  "requestedStartDate" : "2025-11-25T06:46:32.553267-06:00",
  "serviceOrderItem" : [ {
    "id" : "mplify-soitem-ipvcep-0000-1111",
    "action" : "add",
    "coordinatedAction" : [ ],
    "note" : [ ],
    "relatedContactInformation" : [ ],
    "service" : {
      "note" : [ ],
      "serviceRelationship" : [ ],

```

```

"relatedContactInformation" : [ ],
"place" : [ ],
"serviceConfiguration" : {
  "@type" : "urn:mef:lso:spec:service:ipvc-end-point:v1.0.0:all",
  "identifier" : "mplify-ipvcep-0000-1111",
  "prefixMapping" : {
    "ipv4Prefix" : {
      "ipv4Address" : "10.1.1.100",
      "prefixLength" : 24
    }
  },
  "maximumNumberOfIpv4Routes" : {
    "numOfIpv4RoutesUnlimited" : "UNLIMITED"
  },
  "ingressBandwidthProfileEnvelope" : {
    "ingressBwpEnvelopeValue" : {
      "maxIrE" : {
        "irValue" : 50,
        "irUnits" : "GBPS"
      },
      "tE" : 1,
      "ipvcEpIngressBwp" : [ {
        "burstBehavior" : "OPTIMIZE_THROUGHPUT",
        "cir" : {
          "irValue" : 1,
          "irUnits" : "GBPS"
        },
        "maxIr" : {
          "irValue" : 5,
          "irUnits" : "GBPS"
        },
        "weight" : 1,
        "cosName" : [ "cos-name-gold" ]
      } ]
    }
  },
  "serviceOrderItem" : [ ]
},
"serviceOrderItemRelationship" : [ {
  "orderItem" : {
    "itemId" : "mplify-ipvcep-0000-2222",
    "serviceOrderId" : "mplify-soid-0000-1111"
  },
  "relationshipType" : "IPUNI_ENDPOINT_OF_IPVC"
} ]
}, {
  "id" : "mplify-soitem-ipvc-0000-1111",
  "action" : "add",

```

```

"coordinatedAction" : [ ],
"note" : [ ],
"relatedContactInformation" : [ ],
"service" : {
  "note" : [ ],
  "serviceRelationship" : [ {
    "relationshipType" : "CONNECTS_TO_IPUNI",
    "service" : {
      "id" : "IP_UNI_0000_2222"
    }
  } ],
"relatedContactInformation" : [ ],
"place" : [ ],
"serviceConfiguration" : {
  "@type" : "urn:mef:lso:spec:service:ipvc:v1.0.0:all",
  "identifier" : "mplify-ipvc-0000-2222",
  "listOfClassOfServiceNames" : [ "GOLD" ],
  "maximumTransferUnit" : 9000,
  "reservedPrefixes" : [ ]
},
"serviceOrderItem" : [ ]
},
"serviceOrderItemRelationship" : [ ]
} ]
}

```

NOTE: *The Service Order request can contain relationships between Service Order Items (serviceOrderItemRelationship) within the Service Order as well between a Service Order Item and an Inventory component (serviceRelationship).*

The SOF response to the `CreateServiceOrder` is a `ServiceOrder` which is shown below. The main types used for the response are `ServiceOrder` and `ServiceOrderItem`. The one or more `ServiceOrderItems` will reference a specific IP resource as part of the payload and association(s) to other `ServiceOrderItems` as an attribute in the envelope. The response echoes back all the attributes as provided by the Client/Buyer and contains the same number of `ServiceOrderItems` as in the request.

The Service Order Request Response shown in Figure 38 is a partial request for the diagram to be readable.

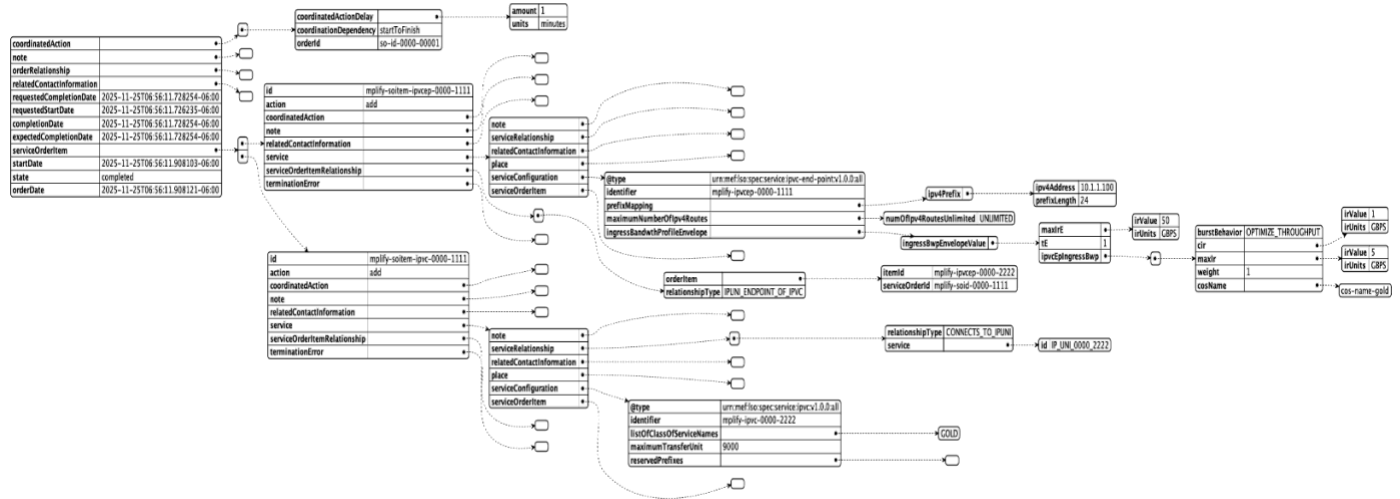


Figure 38-Service Order Response

B.2.1 UC2b: Action-Modify

This section guides through all the steps of Service Order API that is needed to be performed to successfully modify a service.

NOTE: SOF is free to mandate some of these steps.

NOTE: As the examples of steps in many cases will replicate the service-specific information, in some of the snippets some parts of it will be omitted for better readability.

There are rules for all request items for creation requests (Service Order):

- `item.action` must be set to `modify`
- `item.service.id` must be provided.
- `service.serviceConfiguration` must contain all desired configurations

B.2.2 UC2c: Action-Delete

This section guides through all the steps of Service Order API that is needed to be performed to successfully delete a service. The action “delete” only moves the Service to the ‘terminated’ state and does not directly remove the Service from the SOF’s Service Inventory.

NOTE: SOF is free to mandate some of these steps.

There are rules for all request items for creation requests (Service Order):

- `item.action` for each Service Order Item must be set to `delete`

B.3 UC3: GET /serviceOrder/{id} and Response

The following section provides an example for a retrieval of a Service Order with a unique identifier. The REST request is:

```
GET /{{baseUrl}}/mefApi/legato/serviceOrderingManagement/v6/serviceOrder/{id}
```

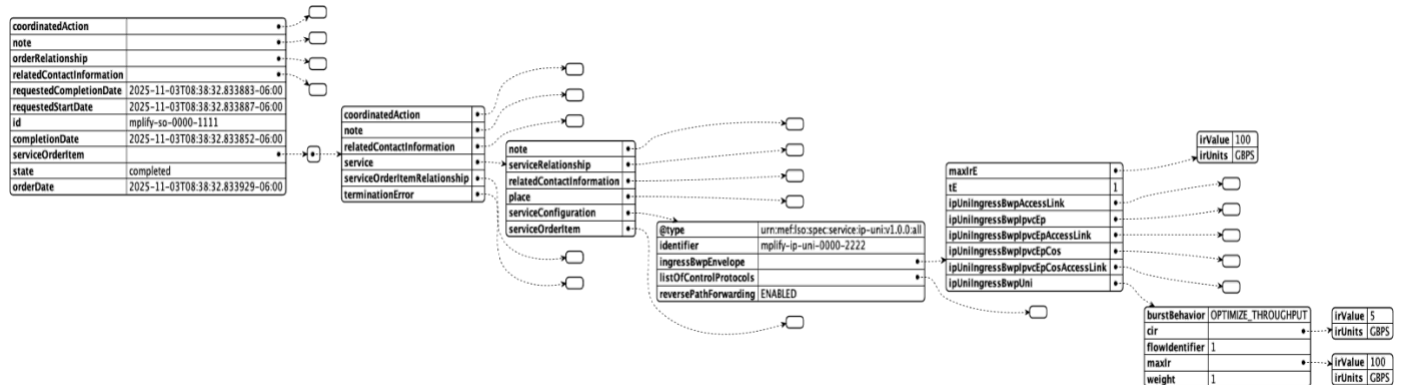


Figure 39- GET Service Order by ID Response

The following snippet presents the actual JSON for the example Service Order by ID response. There is one IP UNI in the response.

```
{
  "coordinatedAction" : [ ],
  "note" : [ ],
  "orderRelationship" : [ ],
  "relatedContactInformation" : [ ],
  "requestedCompletionDate" : "2025-11-03T08:38:32.833883-06:00",
  "requestedStartDate" : "2025-11-03T08:38:32.833887-06:00",
  "id" : "mplify-so-0000-1111",
  "completionDate" : "2025-11-03T08:38:32.833852-06:00",
  "serviceOrderItem" : [ {
    "coordinatedAction" : [ ],
    "note" : [ ],
    "relatedContactInformation" : [ ],
    "service" : {
      "note" : [ ],
      "serviceRelationship" : [ ],
      "relatedContactInformation" : [ ],
      "place" : [ ],
      "serviceConfiguration" : {
        "@type" : "urn:mef:lso:spec:service:ip-uni:v1.0.0:all",
        "identifier" : "mplify-ip-uni-0000-2222",
        "ingressBwpEnvelope" : {
          "maxIrE" : {
            "irValue" : 100,
```

```

    "irUnits" : "GBPS"
  },
  "tE" : 1,
  "ipUniIngressBwpAccessLink" : [ ],
  "ipUniIngressBwpIpvceEp" : [ ],
  "ipUniIngressBwpIpvceEpAccessLink" : [ ],
  "ipUniIngressBwpIpvceEpCos" : [ ],
  "ipUniIngressBwpIpvceEpCosAccessLink" : [ ],
  "ipUniIngressBwpUni" : {
    "burstBehavior" : "OPTIMIZE_THROUGHPUT",
    "cir" : {
      "irValue" : 5,
      "irUnits" : "GBPS"
    },
    "flowIdentifier" : 1,
    "maxIr" : {
      "irValue" : 100,
      "irUnits" : "GBPS"
    },
    "weight" : 1
  }
},
"listOfControlProtocols" : [ ],
"reversePathForwarding" : "ENABLED"
},
"serviceOrderItem" : [ ]
},
"serviceOrderItemRelationship" : [ ],
"terminationError" : [ ]
} ],
"state" : "completed",
"orderDate" : "2025-11-03T08:38:32.833929-06:00"
}

```

B.4 UC4: POST /hub and Response

The following section provides an example register for a Service Order Management notification service from the Seller/Server. The REST POST request with REST Body is:

```
POST /{{baseUrl}}/mefApi/legato/serviceOrderingManagement/v6/hub/
```

```

{
"callback": "clientUri://",
  "query":
    "eventType=
      serviceOrderCreateEvent,
      serviceOrderStateChangeEvent,
      serviceOrderInformationRequiredEvent,
      serviceOrderItemStateChangeEvent"

```

```
}

```

The REST successful (201 Created) Response is shown below:

```
{
  "callback": "clientUri://",
    "id": "Event-Id-10",
    "query":
    "eventType=
      serviceOrderCreateEvent,
      serviceOrderStateChangeEvent,
      serviceOrderInformationRequiredEvent,
      serviceOrderItemStateChangeEvent"
}
```

B.5 UC5: DELETE /hub/{id} and Response

The following section provides an example unregister for a Service Order Management notification service from the Seller/Server. The REST DELETE request is:

```
DELETE /{{baseUrl}}/mefApi/legato/serviceOrderingManagement/v6/hub/{id}
```

A successful DELETE will have a REST Response of 204 (No Content).

B.6 UC6: GET /hub/{id} and Response

The following section provides an example retrieval for a Service Order Management Event Subscription by unique identifier. The REST GET request is:

```
GET /{{baseUrl}}/mefApi/legato/serviceOrderingManagement/v6/hub/{id}
```

The REST successful (200 Success) Response is shown below:

```
{
  "callback": "clientUri://",
    "id": "100",
    "query":
    "eventType=
      serviceOrderCreateEvent,
      serviceOrderStateChangeEvent,
      serviceOrderStateChangeEvent,
      serviceOrderInformationRequiredEvent"
}
```

Appendix C Acknowledgements

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